

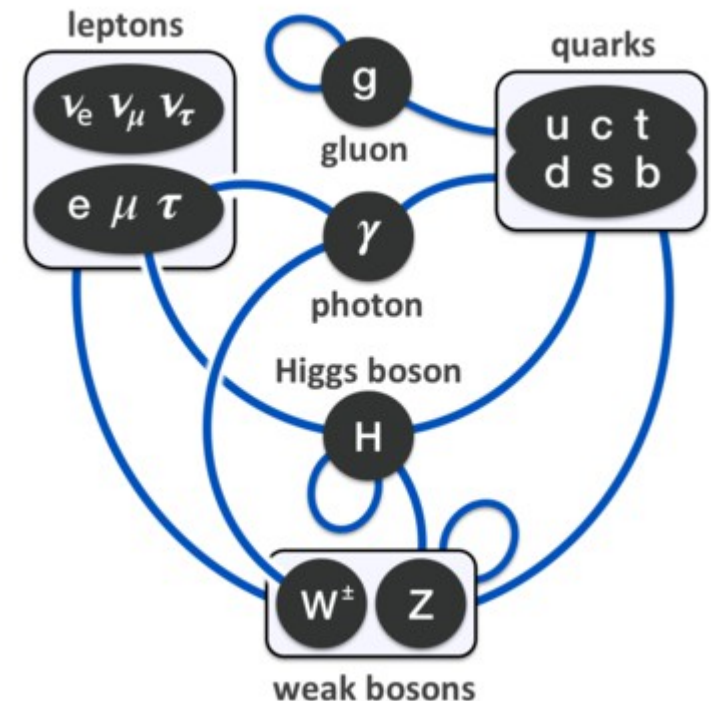
Open Access practices in High Energy Physics

Andrea Giammanco

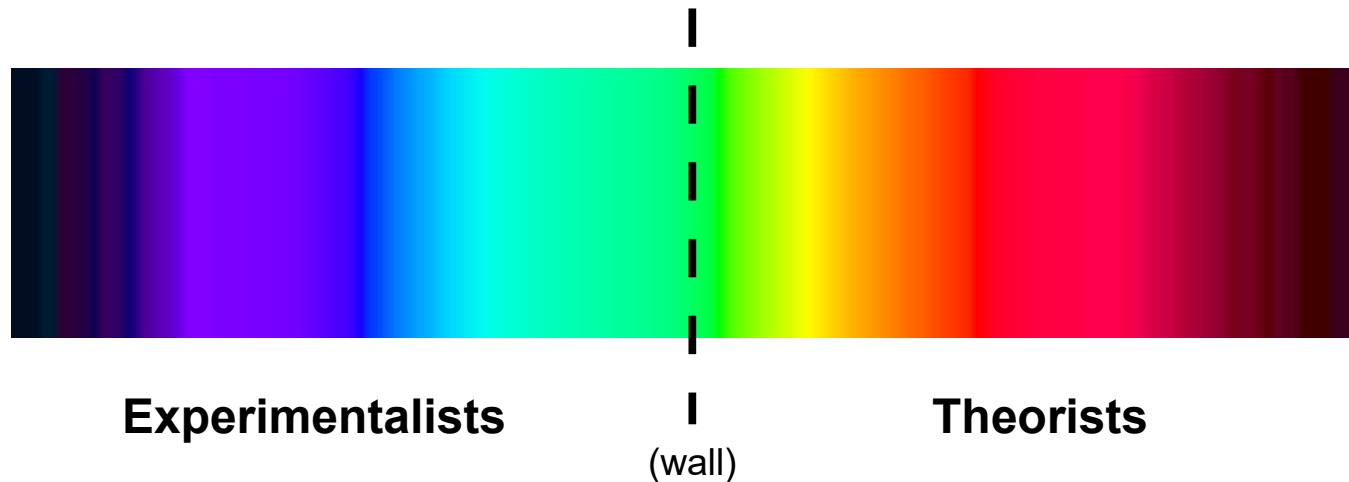
Centre for Cosmology, Particle Physics and Phenomenology
UCL, Louvain-la-Neuve, Belgium

Elementary Particle Physics

- Also known as **High Energy Physics (HEP)** although some of our data have nothing to do with large energies
- Mission: study the most fundamental level of matter (elementary particles = $\alpha\tau\omicron\mu\alpha$)
- Big Bang theory \Rightarrow connection of micro- with macro-physics



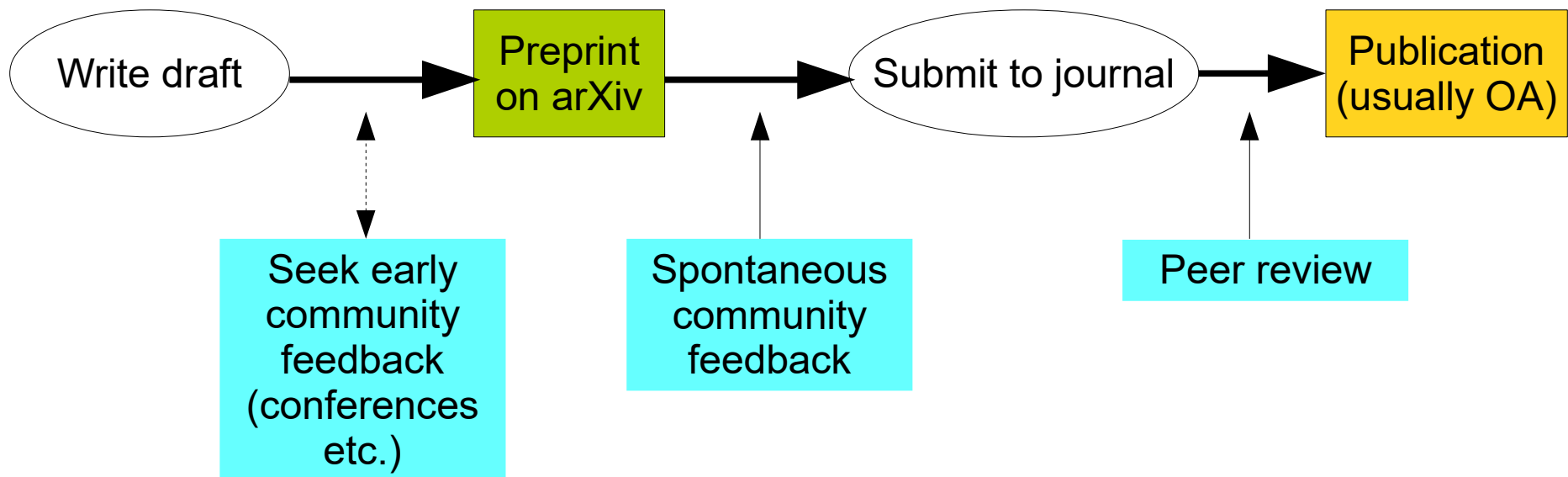
Human spectrum of HEP



- Distinction emerged in Physics around the early XX century; hopping from one side to the other is very unusual in HEP
- Since the 70s, exp people tend to form larger and larger collaborations; record held by the ATLAS and CMS experiments at CERN's LHC with ~3000 co-authors each
- Theory papers have few authors (most frequently 2 or 3)
- Small exp collaborations (<100) still exist; exp-theory collaborations also happen (rarely); experimentalists seldomly publish few-authors papers too
- Theory and exp share the same editorial ecosystem (= read each other)

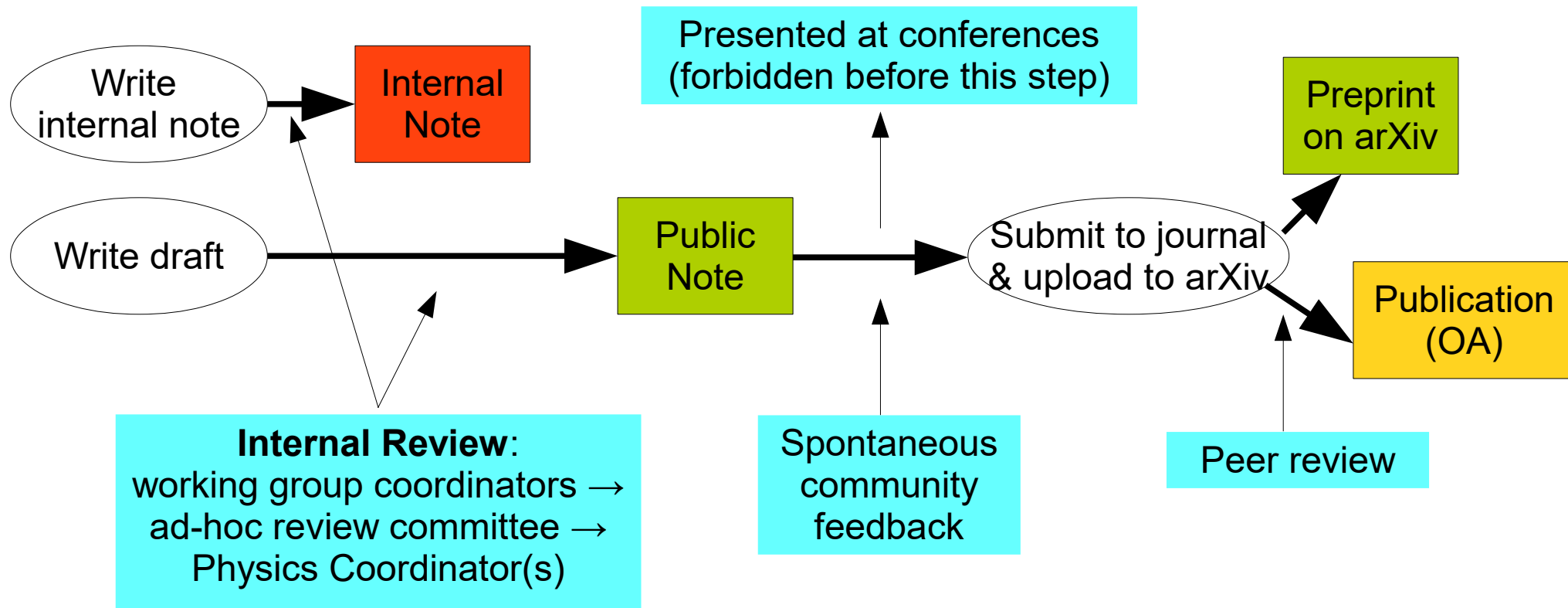
Publication practices: case 1

- Theorists, small experiments, or small groups of experimentalists studying new instruments & methods:



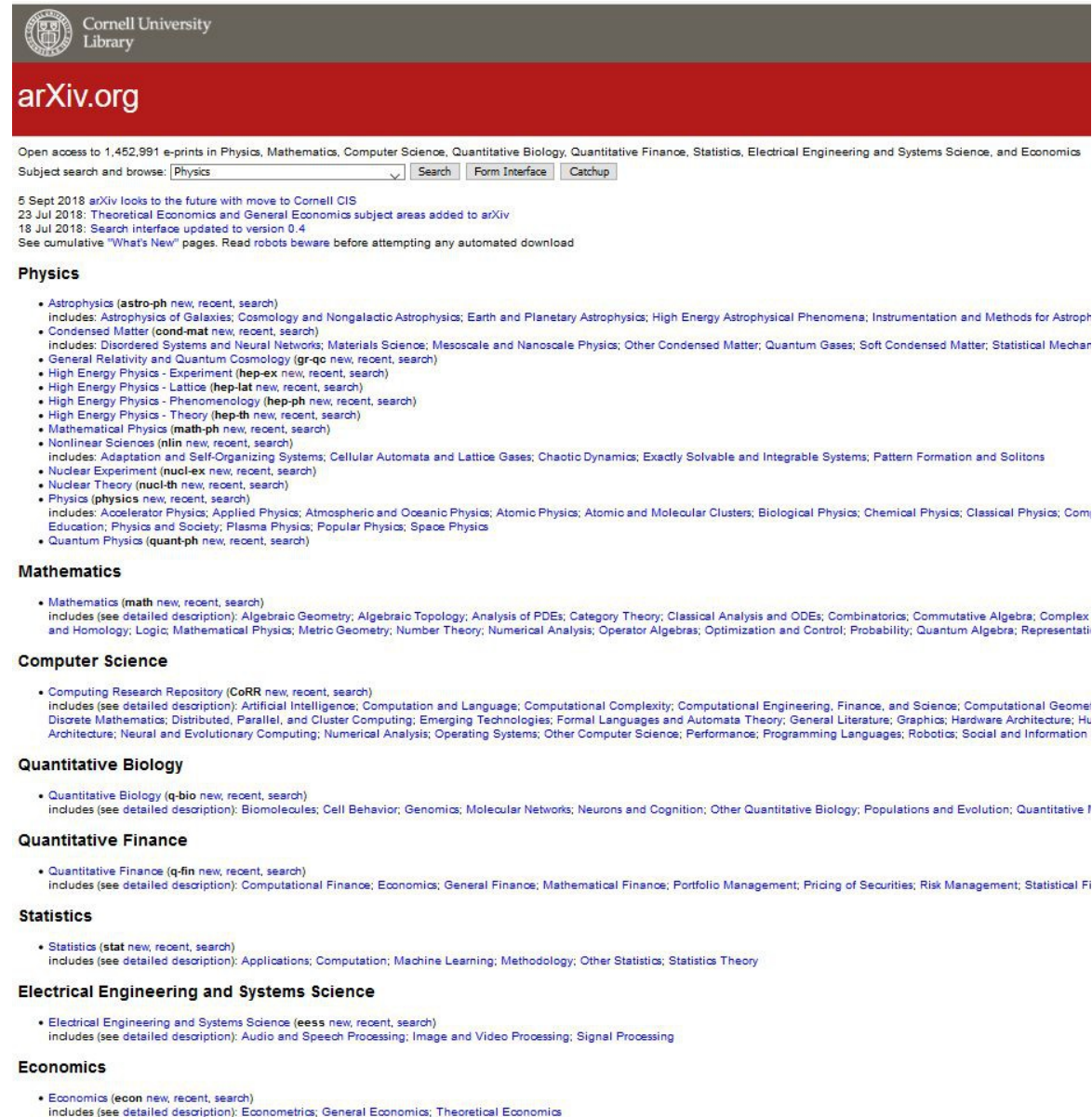
Publication practices: case 2

- Analysis teams within large experimental collaborations:



Preprints: arXiv

- Highly-automated electronic archive and distribution server
- Maintained and operated by the Cornell University Library, funded by a network of O(100) libraries, with guidance from a Scientific Advisory Board and a Member Advisory Board
- Subject moderators may reject submissions in extreme cases; but they do not review



The screenshot shows the arXiv.org website interface. At the top left is the Cornell University Library logo. The main header is a red bar with "arXiv.org" in white. Below the header, there is a navigation bar with the text "Open access to 1,452,991 e-prints in Physics, Mathematics, Computer Science, Quantitative Biology, Quantitative Finance, Statistics, Electrical Engineering and Systems Science, and Economics". A search bar is present with a dropdown menu set to "Physics" and buttons for "Search", "Form Interface", and "Catchup". Below the search bar, there are several lines of text providing updates: "5 Sept 2018 arXiv looks to the future with move to Cornell CIS", "23 Jul 2018: Theoretical Economics and General Economics subject areas added to arXiv", "18 Jul 2018: Search interface updated to version 0.4", and "See cumulative 'What's New' pages. Read robots beware before attempting any automated download". The main content area is divided into sections for different subjects: "Physics", "Mathematics", "Computer Science", "Quantitative Biology", "Quantitative Finance", "Statistics", "Electrical Engineering and Systems Science", and "Economics". Each section lists various sub-fields and includes links for "new", "recent", and "search".

Cornell University Library

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Subject search and browse:

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Physics

- Astrophysics ([astro-ph new](#), [recent](#), [search](#))
includes: Astrophysics of Galaxies; Cosmology and Nongalactic Astrophysics; Earth and Planetary Astrophysics; High Energy Astrophysical Phenomena; Instrumentation and Methods for Astrophysics
- Condensed Matter ([cond-mat new](#), [recent](#), [search](#))
includes: Disordered Systems and Neural Networks; Materials Science; Mesoscale and Nanoscale Physics; Other Condensed Matter; Quantum Gases; Soft Condensed Matter; Statistical Mechanics
- General Relativity and Quantum Cosmology ([gr-qc new](#), [recent](#), [search](#))
- High Energy Physics - Experiment ([hep-ex new](#), [recent](#), [search](#))
- High Energy Physics - Lattice ([hep-lat new](#), [recent](#), [search](#))
- High Energy Physics - Phenomenology ([hep-ph new](#), [recent](#), [search](#))
- High Energy Physics - Theory ([hep-th new](#), [recent](#), [search](#))
- Mathematical Physics ([math-ph new](#), [recent](#), [search](#))
- Nonlinear Sciences ([nlin new](#), [recent](#), [search](#))
includes: Adaptation and Self-Organizing Systems; Cellular Automata and Lattice Gases; Chaotic Dynamics; Exactly Solvable and Integrable Systems; Pattern Formation and Solitons
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includes: Accelerator Physics; Applied Physics; Atmospheric and Oceanic Physics; Atomic Physics; Atomic and Molecular Clusters; Biological Physics; Chemical Physics; Classical Physics; Computational Physics; Education; Physics and Society; Plasma Physics; Popular Physics; Space Physics
- Quantum Physics ([quant-ph new](#), [recent](#), [search](#))

Mathematics

- Mathematics ([math new](#), [recent](#), [search](#))
includes (see detailed description): Algebraic Geometry; Algebraic Topology; Analysis of PDEs; Category Theory; Classical Analysis and ODEs; Combinatorics; Commutative Algebra; Complex Analysis; Homology; Logic; Mathematical Physics; Metric Geometry; Number Theory; Numerical Analysis; Operator Algebras; Optimization and Control; Probability; Quantum Algebra; Representation Theory

Computer Science

- Computing Research Repository (CoRR) ([CoRR new](#), [recent](#), [search](#))
includes (see detailed description): Artificial Intelligence; Computation and Language; Computational Complexity; Computational Engineering, Finance, and Science; Computational Geometry; Discrete Mathematics; Distributed, Parallel, and Cluster Computing; Emerging Technologies; Formal Languages and Automata Theory; General Literature; Graphics; Hardware Architecture; Human-Computer Interaction; Architecture; Neural and Evolutionary Computing; Numerical Analysis; Operating Systems; Other Computer Science; Performance; Programming Languages; Robotics; Social and Information Security

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includes (see detailed description): Biomolecules; Cell Behavior; Genomics; Molecular Networks; Neurons and Cognition; Other Quantitative Biology; Populations and Evolution; Quantitative Finance

Quantitative Finance

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includes (see detailed description): Computational Finance; Economics; General Finance; Mathematical Finance; Portfolio Management; Pricing of Securities; Risk Management; Statistical Finance

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includes (see detailed description): Econometrics; General Economics; Theoretical Economics

Publications: SCOAP3



SCOAP³ – Sponsoring Consortium for Open Access Publishing in Particle Physics

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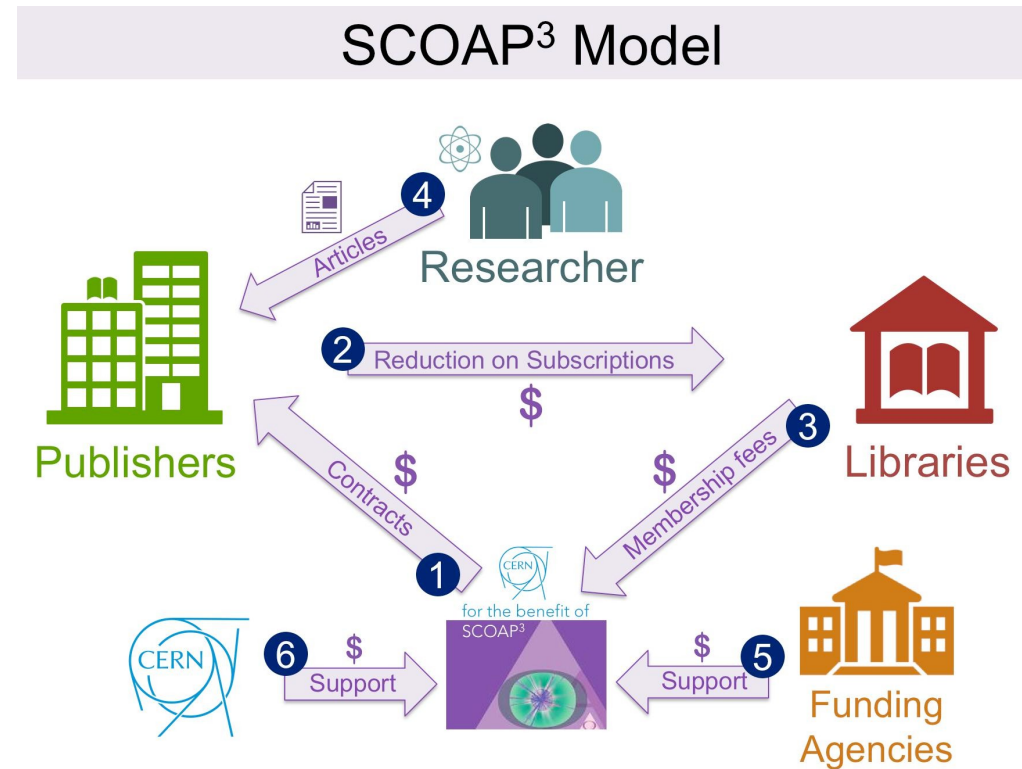
Articles funded by SCOAP³:

49	607	5 665	23 732
yesterday	last 30 days	in 2018	since 2014

<https://scoap3.org/what-is-scoap3/>

SCOAP3

- HEP journals converted to OA at no cost for authors (today ~90% of all HEP papers are published OA)
- SCOAP3 centrally pays publishers for OA costs, publishers in turn reduce subscription fees
- Countries contribute proportionally to scientific output in HEP
- Copyright stays with authors; CC-BY license allows text- and data-mining
- CERN acts as host organization for SCOAP3 (similar to LHC exps)
- LHC exps since 2007 pledge to submit OA; SCOAP3 helps them



A. Kohls, S. Mele, *Converting the Literature of a Scientific Field to Open Access through Global Collaboration: The Experience of SCOAP3 in Particle Physics*, *Publications* 2018, 6(2), 15; <https://doi.org/10.3390/publications6020015>

Some exceptions to the rule



nature
physics

LETTERS

PUBLISHED ONLINE: 22 JUNE 2014 | DOI: 10.1038/NPHYS3005

Evidence for the direct decay of the 125 GeV Higgs boson to fermions

The CMS Collaboration[†]

The discovery of a new boson with a mass of approximately 125 GeV in 2012 at the Large Hadron Collider^{1–3} has heralded a new era in understanding the nature of electroweak symmetry breaking and possibly completing the standard model of particle physics^{4–9}. Since the first observation in decays to $\gamma\gamma$, WW and ZZ boson pairs, an extensive set of measurements of the mass^{10,11} and couplings to W and Z bosons^{11–13}, as well as multiple tests of the spin-parity quantum numbers^{10,11,13,14}, have revealed that the properties of the new boson are consistent with those of the long-sought agent responsible for electroweak symmetry breaking. An important open question is whether the new particle also couples to fermions, and in particular to down-type fermions, as the current measurements mainly constrain the couplings to the up-type top quark. Determination of the couplings to down-type fermions requires direct measurement of the corresponding Higgs boson decays, as recently reported by the Compact Muon Solenoid (CMS) experiment in the study of Higgs decays to bottom quarks¹⁵ and τ leptons¹⁶. Here, we report the combination of these two channels, which results in strong evidence for the direct coupling of the 125 GeV Higgs boson to down-type fermions, with an observed significance of 3.8 standard deviations, when 4.4 are expected.

The CMS and ATLAS experiments at the Large Hadron Collider (LHC) have reported the discovery of a new boson^{1–3} with a mass near 125 GeV and with production rates, decay rates and spin-

the heaviest elementary particle known to date, is implied by an overall agreement of the gluon-gluon fusion production channel cross-section with the standard model prediction. However, the masses of down-type fermions may come about through different mechanisms in theories beyond the standard model¹⁹. Therefore, it is imperative to observe the direct decay of this new particle to down-type fermions to firmly establish its nature. As a consequence of the Yukawa interaction discussed above, the most abundant fermionic Higgs boson decays will be to third-generation quarks and leptons, namely the bottom quark and the τ lepton, as the decay of a Higgs boson with a mass around 125 GeV to top quarks is kinematically not allowed. Therefore, the most promising experimental avenue to explore the direct coupling of the standard model Higgs boson to fermions is in the study of the decay to bottom quark-antiquark pairs (denoted as $b\bar{b}$) as well as to tau lepton-antilepton pairs (denoted as $\tau\tau$).

Recently, the CMS Collaboration reported on a search for the decays of the new boson to $b\bar{b}$ quark pairs¹⁵ as well as to $\tau\tau$ lepton pairs¹⁶ based on data collected in 2011 and 2012. In this Letter, we report on the combination of the results from the study of these two decays to down-type fermion-antifermion pairs, performed for the first time at the LHC.

The CMS apparatus comprises several detectors specialized in identifying different types of particles. These detectors are arranged inside and outside a superconducting solenoid of 6 m internal diameter that provides a magnetic field of 3.8 T. The detector

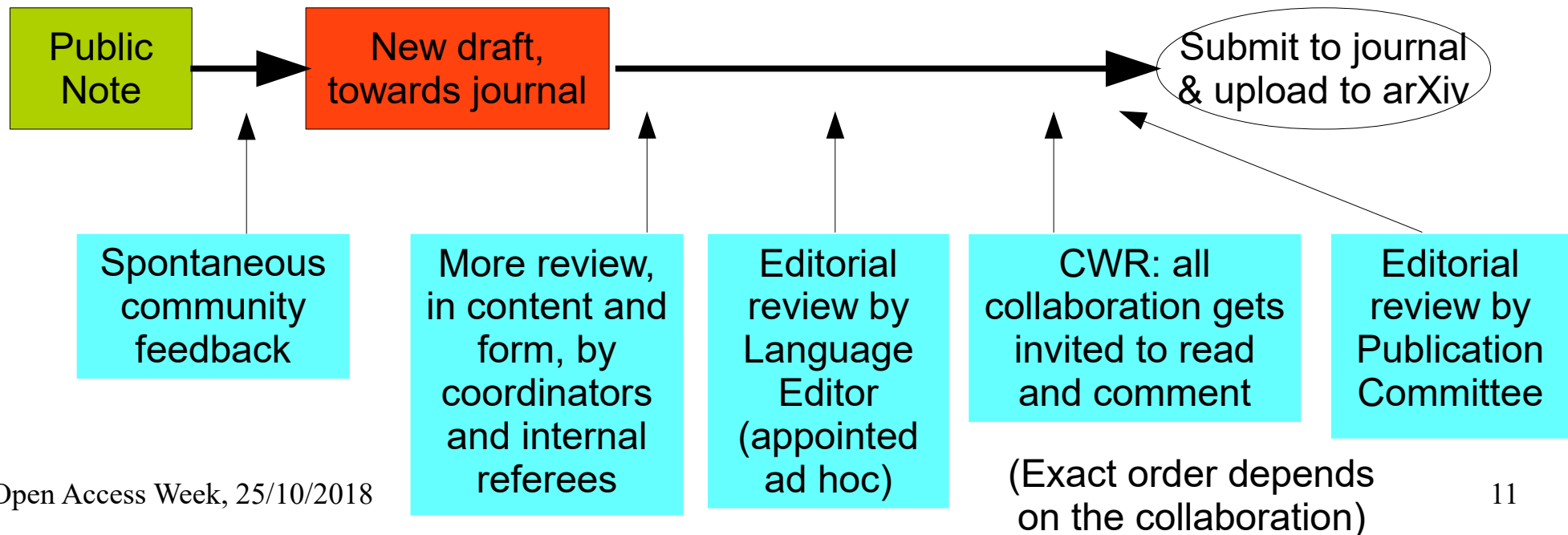
Given their low HEP content, journals as Science or Nature Physics are not in SCOAP3 and are not OA. Occasional LHC articles are OA, reflecting the HEP practices.

Public notes by large collaborations

- Umbrella term for openly accessible online documents that are neither on journals nor on arXiv
 - (e.g.: Physics Analysis Summary in the CMS coll., Conference Note in the ATLAS coll., accessible on CERN Document Server)
 - Typically released in the occasion of key conferences
 - Usually expected to be superseded by a journal article
 - Can also be support material of very technical nature, hence never expected to become a journal article
- There are also cross-experiment working groups that, in some cases, *only* produce public notes

From *public note* to *paper draft*

- In large HEP collaborations, both public notes and journal papers need to pass a severe internal review before being publicly released
- But draft papers must also pass some extra editorial review, plus a Collaboration Wide Review (CWR)



Do we need journals at all?

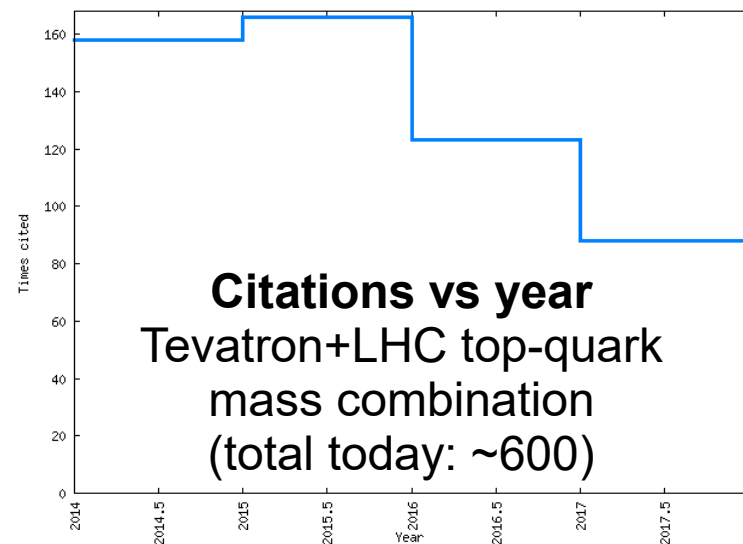
Example #1: most cross-experiment combinations are only public notes:

long-term effect of attracting the attention of the community to the sensitivity of these observables to new physics. This motivated the ATLAS and CMS analysts to join forces for the first joint paper on A_C measurements [51], featuring inclusive measurements at 7 and 8 TeV and a differential measurement as a function of the $t\bar{t}$ invariant mass at 8 TeV (Fig. 8). For the reader interested in the sociology of HEP, it can be remarked that never so far the ATLAS and CMS collaborations had considered a top-quark result worth the editorial burden of a joint peer-reviewed publication (although we had several joint notes already [9].)

Reason: the editorial review within a large collaboration implies significant extra work (with respect to a public note) for many people; a *combination* implies to multiply that by N large collaborations, each having its own procedures and conventions... Gain/cost ratio is often considered too small to be worth this extra work (some exceptions for high-profile combinations, like the one mentioned in this excerpt)

Do we need journals at all?

Example #2: Tevatron+LHC combination of top-quark mass measurements is on arXiv but never submitted for peer-review

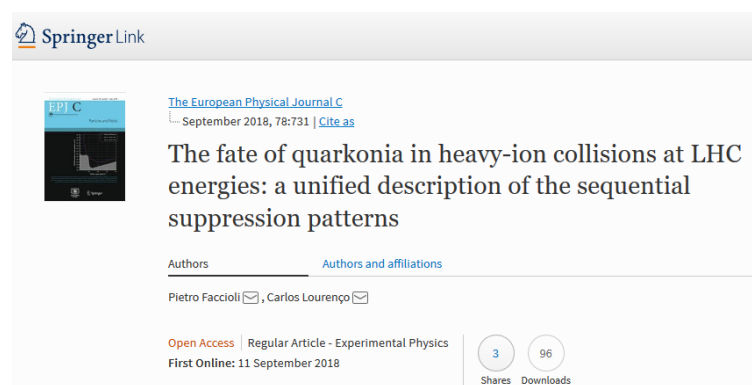


Source: [Inspire](#), the main bibliographic database for HEP, which counts also citations to/from preprints

HEP community trusts public documents by large collaborations; unlikely that major issues are still present by the time of the peer review; CMS submitted ~800 papers, none was ever rejected

Do we need journals at all?

An experiment by a colleague: uploading a theory paper to arXiv only *after* publication by the journal (contrary to the customs of the field)



The screenshot shows the SpringerLink page for the article "The fate of quarkonia in heavy-ion collisions at LHC energies: a unified description of the sequential suppression patterns". The article is from The European Physical Journal C, September 2018, volume 78, issue 731. The authors listed are Pietro Faccioli and Carlos Lourenço. The article is marked as Open Access and is a Regular Article in Experimental Physics. It was first online on 11 September 2018. The page also shows 3 shares and 96 downloads.

First Online: 11 September 2018



The screenshot shows the Cornell University Library page for the arXiv preprint "The fate of quarkonia in heavy-ion collisions at LHC energies: a unified description of the sequential suppression patterns". The preprint is identified by the ID arXiv:1809.10488. It is categorized under High Energy Physics - Phenomenology. The authors listed are Pietro Faccioli and Carlos Lourenço. The preprint was submitted on 27 Sep 2018.

Uploaded: 27 September 2018

Authors started to receive e-mails of spontaneous feedback only the day after the upload to arXiv. Impact factor of this journal: 5.2 (2017)

For the HEP community, visibility comes through arXiv; impact factor of the journals is perceived as only relevant for the CV of the main authors

Thanks for your attention

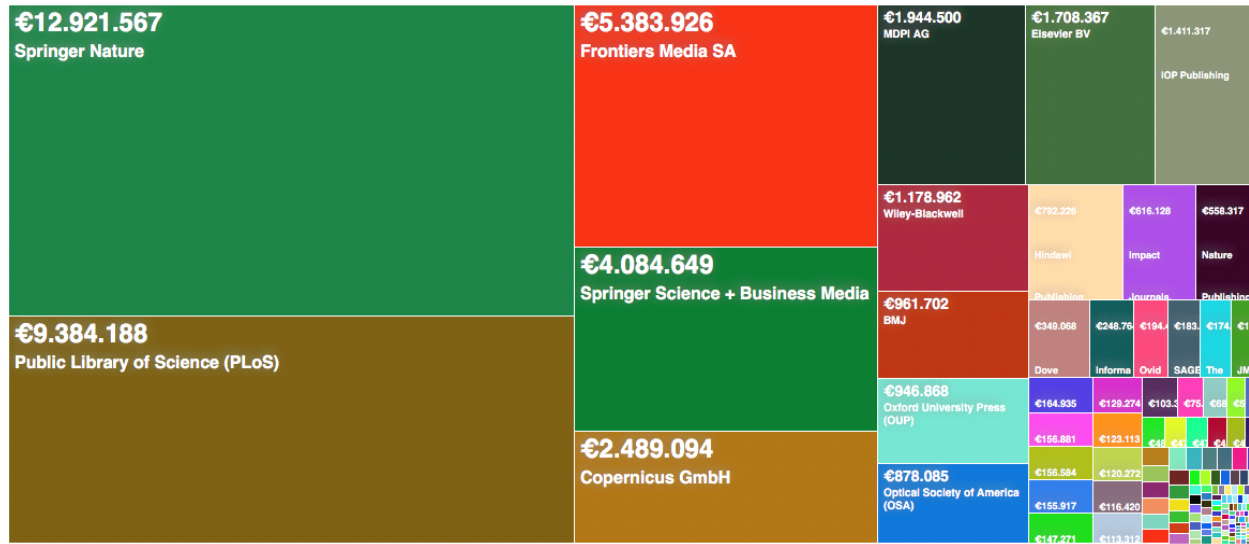
Thanks also to *Boaz Klima* and *Carlos Lourenco* (chair and deputy chair of the CMS Publication Committee), *Salvatore Mele* (head of Open Access at CERN), and to *Georgios Krintiras*, *Pieter David* and *Christophe Delaere* (UCL) for very useful discussions on the subject

Data on 33K articles Open Access **gold (pure)** fees

125 universities, 10 research centers, 3 funding agencies, 1 charity, 10 countries

Average = 1.5 k€

<https://scoap3.org>



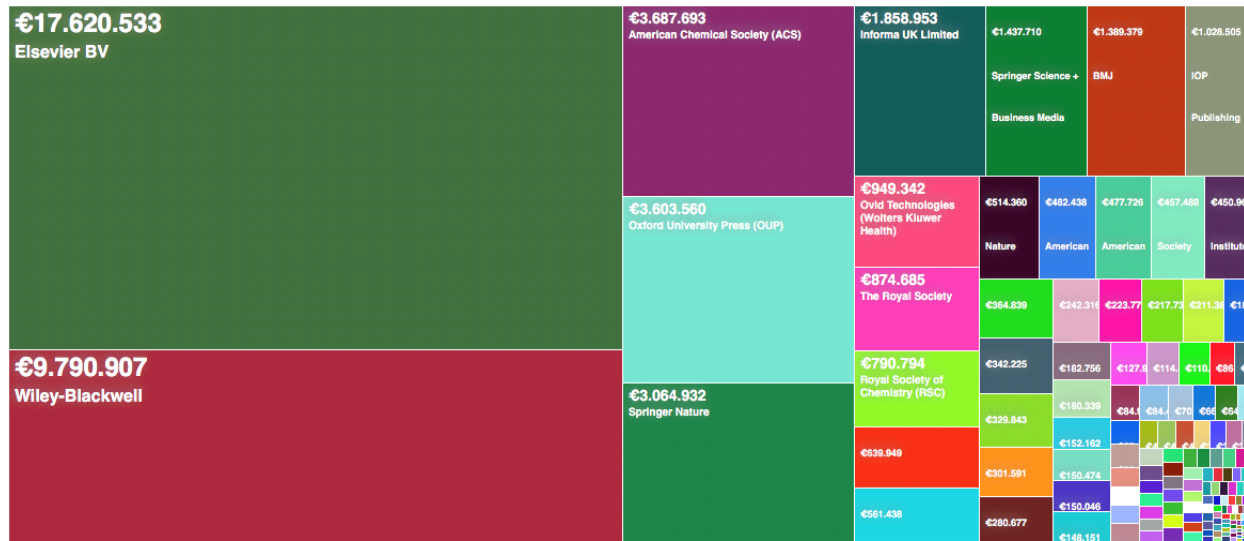
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Publishers (293 entries)	Sum	Number of Articles	Mean Value	Standard Deviation	Percentage
Springer Nature	€12.921.567	7336	€1.761	€789	26.12%
Public Library of Science (PLoS)	€9.384.188	6731	€1.394	€394	18.97%
Frontiers Media SA	€5.383.926	3662	€1.470	€507	10.89%
Springer Science + Business Media	€4.084.649	3071	€1.330	€332	8.26%
Copernicus GmbH	€2.489.094	1847	€1.348	€610	5.03%
MDPI AG	€1.944.500	1654	€1.176	€442	3.93%
Elsevier BV	€1.708.367	792	€2.157	€1.543	3.45%
IOP Publishing	€1.411.317	1172	€1.204	€370	2.85%
Wiley-Blackwell	€1.178.962	753	€1.566	€577	2.38%
BMJ	€961.702	541	€1.778	€375	1.94%
Oxford University Press (OUP)	€946.868	544	€1.741	€676	1.91%
Optical Society of America (OSA)	€878.085	530	€1.657	€472	1.78%
Hindawi Publishing Corporation	€792.226	750	€1.056	€553	1.60%
Impact Journals, LLC	€616.128	247	€2.494	€580	1.25%
Nature Publishing Group	€558.317	203	€2.750	€1.660	1.13%
view small values					
Total	€49.460.913	33299	€1.485	€697	100%

Data on 22K articles Open Access **hybrid** fees

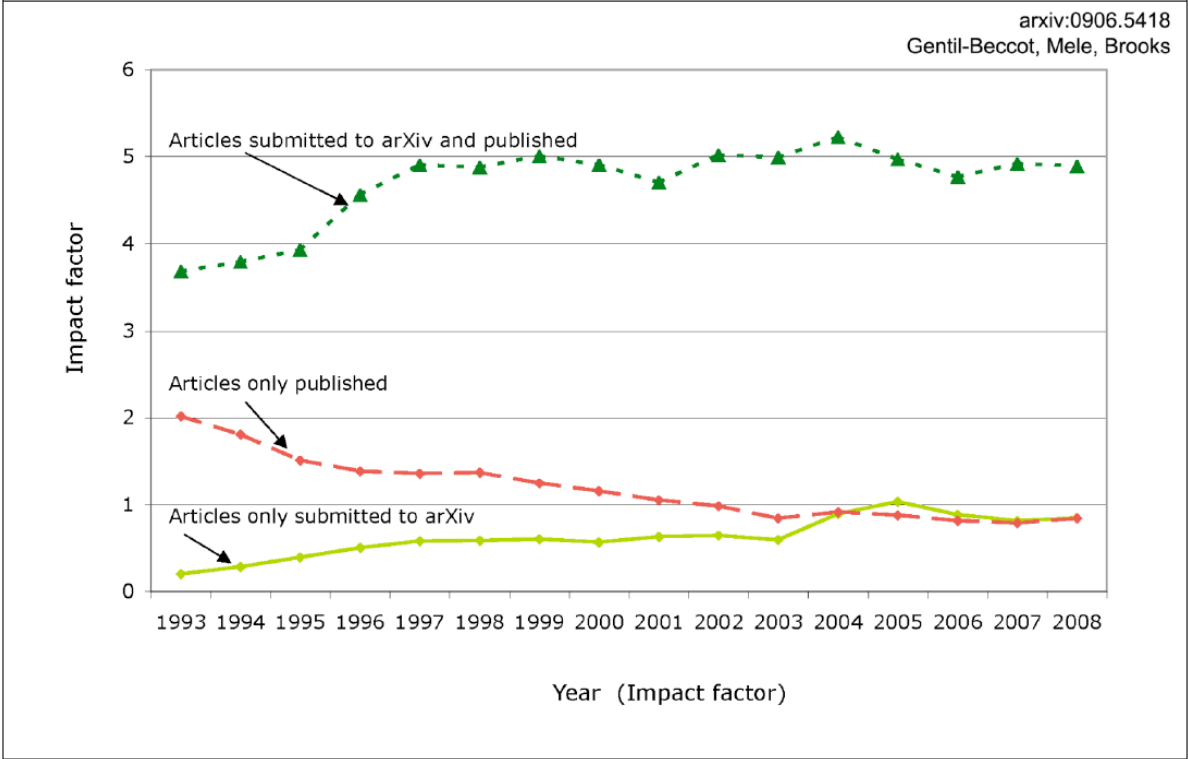
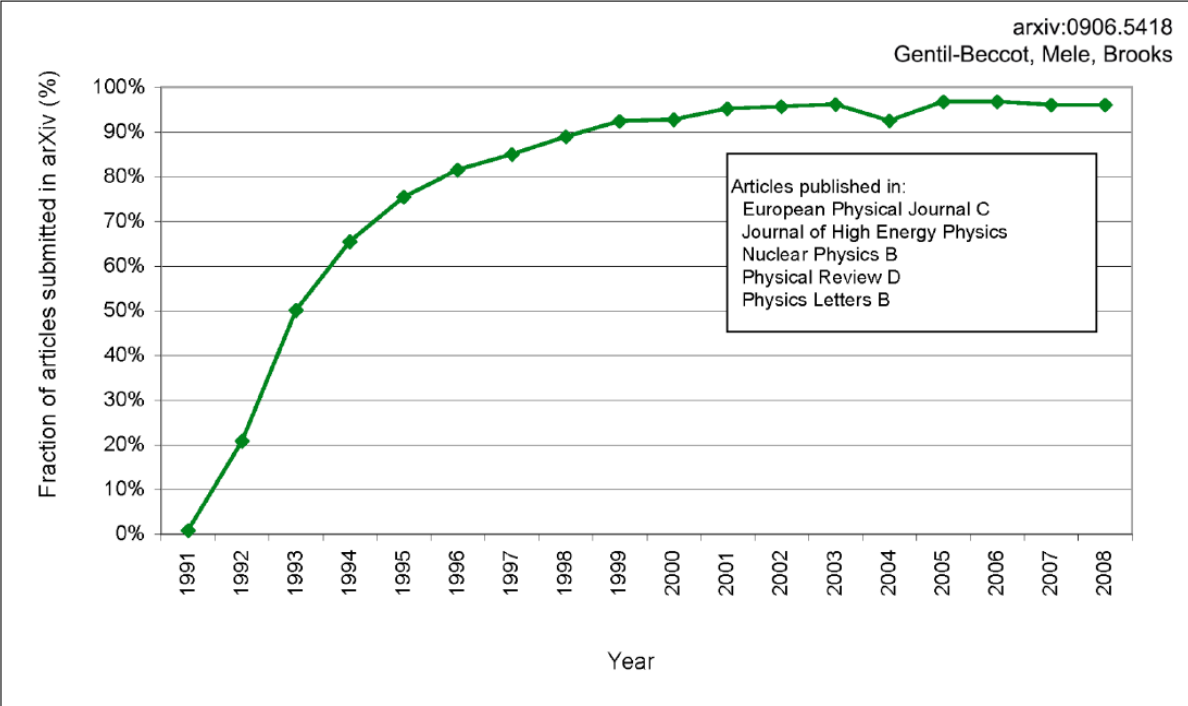
125 universities, 10 research centers, 3 funding agencies, 1 charity, 10 countries

Average = 2.5 k€

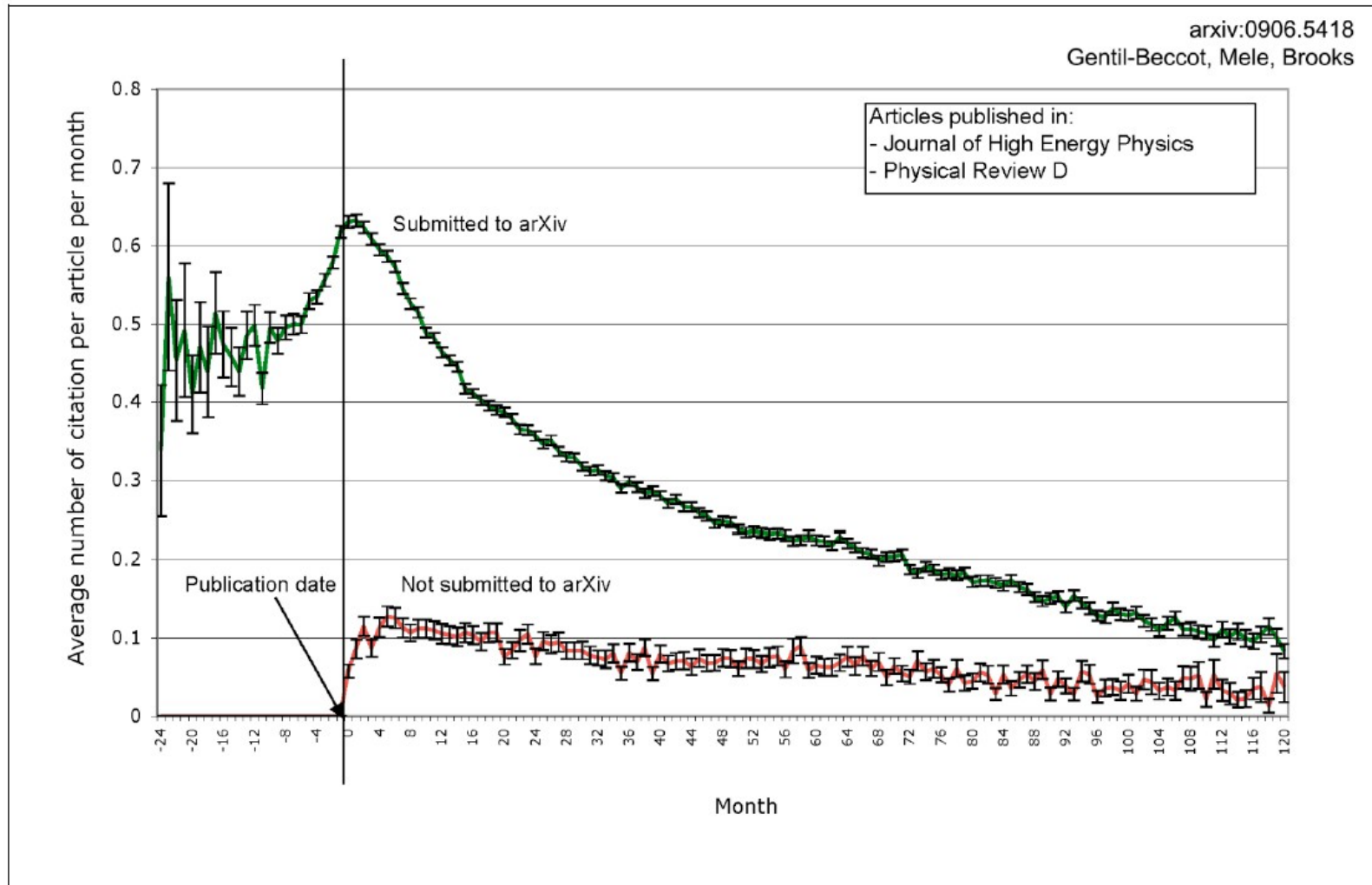
<https://scoap3.org>



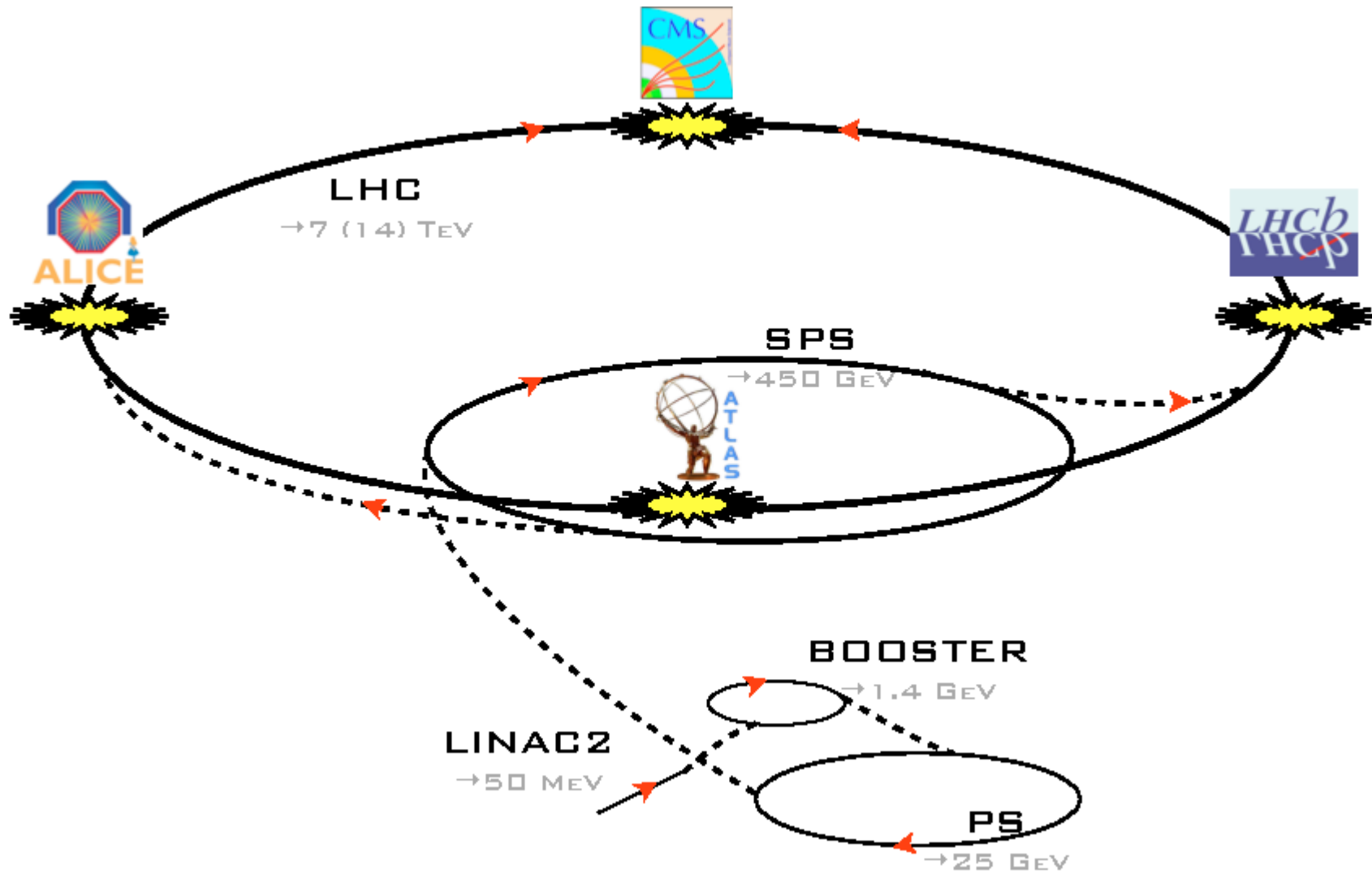
Sort by:	Sum	Number of Articles	Mean Value	Standard Deviation	
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Publishers (175 entries)					
	Sum	Number of Articles	Mean Value	Standard Deviation	Percentage
Elsevier BV	€17.620.533	6607	€2.667	€942	31.59%
Wiley-Blackwell	€9.790.907	3918	€2.499	€665	17.55%
American Chemical Society (ACS)	€3.687.693	1398	€2.638	€1.000	6.61%
Oxford University Press (OUP)	€3.603.560	1331	€2.707	€591	6.46%
Springer Nature	€3.064.932	1021	€3.002	€972	5.49%
Informa UK Limited	€1.858.953	1128	€1.648	€867	3.33%
Springer Science + Business Media	€1.437.710	617	€2.330	€382	2.58%
BMJ	€1.389.379	518	€2.682	€640	2.49%
IOP Publishing	€1.028.505	426	€2.414	€381	1.84%
Ovid Technologies (Wolters Kluwer Health)	€949.342	286	€3.319	€912	1.70%
The Royal Society	€874.685	435	€2.011	€412	1.57%
Royal Society of Chemistry (RSC)	€790.794	425	€1.861	€505	1.42%
Cambridge University Press (CUP)	€639.949	251	€2.550	€398	1.15%
The Company of Biologists	€561.438	162	€3.466	€705	1.01%
+ view small values					
Total	€55.787.613	22492	€2.480	€929	100%

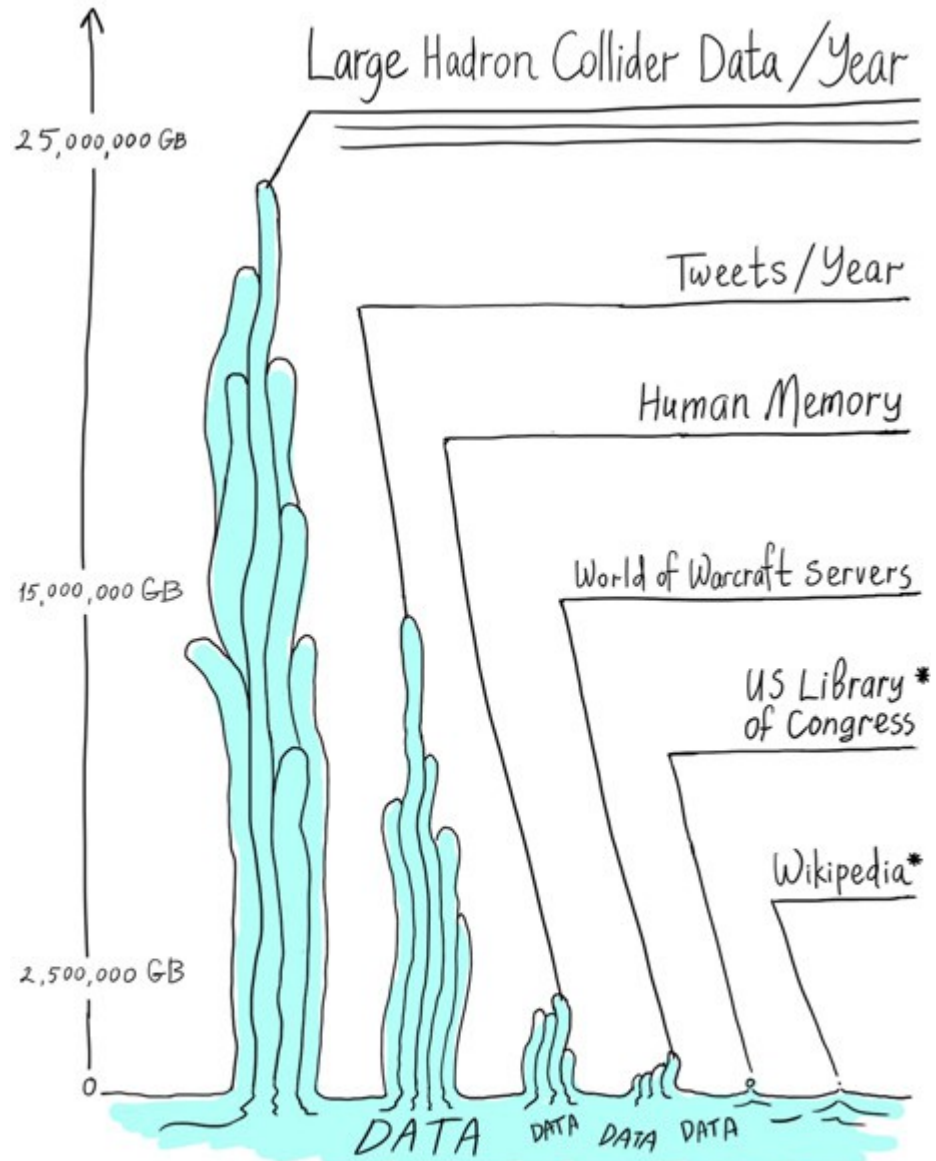


By the time an article is published, it starts already to get 'out of attention'



The Large Hadron Collider





All numbers approximate.

* Binary Data

The context

- General consensus in the LHCTopWG that (at least) some of our combinations deserve to become peer-reviewed papers
 - Different Physics Coordinators have had different opinions on what makes a combination worth publishing, and in general there seems to be a preference for case-by-case discussions rather than general policies
- Proposal to use arXiv more often (à la Tevatron), even without submission to journal, instead of / in addition to public notes
 - Contra: extra editorial burden on both experiments; anyway ignored by Scopus etc., and despised by non-HEP people
 - Pro: arXiv gives more visibility than CDS and exp webpages; citations are taken into account by Inspire's bibliometry
 - Only case from this WG so far: LHC+Tevatron top mass combination, <http://arxiv.org/abs/1403.4427>

Two questions relevant to policy-makers

- How many citations are ATLAS and CMS losing because "users" of our combinations (e.g., theorists) are citing a non-citable source instead of an arXiv / journal paper?
 - Note: more difficult to estimate are those that we are losing because potential users are not even aware of the existence of a combination (as said, CDS and exp websites give less visibility than arXiv)
- How often would ATLAS and CMS analysts really like to cite a LHCTopWG result but can not, because our editorial policies forbid to cite a public note?

