# La emergencia de la Ciencia Ciudadana

**Luis A. Núñez**

Escuela de Física - Facultad de Ciencias

**Universidad Industrial de Santander**

Escuela de Física | Universidad Industrial de Santander | Grupo Halley Astronomía y Ciencias Aeroespaciales | Complejo Astronómico Grupo Halley

- Cambio en el modo de producción
- Una nueva Ciencia
- Datos, Datos y más Datos
- Ciencia ciudadana Inteligencia colectiva y crowdsourcing
- Algunas experiencias
- Red Ambiental Ciudadana Monitoreo Ambiental

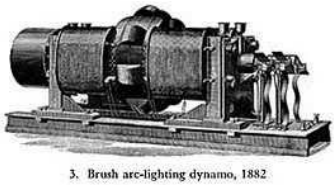
# ¿ Y Ud que opina ?

# Nuevos Paradigmas, Nuevas Realidades, Una Revolución Informacional.

- **Nuevo modo de producción Capitalista**
  - *Cambio de los procesos implica cambios más allá de las TIC*
  - *De la Economía Industrial a la Economía Informacional*
  - *De los bienes materiales a los Servicios*
  - *El Conocimiento como Materia Prima para Producir nuevo Conocimiento*
- **La Economía Informacional**
  - *Global: Procesos de Escala Mundial en Tiempo Real.*
  - *Las economías nacionales se convierten en estrategia nacional.*
  - *Funciona en Red interdependiente*
  - *Requiere RR.HH. Altamente capacitados y creativos*

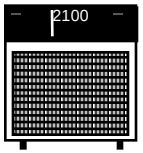
- **Nueva Cultura Científica e-Investigación**
  - *Teoría - Experimentos - Simulación*
  - *Multidisciplinaria & Colaboración Remota*
  - *Data intensiva vs Cómputo Intensiva*
  - *Medición y Minería de Datos.*
  - *Nueva forma de Comunicación: preservación-diseminación del Conocimiento*

# y entonces la electricidad entró en nuestras vidas

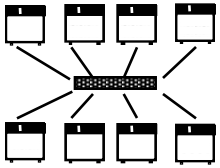



mono Procesador

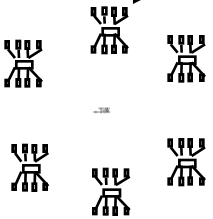
Memoria Compart




Cluster Paralelo local



Cluister Paralelo Universal



Iluminación en el mundo

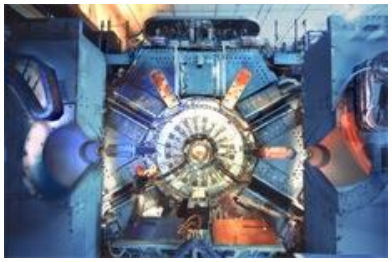

Tráfico Internet en el mundo

# Ciencia/Arte, Ciencia Industrial, e-Investigación/Ciencia 2.0

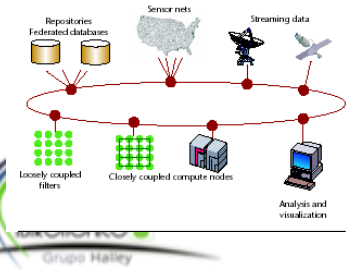
- **Ciencia Arte:** Esfuerzo, ingenio y destrezas personales

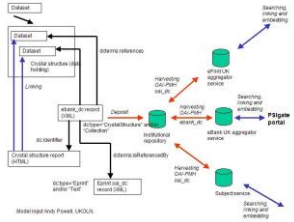
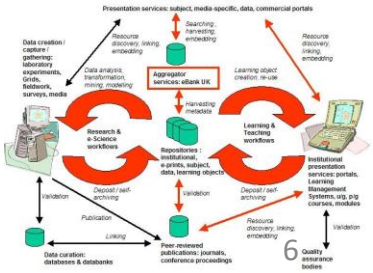


- **Ciencia Industrial:** Esfuerzo Colectivo, destrezas e ingenio tecnológico

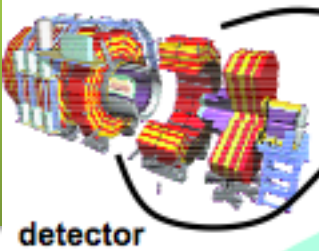
- **e-Investigación/Ciencia 2.0:** Esfuerzo Global, destrezas e ingenio informacional



# Data Handling and Computation for ~~Physics~~ Analysis

e-research



detector

event filter (selection & reconstruction)

reconstruction

raw data

event summary data

event reprocessing

processed data

batch physics analysis

analysis

analysis objects (extracted by physics topic)

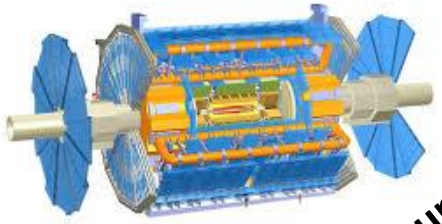
interactive physics analysis

event simulation

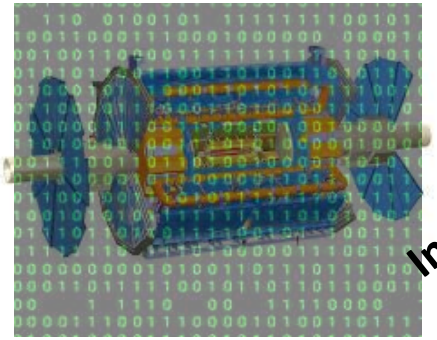
simulation

les.robertson@cern.ch

# Medidas, Instrumento
# Análisis de datos y descubrimiento



Instrumento Real



Instrumento Digital

**Condiciones del Instrumento** ⟷ **Reconstrucción del Instrumento**

↓ ↓

**Datos Medidos** ⟷ **Datos Simulados**

↓ ↓

**Discovery**

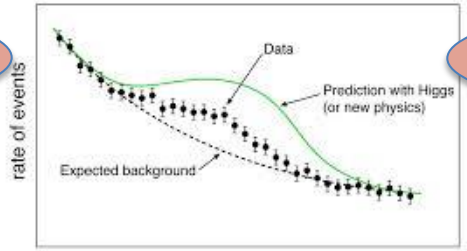
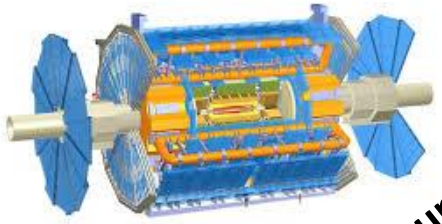
**Análisis de datos** →  ← **Análisis de Datos**

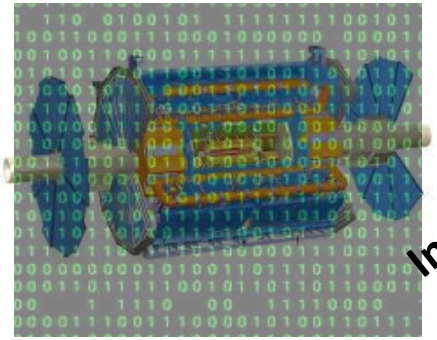


Figure B

# Medidas, Reconstrucción de Medidas
# Análisis de datos y descubrimiento



Instrumento Real



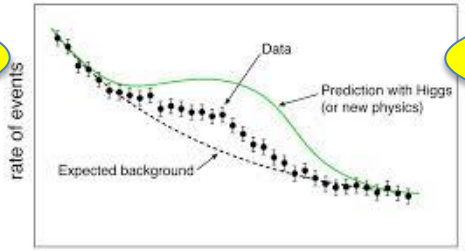
Instrumento Digital

**Condiciones del Instrumento** ⟷ **Reconstrucción del Instrumento**

**Datos Medidos** ⟷ **Datos Simulados**

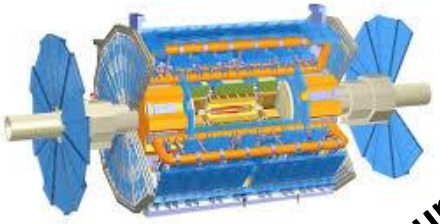
**Discovery**

**Análisis de datos** ⟷ **Análisis de Datos**

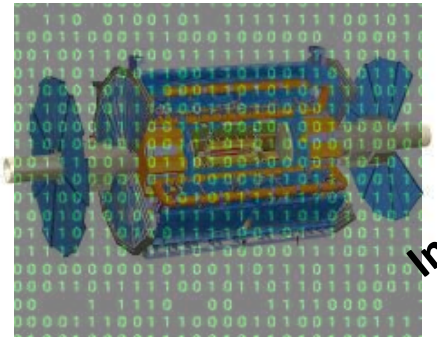



Dependiente del Software

# Medidas, Reconstrucción de Medidas
# Análisis de datos y descubrimiento



Instrumento Real

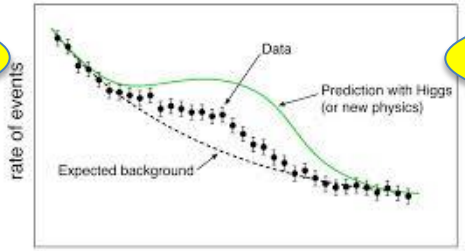


Instrumento Digital

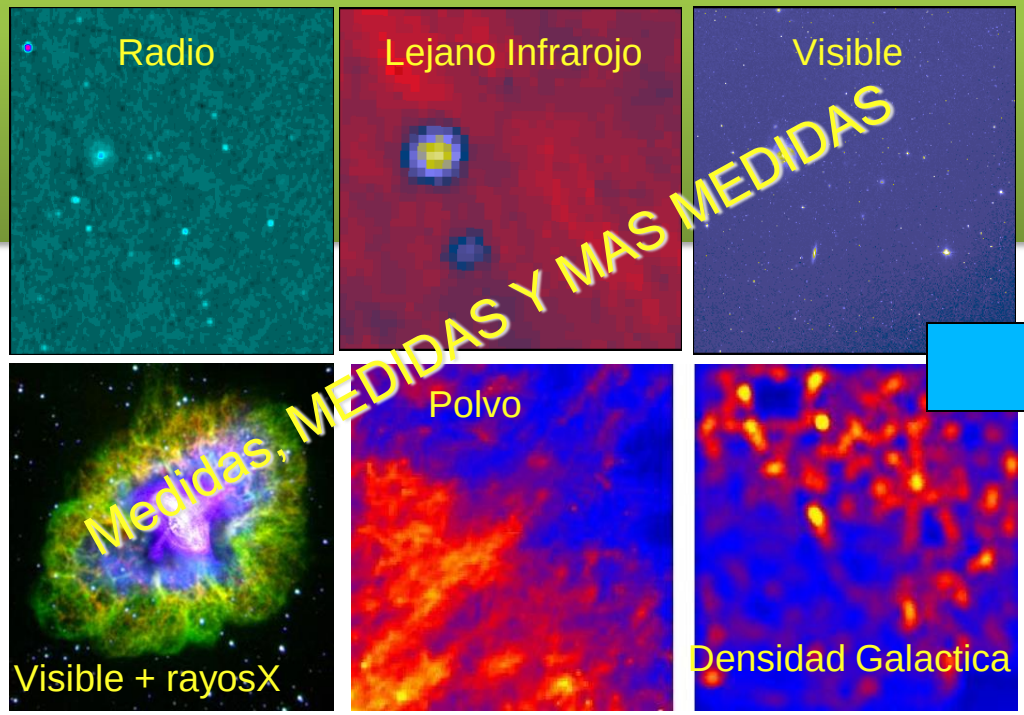
**Condiciones del Instrumento** → **Datos Medidos** → **Análisis de datos**

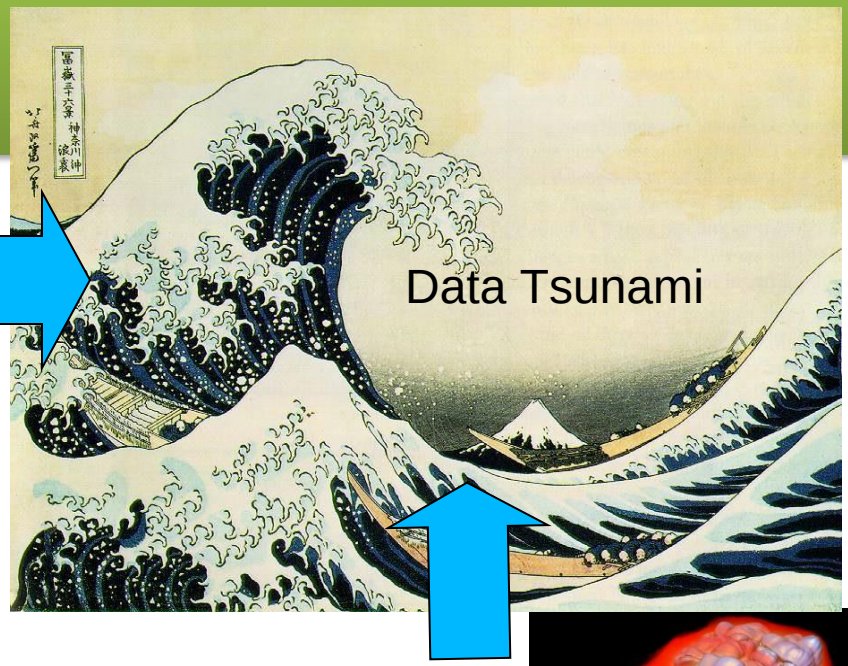
**Reconstrucción del Instrumento** → **Datos Simulados** → **Análisis de Datos**

**Discovery**




Dependiente del Software

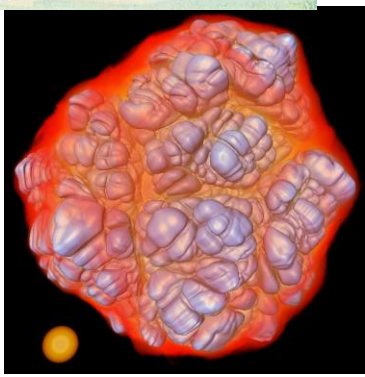


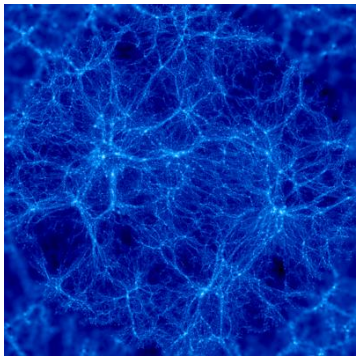




# De los datos al conocimiento

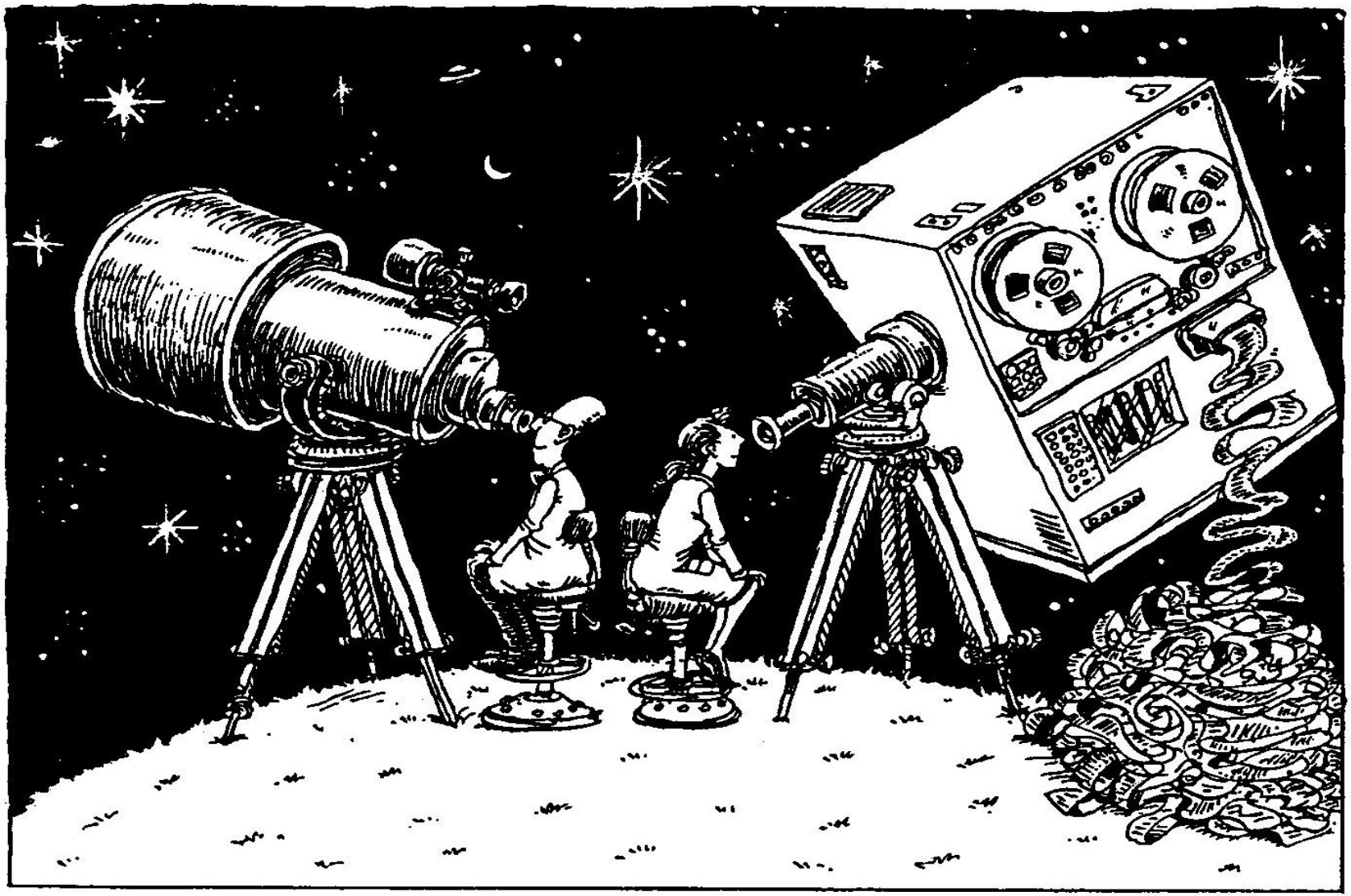
En los últimos 5 años la Astronomía ha registrado/almacenado
más datos que en toda su historia

**Datos Simulados**

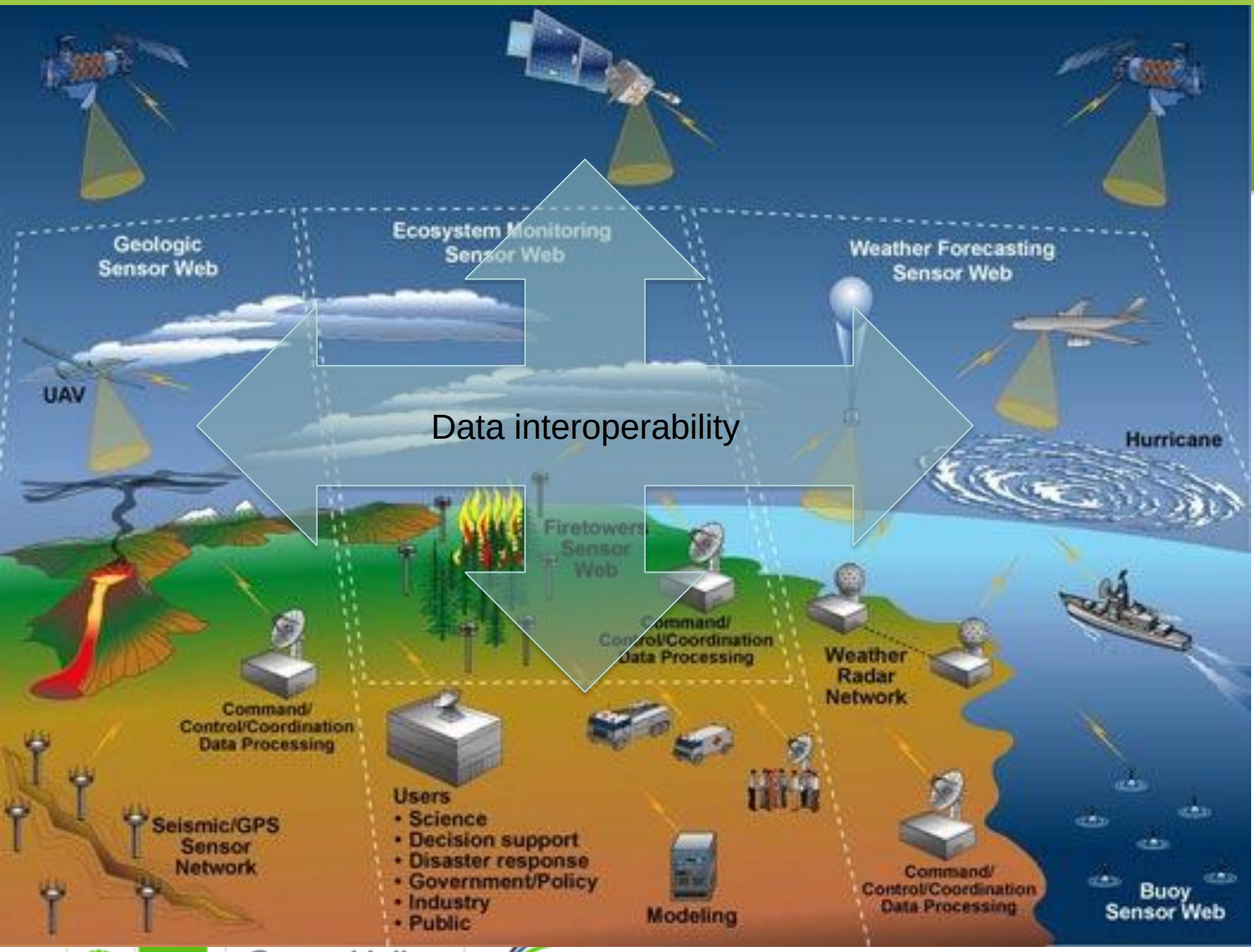




Simulaciones de la evolución de nuestro Universo



# Mining the digital skies


Geologic Sensor Web
Ecosystem Monitoring Sensor Web
Weather Forecasting Sensor Web
UAV
Data interoperability
Hurricane
Firetowers Sensor Web
Command/ Control/Coordination Data Processing
Weather Radar Network
Command/ Control/Coordination Data Processing
Users
• Science
• Decision support
• Disaster response
• Government/Policy
• Industry
• Public
Seismic/GPS Sensor Network
Modeling
Command/ Control/Coordination Data Processing
Buoy Sensor Web

google.org Flu Trends

Language: English (United States)

Google.org home

**Flu Trends**

Home

Select country/regior

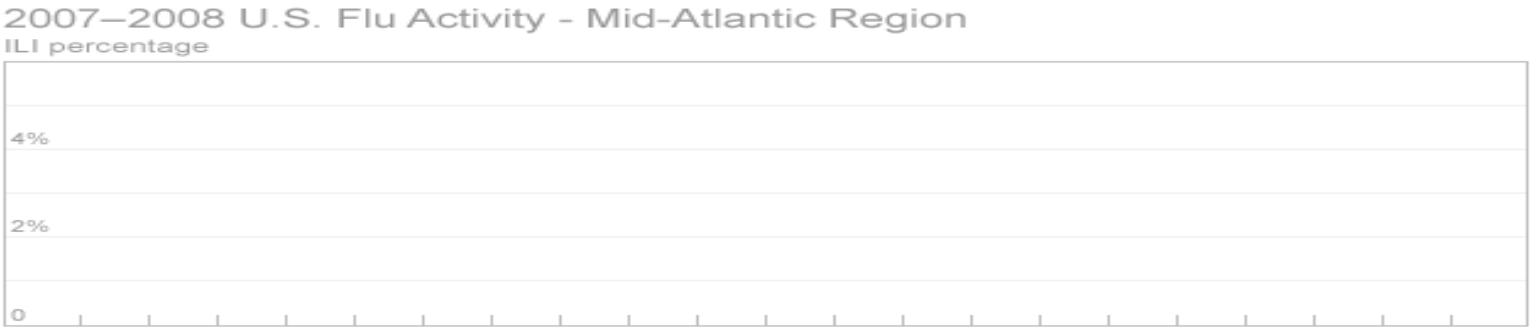
**How does this work?**

FAQ

http://www.google.org/flutrends/about/how.html

# How does this work?

**We've found that certain search terms are good indicators of flu activity. Google Flu Trends uses aggregated Google search data to estimate current flu activity around the world in near real-time.**

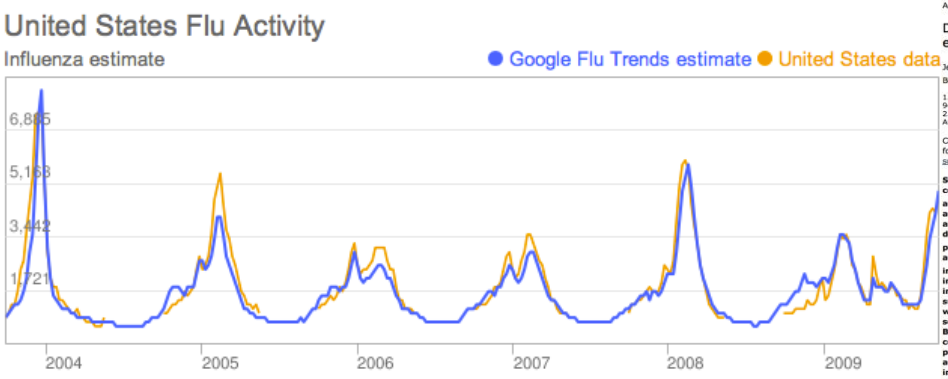



Download video (QuickTime)

Each week, millions of users around the world search for health information online. As you might expect, there are more flu-related searches during flu season, more allergy-related searches during allergy season, and more sunburn-related searches during the summer. You can explore all of these phenomena using Google Insights for Search. But can search query trends provide the basis for an accurate, reliable model of real-world phenomena?

We have found a close relationship between how many people search for flu-related topics and how many p
searches for "flu" is actually sick, but a pattern emerges when all the flu-related search queries are added t
systems and found that many search queries tend to be popular exactly when flu season is happening. By
much flu is circulating in different countries and regions around the world. Our results have been published i

**Historical estimates** See data for: United States




United States: Influenza-like illness (ILI) data provided publicly by the U.S. Centers for Disease Control.


nature International weekly journal of science

Access
To read this story in full you will need to login or make a payment (see right).

Letter

Detecting influenza epidemics using search engine query data

Jeremy Ginsberg, Matthew H. Mohebbi, Rajan S. Patel, Lynnette Brammer, Mark S. Smolinski & Larry Brilliant

Seasonal influenza epidemics are a major public health concern, causing tens of millions of respiratory illnesses and 250,000 to 500,000 deaths worldwide each year. In addition to seasonal influenza, a new strain of influenza virus against which no previous immunity exists and that demonstrates human-to-human transmission could result in a pandemic with millions of fatalities. Early detection of disease activity, when followed by a rapid response, can reduce the impact of both seasonal and pandemic influenza. One way to improve early detection is to monitor health-seeking behaviour in the form of queries to online search engines, which are submitted by millions of users around the world each day. Here we present a method of analysing large numbers of Google search queries to track influenza-like illness in a population. Because the relative frequency of certain queries is highly correlated with the percentage of physician visits in which a patient presents with influenza-like symptoms, we can accurately estimate the current level of weekly influenza activity in each region of the United States, with a reporting lag of about one day. This approach may make it possible to use search queries to detect influenza epidemics in areas with a large population of web search users.

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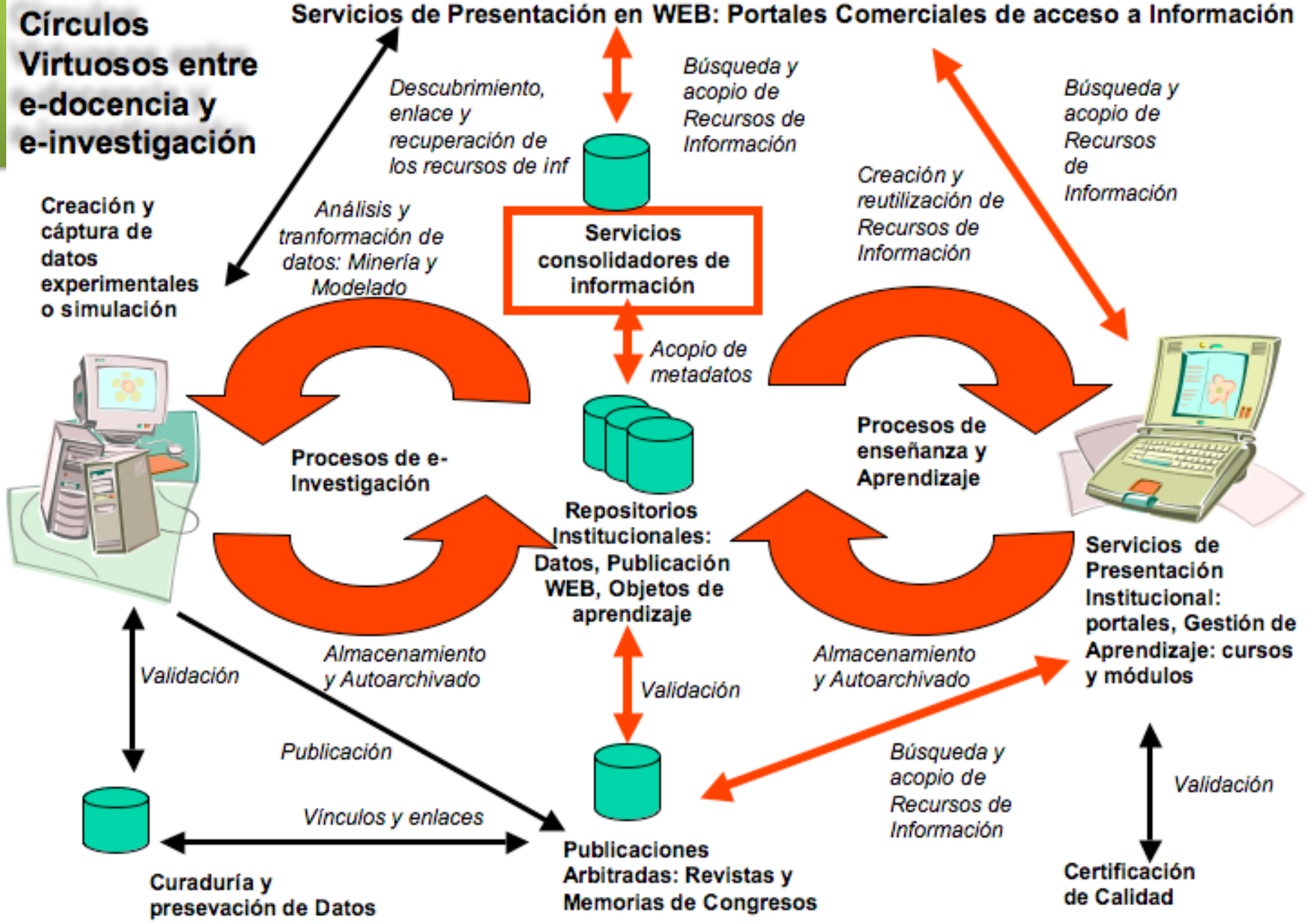
# Círculos Virtuosos entre e-docencia y e-investigación




Liz Lyon (2004) ***Realising the scholarly knowledge cycle*** http:// www.ukoln.ac.uk

# El conocimiento se colectiviza. Wikipedia es Inteligencia Colectiva

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The Free Encyclopedia

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## Collective intelligence

From Wikipedia, the free encyclopedia

This article **needs attention from an expert on the subject**. See the talk page for details. WikiProject Sociology or the Sociology Portal may be able to help recruit an expert. *(April 2010)*

**Collective intelligence** is a shared or group intelligence that emerges from the collaboration and competition of many individuals and appears in consensus decision making in bacteria, animals, humans and computer networks. It can also be understood as an emergent property from synergies among 1) data/info/knowledge, 2) software/hardware; and 3) experts and others with insight that continually learns from feedback to produce (nearly) just in time knowledge for better decisions than these elements acting alone. [1]

The idea emerged from the writings of Douglas Hofstadter (1979), Peter Russell (1983), Tom Atlee (1993), Pierre Lévy (1994), Howard Bloom (1995), Francis Heylighen (1995), Douglas Engelbart, Cliff Joslyn, Ron Dembo, Gottfried Mayer-Kress (2003) and other theorists. Collective intelligence is referred to as **Symbiotic intelligence** by Norman Lee Johnson.[2] The concept is relevant in sociology, business, computer science and mass communications: it also appears in science fiction, frequently in the form of telepathically-linked species and cyborgs.


Main page
Contents
Featured content
Current events
Random article
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Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact Wikipedia

Toolbox

Print/export

Languages
العربية
Česky
Deutsch
Español
Esperanto
Français
한국어
Հայերեն
Hrvatski
Italiano
עברית
日本語
Português
Русский
Suomi
中文

**Contents** [hide]

1 History
2 Dimensions
3 Examples
4 Mathematical techniques
5 Digital media
5.1 Social bookmarking
5.2 Video games
5.3 Stock market predictions
6 Views
7 See also
8 Notes
9 References
10 Further reading
11 External links

### History

A precursor of the concept is found in entomologist
that acted like the cells of a single beast he called a

In 1912 Émile Durkheim identified society as the sol
Vladimir Vernadsky's concept of "noosphere" and H.
a noosphere – a transcendent, rapidly evolving coll

### Dimensions

Howard Bloom has discussed mass behavior - colle
calls "a learning machine". In 1986 Bloom combined
bacterial colonies and human societies can be expla

Bloom traced the evolution of collective intelligence
animal except for humans and co-operate in keeping

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## Talk:Collective intelligence

From Wikipedia, the free encyclopedia

This article is within the scope of *WikiProject Systems*, which collaborates on articles related to Systems science.

*Systems science portal*

Systems rating: Quality unassessed. importance unassessed. Field unassessed.

**Contents** [hide]

1 Comment
2 Needs renaming
3 Needs wikification
4 SOX and CI
5 Important page-can I help?
6 Emergent consciousness and Cartesian Dualism
7 Alternative Meaning: Collective Intelligence in Computer-Based Collaboration?
8 Politics
9 This article needs more...a lot more.
10 Avoid self reference
11 objection to being stalked
12 Anyone willing to take a stab at improving this article?
13 removal of a para
14 Halo Videogame as an example of CI?
15 Intelligence Citations Bibliography for Articles Related to Human Intelligence
16 References

### Comment [edit]

The entire political sense of collective intelligence has been removed, despite a mainstream politician (Al Gore) using it in just this sense. This is censorship, period. I request that you put some element of the material regarding political parties and constitutions as organizing collective action back in, as its removal seems simply to validate the narrowly technical views.

In opposition to the above, I state that technical views are anything but narrow. They are, in fact, quite useful in getting a deep understanding of CI.

Murray Turoff and Roxanne Hiltz researched online Collective Intelligence starting in 1986. Their measure was obtained by comparing the group problem solution with the best individual solution in the group. See http://www.wikiworld.com/wiki/index.php/CollectiveIntelligence

### Needs renaming [edit]

The most prominent opponent of 'Collective Intelligence' was a presumably little known individual called Albert Einstein. Oh, hes the one turning in his grave right now due to the idiotic naming of this phenomenon. If there is any chance that the hideous oxymoron 'Collective Intelligence' could be renamed to, say, 'Consensus' or 'Collective Processing' or more aptly 'Collective Infinite Stupidity', please make it so. —Preceding unsigned comment added by 80.65.242.154 (talk) 11:23, 7 March 2008 (UTC)

> Amen, brother! This reads like stream of consciousness of some low IQ, high pretensions individuals who overdosed on ketamine. Description of views of the supporting "scientists" reads like something straight out of "Who is who in New Agey pseudoscience". And bringing into this Thomas Jefferson who sincerely believed in educated citizenry running a free republic (not a multitude of ignorant postmodern sheeples slaving for their "global-minded" overlords) just adds insult to injury. 76.24.104.52 (talk) 03:15, 27 April 2009 (UTC)

### Needs wikification [edit]

This needs to be split into sections for easier reading/scanning. It probably could also stand to be "tightened up" a bit (i.e., edited), but maybe that's just the impression I got from scanning through the 16 paragraphs with no section breaks. - dcljr (talk) 04:46, 26 August 2005 (UTC)

Okay, I've had a bash at trying to sort it into slightly more managable chunks, but as I don't know a lot about this subject, I'm reluctant to do any more drastic editing!

In particular, the paragraphs that I put under "general concepts" don't make a lot of sense to me. Perhaps they should be edited, re-written or discarded by somebody who understands this topic.

At first glance, the French version of the page appears to be much better written and structured, with more interesting real-world examples. Here's a rough translation of the headings, just to give you a flavour:

1. 1 Definition

```
    * 1.1 Charactistics of collective systems
```

Escuela de Física | Universidad Industrial de Santander | Grupo Astronomía y Ci

# Cambiamos y no nos dimos cuenta

- **Tenemos una nueva economía**
- **La producción de conocimiento replica el modo de producción de la economía: *Global, Colectiva, en tiempo real, Viabilizada por las TIC***
- **Las posibilidades de las TIC Cambian la esencia de la actividad Científica.**
- **La Ciencia se centra en datos y está cambiando metodológicamente**

Universidades

Industrias

## Sociedad Industrial

**Investigación**
Nuevo Conocimiento

**Docencia**
Formación de Personal

**Extensión**
Sociedad

Laboratorios Nacionales
Centros de Investigación

Universidades

Industrias

## Sociedad Informacional

**Investigación**
Nuevo Conocimiento

**Docencia**
Formación de Personal

**Extensión**
Sociedad

# ¿Qué es Ciencia Ciudadana?

- Ejecutada por aficionados
- Participación activa del Ciudadano Investigador
- Interacción entre aficionados e investigadores
- Conducida por grandes grupos: Global Masiva y Distribuida.

**Hoy Ciencia Ciudadana Centrada en WEB**

**INTERNET, Grandes volúmenes de datos, limitaciones presupuestarias, tiempo ocioso**

**GRANNNNNDESSSS PROBLEMAS**

# ¿Ciencia Ciudadana?

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## Citizen science

From Wikipedia, the free encyclopedia

**Citizen science** is scientific research conducted, in whole or in part, by amateur or nonprofessional scientists. Formally, citizen science has been defined as "the systematic collection and analysis of data; development of technology; testing of natural phenomena; and the dissemination of these activities by researchers on a primarily avocational basis"[1]. Citizen science is sometimes called "public participation in scientific research."[2][3]

Citizen-science activities can take many forms:

- Citizen scientists can help gather data that will be analyzed by professional researchers. The Audubon Society's Christmas Bird Count, which began in 1900, is a good example.
- Citizen scientists can help analyze data that has been gathered by professional researchers. SETI Live[4], Galaxy Zoo[5], and other Zooniverse projects are examples.
- Citizen scientists can volunteer at a research center or join a research expedition, such as those organized by the Earthwatch Institute.
- Citizen scientists can compete in competition such as NASA's International Space Apps Challenge.[6]
- Citizen scientists can build and operate their own instruments to gather data for their own experiments or as part of a larger project. Examples include amateur radio, amateur astronomy, and Maker activities.
- Citizen scientists can travel to areas that are seldom visited by [illegible] Space[8]

Citizen science may be performed by individuals, teams, or networ[illegible] volunteer networks often allow scientists to accomplish tasks that [illegible]

Citizen science networks are often involved in the observation of cy[illegible] geographic areas,[9] and in monitoring programs for natural-resourc[illegible]

Many citizen-science projects serve education and outreach goals. [illegible] or an informal education environment such as museums.

In recent years, citizen science projects have become increasingly [illegible]

**Contents** [hide]


1 New Technology
2 Citizens in Space
3 History of citizen science
4 Other definitions of citizen science
5 References
6 External links


Article Talk Read Edit New section View history Search

## Talk:Citizen science

From Wikipedia, the free encyclopedia

Hello,

I would like to suggest to edit the page to:

"Some programs provide materials specifically for use by primary or secondary school students. As such, citizen science is one approach to [both, formal and] informal science education.

Note that it is contradictory to state citizen science is an approach to informal science education, right after stating that some programs provide materials specifically for use by primary or secondary school students.

Unless what one really wanted to say is that citizen science is informal science. But that isn't the case either because there are high qualified scientists behind data gathering and analysis across the world.

My suggestion is to highlight that citizen science encompasses both dimensions, formal and informal in both domains, science and science education.

I hope this is a useful contribution.

It is after all, a nice article with great external references.

Fsoares67 (talk) 17:14, 15 January 2008 (UTC)

Do you have citable sources for these thoughts? Wikipedia cannot use "original research", no matter how valid it might be. --Orlady (talk) 18:55, 15 January 2008 (UTC)

Do you mean a source for considering school education formal education? That's as commonsense as it is considering informal education what doesn't go on in schools. In regards to high qualified scientists, the Cornell Lab of Ornithology cited in the article is a good example, but I would like also to suggest WorldBirds plus the plethora of research studies supported by EarthWatch.

There is no source to state citizen science is an approach to informal science education either in the article. Please, clarify what conjecture source you refer too.

Please, clarify —Preceding unsigned comment added by Fsoares67 (talk • contribs) 19:03, 15 January 2008 (UTC)

Excuse me I'm new to Wikipedia. I'm going to organize my sources and come back. I am affectionate to citizen science and that is actually the research topic of my dissertation. That's why I though I could contribute. Narrowing citizen science to an approach to informal science education is flat wrong, though. I have a short review of projects aimed to K-12 education. It couldn't get more formal than that. Posting sources as soon as possible. Fsoares67 19:23, 15 January 2008 (UTC)

Thus far I was unable to contact the author, and I suspect the review has not been published. Nevertheless, I strongly suggest to not limit the concept of Citizen Science to informal science education. It is also a pedagocial approach to increase scientific literacy among students, thus playing an important role in formal science education.-- —Preceding unsigned comment added by Fsoares67 (talk • contribs) 14:26, 8 February 2008 (UTC)

### Crowd-sourcing? [edit]

Would citizen science be a kind of crowd-sourcing? That's what I would call it from other examples, e.g. publish photos of something and have people look at them and log the details. —Monado (talk) 04:34, 22 January 2011 (UTC)

- Yes, from Wikipedia's own article on same! —Monado (talk) 04:35, 22 January 2011 (UTC)

### Related book [edit]

New book, may be useful for expanding/referencing this article: Reinventing Discovery: The New Era of Networked Science by Michael Nielsen. Jodi.a.schneider (talk) 06:34, 10 October 2011 (UTC)

Escuela de Física Universidad Industrial de Santander Grupo Hall[illegible] Astronomía y Ciencias Aeroespa[illegible]

# El conocimiento se colectiviza. Wikipedia es Inteligencia Colectiva

Log in / create account

Article | Talk | Read | Edit | View history | Search

WIKIPEDIA
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Main page
Contents
Featured content
Current events
Random article
Donate to Wikipedia

Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact Wikipedia

Toolbox

Print/export

Languages
العربية
Česky
Deutsch
Español
Esperanto
Français
한국어
Հայերեն
Hrvatski
Italiano
עברית
日本語
Português
Русский
Suomi
中文

## Collective intelligence

From Wikipedia, the free encyclopedia

This article **needs attention from an expert on the subject**. See the talk page for details. WikiProject Sociology or the Sociology Portal may be able to help recruit an expert. *(April 2010)*

**Collective intelligence** is a shared or group intelligence that emerges from the collaboration and competition of many individuals and appears in consensus decision making in bacteria, animals, humans and computer networks. It can also be understood as an emergent property from synergies among 1) data/info/knowledge, 2) software/hardware; and 3) experts and others with insight that continually learns from feedback to produce (nearly) just in time knowledge for better decisions than these elements acting alone. [1]

The idea emerged from the writings of Douglas Hofstadter (1979), Peter Russell (1983), Tom Atlee (1993), Pierre Lévy (1994), Howard Bloom (1995), Francis Heylighen (1995), Douglas Engelbart, Cliff Joslyn, Ron Dembo, Gottfried Mayer-Kress (2003) and other theorists. Collective intelligence is referred to as **Symbiotic intelligence** by Norman Lee Johnson.[2] The concept is relevant in sociology, business, computer science and mass communications: it also appears in science fiction, frequently in the form of telepathically-linked species and cyborgs.


Contents [hide]
1 History
2 Dimensions
3 Examples
4 Mathematical techniques
5 Digital media
5.1 Social bookmarking
5.2 Video games
5.3 Stock market predictions
6 Views
7 See also
8 Notes
9 References
10 Further reading
11 External links

### History

A precursor of the concept is found in entomologist
that acted like the cells of a single beast he called a

In 1912 Émile Durkheim identified society as the sol
Vladimir Vernadsky's concept of "noosphere" and H.
a noosphere — a transcendent, rapidly evolving coll

### Dimensions

Howard Bloom has discussed mass behavior - colle
calls "a learning machine". In 1986 Bloom combined
bacterial colonies and human societies can be expla

Bloom traced the evolution of collective intelligence
animal except for humans and co-operate in keeping

Article | Talk | Read | Edit | New section | View history | Search

## Talk:Collective intelligence

From Wikipedia, the free encyclopedia

This article is within the scope of *WikiProject Systems*, which collaborates on articles related to Systems science. Systems science portal

Systems rating: Quality unassessed. importance unassessed. Field unassessed.

Contents [hide]
1 Comment
2 Needs renaming
3 Needs wikification
4 SOX and CI
5 Important page-can I help?
6 Emergent consciousness and Cartesian Dualism
7 Alternative Meaning: Collective Intelligence in Computer-Based Collaboration?
8 Politics
9 This article needs more...a lot more.
10 Avoid self reference
11 objection to being stalked
12 Anyone willing to take a stab at improving this article?
13 removal of a para
14 Halo Videogame as an example of CI?
15 Intelligence Citations Bibliography for Articles Related to Human Intelligence
16 References

### Comment [edit]

The entire political sense of collective intelligence has been removed, despite a mainstream politician (Al Gore) using it in just this sense. This is censorship, period. I request that you put some element of the material regarding political parties and constitutions as organizing collective action back in, as its removal seems simply to validate the narrowly technical views.

In opposition to the above, I state that technical views are anything but narrow. They are, in fact, quite useful in getting a deep understanding of CI.

Murray Turoff and Roxanne Hiltz researched online Collective Intelligence starting in 1986. Their measure was obtained by comparing the group problem solution with the best individual solution in the group. See http://www.wikiworld.com/wiki/index.php/CollectiveIntelligence

### Needs renaming [edit]

The most prominent opponent of 'Collective Intelligence' was a presumably little known individual called Albert Einstein. Oh, hes the one turning in his grave right now due to the idiotic naming of this phenomenon. If there is any chance that the hideous oxymoron 'Collective Intelligence' could be renamed to, say, 'Consensus' or 'Collective Processing' or more aptly 'Collective Infinite Stupidity', please make it so. —Preceding unsigned comment added by 80.65.242.154 (talk) 11:23, 7 March 2008 (UTC)

> Amen, brother! This reads like stream of consciousness of some low IQ, high pretensions individuals who overdosed on ketamine. Description of views of the supporting "scientists" reads like something straight out of "Who is who in New Agey pseudoscience". And bringing into this Thomas Jefferson who sincerely believed in educated citizenry running a free republic (not a multitude of ignorant postmodern sheeples slaving for their "global-minded" overlords) just adds insult to injury. 76.24.104.52 (talk) 03:15, 27 April 2009 (UTC)

### Needs wikification [edit]

This needs to be split into sections for easier reading/scanning. It probably could also stand to be "tightened up" a bit (i.e., edited), but maybe that's just the impression I got from scanning through the 16 paragraphs with no section breaks. - dcljr (talk) 04:46, 26 August 2005 (UTC)

Okay, I've had a bash at trying to sort it into slightly more managable chunks, but as I don't know a lot about this subject, I'm reluctant to do any more drastic editing!

In particular, the paragraphs that I put under "general concepts" don't make a lot of sense to me. Perhaps they should be edited, re-written or discarded by somebody who understands this topic.

At first glance, the French version of the page appears to be much better written and structured, with more interesting real-world examples. Here's a rough translation of the headings, just to give you a flavour:

1. 1 Definition

```
    * 1.1 Charactistics of collective systems
```

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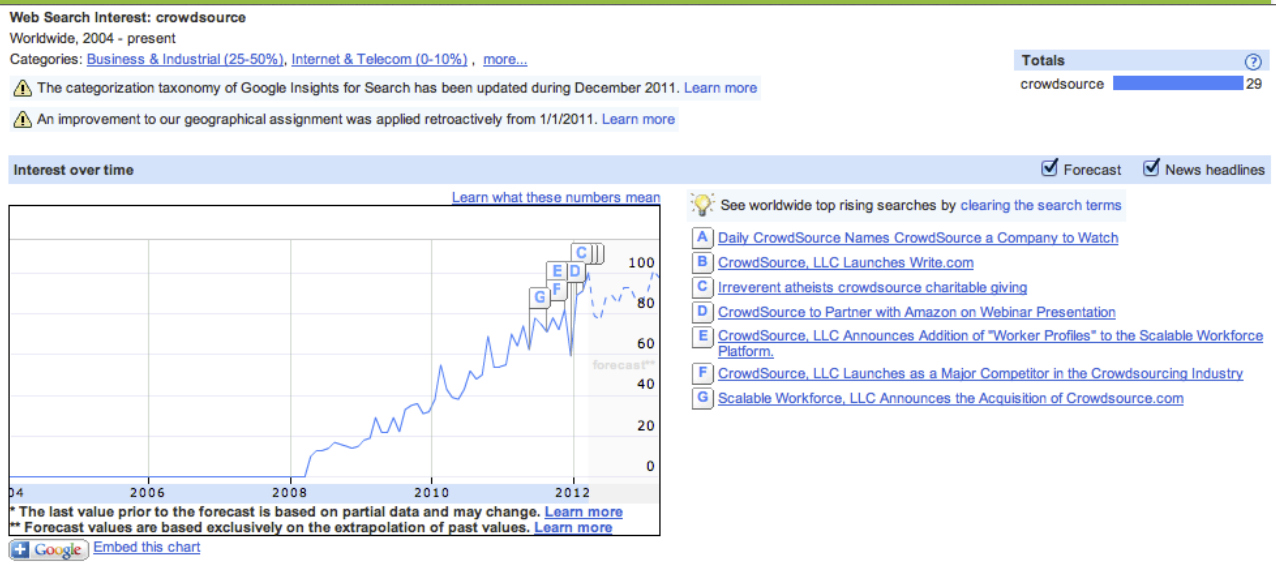
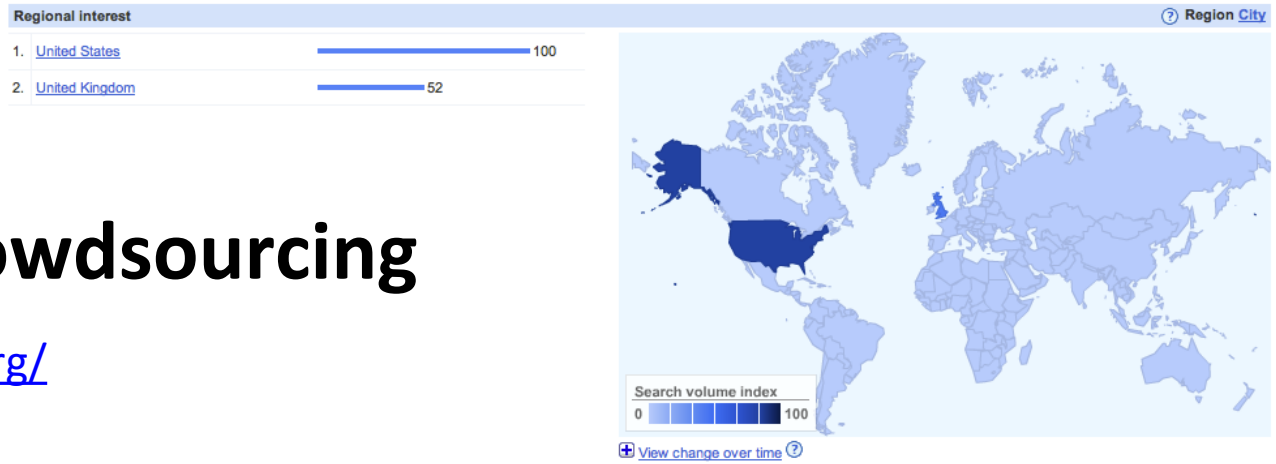
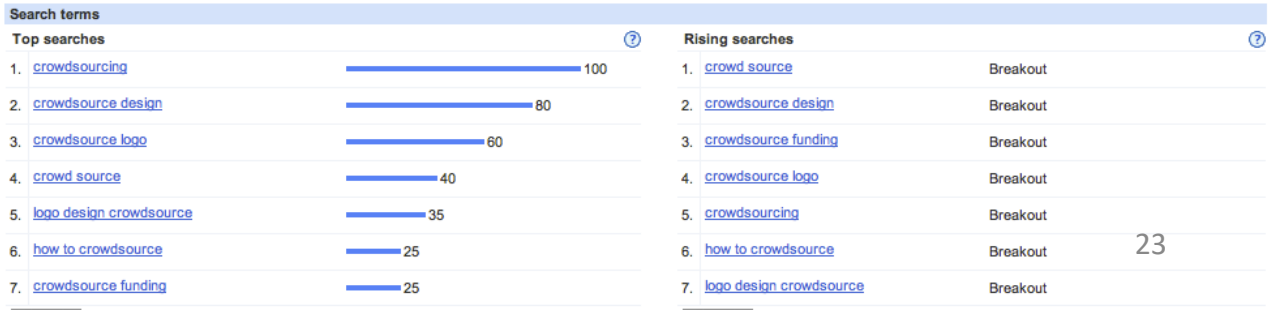
Travis, J. 2008. “Science by the Masses.” Science 319 (5871): 1750–1752.

# Crowdsourcing

http://www.crowdsourcing.org/

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# The Polymath project

http://gowers.wordpress.com/2009/01/27/is-massively-collaborative-mathematics-possible/

Tim Gowers

- **1991-1995 Department of Mathematics at University College London.**
- **1996 Prize of the European Mathematical Society**
- **1998 the Fields Medal for research on functional analysis and combinatorics.**

PolyMath **Gowers's Weblog**

Mathematics related discussions

« A Tricki issue  Background to a Polymath project »

## Is massively collaborative mathematics possible?

Of course, one might say, there are certain kinds of problems that lend themselves to huge collaborations. One has only to think of the proof of the classification of finite simple groups, or of a rather different kind of example such as a search for a new largest prime carried out during the downtime of thousands of PCs around the world. But my question is a different one. What about the solving of a problem that does not naturally split up into a vast number of subtasks? Are such problems best tackled by $n$ people for some $n$ that belongs to the set $\{1, 2, 3\}$? (Examples of famous papers with four authors do not count as an interesting answer to this question.)

It seems to me that, at least in theory, a different model could work: different, that is, from the usual model of people working in isolation or collaborating with one or two others. Suppose one had a forum (in the non-technical sense, but quite possibly in the technical sense as well) for the online discussion of a particular problem. The idea would be that anybody who had anything whatsoever to say about the problem could chip in. And the ethos of the forum — in whatever form it took — would be that comments would mostly be kept short. In other words, what you would *not* tend to do, at least if you wanted to keep within the spirit of things, is spend a month thinking hard about the problem and then come back and write ten pages about it. Rather, you would contribute ideas even if they were undeveloped and/or

# Hales–Jewett theorem

From Wikipedia, the free encyclopedia

In mathematics, the **Hales–Jewett theorem** is a fundamental combinatorial result of Ramsey theory, concerning the degree to which high-dimensional objects must necessarily exhibit some combinatorial structure; it is impossible for such objects to be "completely random".[1]

An informal geometric statement of the theorem is that for any positive integers $n$ and $c$ there is a number $H$ such that if the cells of a $H$-dimensional $n \times n \times n \times \ldots \times n$ cube are colored with $c$ colors, there must be one row, column, diagonal etc. of length $n$ all of whose cells are the same color. In other words, the higher-dimensional, multi-player, $n$-in-a-row generalization of game of tic-tac-toe cannot end in a draw, no matter how large $n$ is, no matter how many people $c$ are playing, and no matter which player plays each turn, provided only that it is played on a board of sufficiently high dimension $H$. By a standard strategy stealing argument, one can thus conclude that if two players alternate, then the first player has a winning strategy when $H$ is sufficiently large, though no constructive algorithm for obtaining this strategy is known.

More formally, let $W_n^H$ be the set of words of length $H$ over an alphabet with $n$ letters; that is, the set of sequences of $\{1, 2, \ldots, n\}$ of length $H$. This set forms the hypercube that is the subject of the theorem. A *variable word* $w(x)$ over $W_n^H$ still has length $H$ but includes the special element $x$ in place of at least one of the letters. The words $w(1)$, $w(2)$, ..., $w(n)$ obtained by replacing all instances of the special element $x$ with 1, 2, ..., $n$, form a *combinatorial line* in the space $W_n^H$; combinatorial lines correspond to rows, columns, and (some of the) diagonals of the hypercube. The Hales–Jewett theorem then states that for given positive integers $n$ and $c$, there exists a positive integer $H$, depending on $n$ and $c$, such that for any partition of $W_n^H$ into $c$ parts, there is at least one part that contains an entire combinatorial line.

For example, take $n = 3$, $H = 2$, and $c = 2$. The hypercube $W_n^H$ in this case is just the standard tic-tac-toe board, with nine positions:

11 12 13

21 22 23

31 32 33

A typical combinatorial line would be the word 2x, which corresponds to the line 21, 22, 23; another combinatorial line is xx, which is the line 11, 22, 33. (Note that the line 13, 22, 31, while a valid line for the game tic-tac-toe, is not considered a combinatorial line.) In this particular case, the Hales–Jewett theorem does not apply; it is possible to divide the tic-tac-toe board into two sets, e.g. {11, 22, 23, 31} and {12, 13, 21, 32, 33}, neither of which contain a combinatorial line (and would correspond to a draw in the game of tic-tac-toe). On the other hand, if we increase $H$ to, say, 8 (so that the board is now eight-dimensional, with $3^8 = 6561$ positions!), and partition this board into two sets (the "noughts" and "crosses"), then one of the two sets must contain a combinatorial line (i.e. no draw is possible in this variant of tic-tac-toe). For a proof, see below.

**Contents** [hide]

1 Proof of Hales–Jewett theorem (in a special case)
2 Connections with other theorems
3 See also
4 References
5 External links

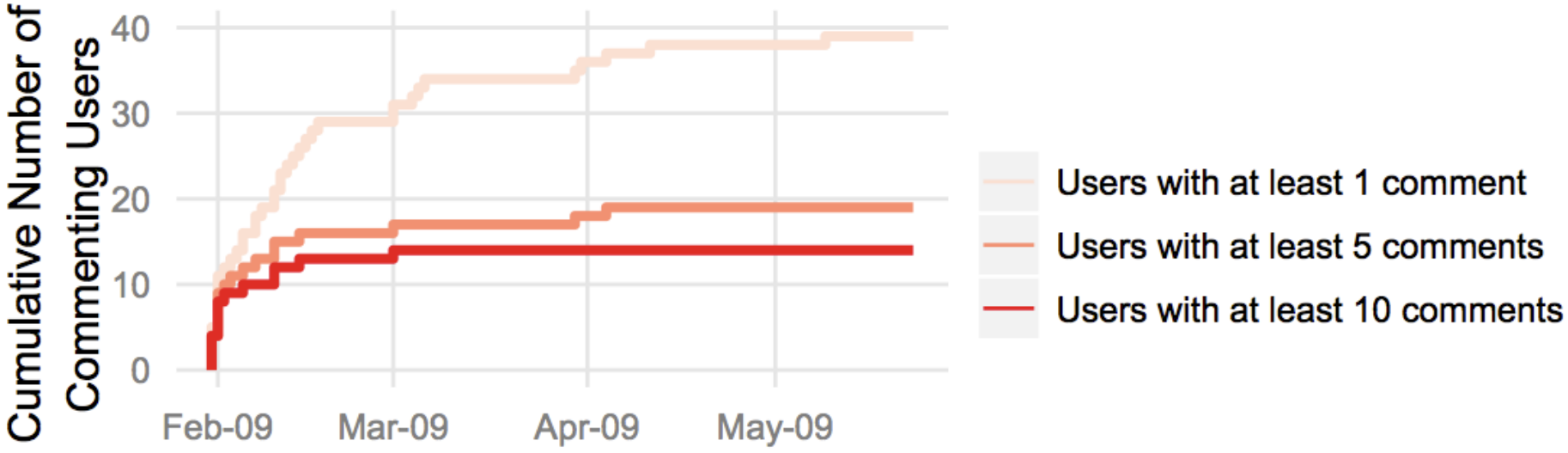
## Proof of Hales–Jewett theorem (in a special case) [edit]

We now prove the Hales–Jewett theorem in the special case $n = 3$, $c = 2$, $H = 8$ discussed above. The idea is to reduce this task to that of proving simpler versions of the Hales–Jewett theorem (in this particular case, to the cases $n = 2$, $c = 2$, $H = 2$ and $n = 2$, $c = 6$, $H = 6$). One can prove the general case of the Hales–Jewett theorem by similar methods, using mathematical induction.

Each element of the hypercube $W_3^8$ is a string of eight numbers from 1 to 3, e.g. 13211321 is an element of the hypercube. We are assuming that this hypercube is completely filled with "noughts" and "crosses". We shall use a proof by contradiction and assume that neither the set of noughts nor the set of crosses contains a combinatorial line. If we fix the first six elements of such a string and let the last two vary, we obtain an ordinary tic-tac-toe board, for instance 132113?? gives such a board. For each such board abcdef??, we consider the positions abcdef11, abcdef12, abcdef22. Each of these must be filled with either a nought or a cross, so by the pigeonhole principle two of them must be filled with the same symbol. Since any two of these positions are part of a combinatorial line, the third element of that line must be occupied by the opposite symbol (since we are assuming that no combinatorial line has all three elements filled with the same symbol). In other words, for each choice of abcdef (which can be thought of as an element of the six-dimensional hypercube $W_3^6$), there are

# PolyMath

- Se organizó la discusión en ideas/propuestas y comentarios. Puede haber varios “hilos” de discusión paralelos
- Cada propuesta tendrá un max 100 comentarios. Una vez alcanzado el máximo, se resumen este hilo de discusión
- A pesar de lo técnico de la discusión, se tiene particular interés con los recién llegados que aportan ideas frescas






Justin Cranshaw y Aniket Kittur. **The polymath project: lessons from a successful online collaboration in mathematics**. *Proceedings of the 2011 annual conference on Human factors in computing systems*, CHI ’11, pag 1865–1874, New York, NY, USA, 2011. ACM

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PolyMath

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Search

Mathematics > Combinatorics

# A new proof of the density Hales-Jewett theorem

D. H. J. Polymath

*(Submitted on 20 Oct 2009 (v1), last revised 16 Feb 2010 (this version, v2))*

The Hales-Jewett theorem asserts that for every r and every k there exists n such that every r-colouring of the n-dimensional grid {1,...,k}^n contains a combinatorial line. This result is a generalization of van der Waerden's theorem, and it is one of the fundamental results of Ramsey theory. The theorem of van der Waerden has a famous density version, conjectured by Erdos and Turan in 1936, proved by Szemeredi in 1975, and given a different proof by Furstenberg in 1977. The Hales-Jewett theorem has a density version as well, proved by Furstenberg and Katznelson in 1991 by means of a significant extension of the ergodic techniques that had been pioneered by Furstenberg in his proof of Szemeredi's theorem. In this paper, we give the first elementary proof of the theorem of Furstenberg and Katznelson, and the first to provide a quantitative bound on how large n needs to be. In particular, we show that a subset of {1,2,3}^n of density delta contains a combinatorial line if n is at least a tower of 2's of height O(1/delta^3). Our proof is reasonably simple: indeed, it gives what is arguably the simplest known proof of Szemeredi's theorem.

Comments: See also this http URL
Subjects: **Combinatorics (math.CO)**
MSC classes: 05D10
Cite as: arXiv:0910.3926v2 [math.CO]

## Submission history

From: Ryan O'Donnell [view email]
[v1] Tue, 20 Oct 2009 17:52:06 GMT (90kb,D)
[v2] Tue, 16 Feb 2010 11:17:10 GMT (42kb)

SAO/NASA Astrophysics Data System (ADS)

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| 2 | 2011arXiv1105.2419D<br>Dodos, Pandelis; Kanellopoulos, Vassilis; Tyros, Konstantinos | 1.000<br>Dense subsets of products of finite trees | 05/2011 | A | X | R | |
| 3 | 2011arXiv1105.2417D<br>Dodos, Pandelis; Kanellopoulos, Vassilis; Tyros, Konstantinos | 1.000<br>Measurable events indexed by trees | 05/2011 | A | X | R | |
| 4 | 2010arXiv1006.0491A<br>Austin, Tim | 1.000<br>Multiple recurrence and the structure of probability-preserving systems | 06/2010 | A | X | R C | U |
| 5 | 2010arXiv1003.2978C<br>Croot, Ernie; Sisask, Olof | 1.000<br>A probabilistic technique for finding almost-periods of convolutions | 03/2010 | A | X | R C | U |
| 6 | 2009arXiv0912.1150P<br>Pór, Attila; Wood, David R. | 1.000<br>On Visibility and Blockers | 12/2009 | A | X | R C | U |

arXiv.org > math > arXiv:1002.0374

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Mathematics > Combinatorics

# Density Hales-Jewett and Moser numbers

D.H.J. Polymath

*(Submitted on 2 Feb 2010 (v1), last revised 25 Apr 2010 (this version, v2))*

For any $n \geq 0$ and $k \geq 1$, the \emph{density Hales-Jewett number} $c_{n,k}$ is defined as the size of the largest subset of the cube $[k]^n$ := $\{1,...,k\}^n$ which contains no combinatorial line; similarly, the Moser number $c'_{n,k}$ is the largest subset of the cube $[k]^n$ which contains no geometric line. A deep theorem of Furstenberg and Katznelson shows that $c_{n,k}$ = $o(k^n)$ as $n \to \infty$ (which implies a similar claim for $c'_{n,k}$); this is already non-trivial for $k = 3$. Several new proofs of this result have also been recently established.
Using both human and computer-assisted arguments, we compute several values of $c_{n,k}$ and $c'_{n,k}$ for small $n,k$. For instance the sequence $c_{n,3}$ for $n=0,...,6$ is $1,2,6,18,52,150,450$, while the sequence $c'_{n,3}$ for $n=0,...,6$ is $1,2,6,16,43,124,353$. We also prove some results for higher $k$, showing for instance that an analogue of the LYM inequality (which relates to the $k = 2$ case) does not hold for higher $k$, and also establishing the asymptotic lower bound $c_{n,k} \geq k^n \exp(- O(\sqrt[\ell]{\log n}))$ where $\ell$ is the largest integer such that $2k > 2^\ell$.

Comments: 49 pages. To appear, Szemeredi birthday conference proceedings
Subjects: **Combinatorics (math.CO)**
MSC classes: 05D05, 05D10
Cite as: arXiv:1002.0374v2 [math.CO]

## Submission history

From: Terence C. Tao [view email]
[v1] Tue, 2 Feb 2010 00:55:11 GMT (114kb,D)
[v2] Sun, 25 Apr 2010 19:22:50 GMT (114kb,D)

Collective intelligence for new knowledge

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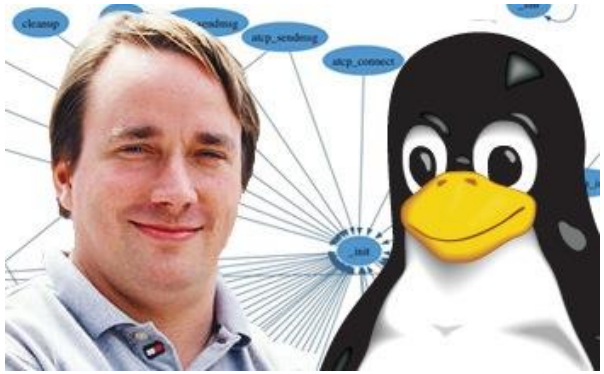

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Jackal@Turkey
from Turkey
Computer Programmer
Technologies, Music, Movies, Electronic

**News**

**Monday Morning Outage**
The entire lab is undergoing some electrical p
servers will be unreachable for 2 hours (from

**Project Back Online After Overnight Out**
Update: After reaching a logical (i.e. not phys
were lost. We resumed normal operations toc

**Huffington Post SETI@home Blog.**
SETI@home Project Scientist Eric Korpela has
Berkeley SETI bloggers may follow. Dependin
things directly related to SETI@home, or we

**First Look at Kepler SETI Candidate Sign**
Check out our First Look at Kepler SETI Cand

**2 Billion Results**
Tuesday morning we reached 2 Billion BOINC
31 results (2,147,483,648). This explains wh
to accept larger numbers.

**BOINC download server is down.**
The BO
http://milkyway.cs.rpi.edu/mi

... mo

News

LSC LIGO

EINSTEIN@HOME
Catch a Wave From Space

World Year of Physics 2005

**About Einstein@Home**

Thank you for your interest in Einstein@Home!

Einstein@Home is a World Year of Physics 2005 and an International Year of Astronomy 2009 project supported by the American Physical Society (APS) and by a number of international organizations.

**User of the day**

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**News**

**Three new pulsars found in Parkes Multi-Beam Pulsar Survey (PMPS) data!**
Einstein@Home volunteers have discovered three more new radio pulsars in data from the Parkes Multi-Beam Pulsar Survey (PMPS). Congratulations to:

- Rolf Schuster, Neu-Isenburg, Germany
- Rudzik Bogusław Sobczak, Krakow, Poland
- Sirko Rosenberg, Bautzen, Germany
- Steve Mellor, Perth WA, Australia
- Ton van Born, Amsterdam, the Netherlands
- Darren Chase, Adelaide, South Australia

Further details about these new discoveries can be found on this web page and will be published in due course. These discoveries bring the Einstein@Home discovery total to 9 new radio pulsars in the first two months of 2012!

Bruce Allen
Director, Einstein@Home
1 Mar 2012 13:04:59 UTC · Comment

**Three more pulsars confirmed in Arecibo data!**
Einstein@Home volunteers have discovered **three new radio pulsars** -- the 11'th, 12'th, and 13'th new radio pulsars found by our volunteers in Arecibo data. Six of these pulsars have been discovered in 2012: almost one per week! Congratulations to:

- Gerald Schrader, San Diego, California, USA
- Uwe Tittmar, Kressbronn, Germany
- Thomas Herdtle, St. Paul, Minnesota, USA
- Zsolt Szvoboda, Szentendre, Hungary
- Carat@voice, Ichikawa City, Japan
- Rensk, Switzerland

Further details are available on this web page, and will be published in due course.

BOINC

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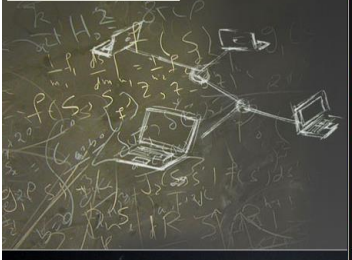
JOIN | RETURNING PARTICIPANTS | COMMU

The goal of Cosmology@Home is to search for the model that best describes our Universe and to find the range of models that agree with the available astronomical and particle physics data.

> how to join
> your account
> message boards
> goodies



USER OF

NEWS

We\'re back.
March 2, 2012
We are running
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Assimilator not
February 7, 2012
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Physics Nobel P
October 4, 2011
Congratulations
Adam Riess! Read Ben's post about today's Physics Nobel Prize.


## About MilkyWay@Home

Milkyway@Home uses the BOINC platform to harness volunteered computing resources, creating a highly accurate three dimensional model of the Milky Way galaxy using data gathered by the Sloan Digital Sky Survey. This project enables research in both astroinformatics and computer science.

In computer science, the project is investigating different optimization methods which are resilient to the fault-prone, heterogeneous and asynchronous nature of Internet computing; such as evolutionary and genetic algorithms, as well as asynchronous newton methods. While in astroinformatics, Milkyway@Home is generating highly accurate three dimensional models of the Sagittarius stream, which provides knowledge about how the Milky Way galaxy was formed and how tidal tails are created when galaxies merge.

Milkyway@Home is a joint effort between Rensselaer Polytechnic Institute's departments of Computer Science and Physics, Applied Physics and Astronomy. Feel free to contact us via our forums, or email astro [at] cs [dot] rpi [dot] edu.

## Join MilkyWay@Home

- Read our rules and policies
- This project uses BOINC. If you're already running BOINC, select Attach to Project. If not, download BOINC.
- When prompted, enter **http://milkyway.cs.rpi.edu/milkyway/**
- If you're running a command-line or pre-5.0 version of BOINC, create an account first.
- If you have any problems, get help here.

## Community

- Donate to MilkyWay@Home via the Dudley Observatory
- Message boards
- Server Status
- Profiles
- User search
- Statistics
- Languages

## Science

- Search Progress Plots
- Astrophysics Overview
- Publications, Public Talks and Funding
- Donations

Folding@home
distributed computing

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(Help)
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Lietuvių
Magyar
Nederlands
Norsk
Occitan
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Polski
Português
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Suomeksi
Svenska
Turkish
Tiếng Việt

Site search

## Our goal: to understand protein folding, misfolding, and related diseases

**You can help scientists studying these diseases by simply running a piece of software.**
Folding@home is a distributed computing project -- people from throughout the world download and run software to band together to make one of the largest supercomputers in the world. Every computer takes the project closer to our goals. Folding@home uses novel computational methods coupled to distributed computing, to simulate problems millions of times more challenging than previously achieved.

Download Folding@home

**Protein folding is linked to disease, such as Alzheimer's, ALS, Huntington's, Parkinson's disease, and many Cancers.**
Moreover, when proteins do not fold correctly (i.e. "misfold"), there can be serious consequences, including many well known diseases, such as Alzheimer's, Mad Cow (BSE), CJD, ALS, Huntington's, Parkinson's disease, and many Cancers and cancer-related syndromes.

**What is protein folding?**
Proteins are biology's workhorses -- its "nanomachines." Before proteins can carry out these important functions, they assemble themselves, or "fold." The process of protein folding, while critical and fundamental to virtually all of biology, in many ways remains a mystery.

**What have we done so far?**
We have had several successes. You can read about them on our Science page, on our Awards page, or go directly to our Results page.

**Want to learn more?**
Click on the links at the top of the page for downloads, install guides, or more information. You can also download our Executive Summary, which is a PDF suitable for distribution. One can also help by donating funds to the project, via Stanford University.

The School of Ants project is a citizen-scientist driven study of the ants that live in urban areas, particularly around homes and schools. Participation is open to anyone interested in contributing…..
The maps that we create with these data are telling us quite a lot about native and introduced ants in cities, not just here in North Carolina, but across the United States and, as this project grows, about the ants of the world! I

http://schoolofants.org/


Escuela de Física · Universidad Industrial de Santander · Grupo Halley Astronomía y Ciencias Aeroespaciales

http://www.youtube.com/watch?v=TTYsmHsQ4qk

http://beamartian.jpl.nasa.gov/


One game asks people to count craters in photos of Mars; the other asks people to match small, high-res photos of the Martian surface with their corresponding locations on a low-res photo taken from a higher altitude

http://fold.it/portal/

nature International weekly journal of science



NATURE | NEWS

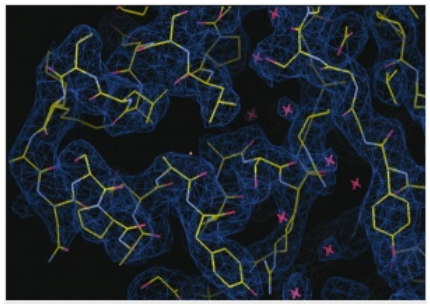
# Victory for crowdsourced biomolecule design

**Players of the online game Foldit guide researchers to a better enzyme.**

Jessica Marshall

22 January 2012

Obsessive gamers' hours at the computer have now topped scientists' efforts to improve a model enzyme, in what researchers say is the first crowdsourced redesign of a protein.



An enzyme designed by players of the protein-folding game Foldit was better than anything scientists could come up with.

The online game Foldit, developed by teams led by Zoran Popovic, director of the Center for Game Science, and biochemist David Baker, both at the University of Washington in Seattle, allows players to fiddle at folding proteins on their home computers in search of the best-scoring (lowest-energy) configurations.

The researchers have previously reported successes by Foldit players in folding proteins[1], but the latest work moves into the realm of protein design, a more open-ended problem. By posing a series of puzzles to Foldit players and then testing variations on the players' best designs in the lab, researchers have created an enzyme with more than 18-fold higher activity than the original. The work is published today in *Nature Biotechnology*[2].



"I worked for two years to make these enzymes better and I couldn't do it," says Justin Siegel, a post-doctoral researcher working in biophysics in Baker's group. "Foldit players were able to make a large jump in structural space and I still don't fully understand how they did it."

The project has progressed from volunteers donating their computers' spare processing power for protein-structure research, to actively predicting protein structures, and now to designing new proteins. The game has 240,000 registered players, 2,200 of whom were active last week.

foldit BETA 07:09:25 GMT
Solve Puzzles for Science

BLOG | PUZZLES | FEEDBACK | GROUPS | FORUM | PLAYERS | WIKI | FAQ | RECIPES | ABOUT | CONTESTS | CREDITS

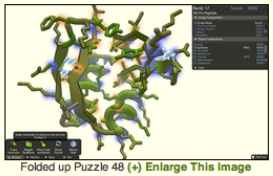
## The Science Behind Foldit

**Foldit is a revolutionary new computer game enabling *you* to contribute to important scientific research. This page describes the science behind Foldit and how your playing can help.**

Page Contents:
- What is protein folding?
- Why is this game important?
- Foldit Scientific Publications
- News Articles about Foldit
- News Articles about Rosetta
- Rosetta@Home Screensaver
- Community Guidelines

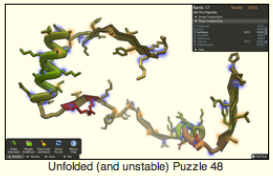
### What is protein folding?

**What is a protein?** Proteins are the workhorses in every cell of every living thing. Your body is made up of trillions of cells, of all different kinds: muscle cells, brain cells, blood cells, and more. Inside those cells, proteins are allowing your body to do what it does: break down food to power your muscles, send signals through your brain that control the body, and transport nutrients through your blood. Proteins come in thousands of different varieties, but they all have a lot in common. For instance, they're made of the same stuff: every protein consists of a long chain of joined-together amino acids.



Folded up Puzzle 48 (+) Enlarge This Image

**What are amino acids?** Amino acids are small molecules made up of atoms of carbon, oxygen, nitrogen, sulfur, and hydrogen. To make a protein, the amino acids are joined in an unbranched chain, like a line of people holding hands. Just as the line of people has their legs and feet "hanging" off the chain, each amino acid has a small group of atoms (called a sidechain) sticking off the main chain (backbone) that connects them all together. There are 20 different kinds of amino acids, which differ from one another based on what atoms are in their sidechains. These 20 amino acids fall into different groups based on their chemical properties: acidic or alkaline, hydrophilic (water-loving) or hydrophobic (greasy).



Unfolded (and unstable) Puzzle 48 (+) Enlarge This Image

**What shape will a protein fold into?** Even though proteins are just a long chain of amino acids, they don't like to stay stretched out in a straight line. The protein folds up to make a compact blob, but as it does, it keeps some amino acids near the center of the blob, and others outside; and it keeps some pairs of amino acids close together and others far apart. Every kind of protein folds up into a very specific shape -- the same shape every time. Most proteins do this all by themselves, although some need extra help to fold into the right shape. The unique shape of a particular protein is the most stable state it can adopt. Picture a ball at the top of a hill -- the ball

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Password: *
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SOLOISTS | EVOLVERS | GROUPS | TOPICS

| PLAYER | PUZZLE | SCORE |
|---|---|---|
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| Timo van&n... 101 56 | 524: Symmetry C...zle | 15,103 |
| Bletchley Park 4 21 | 523: CASP ROLL ...10 | 10,020 |
| grabhorn 113 46 | Bonus Symmetry ...zle | 17,993 |
| tokens 130 49 | Beginner Puzzle...ein | 10,202 |
| kumori 203 1225 | Beginner Puzzle...ein | 9,886 |
| JackWeaver 203 844 | Beginner Puzzle...ein | 10,067 |
| | | FULL |

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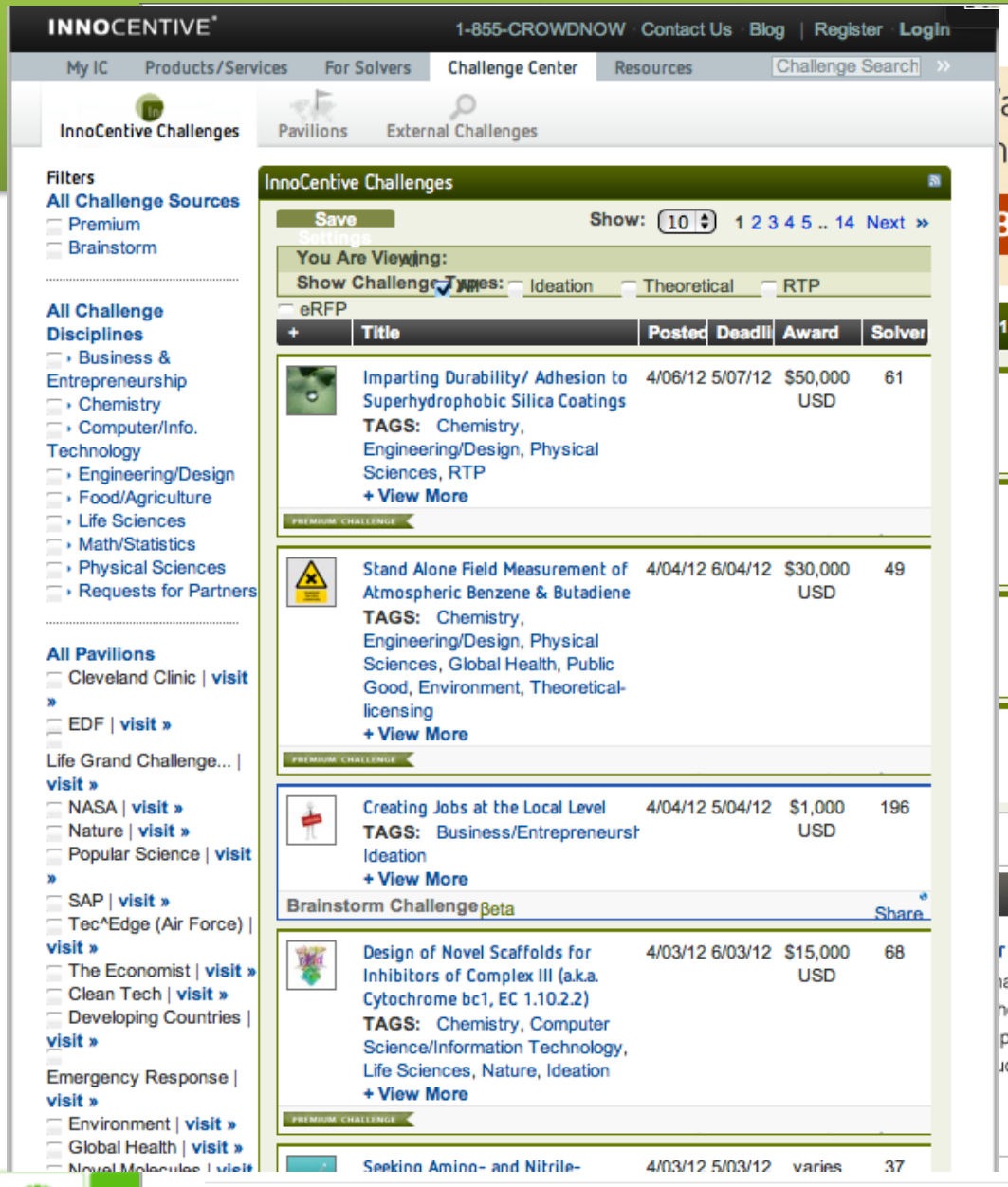
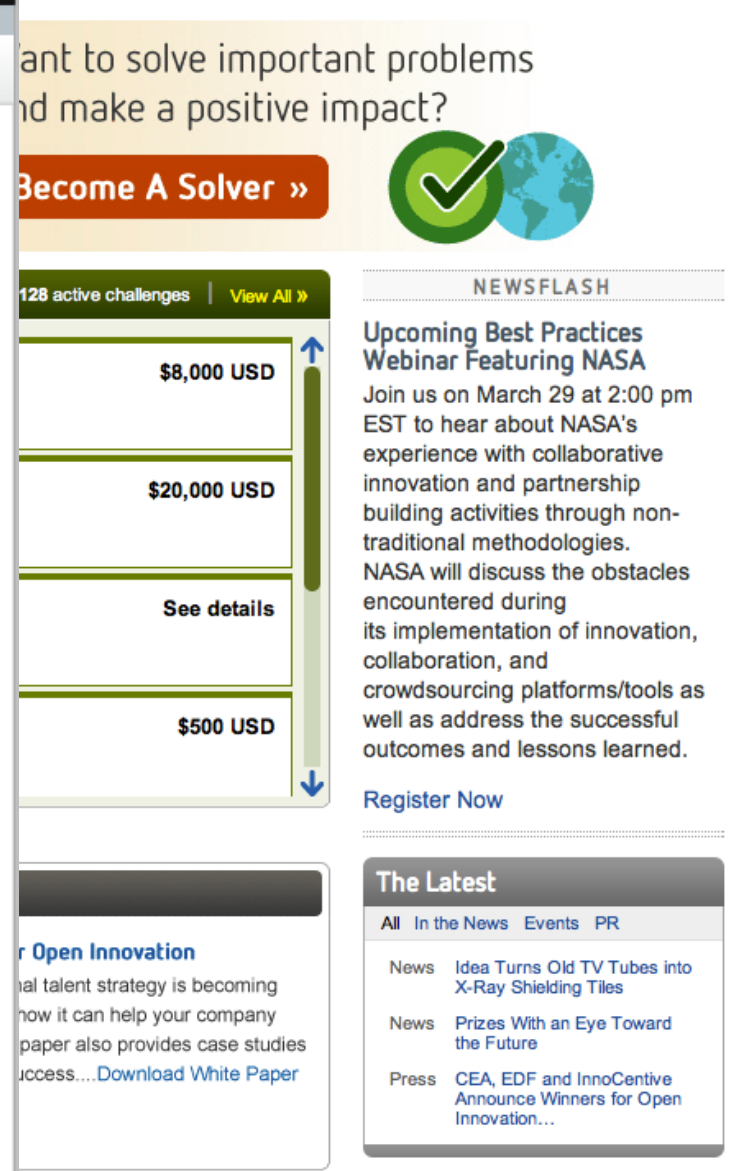
Foldit en Facebook
Me gusta 10,075

TOP NEW USERS
- AlexSun

The project has progressed from volunteers donating their computers' spare processing power for protein-structure research, to actively predicting protein structures, and now to designing new proteins. The game has 240,000 registered players, 2,200 of whom were active last week.

http://www.innocentive.com/

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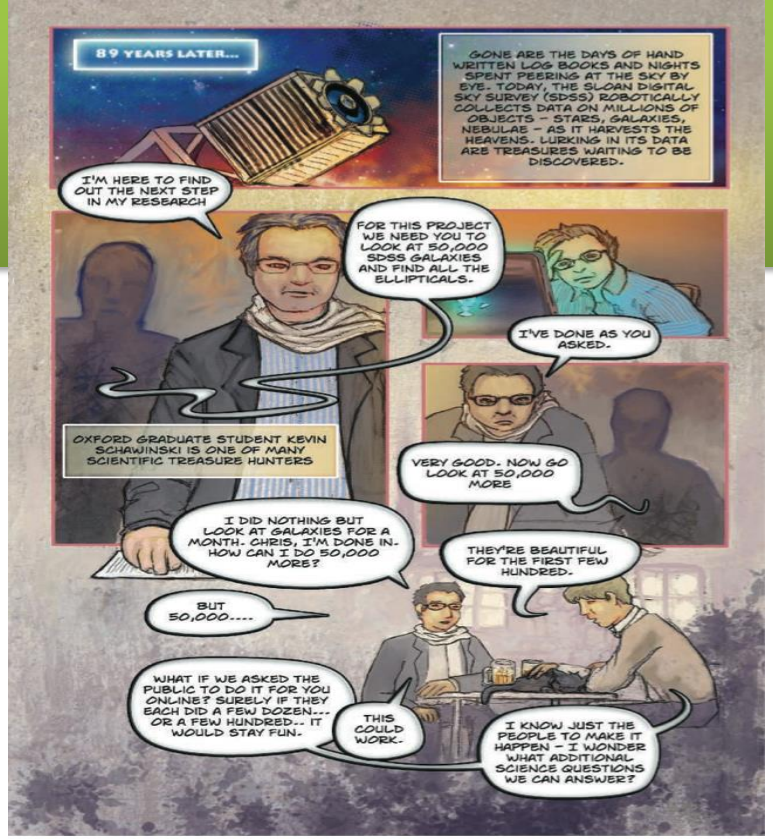


The original Galaxy Zoo was launched in July 2007, with a data set made up of a million galaxies imaged with the robotic telescope of the Sloan Digital Sky Survey. With so many galaxies, the team thought that it might take at least two years for visitors to the site to work through them all. Within 24 hours of launch, the site was receiving 70,000 classifications an hour, and more than 50 million classifications were received by the project during its first year, from almost 150,000 people

**A news story on a BBC Web site set the ball rolling; after just 3 hours, Schawinski recalls, traffic was so heavy that Galaxy Zoo's site, hosted by Johns Hopkins University, crashed.**

KevinSchawinski

Chris Lintott

NebulAtom



Clery, D. 2011. "Galaxy Zoo Volunteers Share Pain and Glory of Research." Science 333 (6039): 173

## The Science

Galaxy Zoo 1 and 2 have already produced lots of brand new science — have a look at 'The Story So Far' section for details of what we've done with all the clicks on the websites. However, they only give us a glimpse of the nearby Universe. With Galaxy Zoo: Hubble we can look further back than ever before, and begin to understand how the Universe has changed over time.

## What we want to know

Just as with the original incarnations of Galaxy Zoo, the aim of the project is to collect information on the shape of the galaxies. This one fact turns out to be a guide to many other facts about a galaxy. Find a spiral galaxy and normally - but crucially not always — you'll know that it's a rotating disk which has plenty of fuel for its ongoing star formation. A typical elliptical, on the other hand, has older stars and will have long since finished forming stars.

These rules don't always hold, and finding the exceptions has been one of the important results from Galaxy Zoo to they do illustrate just how important knowing the shape of a galaxy is. With Galaxy Zoo: Hubble, we want to see how of galaxies has changed over time. More stars were forming back then, so does that mean we should expect more sp does the proportion of blue ellipticals increase as we travel back in time? Only you can tell us.

Another critical question is what happens to the number of merging galaxies. We know that a merger can have a effect on the galaxies involved; one good way to form an elliptical, for example, is to collide two spirals toget question is how much of an effect mergers had in producing the mix of galaxies we see today and to determine that to know how common they were in the past. Yesterday's mergers may well have produced today's galaxies.

Each of the questions we ask is designed to get more useful information about the galaxies that lurk in the ima shapes of ellipticals contain information about their past, and many spiral galaxies have bars across their centres, our own Milky Way galaxy. How these bars formed, how long they exist, and what their connection is to galaxy ev also a currently debated topic, and comparing Hubble and Sloan data will help us unravel the answers.

Then there are other questions to ask about a galaxy, such as: What fraction of galaxies have two, three, or mo How tightly wound are the spiral arms? Does the galaxy have a 'boxy' or a 'rounded' bulge? How many galaxies a with 'irregular' morphologies? Answering these questions about every galaxy, one galaxy at a time, is essential if we to understand the fine details of galaxy formation.

Those of you who took part in Galaxy Zoo 2 will have noticed that there's a whole new set of questions. Previous s galaxy shapes in Hubble data sets have noticed a greater number of irregular galaxies, and so we want to make systematic study of these intriguing objects.

We want to know the answer to all these questions, and more. The primary goal of Galaxy Zoo is to construct a dat detailed shape information for almost all the galaxies the Hubble Space Telescope has ever seen. Such a database substantial legacy value for the international astronomy community. In short, we hope to find out everything there is about the appearance of galaxies!

If you've read the 'How to Take Part' page then you know that we're also asking you to keep a look out for so objects.

### Rare Objects

The sharp-eyed visitors to the Galaxy Zoo are very good at spotting the weird and wonderful — indeed, this is one of the most active areas of the discussion forum. So, we'd like to see if we can help the community be more effective at discovering certain types of rare object. We have several examples in mind for GZ2, based on the kinds of things found by the community so far.

#### Gravitational Lenses

Gravitational lenses are galaxies and groups of galaxies that are so massive that they bend the path of light from more distant objects towards themselves, distorting the shapes of background galaxies into arcs and rings, and even causing multiple copies of the images of galaxies and quasars to appear in symmetrical patterns around them on the sky. These cosmic alignments are quite rare — only about one in a thousand elliptical galaxies is acting as a lens in this way. In some cases it is possible to find them using clever image analysis software, but the most interesting cases are too complex for this. However, humans seem to be very good at recognising the tell-tale signs of gravitational lensing!

Why do we want to know about more instances of gravitational lensing? The separation of the multiple images allows us to weigh the lens galaxy, something that is typically very hard to do in astronomy. Once we have measured the mass of the lens, we then know how strong a lens it is — and how much magnifying power it has. The lensed images appear typically 10-100 times brighter than they would without the lens: we can use gravitational lenses as cosmic telescopes to observe the very distant universe. And as usual, the more telescopes we have the better!

#### Galaxy Mergers

Galaxies can grow in two ways: by forming stars, or by merging together. Our current theories of galaxy formation expect there to be a lot of merging happening, and indeed we do see many examples, but it is very difficult to reliably measure how much merging is really going on. We need big samples, and keen eyes — Sounds like a job for Galaxy Zoo!

#### Expect the Unexpected — Hanny's Voorwerp

One of the most exciting discoveries from the original Galaxy Zoo was something we never expected. Hanny Van Arkel, a Dutch schoolteacher and Galaxy Zoo volunteer, posted an image to the Galaxy Zoo forum and asked 'What's the blue stuff below?' No one knew. The object became known as Hanny's 'Voorwerp' — Dutch for 'object'. The original images from the Sloan Digital Sky Survey couldn't tell us what it was, so we've taken follow-up telescope observations, in the optical, ultra-violet, and radio ranges, as well X-ray measurements from several satellites and exquisite images from the Hubble Space Telescope.

Blog links:

- Nature of Voorwerp
- The Mystery Deepens
- Follow-up observations
- HST plans

The Voorwerp is shown above but you can read more about it and see additional examples on the Galaxy Zoo blog article: The Mystery Deepens.

Hanny Van Arkel

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planethunters.org

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REAL SCIENCE ONLINE

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585,199 people taking part worldwide

All | Space | Climate | Humanities | Nature

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## Space

**How do galaxies form?**
NASA's Hubble Space Telescope archive provides hundreds of thousands of galaxy images.

GALAXY ZOO

**Explore the surface of the Moon**
We hope to study the lunar surface in unprecedented detail.

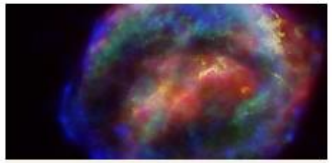
MOON ZOO

**Study explosions on the Sun**
Explore interactive diagrams to learn out about the Sun and the spacecraft monitoring it.

SOLAR STORMWATCH

**How do galaxies merge?**
One important area of research in astronomy studies the role of interacting galaxies.

GALAXY ZOO

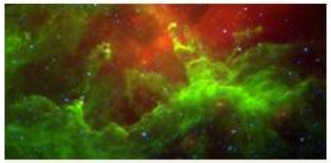


**Search for exploding stars**
Help to find Supernovae, astronomers are ready to follow up.

GALAXY ZOO

**Find planets around stars**
Lightcurve changes from the Kepler spacecraft can indicate transiting planets.

planethunters.org



**How do stars form?**
We're asking you to help us find and draw circles on infrared image data from the Spitzer Space Telescope.

THE MILKY WAY PROJECT

**Find targets for the New Horizons Probe**
Locate Kuiper Belt Objects that are eligible for a visit from a space probe.

New Horizons ICEHUNTERS

## Climate

**Model Earth's climate using wartime ship logs**
Help scientists recover worldwide weather observations made by Royal Navy ships.

oldWeather

## Humanities

**Study the lives of ancient Greeks**
The data gathered by Ancient Lives helps scholars study the Oxyrhynchus collection.

ANCIENT LIVES

## Nature

**Hear Whales communicate**
You can help marine researchers understand what whales are saying

WHALEFM

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http://blogs.zooniverse.org/

This is a ZOONIVERSE Project. Try out GALAXY ZOO

# ZOONIVERSE BLOGS

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## Featured

### A very good day in Austin

10 January 2012 by Chris, 2 Comments

Every January, a travelling circus of astronomers and their friends rolls into an American city. This travelling carnival, the winter meeting of the American Astronomical Society, brings together literally thousands of people, ostensibly to give talks about cutting edge research, but more importantly to meet, greet, gossip and collaborate. Eli Bressert (Milky Way Project) & [...]

What are you looking For? Search and hit enter...

### Clerihews

21 December 2011 by admin, 2 Comments

A Clerihew is a whimsical, four-line biographical poem invented by Edmund Clerihew Bentley. We had fun hearing your Haiku last week, so about some science- and Zooniverse-based Clerihews? One of the best known examples is: Sir Christopher Wren Said, "I am going to dine with some men. If anyone calls Say I am designing St. [...]

### Zooniverse Cocktail Hour

20 December 2011 by Robert Simpson, 1 Comment

Our advent calendar gets really festive today with the publication of Zooniverse Cocktails. If you make any of

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Search and hit enter...

**Quick Links to Other Zooniverse Project Blogs**

Galaxy Zoo, IceHunters, Moon Zoo, Old Weather, Planet Hunters, Solar Storm Watch, The Milky Way Project

[blog directory]

**Twitter: The_Zooniverse**

@EchoLilyMai For the sweepstake, yes. Aliens might be available for all. 06:24:23 PM February 29, 2012 in reply to EchoLilyMai

RT @GeertMcTwit: I thought @the_zooniverse had already reached the awesomest level of awesomeness, but the awesomeness is now epic: http ... 02:28:39 PM February 29, 2012

Along with #TED and the @SETIInstitute we've launched @SETILive http://t.co/e5EFaGVs - it's citizen science for SETI 01:48:13 PM February 29, 2012

Excited to be talking about @the_zooniverse at Public Participation in Scientific Research this August: http://t.co/FXGuQ13L (via @arfon) 02:03:38 AM February 15, 2012

Follow @The_Zooniverse 3,167 followers

**Posts from Around the Zoo**

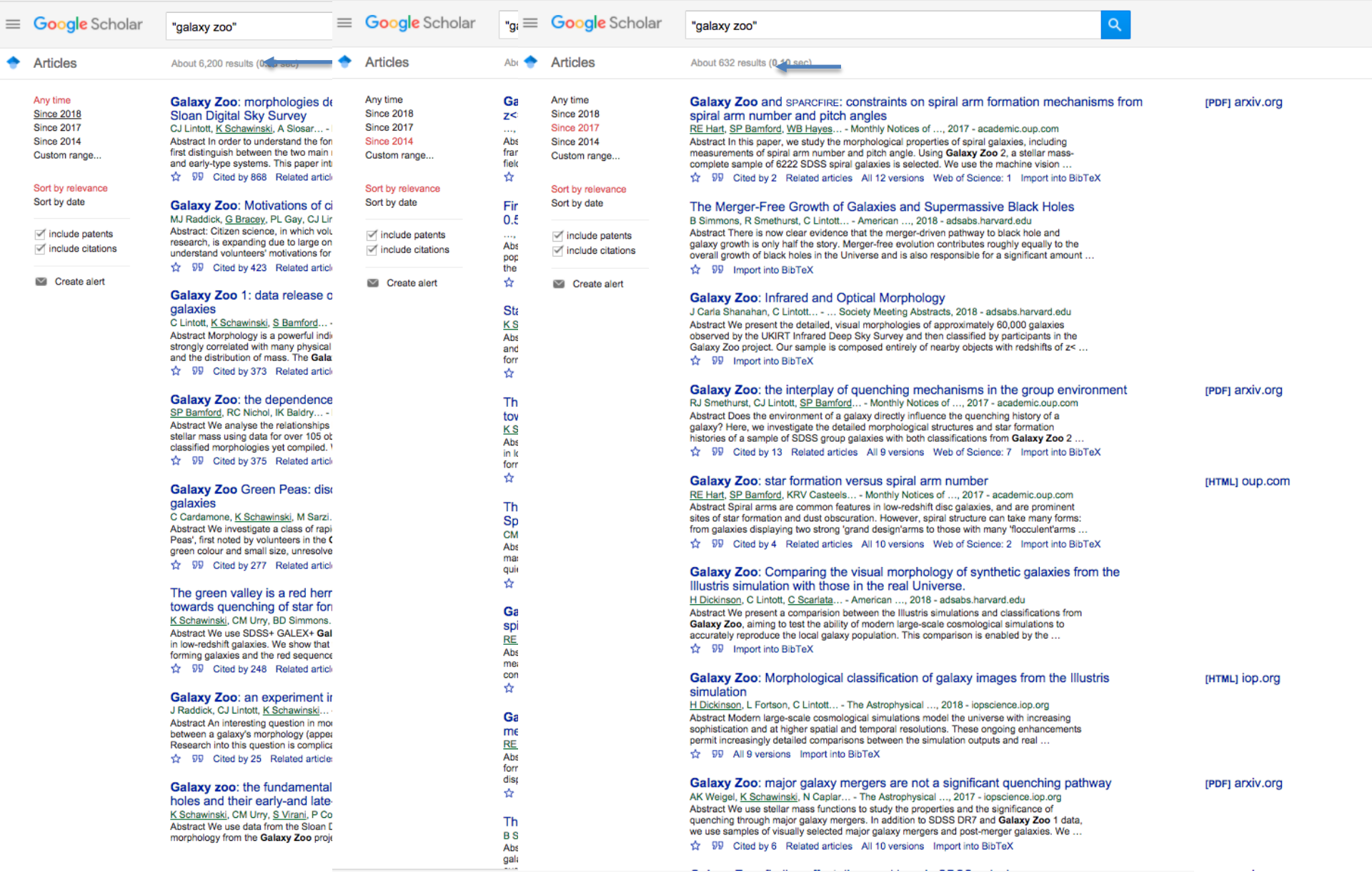
Planet Hunters Blog: 2nd Planet Hunters Paper Submi

Way back in January I blogged about our announcement of two new candidates, confidently predicting that the paper would be out in the next few days. That didn't happen for all sorts of reasons, but it's now submitted to the Astronomical Journal. Rath...

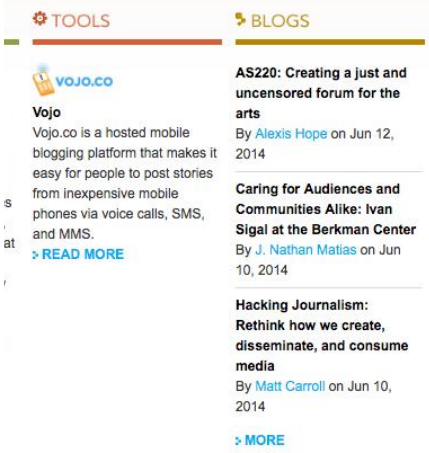
Moon Zoo Blog: Schiller Crater

Escuela de Física Universidad Industrial de Santander Grupo Halley Astronomía y Ciencias Aeroespaciales

COMPLEJO ASTRONÓMICO Grupo Halley



# LA CIENCIA CIUDADANA COMIENZA A ESTAR DE MODA


http://civic.mit.edu

UCL citizen cyberLab

citizen cyberscience centre

THE MOBILE COLLECTIVE

**UCL's interdisciplinary Extreme Citizen Science research group** ExCites brings together scholars from diverse fields to develop and contribute to the guiding theories, tools and methodologies that will enable any community to start a Citizen Science project to deal with issues that concern them. With an interdisciplinary research approach we aim to provide any user, regardless of their background or literacy level, with a set of tools that can be used to collect, analyse and act on information according to agreed upon scientific methods.

**The Citizen Cyberlab** is researching and evaluating online collaborative environments and software tools that stimulate creative learning in the context of Citizen Cyberscience. The Lab will pioneer open source platforms and tools that enable and enhance learning and creativity in Citizen Cyberscience, using four pilot projects as testbeds. These pilots, platforms and tools will then be evaluated in order to produce new understanding of creative learning behaviours, anchored in real-world examples of Citizen Cyberscience.

**The Citizen Cyberscience Centre** is a partnership established in 2009 to promote the use of citizen science on the Web, as an appropriate low-cost technology for researchers in developing regions. The CCC partners are CERN, the UN Institute for Training and Research and the University of Geneva.

**The Mobile Collective** brings people together to work on exciting new mobile and web projects. We believe in the power of collaboration. We are currently working with CERN, the UN, Imperial College London, UCL, and others as part of the Citizen Cyberlab consortium. Together we are building tools and platforms for Citizen Science and launching pilot projects in Particle Physics, Synthetic Biology, Humanitarian Disaster Mapping, and "Extreme" Citizen Science.

http://www.ucl.ac.uk/excites

http://citizencyberlab.eu

http://www.citizencyberscience.net

http://www.mobilecollective.co.uk

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http://goteo.org/project/smart-citizen-sensores-ciudadanos

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# Junglas y desiertos en Innovación, Ciencia y Tecnología

Podemos y debemos
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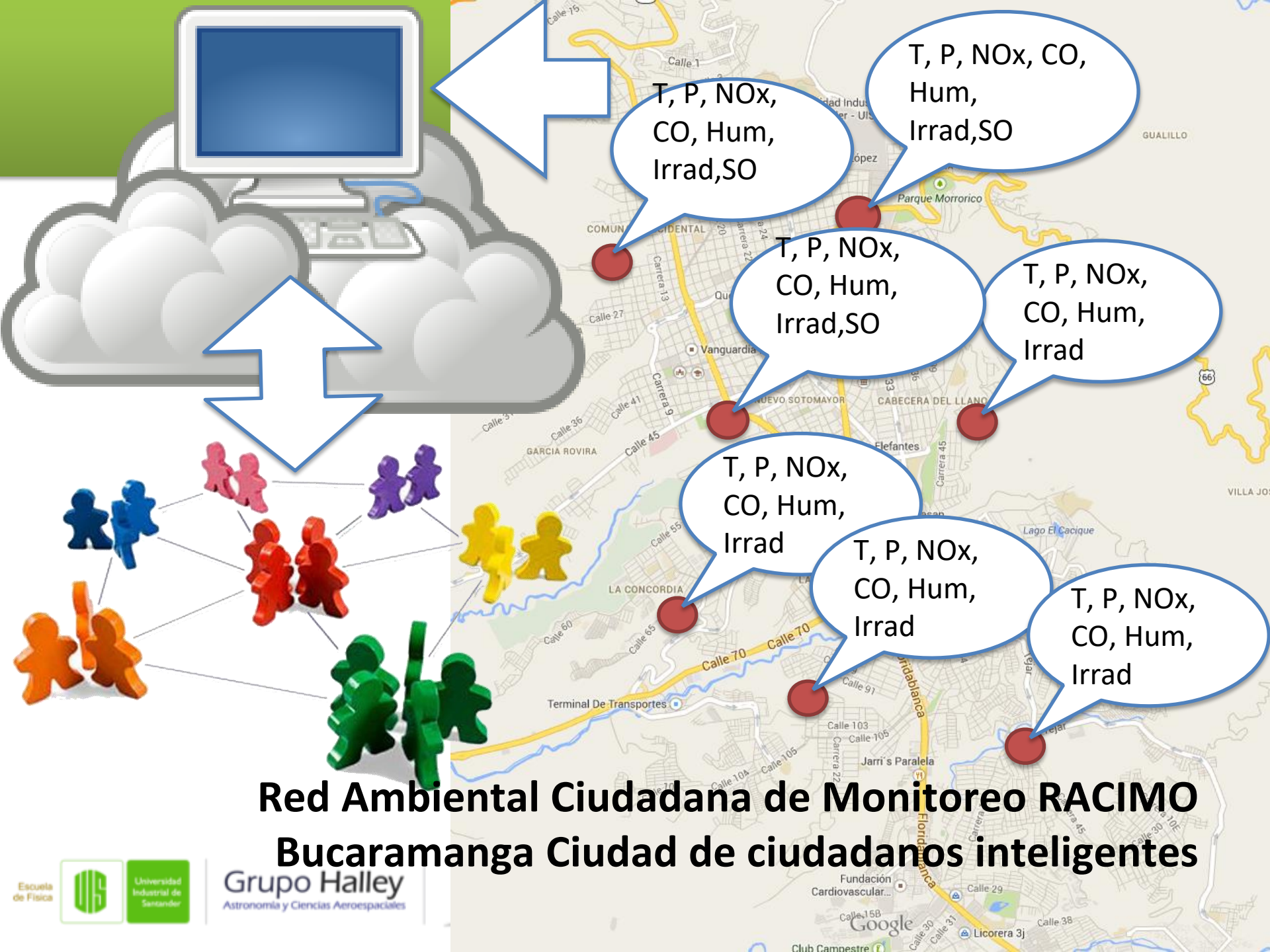
# Hecho en Bucaramanga


T, P, NOx, CO, Hum, Irrad,SO
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SAFECAST

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BGEIGIE IN FRONT OF REACTOR UNIT #1

Safecast's primary mission is to foster transparency and openness, particularly on the part of government and industry regarding the consequences of their actions for the environment. We'll talk to anybody about this, and our non-ideological stance enables us to engage with a much wider range of counterparts than most organizations. This past summer our head researcher Azby Brown attended a conference at the IAEA in Vienna at which a couple of guys from TEPCO also presented. Their presentation sucked. And Azby told them so at dinner. That started the conversation. "How can we suck less?" they asked. "By being more transparent" Azby replied. The Tepco staff actually listened for a long time as Azby explained the Safecast viewpoint on what it means to be truly open, and how far Tepco has to go to meet that high bar. The key point being that even though they think they're being open, and their openness has in fact improved a lot since 2011, it's still a lot less than what the public has a right to expect, and less than the public can get from other sources, like Safecast.

# How 5th Graders Are Learning To Monitor Their Air Quality



Want to make an impact on your students and the world at the same time? Thanks to the Internet, there's no shortage of ways to get involved in powerful "citizen science" projects, and the teachers and students at The Option Program at the Seward School (TOPS) are jumping right in.

TOPS is a is a public K-8 magnet school in Seattle that emphasizes social justice. The fifth grade class here is taking a hands-on approach to monitoring the school's air quality with the Safecast Air Quality Monitoring Station, a DIY electronics kit for assembling a monitoring system. The final product records GPS-tagged particulate levels, and automatically shares the data with the Safecast citizen science initiative over WIFI.

The kit, which is currently in the beta testing stage, comes in soldered and "soldering required" versions. Both kits teach students about electronics, information technology, environmental monitoring, and air quality through hands-on citizen science activities.


Newton Street Study Group's Pamela Moore is spearheading the project. The Newton Street Study Group is an education projects company located in Seattle, WA. The company, which was founded in 1993, teaches, researches, designs, edits, and curates learning experiences with a focus on learning skills acquisition and performance. Customers include students, institutions, and businesses.

Pamela was immediately drawn to the idea of using KitHub's Safecast Air Quality Monitoring Kit. "I was familiar with Safecast's efforts in Fukushima and was already struck by its immense power: citizen science married to a real and understandable goal and a small team of well-connected and capable scientists and engineers," she explains.

Search...

Thanks For All The Fish!

Hydrophone (Underwater Microphone) Kit

$40.00

Basic

Out of stock

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## Technical Specifications

The Safecast team has more than 5 years of experience developing environmental monitoring devices and large scale deployment. They have spent a considerable amount of time testing many particulate sensors to ensure that the sensor data will be reliable and supported by governmental agencies and environmental institutions.

It's incredible important to you as a consumer, that the data is not only accurate but is recognized as trustworthy. Safecast supports open source hardware and data. That means that anyone can build these devices and access the data as opposed to being closed and proprietary.

The Safecast Air device is designed to be a static sensor, permanently installed in a single location with fixed power and internet for the data consumption. This model measures particulate (in PM10, PM2.5 and PM1.0) and environmental calibration data (temperature and humidity).

| Part | Description |
|---|---|
| Particulate Sensor - Alphasense OPC-N2 | Optical Particle Monitor measures PM 1.0, 2.5, 10. Data Sheet. |
| Sensiron Temperature/Humidity sensor with I2C | ±2% relative humidity and ±0.3°C accuracy |
| Teensy 3.2 | 32 bit ARM Cortex-M4 72 MHz CPU, 256K Flash Memory, 64K RAM, 2K EEPROM |
| Wee Wifi Module | ESP8266 Wee Serial Wifi Module For Arduino |
| GPS Module | -165 dBm sensitivity, 10 Hz updates, 66 channels |

https://blog.safecast.org/2016/01/safecast-air-prototypes/


Safecast Air Quality Discussion Shared publicly

30 of 125 topics (99+ unread)

- **Do you have any calibration procedure?** (2) — By Karen Forero - 2 posts - 4 views
- **Can't get the PM data CSV files. Error ID: c6e0a600** (2) — By Alberto Villa - 2 posts - 7 views
- **Back Online--Needed to restart once to eliminate high values** (4) — By Catherine Saldutti - 4 posts - 27 views
- **Huge bursts of PM10 values only** (1) — By Alberto Villa - 2 posts - 11 views
- **Again very high bursts of PM10 values, up to >6300 ug/m3** (1) — By Alberto Villa - 1 post - 10 views
- I found some reasonably good air quality monitor — By Andrew - 2 posts - 23 views
- Re: [Safecast Air] Digest for safeca...@googlegroups.com - 1 update in 1 topic — By Catherine Saldutti - 2 posts - 18 views
- **Is the site down?** (5) — By James Petts - 5 posts - 23 views
- **Abnormally high PM values again (third case) - Again solved by vacuum cleaning the sensor.** (1) — By Alberto Villa - 1 post - 11 views
- **Colorado beta site** (11) — By Zach Krapfl - 11 posts - 34 views
- **Timestamp Weirdness** (7) — By ta...@kithub.cc - 7 posts - 17 views
- **Vacuum cleaning the air sensor stabilizes abnormal readings again** (3) — By Alberto Villa - 3 posts - 34 views
- **Some recent PM peaks explained (sensor OK)** (2) — By Alberto Villa - 2 posts - 17 views

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Safecast / Safecast-Air — Watch 54 Star 4 Fork 4

Code Issues 11 Pull requests 0 Projects 0 Wiki Insights

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GitHub is home to over 20 million developers working together to host and review code, manage projects, and build software together.

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Repo for all things related to Safecast's air quality monitoring platform.

232 commits 3 branches 0 releases 6 contributors

Branch: master New pull request Find file Clone or download

seanbonner Merge pull request #19 from Safecast/add-wiki-images ... Latest commit de62884 on Apr 9, 2017

| | | |
|---|---|---|
| docs | Update v4_pcb_10.rst | 2 years ago |
| firmware | Merge /home/wbd/work/safecast/Safecast-Air-Dev | a year ago |
| hardware | Mount and Drilling Instructions for Serpac Case | a year ago |
| images | Add images for electronics assembly | a year ago |
| notes | Added ESP8266 library for Wee wifi module. Modified 'particulate_only' | a year ago |
| utility | Added python plotting script to utility sub-directory. | 3 years ago |
| .gitignore | Added ESP8266 library for Wee wifi module. Modified 'particulate_only' | a year ago |
| .hgignore | Added up-to-date versions of the documenation. Split into 'particulat... | 2 years ago |
| README.md | Update README.md | a year ago |
| rebuild_gh_pages | Modified particulate_only Makefile (removed gh-pages target) and added | 2 years ago |

README.md

## Safecast Air

Documentation for Safecast's Air Quality Monitoring device and platform.

Purchase Kit or Parts
Kit
https://shop.kithub.cc/products/safecast-air-quality-monitoring-kit-beta-version

Parts
https://github.com/Safecast/Safecast-Air/wiki/Assembly-Manual#parts-list

Assembly Manual
https://github.com/Safecast/Safecast-Air/wiki/Assembly-Manual

Operation Manual
https://github.com/Safecast/Safecast-Air/wiki/Operations-Manual

**Safecast** is an international, volunteer-centered organization devoted to open citizen science for the environment. Safecast was established by Sean Bonner, Pieter Franken and Joi Ito shortly after the Fukushima Daiichi nuclear disaster in Japan, following the Tōhoku earthquake on 11 March 2011 and manages a global open data network for ionizing radiation monitoring.

The Safecast team, with help of International Medcom, Tokyo Hackerspace and other volunteers, has designed various devices for radiation mapping. These include the bGeigie and bGeigie Nano for mobile applications (carborne and walking measurements) as well as fixed stations called Pointcast.

All data are collected via the Safecast API and are presented on the publicly available interactive Safecast Tile Map.

**Safecast**

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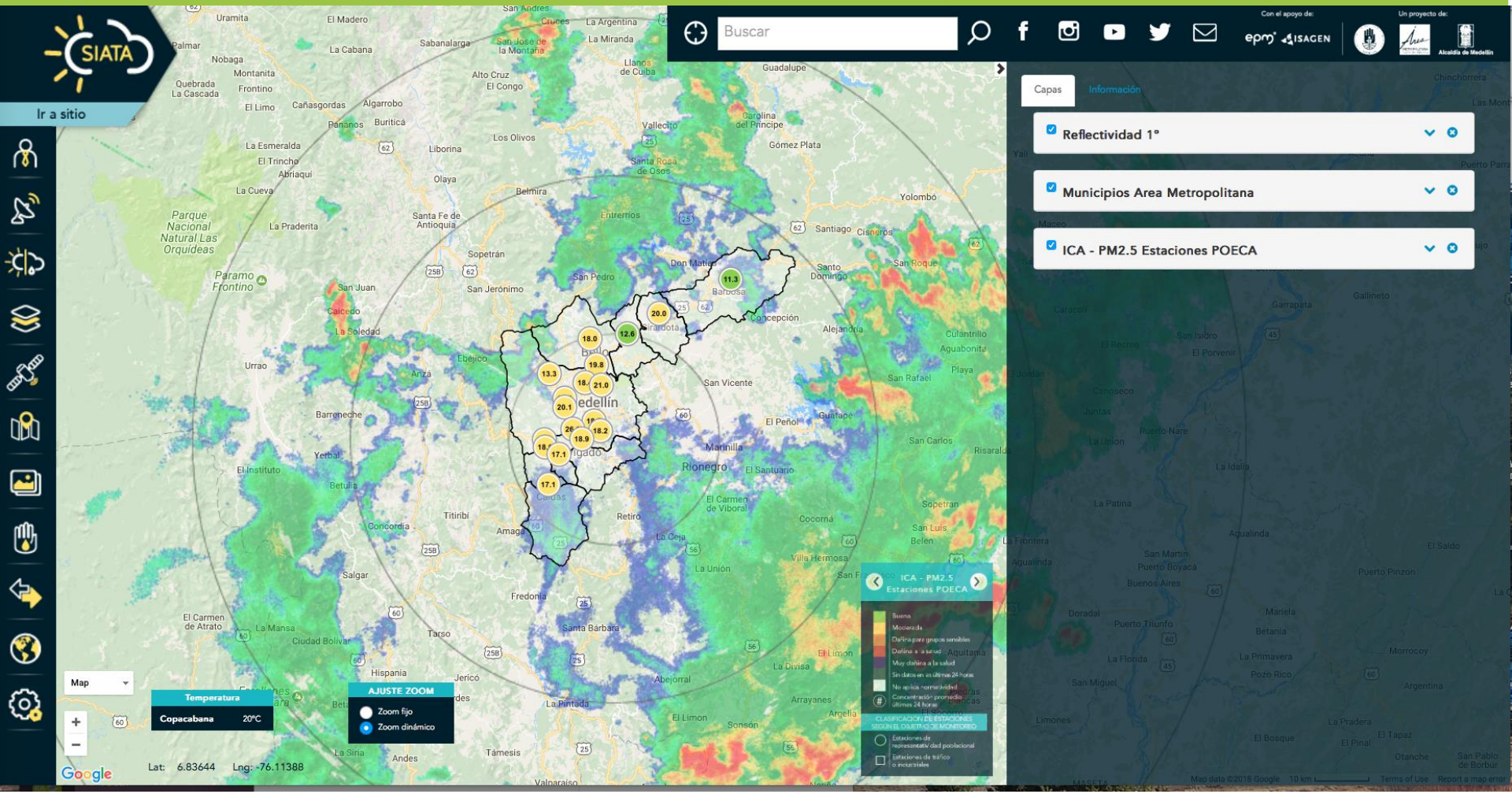


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# Evaluación tecnológica

**Table 3**
A summary of performance characteristics of low-cost PM sensors.

| Model | Comparison with reference measurements ($R^2$) | Repeatability and reproducibility | Limit of detection (μg/m³) | Effect of particle composition on sensor output | Effect of particle size on sensor output | Effect of humidity on sensor output | Effect of temperature on sensor output |
|---|---|---|---|---|---|---|---|
| Alphasense OPC-N2 | $R^2_{lab} = 0.94–0.99$[a] | $CV_{Rt} = 4.2–16\%$[a] | NA | $\delta_{PC} \approx 30$, estimated from Sousan et al. (2016a). | $\eta_d = 0.83–1.01$[a] | NA | NA |
| Dylos models 1100 Pro and 1700 | $R^2_{lab} = 0.97–0.99$[b]<br>$R^2_{lab} = 0.64–0.95$[c]<br>$R^2_{lab} = 0.91–0.98$[d]<br>$R^2_{fld} = 0.81–0.99$[b]<br>$R^2_{fld} = 0.58–0.99$[e]<br>$R^2_{fld} = 0.70–0.90$[f]<br>$R^2_{fld} = 0.48–0.78$[g]<br>$R^2_{fld} = 0.40–0.45$[h]<br>$R^2_{fld} = 0.74–0.84$[i]<br>$R^2_{fld} = 0.55$[j] | $CV_{Rt} = 1.4–8.0\%$[d]<br>$R^2 = 0.67–0.98$[b]<br>nRMSE = 13.4–46.1%[c] | <1[b] | $\delta_{PC} \leq 20$, estimated from Sousan et al. (2016b).<br>$\delta_{PC} \leq 3$, estimated from Northcross et al. (2013).<br>Did not seem to affect the sensor output under ambient conditions.[f] | $\eta_d = 0.6–1.1$, estimated from Sousan et al. (2016b).<br>$\eta_d = 0.25–4.0$, estimated from Han et al. (2017). | $\eta_d = 0.5–4.8$, estimated from Han et al. (2017).<br>Slight correlation between sensor output and humidity ($R^2 = 0.18$).[j]<br>Seems affected by humidity.[h] | NA<br>No correlation between sensor output and temperature ($R^2 = 0.03$).[j]<br>Sensor response probably not dependent on temperature.[h] |
| Plantower PMS 1003 | $R^2_{fld} = 0.82–0.93$[k]<br>$R^2_{lab} = 0.69–0.99$[k] | $R^2 = 0.99$[k] | 0.721–10.5[k] | NA | NA | Slight correlation between sensor output and humidity ($R^2 = 0.09–0.17$).[k] | No correlation between sensor output and temperature ($R^2 < 0.02$).[k] |
| Plantower PMS 3003 | $R^2_{lab} = 0.73–0.97$[k] | NA | NA | NA | NA | NA | NA |
| Samyoung DSM501A | $R^2_{lab} = 0.88–0.90$[l]<br>$R^2_{lab} \approx 0.50$[m]<br>$R^2_{lab} = 0.58–0.97$[c]<br>$R^2_{fld} = 0.07–0.46$[c] | $CV_{Rt} = 2–28\%$[l]<br>nRMSE = 22.3–52.7%[c] | 4.28–11.4[l]<br>10[c] | $\delta_{PC} \leq 8$, estimated from Wang et al. (2015). | $\delta_{PS} \leq 18$, estimated from Wang et al. (2015). | $\delta_{RH\text{-}PM} \leq 2.8$, estimated from Wang et al. (2015). | $\delta_{T\text{-}PM} \leq 1.2$, estimated from Wang et al. (2015). |
| Sharp DN7C3CA006 | $R^2_{lab} = 0.98–0.99$[d] | $CV_{Rt} = 0.8–7.1\%$[d] | NA | $\delta_{PC} \leq 2$, estimated from Sousan et al. (2016b). | NA | NA | NA |
| Sharp GP2Y1010AU0F | $R^2_{lab} = 0.42–0.99$[c]<br>$R^2_{lab} = 0.95–0.99$[d]<br>$R^2_{lab} = 0.98–0.99$[l]<br>$R^2_{lab} = 0.92–0.98$[m]<br>$R^2_{fld} = 0.72$[n]<br>$R^2_{fld} = 0.99$[o] | $CV_{Rt} = 5–25\%$[l]<br>$CV_{Rt} = 0.9–5.9\%$[d]<br>nRMSE = 2.6–118.2%[c] | 26.1–26.9[l] | $\delta_{PC} \leq 6$, estimated from Wang et al. (2015).<br>$\delta_{PC} \leq 4$, estimated from Sousan et al. (2016b). | $\delta_{PS} \leq 2.4$, estimated from Wang et al. (2015). | $\delta_{RH\text{-}PM} \leq 1.5$, estimated from Wang et al. (2015). | $\delta_{T\text{-}PM} \leq 1.5$, estimated from Wang et al. (2015).<br>Baseline response linearly proportional to temperature.[o]<br>Seems unaffected by temperature.[n] |
| Shinyei PPD42NS | $R^2_{lab} = 0.66–0.99$[p]<br>$R^2_{lab} = 0.93–0.96$[i]<br>$R^2_{fld} < 0.16$[h]<br>$R^2_{fld} = 0.53–0.98$[q]<br>$R^2_{fld} = 0.55–0.94$[e]<br>$R^2_{lab} = 0.50–0.80$[e]<br>$R^2_{fld} = 0.43$[h] | $CV_{Rt} = 4–28\%$[i]<br>$R^2 = 0.91–0.94$[e]<br>$R^2 = 0.25–0.44$[h] | 4.59–6.44[i]<br>1[p] | $\delta_{PC} \leq 18$, estimated from Wang et al. (2015). | $\delta_{PS} \leq 24$, estimated from Wang et al. (2015).<br>$\delta_{PS} \leq 13$, estimated from Austin et al. (2015). | $\delta_{RH\text{-}PM} \leq 8.0$, estimated from Wang et al. (2015).<br>Seems affected by humidity.[q]<br>Slight correlation between sensor output and humidity ($R^2 = 0.01–0.27$).[e]<br>Seems unaffected by humidity.[h] | $\delta_{T\text{-}PM} \leq 1.6$, estimated from Wang et al. (2015).<br>Seems affected by temperature.[q]<br>No correlation between sensor output and temperature ($R^2 = 0.01$).[e]<br>Seems unaffected by temperature.[h] |
| Shinyei PPD60PV | $R^2_{fld} = 0.43$[h] | $R^2 = 0.98–1.0$[h] | NA | NA | NA | NA | NA |

$R^2$ and CV are the coefficients of determination and variance, respectively. The subscript is lab or fld when referring to comparison between sensor and reference measurements under laboratory or field conditions, respectively; subscript is Rt or R when referring to repeatability or reproducibility, respectively. nRMSE is the normalised root mean square error, which is define as $nRMSE = \frac{\sqrt{\frac{\sum_{i=1}^{n}(M_{Ai}-M_{Bi})^2}{n}}}{\frac{\sum_{i=1}^{n}(M_{Ai}+M_{Bi})}{n}}$, where $M_{Ai}$ and $M_{Bi}$ are the ith values measured by sensors A and B, respectively, and n the number of measurements. $\delta_{PC}$, $\delta_{PS}$, $\delta_{RH\text{-}PM}$, $\delta_{T\text{-}PM}$ is the change in sensor response due to change in particle composition, particle size, relative humidity, and temperature, respectively, measured at the same mass concentration. It is defined as $\delta_x = y_{high}/y_{low}$, where the subscript x is PC, PS, RH-PM, and T-PM when refereeing to particle composition, particle size, relative humidity, or temperature, respectively. $y_{high}$ and $y_{low}$ are the different (high and low) sensor responses under different conditions. NA stands for not available. The alphabets refer to the following studies - a: (Sousan et al., 2016a), b: (Northcross et al., 2013), c: (Manikonda et al., 2016), d: (Sousan et al., 2016b), e: (Holstius et al., 2014), f: (Steinle et al., 2015), g: (Han et al., 2017), h: (Jiao et al., 2016), i: (Jovašević-Stojanović et al., 2015), j: (Williams et al., 2014a), k: (Kelly et al., 2017), l: (Wang et al., 2015), m: (Alvarado et al., 2015), n: (Olivares and Edwards, 2015), o: (Olivares et al., 2012), p: (Austin et al., 2015), q: (Gao et al., 2015), and r: (Zikova et al., 2016).

**Table 2**
Specifications of the different PM sensors as given by their respective manufacturers.

| Model | Size (mm) | Weight (g) | Power supply | Maximum current consumption (mA) | Cost (US$) | Detectable particle size | Concentration range of measurement | Performance tested in scientific literature |
|---|---|---|---|---|---|---|---|---|
| Alphasense OPC-N2 | 75×64×60 | 105 | 5 V DC | 175 | ~500 | 0.38–17 μm in 16 size bins | 0.1–1,500,000 μg/m³ | Yes |
| Dylos DC 1100 Pro | 178×114×76 | 544 | 110 V AC | NA | ~300 | 0.5–2.5 μm and 0.5–10 μm in two size bins | 0–106 particles/cm³ | Yes |
| Dylos DC 1700 | 178×114×76 | 544 | 110 V AC or battery | NA | ~400 | 0.5–2.5 μm and 0.5–10 μm in two size bins | 0–106 particles/cm³ | Yes |
| Novafitness SDL301 | 204×100×36 | 580 | 5 V DC | NA | ~250 | 0.3–2.5 μm and 0.3–10 μm in two size bins | 0–1000 μg/m³ | No |
| Novafitness SDL607 | 73×73×20 | 120 | 5 V DC | NA | ~120 | 0.3–2.5 μm and 0.3–10 μm in two size bins | 0–1000 μg/m³ | No |
| Novafitness SDS011 | 71×70×23 | NA | 5V DC | 80 | ~35 | 0.3–2.5 μm and 0.3–10 μm in two size bins | 0–1000 μg/m³ | No |
| Novafitness SDS018 | 59×45×20 | NA | 5 V DC | 70 | ~40 | 0.3–2.5 μm and 0.3–10 μm in two size bins | 0–1000 μg/m³ | No |
| Novafitness SDS021 | 42×32×24 | NA | 5 V DC | 70 | ~35 | 0.3–2.5 μm and 0.3–10 μm in two size bins | 0–1000 μg/m³ | No |
| Novafitness SDS198 | 71×70×23 | NA | 5 V DC | 80 | ~80 | 1–100 μm | 0–20000 μg/m³ | No |
| Plantower PMS 1003 | 65×42×23 | NA | 5 V DC | 120 | ~20 | 0.3–1.0 μm, 1.0–2.5 μm, and 2.5–10 μm in three size bins | 0–500 μg/m³ | Yes |
| Plantower PMS 3003 | 65×42×23 | NA | 5 V DC | 120 | ~20 | 0.3–1.0 μm, 1.0–2.5 μm, and 2.5–10 μm in three size bins | NA | Yes |
| Samyoung DSM501A | 59×45×20 | 25 | 5 V DC | 90 | ~15 | Greater than 1.0 μm | 0–1400 μg/m³ | Yes |
| Sharp DN7C3CA006 | 50×44×20 | 52 | 5 V DC | 180 | ~20 | 0.5–2.5μm | 25–500 μg/m³ | Yes |
| Sharp GP2Y1010AU0F | 46×30×18 | 15 | 5 V DC | 20 | ~10 | Greater than 0.5μm | 0–600 μg/m³ | Yes |
| Shinyei PPD42NS | 59×45×22 | 24 | 5 V DC | 90 | ~15 | Greater than 1.0 μm | 0–28 particles/cm³ | Yes |
| Shinyei PPD60PV | 88×60×20 | 36 | 5 V DC | NA | ~250 | Greater than 0.5 μm | 0–70 particles/cm³ | Yes |

NA stands for not available.

Science of the Total Environment 607–608 (2017) 691–705

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Review

## End-user perspective of low-cost sensors for outdoor air pollution monitoring

Aakash C. Rai [a], Prashant Kumar [a,b,*], Francesco Pilla [c], Andreas N. Skouloudis [d], Silvana Di Sabatino [e], Carlo Ratti [f], Ansar Yasar [g], David Rickerby [d]

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Bucaramanga

★★★★★
Su voto: Ninguno (4 vo

Miércoles 15 de Marzo de 2017 - 12:01 AM

# Hace 4 años que en Bucaramanga no se mide la calidad del aire

*La contaminación del aire debido a concentraciones elevadas de pequeñas partículas (MP10), de partículas finas (MP2,5), que contienen sulfato, nitratos y carbono negro, supone el princip riesgo medioambiental para la salud.*



Este cuadro revela las escasas mediciones de la calidad del aire que se han hecho durante los últimos años en diferentes estaciones de Bucaramanga y Floridablanca. Al detallar los resultados se evidenci que las autoridades ambientales solo se han dedicado a realizar controles esporádicos.



Pese a que los fétidos olores se respiran a diario en el ambiente, que registramos altos niveles de enfermedades respiratorias y que por cada dos habitantes del área metropolitana hay en promedio un vehículo en circulación con toda su carga contaminan en Bucaramanga no se le está haciendo un seguimiento periódico a la calidad del aire qu se respira.



Bucaramanga

★★★★★
Sin votos aún

Viernes 09 de Febrero de 2018 - 12:01 AM

# Esfuerzo público-privado y académico busca crear un mapa de calidad del aire

*En un ejercicio conjunto entre el AMB y las alcaldías de Bucaramanga y Floridablanca, se hará una plataforma tecnológica, con el apoyo de la UIS y la empresa Multiprocesos, para crear una Red Ambiental Ciudadana Ambiental de Monitoreo, denominada Racimo-Aire.*



El proyecto Racimo-Aire seguirá vinculando a la comunidad por medio de los estudiantes, para que ellos generen los datos y apoyen las decisiones futuras en mejoras ambientales. (Foto: Suministrada / VANGUARDIA LIBERAL)



El proyecto Racimo fue aplicado en una primera etapa como experiencia colaborativa con estudiantes de secundaria en cinco colegios de Bucaramanga, acercándolos a ambientes y herramientas de investigación, usando las TIC para la generación de un banco de datos climáticos, como presión, temperatura, humedad y nubosidad, entre otros.

# RACIMO-Aire
# Red Ambiental Ciudadana de Monitoreo en Calidad de Aire de Bucaramanga

RA Ci Mo
Red Ambiental Ciudadana de Monitoreo

MPSIG

ÁREA METROPOLITANA DE BUCARAMANGA
BUCARAMANGA - FLORIDABLANCA - GIRÓN - PIEDECUESTA

Alcaldía Municipal de Floridablanca

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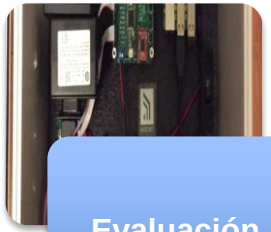
# Arquitectura del Sistema

# Red metropolitana de sensores de bajo costo

Completado

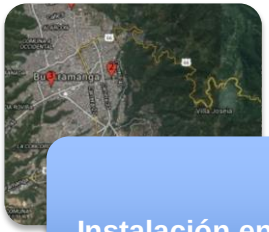
En curso



Evaluación técnológica

Construcción/ Adaptación de sensores

Calibración en Campo



Instalación en sitio

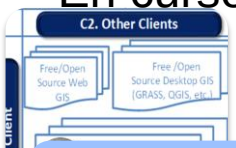
Medición Comunitaria

# Apps ciudadana y plataforma de análisis situacional

Completado

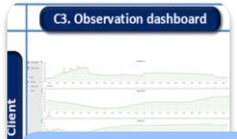
En curso


Identificación de requerimientos




Desarrollo Apps y Cliente/Servidor


Implantación y validación




Prueba de interfaces

Prueba Sistema

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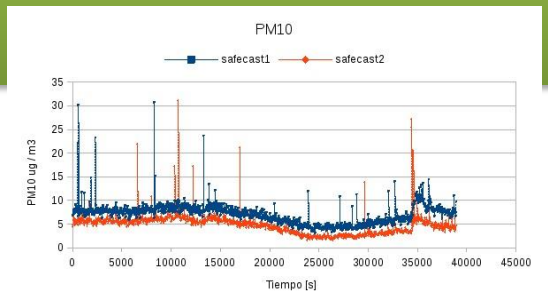
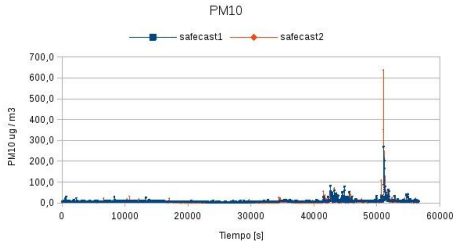
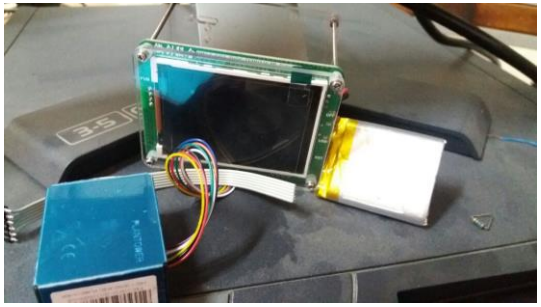
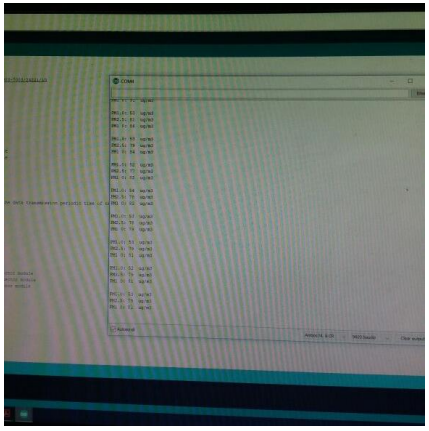

PM10
safecast1
safecast2
PM10 ug / m3
Tiempo [s]


PM10
safecast1
safecast2
PM10 ug / m3
Tiempo [s]


Stream Starting
6
pop





1. REPRESENTA EL 10% DEL ÁREA TOTAL DE BUCARAMANGA (2.732 HA).

2. HABITAN APROXIMADAMENTE 44, 700 PERSONAS.

3. NIVEL SOCIO ECONÓMICO BAJO – MEDIO.

4. BAJA DENSIDAD POBLACIONAL FRENTE AL PROMEDIO DE LA CIUDAD, CON 161 HABITANTES POR HECTÁREA, EL PROMEDIO DEL MUNICIPIO DE BUCARAMANGA DE ES 189PERSONAS/ HA.

5. TERCERA COMUNA CON MAYOR PARTICIPACIÓN ECONÓMICA, 29% LE ANTECEDE LA ZONA CENTRO Y DE LA CONCORDIA.

6. CONSIDERADA RECEPTORA DE MÁS DE 8.500 PERSONAS AL DÍA PARA EJERCER ACTIVIDADES ECONÓMICAS.

7. CONCENTRACIÓN IMPORTANTE DE MOVILIZACIÓN DE PERSONAS A SUS EMPLEOS, CERCA DEL 12% DEL TOTAL DE VIAJES DE MOVILIZACIÓN DE PERSONAS EN EL MUNICIPIO (Se estima 130.000 viajes/ día).

8. POLO DE INVESTIGACIÓN, DESARROLLO E INNOVACIÓN ( 4 Universidades, 5 Colegios, 2 Parques, 1 Plaza De Mercado….)


MUNICIPIO DE BUCARAMANGA

Escuela de Física · Universidad Industrial de Santander · Grupo Halley Astronomía y Ciencias Aeroespaciales · Complejo Astronómico Grupo Halley

MUNICIPIO DE BUCARAMANGA

**22** Cámaras de Seguridad

**14** Kit de cámaras de video vigilancia (cada kit contiene 3 cámaras) con analísticas de embebidas, almacenamiento de video local botón de pánico y conectividad;

Sensores para la Medición de la Calidad del Aire

**4** Zonas WIFI

**2** Puntos Vive Digital

**2,6** km de Cicloruta


Alumbrado Inteligente

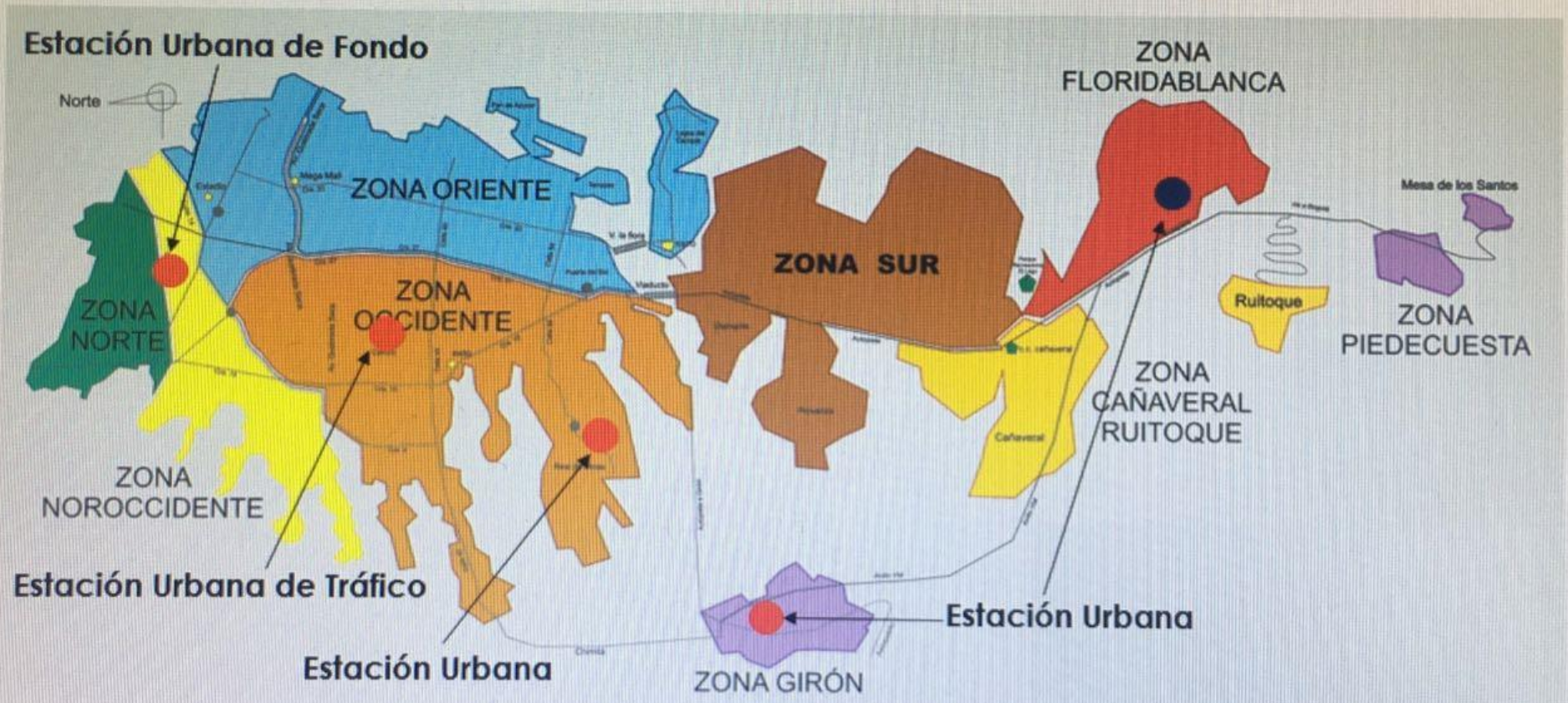
**4** Colegios con Plataforma Educativa de Gestión Educativa Integral

**3** Universidades desarrollando soluciones tecnológicas

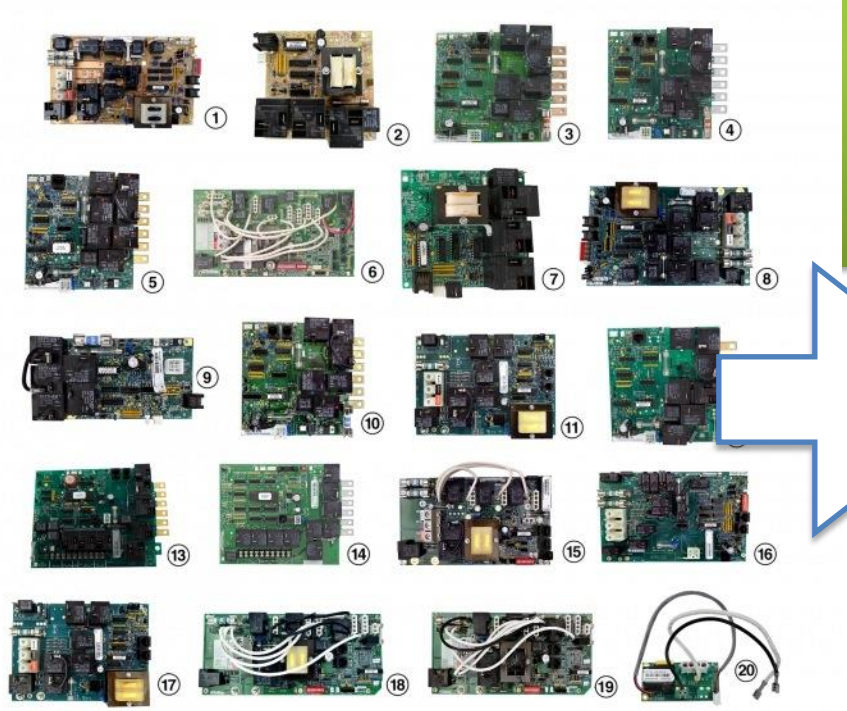
Escuela de Física · Universidad Industrial de Santander · Grupo Halley Astronomía y Ciencias Aeroespaciales · Complejo Astronómico Grupo Halley

# Posible ubicación de los Puntos del SVCA

ÁREA METROPOLITANA DE BUCARAMANGA
BUCARAMANGA - FLORIDABLANCA - GIRÓN - PIEDECUESTA




● Puntos de Ubicación SVCA




- Entregas semanales en Kioscos
- Operado desde las casas
- Fáciles de integrar
- Aprendiendo Haciendo
- Intercambio de Datos en la Nube
- Ambientes de colaboración

# O inventamos o erramos

# Graciasssss

lnunez@uis.edu.co

@nunezluis