SCOAP^3

A (r)evolution in 20 min

27th November 2015

Alexander Kohls, CERN

John Ellis in his office at CERN

- High-Energy Physics ~7’500 papers/year
- 90% written by 1 to 5 authors
- Only 2% of overall publications from CERN

Physics Letters B 716 (2012) 30–61

Contents lists available at SciVerse ScienceDirect

Physics Letters B

www.elsevier.com/locate/physletb

Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC ☆

CMS Collaboration *

CERN, Switzerland

This paper is dedicated to the memory of our colleagues who worked on CMS but have since passed away. In recognition of their many contributions to the achievement of this observation.

ARTICLE INFO

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ABSTRACT

Results are presented from searches for the standard model Higgs boson in proton–proton collisions at $\sqrt{s} = 7$ and 8 TeV in the Compact Muon Solenoid experiment at the LHC, using data samples corresponding to integrated luminosities of up to 5.1 fb^{-1} at 7 TeV and 5.3 fb^{-1} at 8 TeV. The search is performed in five decay modes: $\gamma\gamma$, ZZ, W^+W^-, $\tau^+\tau^-$, and $b\bar{b}$. An excess of events is observed above the expected background, with a local significance of 5.0 standard deviations, at a mass near 125 GeV, signalling the production of a new particle. The expected significance for a standard model Higgs boson of that mass is 5.8 standard deviations. The excess is most significant in the two decay modes with the best mass resolution, $\gamma\gamma$ and ZZ; a fit to these signals gives a mass of $125.3 \pm 0.4(\text{stat.}) \pm 0.5(\text{syst.})$ GeV. The decay to two photons indicates that the new particle is a boson with spin different from one.

1. Introduction

The standard model (SM) of elementary particles provides a remarkably accurate description of results from many accelerator and non-accelerator based experiments. The SM comprises quarks and leptons as the building blocks of matter, and describes their interactions through the exchange of force carriers: the photon for electromagnetic interactions, the W and Z bosons for weak interactions, and the gluons for strong interactions. The electromagnetic and weak interactions are unified in the electroweak theory. Although the predictions of the SM have been extensively confirmed, the question of how the W and Z gauge bosons acquire mass whilst the photon remains massless is still open.

Nearly fifty years ago it was proposed [1–6] that spontaneous symmetry breaking in gauge theories could be achieved through the introduction of a scalar field. Applying this mechanism to the electroweak theory [7–9] through a complex scalar doublet field leads to the generation of the W and Z masses, and to the prediction of the existence of the SM Higgs boson (H). The scalar field also gives mass to the fundamental fermions through the Yukawa interaction. The mass m_H of the SM Higgs boson is not predicted by theory. However, general considerations [10–13] suggest that m_H should be smaller than ~1 TeV, while precision electroweak measurements imply that $m_H < 152$ GeV at 95% confidence level (CL) [14]. Over the past twenty years, direct searches for the Higgs boson have been carried out at the LEP collider, leading to a lower bound of $m_H > 114.4$ GeV at 95% CL [15], and at the Tevatron proton–antiproton collider, excluding the mass range 162–166 GeV at 95% CL [16] and detecting an excess of events, recently reported in [17–19], in the range 120–135 GeV.

The discovery or exclusion of the SM Higgs boson is one of the primary scientific goals of the Large Hadron Collider (LHC) [20]. Previous direct searches at the LHC were based on data from proton–proton collisions corresponding to an integrated luminosity of 5 fb^{-1} collected at a centre-of-mass energy $\sqrt{s} = 7$ TeV. The CMS experiment excluded at 95% CL a range of masses from 127 to 600 GeV [21]. The ATLAS experiment excluded at 95% CL the ranges 111.4–116.6, 119.4–122.1 and 129.2–541 GeV [22]. Within the remaining allowed mass region, an excess of events near 125 GeV was reported by both experiments. In 2012 the proton–proton centre-of-mass energy was increased to 8 TeV and by the end of June an additional integrated luminosity of more than 5 fb^{-1} had been recorded by each of these experiments, thereby enhancing significantly the sensitivity of the search for the Higgs boson.

This Letter reports the results of a search for the SM Higgs boson using samples collected by the CMS experiment, comprising data recorded at $\sqrt{s} = 7$ and 8 TeV. The search is performed in

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* *E-mail address:* cms-publication-committee-chair@cern.ch.

0370-2693/
http://dx.doi.org/10.1016/j.physletb.2012.08.021


article
references
2899 authors

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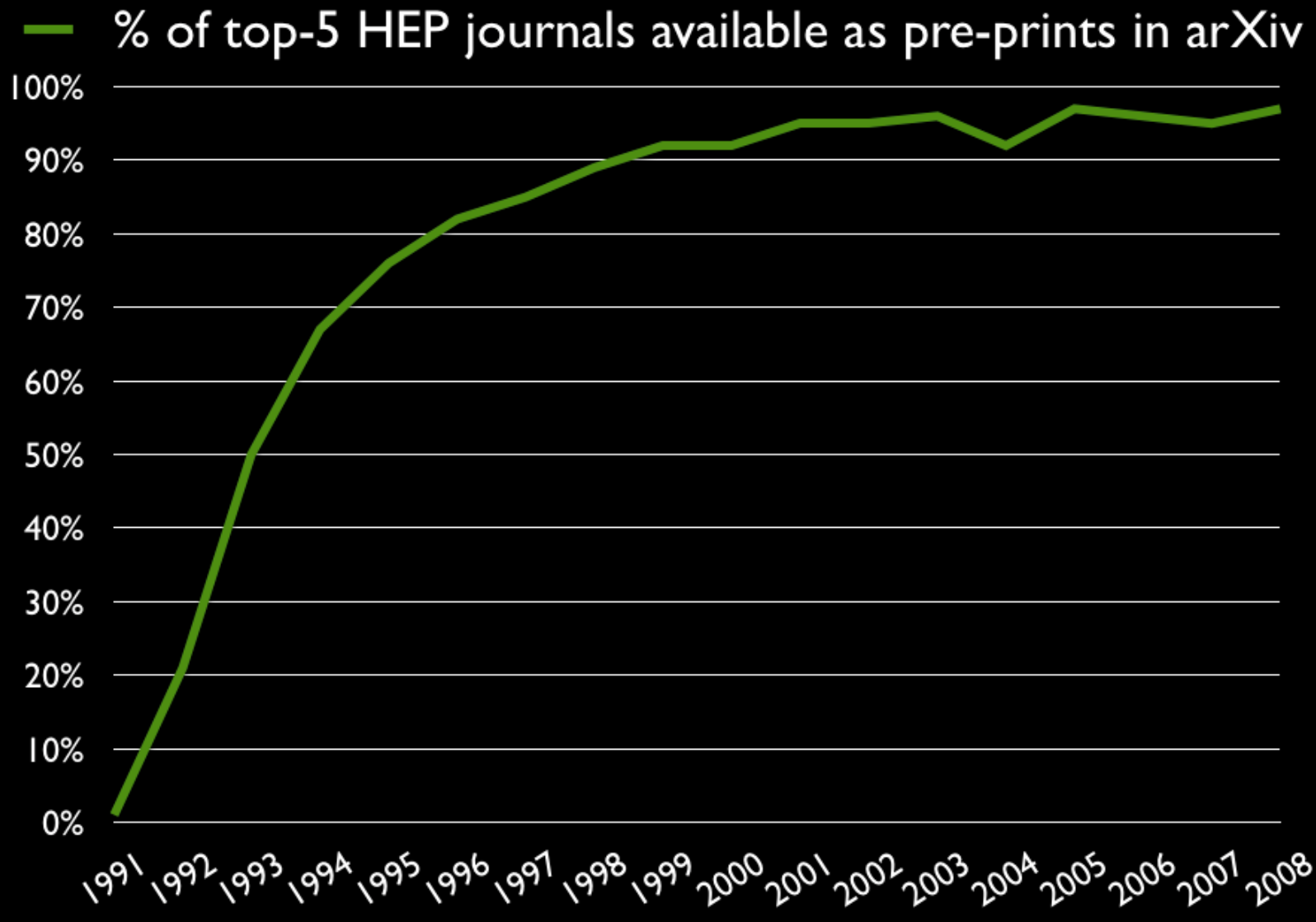
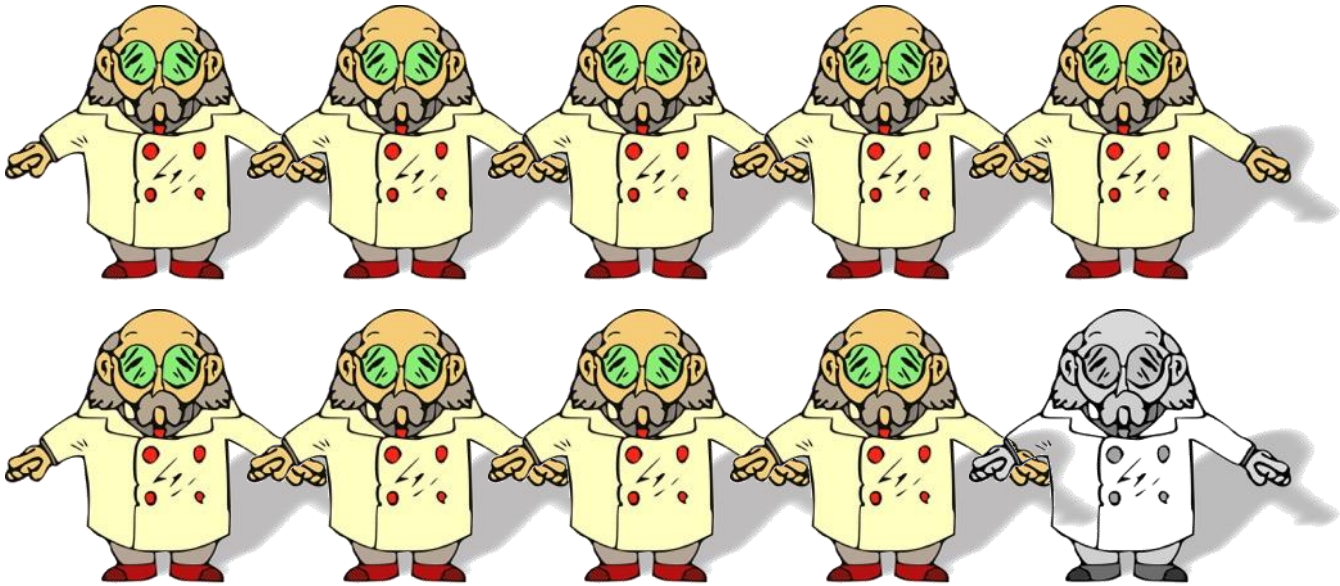
97% of HEP journals' content is in arXiv



Gentil-Beccot, Mele, Brooks, arXiv:0906.5418

Do High-Energy Physicists “read” journals ?

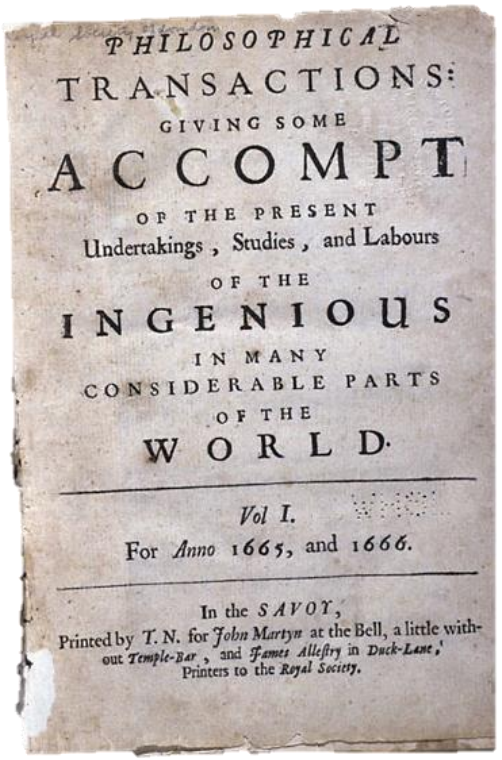
9 HEP scientists in 10…



…use arXiv also when a journal version exists!

Gentil-Beccot, Mele, Brooks arXiv: 0906.5418

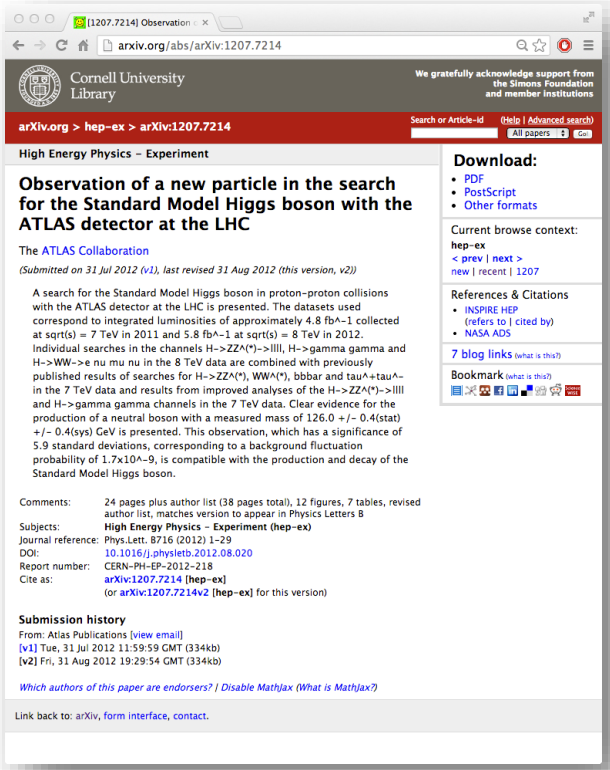
Dissemination on arXiv.org; Peer-review on journals



PHILOSOPHICAL
TRANSACTIONS:
GIVING SOME
ACCOMPT
OF THE PRESENT
Undertakings, Studies, and Labours
OF THE
INGENIOUS
IN MANY
CONSIDERABLE PARTS
OF THE
WORLD.

Vol I.
For Anno 1665, and 1666.

In the SAVOY,
Printed by T. N. for John Martyn at the Bell, a little without Temple-Bar, and James Allestry in Duck-Lane,
Printers to the Royal Society.



[1207.7214] Observation

arxiv.org/abs/arXiv:1207.7214

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High Energy Physics – Experiment

Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC

The ATLAS Collaboration

(Submitted on 31 Jul 2012 (v1), last revised 31 Aug 2012 (this version, v2))

A search for the Standard Model Higgs boson in proton–proton collisions with the ATLAS detector at the LHC is presented. The datasets used correspond to integrated luminosities of approximately 4.8 fb^-1 collected at sqrt(s) = 7 TeV in 2011 and 5.8 fb^-1 at sqrt(s) = 8 TeV in 2012. Individual searches in the channels H->ZZ^(*)->llll, H->gamma gamma and H->WW->e nu mu nu in the 8 TeV data are combined with previously published results of searches for H->ZZ^(*), WW^(*), bbbar and tau^+tau^- in the 7 TeV data and results from improved analyses of the H->ZZ^(*)->llll and H->gamma gamma channels in the 7 TeV data. Clear evidence for the production of a neutral boson with a measured mass of 126.0 +/- 0.4(stat) +/- 0.4(sys) GeV is presented. This observation, which has a significance of 5.9 standard deviations, corresponding to a background fluctuation probability of 1.7x10^-9, is compatible with the production and decay of the Standard Model Higgs boson.

Comments: 24 pages plus author list (38 pages total), 12 figures, 7 tables, revised author list, matches version to appear in Physics Letters B
Subjects: **High Energy Physics – Experiment (hep-ex)**
Journal reference: Phys.Lett. B716 (2012) 1–29
DOI: 10.1016/j.physletb.2012.08.020
Report number: CERN–PH–EP–2012–218
Cite as: **arXiv:1207.7214 [hep-ex]**
(or **arXiv:1207.7214v2 [hep-ex]** for this version)

Submission history
From: Atlas Publications [view email]
[v1] Tue, 31 Jul 2012 11:59:59 GMT (334kb)
[v2] Fri, 31 Aug 2012 19:29:54 GMT (334kb)

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Physics Letters B 716 (2012) 1–29

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Physics Letters B

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ELSEVIER

Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC ☆

ATLAS Collaboration *

This paper is dedicated to the memory of our ATLAS colleagues who did not live to see the full impact and significance of their contributions to the experiment.

ARTICLE INFO

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Received in revised form 8 August 2012
Accepted 11 August 2012
Available online 14 August 2012
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ABSTRACT

A search for the Standard Model Higgs boson in proton–proton collisions with the ATLAS detector at the LHC is presented. The datasets used correspond to integrated luminosities of approximately 4.8 fb^{-1} collected at $\sqrt{s}=7$ TeV in 2011 and 5.8 fb^{-1} at $\sqrt{s}=8$ TeV in 2012. Individual searches in the channels $H\to ZZ^{(*)}\to 4\ell$, $H\to\gamma\gamma$ and $H\to WW^{(*)}\to e\nu\mu\nu$ in the 8 TeV data are combined with previously published results of searches for $H\to ZZ^{(*)}$, $WW^{(*)}$, $b\bar{b}$ and $\tau^+\tau^-$ in the 7 TeV data and results from improved analyses of the $H\to ZZ^{(*)}\to 4\ell$ and $H\to\gamma\gamma$ channels in the 7 TeV data. Clear evidence for the production of a neutral boson with a measured mass of $126.0\pm0.4\,(\text{stat})\pm0.4\,(\text{sys})$ GeV is presented. This observation, which has a significance of 5.9 standard deviations, corresponding to a background fluctuation probability of 1.7×10^{-9}, is compatible with the production and decay of the Standard Model Higgs boson.

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1. Introduction

The Standard Model (SM) of particle physics [1–4] has been tested by many experiments over the last four decades and has been shown to successfully describe high energy particle interactions. However, the mechanism that breaks electroweak symmetry in the SM has not been verified experimentally. This mechanism [5–10], which gives mass to massive elementary particles, implies the existence of a scalar particle, the SM Higgs boson. The search for the Higgs boson, the only elementary particle in the SM that has not yet been observed, is one of the highlights of the Large Hadron Collider [11] (LHC) physics programme.

Indirect limits on the SM Higgs boson mass of $m_H < 158$ GeV at 95% confidence level (CL) have been set using global fits to precision electroweak results [12]. Direct searches at LEP [13], the Tevatron [14–16] and the LHC [17,18] have previously excluded, at 95% CL, a SM Higgs boson with mass below 600 GeV, apart from some mass regions between 116 GeV and 127 GeV.

Both the ATLAS and CMS Collaborations reported excesses of events in their 2011 datasets of proton–proton (pp) collisions at centre-of-mass energy $\sqrt{s}=7$ TeV at the LHC, which were compatible with SM Higgs boson production and decay in the mass region 124–126 GeV, with significances of 2.9 and 3.1 standard deviations (σ), respectively [17,18]. The CDF and D0 experiments at the Tevatron have also recently reported a broad excess in the mass region 120–135 GeV; using the existing LHC constraints, the observed local significances for $m_H=125$ GeV are 2.7σ for CDF [14], 1.1σ for D0 [15] and 2.8σ for their combination [16].

The previous ATLAS searches in 4.6–4.8 fb^{-1} of data at $\sqrt{s}=7$ TeV are combined here with new searches for $H\to ZZ^{(*)}\to 4\ell$, $H\to\gamma\gamma$ and $H\to WW^{(*)}\to e\nu\mu\nu$ in the 5.8–5.9 fb^{-1} of pp collision data taken at $\sqrt{s}=8$ TeV between April and June 2012.

The data were recorded with instantaneous luminosities up to 6.8×10^{33} cm^{-2}s^{-1}; they are therefore affected by multiple pp collisions occurring in the same or neighbouring bunch crossings (pile-up). In the 7 TeV data, the average number of interactions per bunch crossing was approximately 10; the average increased to approximately 20 in the 8 TeV data. The reconstruction, identification and isolation criteria used for electrons and photons in the 8 TeV data are improved, making the $H\to ZZ^{(*)}\to 4\ell$ and $H\to\gamma\gamma$ searches more robust against the increased pile-up. These analyses were re-optimised with simulation and frozen before looking at the 8 TeV data.

In the $H\to WW^{(*)}\to e\nu\mu\nu$ channel, the increased pile-up deteriorates the event missing transverse momentum, $E_{\mathrm{T}}^{\mathrm{miss}}$, resolution, which results in significantly larger Drell–Yan background in the same-flavour final states. Since the $e\mu$ channel provides most of the sensitivity of the search, only this final state is used in the analysis of the 8 TeV data. The kinematic region in which a SM Higgs boson with a mass between 110 GeV and 140 GeV is

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* E-mail address: atlas.publications@cern.ch.

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http://dx.doi.org/10.1016/j.physletb.2012.08.020

[1] The symbol ℓ stands for electron or muon.

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Part of the CERN mission (1953): “[...] sponsoring of international co-operation in nuclear research, including co-operation outside the Laboratories [which] may include in particular [...] the dissemination of information”

LHC: largest scientific instrument ever built, 27km

CERN principle of Openness (1953): “the results of its experimental and theoretical work shall be published or otherwise made generally available”


IDEA


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a global
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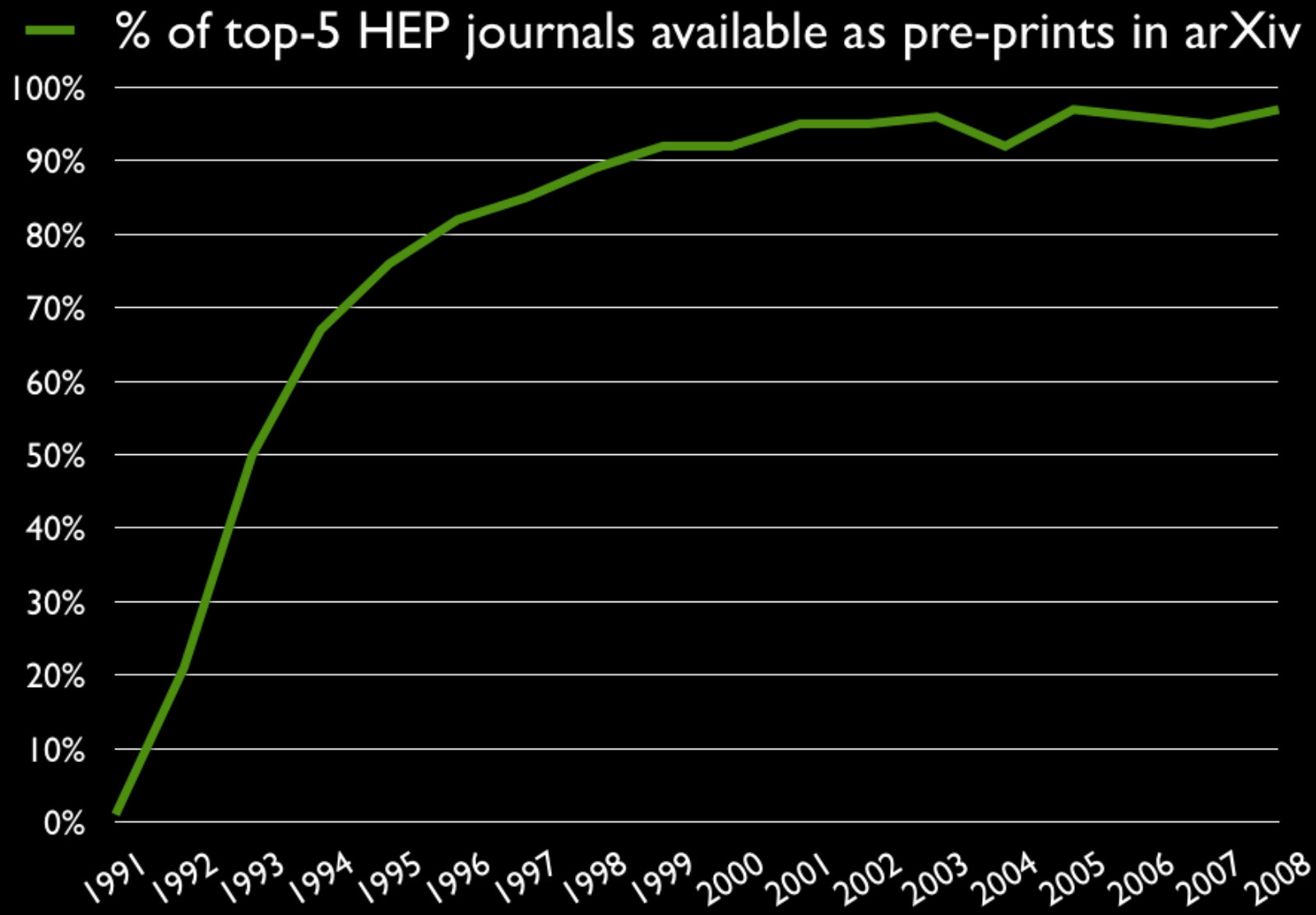
…and liaise with Funding Agencies…

…to pay peer-review & publishing services…



…and not for content!

What is SCOAP3 ?

Libraries

Funding Agencies

SCOAP^3 is a global partnership which converts high-quality subscription journals in the field of High-Energy Physics to Open Access through re-direction of existing subscription funds

Publishers

CERN

The SCOAP³ Business Model

Reads and Writes

- No change in behavior
- No burden
- Retains the copyright

Writes

Reads

Researcher

Publishers

Reduction on Subscriptions

Libraries / Consortia

- Support OA policies with existing funds

Open Access

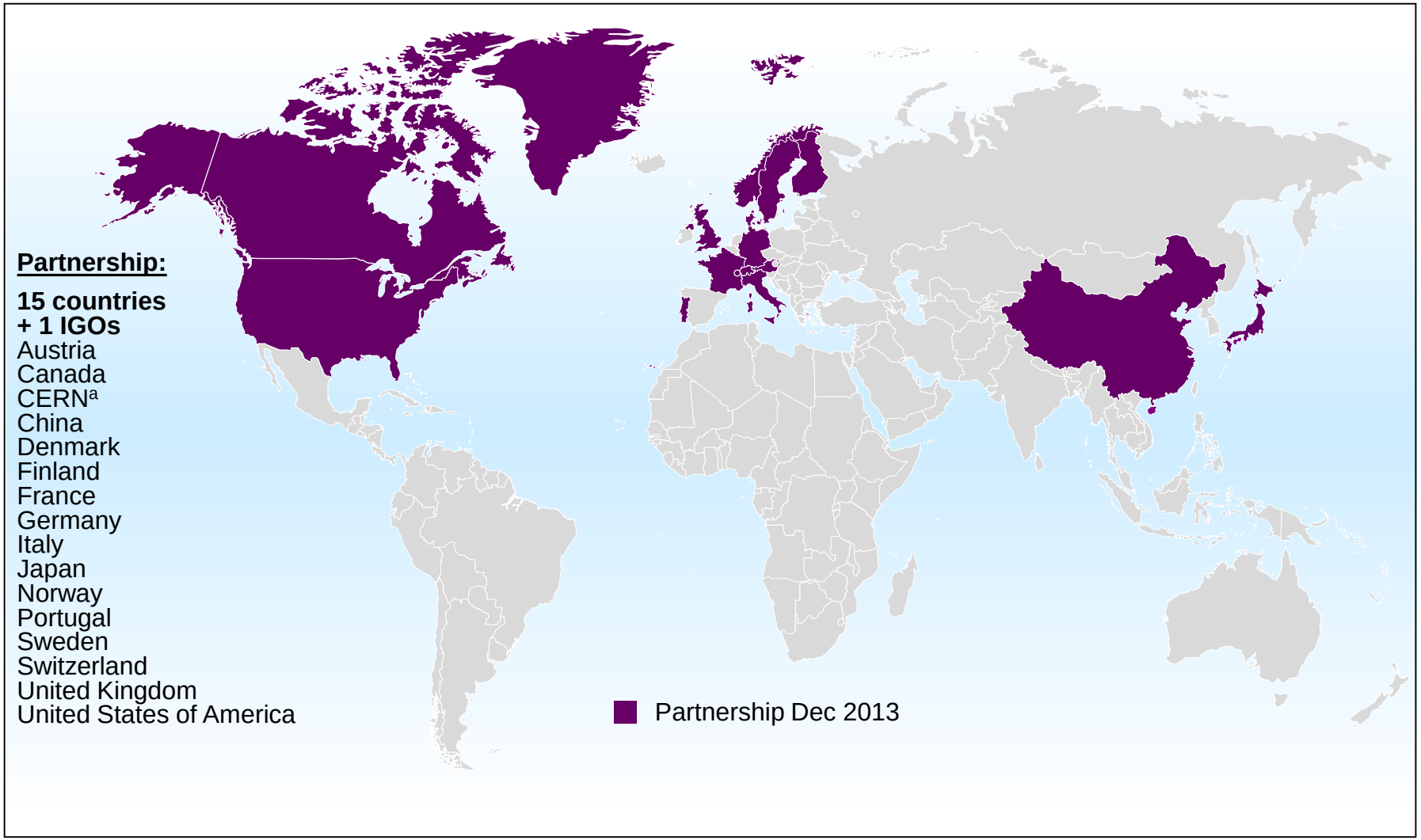
APC's

Membership

Support

Funding Agencies

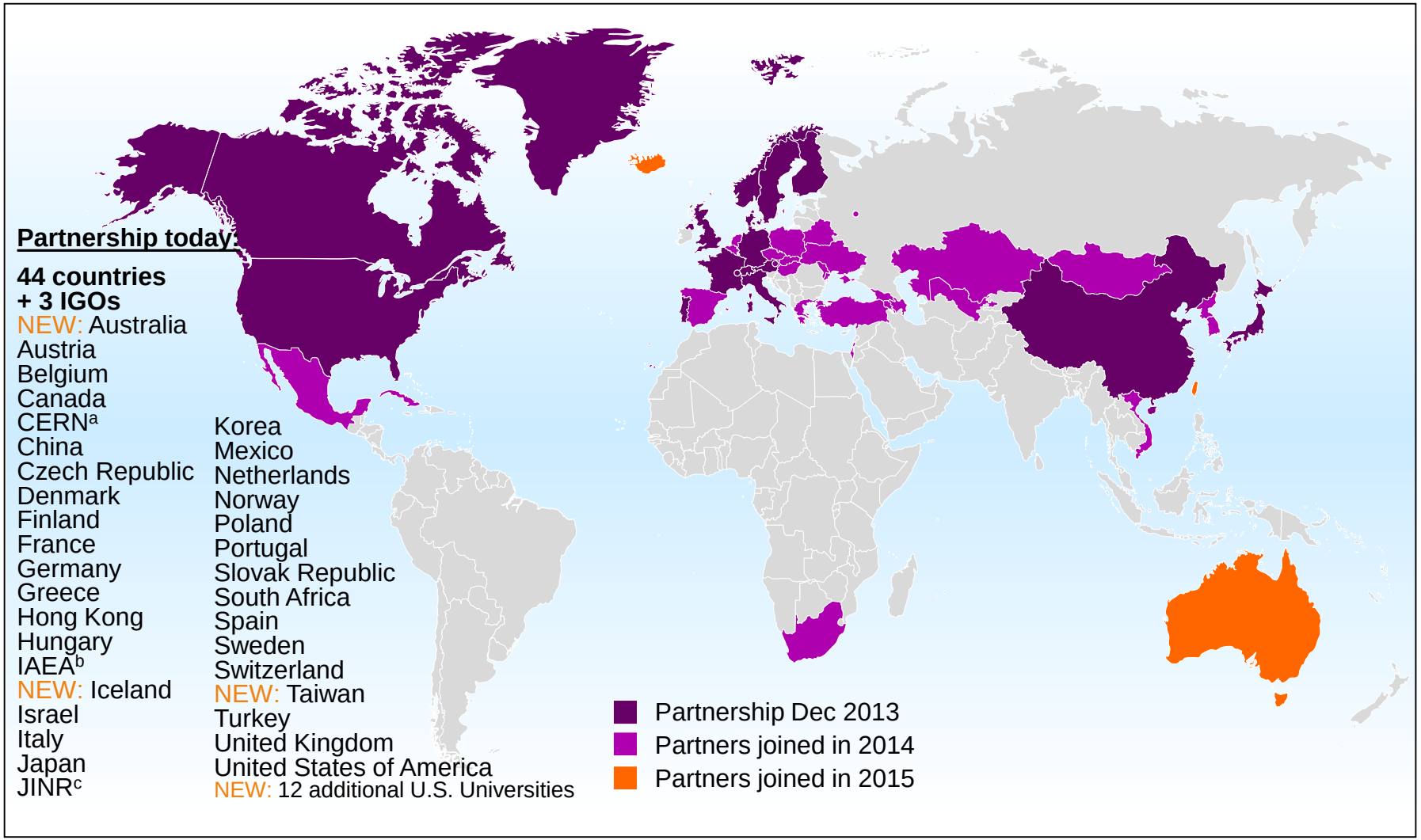
At start of operation: 15 countries + CERN



a) European Organization for Nuclear Research, Geneva

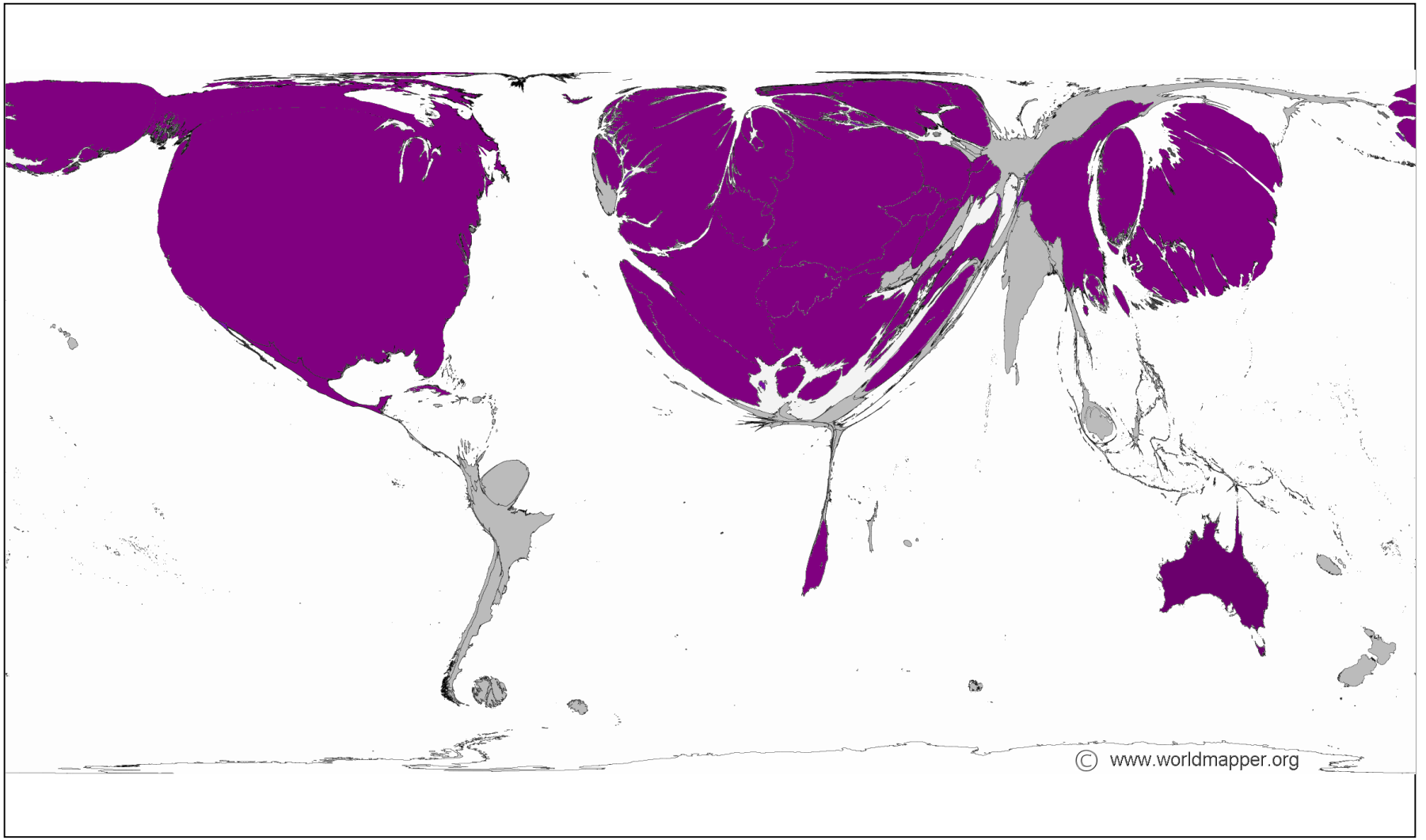
47 countries and IGOs today - and still growing…

~3,000 libraries, funding agencies and research institutions



a) European Organization for Nuclear Research, Geneva
b) International Atomic Energy Agency, Vienna
c) Joint Institute for Nuclear Research, Dubna representing 12 of its member states

Research intensive countries and SCOAP^3



Territory size shows the proportion of all scientific papers published in 2001 written by authors living there http://www.worldmapper.org/display.php?selected=205

Central operation and framework for cooperation

11
Publishers

CERN

on behalf of

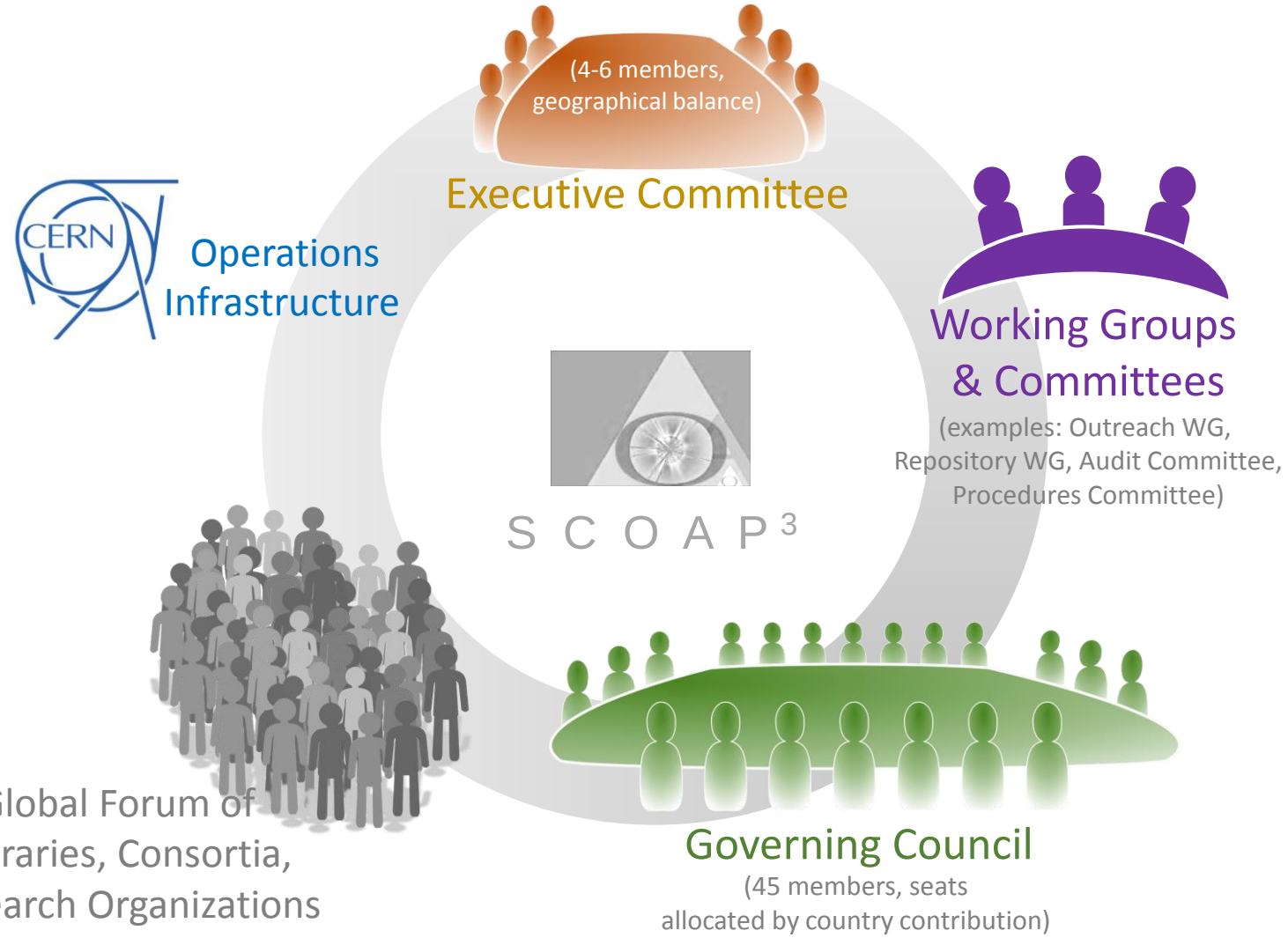
SCOAP³

46
Countries

3'000 Libraries

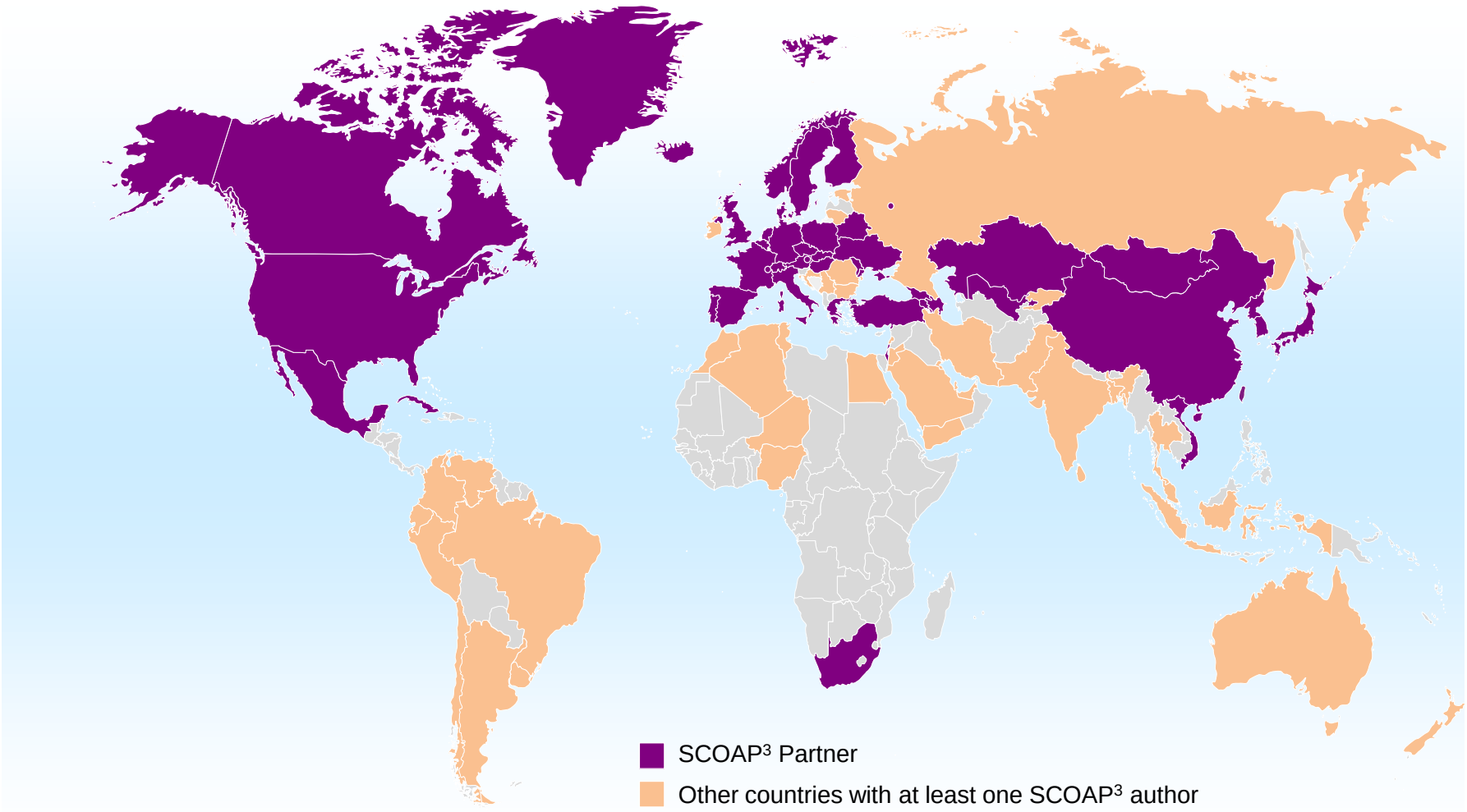
Governance Structure

Global participation for transparency and good governance



Publisher	Journal	articles
ELSEVIER	Nuclear Physics B	615
	Physics Letters B	1’676
Hindawi	Advances in High Energy Physics	316
IOP Publishing	Chinese Physics C	44
	Journal of Cosmology & Astroparticle Physics	414
DPG	New Journal of Physics	17
Jagiellonian University in Krakow	Acta Physica Polonica B	33
Oxford University Press / JPS	Progress of Theoretical & Experimental Physics	152
Springer	European Physical Journal C	1’055
	Journal of High Energy Physics	3’911

Articles as of November 23rd 2015: 8,233



18’000 authors from 90 countries

Publisher	Journal	APC
ELSEVIER	Nuclear Physics B	$ 2’000
	Physics Letters B	$ 1’800
Hindawi	Advances in High Energy Physics	$ 1’000
IOP Publishing	Chinese Physics C	£ 1’000
	Journal of Cosmology & Astroparticle Physics	£ 1’400
DPG	New Journal of Physics	£ 1’200
Jagiellonian University in Krakow	Acta Physica Polonica B	€ 500
Oxford University Press / JPS	Progress of Theoretical and Experimental Physics	£ 1’000
Springer	European Physical Journal C	€ 1’500
	Journal of High Energy Physics	€ 1’200

Average effective APC 2014-2015: € 1’105

(SCOAP^3 pays maximum = 2011 #articles, rest free)

Comparison of effective APCs

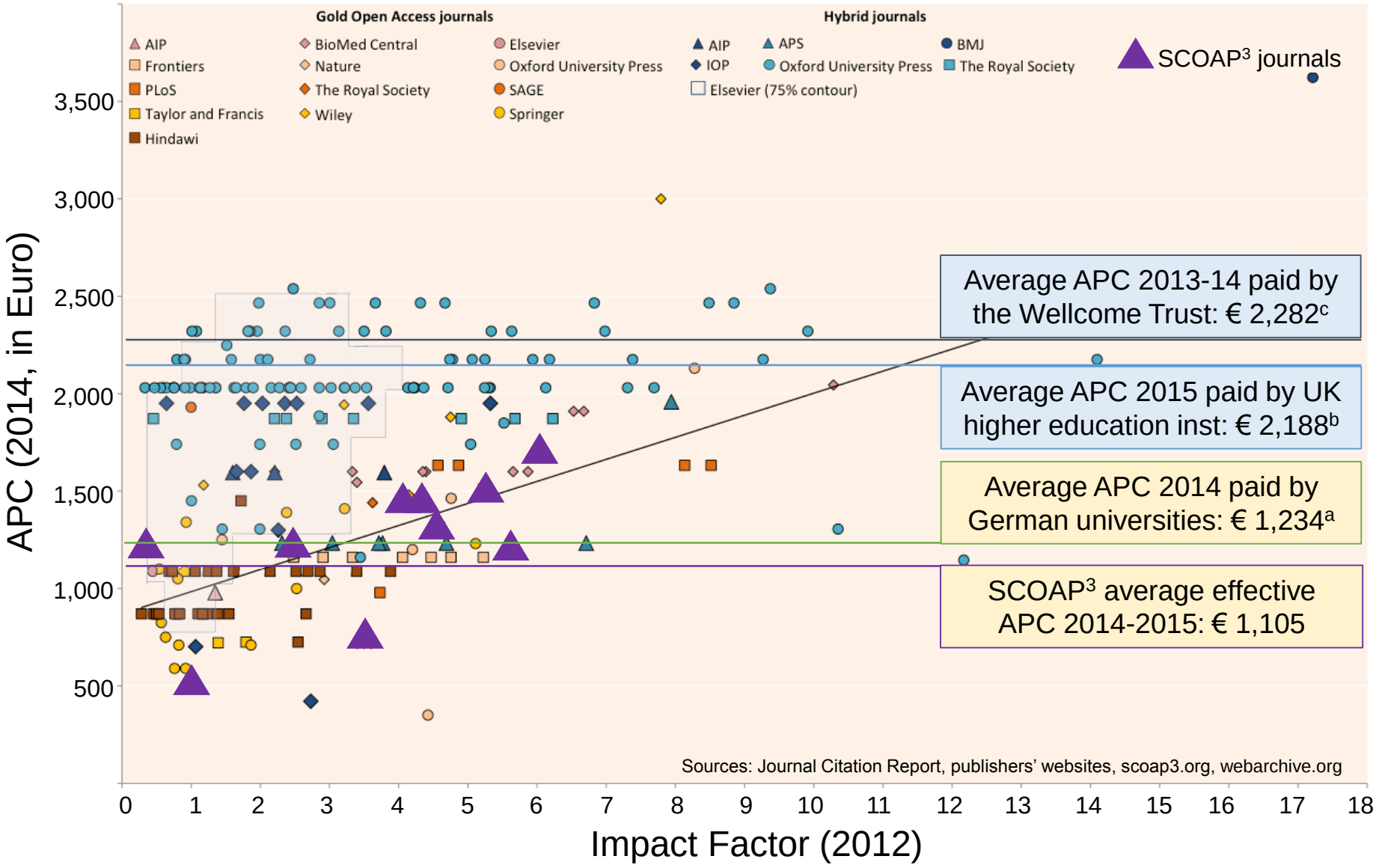


Chart: C. Romeu *et al.* (2014) *The SCOAP3 initiative and the Open Access - Article-Processing-Charge market: global partnership and competition improve value in the dissemination of science* DOI: 10.2314/CERN/C26P.W9DT

a) https://github.com/OpenAPC/openapc-de;
b) http://figshare.com/articles/2015_Jan_June_UK_APC_data_combined/1509860
c) http://blog.wellcome.ac.uk/2015/03/03/the-reckoning-an-analysis-of-wellcome-trust-open-access-spend-2013-14/

Article compliance is not a given

wellcome trust

The Reckoning: An Analysis of Wellcome Trust Open Access Spend 2013-14

3 MAR, 2015

by Wellcome Trust

tags: Data, Journals, Open Access, Open data, policy, Publishing, Robert Kiley

	2013-14
Number of articles for which an APC was paid	2556
Total spend on APCs	£4,694,428
Average APC	£1837
Median APC	£1800

CC-BY and Europe PMC deposit: compliance

Basic compliance	Number	%
Articles for which an APC has been paid	2556	100%
Number of these articles available via Europe PMC as full text (as of 1st February 2015)	2221	87%
Number of these articles NOT available as full text in Europe PMC	335	13%
Licence compliance		
Number of articles with a CC-BY (or CC-0) licence:	1679	66%
Number of articles with other licence (or no licence)	877	34%
Full compliance		
Total number of papers with full text in Europe PMC, and CC-BY licence	1565	61%

13% of articles not in repository

Only 66% with CC-BY

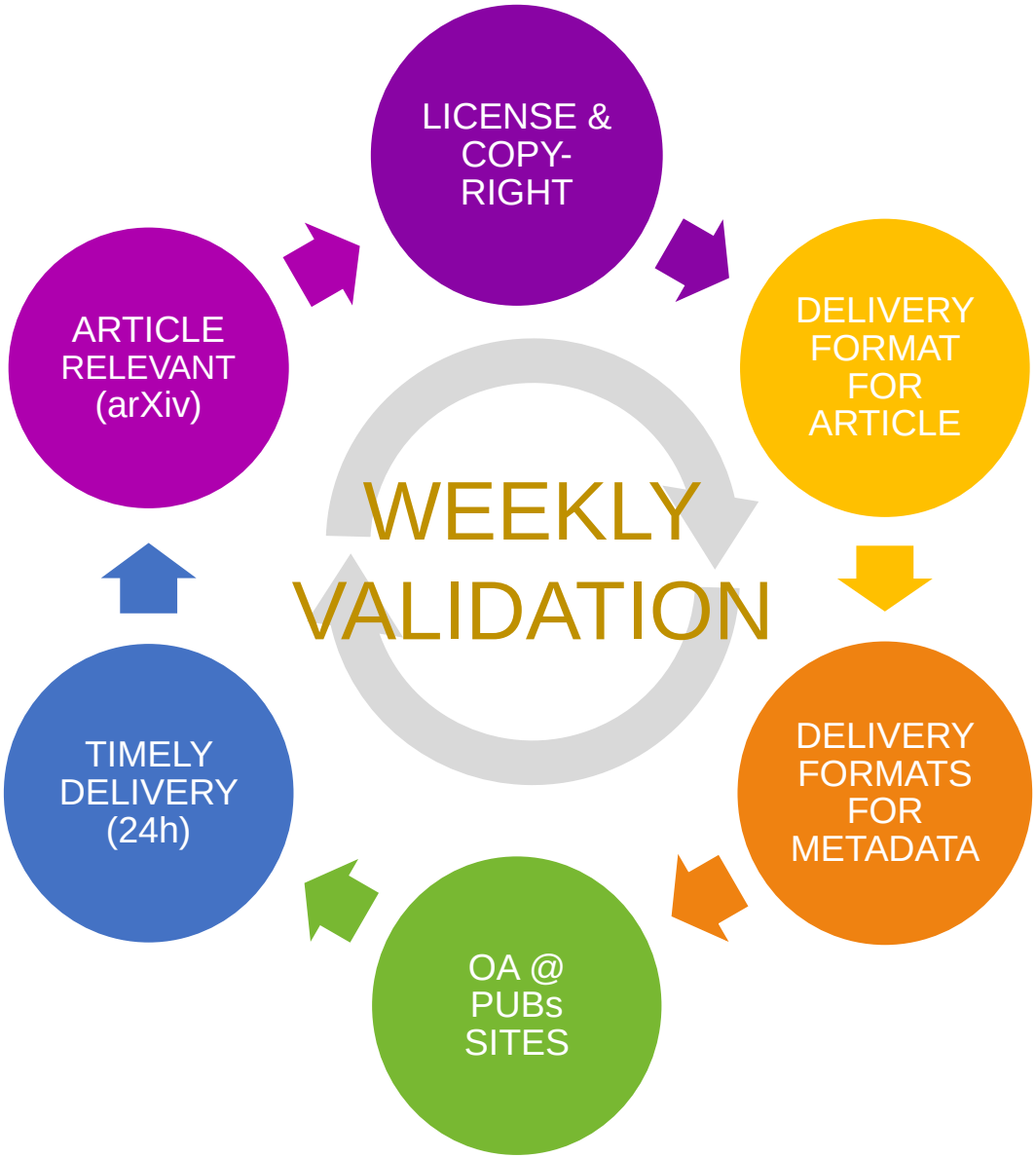
Only 61% fully compliant

Analysis of articles not avail. in Europe PMC

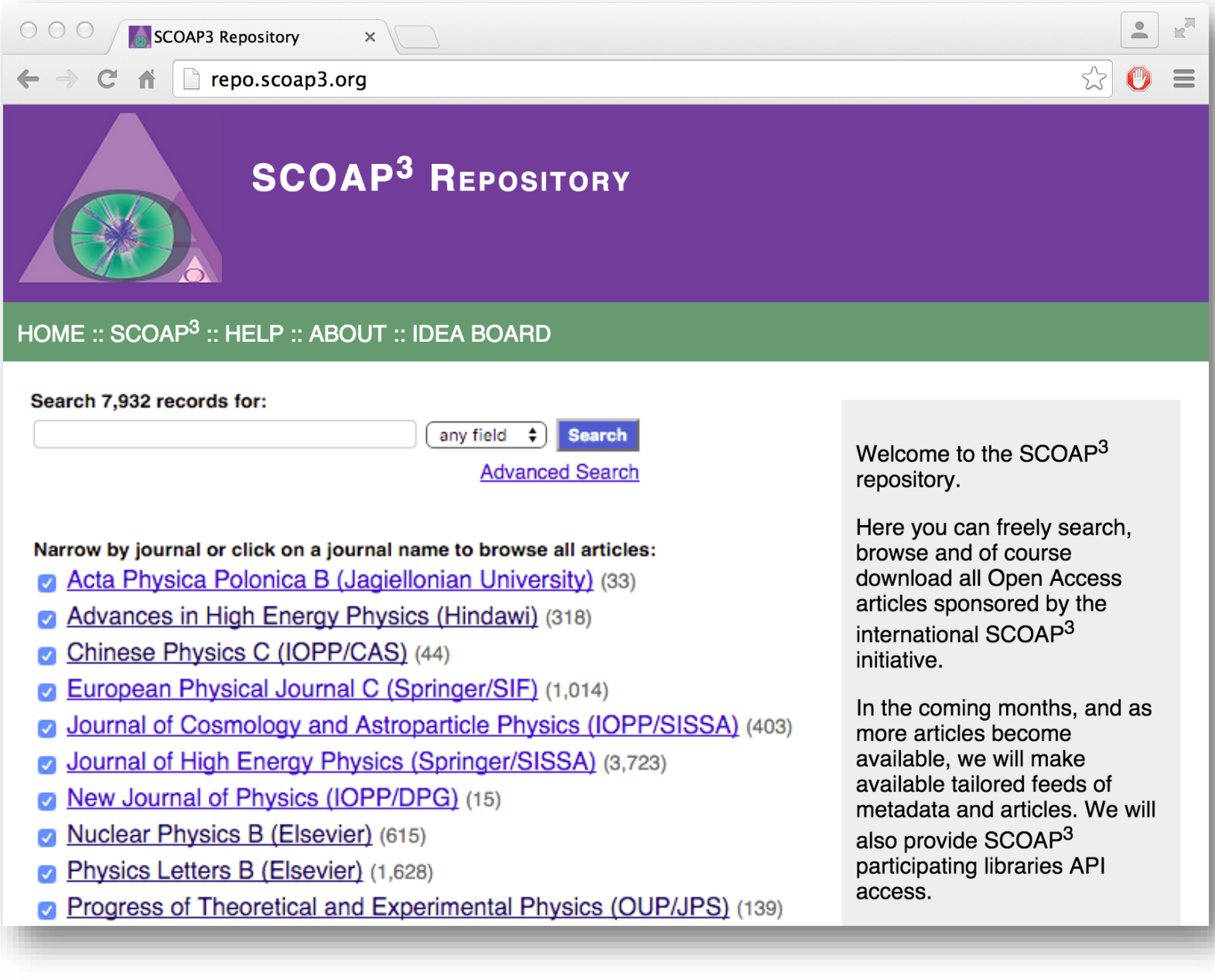
Analysis	Number	Percentage
Total Number of articles not in Europe PMC	335	100
Duplicate articles identified in the dataset supplied by Institutions	3	<1%
Total number of articles which could be found (via Google and a DOI/title search) but are not in Europe PMC	325	97%
Of those 325 papers we could find:		
OA on the publisher site	308	95%
Not OA on the publisher site	17	5%
Of those 308 papers which are OA on the publisher site:		
Early View/Ahead of Print	71	23%
Final published version	237	77%

5% not even OA on publisher site

Article Compliance



99.98%



The SCOAP^3 Repository

Building services on open content...

Presented by:
Salvatore Mele (CERN)

SCOAP³ Repository
(metadata, PDFs, XMLs, ORCiDs)

repo.scoap3.org

All applications available open source on GitHub
https://github.com/SCOAP3

SCOAP³ Search API

- Piloted by INFN in Q4 2014
- Available for SCOAP³ partners (pilot)
  Register at: http://api.scoap3.org
- Powerful customized searches
- Currently 46 registered users and 15 active implementations

OAI-PMH

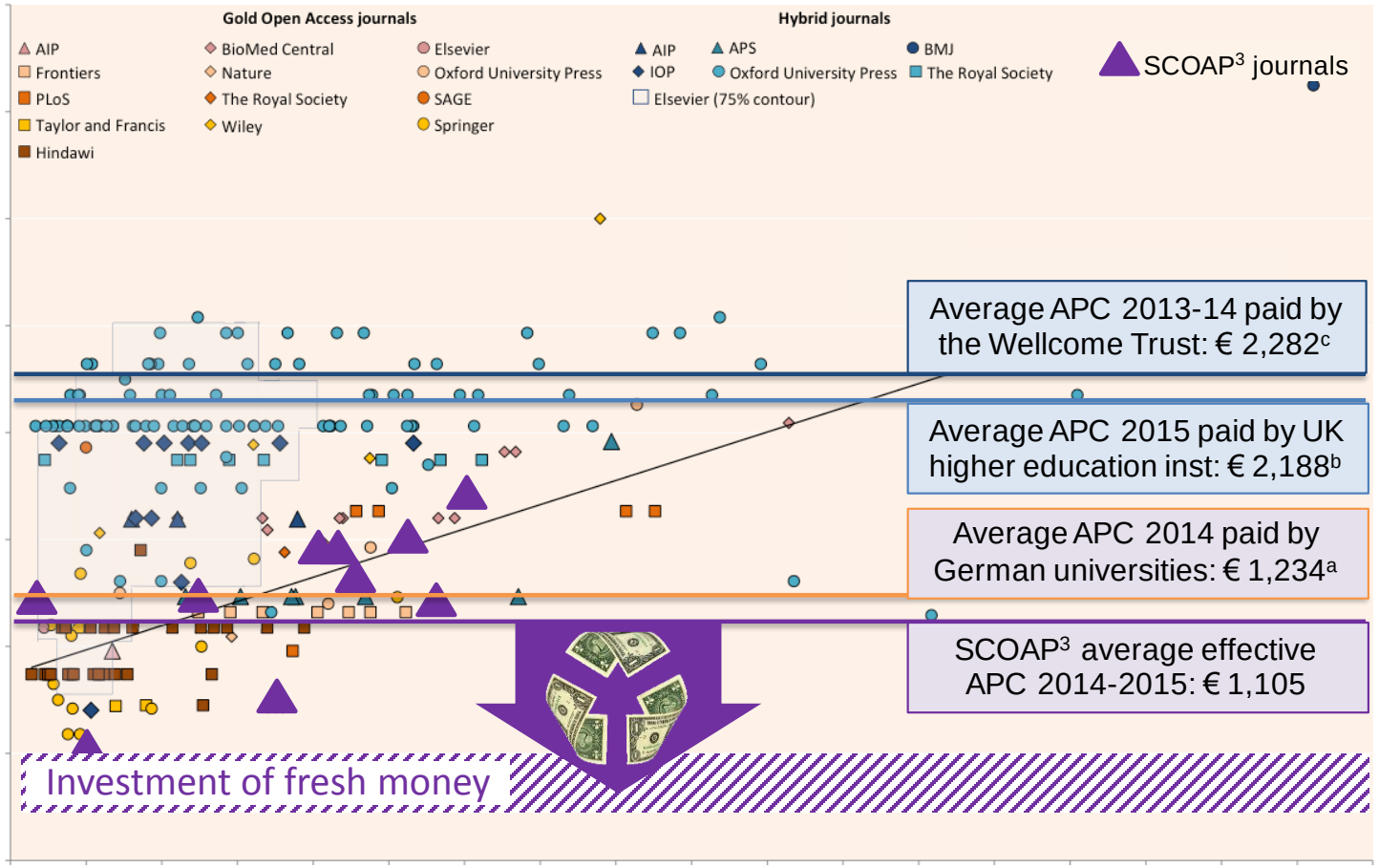
- Piloted by NSTL in Q3 2014
- Available for everybody

…enabling libraries to provide services for their researchers.

Benefits for the library community

Benefits for funding agencies

- Much better value for money than hybrid OA
- Low efforts for administration
- Re-use of funds formerly spent for subscription



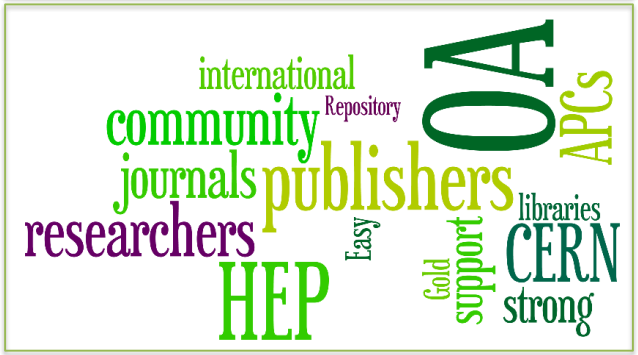
Benefits for scientists

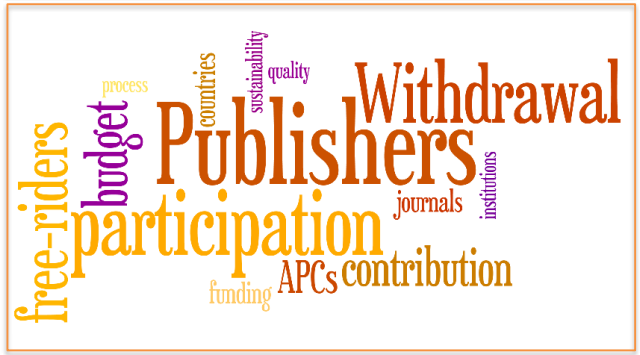
SCOAP³ Phase 2

Q1 2015

SWOT analysis to assess the status

- Strong response and engagement from SCOAP³ community
- More than 300 Strengths, Weaknesses, Opportunities & Threats identified





SCOAP^3 Phase 2

Q1 2015	SWOT analysis by the SCOAP^3 Partnership
June 2015	SCOAP^3 governance agrees with extension to 2017-2019
Ongoing	Preparation of the continuation of SCOAP^3 initially with currently participating parties