

Muy bonito, sí, pero y ahora...

¿qué?

**FÍSICA
DE PARTÍCULAS
EN EL
INSTITUTO**



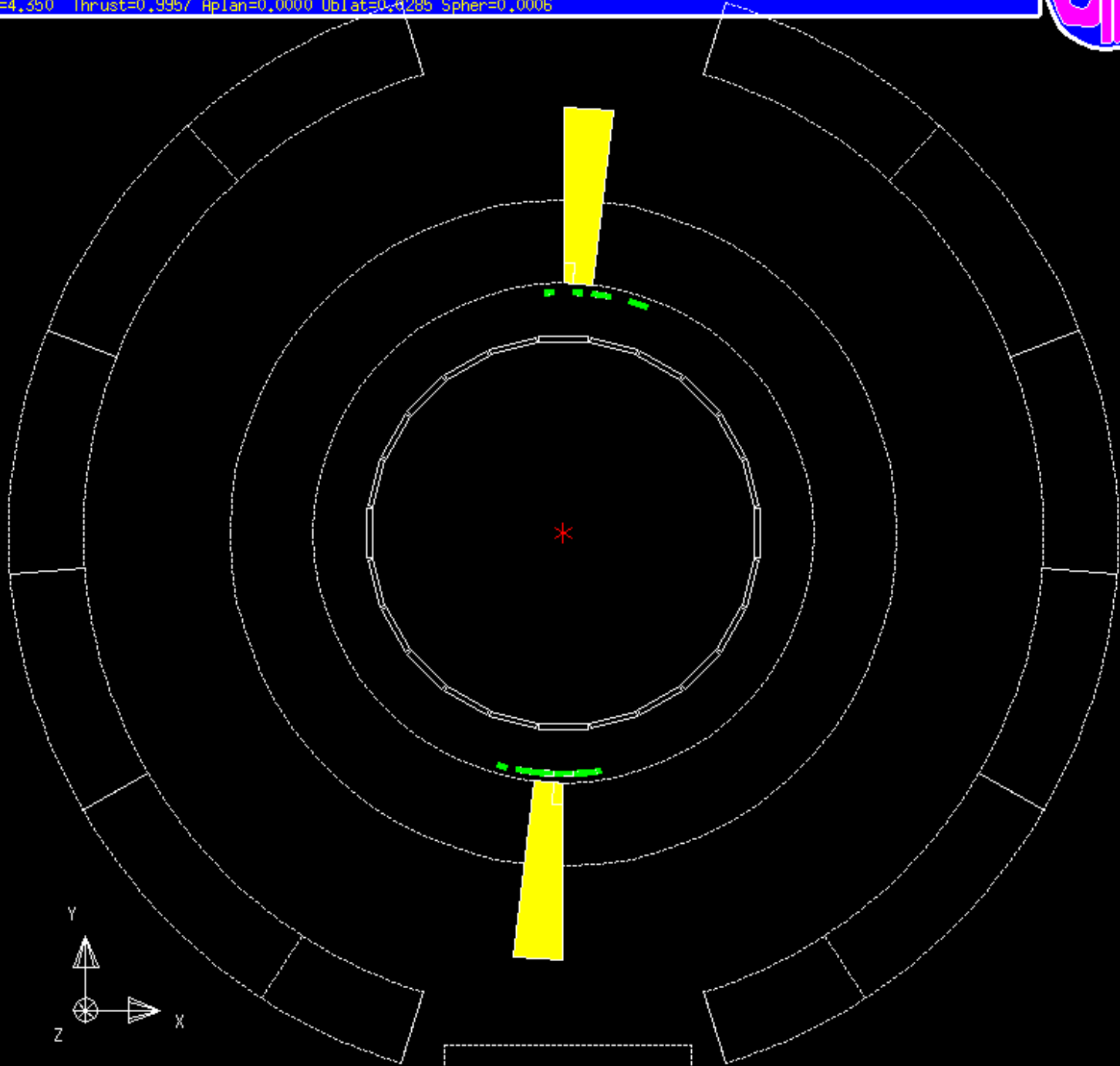
FÍSICA DE
PARTÍCULAS PARA
PROFESORES DE
CIENCIAS Y
TECNOLOGÍA

Lo que podemos hacer

EN EL AULA (y más allá)

¿Hay para todos
de ciencias y tecnología?

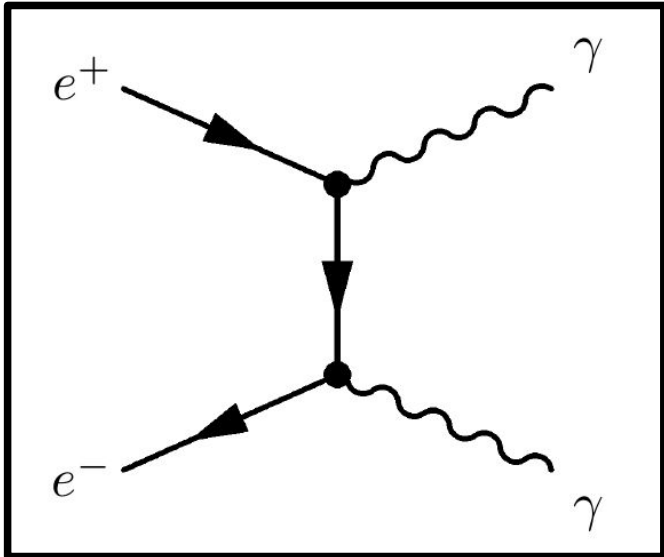
Run:event 4177:115034 Date 930612 Time 10314 Ctrk(N= 0 Sump= 0.0) Ecal(N= 8 SumE= 97.4) Hcal(N= 1 SumE= 2.5)
Ebeam 45.861 Evis 99.6 Emiss -8.3 Vtx (-0.04, 0.08, 0.45) Muon(N= 0) Sec Vtx(N= 0) Fdet(N= 0 SumE= 0.0)
Bz=4.350 Thrust=0.9957 Aplan=0.0000 Oblat=0.6285 Spher=0.0006



200. cm.

5 10 20 50 GeV

Centre of screen is (0.0000, 0.0000, 0.0000)

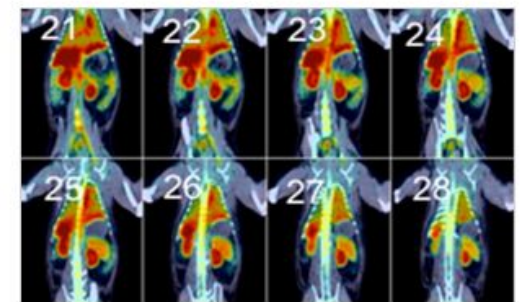


Article | 9 March 2015

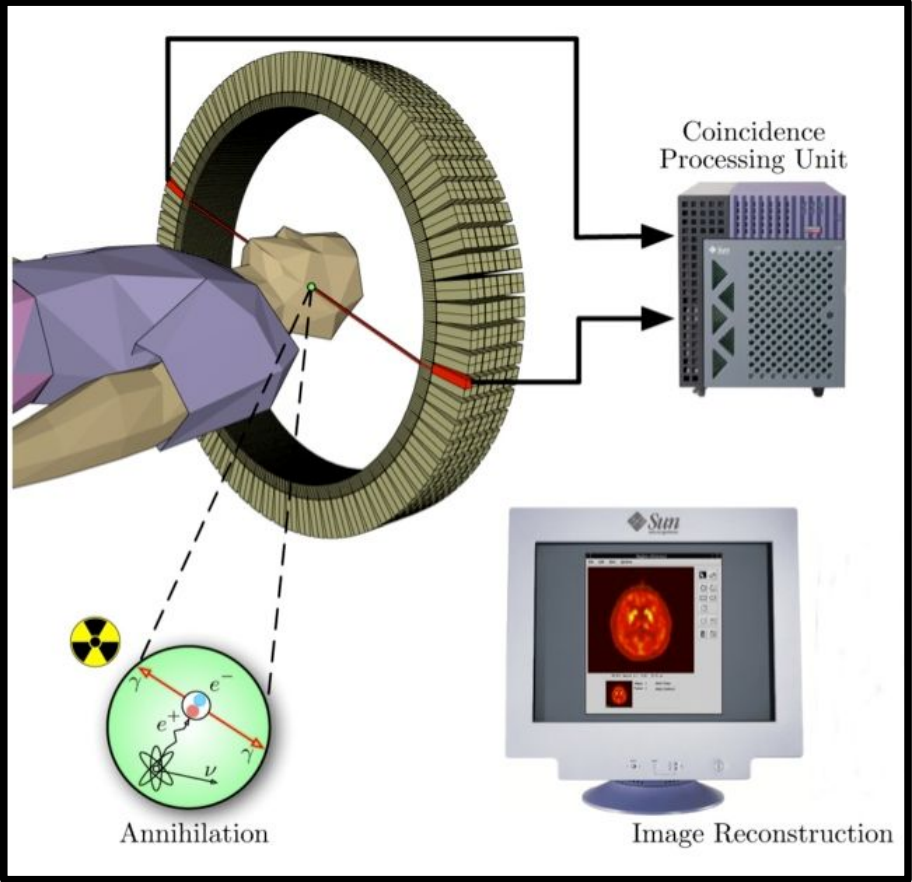
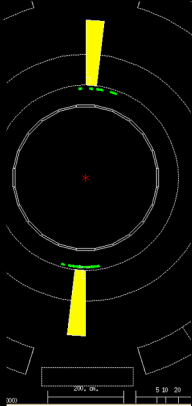
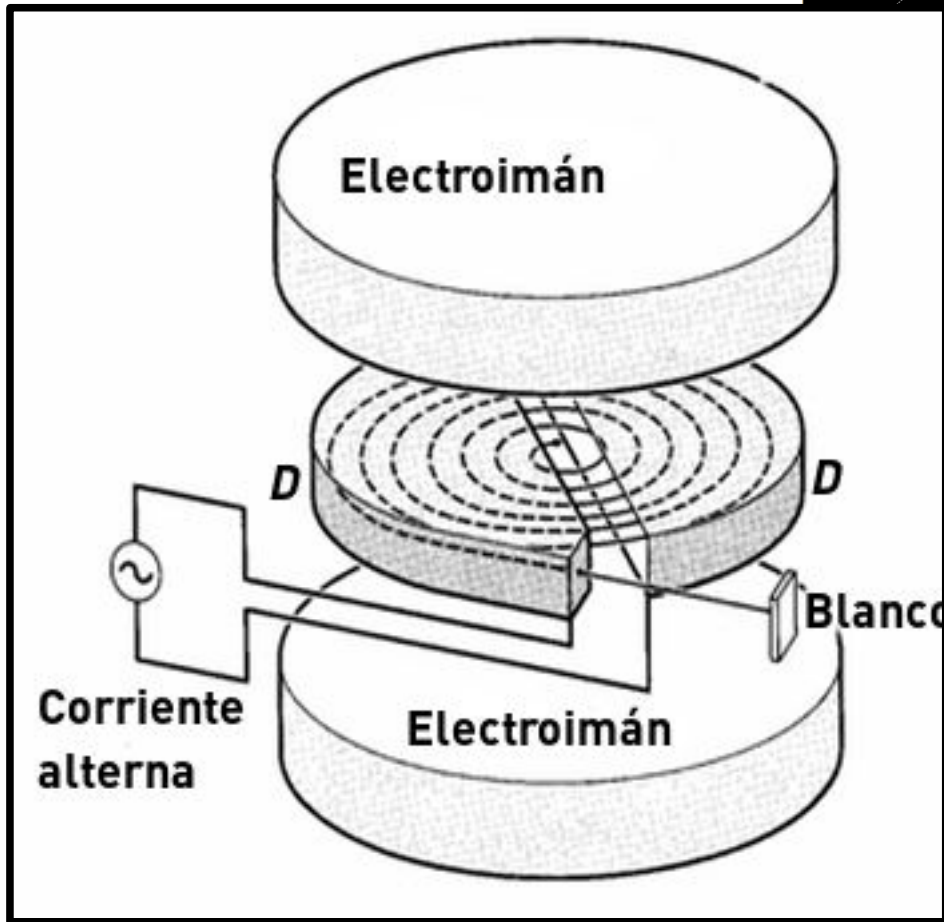
Whole-body immunoPET reveals active SIV dynamics in viremic and antiretroviral therapy-treated macaques

Philip J Santangelo *et al.*

ImmunoPET/CT imaging using a labeled simian immunodeficiency virus (SIV)-specific antibody can identify sites of viral infection in SIV-infected



Received: 02/12/2014; Date Accepted: 14/01/2015
 DOI: 10.1038/nmeth.2814



Pues sí...

con diferentes enfoques

Y al menos dos motivos:

**La importancia “cultural”
de la física fundamental**

Las “aplicaciones”

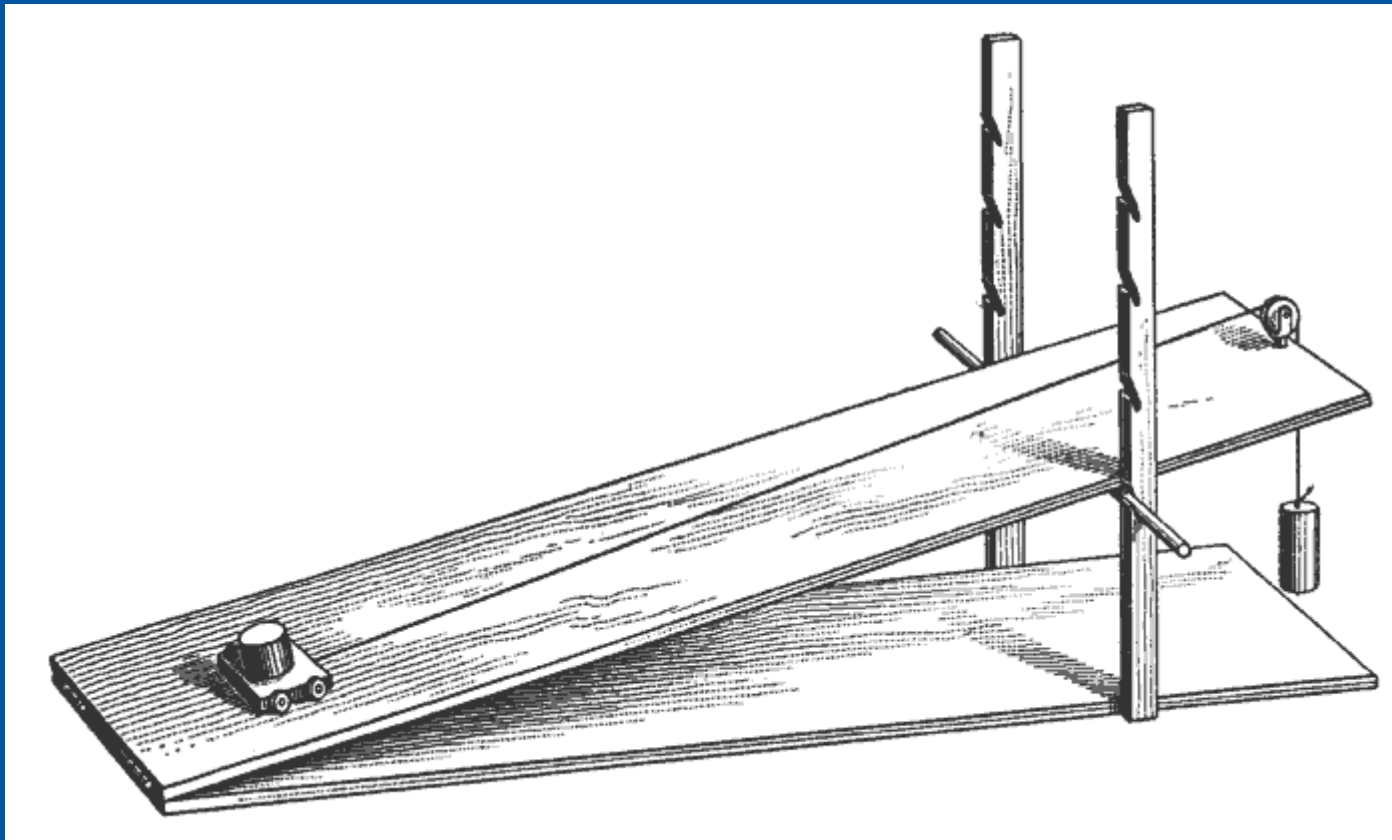
Lo que podemos hacer en el aula

1. El *programa mínimo*.
- 2. Adaptarlo a la programación.**
3. Introducirlo en la programación.

**¿SE ACABÓ LA CIENCIA
EN EL SIGLO XIX?**

¿O SIQUIERA EN 1905 O EN LOS
AÑOS 1930?

PUES A VECES LO PARECE,



pero...

SHUTDOWN: NO BEAM

Comments (29-Feb-2016 08:22:25)

technical stop

Powering tests start Friday evening

BIS status and SMP flags

B1

B2

Link Status of Beam Permits

true

true

Global Beam Permit

false

false

Setup Beam

true

true

Beam Presence

false

false

Moveable Devices Allowed In

false

false

Stable Beams

false

false

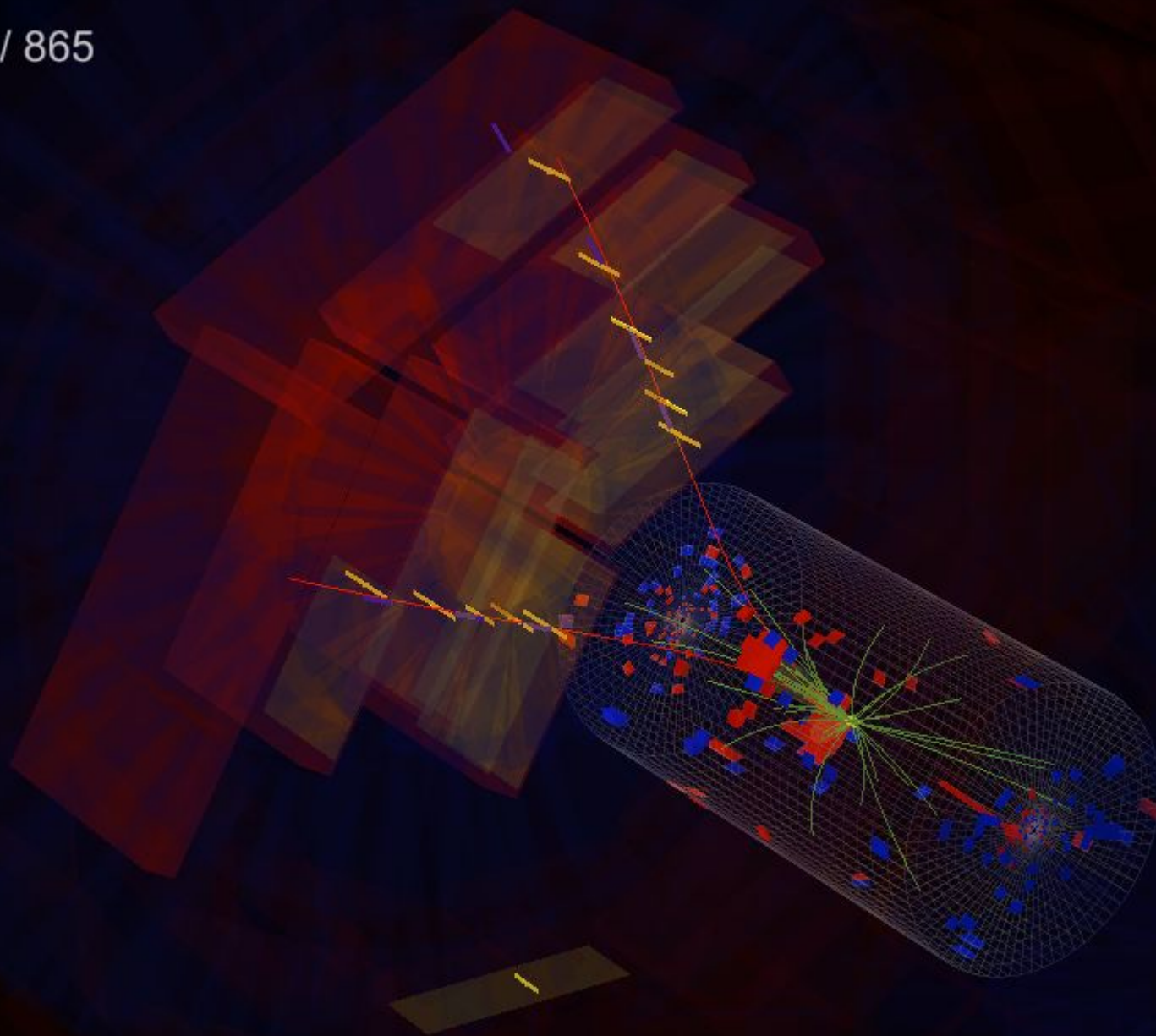
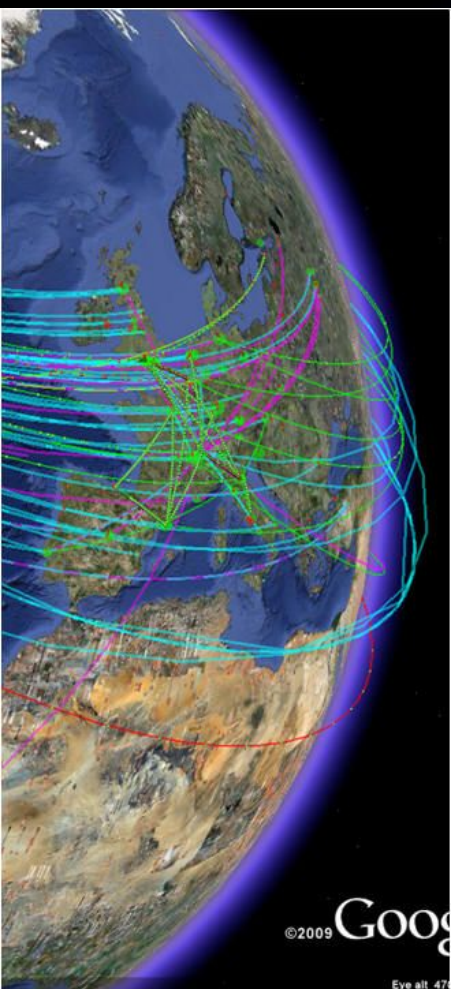
CMS Experiment at LHC, CERN

Data recorded: Mon Jun 27 16:22:49 2011 CEST

Run/Event: 167830 / 320458670

Lumi section: 321

Orbit/Crossing: 84062842 / 865



http://cmsdoc.cern.ch/B40tvs/live_event.html

<https://op-webtools.web.cern.ch/vistar/vistars.php>

<http://mcmstv.web.cern.ch/mcmstv/#home>

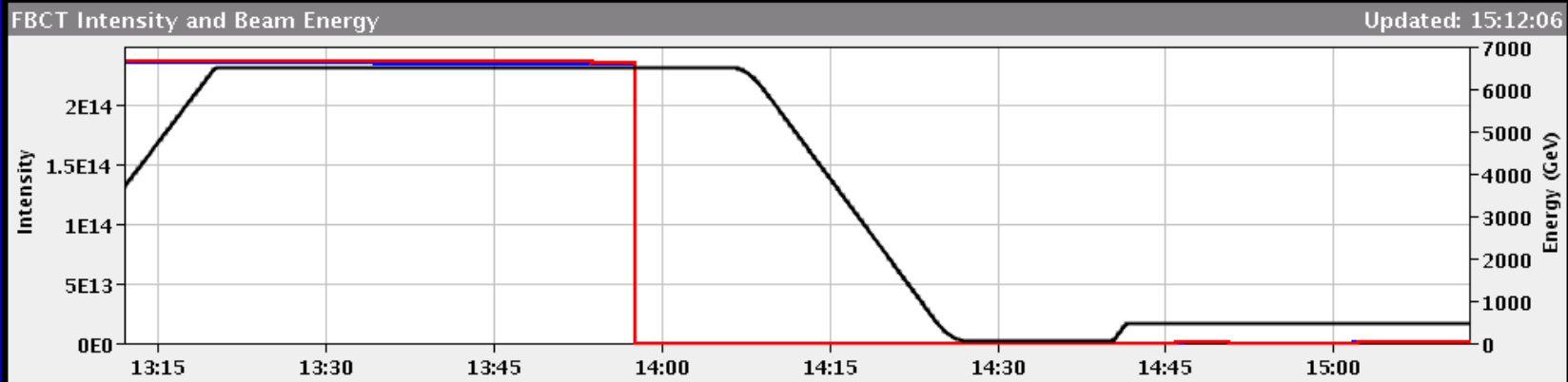
LHC Page1 Fill: 5019 E: 450 GeV 14-06-16 15:12:07

PROTON PHYSICS: INJECTION PHYSICS BEAM

BCT TI2: 0.00e+00 I(B1): 7.63e+09 BCT TI8: 0.00e+00 I(B2): 8.91e+09

TED TI2 position: **BEAM** TDI P2 gaps/mm up: 8.20 down: 6.88

TED TI8 position: **BEAM** TDI P8 gaps/mm up: 9.28 down: 7.06



| Comments (14-Jun-2016 14:11:48) | BIS status and SMP flags | |
|---|-----------------------------|---------|
| | B1 | B2 |
| Dumped by an UFO in point 1 Ramping down and reinjecting | Link Status of Beam Permits | false |
| | Global Beam Permit | true |
| | Setup Beam | false |
| | Beam Presence | true |
| | Moveable Devices Allowed In | false |
| | Stable Beams | false |
| AFS: 25ns_2040b_2028_1697_1712_72bpi_30inj | PM Status B1 | ENABLED |
| | PM Status B2 | ENABLED |



CMS DAQ Status
Running

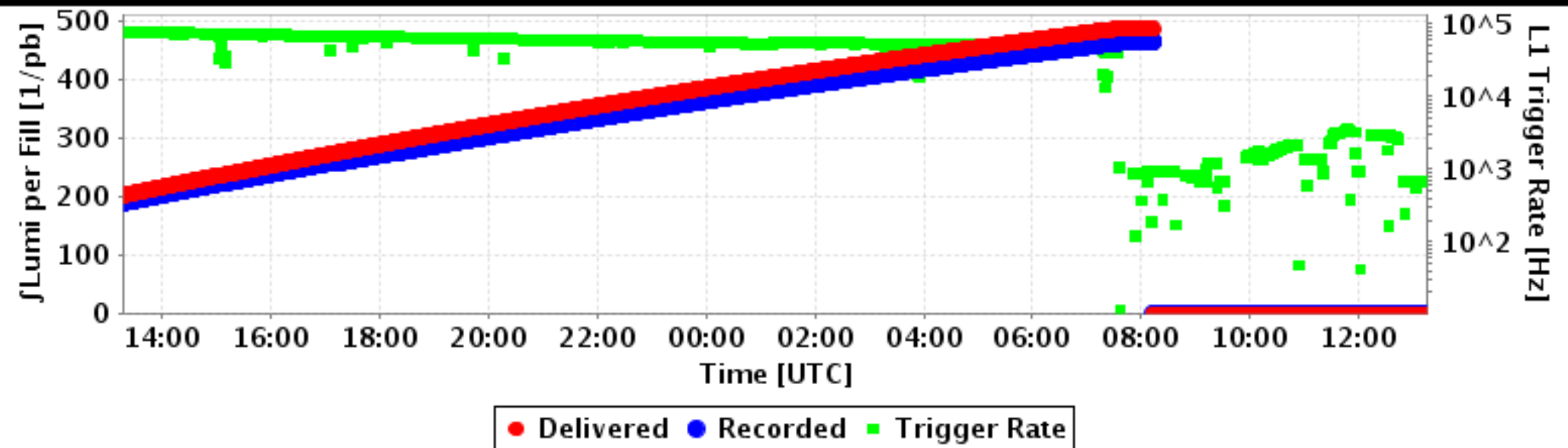
LHC Status
INJPHYS

Beam Energy
450 GeV

Intensity

Beam1: 1.3×10^{12}
Beam2: 1.3×10^{12}

History of Data-taking with Stable Beams for Last 24 Hours



● Delivered ● Recorded ■ Trigger Rate

CMS Comments Tue 14-06-2016 07:53:07 UTC

[Empty comment box]

Sub-System DAQ / DCS

| | | |
|---------|----|--------|
| CSC | IN | NOT ON |
| DT | IN | NOT ON |
| ECAL | IN | ON |
| ES | IN | ON |
| HCAL | IN | ON |
| HF | IN | ON |
| PIXEL | IN | NOT ON |
| RPC | IN | NOT ON |
| TRACKER | IN | NOT ON |

Run/Trigger/DAQ Status

| | |
|--------------------|--------|
| Fill Number | 5019 |
| Run Number | 275044 |
| LumiSection | 19 |
| Physics Bit Set | OFF |
| Magnet [T] | 3.801 |
| Total L1 Rate [Hz] | 682 |
| Total L1 Triggers | 288977 |
| Instant Lumi[E30] | 0.00 |
| fLumi Rec[1/pb] | 0.00 |
| Tier0 Transfer | ON |

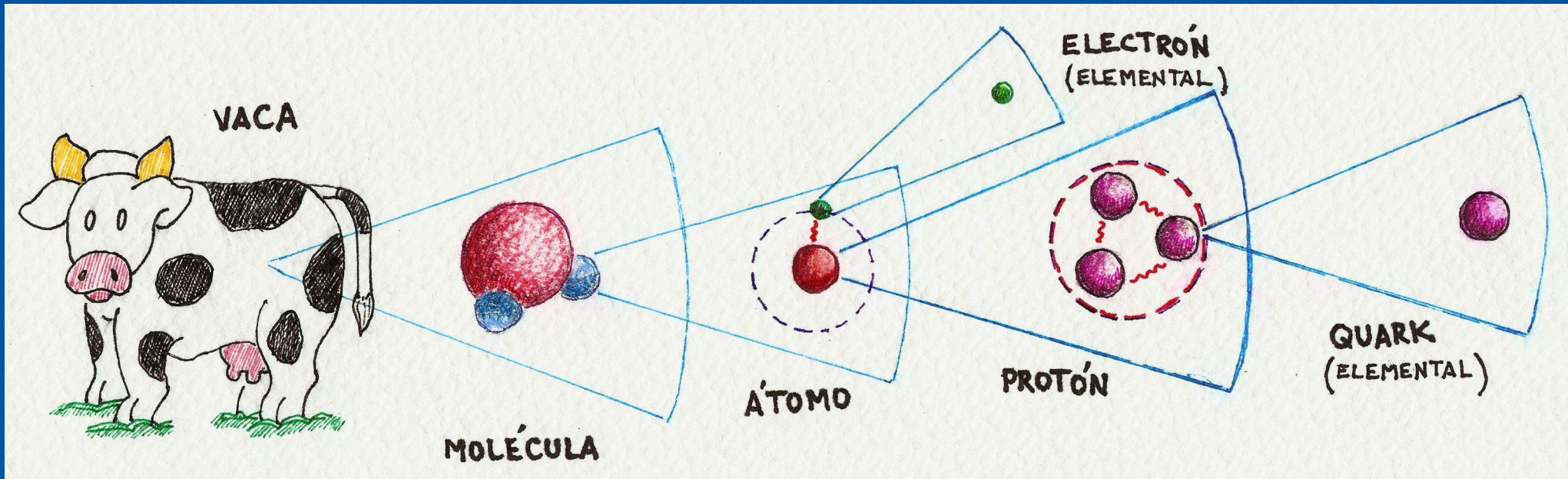
LHC Page1 Comments Tue 14-06-2016 12:11:48 UTC

Dumped by an UFO in point 1
Ramping down and reinjecting

| | |
|-----------|----|
| DAQ | IN |
| DQM | IN |
| SCAL | IN |
| TRG | IN |
| CTPPS_TOT | IN |

EL PROGRAMA MÍNIMO

No se puede ignorar lo que hemos aprendido aquí...



AHORA HAY QUE DEFINIR ESOS
ELEMENTOS MÍNIMOS



$$E=mc^2$$

Quarks

| | | |
|--------------------------|-----------------------------|----------------------------|
| u <small>up</small> | c <small>charm</small> | t <small>top</small> |
| d <small>down</small> | s <small>strange</small> | b <small>bottom</small> |

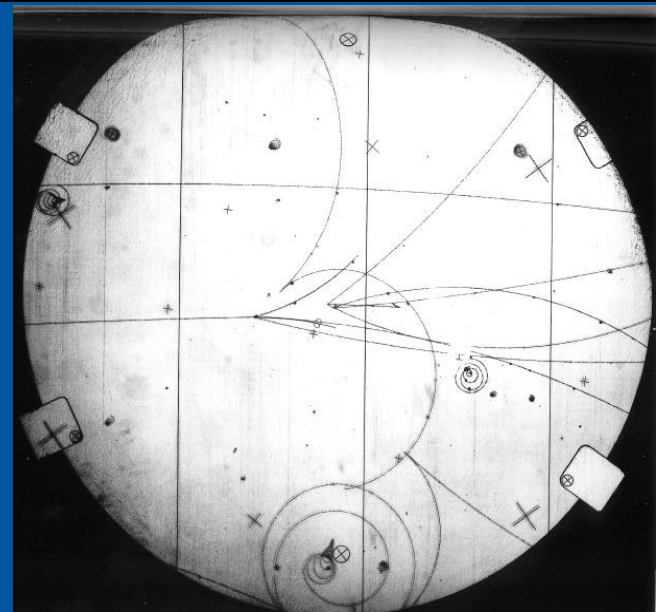
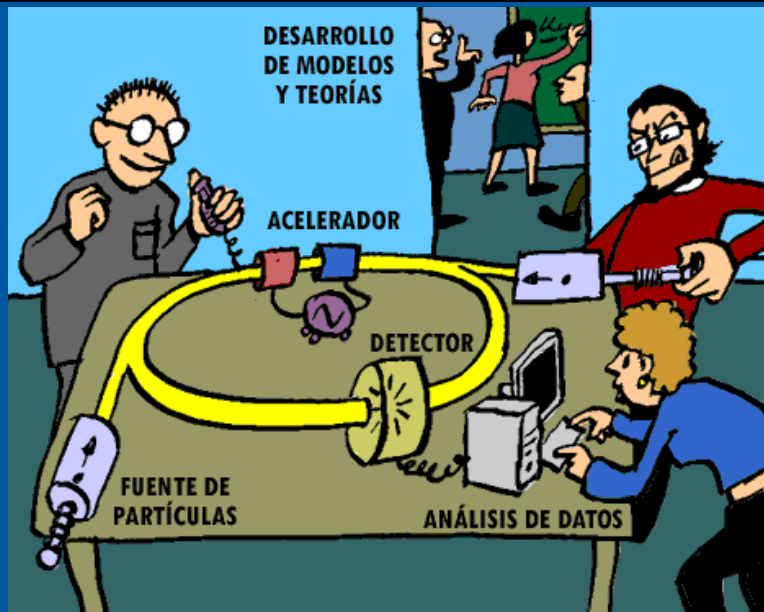
Forces

| | |
|-----------------------------|-----------------------------------|
| Z <small>Z boson</small> | γ <small>photon</small> |
| W <small>W boson</small> | g <small>gluon</small> |

Leptons

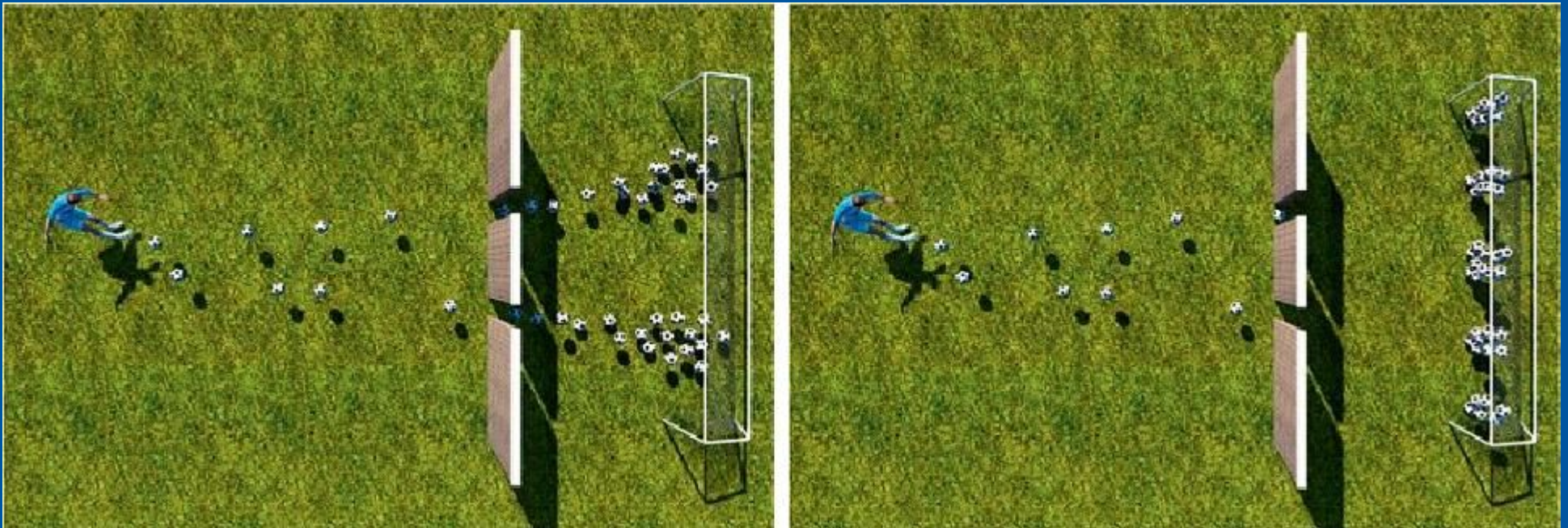
| | | |
|---|---|---|
| e <small>electron</small> | μ <small>muon</small> | τ <small>tau</small> |
| ν_e <small>electron neutrino</small> | ν_μ <small>muon neutrino</small> | ν_τ <small>tau neutrino</small> |

H
Higgs boson

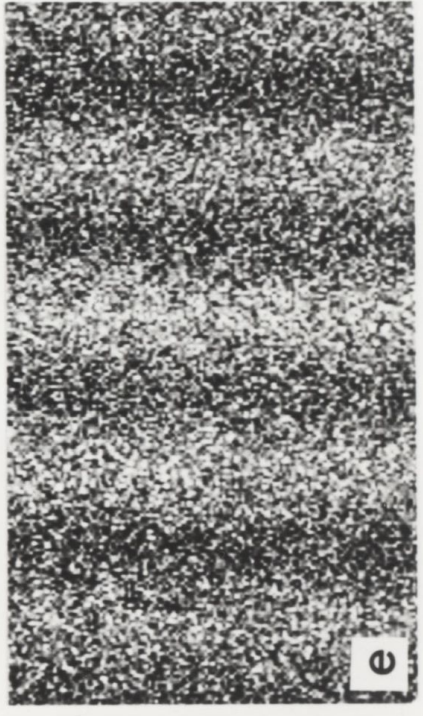
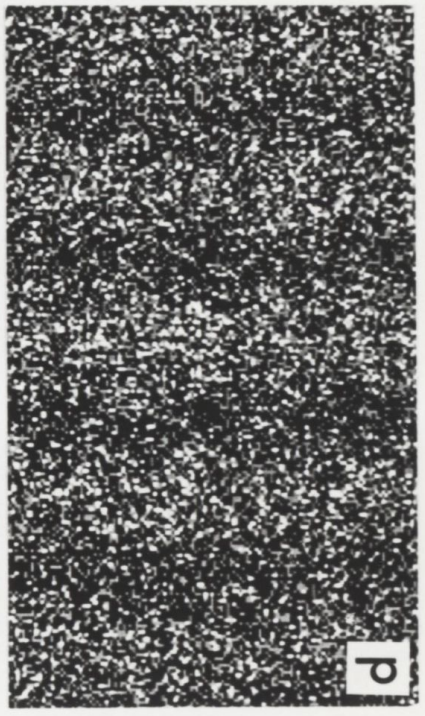
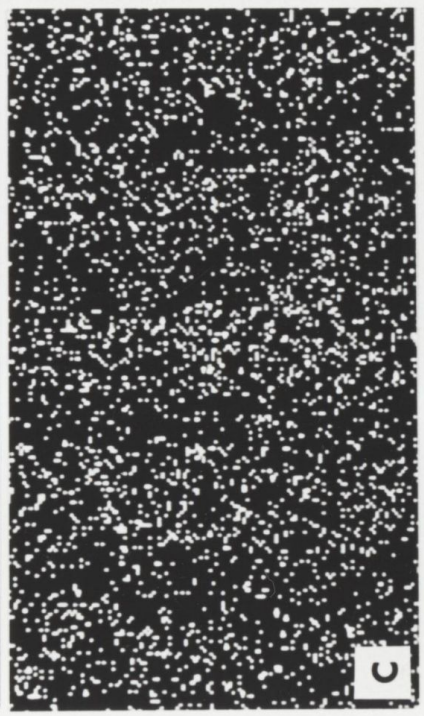
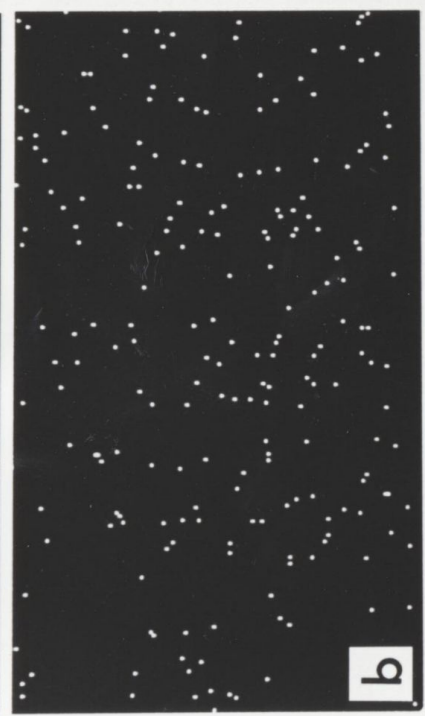


DOS CANDIDATOS CLAROS PARA EL PROGRAMA MÍNIMO:

A) Las partículas NO son bolitas

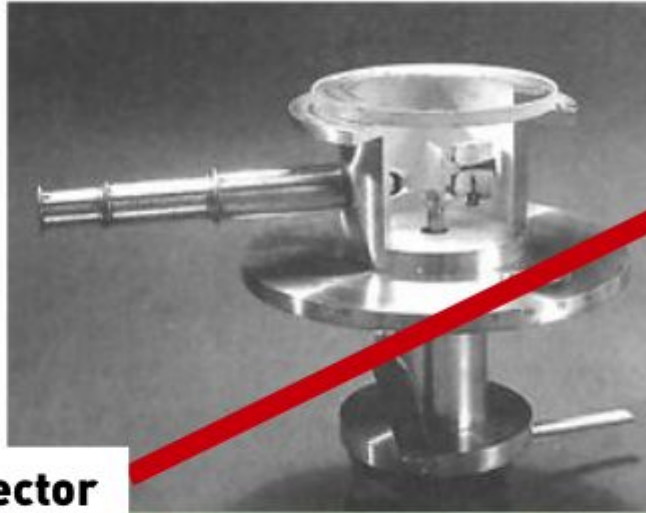


y hacen algunas cosas propias de las ondas

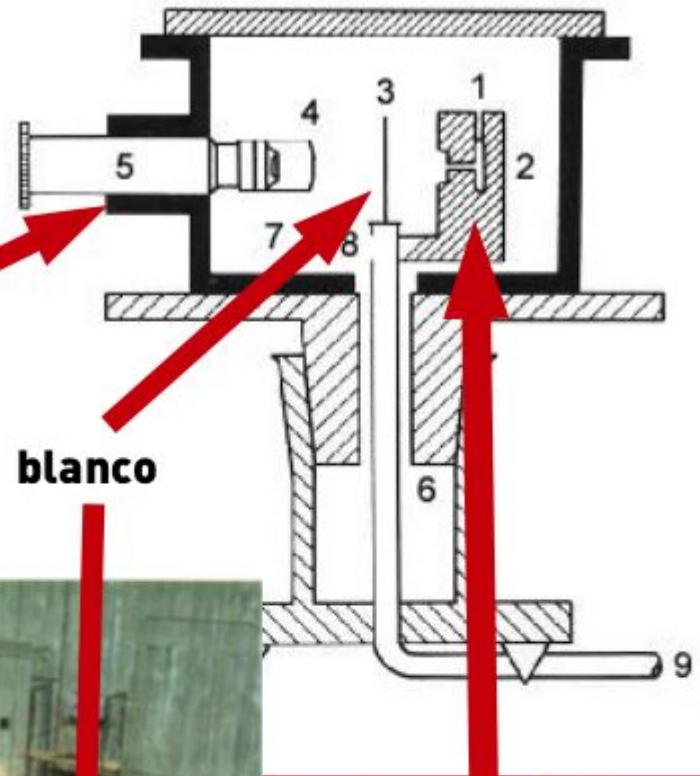


B) La física NO se acabó en los años 1930 cuando los átomos parecían estar compuestos de protones, neutrones y electrones

Por ejemplo, los quarks se descubrieron experimentalmente hace más de cuarenta años



detector



blanco

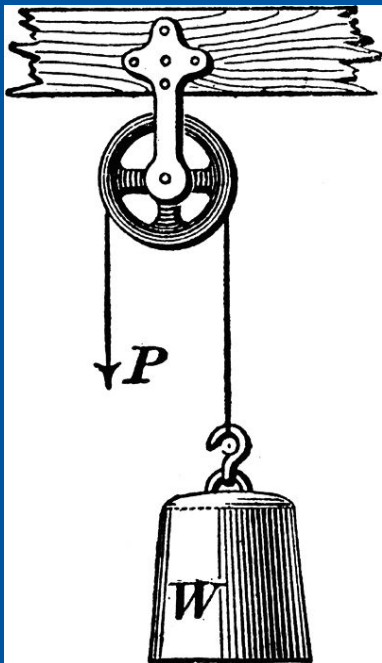
partículas



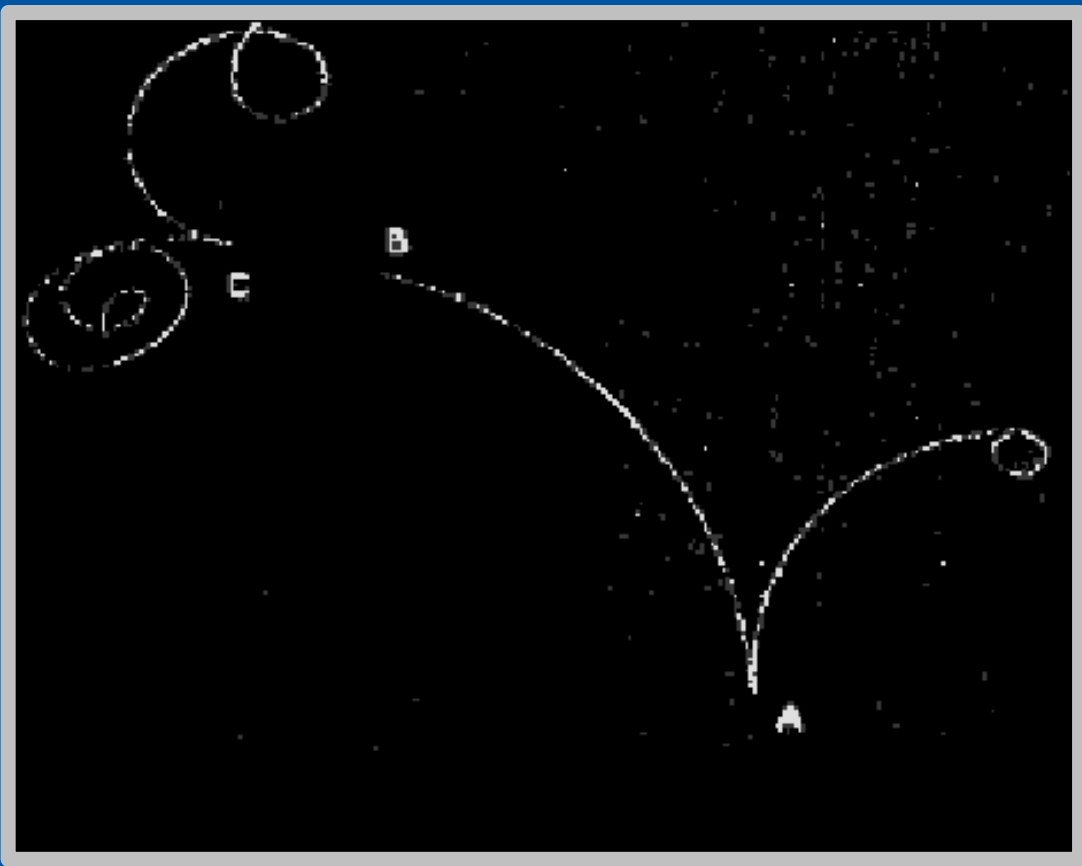
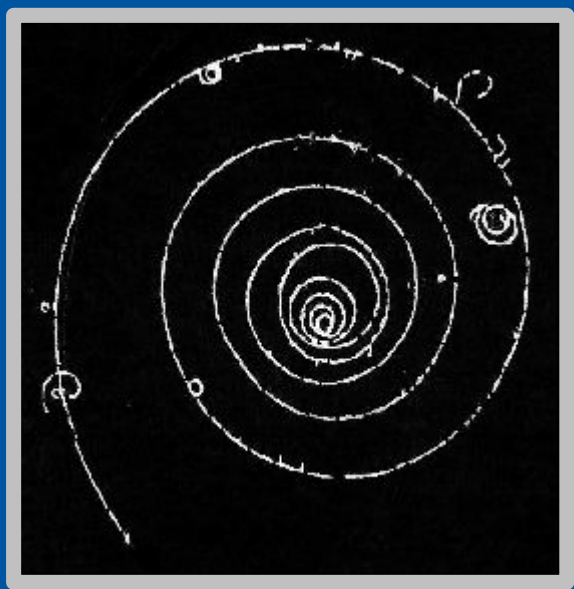
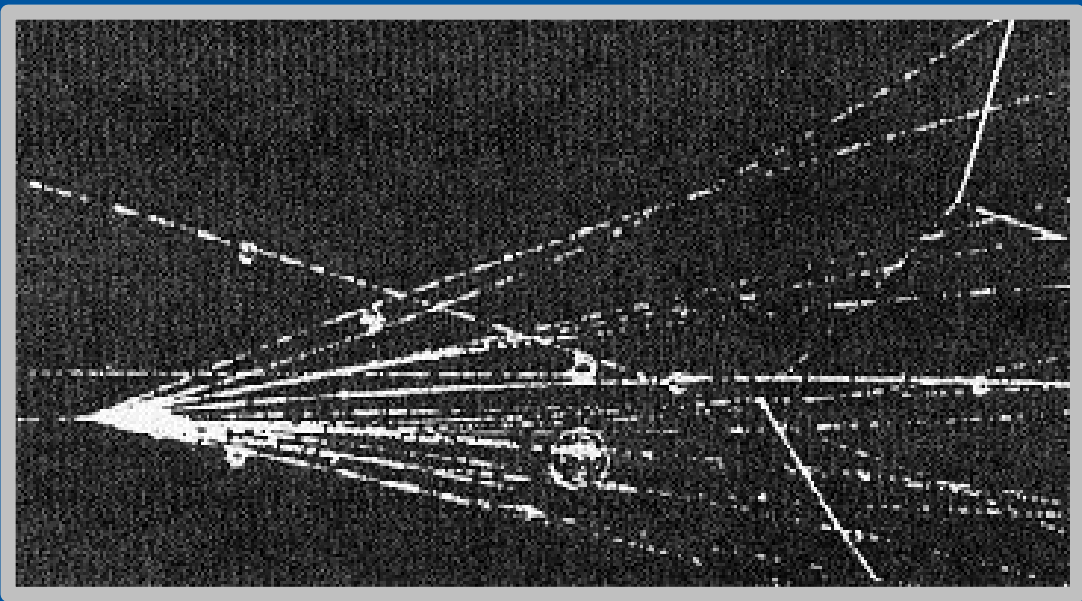
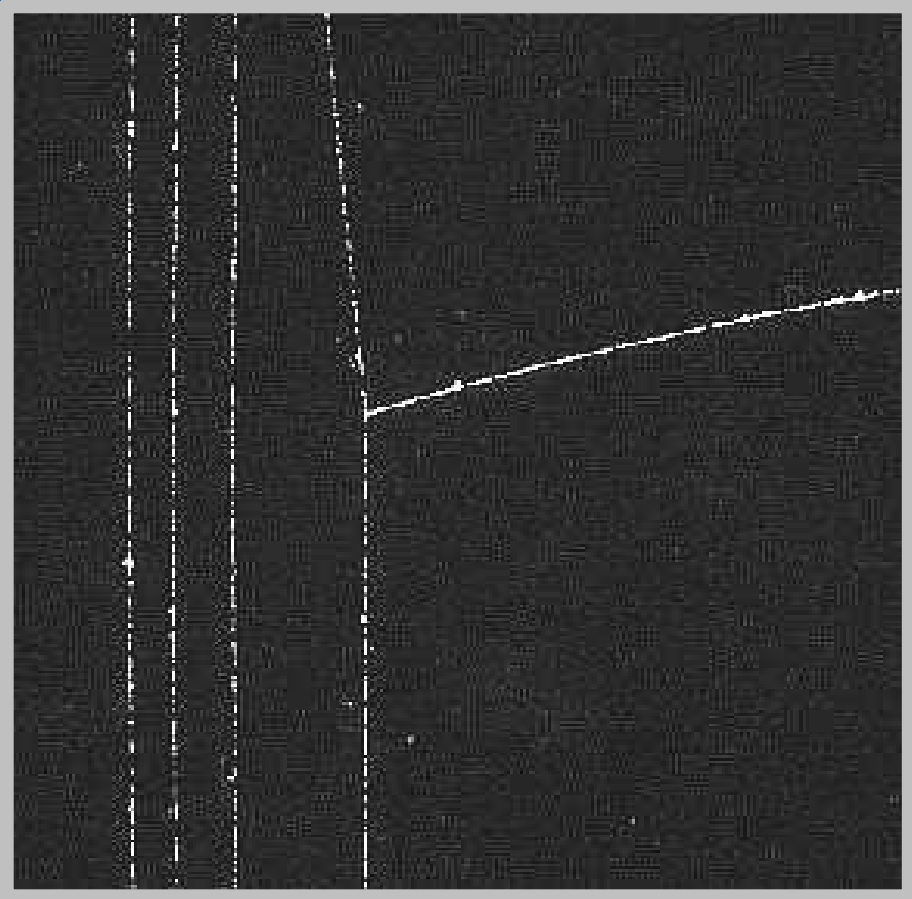
**Curioso,
¿no?**

ADAPTAR LA PROGRAMACIÓN

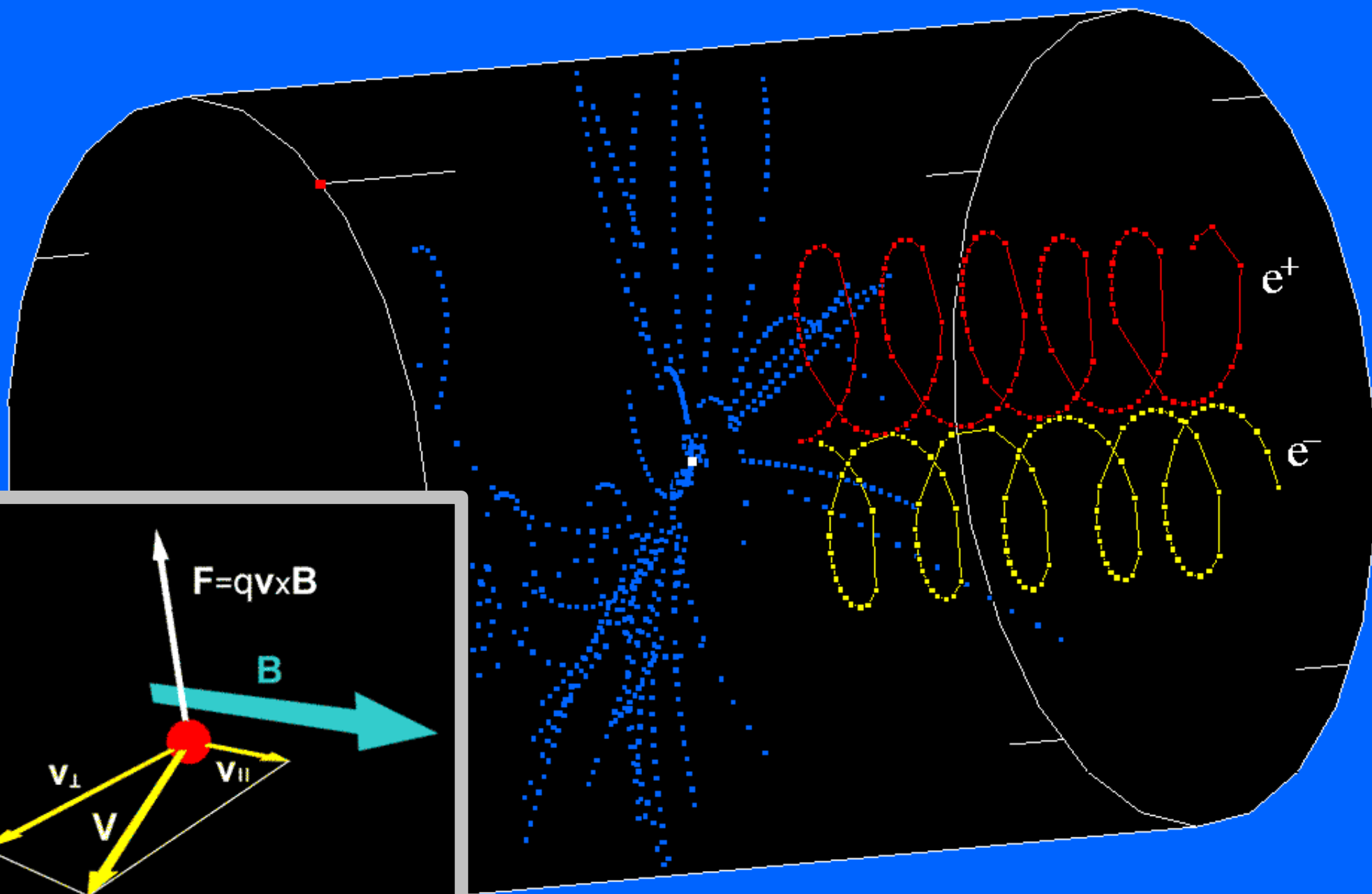
SIN IR MUCHO MÁS ALLÁ DEL
programa mínimo



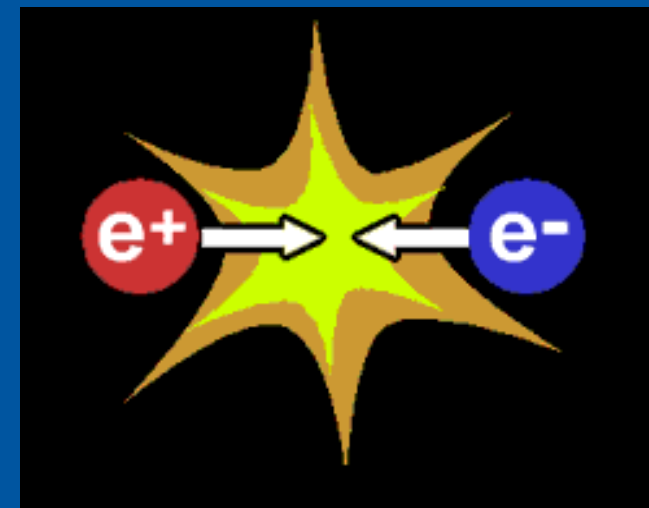
LA CONSIGNA ES
**sustituir choques de
coches por colisiones
de partículas**



Movimiento de partículas cargadas en campos magnéticos

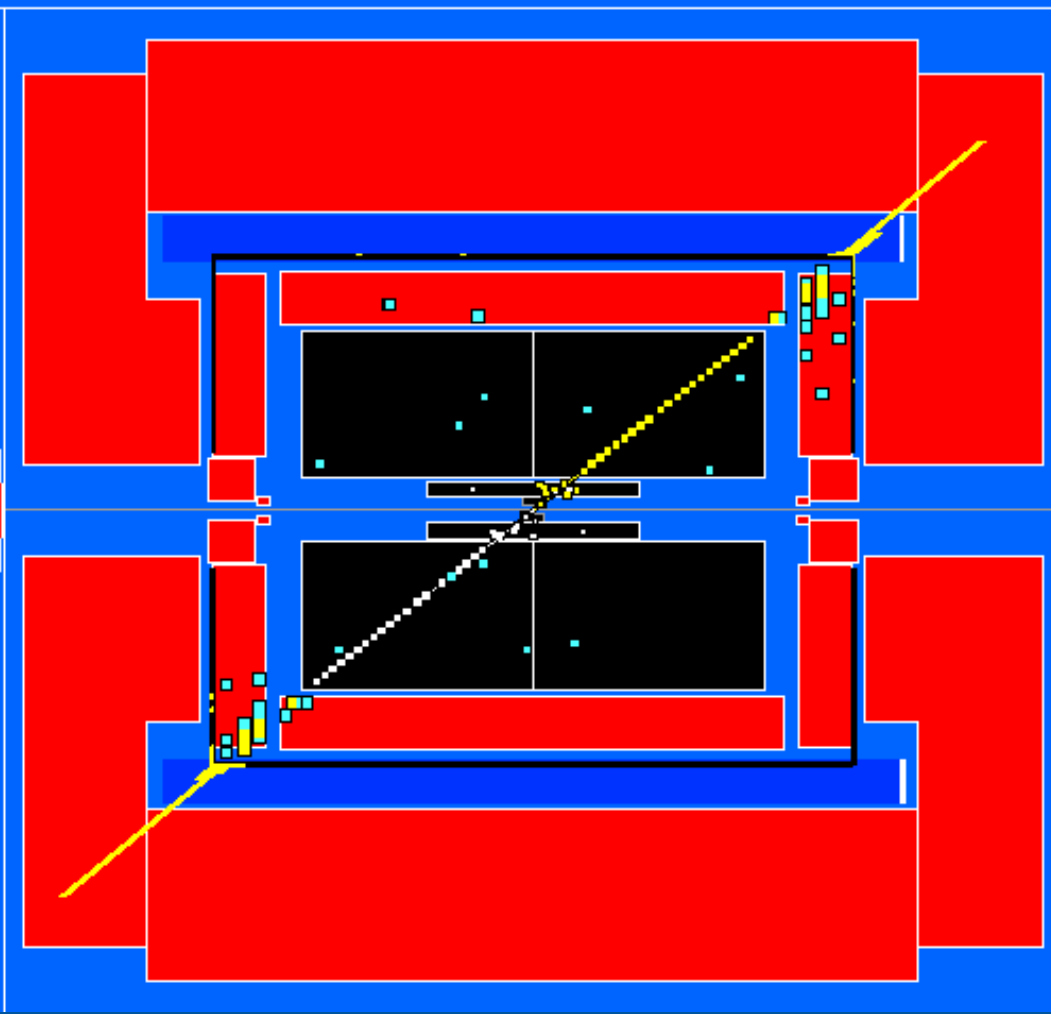
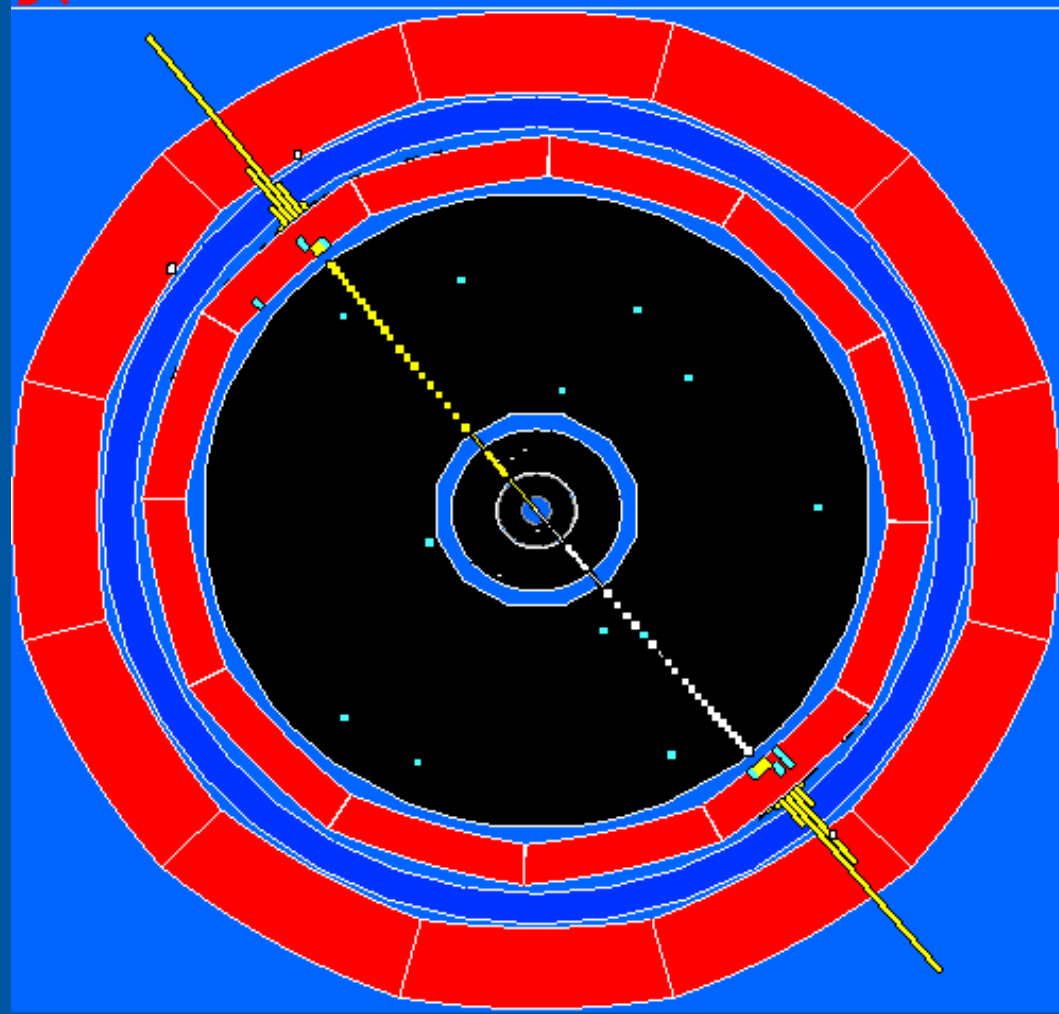


Conservación del momento lineal. Detector *ALEPH*, LEP

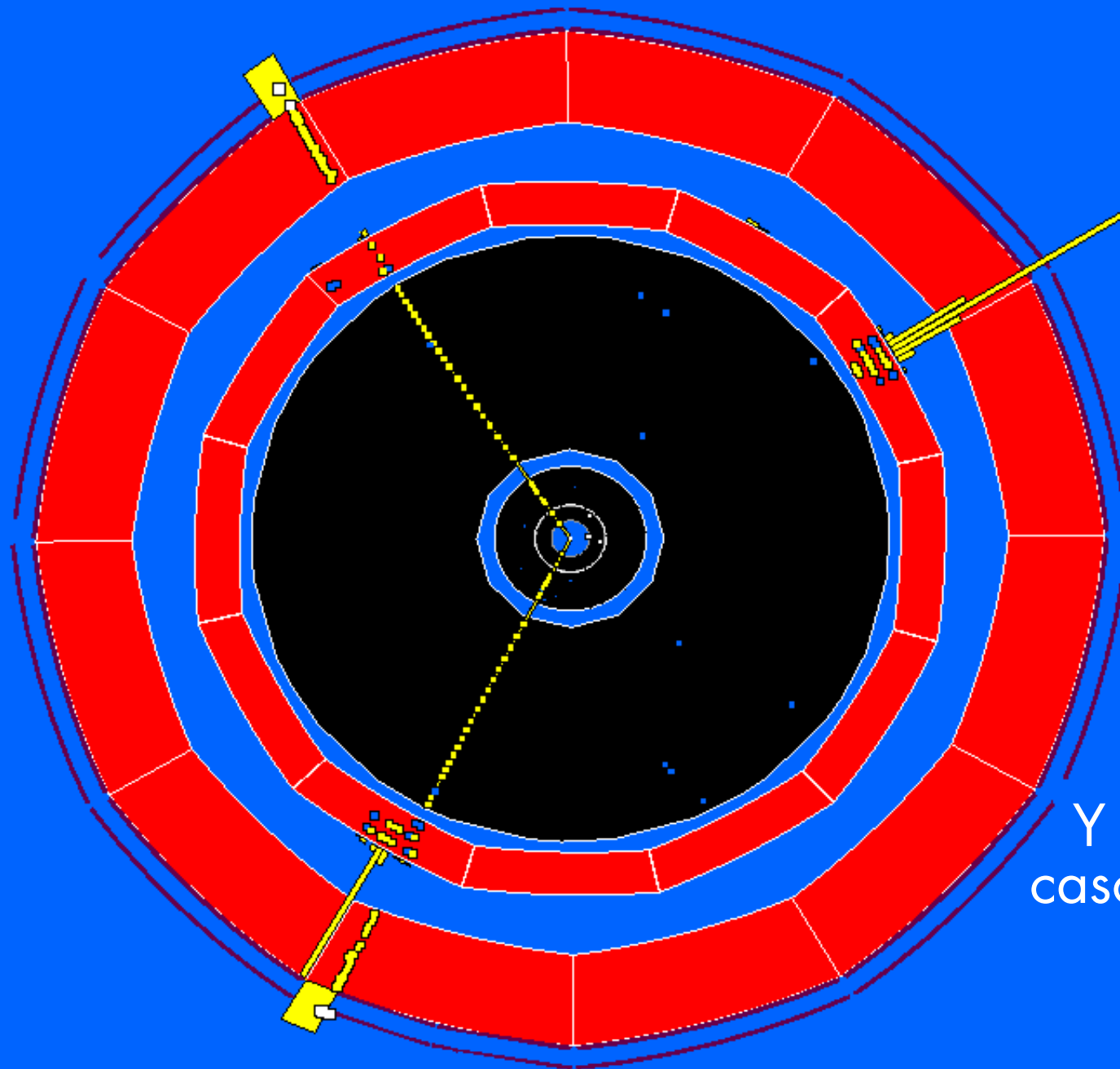


 **ALEPH** DALI

Run=15995 Evt=5435



Otra de conservación del momento lineal



Y en muchos
casos tenemos
datos
numéricos

Hay mucho material disponible y probado:

CINEMÁTICA, DINÁMICA, ENERGÍA, LEYES DE CONSERVACIÓN, GASES, ELECTRICIDAD Y MAGNETISMO, GASES...

**PARA TODOS LOS NIVELES DESDE SECUNDARIA,
(no con la misma abundancia)
CUALITATIVO Y CUANTITATIVO**

POR EJEMPLO:

Viaje al corazón de la materia: <http://palmera.pntic.mec.es/~fbarrada/>

Física de partículas en el Instituto: <http://www.educa2.madrid.org/web/fbarradas/inicio>

Acercándonos la LHC http://www.lhc-closer.es/pages_es/phy_1.html

Bibliografía de urgencia: <http://goo.gl/txNNz>

OTROS ENFOQUES:

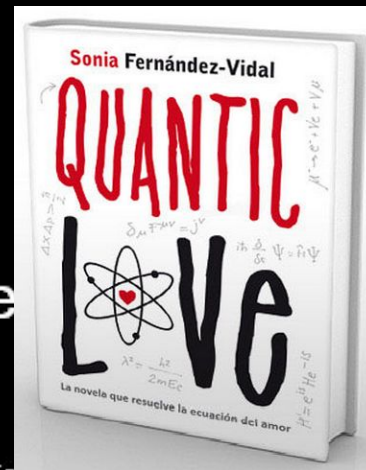
- A través de la ficción
- A través de aplicaciones biomédicas (u otras)
- Construir detectores caseros
- "Ciencia ciudadana"

A través de la ficción

SCIENCE AND FICTION: FLASHFORWARD

CERN > FlashForward

Two minutes and seventeen
that changed the world...



Robert Sawyer's novel FlashForward is currently being transformed into a big budget ABC TV series. Sawyer's story follows a research team using the particle accelerator at CERN in pursuit of the elusive Higgs Boson, a theoretical subatomic particle. But instead of finding the Higgs, the consciousness of the entire human race is thrown ahead by twenty-one years.



SCIENCE BEHIND THE STORY



European Organization for Nuclear Research

ANGELS & DEMONS

the science behind the story



Français English

Física de partículas y (bio)medicina:

<http://palmera.pntic.mec.es/~fbarrada/aula/aula0.html>

– Física de partículas y medicina

Se trata de encontrar la relación entre una noticia de prensa que habla de la extensión de la tomografía de emisión de positrones como técnica diagnóstica y las dificultades que supone su alto coste con la imagen de un suceso en el colisionador LEP del CERN.

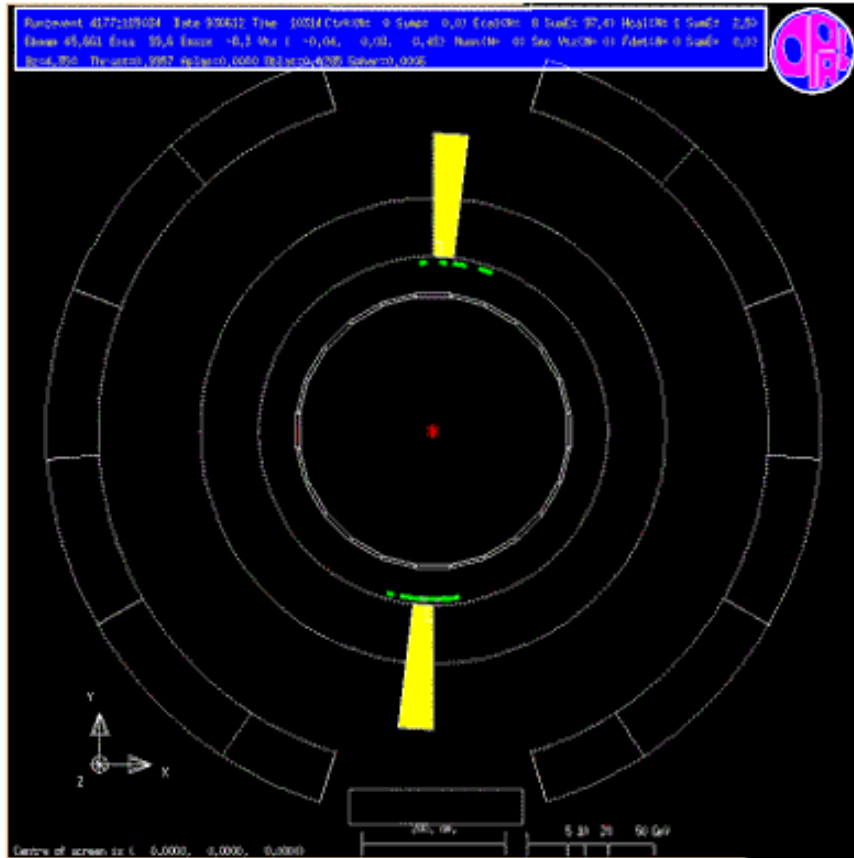


Foto CERN

Reconstrucción de un suceso en el colisionador LEP del CERN. En el punto rojo del centro se han hecho chocar un electrón y un positrón.

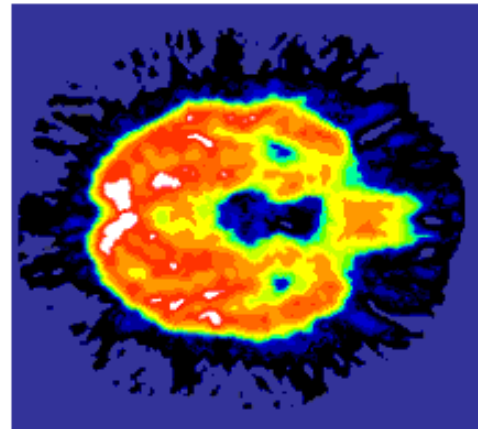


Foto Brunel University

Imagen del cerebro por escáner PET. Se usan para el diagnóstico médico y para investigar, por ejemplo, cómo cambia cuando se piensa o se lee...

Y quien dice medicina dice tecnología o informática o tantas cosas que salen en los medios...

A primera vista, la relación puede no existir, pero cuando se rasca un poco la superficie, sí aparece un enlace directo y natural... Tal como se empleó en el aula, los alumnos sabían interpretar las imágenes del detector (ver la sección 2.4 de la Introducción para alumnos y las secciones 4.2.2b y 3.2 de la Introducción para profesores)

DEMUESTRAN LA EFICACIA DE UNA PROTEÍNA QUE PUEDE INHIBIR EL VIRUS DEL VIH-1

INICIO / ACTUALIDAD / NOTICIAS / DEMUESTRAN LA EFICACIA DE UNA PROTEÍNA QUE PUEDE INHIBIR EL VIRUS DEL VIH-1

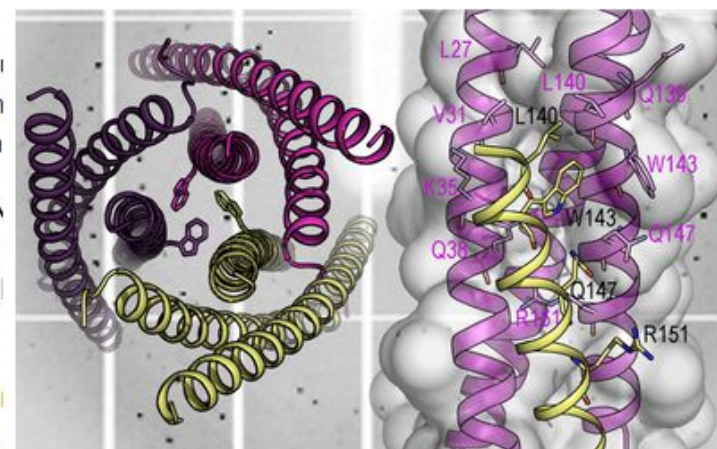
Utilizando los brillantes rayos X del Sincrotrón ALBA, un grupo de investigadores ha resuelto la estructura cristalina de una cadena proteica sintética que puede evitar la infección del **VIH-1**.

La glicoproteína gp41 forma parte de la envoltura del virus de la inmunodeficiencia humana en la célula huésped. Durante la infección del **VIH-1**, dos regiones de gp41 (la repetición NHR y CHR respectivamente) pueden ser accesibles a inhibidores de manera temporal.

Los investigadores diseñaron una **cadena proteica simple que imita la superficie de NHR**. De esta manera, esta cadena evita que el virus se pliegue e infecte a la célula huésped, tal y como ocurre con los pseudovirus y virus aislados. El siguiente paso fue **hacer crecer la proteína en cristales** generados en el [Sincrotrón ALBA](#).

Los experimentos de difracción de rayos X realizados en la **línea de luz XALOC** han permitido confirmar su capacidad de imitar a la perfección la superficie de NHR en la región

Esta proteína - que es muy estable y precisa - tiene un **gran potencial para el desarrollo de fármacos, vacunas o microbicidas contra el VIH-1**.



PARTÍCULAS DE VERDAD

DETECTORES CASEROS

“Ver” para creer

LETRA PEQUEÑA:

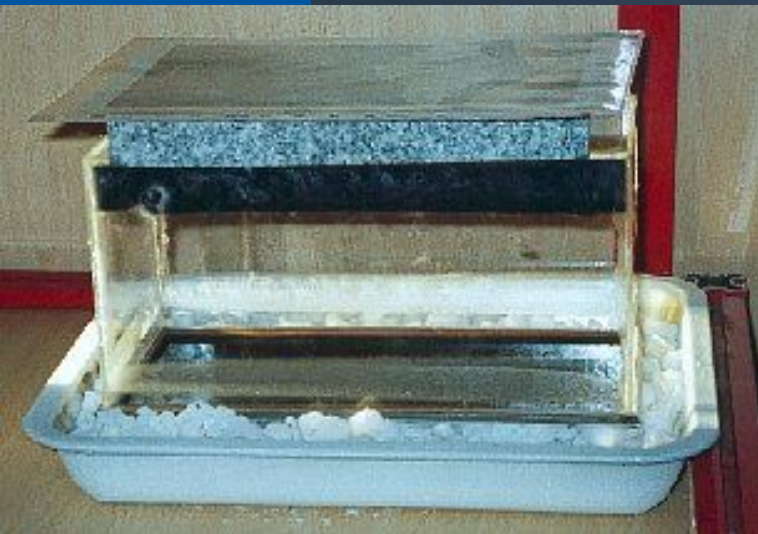
Pero cuidado, que ni “vemos” ni se trata de “creer” en sentido estricto.

Tira de fieltro empapada de alcohol

Placa metálica

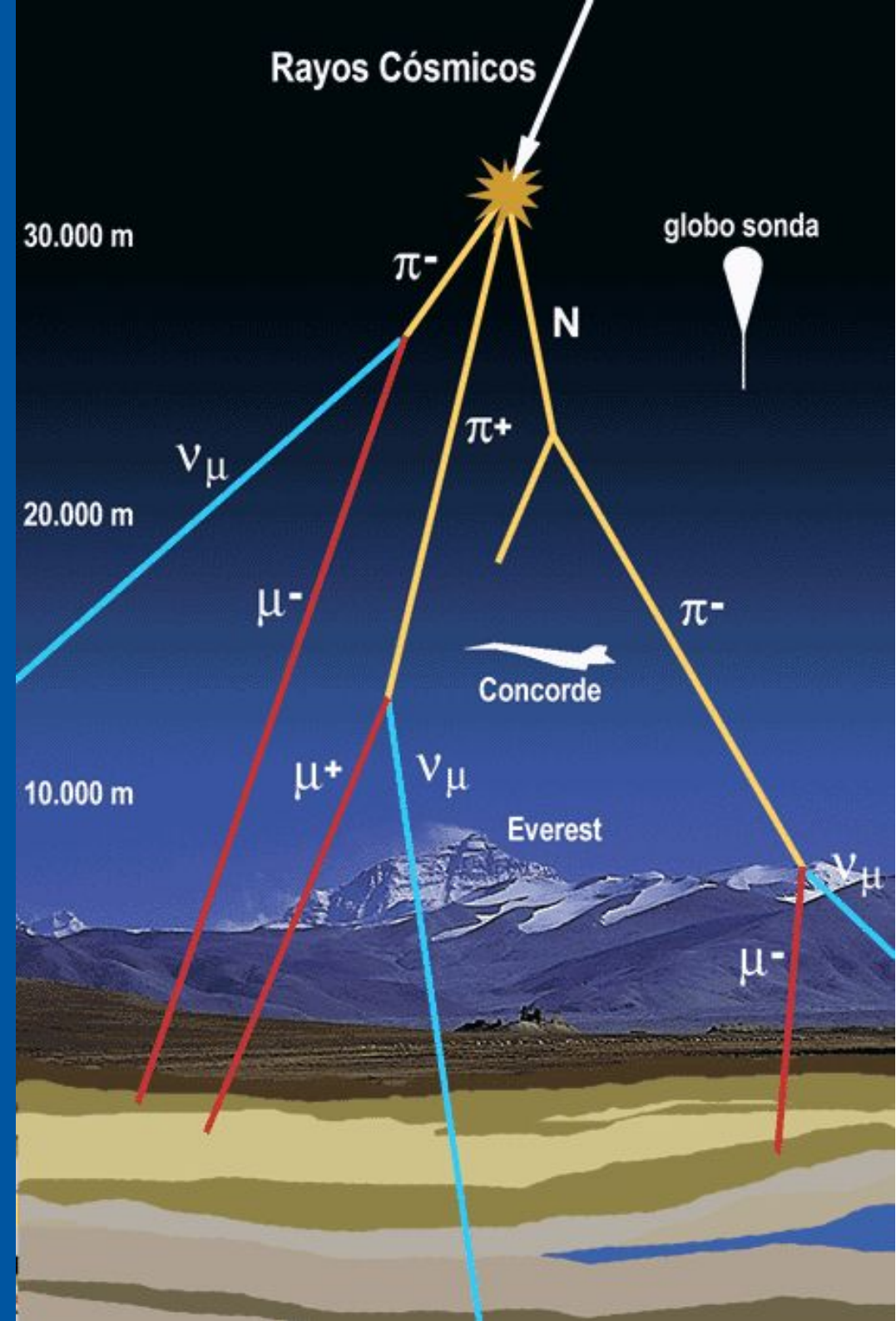
Burlete de goma

CO₂ sólido



La cámara de niebla

Se puede comprobar (**¡vaya frase!**) que la mayoría de las partículas detectadas son **muones (m)** de los rayos cósmicos secundarios



**También se pueden construir
otras cosas en el taller:**

Opciones más avanzadas, que permiten medir cosas sobre los rayos cósmicos...



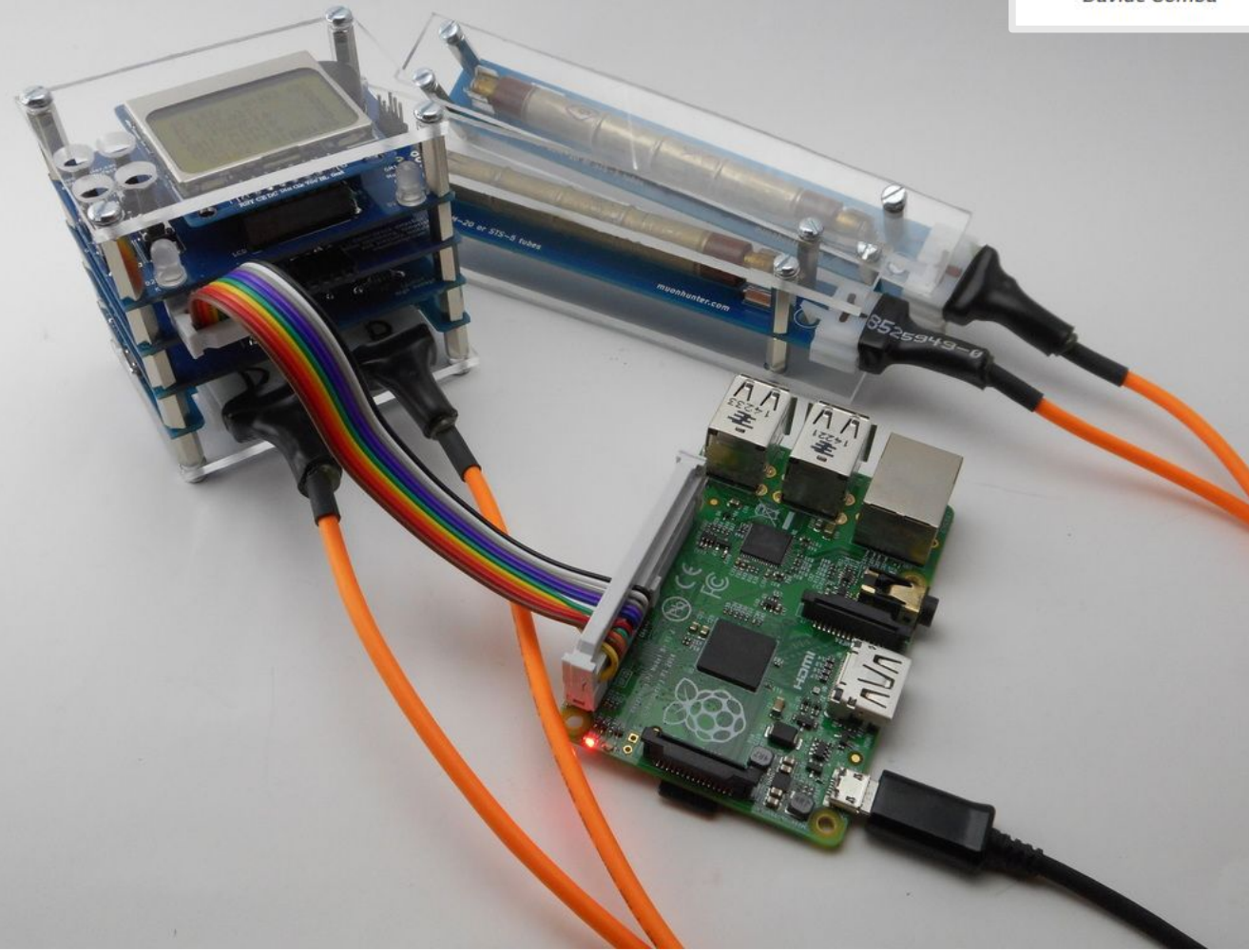
Home Buy Download Products Learning Forum Support Blog

Speed Trap! A GPS-Based Speeding Alert

Cubeduino

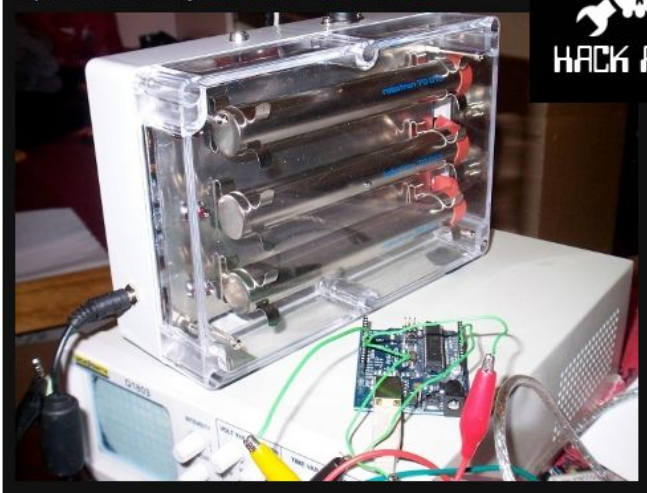
"BUILD YOUR OWN" GEIGER COUNTER [2 PART TUTORIAL]

Davide Gomba — April 13th, 2010



Arduino muon detector

September 3, 2009 By Zach Banks · 22 Comments





An Inexpensive Cosmic Ray Detector for the Classroom

Jeffrey D. Goldader and Seulah Choi

Citation: *The Physics Teacher* **48**, 594 (2010); doi: 10.1119/1.3517025

View online: <http://dx.doi.org/10.1119/1.3517025>

View Table of Contents: <http://scitation.aip.org/content/aapt/journal/tpt/48/9?ver=pdfcov>

Published by the [American Association of Physics Teachers](#)

Articles you may be interested in

Walther Bothe and Bruno Rossi: The birth and development of coincidence methods in cosmic-ray physics
Am. J. Phys. **79**, 1133 (2011); 10.1119/1.3619808

Student Projects in Cosmic Ray Detection

Phys. Teach. **47**, 494 (2009); 10.1119/1.3246465

Astroparticle Physics: Detectors for Cosmic Rays

AIP Conf. Proc. **857**, 382 (2006); 10.1063/1.2359423

Educational Cosmic Ray Arrays

AIP Conf. Proc. **828**, 271 (2006); 10.1063/1.2197427

Measuring and modeling cosmic ray showers with an MBL system: An undergraduate project

Am. J. Phys. **69**, 896 (2001); 10.1119/1.1370236

[arXiv.org](#) > [physics](#) > [arXiv:physics/0701015](#)

[Physics](#) > [Physics Education](#)

Educational cosmic ray experiments with Geiger counters

F. Blanco, F. Fichera, P. La Rocca, F. Librizzi, O. Parasole, F. Riggi

(Submitted on 31 Dec 2006)

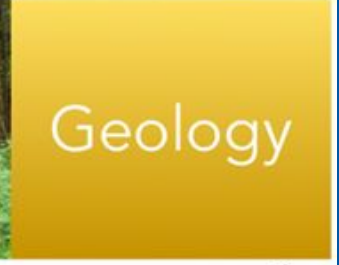
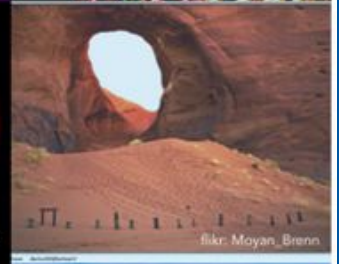
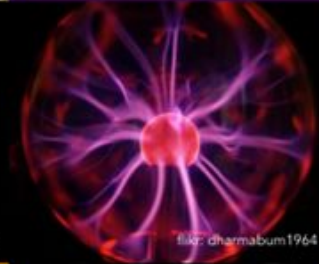
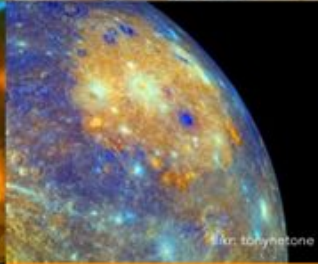
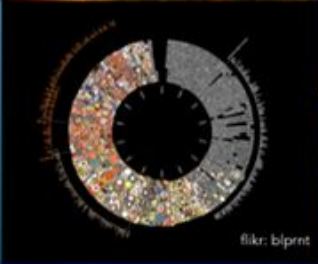
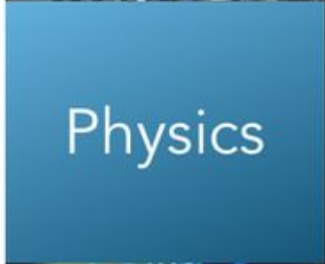
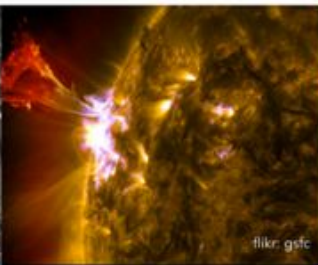
“CIENCIA CIUDADANA”

Particularmente usando
métodos propios de la *grid*



CitizenGrid Application Directory

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Citizen Science Grid

The University of North Dakota Citizen Science Grid is run by [Travis Desell](#), an Assistant Professor in UND's Computer Science Department. It is hosted by UND's Computational Research Center and Information Technology Systems and Services. The CSG is dedicated to supporting a wide range of research and educational projects using volunteer computing and citizen science, which you can read about and visit below.

[Volunteer Your Computer](#)

[Volunteer Your Brain](#)



DNA@Home

The goal of DNA@Home is to discover what regulates the genes in DNA. Ever notice that skin cells are different from a muscle cells, which are different from a bone cells, even though all these cells have every gene in your genome? That's because not all genes are "on" all the time. Depending on the cell type and what the cell is trying to do at any given moment, only a subset of the genes are used, and the remainder are shut off. DNA@home uses statistical algorithms to unlock the key to this differential regulation, using your volunteered computers.



¡Con teléfonos móviles!



DECO is a citizen science project that enables users around the world to detect cosmic rays and other energetic particles with their cell phones and tablets. The recorded events are automatically uploaded to a central database. In addition to detecting particle events, users can analyze the data produced by their own or other users' phones.

Getting started with DECO: The Distributed Electronic Cosmic-ray Observatory

J. Vandenbroucke (vandenbrouck@wisc.edu)
May 19, 2014 (Revised October 10, 2014)



About CRAYFIS

The CRAYFIS project is a novel approach to observing cosmic ray particles at the highest energies. It uses the world-wide array of existing smartphones instead of building an expensive dedicated detector.

[Learn more ↓](#)

[Join!](#)

[arXiv.org](#) > [astro-ph](#) > [arXiv:1410.2895](#)

[Astrophysics](#) > [Instrumentation and Methods for Astrophysics](#)

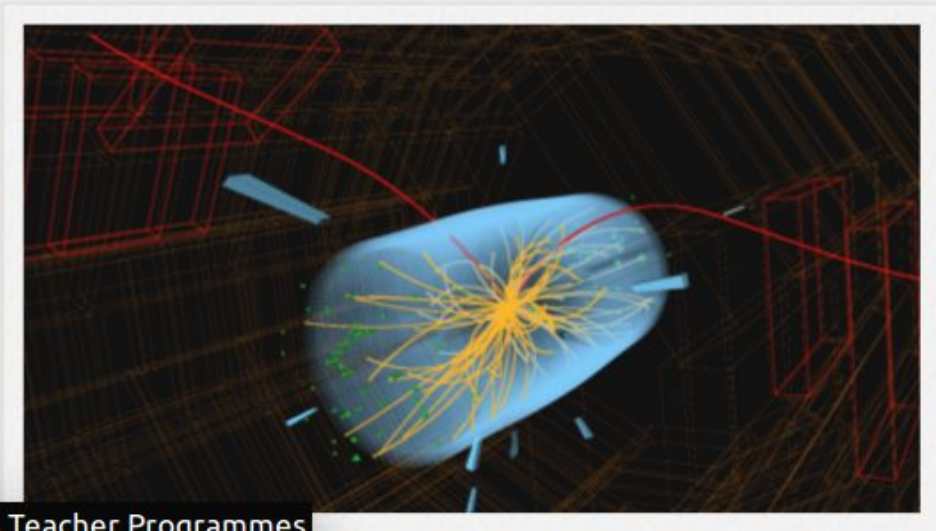
Observing Ultra-High Energy Cosmic Rays with Smartphones

[Daniel Whiteson](#), [Michael Mulhearn](#), [Chase Shimmin](#), [Kyle Brodie](#), [Dustin Burns](#)

(Submitted on 10 Oct 2014)



Search



CERN's Teacher Programmes

CMS@Home

Open a window to theories beyond the Standard Model.

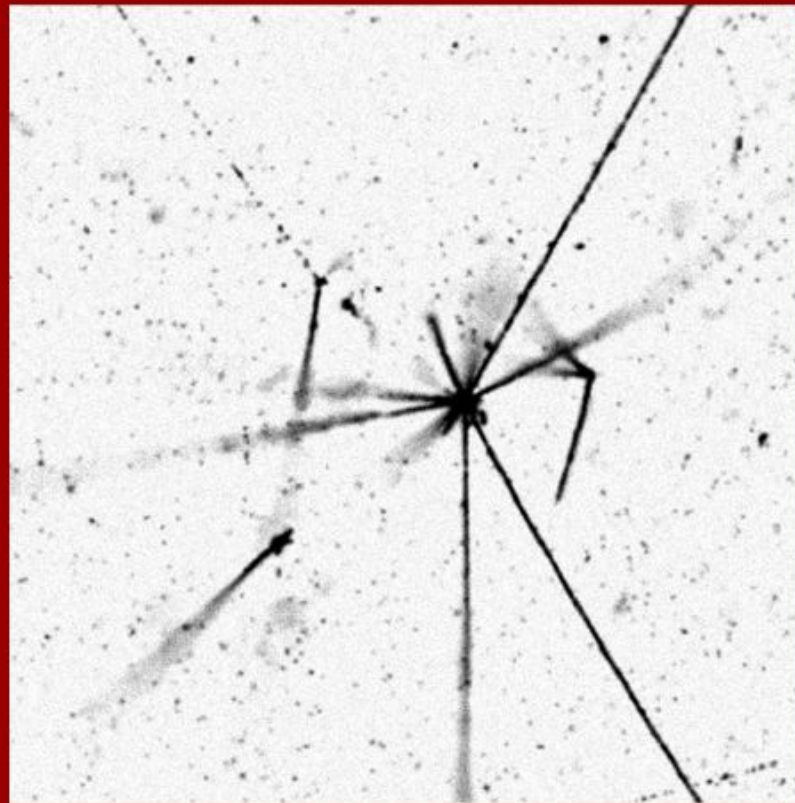
Help CMS search for extra dimensions and particles that could make up dark matter.

Tell me more

O contribuyendo con nuestras habilidades humanas

AEGIS EXPERIMENT

TESTING GRAVITY WITH ANTIMATTER AT CERN



CERN's Teacher Programmes

WHAT IS AEGIS?

IN THE NEWS

MULTIMEDIA

BLOGS

HELP US

PUBLICATIONS

JOBS

CONTACT

COLLABORATION

Copyright 2014 - AEgIS Collaboration - CERN

hay muchas otras
cosas en las que
podéis participar →



INTERNATIONAL

MASTERCLASSES

hands on particle physics

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Schedule

My Country

Physics

Local Organisation

In the Media

Archive

Contributors

Contact Us



International Masterclasses

9th International Masterclasses 2013

Each year about 10.000 high school students in 37 countries come to local centres for one day in order to unravel the mysteries of particle physics. In the topics and methods of basic research at the fundamentals of particle physics, measurements on real data from particle physics experiments then in the research collaboration, the participants join in a video conference for

Ciemat

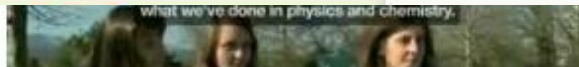
Centro de Investigaciones
Energéticas, Medioambientales
y Tecnológicas

facebook

Name:
International
Particle Physics



Instituto de Física Teórica UAM/CSIC



get out of school for one day and come to a nearby university or research centre

were organized from 9.3.

Vosotros, y luego vuestros alumnos, hacéis física de partículas con vuestras propias manos.

¡Con datos reales!

Public Data

Data Samples

Analysis Tools &

Formats

CMS Masterclass

Useful links


CMS Public Data

The CMS experiment at the LHC has release education and outreach. Explore this page and analyse it yourself.

Try the online event display below.

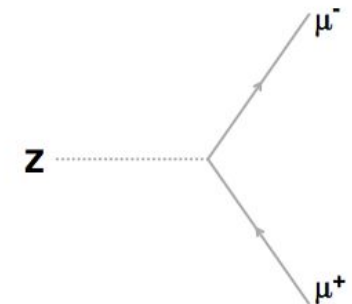
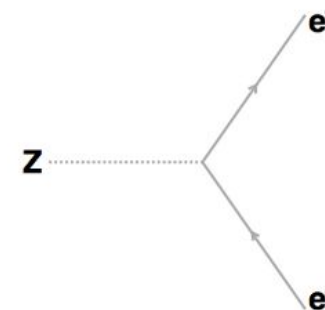
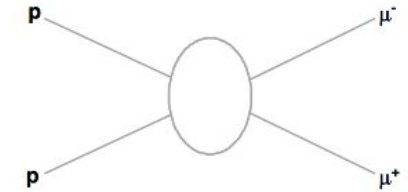
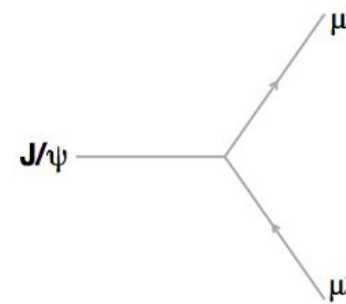
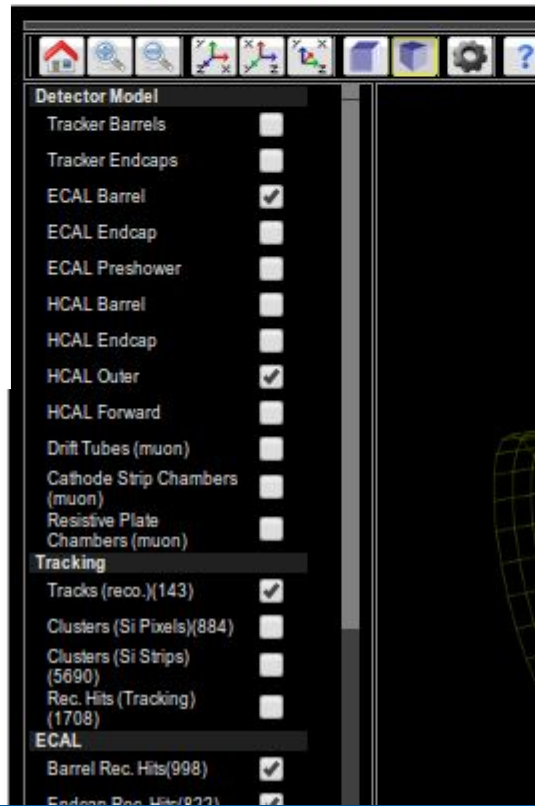
Use the Mouse to rotate.

Ctrl+Mouse or Ctrl +  to pan x/y.

Shift+Mouse or Shift +  to zoom.

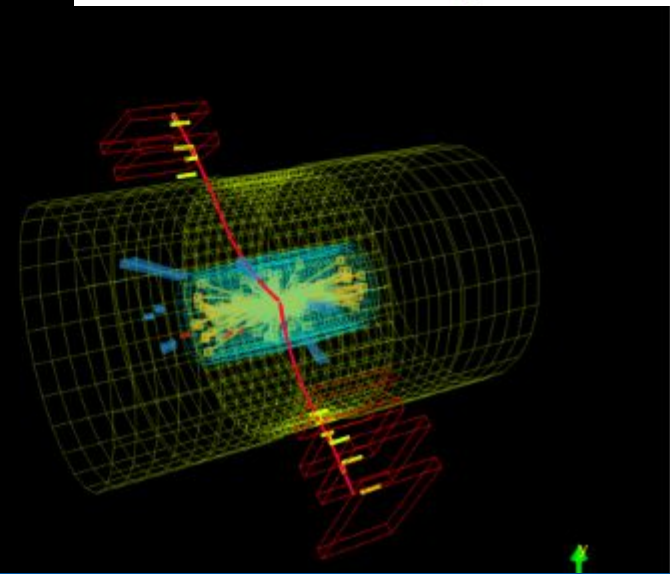
Follow the links at left to access the full version of the display.

Click on the diagrams below to access the data:

Detector Model

- Tracker Barrels
- Tracker Endcaps
- ECAL Barrel
- ECAL Endcap
- ECAL Preshower
- HCAL Barrel
- HCAL Endcap
- HCAL Outer
- HCAL Forward
- Drift Tubes (muon)
- Cathode Strip Chambers (muon)
- Resistive Plate Chambers (muon)
- Tracking**
- Tracks (reco.)(143)
- Clusters (Si Pixels)(884)
- Clusters (Si Strips) (5690)
- Rec. Hits (Tracking) (1708)
- ECAL**
- Barrel Rec. Hits(998)
- Endcap Rec. Hits(823)




Y no hace falta participar en las masterclasses

Education

<http://opendata.cern.ch/>


Firefox Web Browser



The CMS (Compact Muon Solenoid) experiment is one of two large general-purpose detectors built on the Large Hadron Collider (LHC). Its goal is to investigate a wide range of physics such as the characteristics of the Higgs boson, extra dimensions or dark matter.

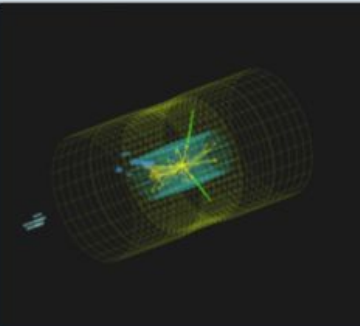
[Explore CMS >](#)

For education purposes, the complex primary data need to be processed into a format (examples below) that is good for simple applications. Get in touch if you wish to build your own applications similar to those shown here

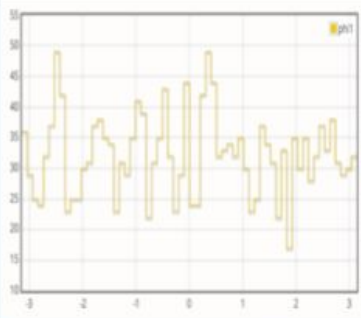


ALICE (A Large Ion Collider Experiment) is a heavy-ion detector designed to study the physics of strongly interacting matter at extreme energy densities, where a phase of matter called **quark-gluon plasma** forms. More than 1000 scientists are part of the collaboration.


[Explore ALICE >](#)



[Visualise events >](#)



[Visualise histograms >](#)




The ATLAS (A Toroidal LHC ApparatuS) experiment is a general purpose detector exploring topics like the properties of the Higgs-like particle, extra dimensions of space, unification of fundamental forces, and evidence for dark matter candidates in the Universe.

[Explore ATLAS >](#)



[Learning Resources >](#)



The LHCb (Large Hadron Collider beauty) experiment aims to record the decay of particles containing b and anti-b quarks, known as B mesons. The detector is designed to gather information about the identity, trajectory, momentum and energy of each particle.

[Explore LHCb >](#)

Otros programas del CERN para profesores

 CERN — European Organization for Nuclear Research

CERN Programme for Physics High School Teachers

This 3-week residential programme, which has been taking place every year since 1998 at CERN during the month of July, is open to Physics High School Teachers from all CERN member and observer States, as well as from other countries subject to funding availability, who would like to update their knowledge of particle physics, its associated technologies and related subjects.

Goals of the High School teachers' programme:

- To promote the teaching of physics and, in particular of particle physics, in high schools
- To promote the exchange of knowledge and experience among teachers of different nationalities
- To expose teachers to the world of research
- To stimulate activities related to the popularization of physics within and beyond the classroom
- To help CERN establish closer links with European schools
- To encourage the cooperation between CERN and existing programs sponsored by the European Union in the area of scientific education

The work produced during the 3-week programme is documented and collected by the participants at -

<http://teachers.cern.ch/>.

Please consult this site for more details about the programme, and for a good collection of materials to be used in the class-room.

Merece la pena...

My trip to CERN



Before



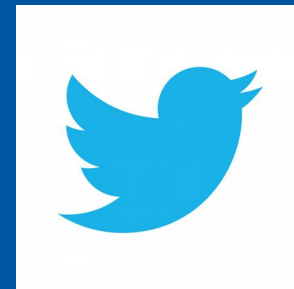
After

DESPUÉS DEL CERN

Experiencias de los participantes en los programas de formación para profesores de la Comunidad de Madrid

¿Y cómo me sigo yo informando...?

@fbarradass



O más fácil:



VIAJE AL CORAZÓN DE LA MATERIA
Física de partículas en el Instituto

Introducción e instrucciones de uso

Física de partículas para profesores

Actividades en el aula

Recursos y noticias

Vd. puede conocer el CERN

Índice

Autor **LHC: El blog del profesor**

Financiado por  

FÍSICA DE PARTÍCULAS EN EL INSTITUTO
Una guía práctica

<http://palmera.pntic.mec.es/~fbarrada/>

**Y recordad; me podéis preguntar
por lo que sea...**

Paco Barradas

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fbarradas@educa.madrid.org

FIN

¡Gracias!

Francisco Barradas Solas
Centro de Intercambios Escolares
Consejería de Educación
Comunidad de Madrid