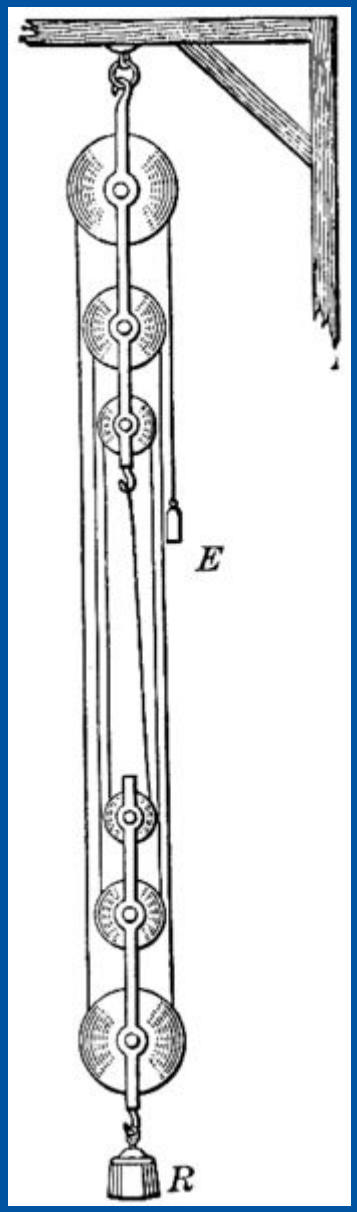
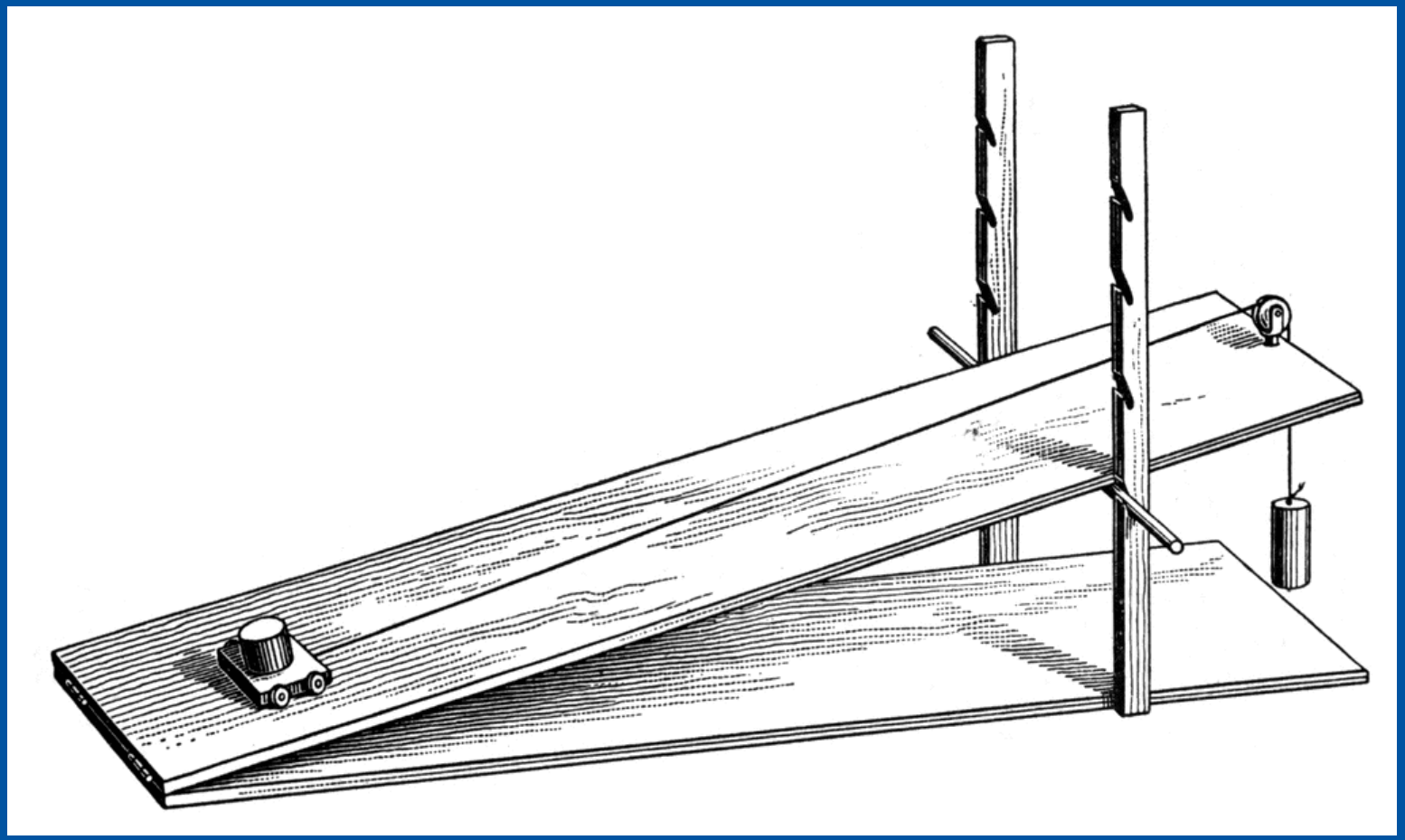
FÍSICA DE PARTÍCULAS
(Y COSMOLOGÍA, Y ONDAS GRAVITACIONALES...)
EN EL AULA

¿SE PUEDE? ¿SE DEBE?





https://etc.usf.edu/clipart/galleries/143-inclined-planes

AUNQUE EL CERN NO SEA EL MEJOR SITIO PARA HABLAR DE ESTO...

¡PARECE MENTIRA!

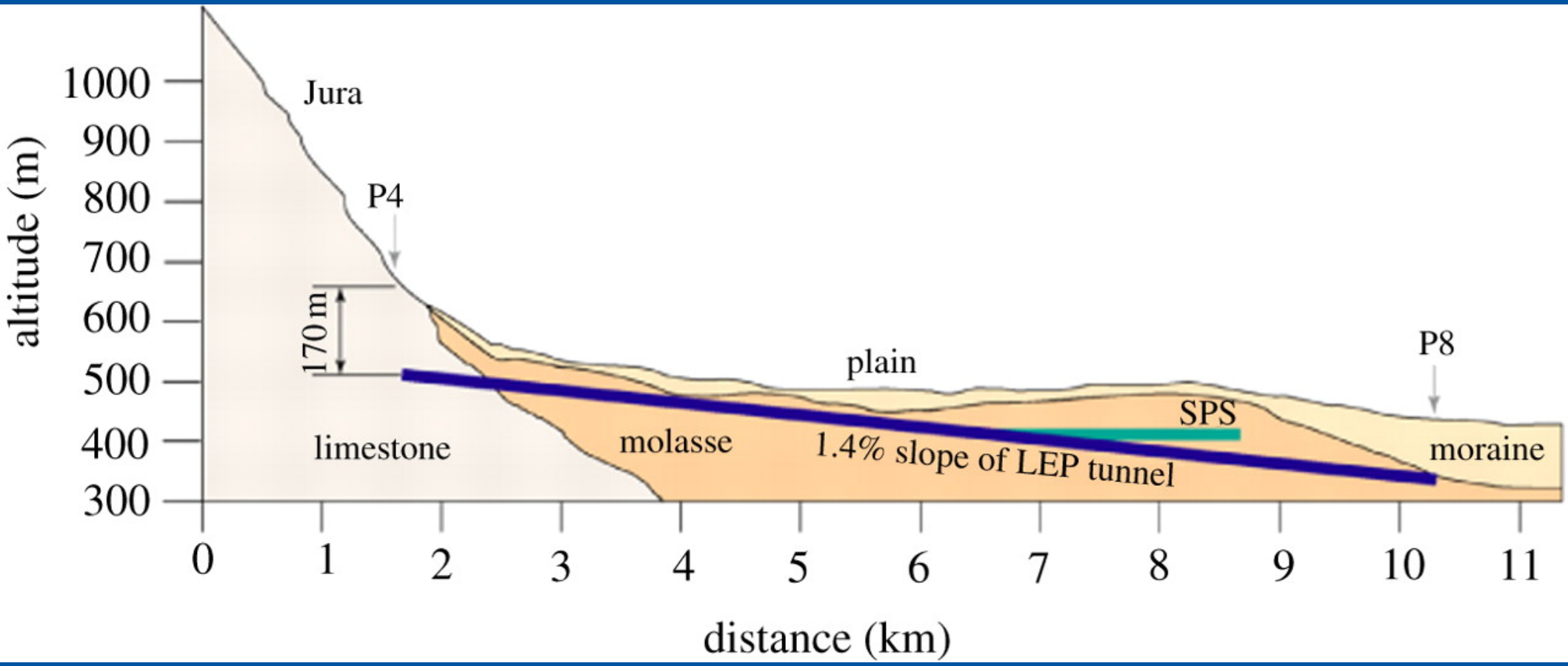
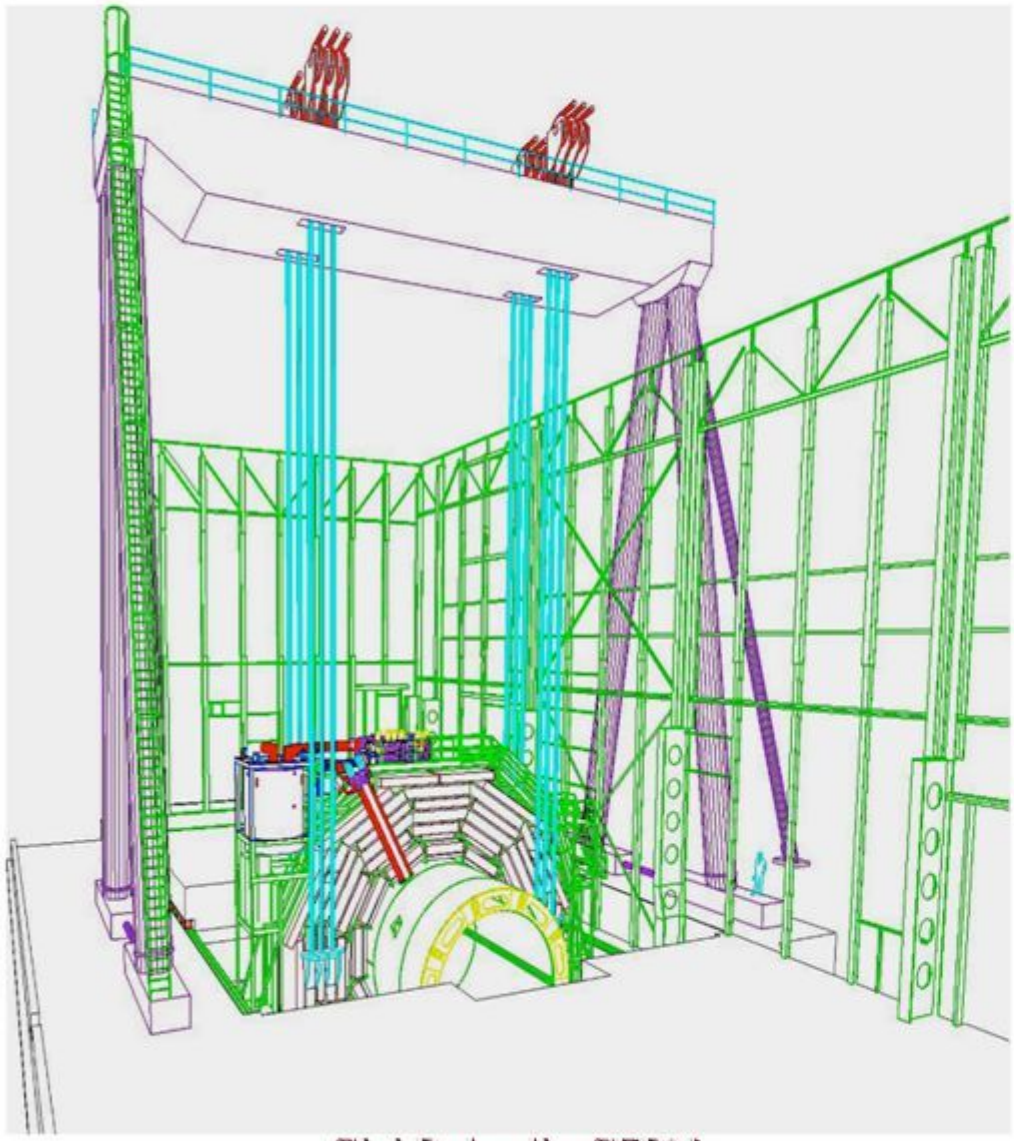

altitude (m)
1000
900
800
700
600
500
400
300
Jura
P4
170 m
limestone
molasse
plain
1.4% slope of LEP tunnel
SPS
P8
moraine
0
1
2
3
4
5
6
7
8
9
10
11
distance (km)

Foto CERN

CMS Heavy Lowering



Gigi Rolandi - CERN

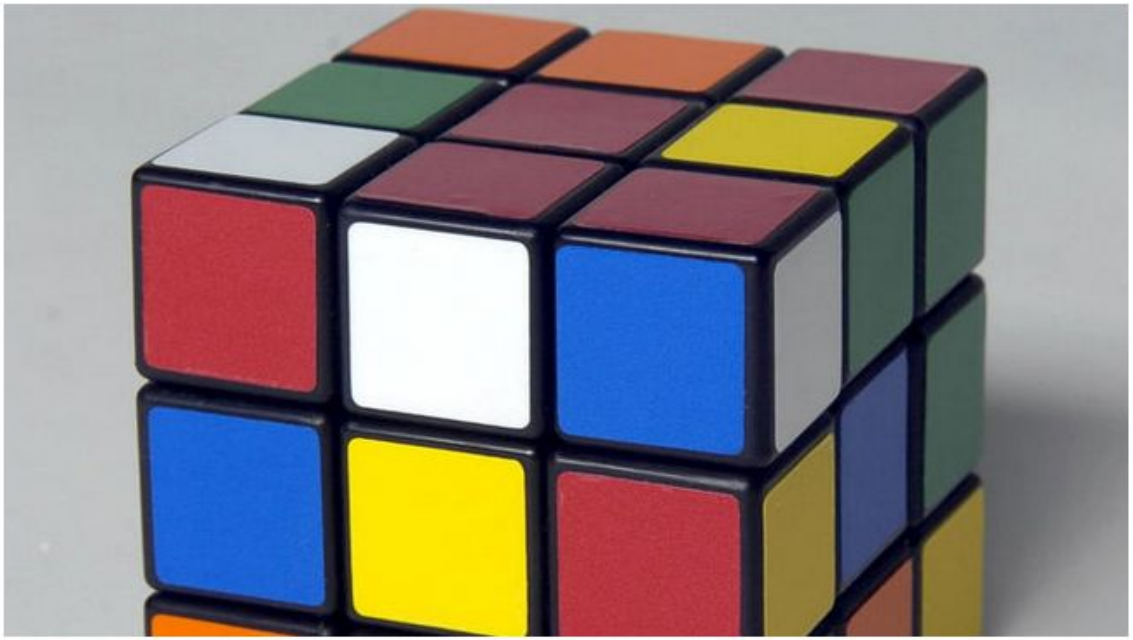
What if you had to take an art class in which you were taught only how to paint a fence, but were never shown the paintings of van Gogh or Picasso?

Alas, this is how math is taught, and so for most of us it becomes the intellectual equivalent of watching paint dry.

Los Angeles Times

How our 1,000-year-old math curriculum cheats America's kids

Ed Frenkel



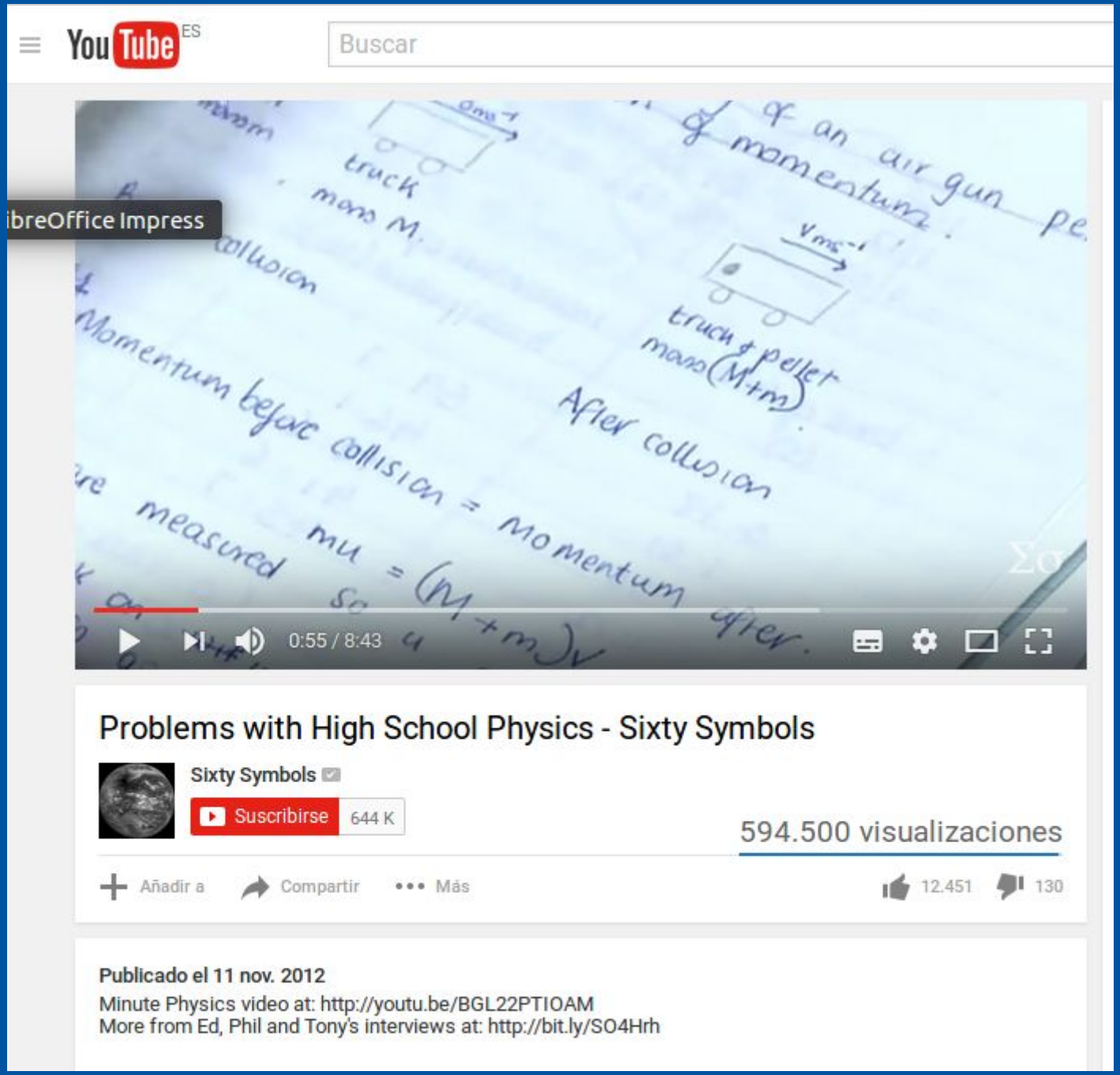
You can use a Rubik's Cube to explain symmetry groups: Every rotation of the cube is a "symmetry," and these combine into what mathematicians call a group. (Jeffrey F. Bill / The Baltimore Sun)

By Edward Frenkel

MARCH 2, 2014

Imagine you had to take an art class in which you were taught how to paint a fence or a wall, but you were never shown the paintings of the great masters, and you weren't even told that such paintings existed. Pretty soon you'd be asking, why study art?

That's absurd, of course, but it's surprisingly close to the way we teach children



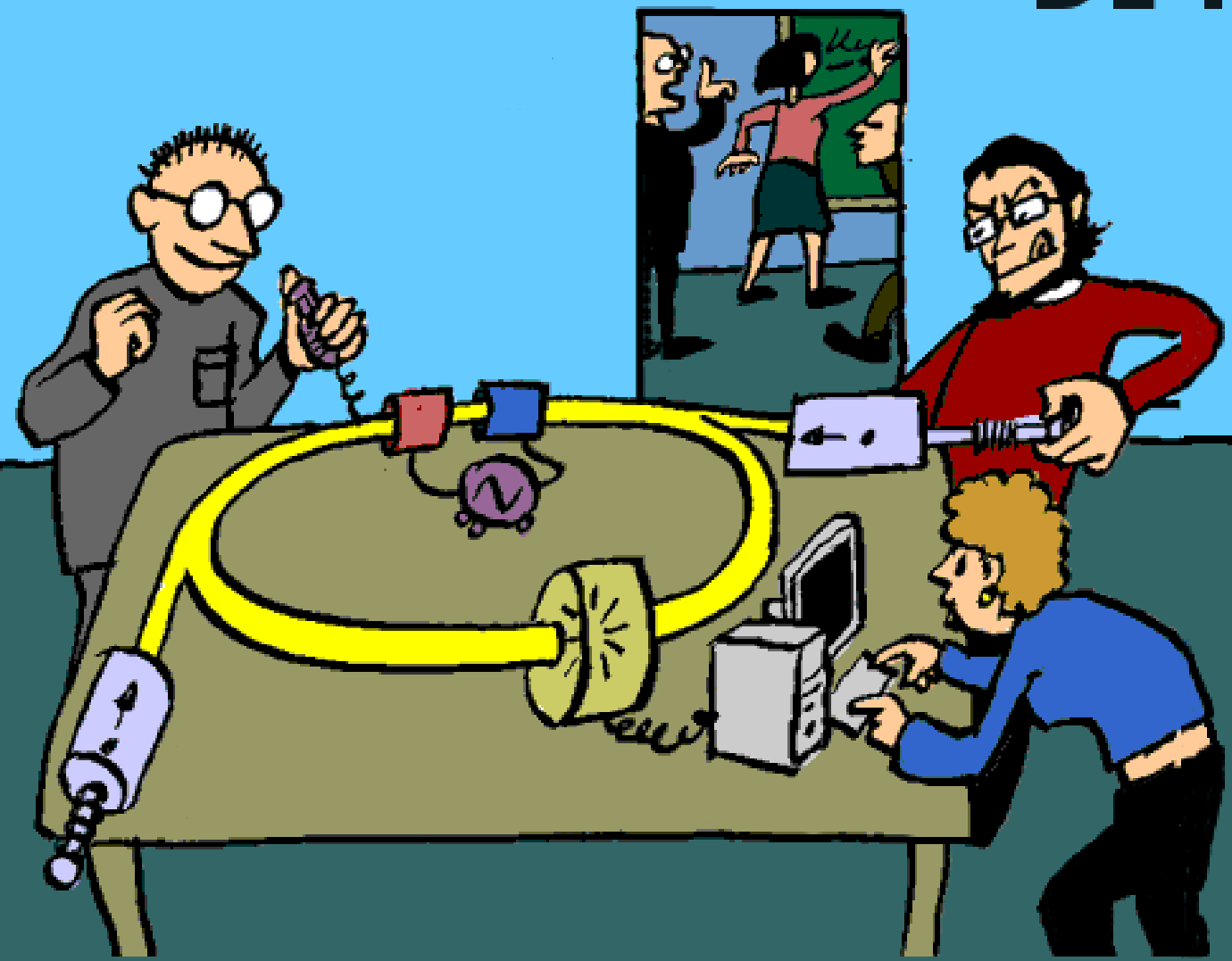
https://youtu.be/Xzn2ecB4Hzs

https://youtu.be/BGL22PTIOAM

Muy bonito, sí, pero y ahora...

¿qué?

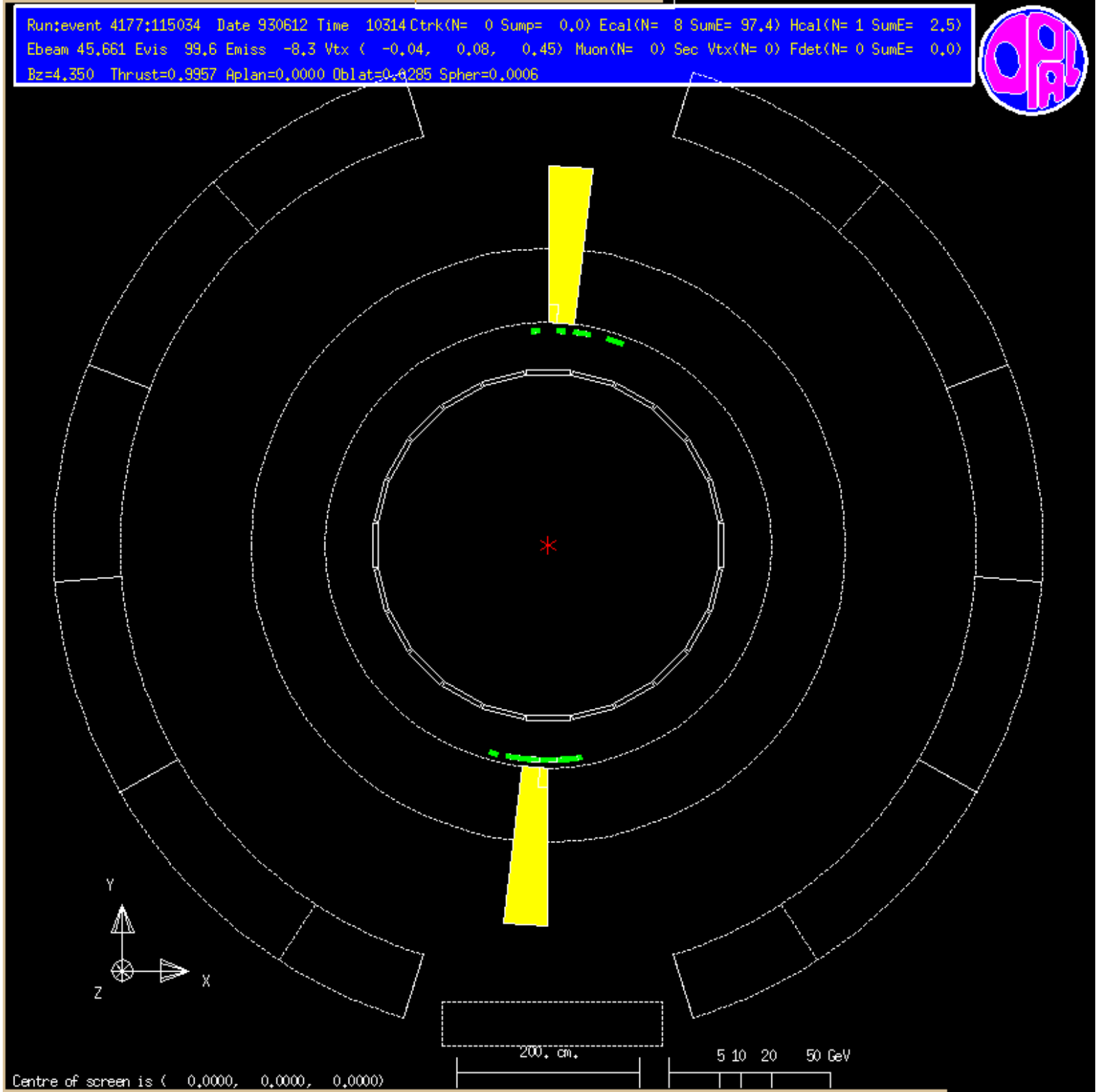
FÍSICA DE PARTÍCULAS EN EL INSTITUTO

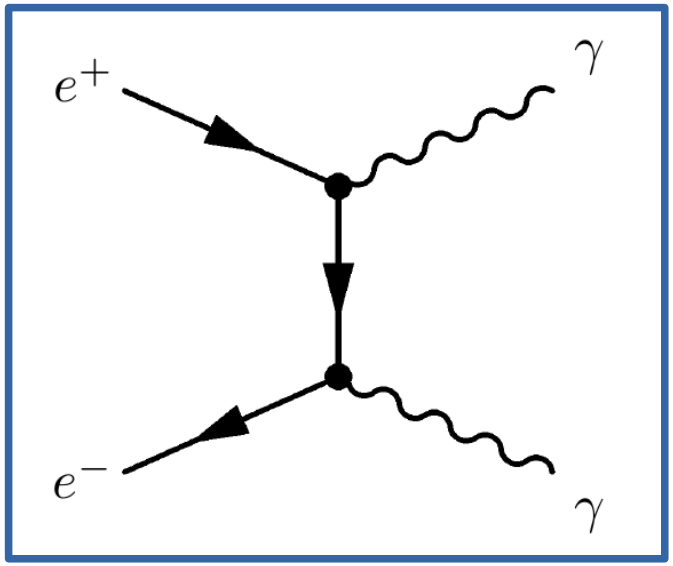


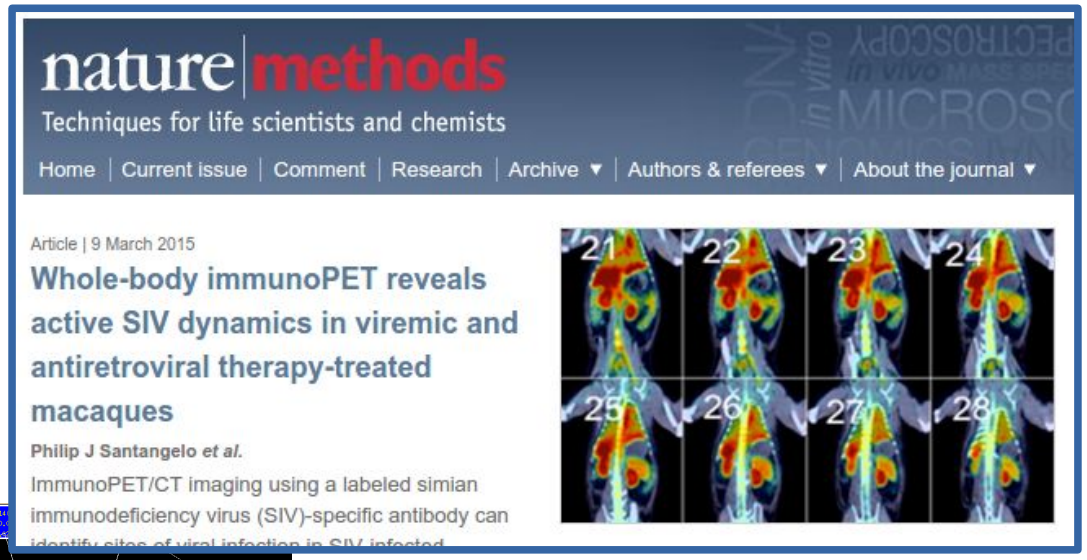
FÍSICA DE PARTÍCULAS PARA PROFESORES DE CIENCIAS Y TECNOLOGÍA

Lo que podemos hacer
EN EL AULA (y más allá)

¿Hay para todos los que enseñan 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 45.661 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=0.0285 Spher=0.0006
Y
X
Z
200. cm.
5 10 20 50 GeV
Centre of screen is (0.0000, 0.0000, 0.0000)


e^+
γ
e^-
γ


nature methods
Techniques for life scientists and chemists
Home | Current issue | Comment | Research | Archive ▼ | Authors & referees ▼ | About the journal ▼
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
21
22
23
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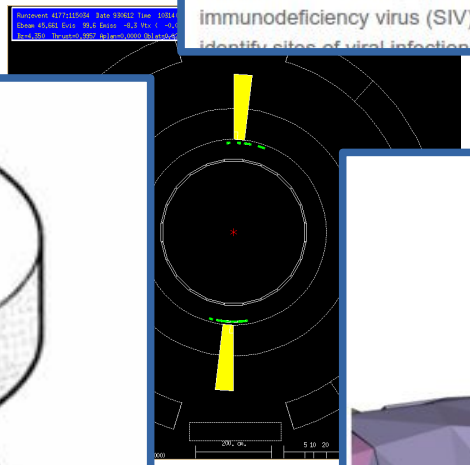
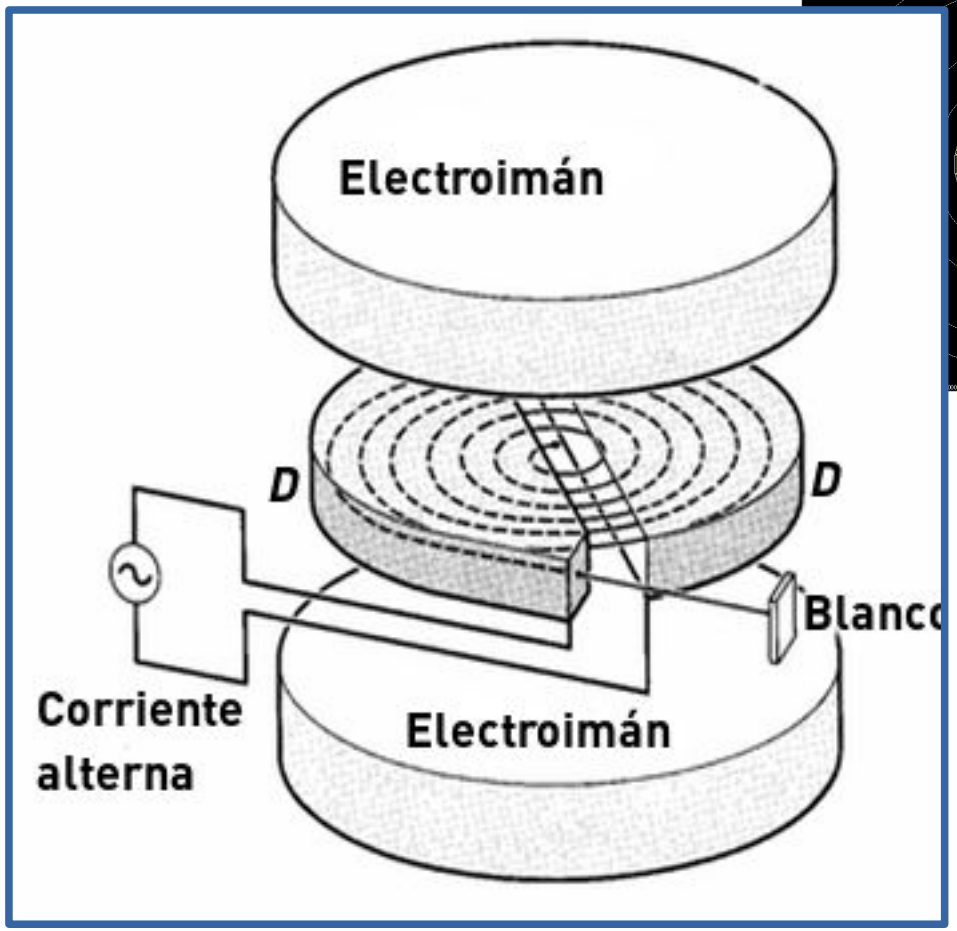
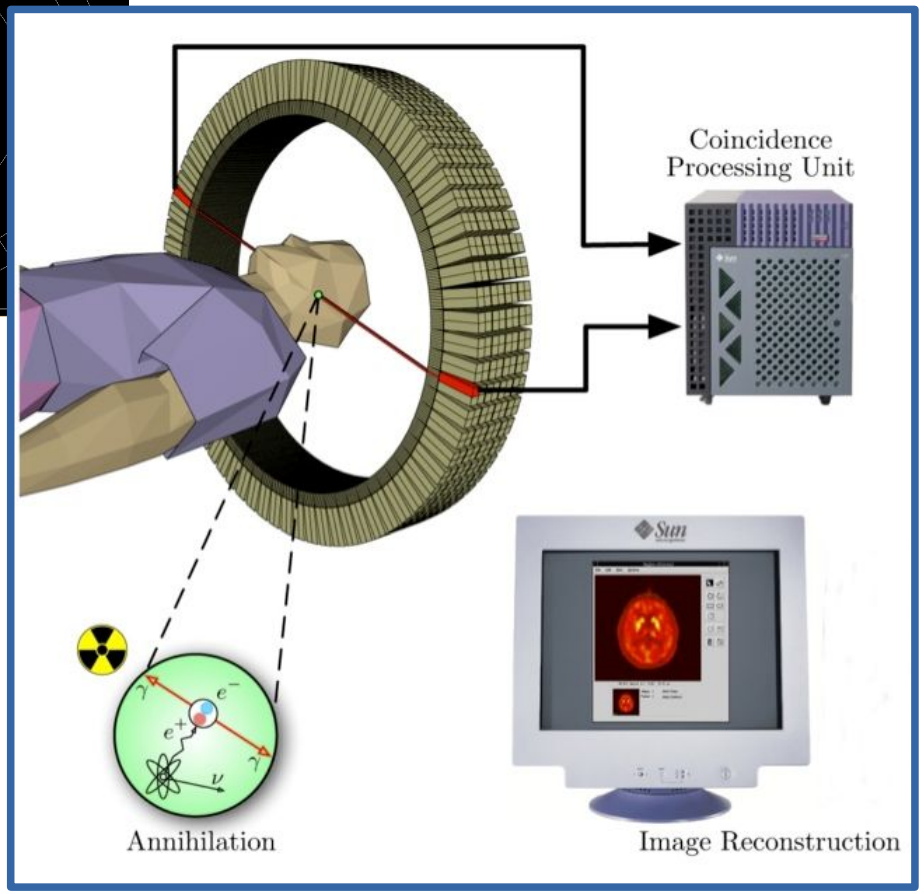



Electroimán
D
D
Blanco
Corriente alterna
Electroimán


Coincidence Processing Unit
Annihilation
Image Reconstruction

Pues sí...
con diferentes enfoques

Y al menos por dos motivos:

La importancia “cultural” de la física fundamental

Las “aplicaciones”

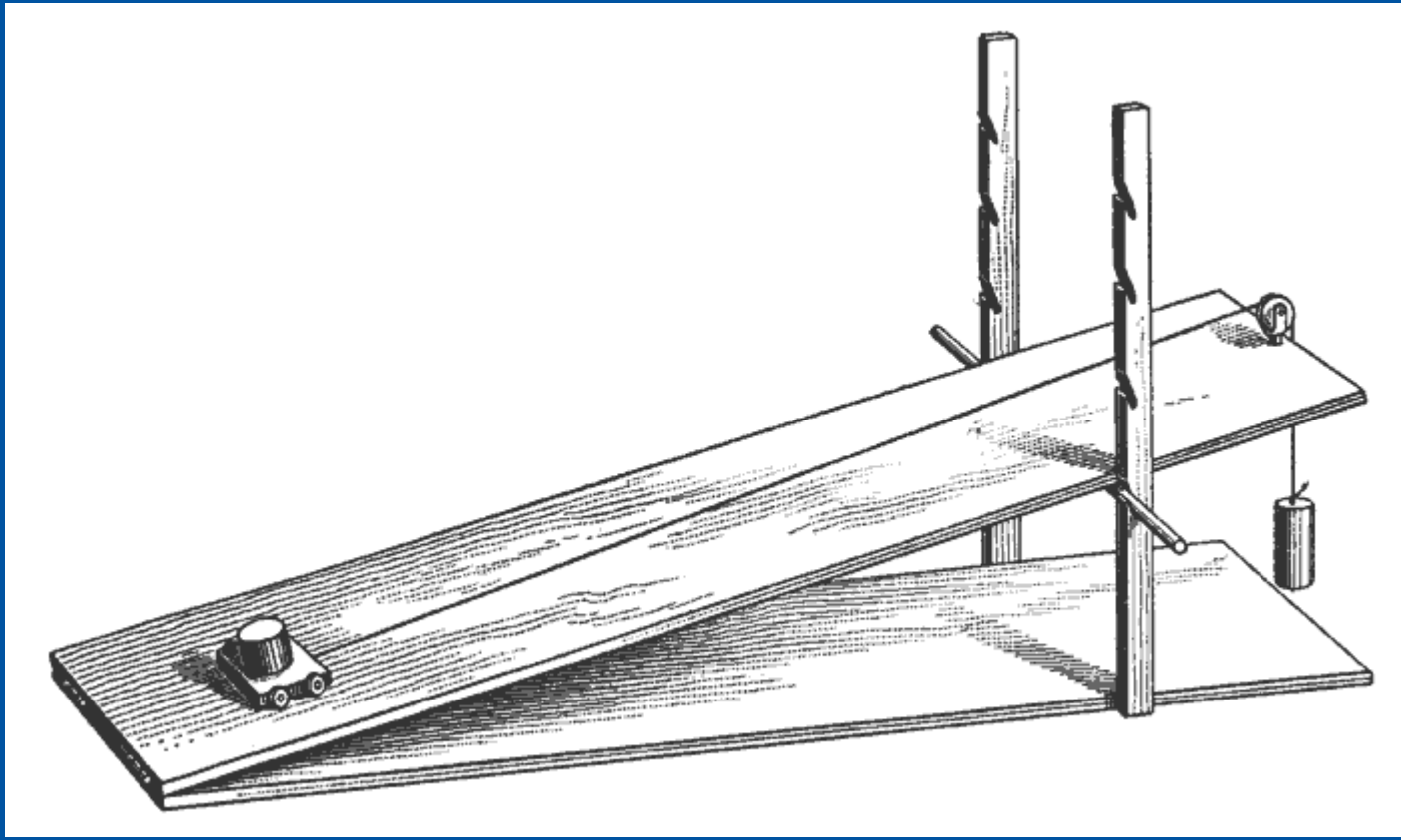
Lo que podemos hacer en el aula

1. El *programa mínimo.*
2. Adaptarlo al currículo existente.
3. Introducirlo en el currículo.

¿SE ACABÓ LA CIENCIA EN EL SIGLO XIX?

¿O SIQUIERA EN 1905 O EN LOS AÑOS 1930?

PUES A VECES LO PARECE,



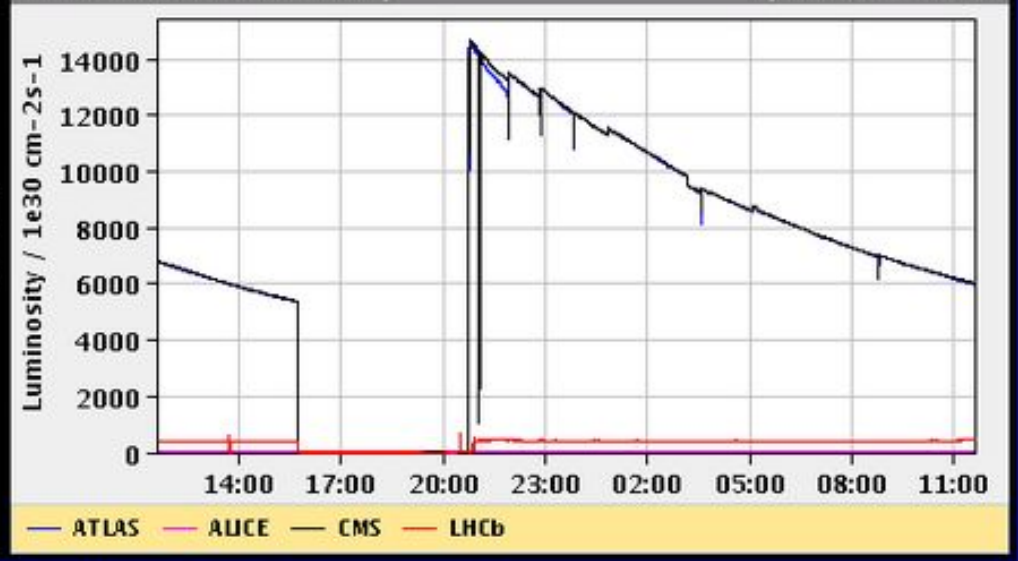
pero...

LHC Page1 | Fill: 6026 | E: 6499 GeV | t(SB): 14:47:52 | 31-07-17 11:36:06

PROTON PHYSICS: STABLE BEAMS

Energy:	6499 GeV	I(B1):	1.78e+14	I(B2):	2.02e+14

Inst. Lumi [(ub.s)^-1] IP1: 5986.83 IP2: 2.59 IP5: 6037.74 IP8: 446.13



Comments (31-Jul-2017 09:42:08)

Fill for physics (XING at 120urad)

Dump planned around 12noon

BIS status and SMP flags	B1	B2
Link Status of Beam Permits	true	true
Global Beam Permit	true	true
Setup Beam	false	false
Beam Presence	true	true
Moveable Devices Allowed In	true	true
Stable Beams	true	true

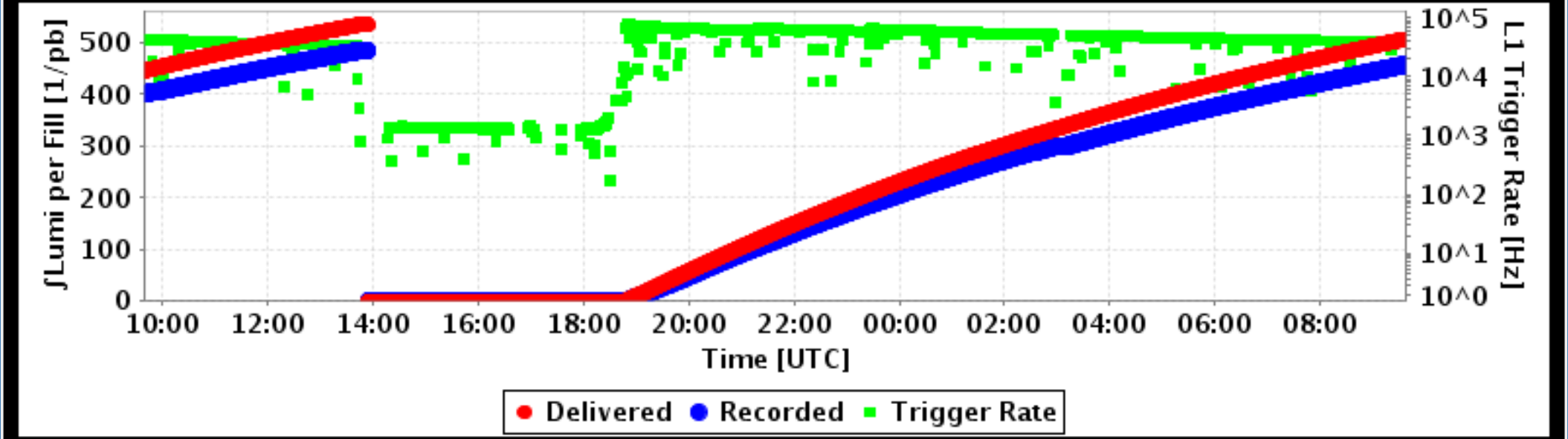
AFS: 25ns_2556b_2544_2215_2332_144bpi_20inj

PM Status B1: ENABLED | PM Status B2: ENABLED

CMS Page1 | Fill : 6026 | Run : 300157 | Mon 31-07-2017 09:38:28 UTC

CMS DAQ Status	LHC Status	Beam Energy	Intensity
Running	STABLE	6499 GeV	Beam1: 1.8×10^{14} Beam2: 2.0×10^{14}

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



CMS Comments Sun 30-07-2017 18:54:29 UTC

happily taking pp collisions !

LHC Page1 Comments Mon 31-07-2017 07:42:08 UTC

Fill for physics (XING at 120urad)

Dump planned around 12noon

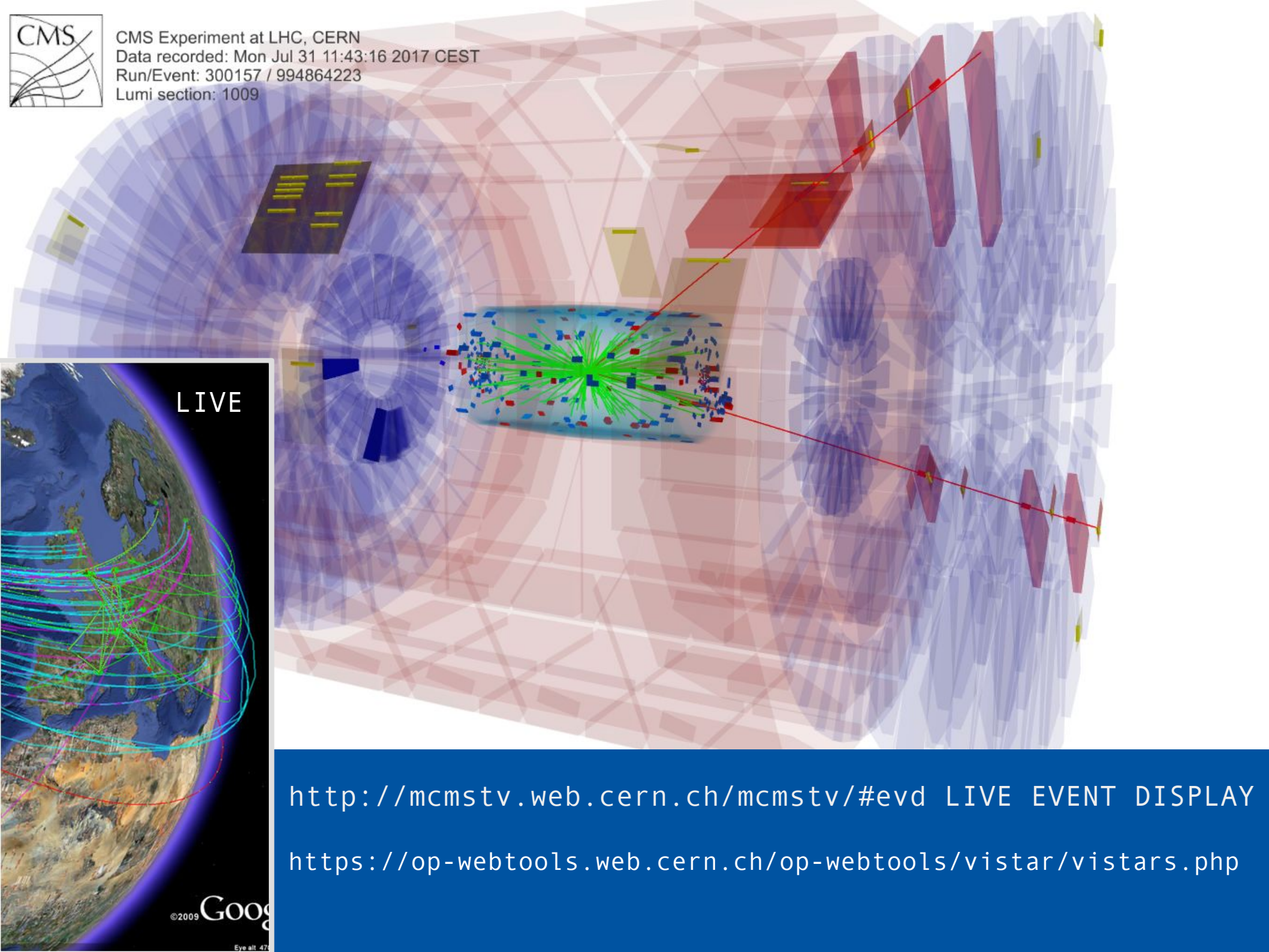
Sub-System DAQ / DCS

CSC	IN	ON
DT	IN	ON
ECAL	IN	ON
ES	IN	ON
HCAL	IN	ON
HF	IN	ON
PIXEL	IN	ON
RPC	IN	ON
TRACKER	IN	ON

DAQ	IN
DQM	IN
SCAL	IN
TRG	IN
CTPPS_TOT	IN

Run/Trigger/DAQ Status

Fill Number	6026
Run Number	300157
LumiSection	996
Physics Bit Set	ON
Magnet [T]	3.801
Total L1 Rate [Hz]	38429
Total L1 Triggers	983258531
Instant Lumi[E30]	6024.07
∫Lumi Rec[1/pb]	457.72
Tier0 Transfer	ON

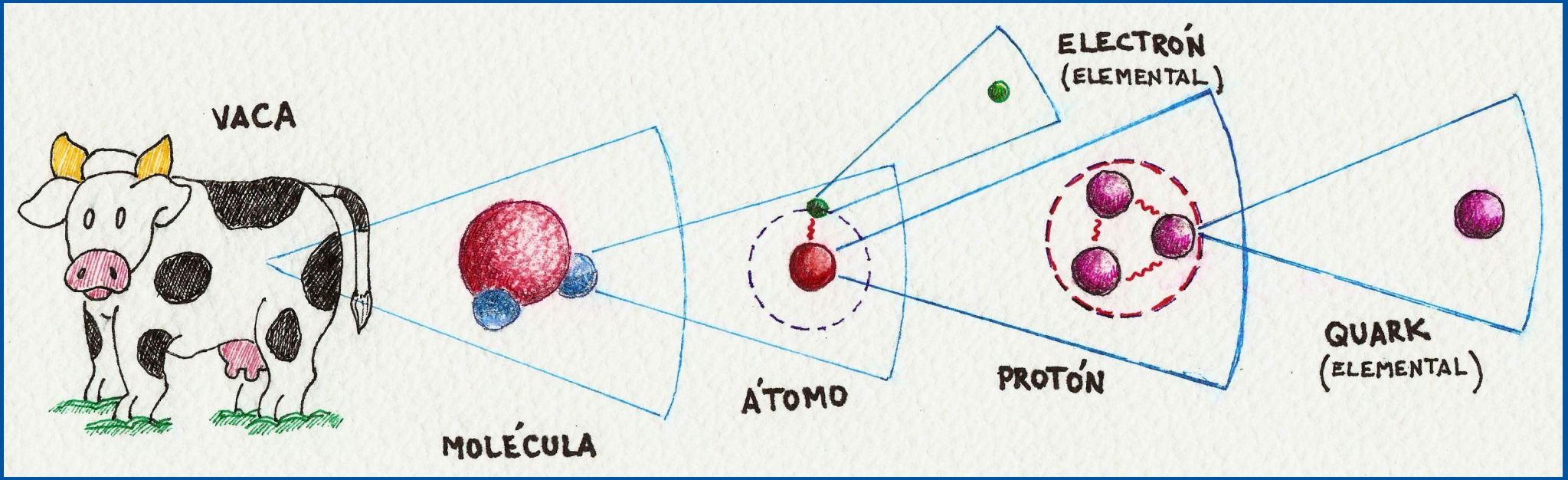


http://mcmstv.web.cern.ch/mcmstv/#evd LIVE EVENT DISPLAY

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

EL PROGRAMA MÍNIMO

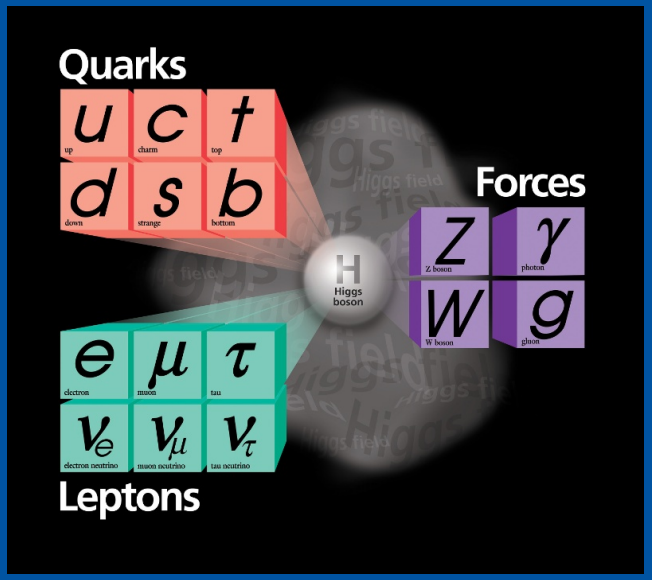
No se puede ignorar lo que estamos aprendiendo aquí...

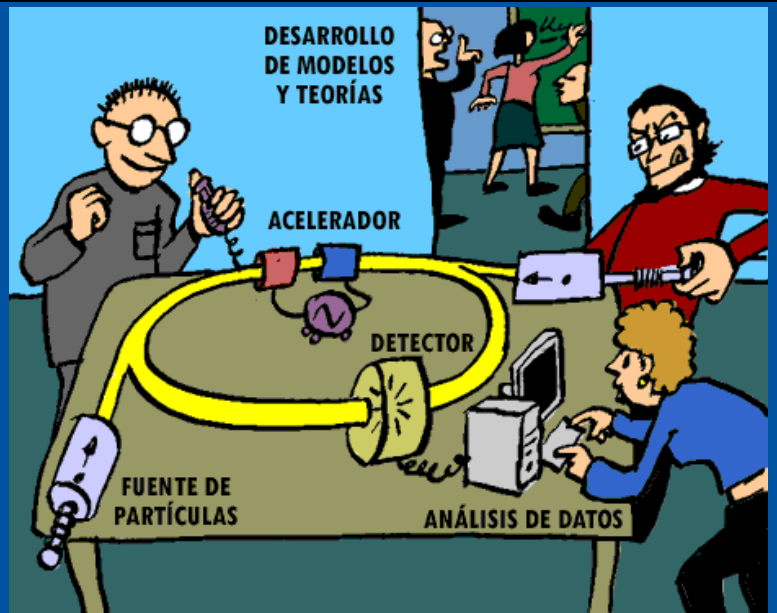


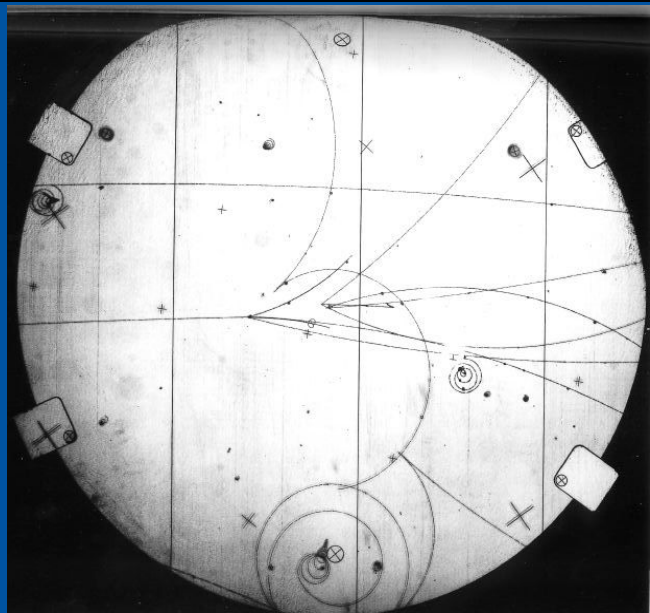
AHORA HAY QUE DEFINIR ESOS
ELEMENTOS MÍNIMOS

EXPERIMENTO
ACELERADOR
INTERACCIONES
PARTÍCULAS
COLISIONES
DETECTOR
TEÓRICOS
ELECTRÓN
MEDIADORAS
FUERZAS
MÉTODOS
FÍSICA
UNIDAS
FOTONES
QUEDA
MANTIENEN
TEORÍA
DOS
ELECTROMAGNÉTICA
BÁSICOS
QUARKS
INTERCAMBIO
MODELO
ELEMENTALES
NEUTRÓN
ESTÁNDAR
PROTÓN
FUERZA
CÓMO
UNIVERSO
DEDICAN
PROCESOS
ADEMÁS
HACEN
HACER
ESTUDIA

$E=mc^2$

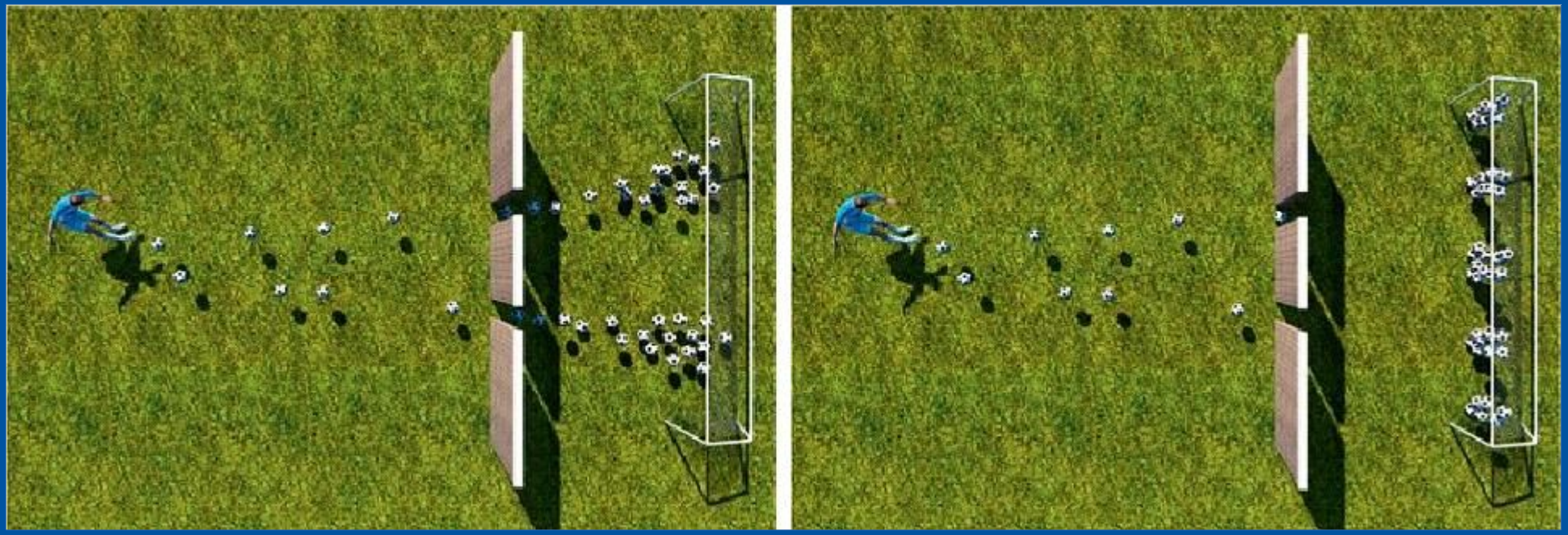

Quarks
u c t
d s b
Forces
Z γ
W g
H
Higgs boson
e μ τ
νe νμ ντ
Leptons


DESARROLLO DE MODELOS Y TEORÍAS
ACELERADOR
DETECTOR
FUENTE DE PARTÍCULAS
ANÁLISIS DE DATOS

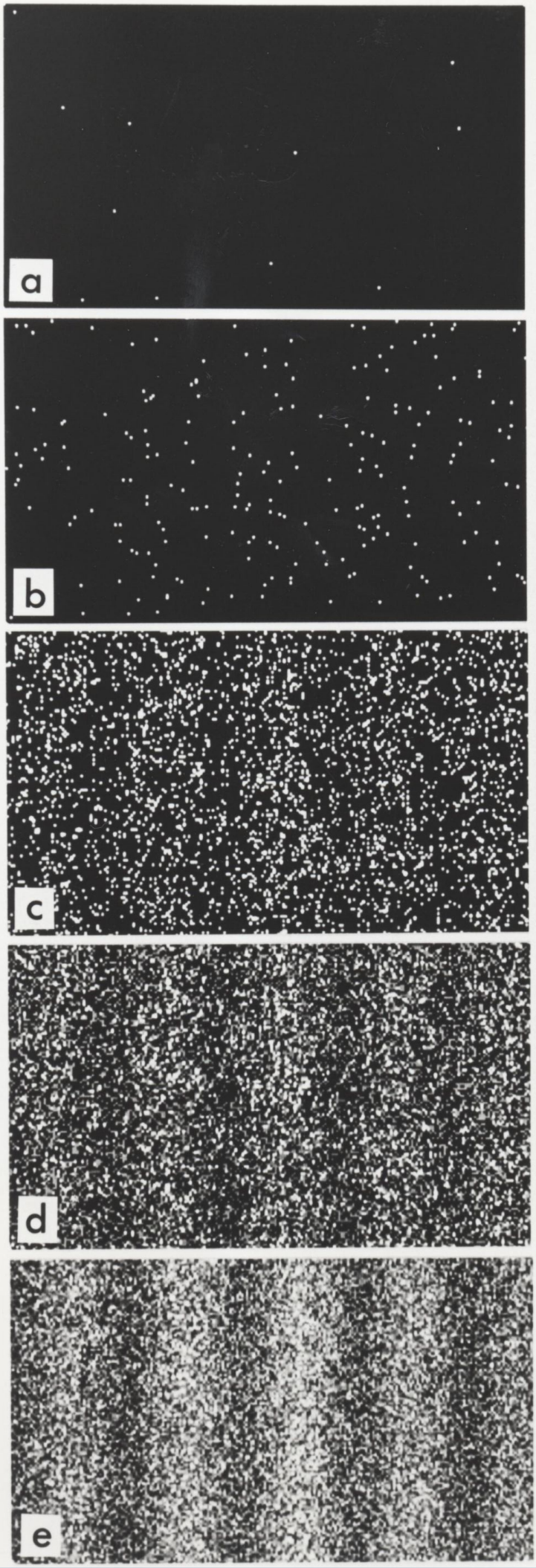


DOS CANDIDATOS CLAROS PARA EL PROGRAMA MÍNIMO:

A) Las partículas NO son bolitas

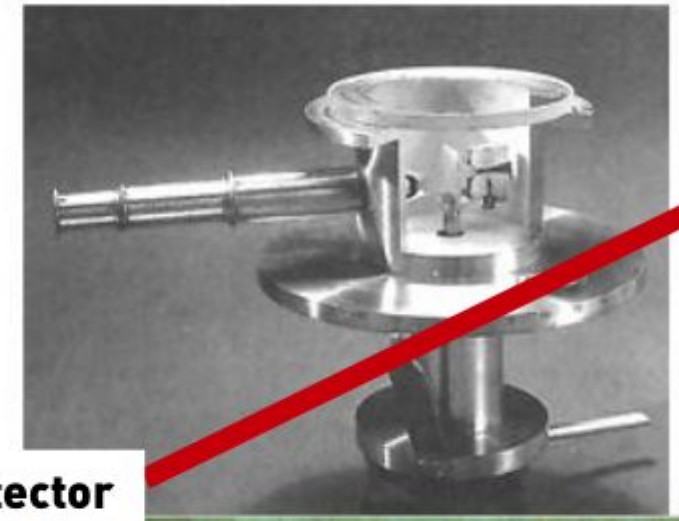


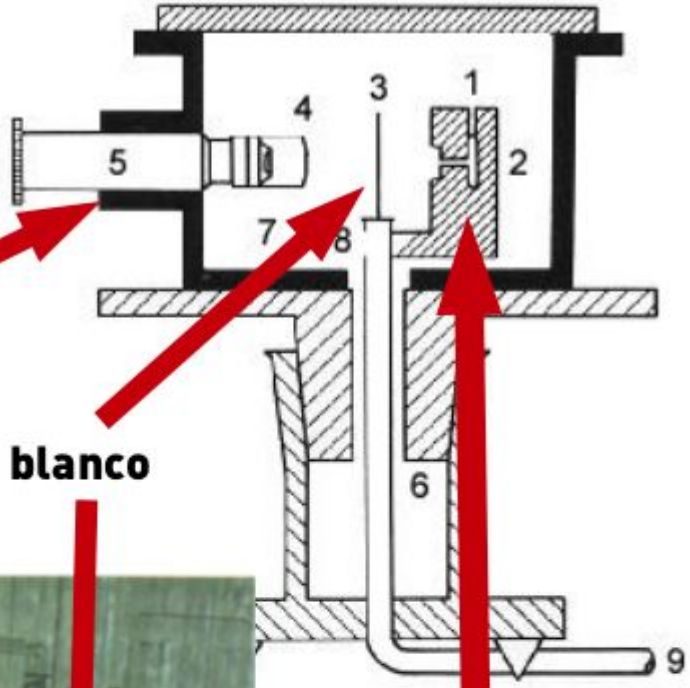
y hacen algunas cosas propias de las ondas


a
b
c
d
e

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?

IOPscience Journals Books Login Search all IOPsc

Physics Education

PAPER • OPEN ACCESS

Introducing 12 year-olds to elementary particles

Gerfried J Wiener[1,2], Sascha M Schmeling[1] and Martin Hopf[2]

Published 8 May 2017 • © 2017 IOP Publishing Ltd
Physics Education, Volume 52, Number 4
Focus on Nuclear and Particle Physics

Article PDF

Figures References

+ Article information

Abstract

We present a new learning unit, which introduces 12 year-olds to the subatomic structure of matter. The learning unit was iteratively developed as a design-based research project using the technique of

http://iopscience.iop.org/article/10.1088/1361-6552/aa6cfe/meta

(cuasi) independiente del currículo...

Análisis de la enseñanza de la estructura e interacciones de la materia según la física moderna en primero de bachillerato

Study of the teaching process about the structure and interactions of matter through modern physics at the second-to-last year of high school

Paula Tuzón
Jordi Solbes
Universitat de València

https://ojs.uv.es/index.php/dces/article/viewFile/3599/4238

PLOS | ONE

RESEARCH ARTICLE

Particle Physics in High School: A Diagnose Study

Paula Tuzón*, Jordi Solbes

Science Education Department, Facultat de Magisteri, Universitat de València, 46022 València, Spain

http://roderic.uv.es/bitstream/handle/10550/54324/113222.pdf?sequence=1&isAllowed=y

El texto del manual escolar de ciencias: ¿puente u obstáculo para el aprendizaje?

The text of the science textbook: bridge or obstacle for learning?

REVISTA DE ENSEÑANZA DE LA FÍSICA

Carla Maturano, Carina Rudolph, María Amalia Soliveres
Instituto de Investigaciones en Educación en las Ciencias Experimentales (I.I.E.C.E.). Facultad de Filosofía, Humanidades y Artes, Universidad Nacional de San Juan, Av. J.I. de La Roza 230 (Oeste). Capital, CP 5400, San Juan, Argentina.

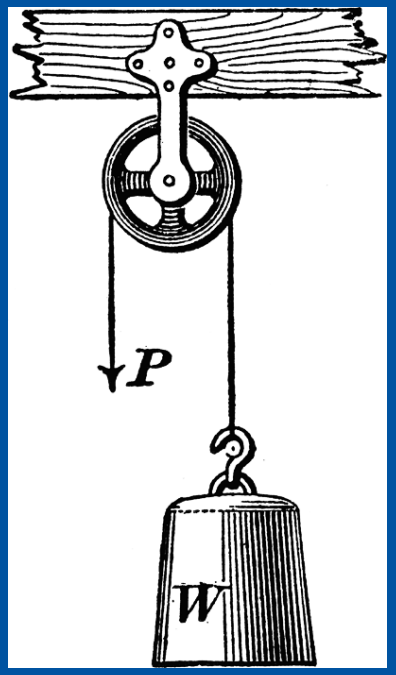
E-mail: cmatur@ffha.unsj.edu.ar

https://revistas.unc.edu.ar/index.php/revistaEF/article/view/15620

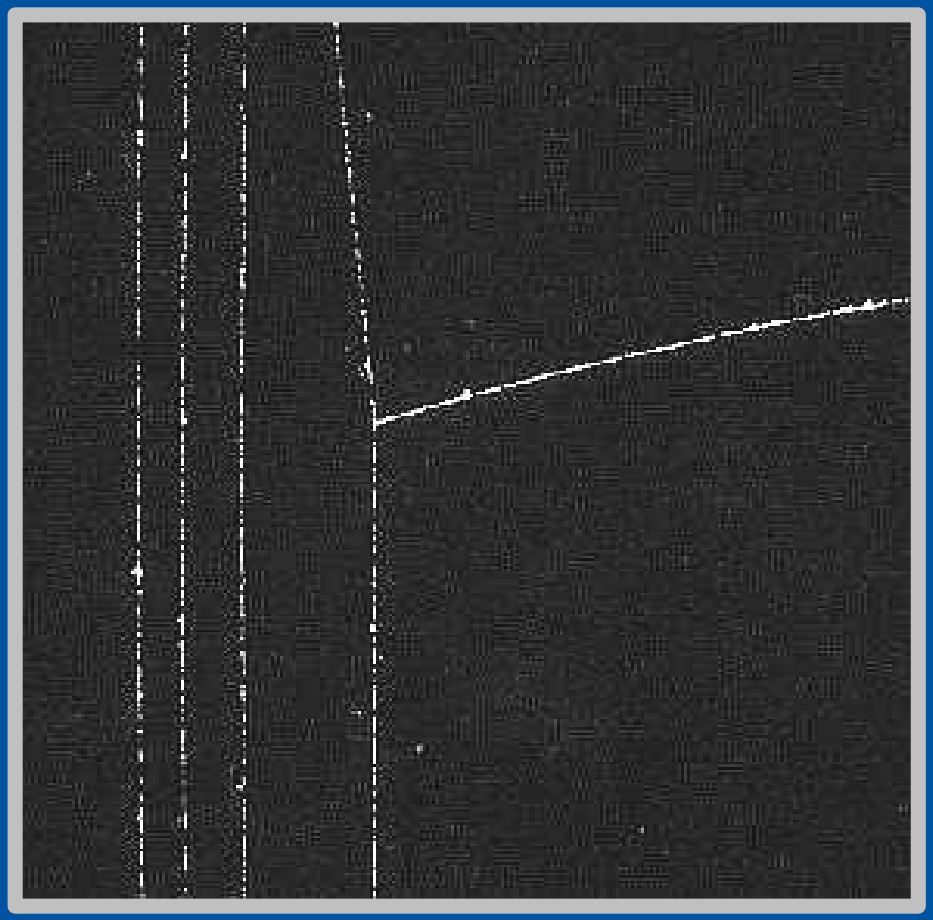
http://sedici.unlp.edu.ar/handle/10915/61193

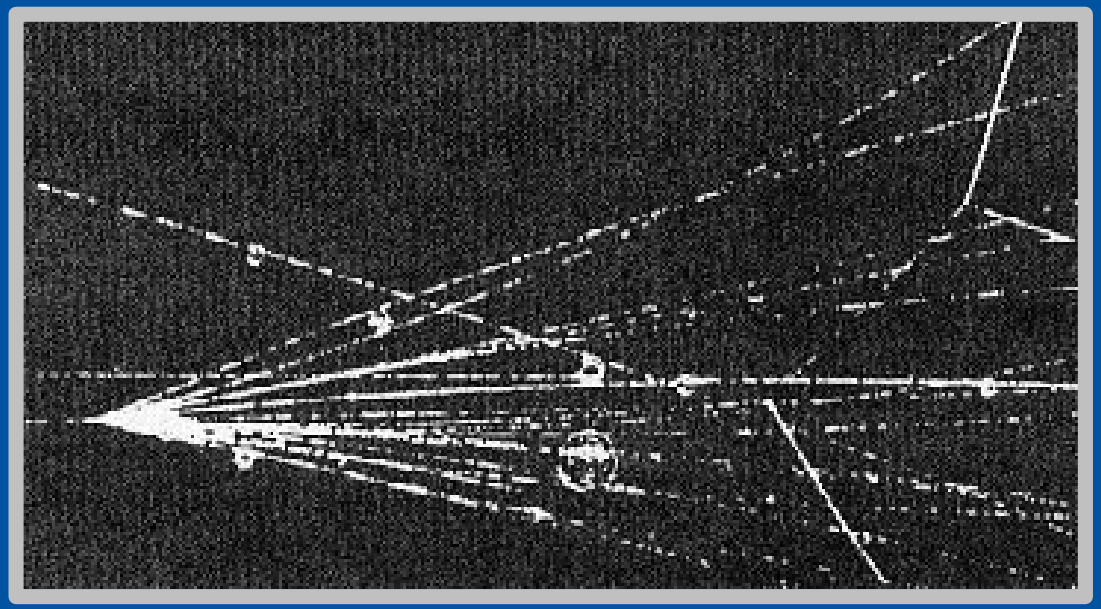
ADAPTAR LA PROGRAMACIÓN

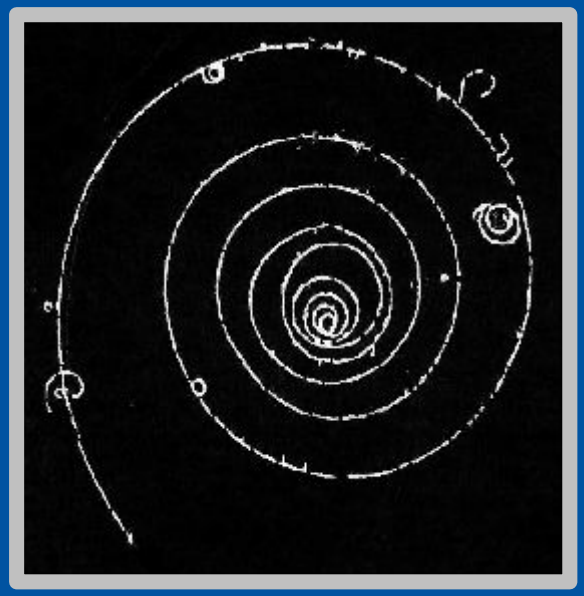
SIN IR MUCHO MÁS ALLÁ DEL *programa mínimo*

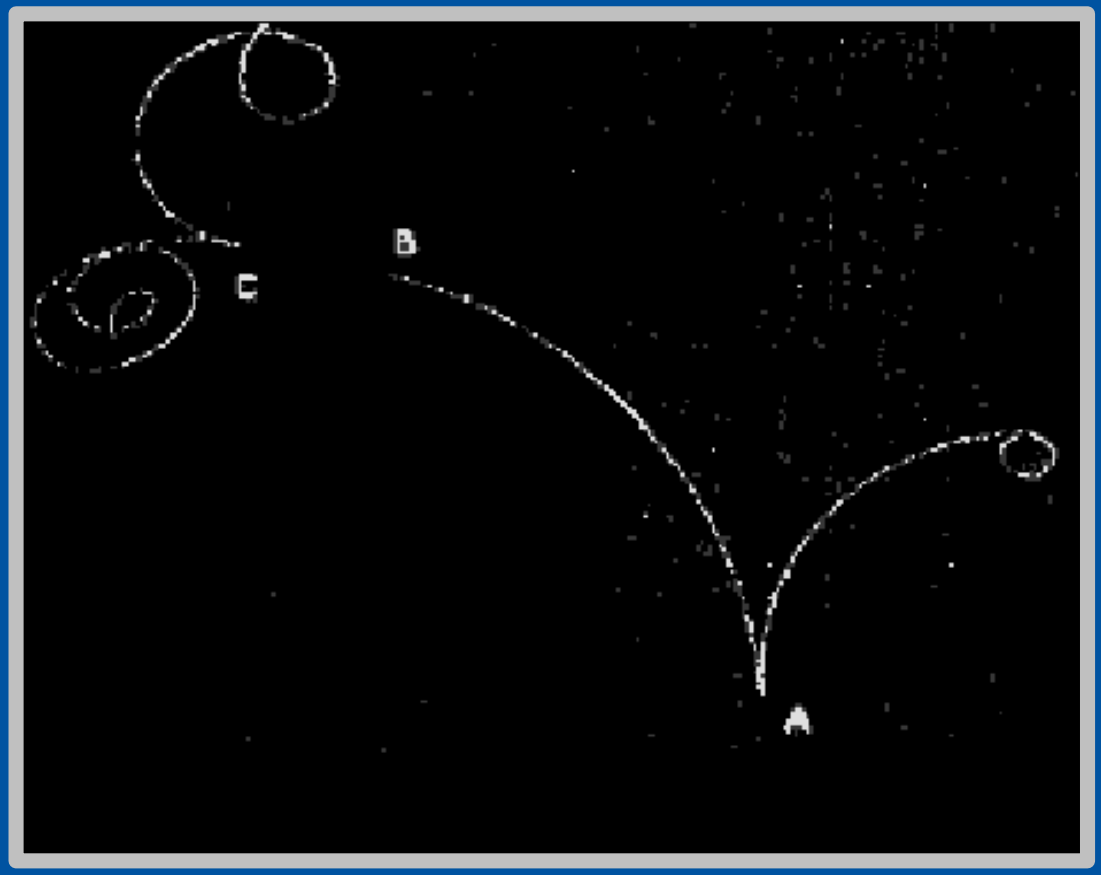


LA CONSIGNA ES **sustituir choques de coches por colisiones de partículas**

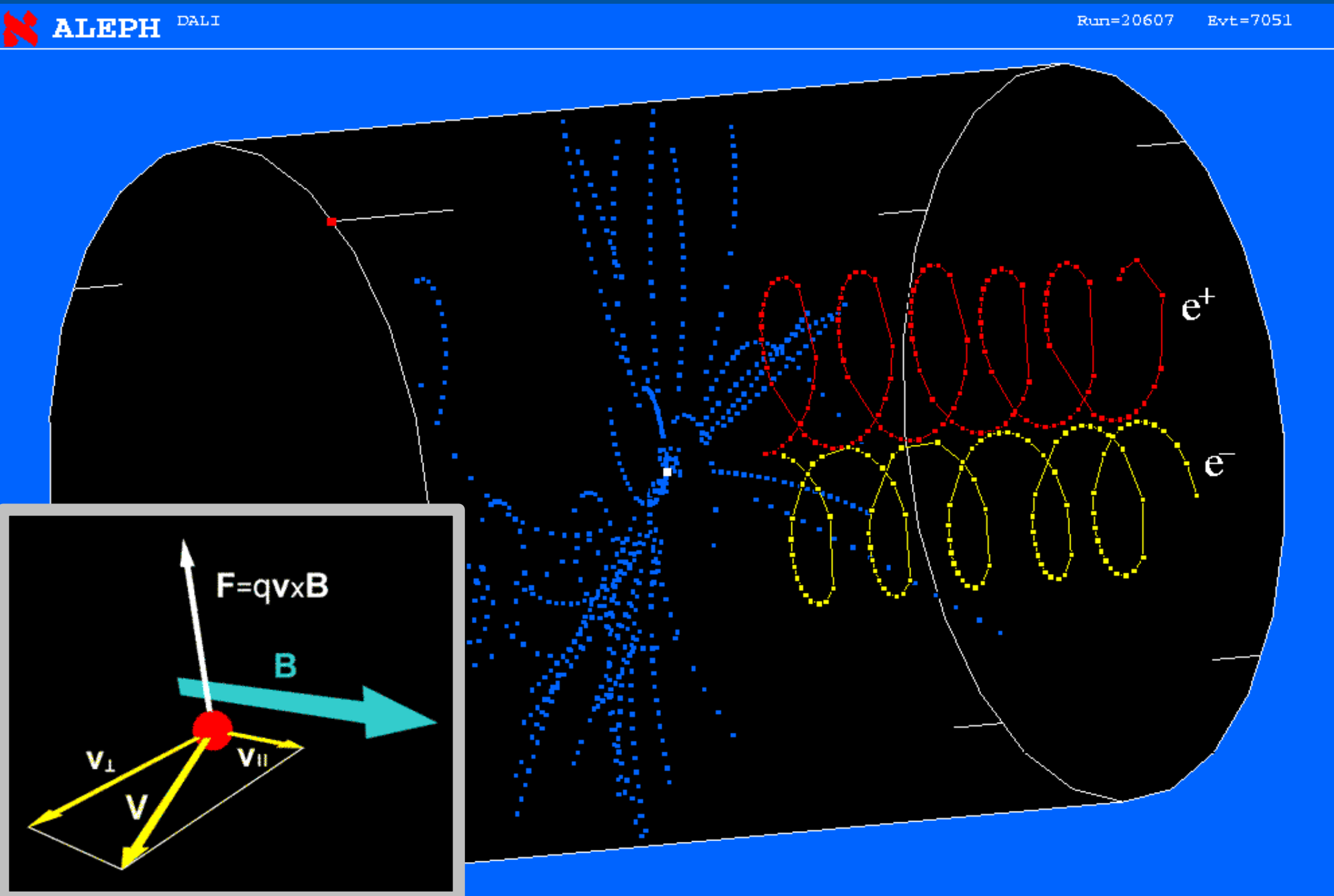




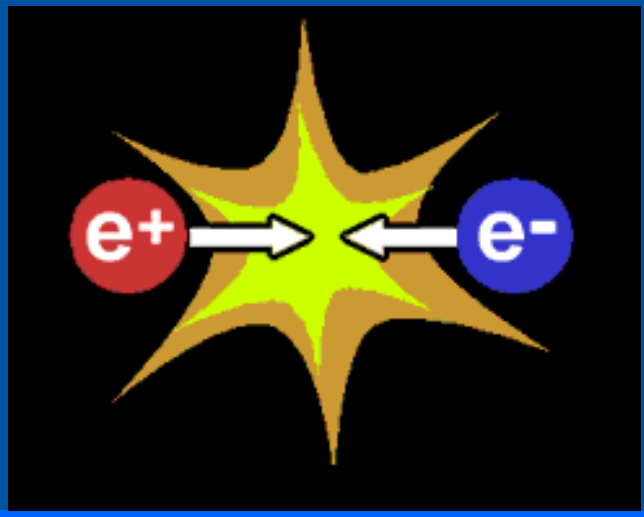


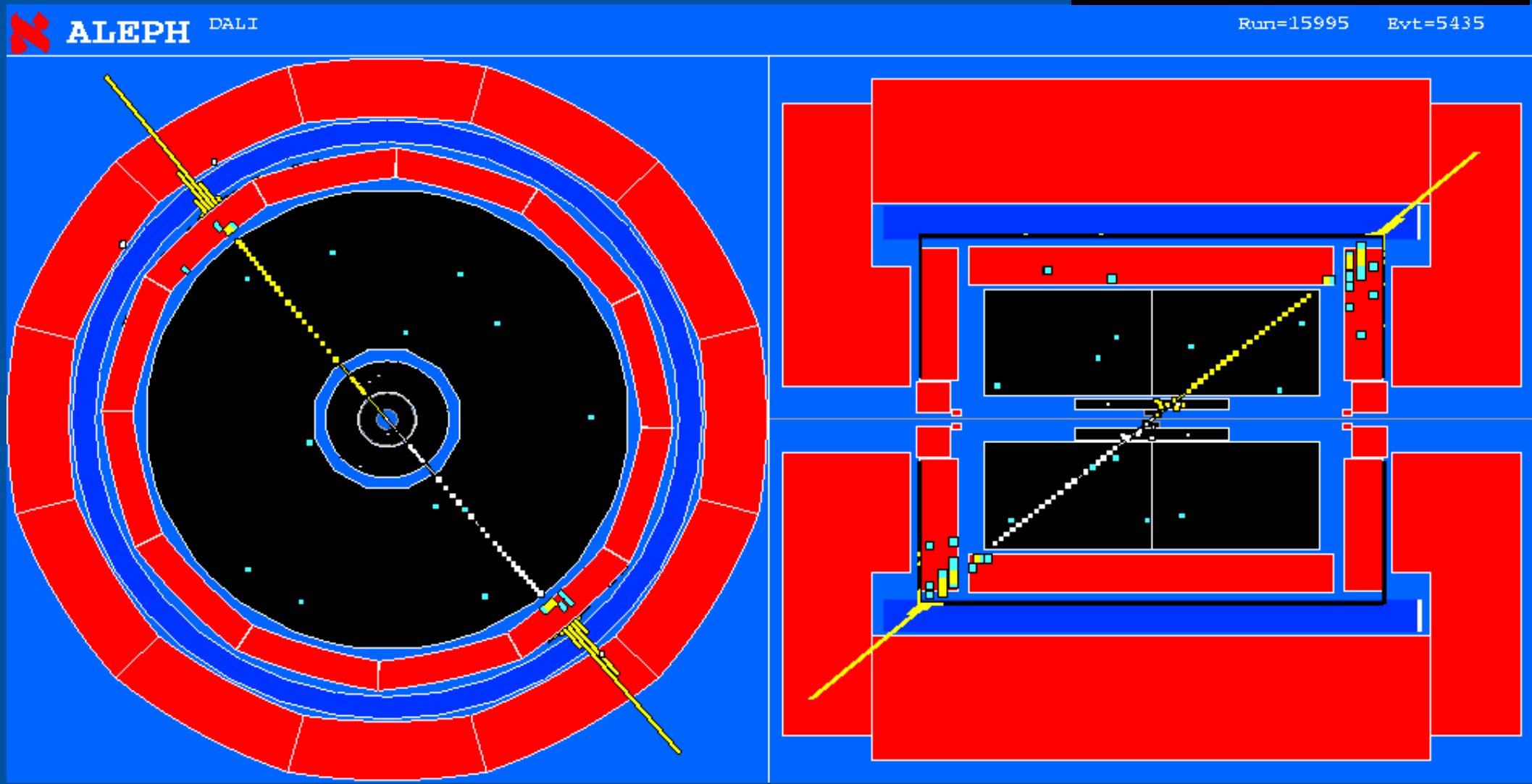

B
C
A

Movimiento de partículas cargadas en campos magnéticos

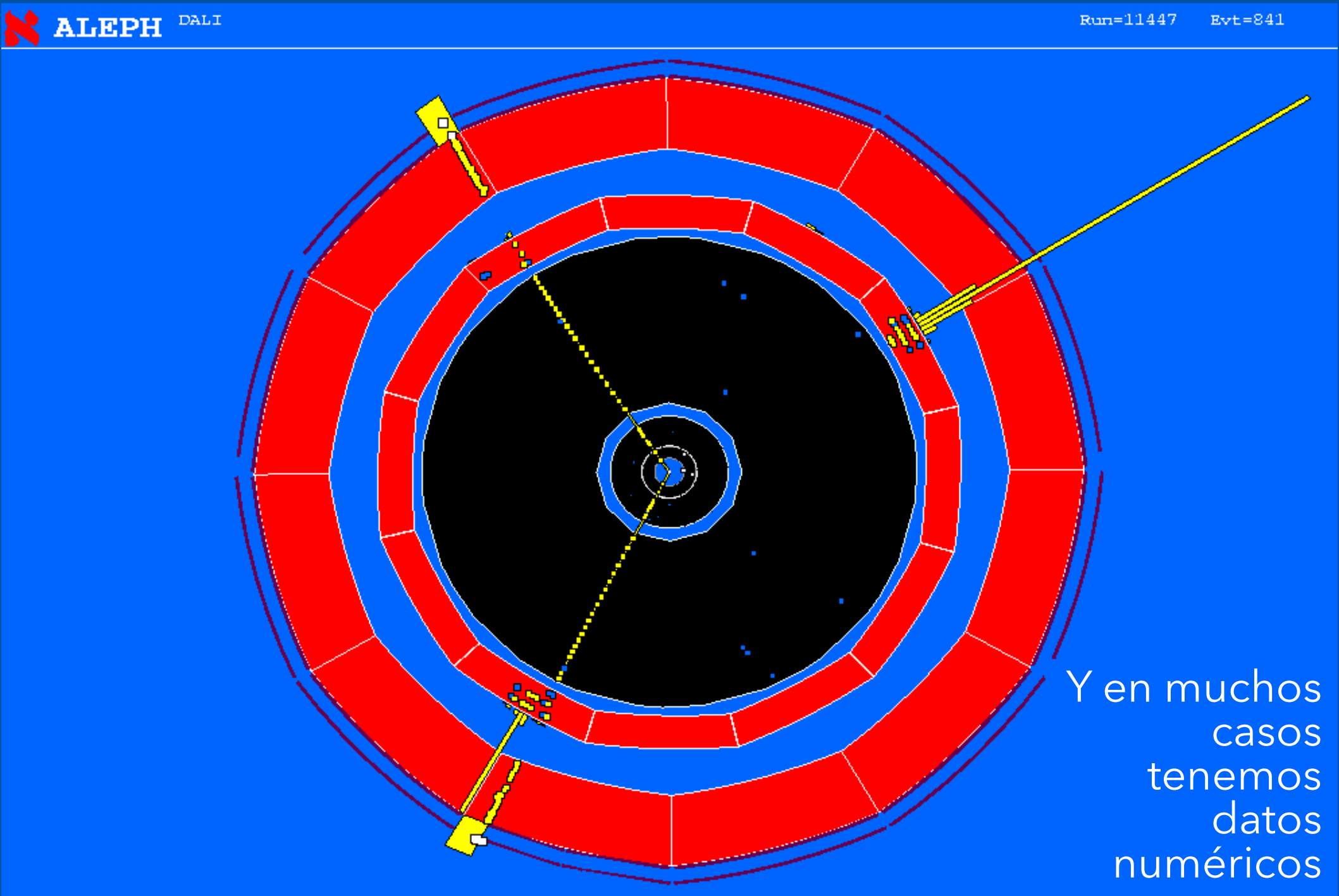


Conservación del momento lineal. Detector *ALEPH*, LEP





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
Cámaras de burbujas: https://scool.web.cern.ch/content/bubble-chamber

Biblografía de urgencia: http://goo.gl/txNNz

ESO SIN CONTAR CON QUE –NECESARIAMENTE EN ALGUNAS MATERIAS NECESARIAMENTE TENDREMOS QUE ADOPTAR UN

Enfoque curricular

Bloque 6. Física del siglo XX

Contenidos

-Introducción a la Teoría Especial de la Relatividad.

-Energía relativista. Energía total y energía en reposo.

-Física Cuántica.

-Insuficiencia de la Física Clásica.

-Orígenes de la Física Cuántica. Problemas precursores.

-Interpretación probabilística de la Física Cuántica.

-Aplicaciones de la Física Cuántica. El Láser.

-Física Nuclear.

-La radiactividad. Tipos.

-El núcleo atómico. Leyes de la desintegración radiactiva.

-Fusión y Fisión nucleares.

-Interacciones fundamentales de la naturaleza y partículas fundamentales. Las cuatro interacciones fundamentales de la naturaleza: gravitatoria, electromagnética, nuclear fuerte y nuclear débil.

-Partículas fundamentales constitutivas del átomo: electrones y quarks.

-Historia y composición del Universo. Fronteras de la Física.

Estándares (PRINCIPALES) de aprendizaje evaluables

16.1. Compara las principales características de las cuatro interacciones fundamentales de la naturaleza a partir de los procesos en los que éstas se manifiestan.

19.1. Describe la estructura atómica y nuclear a partir de su composición en quarks y electrones, empleando el vocabulario específico de la física de quarks.

20.2. Explica la teoría del Big Bang y discute las evidencias experimentales en las que se apoya, como son la radiación de fondo y el efecto Doppler relativista.

OTROS ENFOQUES:

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

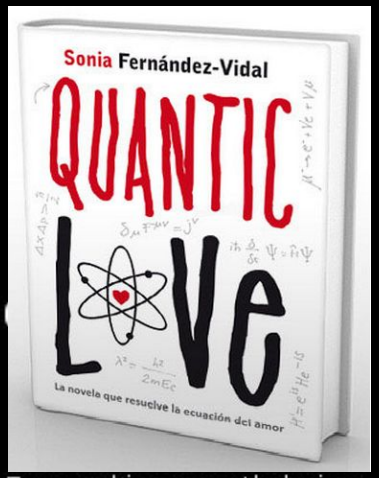
A través de la ficción

European Organization for Nuclear Research

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

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 tomografía de emisión de positrones como técnica diagnóstica y las dificultades que supone s coste con la imagen de un suceso en el colisionador LEP del CERN.

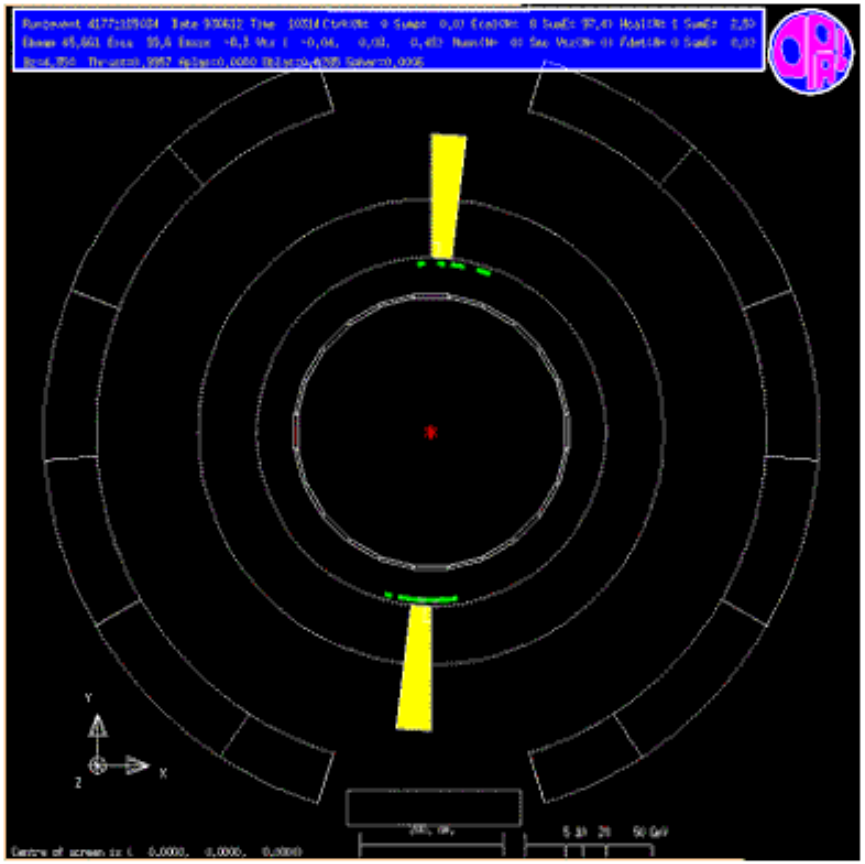


Foto CERN
Reconstrucción de un suceso en el colisionador LEP del CERN. En el pu rojo del centro se han hecho chocar electrón y un positrón.

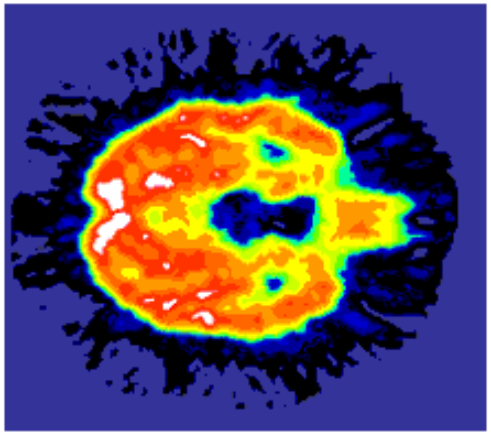


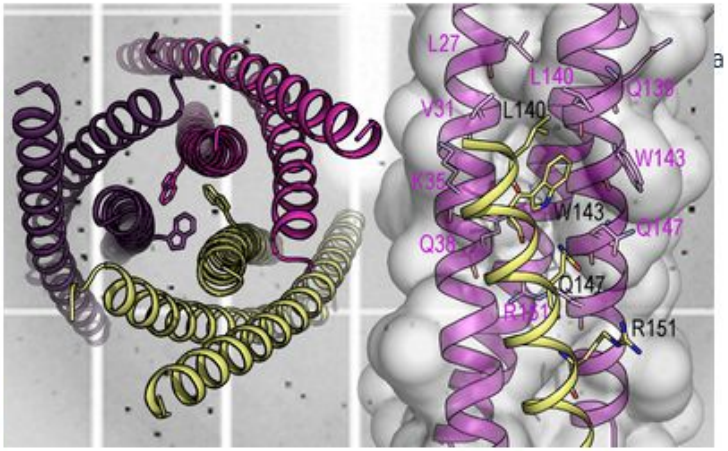
Foto Brunel University
Imagen del cerebro por escáner P Se usan para el diagnóstico médi y para investigar, por ejemplo, có cambia cuando se piensa o se lee

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)

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

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 glipoproteína gp41 forma parte de la envoltura del virus de la inmunodeficiencia h a
célula huésped. Durante la infección del VIH-1, dos regiones de gp41 (la repetición h
NHR y CHR respectivamente) pueden ser accesibles a inhibidores de manera tempora

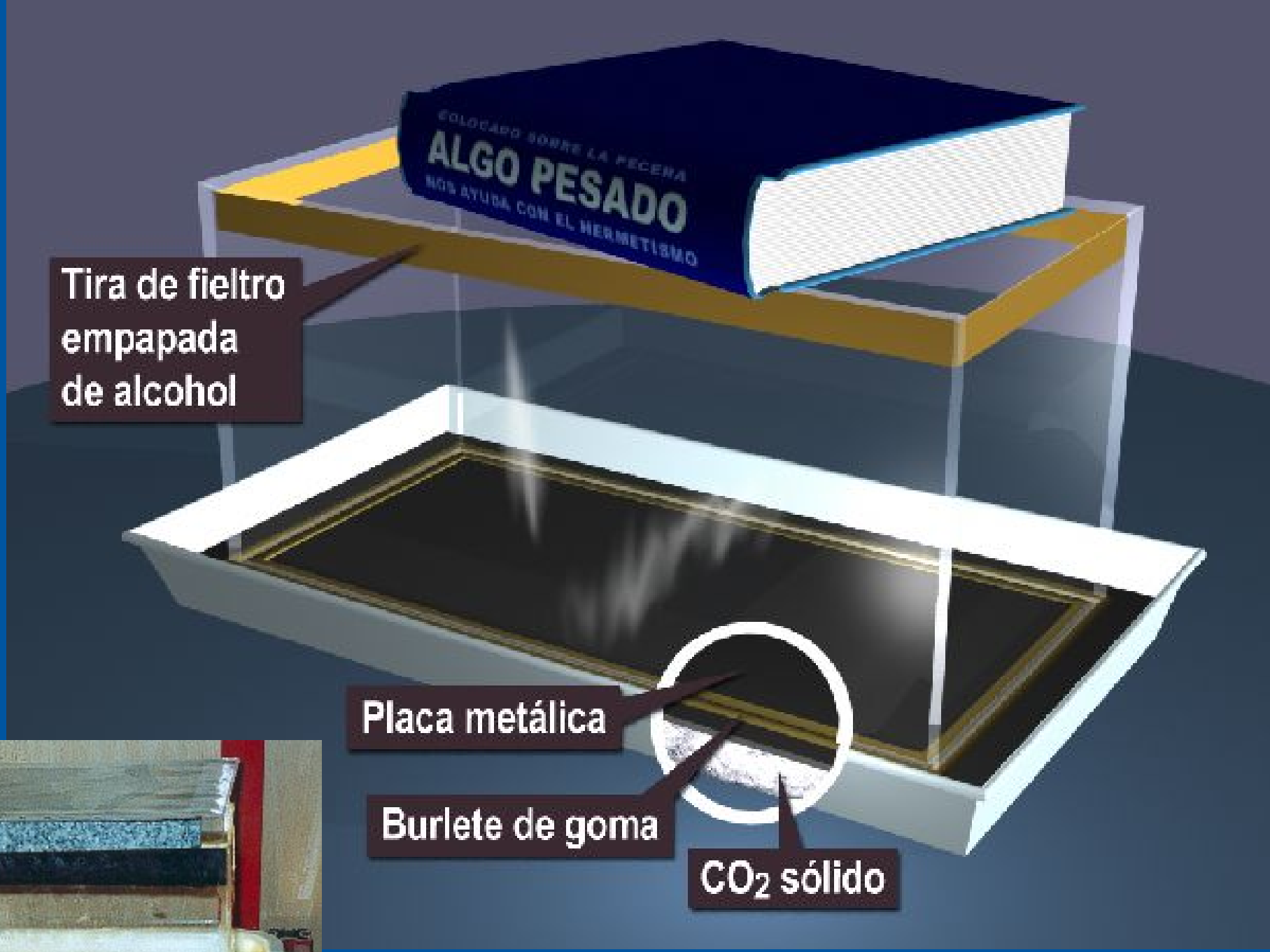
Los investigadores diseñaron una **cadena proteica simple que imita la superficie de N**
manera, esta cadena evita que el virus se pliegue e infecte a la célula huésped, tal y
pseudovirus y virus aislados. El siguiente paso fue **hacer crecer la proteína en crista**
generados en el Sincrotrón ALBA.

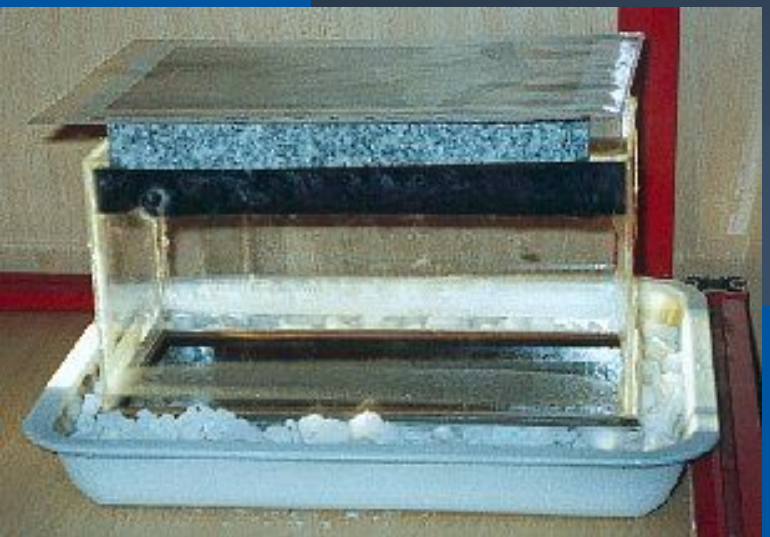
Los experimentos de difracción de rayos X realizados en la **línea de luz XALOC** han pe
confirmando su capacidad de imitar a la perfección la superficie de NHR en la región

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

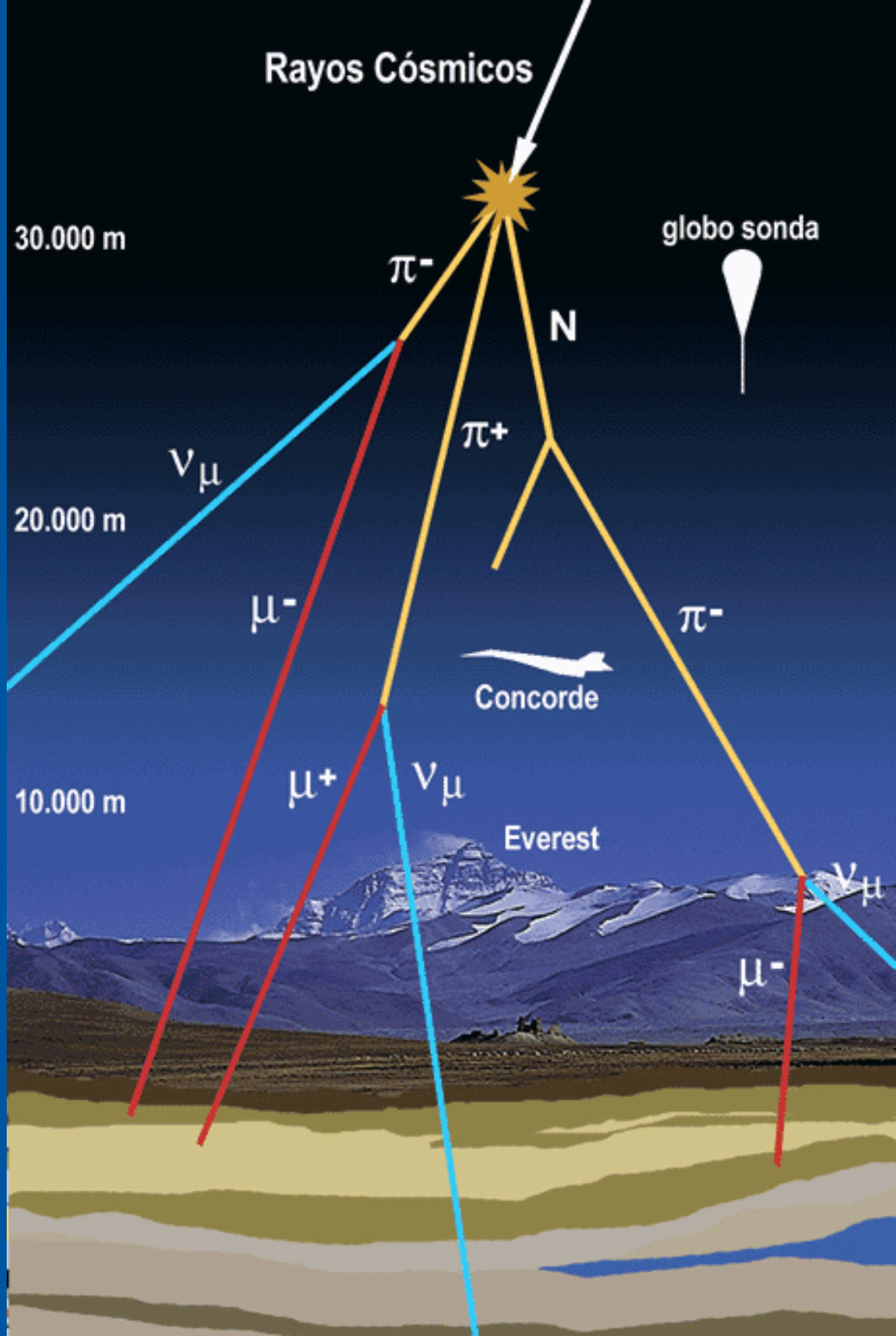
LETRA PEQUEÑA:
Pero cuidado, que ni “vemos” ni se trata de “creer” en sentido estricto.





La cámara de niebla

Se puede comprobar *(¡vaya frase!)* que la mayoría de las partículas detectadas son **muones (μ)** 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...

ARDUINO

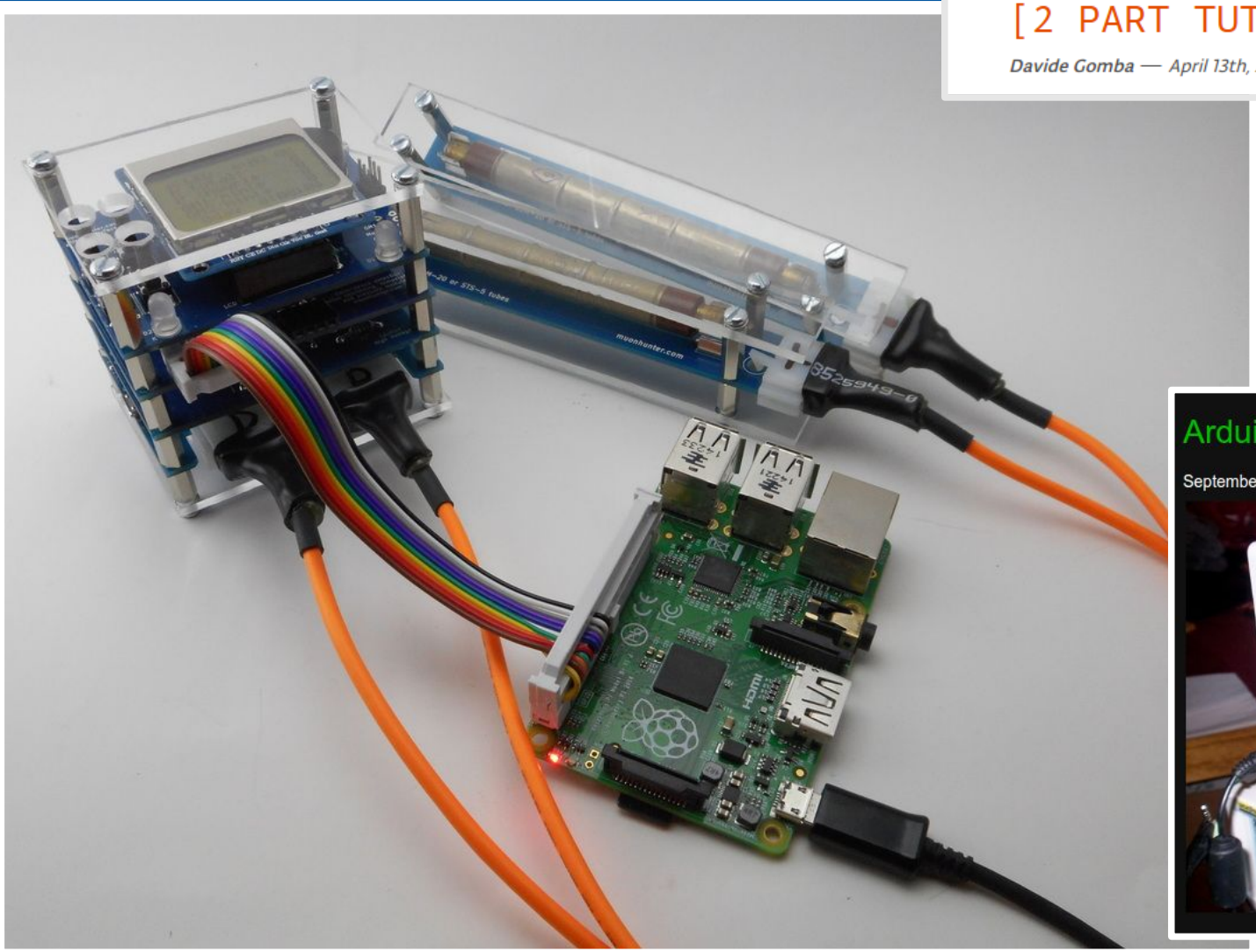
Home Buy Download Products Learning Forum Support Blog

« Speed Trap! A GPS-Based Speeding Alert

Cubeduino »

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

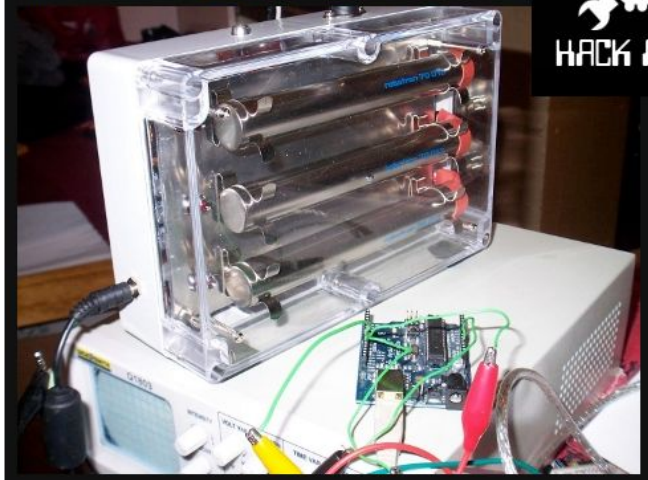
Davide Gomba — April 13th, 2010

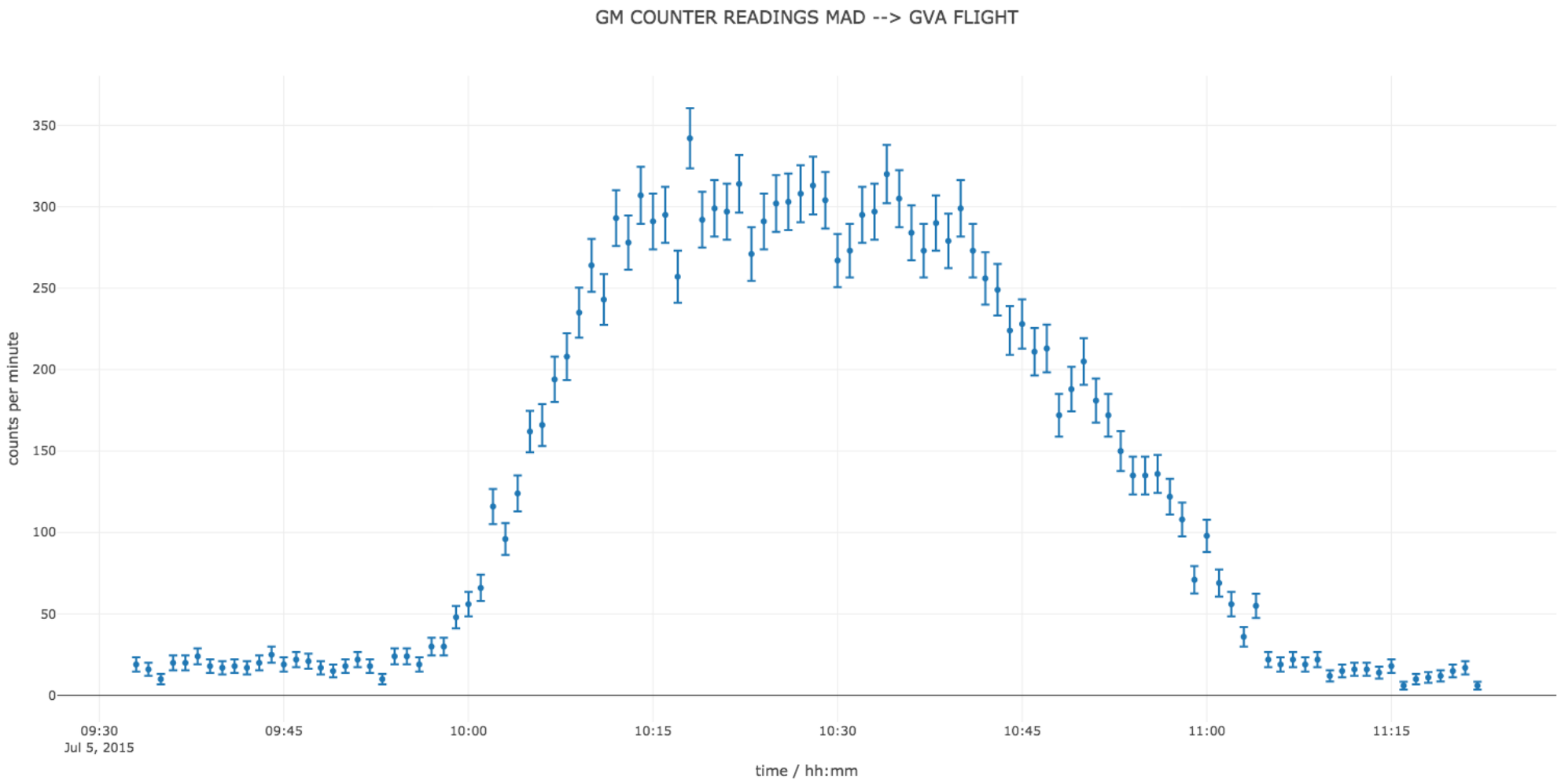


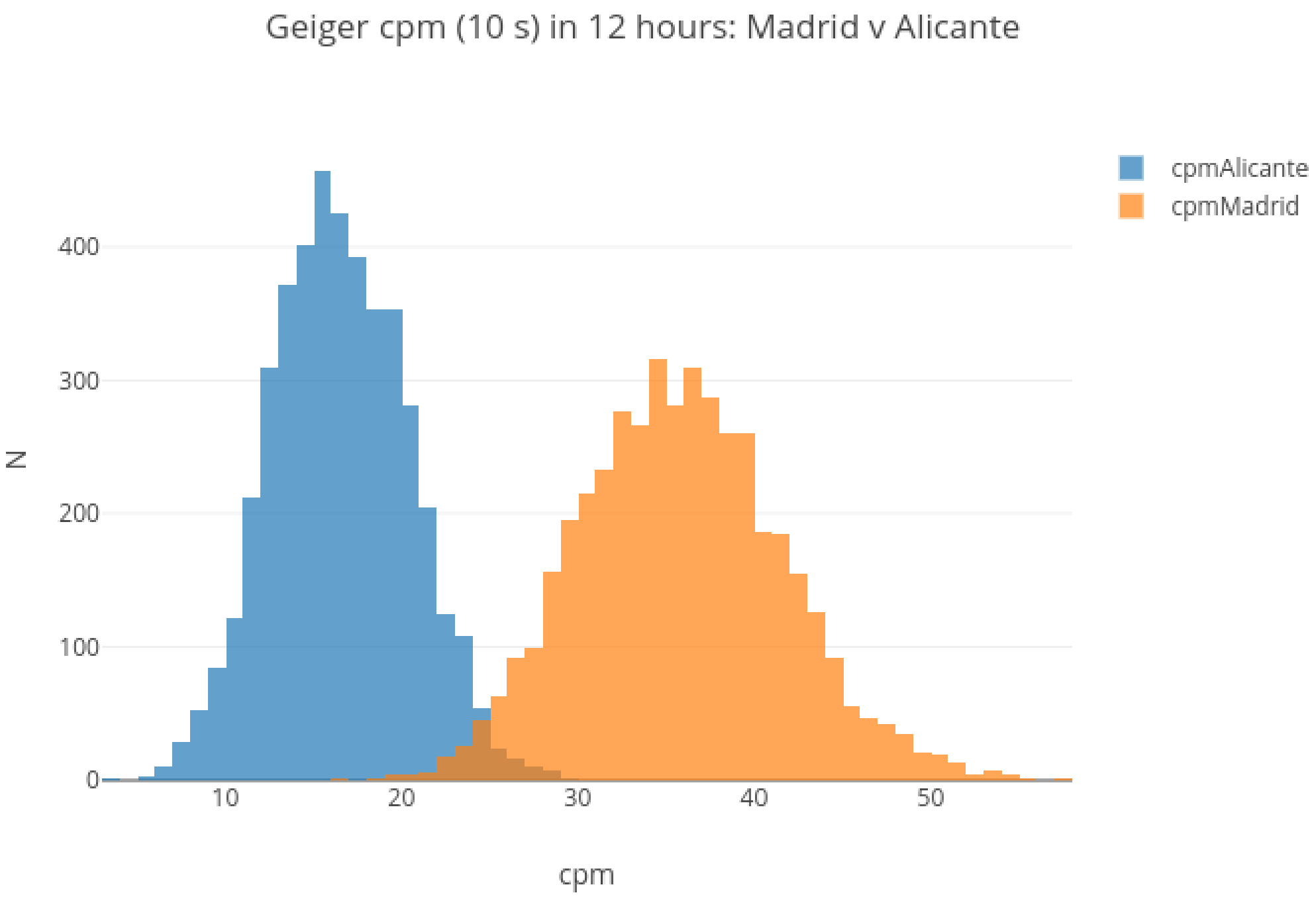
Arduino muon detector

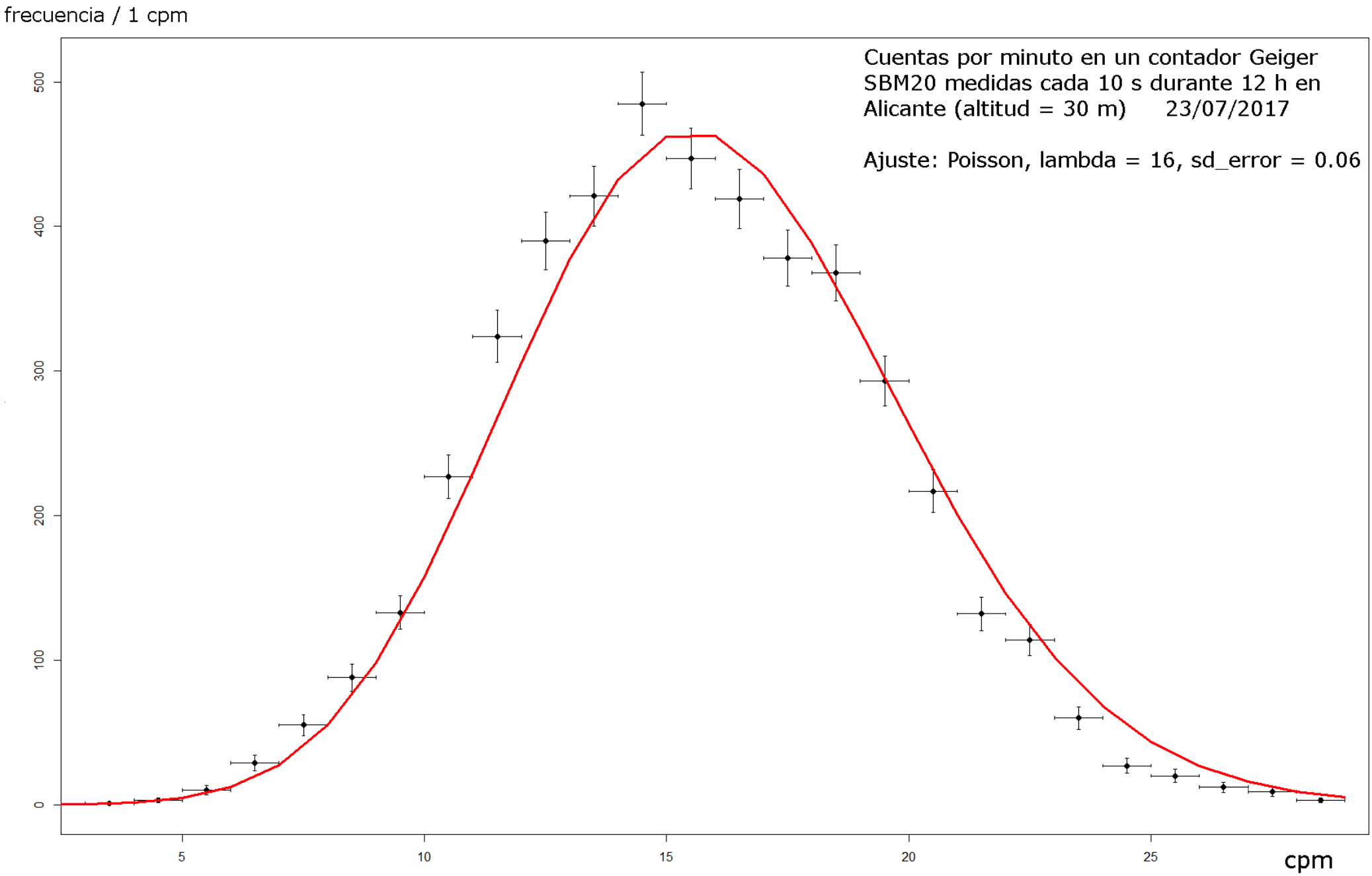
September 3, 2009 By Zach Banks · 22 Comments

HACK A DAY




GM COUNTER READINGS MAD --> GVA FLIGHT
counts per minute
0
50
100
150
200
250
300
350
09:30
Jul 5, 2015
09:45
10:00
10:15
10:30
10:45
11:00
11:15
time / hh:mm


Geiger cpm (10 s) in 12 hours: Madrid v Alicante
cpmAlicante
cpmMadrid
N
400
300
200
100
0
10
20
30
40
50
cpm


frecuencia / 1 cpm
Cuentas por minuto en un contador Geiger SBM20 medidas cada 10 s durante 12 h en Alicante (altitud = 30 m) 23/07/2017
Ajuste: Poisson, lambda = 16, sd_error = 0.06
0
100
200
300
400
500
5
10
15
20
25
cpm

AAPT The Physics Teacher
NOW INDEXED IN THOMSON REUTERS DATABASES

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*

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CitizenGrid

CitizenGrid Application Directory

Find applications to run or contribute resources to

En su computadora

Citizen Science Grid ▾ Information ▾ Top Lists ▾ Message Boards

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.

o...

¡Con teléfonos celulares!

WIPAC
Wisconsin IceCube Particle Astrophysics Center

DECO
Distributed Electronic Cosmic-ray Observatory

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)

CRAYFIS

cosmic rays found in smartphones

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)

lhcathome.web.cern.ch

LHC@home

Volunteer computing for the LHC

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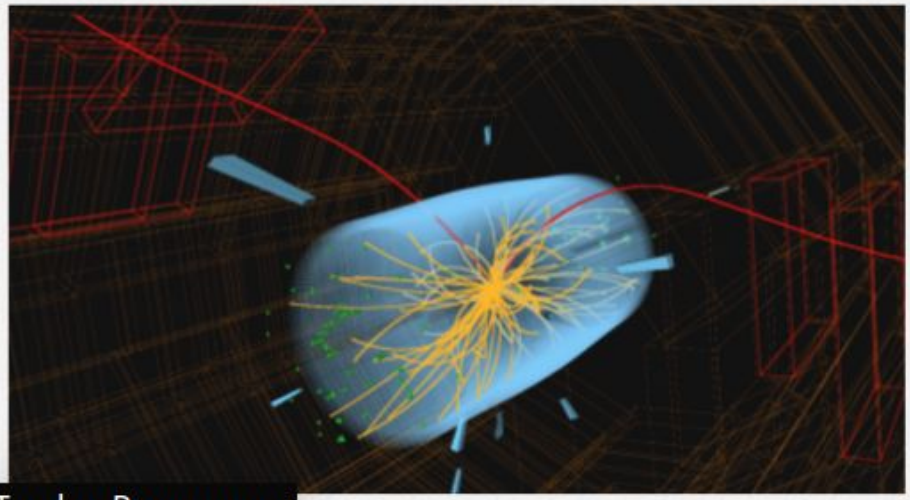
Search

HOME ABOUT PROJECTS JOIN US! HELP & FAQ CONTACT



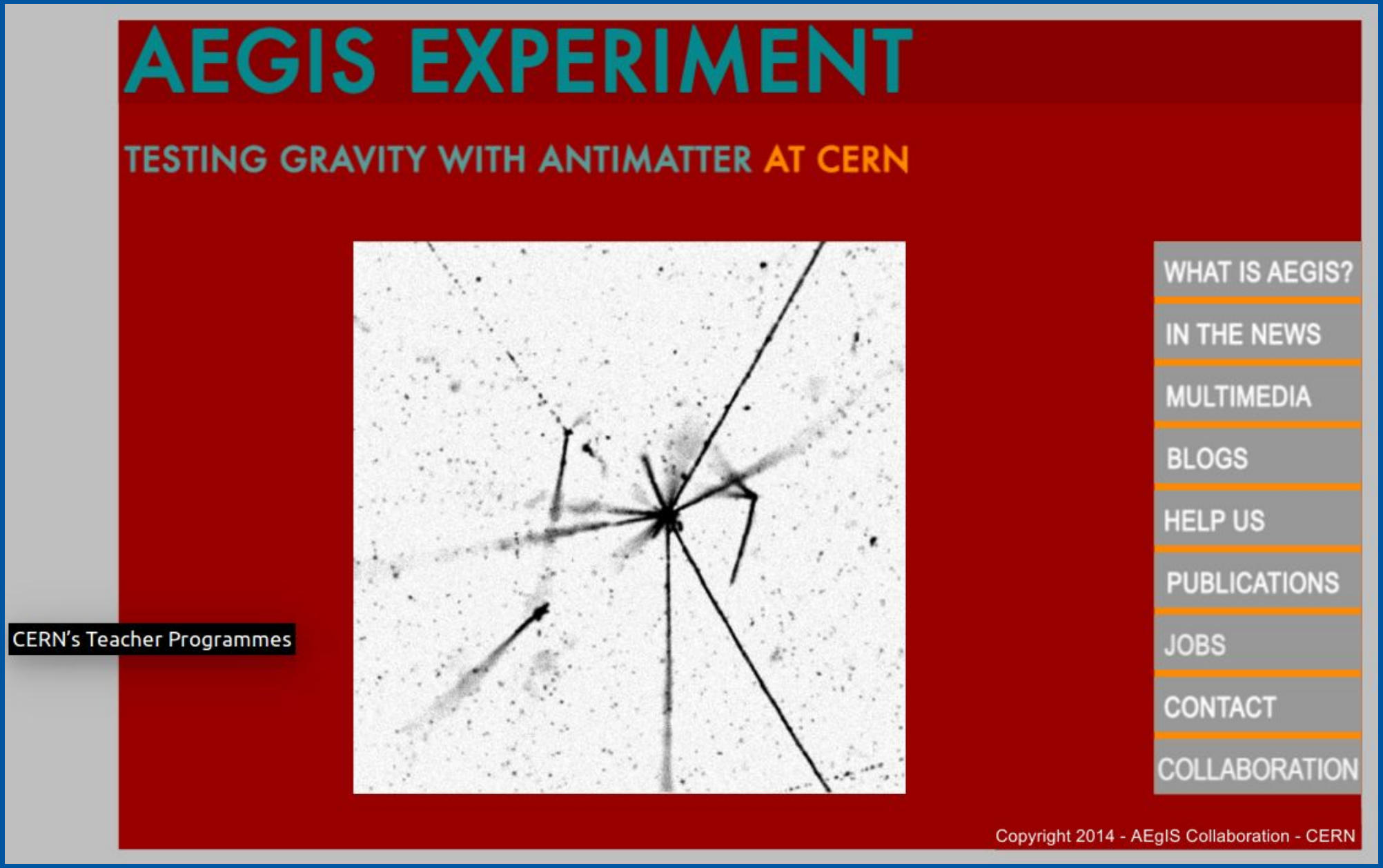
CMS@Home

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



CERN's Teacher Programmes

FINALMENTE,

hay muchas otras cosas en las que pueden participar →

Distribution of All CERN Users by Nationality on 12 January 2016

MEMBER STATES	7319
Austria	106
Belgium	125
Bulgaria	88
Czech Republic	217
Denmark	56
Finland	102
France	858
Germany	1267
Greece	216
Hungary	79
Israel	63
Italy	1974
Netherlands	164
Norway	63
Poland	302
Portugal	113
Slovakia	111
Spain	399
Sweden	90
Switzerland	220
United Kingdom	706

ASSOCIATE MEMBERS	224
Pakistan	58
Turkey	166

OBSERVERS	2775
India	284
Japan	316
Russia	1071
USA	1104

STATES IN ACCESSION TO MEMBERSHIP	195
Cyprus	19
Romania	131
Serbia	45

Universidad Autónoma de Puebla
Universidad Nacional Autónoma de México
Universidad Autónoma de San Luis de potosí
Universidad Autónoma de Sinaloa
Universidad Iberoamericana

OTHERS																	
		Bosnia & Herzegovina	1	Ecuador	4	Kazakhstan	1	Malta	5	Qatar	1	Thailand	20
		Brazil	135	Egypt	24	Kenya	2	Mauritius		San Marino	1	T.F.Y.R.O.M.	2
Albania	4	Cameroon	2	El Salvador	1	Korea, D.P.R.	4	Mexico	84	Saudi Arabia	1	Tunisia	3
Algeria	8	Canada	154	Estonia	15	Korea Rep.	151	Montenegro		Senegal	1	Ukraine	88
Argentina	24	Central African Rep.	1	Georgia	44	Latvia	1	Morocco	13	Singapore	3	Uzbekistan	5
Armenia	27	Chile	20	Iceland	4	Lebanon	12	Nepal	7	Sint Maarten	1	Venezuela	11
Australia	31	China	421	Indonesia	10	Libya	1	New Zealand	6	Slovenia	27	Viet Nam	8
Azerbaijan	11	Colombia	38	Iran	54	Lithuania	30	Oman	1	South Africa	31	Zimbabwe	5
Bangladesh	7	Costa Rica	1	Iraq	1	Luxembourg	2	Palestine (O.T.).	7	Sri Lanka	3		
Belarus	50	Croatia	38	Ireland	20	Madagascar	4	Peru	6	Syria	1		
Bolivia	2	Cuba	13	Jordan	8	Malaysia	18	Philippines	4	Taiwan	56		

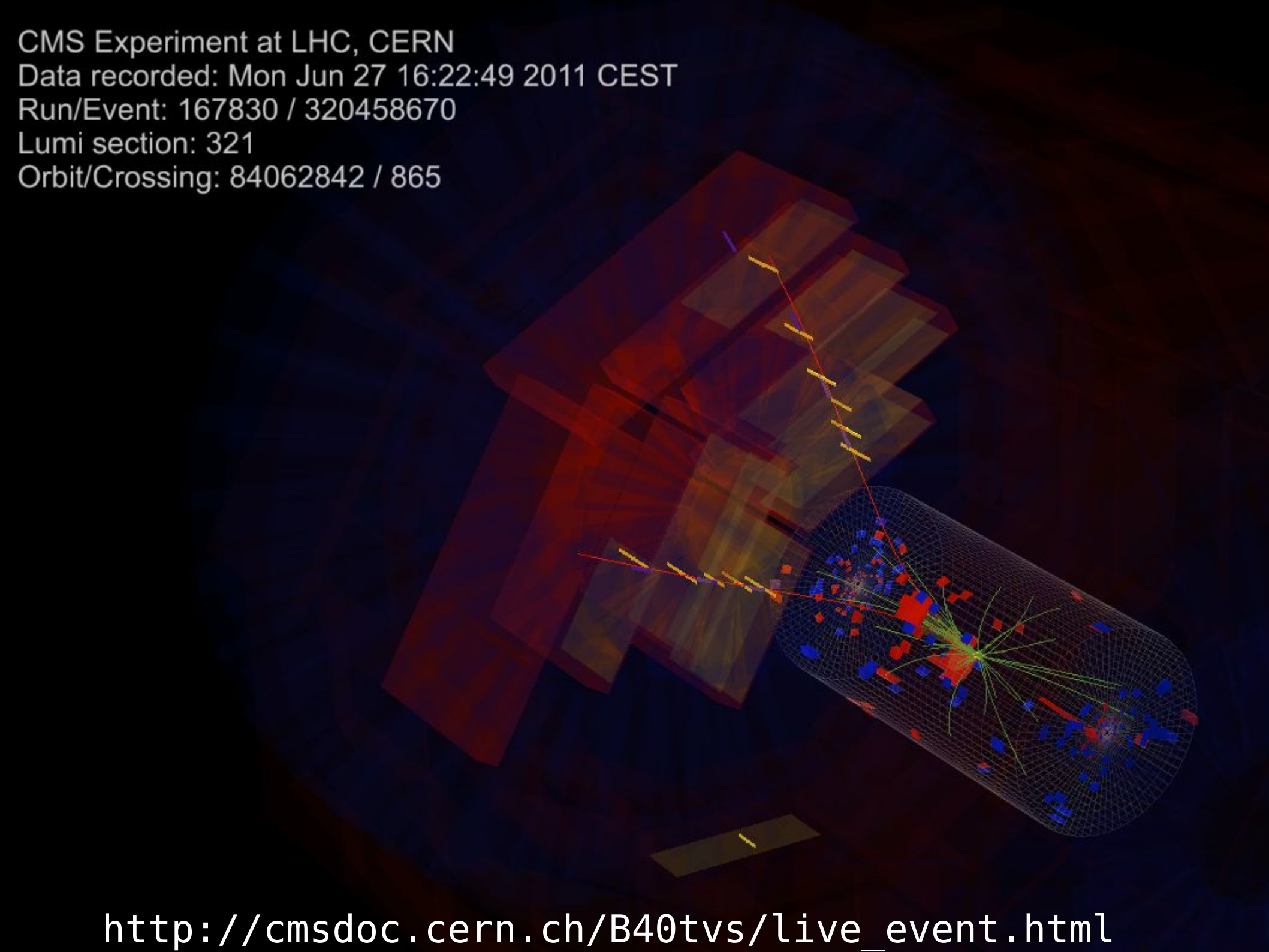
1803

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



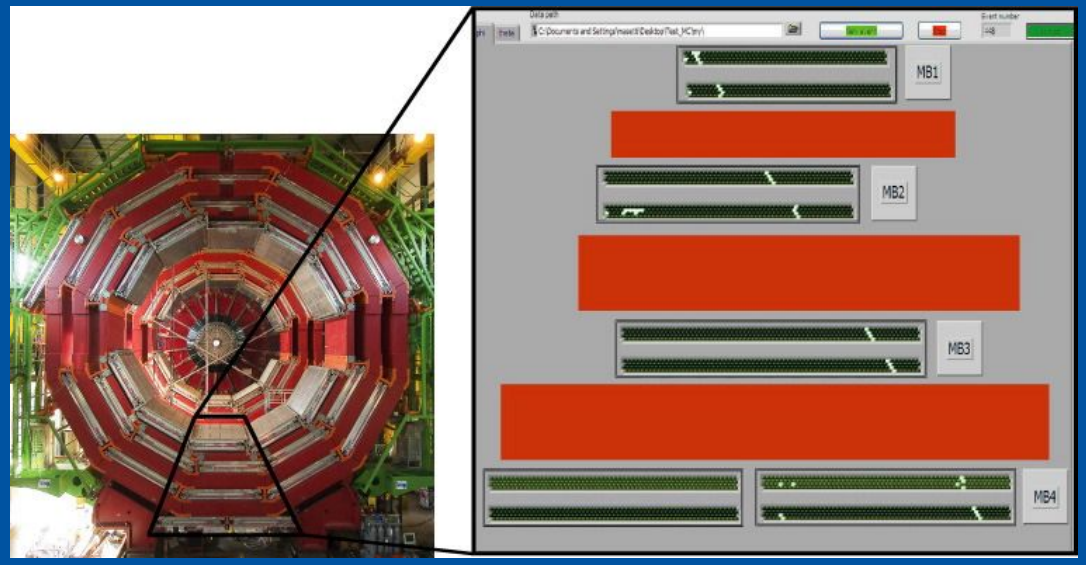
http://cmsdoc.cern.ch/B40tvs/live_event.html

En casa también tenemos física de partículas...

https://www.i-cpan.es/

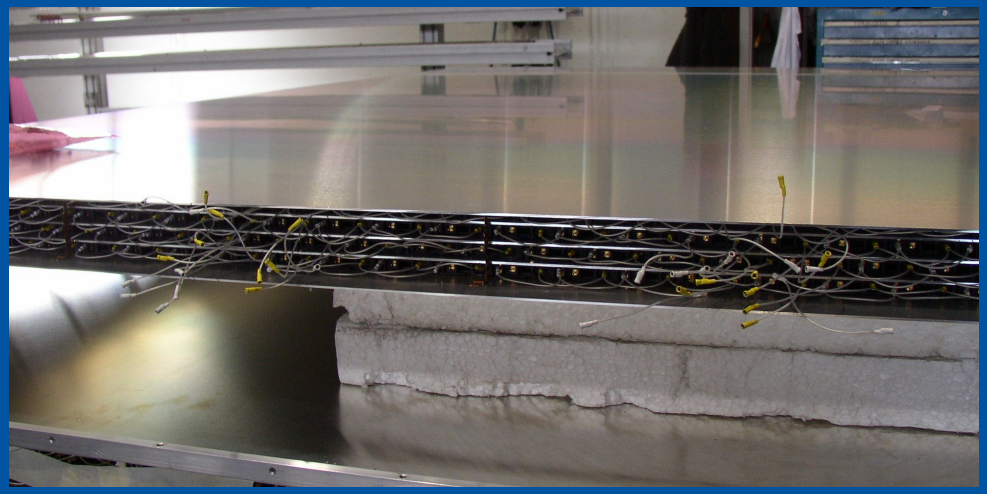
Los datos son de

CPAN
Ingenio 2010



Por ejemplo está el CIEMAT, donde hay gente que trabaja en AMS , CMS, materia oscura, neutrinos, cosmología...

Y además son bastante activos en divulgación (gracias, Pablo)



También hay otros (IFT, UAM, etc): Aquí se hace física de partículas...

International Particle Physics Outreach Group

INTERNATIONAL MASTERCLASSES

hands on particle physics

http://physicsmasterclasses.org/

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facebook

Name: International Particle Physics

International Masterclasses

9th International Masterclasses 2013

Each year about 10.000 high school students in 37 countries com
centres for one day in order to unravel the mysteries of particle p
topics and methods of basic research at the fundaments of ma
measurements on real data from particle physics experiments them
research collaboration, the participants join in a video conference for

Ciemat

Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

ift Instituto de Física Teórica UAM/CSIC

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

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

¡Con datos reales!

Se pueden buscar recursos a través del CPAN:

https://www.i-cpan.es/contenidos/Bachillerato/Bachillerato

Algunos fotos de la edición de 2009/2010.

El año próximo vuestros alumnos podrían participar

Y no hace falta participar en las masterclasses

http://opendata.cern.ch/docs/cms-guide-for-education

opendata.cern.ch/docs/cms-guide-for-education

opendata CERN

Search

CMS Guide to education use of CMS Open Data

Documentation Guide

This page will guide you through contents of the CMS Open Data collections that are meant for educational use (or for physics enthusiasts!). It is roughly broken down into three levels of difficulty:

- Beginner: *Visualise collisions*
- Intermediate: *Make histograms with collision data*
- Advanced: *Dive deeper into the data*

Visualise collisions

If you are new to particle physics, your time is limited, or you want to do something online fairly quickly, have a look at visual displays of real particle collisions. For example, here are collision events which contributed to the discovery of the Higgs boson in 2012:

1. Go to the CMS event display,
2. wait for the tool to load, and click on the `Open file` button,
3. choose `Open file(s) from web`,
4. choose `HiggsCandidates/`,
5. click on `4lepton.ig` to see candidate collisions events for a Higgs boson transforming into electrons and/or muons, or click on `diphoton.ig` to see candidate collision events for a Higgs boson transforming into two photons, and wait for the events to load to the right,
6. choose any specific event from the selection and click on `Load`.

Your collision event should now appear in the display.

- If you chose the `4lepton.ig` set and you want to see electrons, check `Electrons` under `Physics` and uncheck `Tracks (reco)` under `Tracking` in the menu to the left (the choice is only visible if electrons are present in the collision).
- If you chose the `diphoton.ig` set, check `Photons` under `Physics` in the menu to the left (the choice is only visible if photons are present in the collision).

Otros programas del CERN para profesores

http://teacher-programmes.web.cern.ch/itp/international-teacher-programmes

Merece la pena...

CERN Accelerating science

National Teacher Programmes | International Teacher Programmes | FAQ | Contact

In addition to national teacher programmes, CERN offers two 2-week international teacher programmes: The **International High School Teacher (HST)** Programme and the **International Teacher Weeks (ITW)** Programme. Both programmes are delivered entirely in English and are open for teachers from around the world. The goals of CERN's international teacher programmes are:

- To support teachers' professional development in the field of particle physics.
- To promote the teaching of particle physics in high schools.
- To facilitate the exchange of knowledge and experience among teachers of different nationalities.
- To stimulate activities related to the popularisation of physics within and beyond the classroom.
- To help CERN establish closer links with schools all around the world.

Select the respective programme to find out more about upcoming sessions and how to apply. You can also access the programme agendas of previous international programmes and explore archived material.

The application process for both International Teacher Programmes (HST & ITW) 2019 will be open 1 November 2018 - 13 January 2019!

Visitas al CERN con alumnos

Solicitud Alojamiento y transporte Posibles visitas en la zona

https://scool.web.cern.ch/scoollab-workshops S'Cool Lab

CERN Accelerating science Sign in

Visit CERN

Français English

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Guided tours for groups of pupils or students

Conditions

- Guided tours for pupils and students are for groups of between 12 and 48 (*48 is a maximum including teachers or accompanying adults*).
- For groups of minors, there should be at least 2 accompanying adults.
- All tours are free of charge.
- Tours are available from Monday to Saturday, both mornings and afternoons.

Content

- Each tour lasts about three hours and includes an introduction with a short film followed by a visit to one or two of the ground-level visit points.
- Please note that, in general, it is not possible to visit the underground experiments, especially for visitors under 16.

CERN TOURS

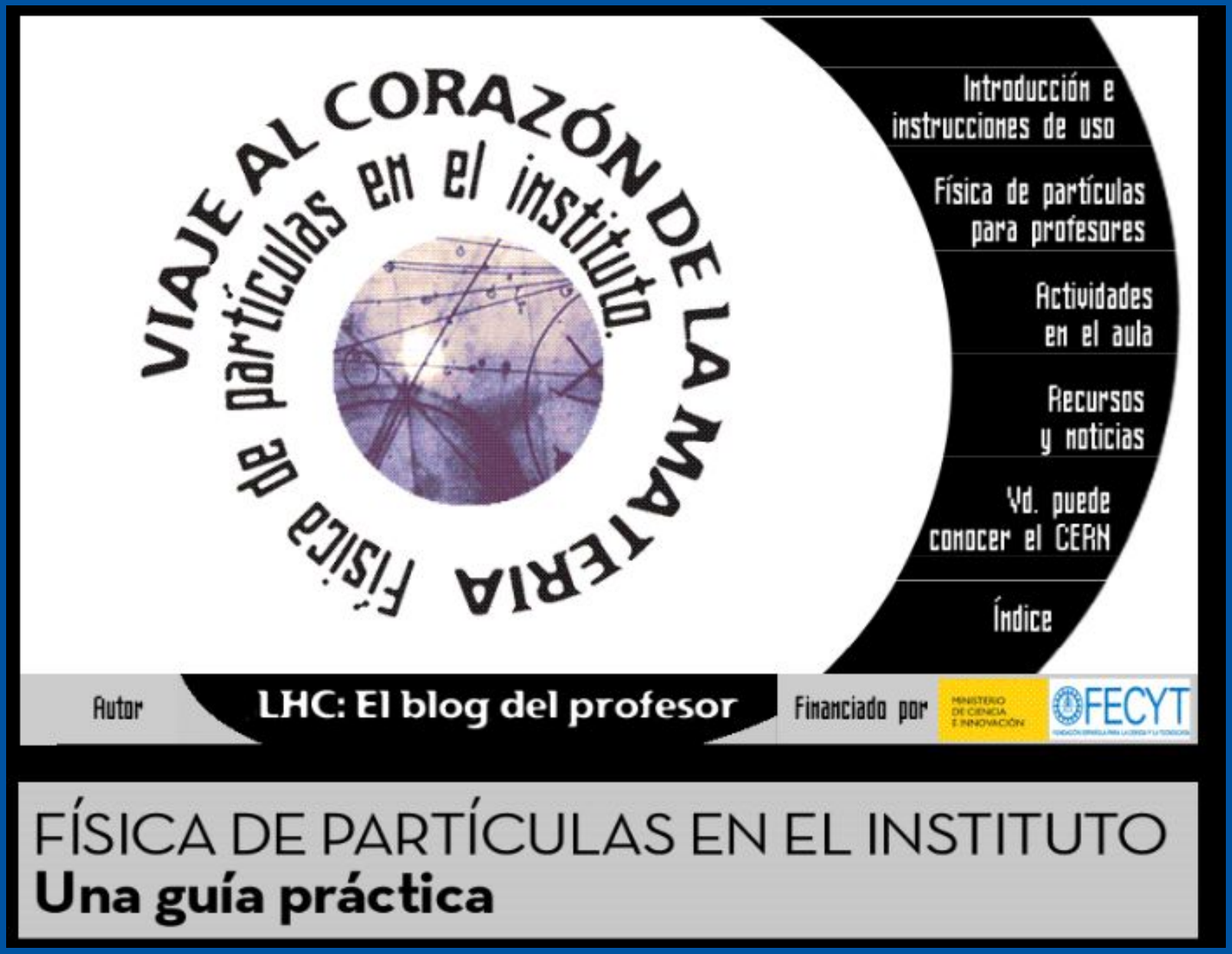
Guided tours

- Individual
- Pupils or students groups
- Other groups
- Private (CERN only)
- Important instructions
- Frequently asked questions
- How to get to CERN
- My Guided Tour requests

Virtual Visits

Passport to the Big Bang

Más información



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

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

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FIN

¡Gracias!

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