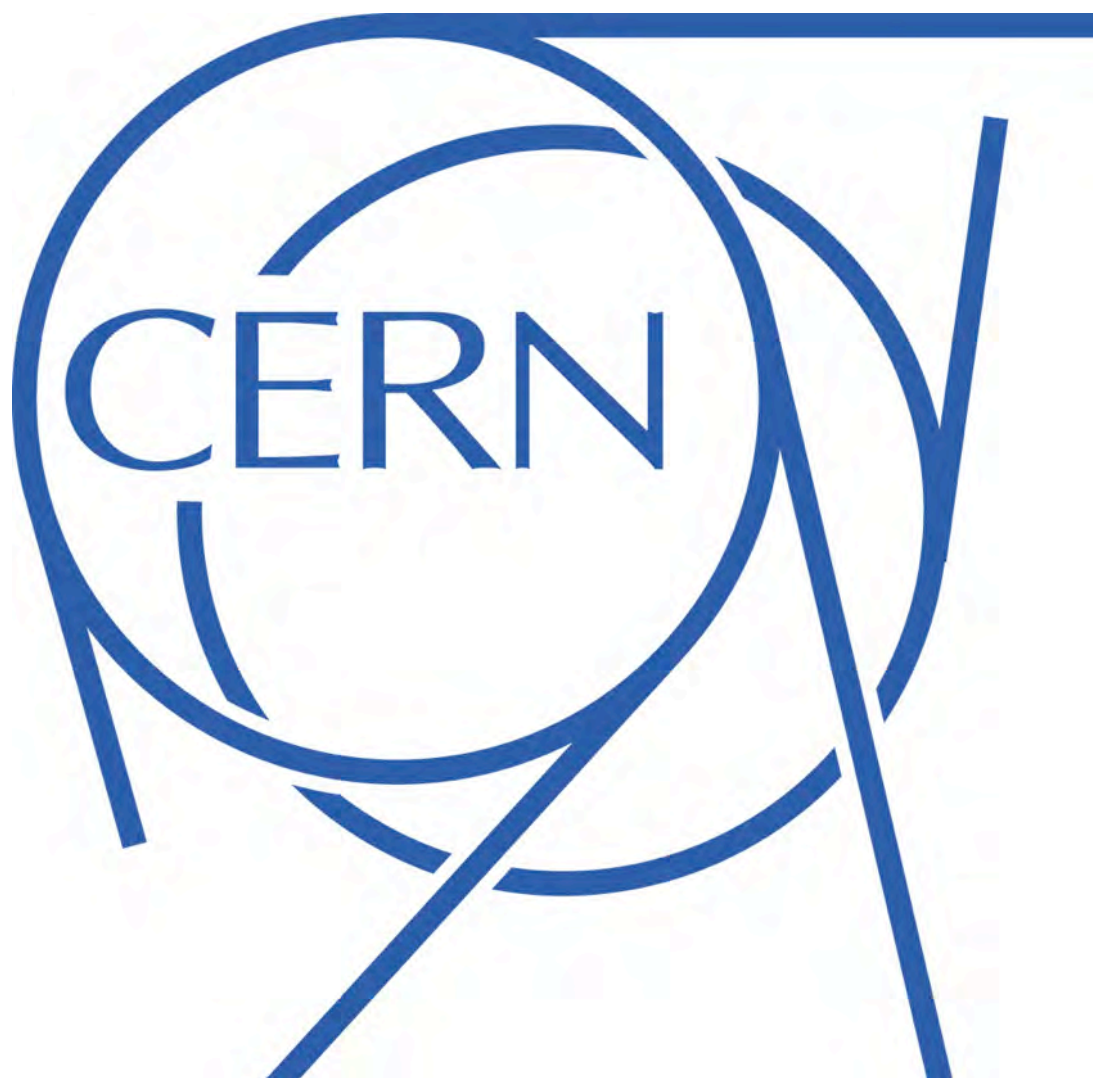


# text-mining meets crowd-sourcing

(author disambiguation in high-energy physics)

Samuele Carli, Sünje Dallmeier-Tiessen, Nikola Yolov,  
Salvatore Mele, Heath O'Connell, Henning Weiler  
CERN-Berlin-Erlangen-Fermilab



(Yes, there is something which goes faster than light)

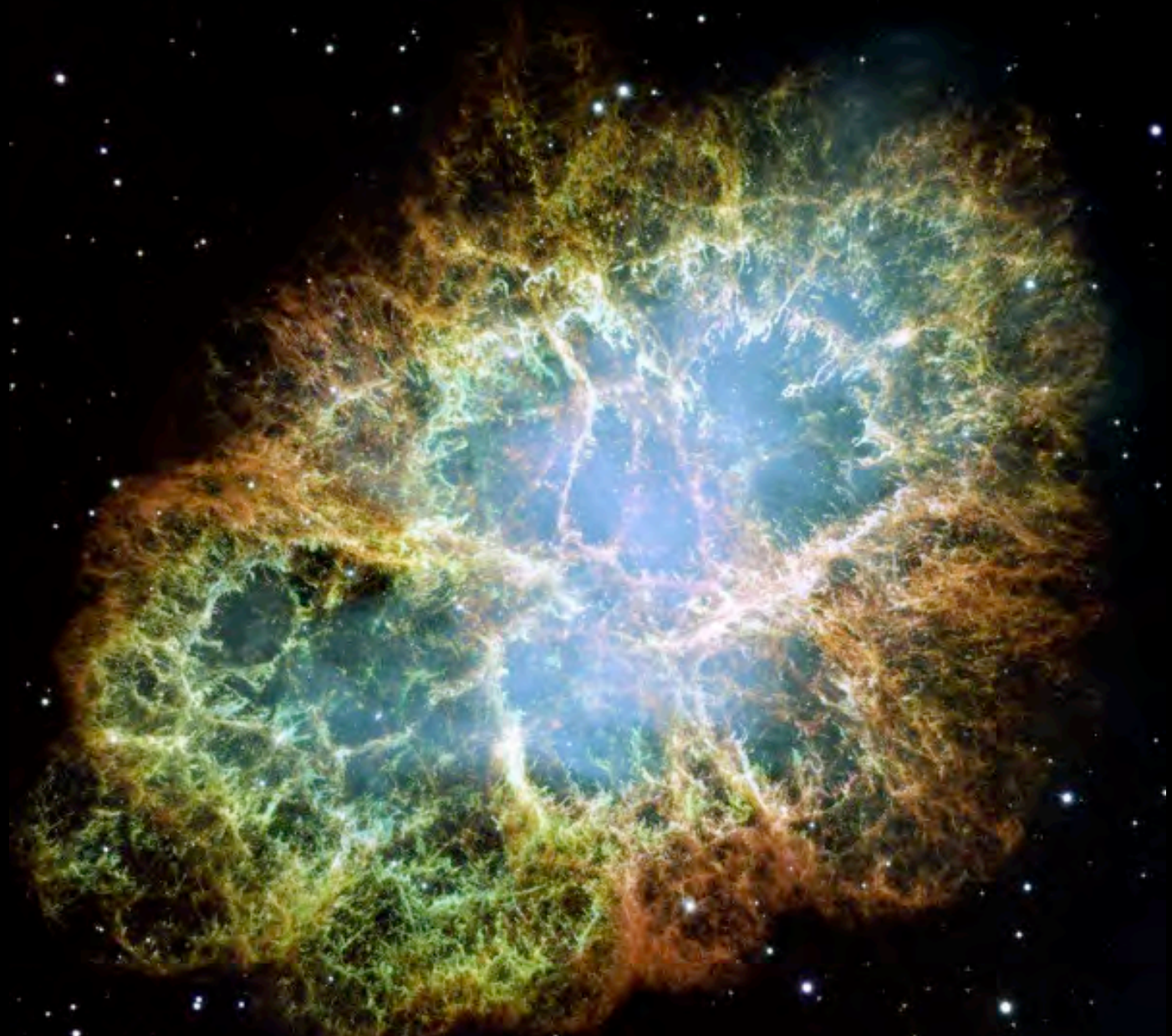


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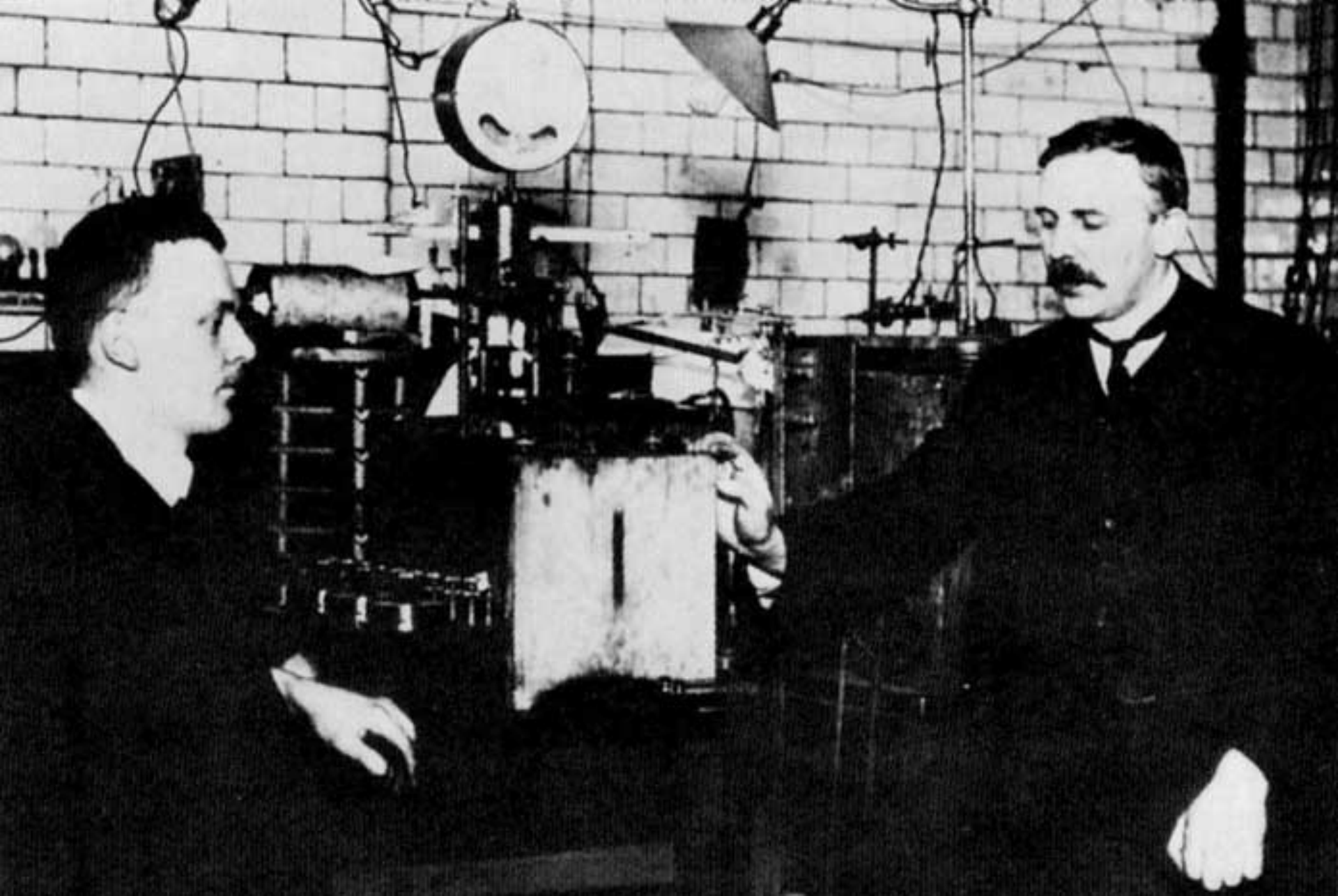
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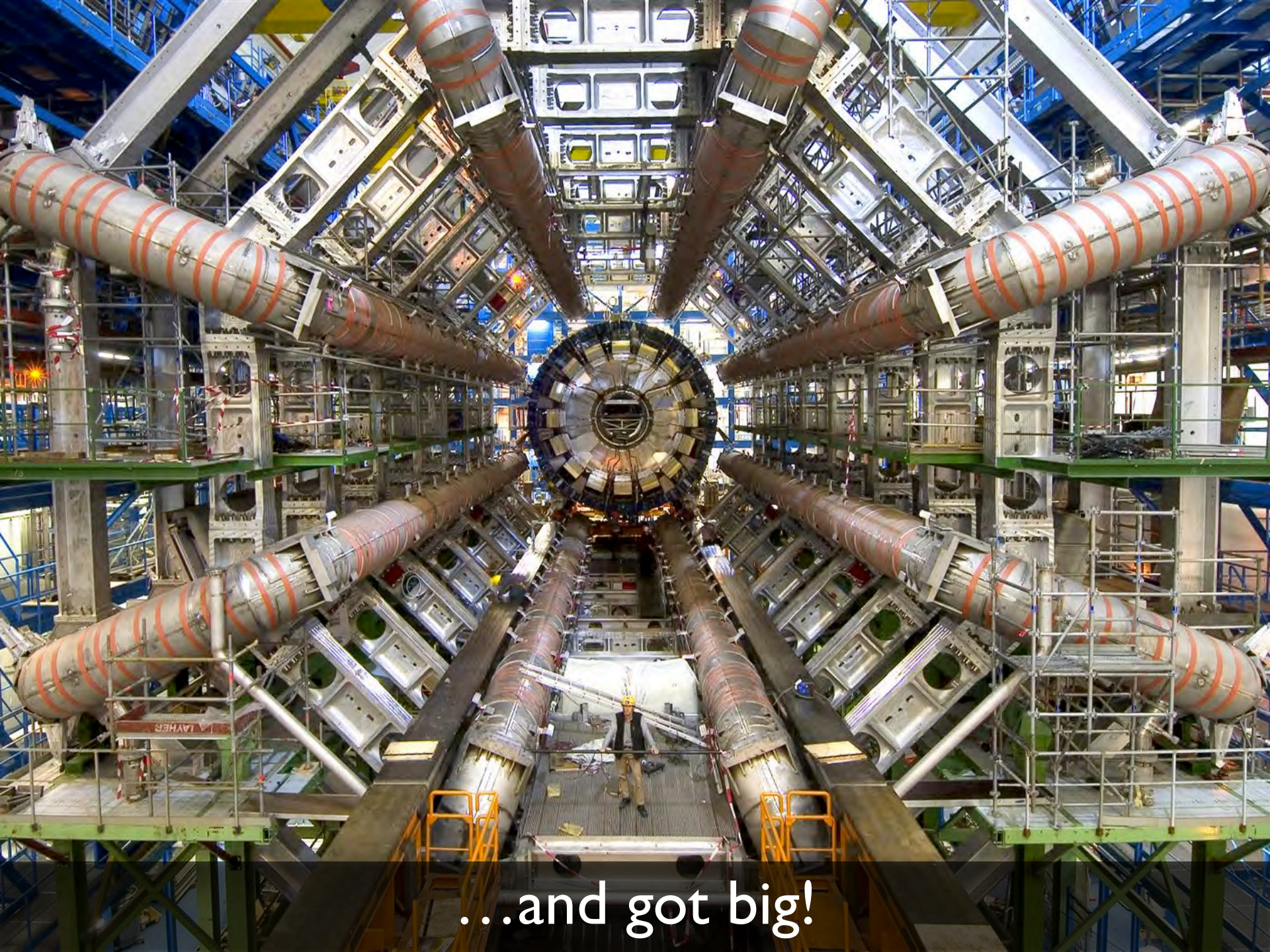


What is the universe made of ?



Like most things, it started small...





...and got big!



## First Measurement of Bose-Einstein Correlations in Proton-Proton Collisions at $\sqrt{s} = 0.9$ and 2.36 TeV at the LHC

V. Khachatryan *et al.*<sup>\*</sup>  
(CMS Collaboration)

(Received 18 May 2010; published 13 July 2010)

Bose-Einstein correlations have been measured using samples of proton-proton collisions at 0.9 and 2.36 TeV center-of-mass energies, recorded by the CMS experiment at the CERN Large Hadron Collider. The signal is observed in the form of an enhancement of pairs of same-sign charged particles with small relative four-momentum. The size of the correlated particle emission region is seen to increase significantly with the particle multiplicity of the event.

DOI: 10.1103/PhysRevLett.105.032001

PACS numbers: 13.85.Hd

In particle collisions, the space-time structure of the hadronization source can be studied using measurements of Bose-Einstein correlations (BEC) between pairs of identical bosons. Since the first observation of BEC 50 years ago in proton-antiproton interactions [1], a number of measurements have been made by several experiments using different initial states; a detailed list of the experimental results can be found in [2,3]. Boson interferometry at the Large Hadron Collider provides a powerful tool to investigate the space-time structure of the particle emission source on femtometric length scales at different center-of-mass energies and with different initial states, using the same detector. This Letter reports the first measurements of BEC at the LHC with the CMS detector, namely, the first measurement in  $pp$  collisions at 0.9 TeV and the highest energy measurement at 2.36 TeV.

Constructive interference affects the joint probability for the emission of a pair of identical bosons with four-momenta  $p_1$  and  $p_2$ . Experimentally, the proximity in phase space between final-state particles is quantified by the Lorentz-invariant quantity  $Q = \sqrt{-(p_1 - p_2)^2} = \sqrt{M^2 - 4m_\pi^2}$ , where  $M$  is the invariant mass of the two particles, assumed to be pions with mass  $m_\pi$ . The BEC effect is observed as an enhancement at low  $Q$  of the ratio of the  $Q$  distributions for pairs of identical particles in the same event, and for pairs of particles in a reference sample that, by construction, is expected to include no BEC effect:

$$R(Q) = (dN/dQ)/(dN_{ref}/dQ), \quad (1)$$

which is then fitted with the parametrization

$$R(Q) = C[1 + \lambda\Omega(Q)](1 + \delta Q). \quad (2)$$

In a static model of particle sources,  $\Omega(Q)$  is the Fourier

transform of the spatial distribution of the emission region of bosons with overlapping wave functions, characterized by an effective size  $r$ . It is often parametrized as an exponential function  $\Omega(Q) = e^{-Qr}$ , or with a Gaussian form  $\Omega(Q) = e^{-\Lambda Q^2}$  (see [4] and references therein). The parameter  $\Lambda$  reflects the BEC strength for incoherent boson emission from independent sources,  $\delta$  accounts for long-range momentum correlations, and  $C$  is a normalization factor.

The data used for the present analysis were collected by the CMS experiment in December 2009 from proton-proton collisions at center-of-mass energies of 0.9 and 2.36 TeV. A detailed description of the CMS detector can be found in [5]. The central feature of the CMS apparatus is a superconducting solenoid of 6 m internal diameter, providing a uniform magnetic field of 3.8 T. The inner tracking system is the most relevant detector for the present analysis. It is composed of a pixel detector with three barrel layers at radii between 4.4 and 10.2 cm and a silicon strip tracker with 10 barrel detection layers extending outwards to a radius of 1.1 m. Each system is completed by two end caps, extending the acceptance up to a pseudorapidity  $|\eta| = 2.5$ . The transverse-momentum ( $p_T$ ) resolution, for 1 GeV charged particles, is between 0.7% at  $\eta = 0$  and 2% at  $|\eta| = 2.5$ . The events were selected by requiring activity in both beam scintillator counters [6]. A minimum-bias Monte Carlo (MC) sample was generated using PYTHIA (with D6T tune) [7] followed by full detector simulation based on the GEANT4 program [8]. Additional PYTHIA MC samples were generated to simulate BEC effects with both Gaussian and exponential forms of  $\Omega(Q)$ .

Charged particles are required to have  $p_T > 200$  MeV, which is sufficient for particles emitted from the interaction region to cross all three barrel layers of the pixel detector and ensure good two-track separation. Their pseudorapidity is required to satisfy  $|\eta_{track}| < 2.4$ . To ensure high purity of the primary track selection, the trajectories are required to be reconstructed in fits with more than 5 degrees of freedom (dof) and  $\chi^2/N_{dof} < 5.0$ . The transverse impact parameter with respect to the collision point is

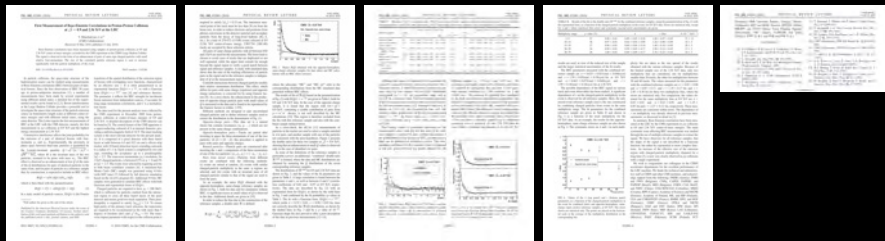
<sup>\*</sup>Full author list given at the end of the article.

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4 ½ pages of article



9 ½ pages for 2500 authors/affiliations

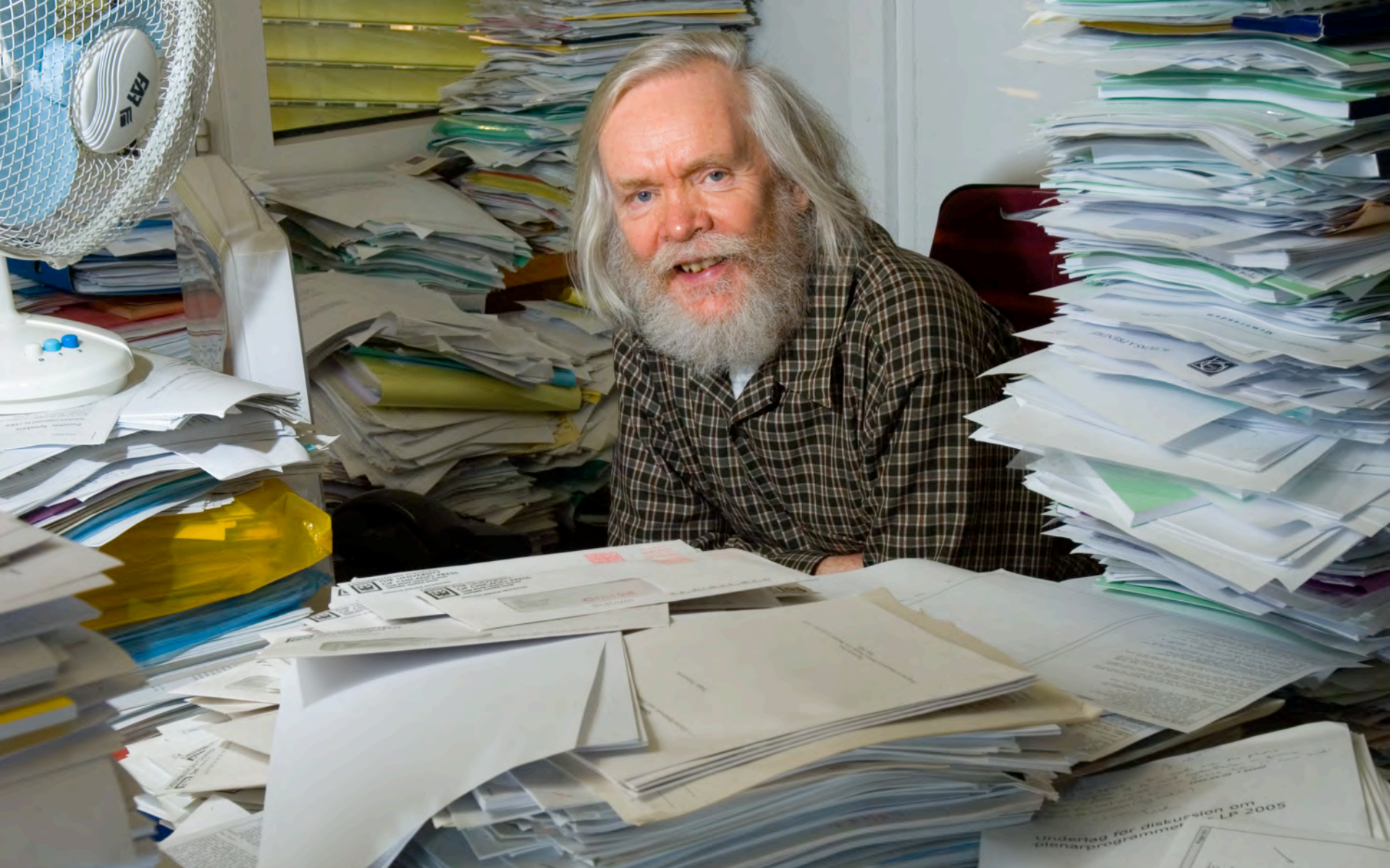


hyperauthorship

~15'000 experimental physicists in big teams,  
smashing stuff at the speed of light (and beyond)







~ 15'000 HEP theorists scratching their heads to make sense of all that stuff (9 in 10 papers)



what about text mining?



Once upon a time, when air-mail was fast...



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...then mailed them to journals AND colleagues...



...other scientists read these preprints...



MAT  
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TECHNOLOGY, CAMBRIDGE, RES.

C

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge.  
Laboratory for Nuclear Science.  
A limit on the branching ratio  $X^* \rightarrow X^* + \gamma$ , by D.  
Friedell, R. Deutsch, D. Cutts, R. Stiening and C. Wiegand.  
December 1967. 10 p.

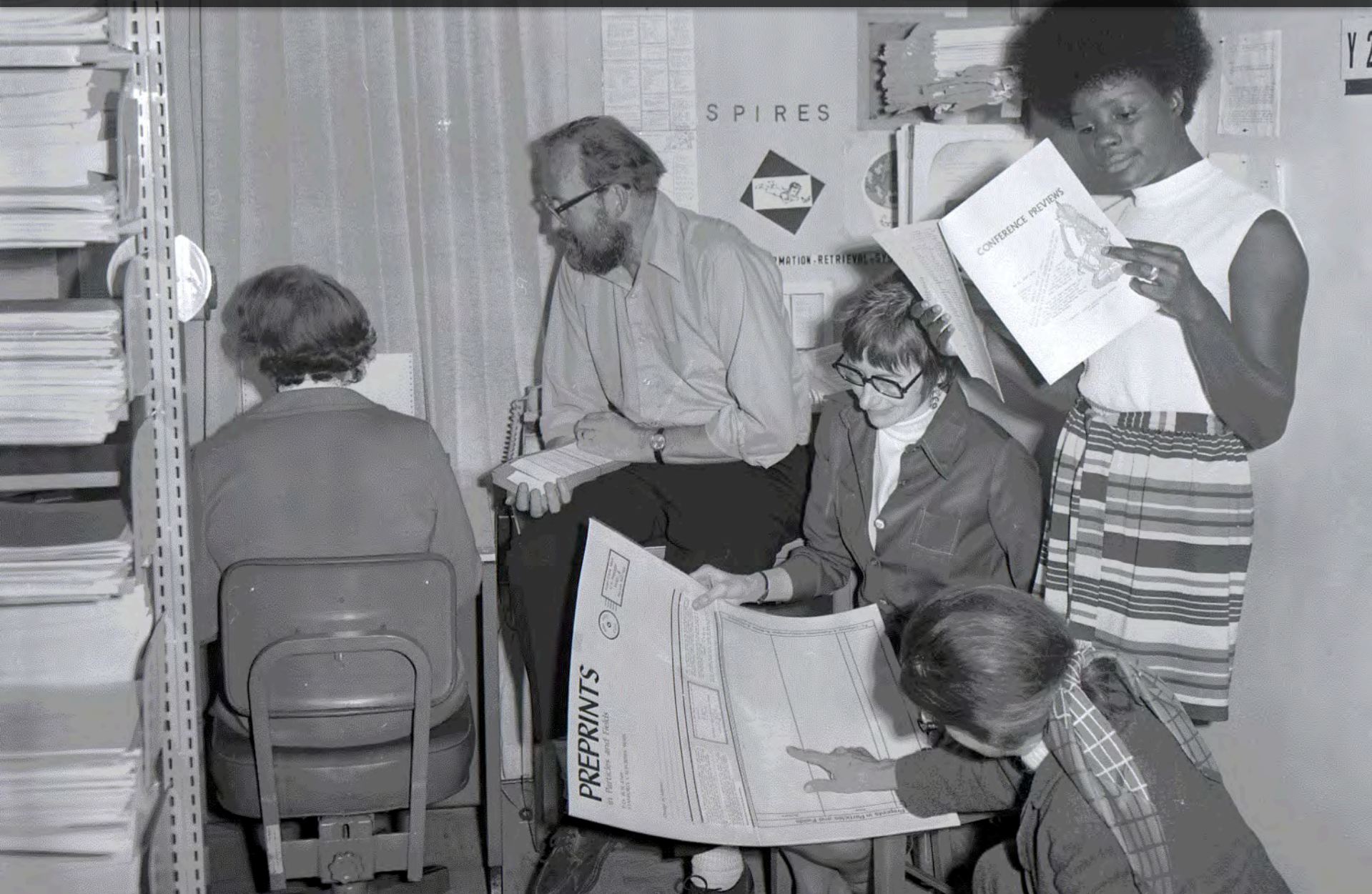
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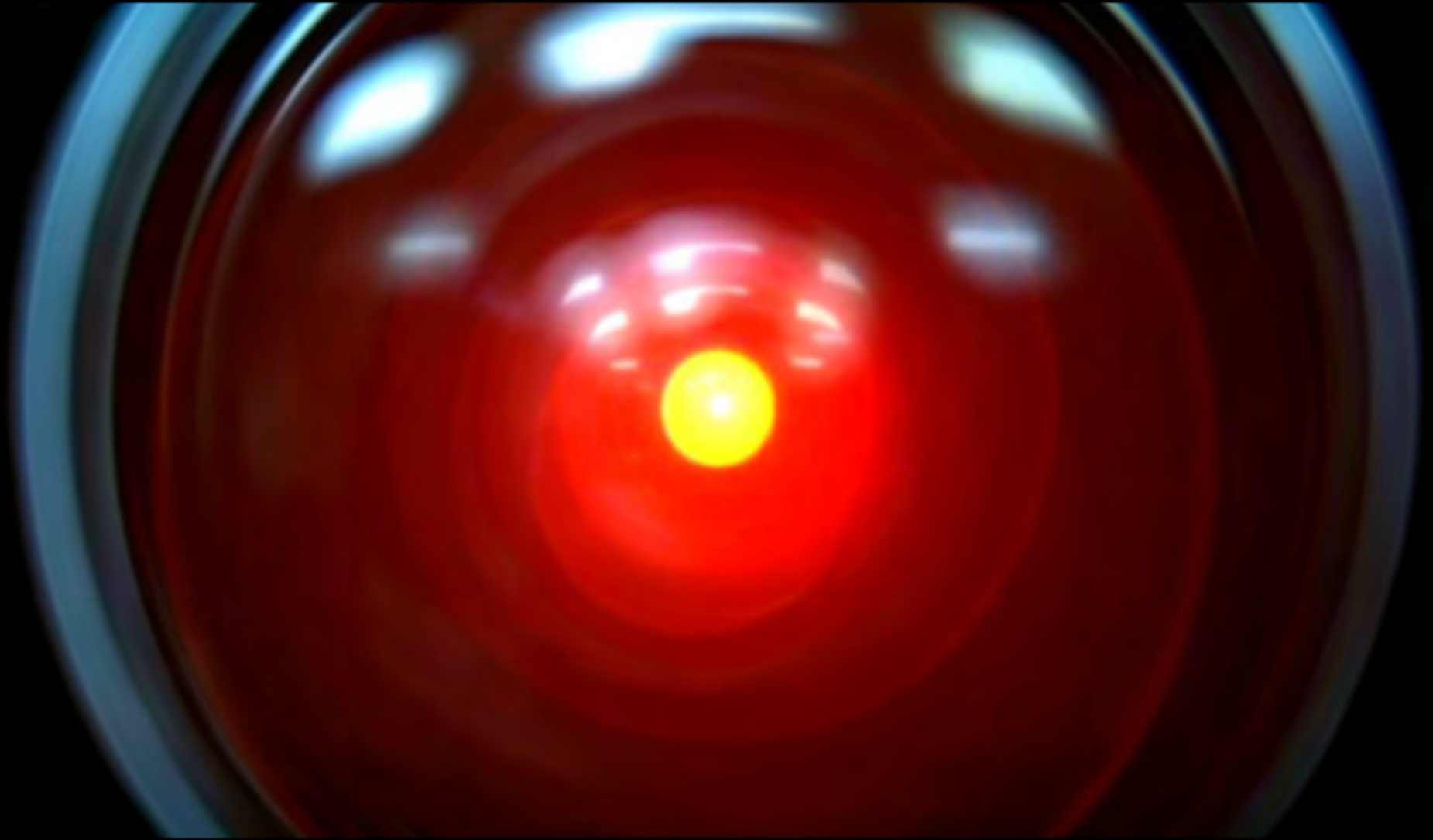
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(and the first database on the web)





...a few years later...

...taught machines to take care of most things





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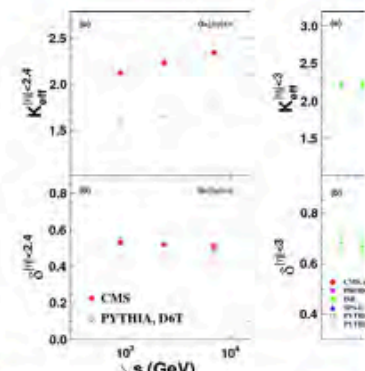
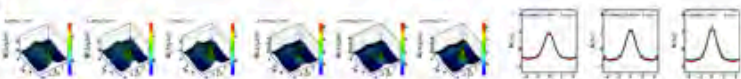
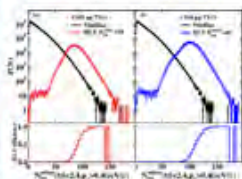
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CMS Collaboration ([Vardan Khachatryan et al.](#)) [Show all 2164 authors.](#)  
 CMS-QCD-10-002, CERN-PH-EP-2010-031.  
 Sep 2010

**JHEP 1009 (2010) 091**  
 e-Print: [arXiv:1009.4122 \[hep-ex\]](#)

**Abstract:** Results on two-particle angular correlations for charged particles emitted in proton-proton collisions at center-of-mass energies of 0.9, 2.36, and 7 TeV are presented, using data collected with the CMS detector over a broad range of pseudorapidity ( $\eta$ ) and azimuthal angle ( $\phi$ ). Short-range correlations in  $\Delta\eta(\eta)$ , which are studied in minimum bias events, are characterized using a simple 'independent cluster' parametrization in order to quantify their strength (cluster size) and their extent in  $\eta$  (cluster decay width). Long-range azimuthal correlations are studied differentially as a function of charged particle multiplicity and particle transverse momentum using a 980 inverse nb data set at 7 TeV. In high multiplicity events, a pronounced structure emerges in the two-dimensional correlation function for particle pairs with intermediate transverse momentum of 1-3 GeV/c,  $2.0 < |\Delta\eta(\eta)| < 4.8$  and  $\Delta\phi(\phi)$  near 0. This is the first observation of such a long-range, near-side feature in two-particle correlation functions in pp or p-pbar collisions.

**Keyword(s):** [INSPIRE: correlation function: two-particle](#) | [angular correlation: two-particle](#) | [charged particle: multiplicity](#) | [rapidity: correlation](#) | [correlation: short-range](#) | [p p: inelastic scattering](#) | [correlation: long-range](#) | [CERN LHC Coll](#) | [CMS](#) | [transverse momentum: dependence](#) | [experimental results](#) | [track data analysis: cluster](#) | [900: 2360: 7000 GeV-cms](#)  
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## Observation of Long-Range Near-Side Angular Correlations in Proton-Proton Collisions at the LHC.

CMS Collaboration ([Vardan Khachatryan et al.](#)) [Show all 2164 authors.](#)

CMS-QCD-10-002, CERN-PH-EP-2010-031.

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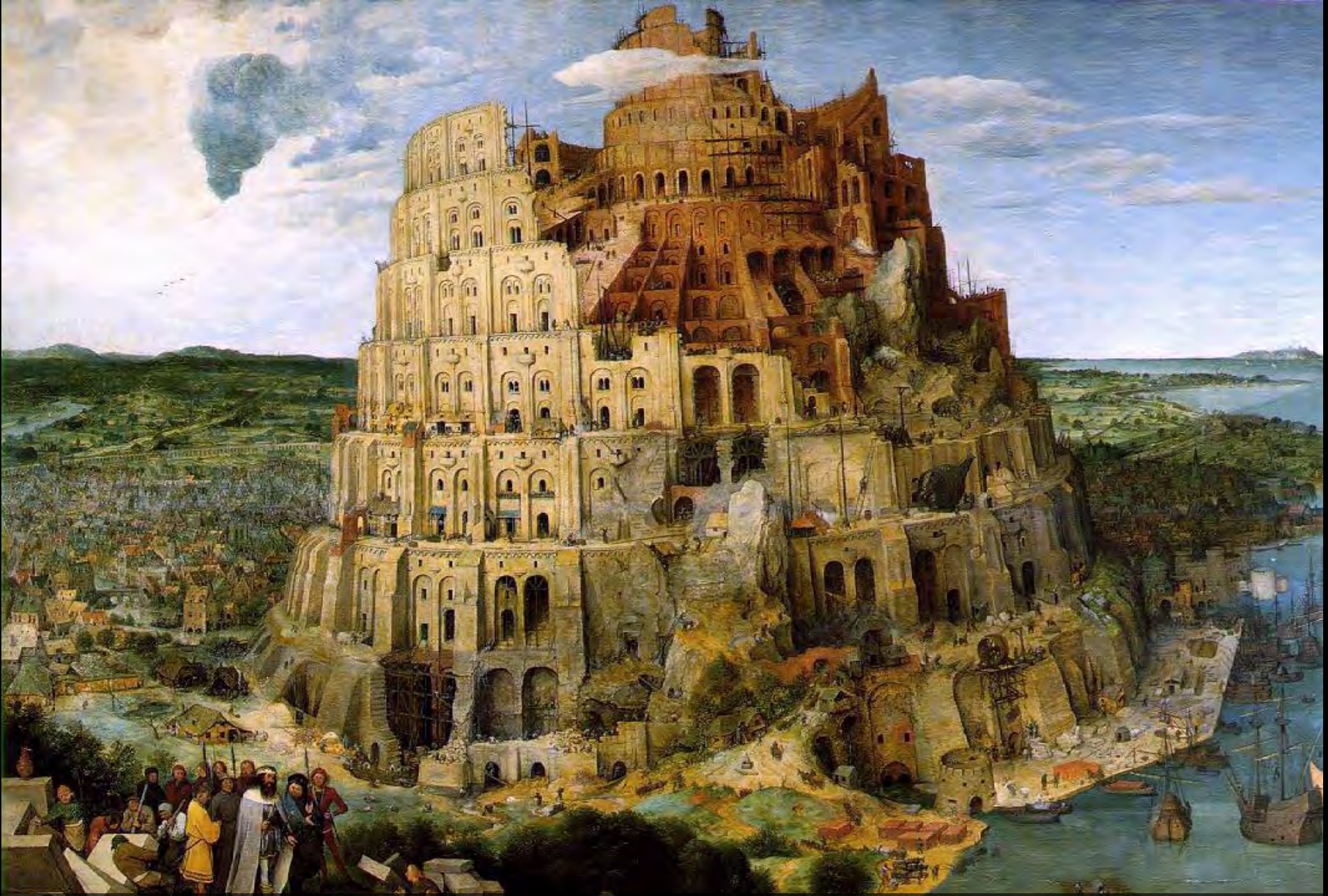
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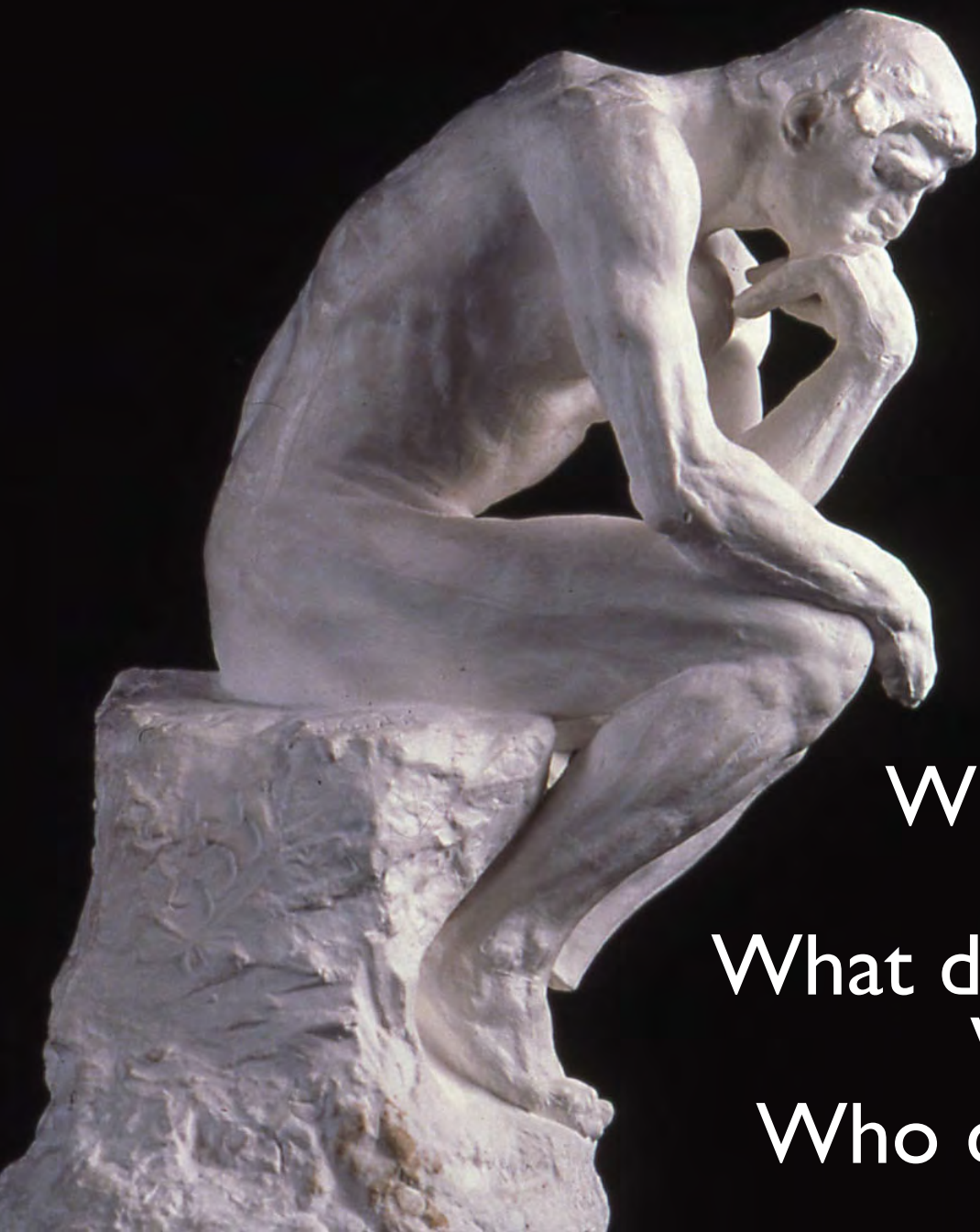


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How do we go beyond?





**Making scientists happy !**





First collisions at the LHC





What else makes scientists happy ?

**citations**



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## Measurement of the neutrino velocity with the OPERA detector in the CNGS beam.

OPERA Collaboration (T. Adam *et al.*) [Show all 174 authors.](#)

Sep 2011

24 pp. e-Print: [arXiv:1109.4897 \[hep-ex\]](#)

**Abstract:** The OPERA neutrino experiment at the underground Gran Sasso Laboratory has measured the velocity of neutrinos from the CERN CNGS beam over a baseline of about 730 km with much higher accuracy than previous studies conducted with accelerator neutrinos. The measurement is based on high-statistics data taken by OPERA in the years 2009, 2010 and 2011. Dedicated upgrades of the CNGS timing system and of the OPERA detector, as well as a high precision geodesy campaign for the measurement of the neutrino baseline, allowed reaching comparable systematic and statistical accuracies. An early arrival time of CNGS muon neutrinos with respect to the one computed assuming the speed of light in vacuum of  $(57.8 \pm 7.8 \text{ (stat.)} + 8.3\text{-}5.9 \text{ (sys.)})$  ns was measured. This anomaly corresponds to a relative difference of the muon neutrino velocity with respect to the speed of light  $(v-c)/c = (2.37 \pm 0.32 \text{ (stat.)} \pm 0.5 \text{ (sys.)}) \times 10^{-5}$ . The above result, obtained by comparing the time distributions of neutrino interactions and of protons hitting the CNGS target in 10.5  $\mu$ s long extractions, was confirmed by a test performed using a beam with a short-bunch time-





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### 2. Combined results on $b\bar{b}$ hadron production rates and decay properties.

(50) [ALEPH](#) and [CDF](#) and [DELPHI](#) and [L3](#) and [OPAL](#) and [SLD](#) Collaborations ([D. Abbaneo et al.](#)).

SLAC-PUB-9500. CERN-EP-2001-050. Jun 2001. 90 pp.

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### Frequent keywords

[electron positron: colliding beams \(224\)](#)

[L3 \(219\)](#)

[CERN LEP Stor \(213\)](#)

[electron positron: annihilation \(182\)](#)

[Z0: electroproduction \(67\)](#)

[approx. 91 GeV-cms \(60\)](#)

[Z0: hadronic decay \(50\)](#)

[exchange: two-photon \(37\)](#)

[Higgs particle: mass \(32\)](#)

[channel cross section \(29\)](#)

### Affiliations

[unknown affiliation \(228\)](#)

[CERN \(34\)](#)

[INFN, Naples \(19\)](#)

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### Frequent co-authors

[Banerjee, S. \(254\)](#)

[Bourlikov, D. \(231\)](#)

[Gurtu, A. \(231\)](#)

[Sciacca, C. \(231\)](#)

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[Paolucci, P. \(230\)](#)

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<b>Breakdown of papers by citations:</b>		
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Famous papers (250-499)	<a href="#">1</a>	<a href="#">1</a>
Very well-known papers (100-249)	<a href="#">7</a>	<a href="#">4</a>
Well-known papers (50-99)	<a href="#">26</a>	<a href="#">23</a>
Known papers (10-49)	<a href="#">156</a>	<a href="#">153</a>
Less known papers (1-9)	<a href="#">54</a>	<a href="#">46</a>
Unknown papers (0)	<a href="#">11</a>	<a href="#">7</a>
<b>Additional Citation Metrics</b> <a href="#">?</a>		
h-index <a href="#">?</a>	43	42



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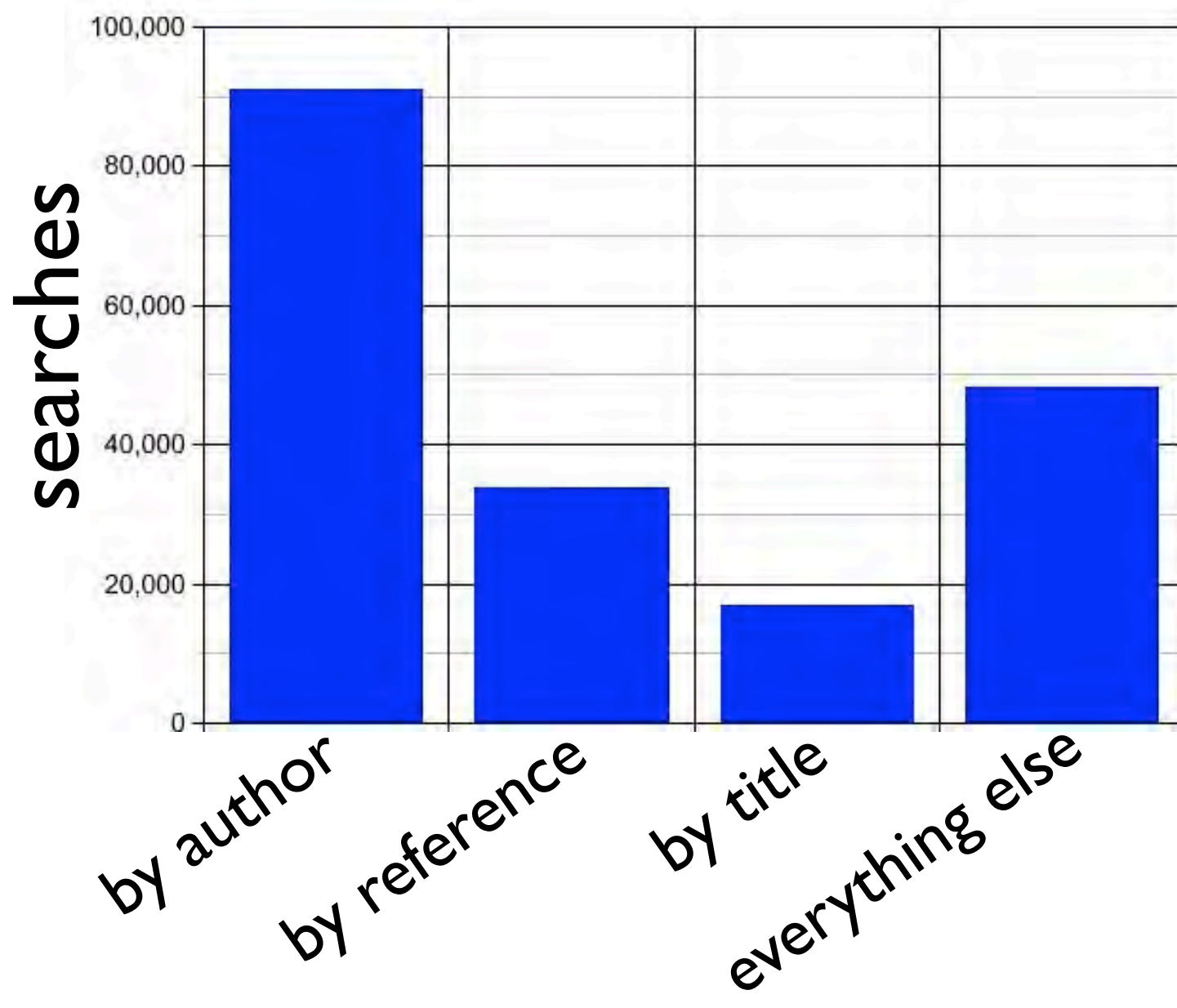
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<b>list of authors for entry</b> [redacted]@mpg.de	new 28 hours ago
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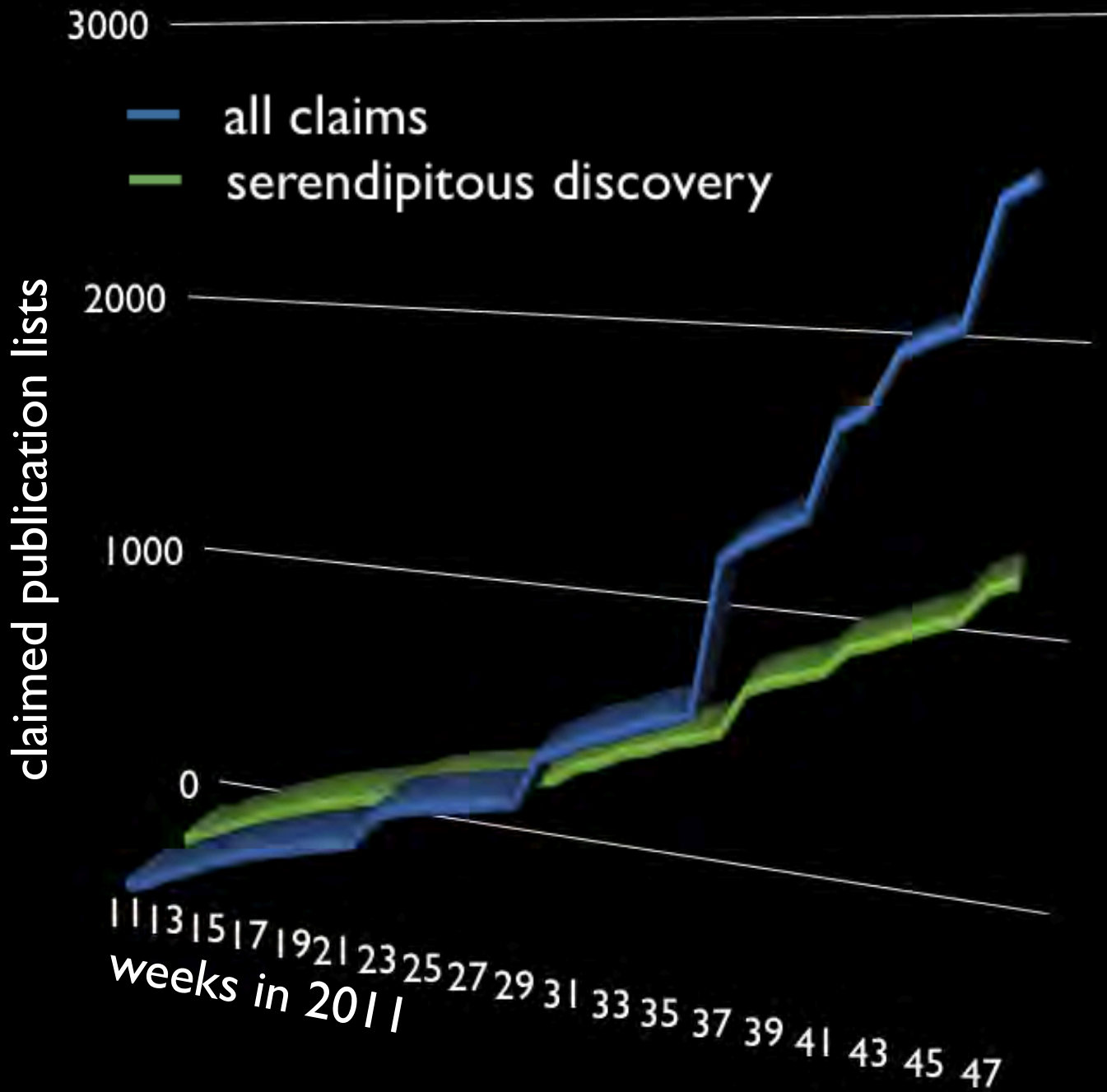
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<input type="checkbox"/>	<b>1. Data Preservation in High Energy Physics</b> DPHEP Study Group Collaboration (Richard Mount (SLAC) <i>et al.</i> ).	Mele, Salvatore	CERN	2009-11	None	<input checked="" type="checkbox"/> Yes, this paper is by this person. <input checked="" type="checkbox"/> No, this paper is <i>not</i> by this person <input checked="" type="checkbox"/> Assign to another person
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<input type="checkbox"/>	<b>4. The BaBar detector for muon identification and neutral hadron detection</b> P. Paolucci, C. Evangelista, A. Palano, R. Baldini, A. Calcaterra, R. De Sangro, M. Piccolo, A. Zallo, I. Peruzzi, A. Buzzo <i>et al.</i>	Mele, S.	Not assigned	1996	SLAC-PEP2-BABAR	<input checked="" type="checkbox"/> Yes, this paper is by this person. <input checked="" type="checkbox"/> No, this paper is <i>not</i> by this person <input checked="" type="checkbox"/> Assign to another person
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> 2'500

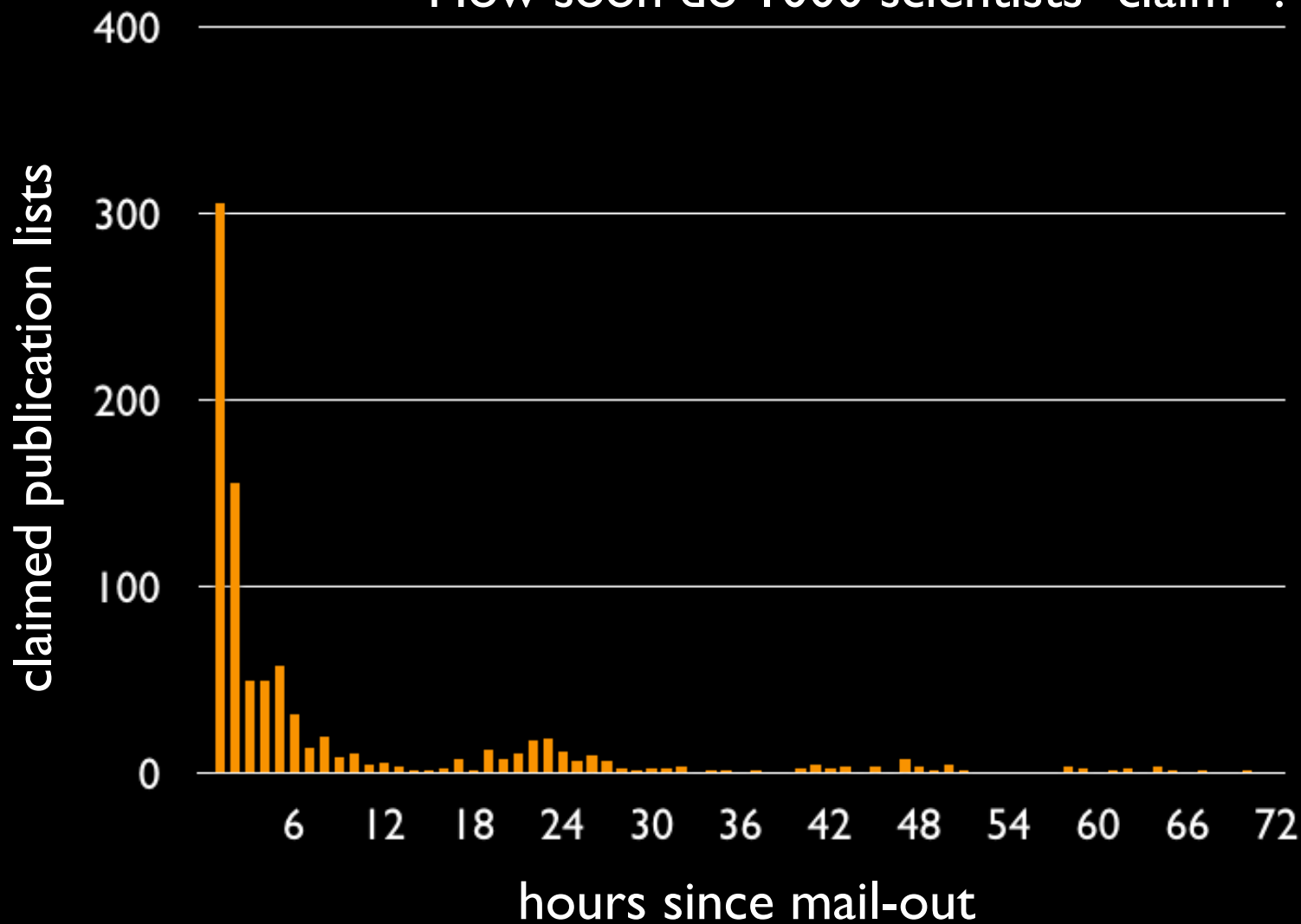
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(out of 30'000 active physicists, without major effort)





How soon do 1000 scientists “claim” ?



> 30%

response rate to solicitation  
(mostly within hours!)

> 160'000

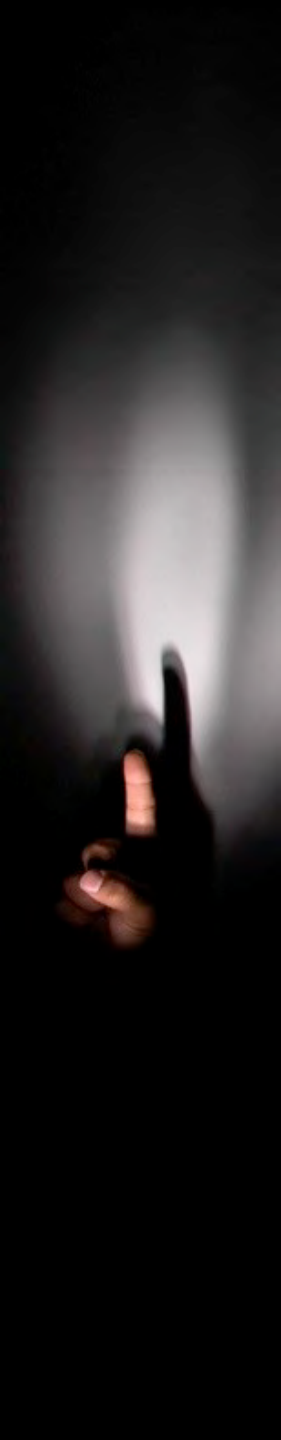
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(out of 1million)



we learnt three things





text-mining goes only so far



need (qualified) humans to look at stuff





they will if they care

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**build  
partnership  
with users**

**ORCID**

**Open Research  
& Contributor ID**



**Working together to align the global network**

An independent, community effort to standardize researcher identification



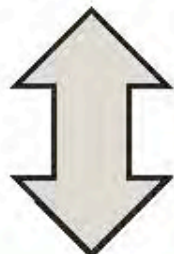
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**ResearcherID**

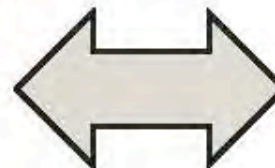
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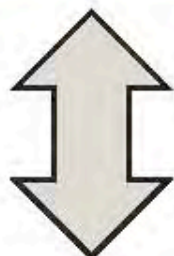
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