Uso de datos públicos del CERN en el aula

Una invitación y una microguía

…y también física experimental de partículas en el aula

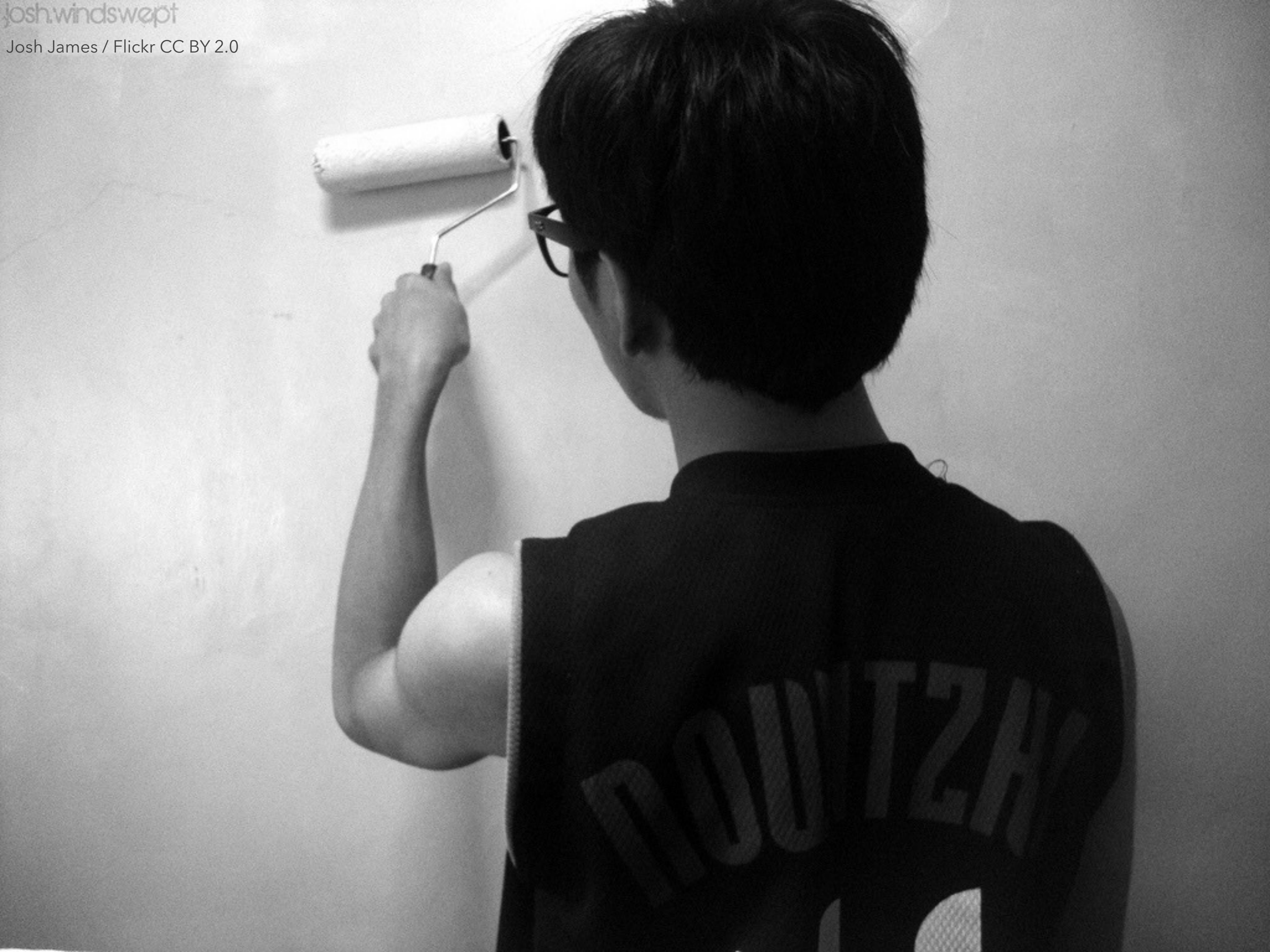
CosmicWatch, Taller MiniPIX

Motivación:

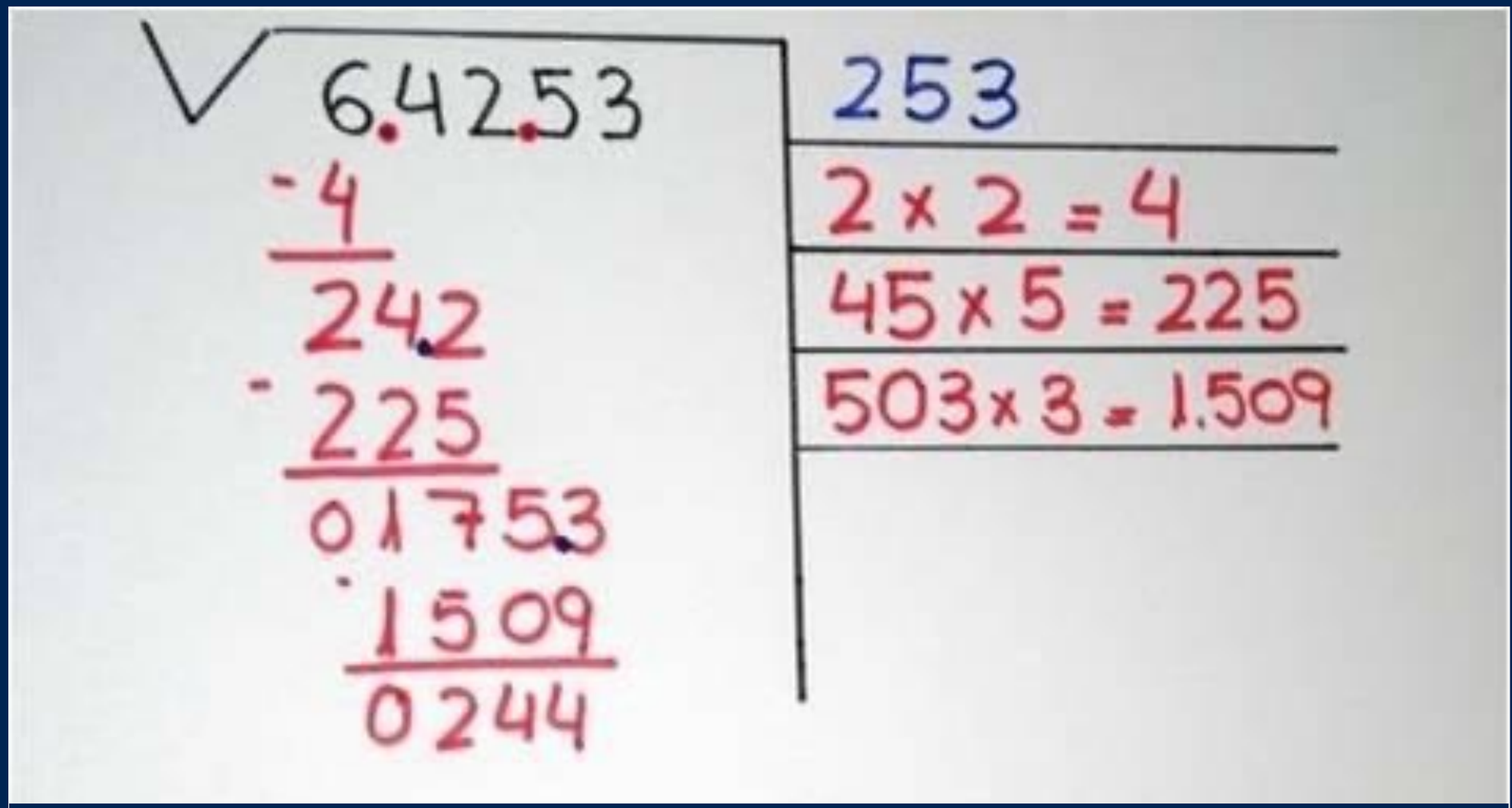
Imaginemos que vais a una clase de pintura y os encontráis esto:

josh.windswept

Josh James / Flickr CC BY 2.0



o que en clase de
matemáticas
no hay nada más que cosas
como esta:



o en física…

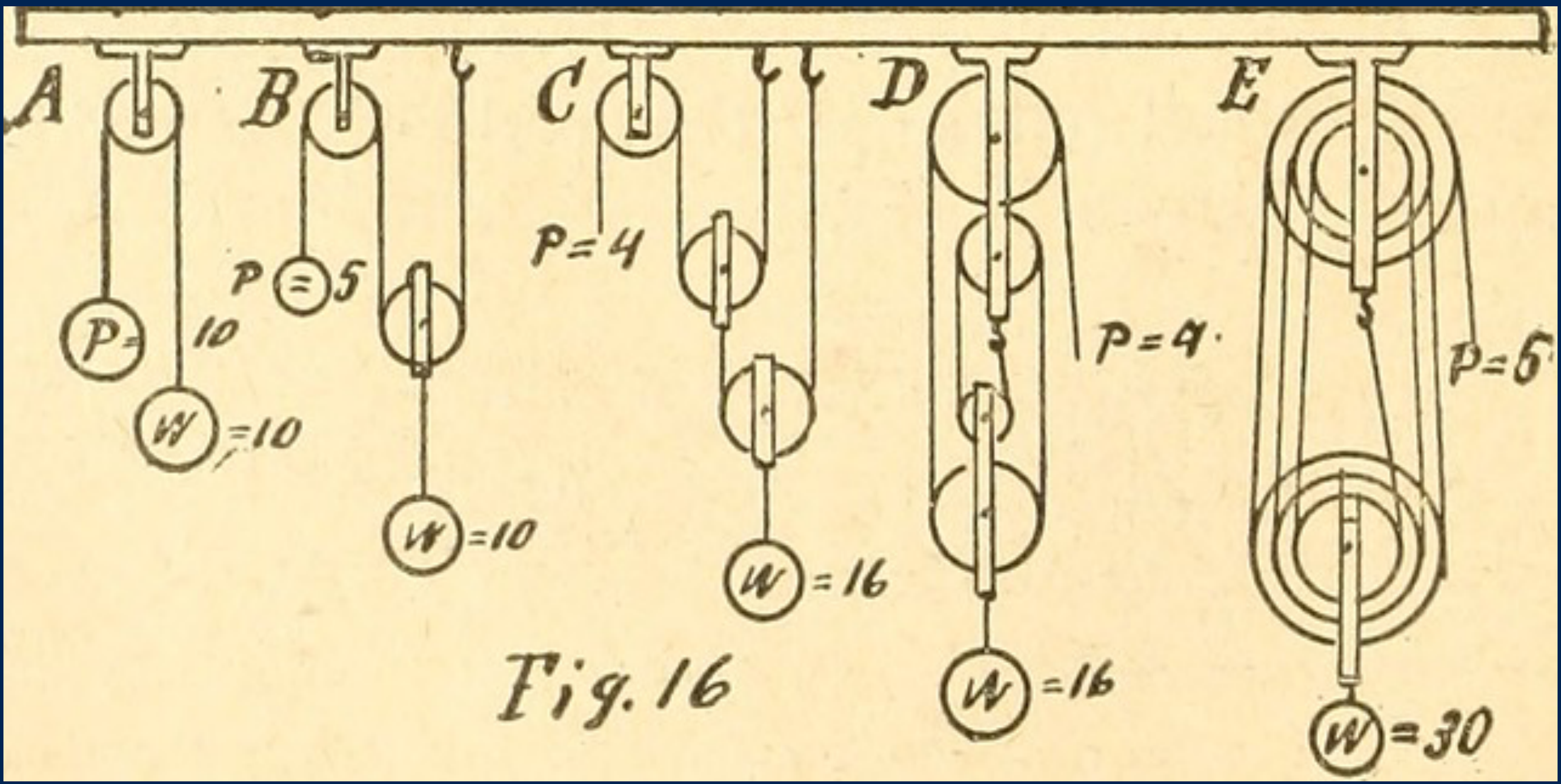


Fig. 16

Image from page 45 of "Elementary lessons in the physics of agriculture" (1894)

Hay alternativas...

Adam Jones / Flickr CC BY-SA 2.0

Diana González Yuste
The October Press, Alicante

Begoña V.

Flickr CC BY-NC-SA 2.0

Motivación

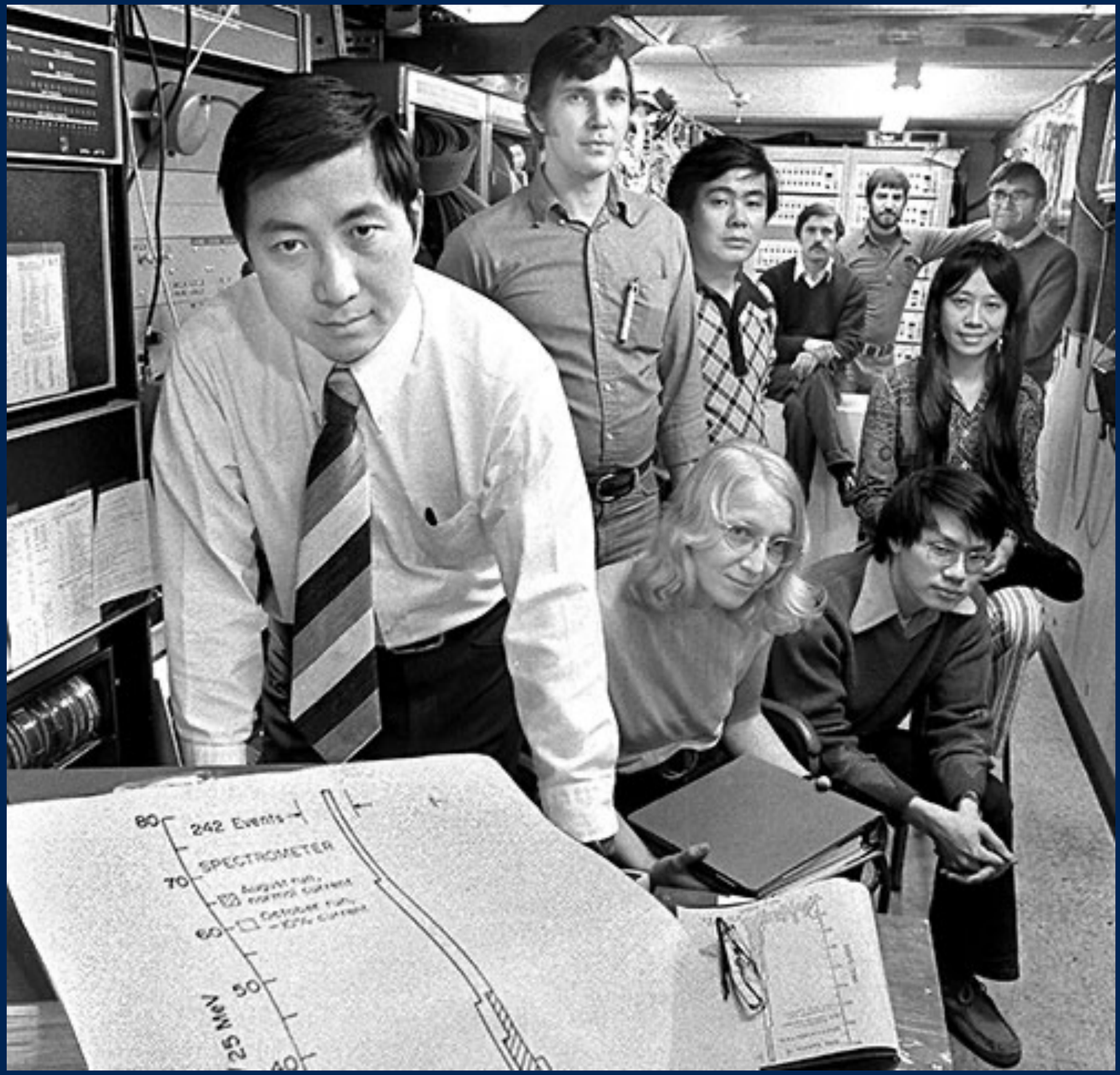
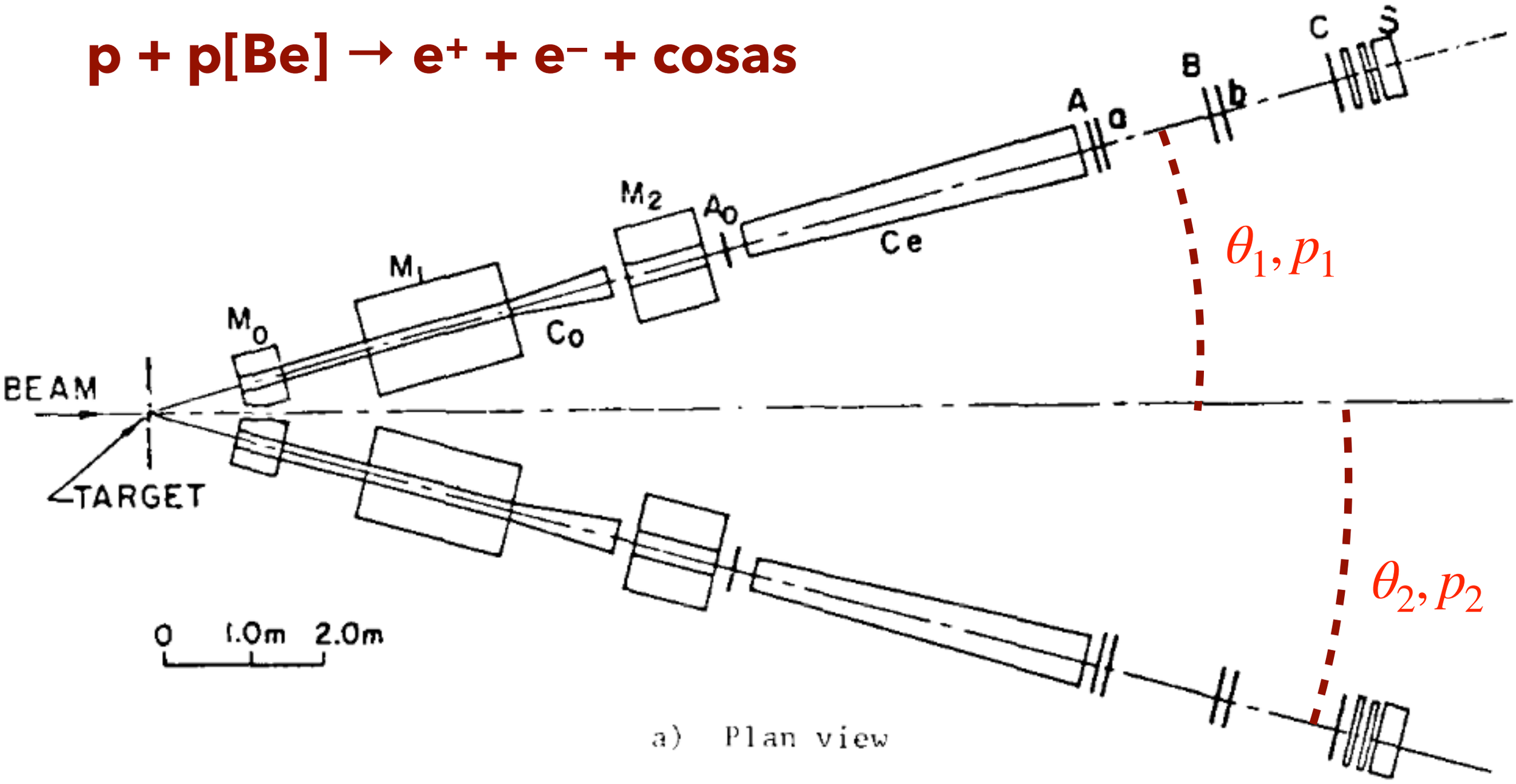


foto BNL

p + p[Be] → e⁺ + e⁻ + cosas



a) Plan view

https://www.nobelprize.org/uploads/2018/06/ting-lecture.pdf

Si resulta que **p + p → X → e⁺ + e⁻** la masa m de X será:

$$m^2 = m_1^2 + m_2^2 + 2[E_1 E_2 - p_1 p_2 \cos(\theta_1 + \theta_2)]$$

VOLUME 33, NUMBER 23 PHYSICAL REVIEW LETTERS 2 DECEMBER 1974

Experimental Observation of a Heavy Particle J†

J. J. Aubert, U. Becker, P. J. Biggs, J. Burger, M. Chen, G. Everhart, P. Goldhagen, J. Leong, T. McCorriston, T. G. Rhoades, M. Rohde, Samuel C. C. Ting, and Sau Lan Wu
Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

and

Y. Y. Lee
Brookhaven National Laboratory, Upton, New York 11973
(Received 12 November 1974)

We report the observation of a heavy particle J, with mass $m = 3.1$ GeV and width approximately zero. The observation was made from the reaction $p + \mathrm{Be} \rightarrow e^+ + e^- + x$ by measuring the e^+e^- mass spectrum with a precise pair spectrometer at the Brookhaven National Laboratory's 30-GeV alternating-gradient synchrotron.

This experiment is part of a large program to study the behavior of timelike photons in $p + p \rightarrow e^+ + e^- + x$ reactions[1] and to search for new particles which decay into e^+e^- and $\mu^+\mu^-$ pairs.

daily with a thin Al foil. The beam spot size is 3×6 mm^2, and is monitored with closed-circuit television. Figure 1(a) shows the simplified side view of one arm of the spectrometer. The two

J. J. Aubert, U. Becker, P. J. Biggs, J. Burger, M. Chen, G. Everhart, P. Goldhagen, J. Leong, T. McCorriston, T. G. Rhoades, M. Rohde, Samuel C. C. Ting, Sau Lan Wu, and Y. Y. Lee

Phys. Rev. Lett. 33, 1404 – Published 2 December 1974

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Received 12 November 1974

Discovery of a Narrow Resonance in e^+e^- Annihilation

J. -E. Augustin *et al.*
Phys. Rev. Lett. **33**, 1406 – Published 2 December 1974

Physics See Focus story: *Landmarks*—The Charming Debut of a New Quark

An article within the collection: Letters from the Past - A PRL Retrospective

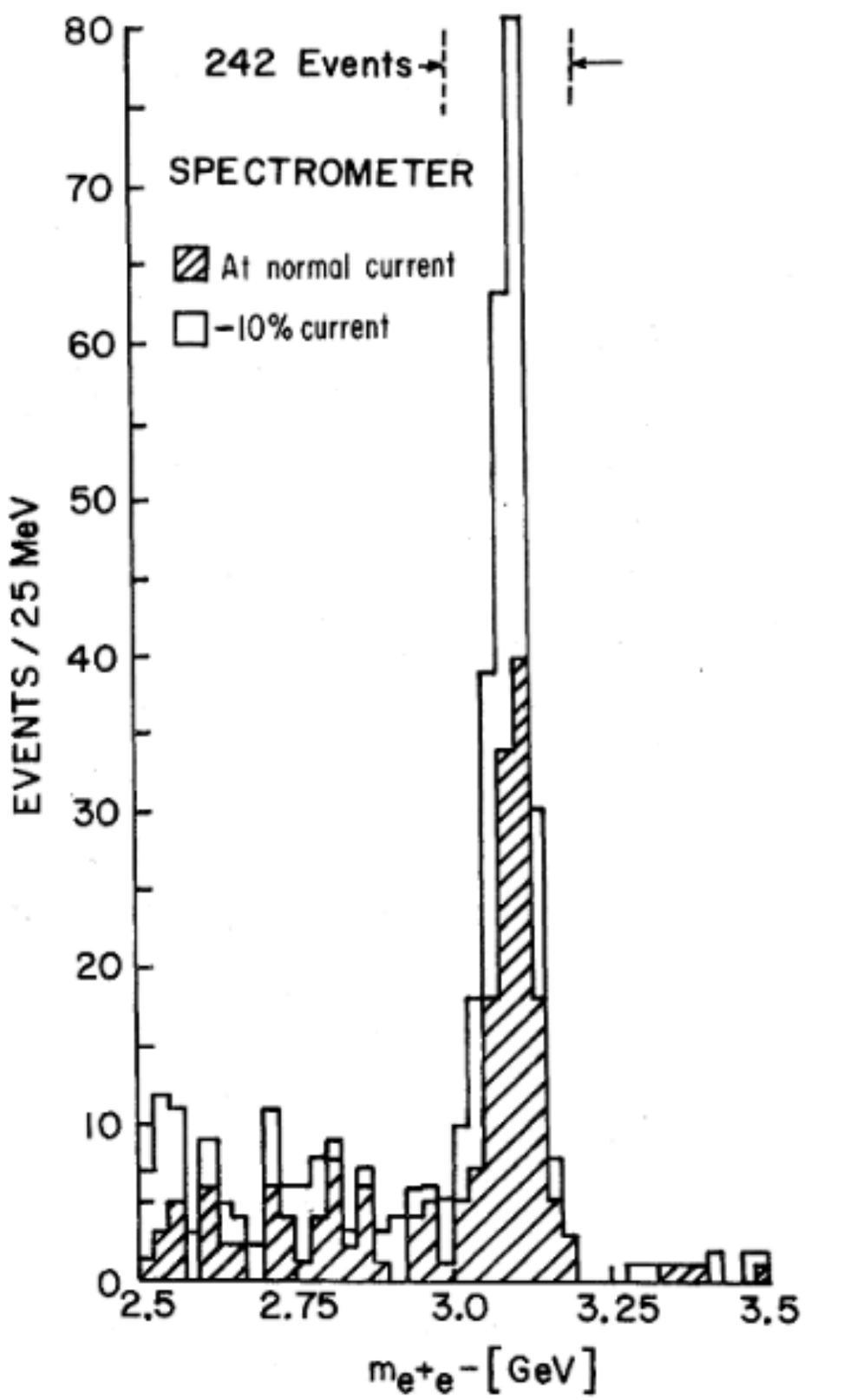


FIG. 2. Mass spectrum showing the existence of J. Results from two spectrometer settings are plotted showing that the peak is independent of spectrometer currents. The run at reduced current was taken two months later than the normal run.

La revolución de noviembre en la física de partículas

With the discovery of the J/Psi particle, we realized that many diverse strands of research were converging on a single theory of physics.

El modelo estándar

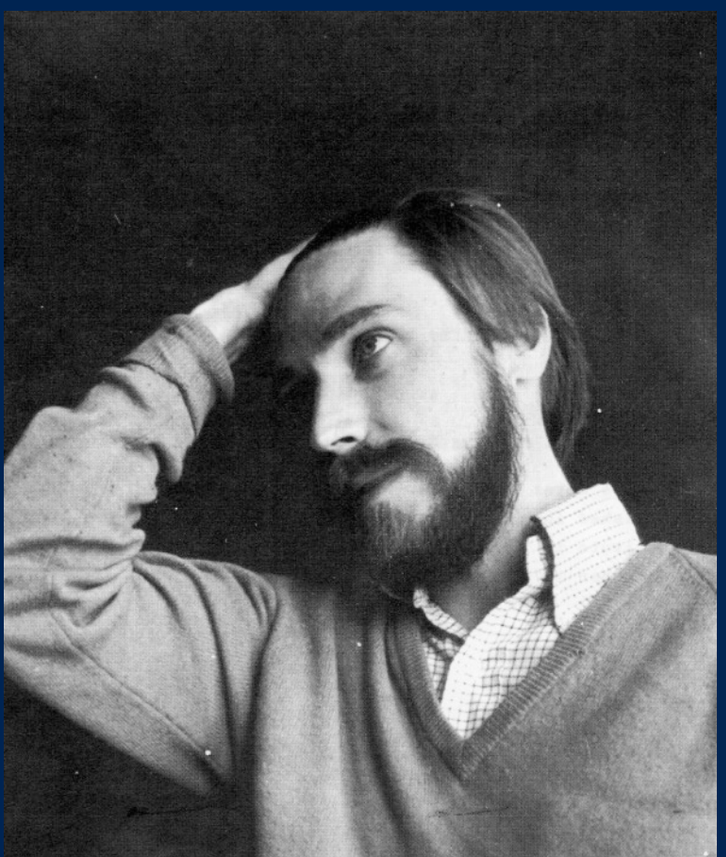
Sheldon Glashow:

In 1969, John Iliopoulos and Luciano Maiani came to Harvard as research fellows. Together, we found the arguments that predicted the existence of charmed hadrons. Much of my later work was done in collaboration with Alvaro de Rujúla or Howard Georgi.

In early 1974, we predicted that charm would be discovered in neutrino physics or in $e^+ e^-$ annihilation. So it was.

With the discovery of the J/Psi particle, we realized that many diverse strands of research were converging on a single theory of physics.

https://www.nobelprize.org/prizes/physics/1979/glashow/biographical/



Álvaro de Rújula
AIP Emilio Segrè
Visual Archives

Sheldon Glashow
courtesy AIP Emilio Segrè
Visual Archives

VOLUME 34, NUMBER 1 PHYSICAL REVIEW LETTERS 6 JANUARY 1975

Is Bound Charm Found?*

A. De Rújula
Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138

and

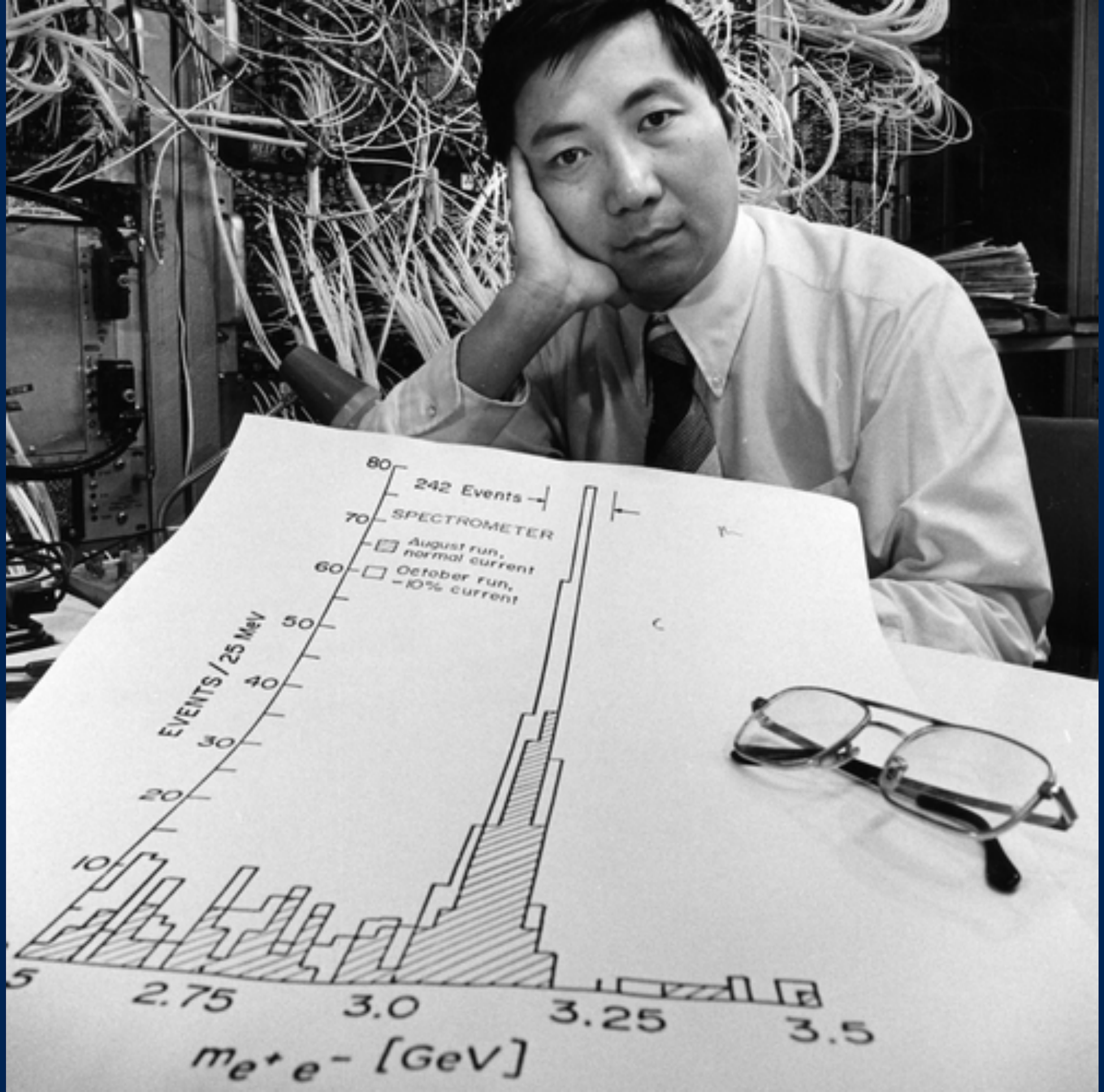
S. L. Glashow†
Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

(Received 27 November 1974)

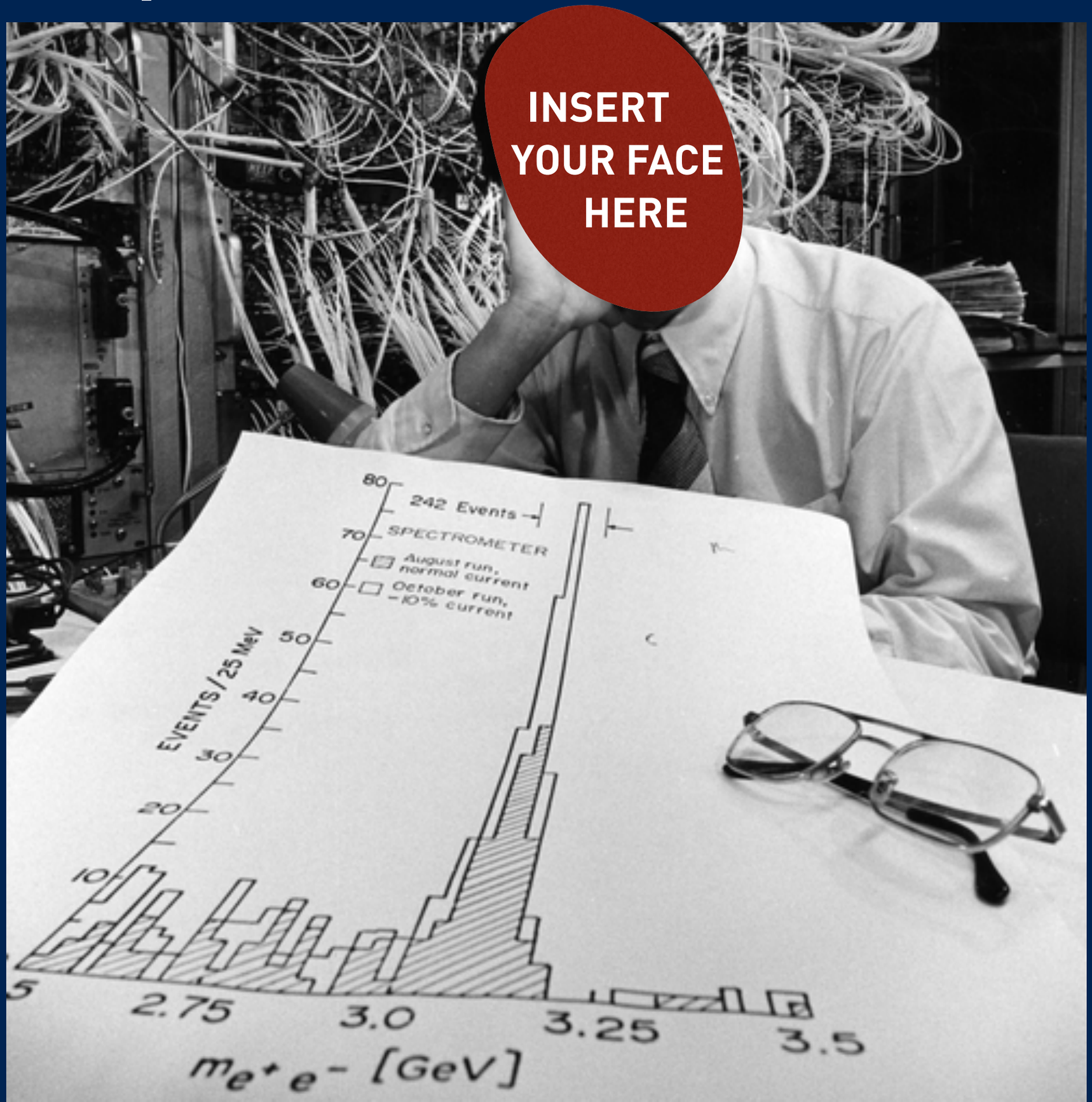
We argue that the newly discovered narrow resonance at 3.1 GeV is a $^3S_1$ bound state of charmed quarks and we show the consistency of this interpretation with known meson systematics. The crucial test of this notion is the existence of charmed hadrons near 2 GeV.

A surprisingly narrow resonance at $M = 3.1$ GeV was discovered in $p + \mathrm{Be} \to e^+ + e^- + \ldots$[1] and in e^+e^- annihilation.[2] Estimates[3] of its decay

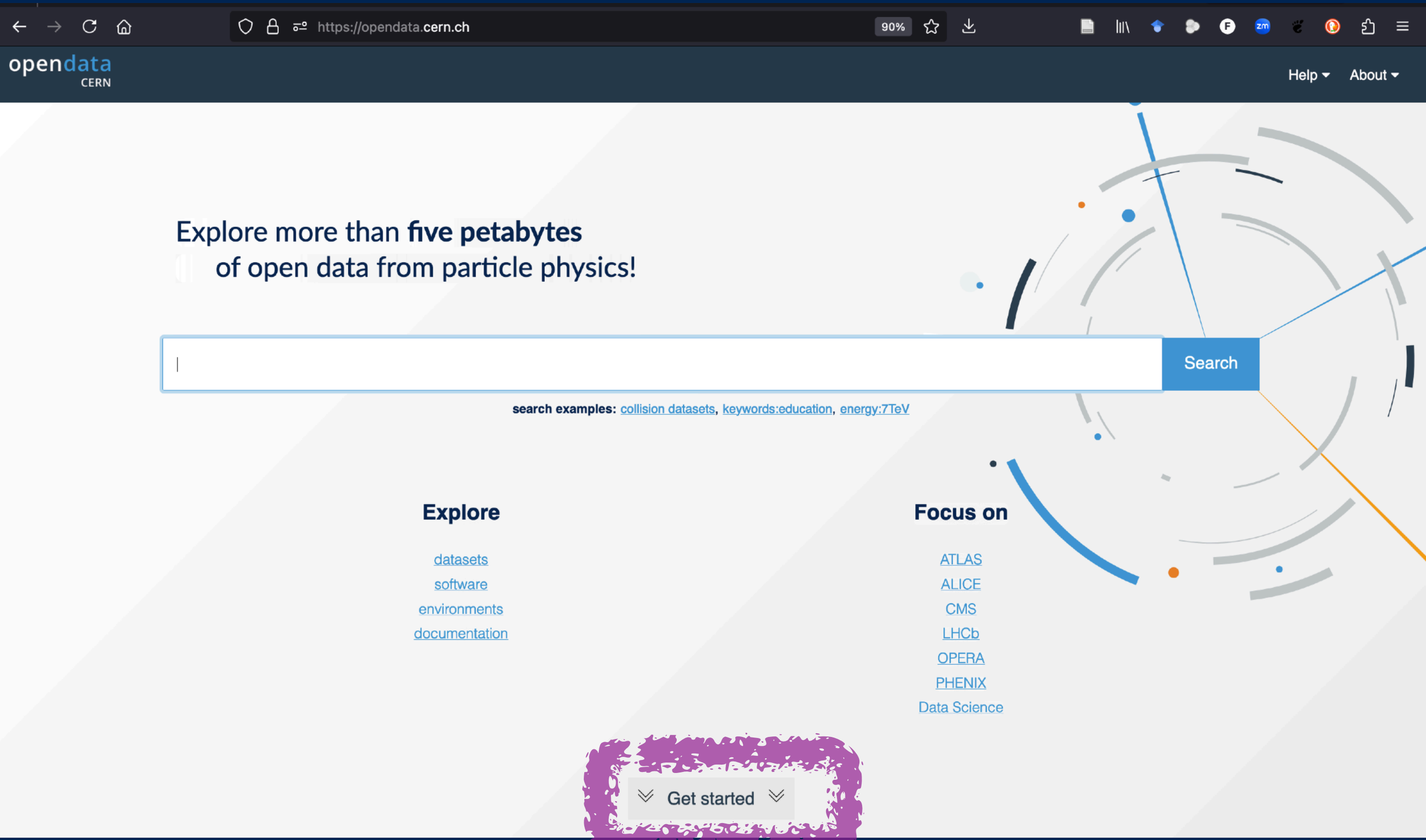
variant. It contributes to the singlet mass. We suggest that the remaining term is just the sum of the quark masses plus a common additive con-


242 Events
SPECTROMETER
August run, normal current
October run, -10% current
EVENTS/25 MeV
80
70
60
50
40
30
20
10
2.75
3.0
3.25
3.5
$m_{e^+e^-}$ [GeV]

Objetivo


INSERT
YOUR FACE
HERE
242 Events
SPECTROMETER
August run, normal current
October run, ~10% current
EVENTS/25 MeV
80
70
60
50
40
30
20
10
2.75
3.0
3.25
3.5
$m_{e^+e^-}$ [GeV]

https://opendata.cern.ch/

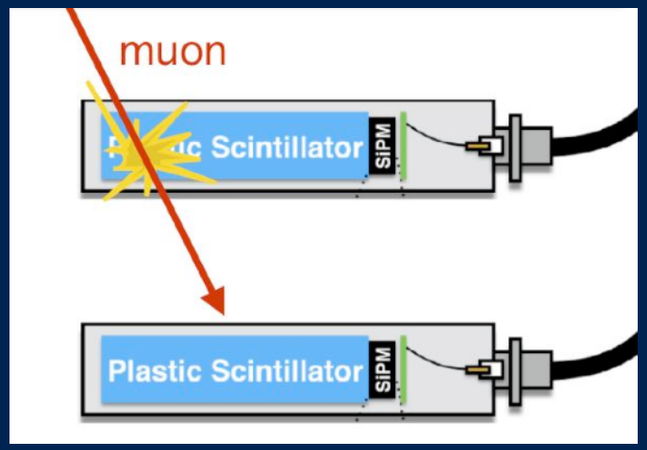


Get started!!!

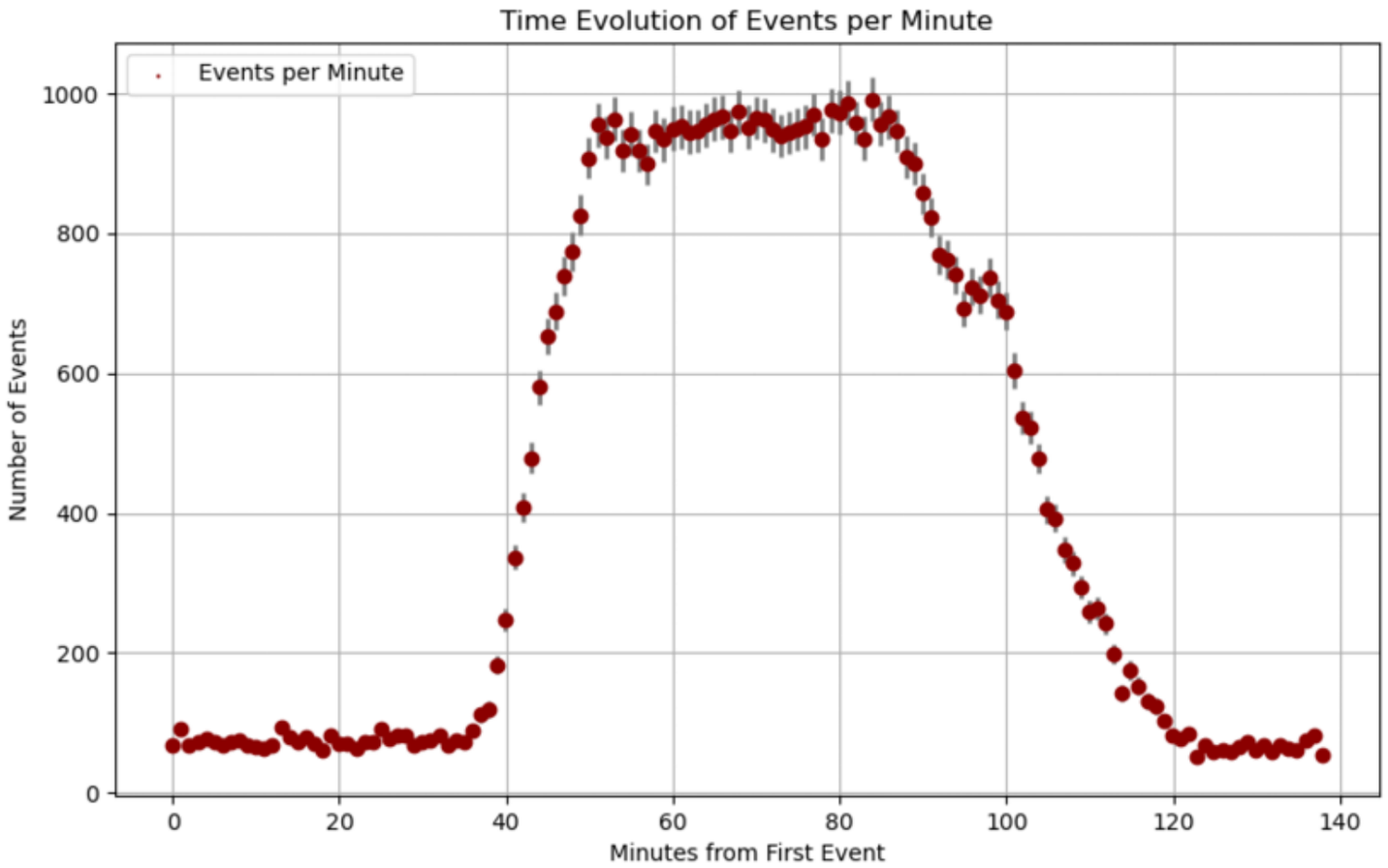
y también física experimental de partículas en el aula

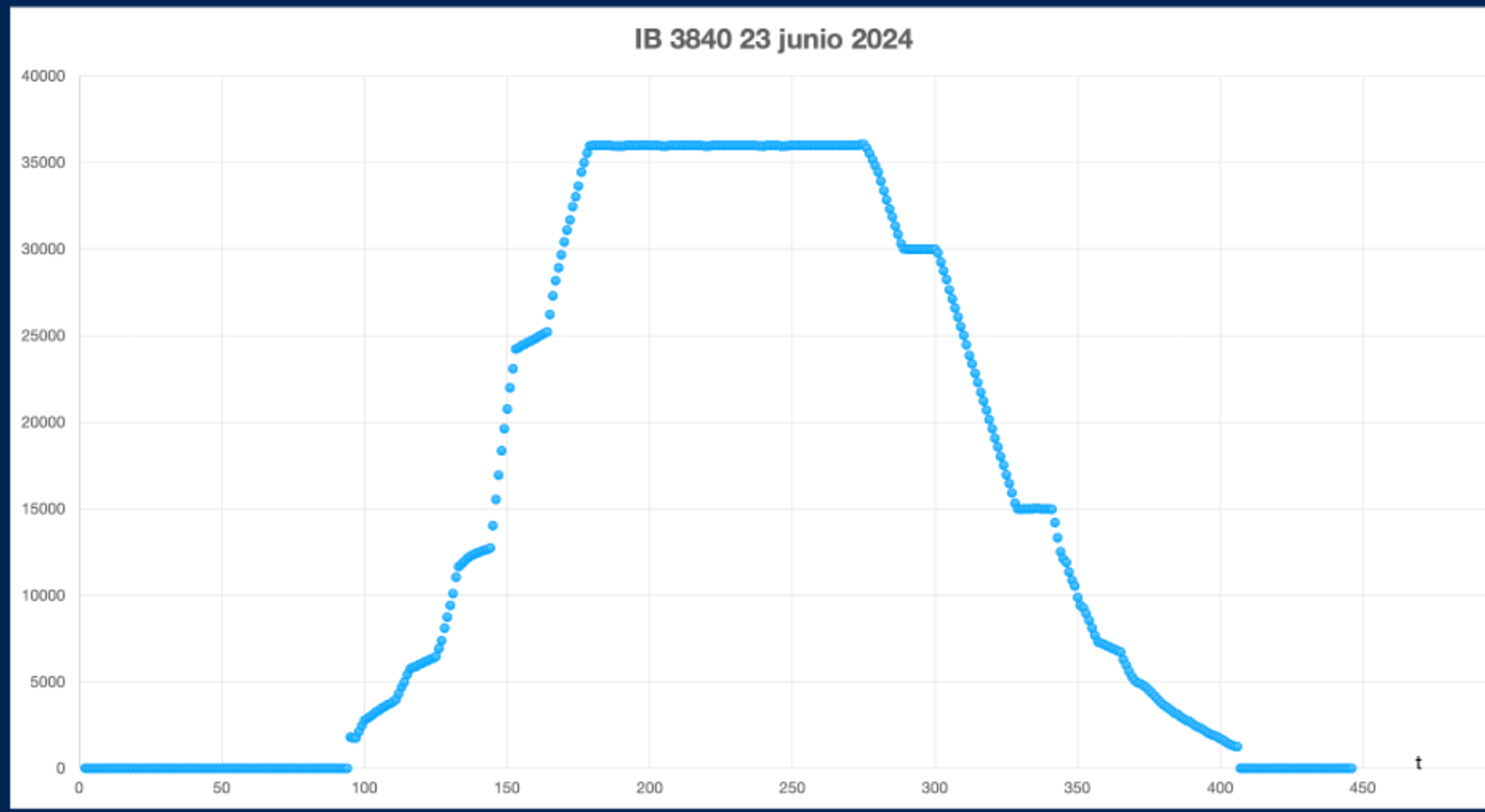
CosmicWatch, Taller MiniPIX

Cosmic Watch

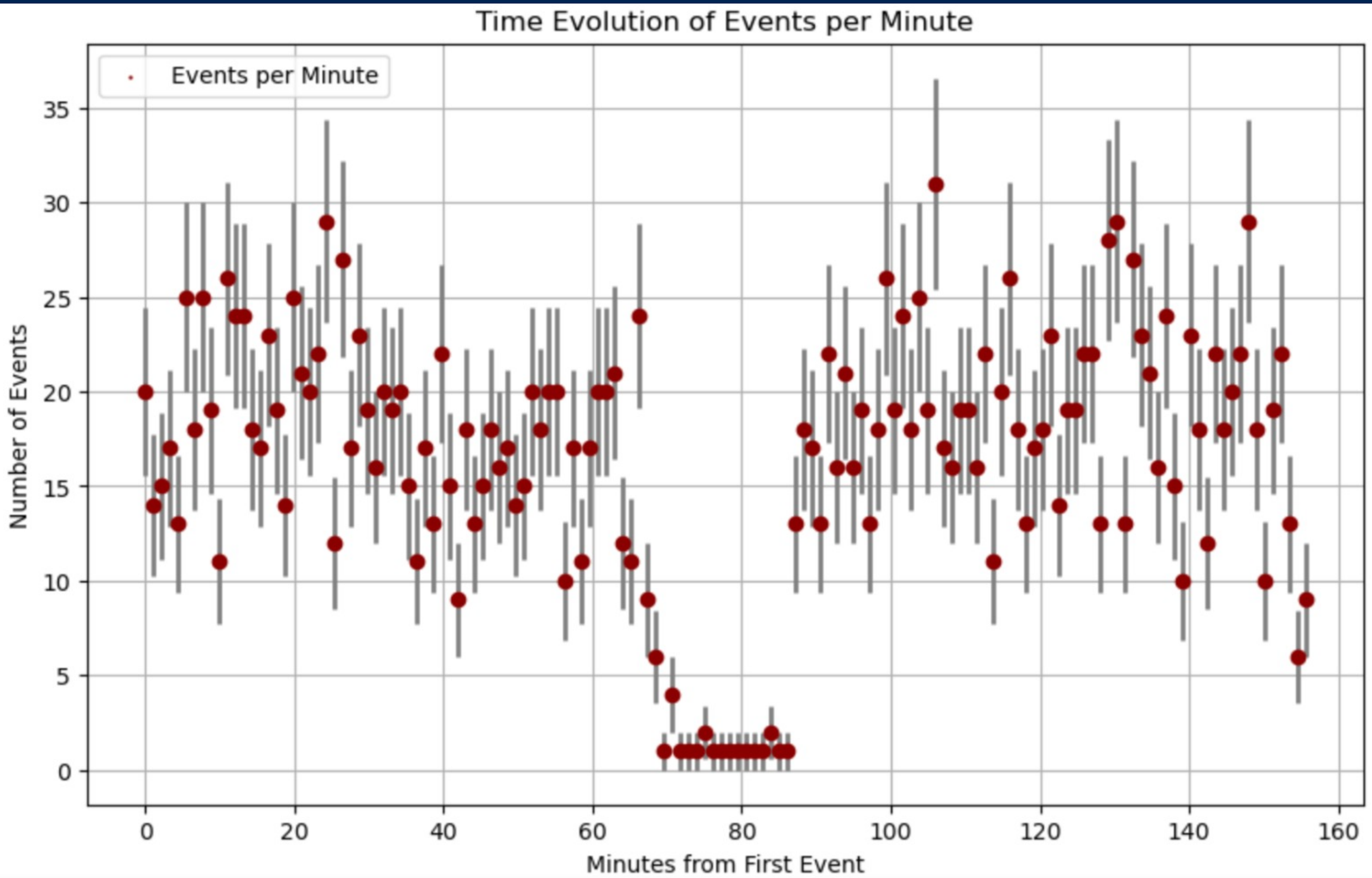


vuelo
MAD -> GVA

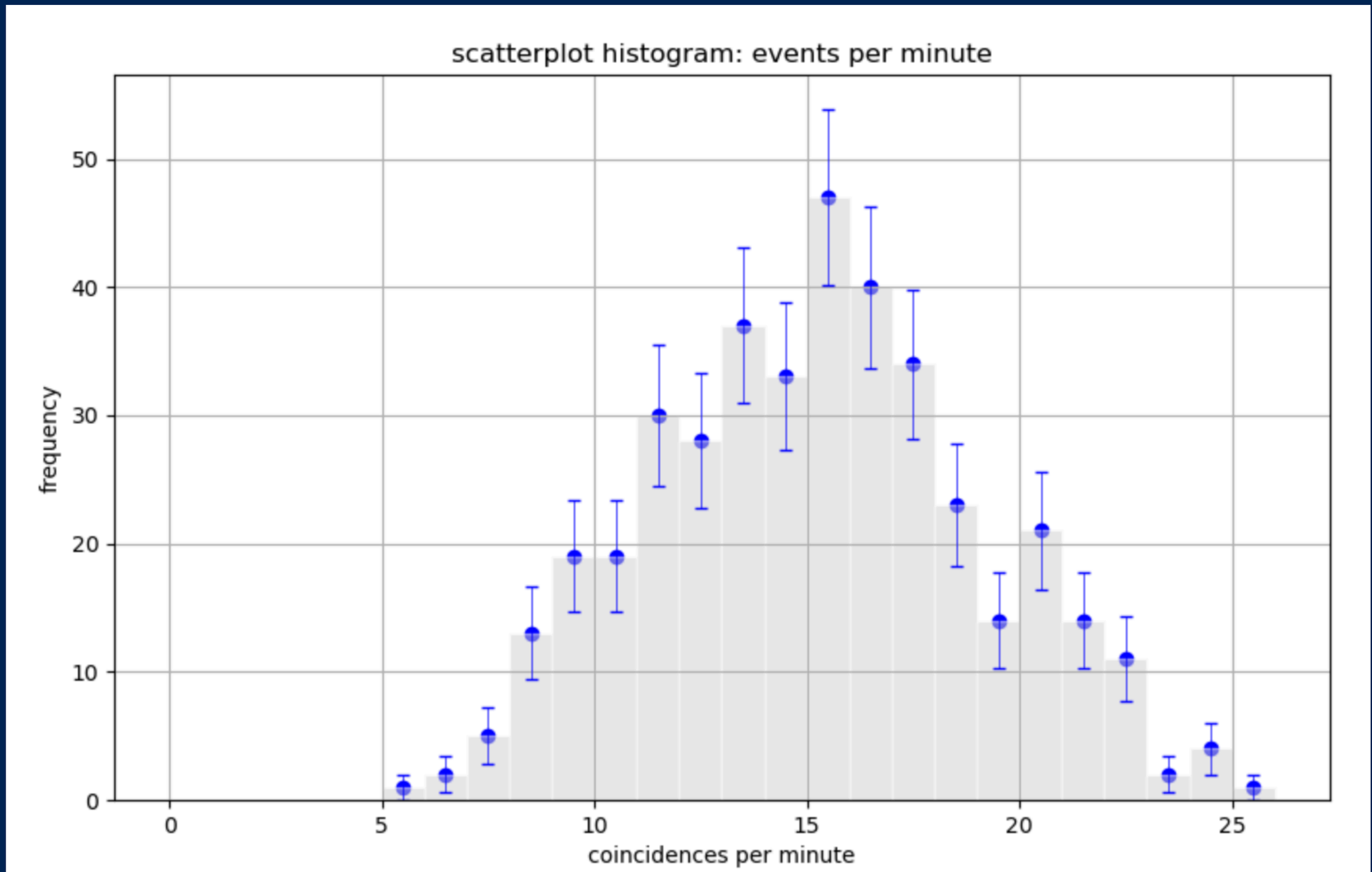




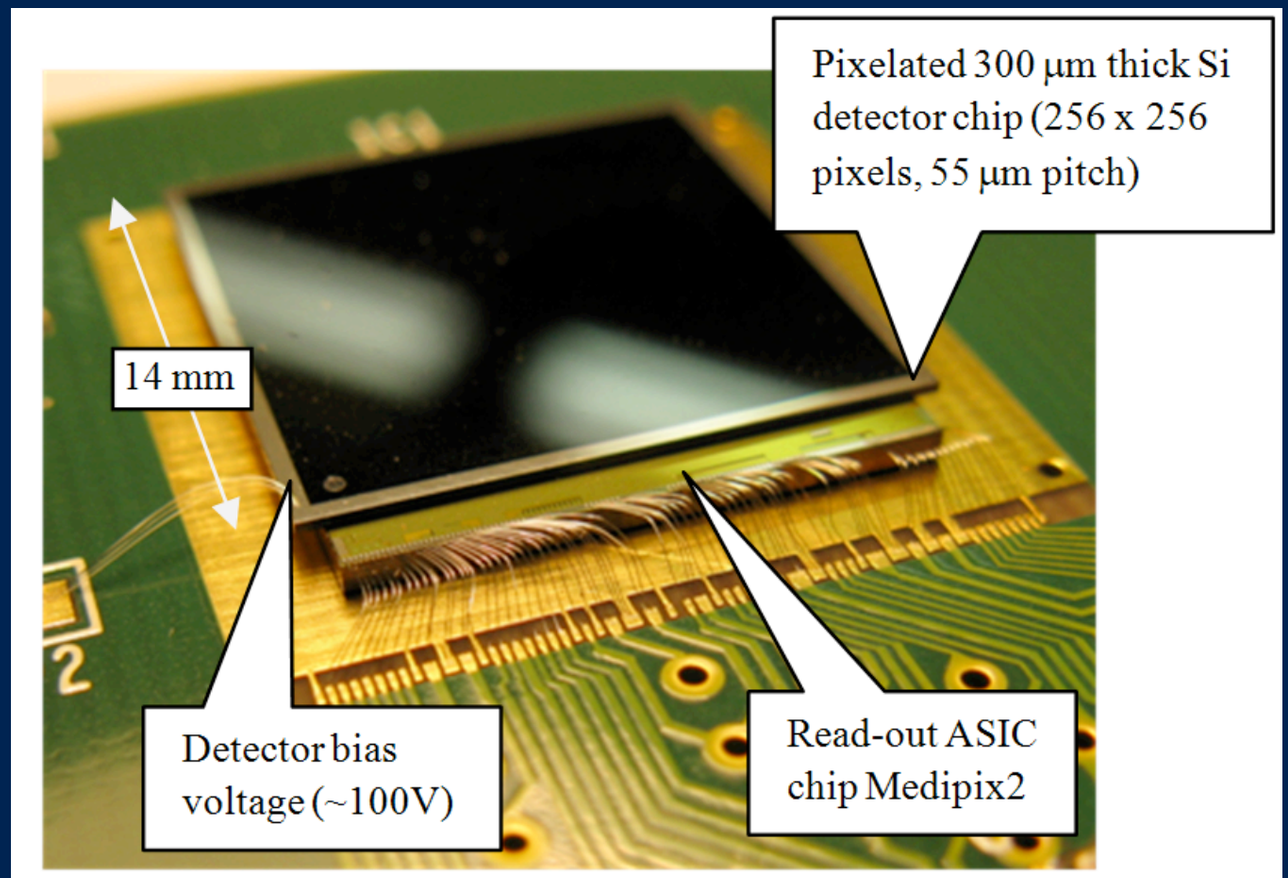
visita a la caverna de servicio de CMS



6 horas en el B39



MiniPIX EDU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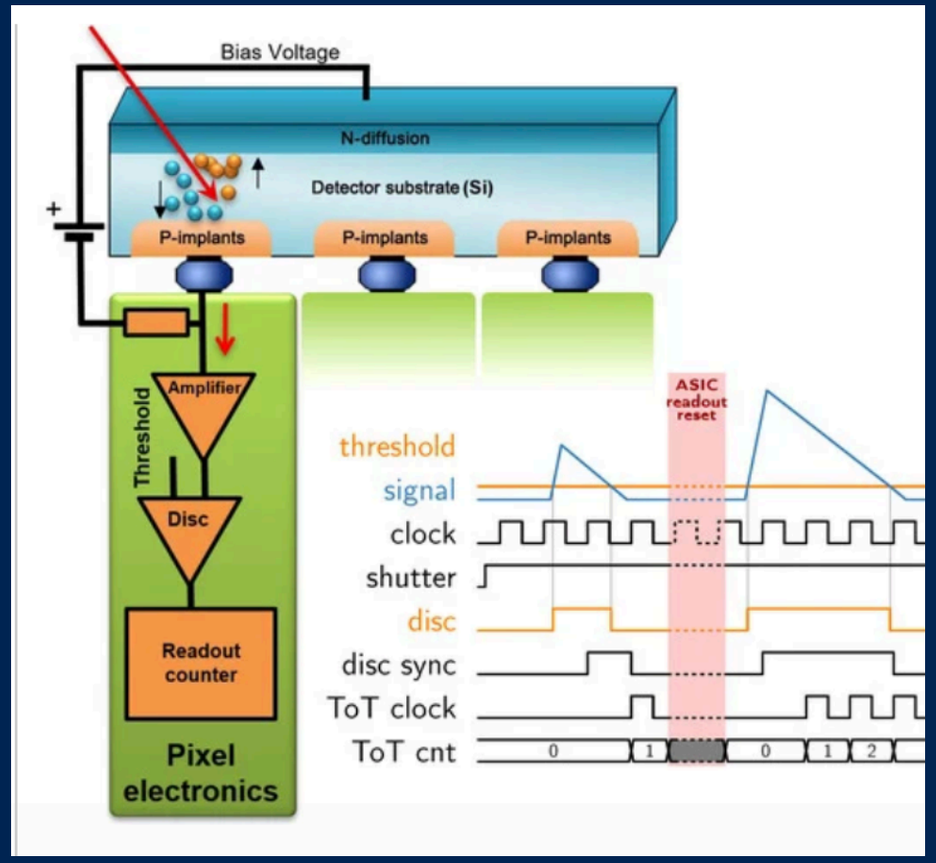
14 mm
Detector bias voltage (~100V)
Read-out ASIC chip Medipix2


Bias Voltage
N-diffusion
Detector substrate (Si)
P-implants
P-implants
P-implants
+
Amplifier
Threshold
Disc
Readout counter
Pixel electronics
ASIC readout reset
threshold
signal
clock
shutter
disc
disc sync
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0
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Pixet Basic 1.7.8.936 - MiniPIX F11-W0349 sn 2050

MPX

F11-W0349

PRO

256

Y

1

1 X (column number) 256

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Frame: 414

Image Properties

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Measurement

Mode: Frames: Exposure [s]:

Tracking 1800 1

Sum Stop Image

Image Info

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Min: 0
Max: 130
Pixel Count: 446
Total: 10313
Mean: 0.157364

Info Tracks

Spectra

7
6
450
300
150
0

0 1500 3000 4500 6000 7500

Alpha Electron Muon Dot

Energy [keV] Size [pix] Timeline

1 Messages

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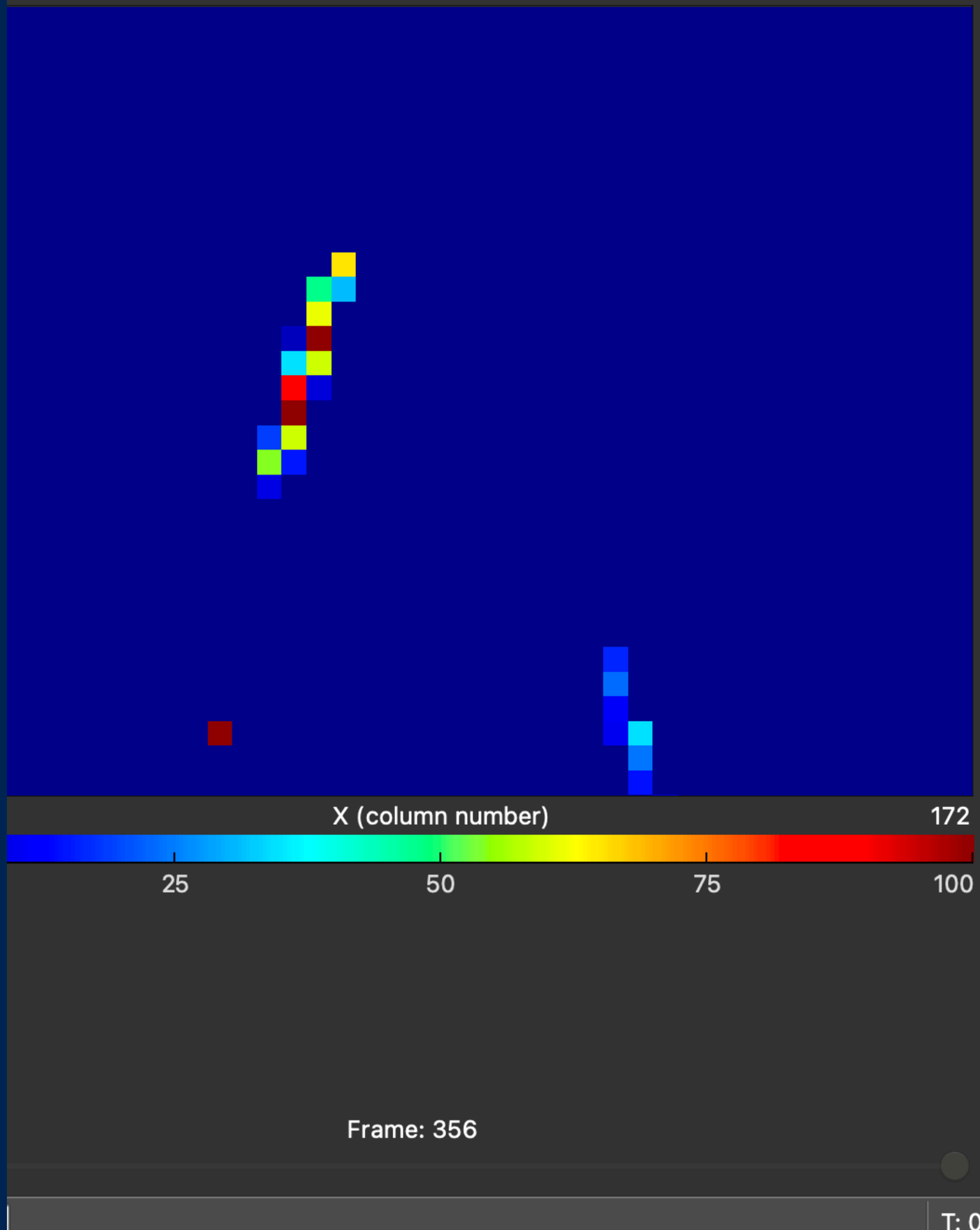

Measurement

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Sum | Stop | Image

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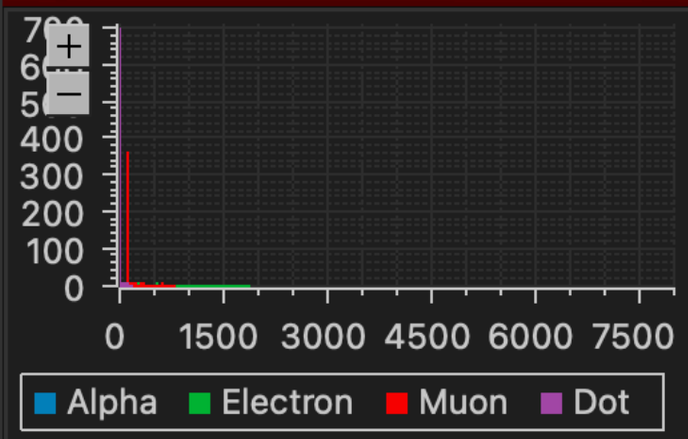
Info | Tracks

Spectra



Energy [keV] | Size [pix] | Timeline

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