The SCOAP^3 project: converting the literature of an entire discipline to Open Access

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Abstract

The High-Energy Physics (HEP) community spearheaded Open Access with over half a century of dissemination of pre-prints, culminating in the arXiv system. It is now proposing an Open Access publishing model which goes beyond present, sometimes controversial, proposals, with a novel practical approach: the Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP^3). In this model, libraries and research institutions federate to explicitly cover the costs of the peer-review and other editorial services, rather than implicitly supporting them via journal subscriptions. Rather than through subscriptions, journals will their costs from SCOAP^3 and make the electronic versions of their journals free to read. Unlike many "author-pays" Open Access models, authors are not directly charged to publish their articles in the Open Access paradigm. Contributions to the SCOAP^3 consortium are determined on a country-by-country basis, according to the volume of HEP publications originating from each country. They would come from nation-wide re-directions of current subscriptions to HEP journals. SCOAP^3 will negotiate with publishers in the field the price of their peer review services through a tendering process. Journals converted to Open Access will be then decoupled from package licenses. The global yearly budget envelope for this transition is estimated at about 10 Million Euros. This unique experiment of "flipping" from Toll Access to Open Access all journals covering the literature in a given subject is rapidly gaining momentum, and about a third of the required budget envelope has already been pledged by leading libraries, library consortia and High-Energy Physics funding agencies worldwide. This conference paper describes the HEP publication landscape and the bibliometric studies at the basis of the SCOAP^3 model. Details of the model are provided and the status of the initiative is presented, debriefing the lessons learned in this attempt to achieve a large-scale conversion of an entire field to Open Access.

Keywords: SCOAP3; Open Access Publishing; High-Energy Physics.

1. Introduction

Recently, the Open Access debate has become mainstream, spreading to all areas and actors of scholarly communication and affecting its entire spectrum, from policy making to financial aspects [1]. Open Access models are actively being proposed by scholars, libraries and publishers alike, and Open Access definitions, of varying shades and colours, are actively debated. This change falls under the umbrella of the groundbreaking technological changes that are inspiring the transformation of science into e-Science in the XXIst century.

This contribution will not enter into these wide ranging issues: its objective is to present a specific Open Access model tailored to the needs of a specific community, High-Energy Physics (HEP), as embodied by the SCOAP^3 initiative (Sponsoring Consortium for Open Access Publishing in Particle Physics). Although this is a discipline-specific approach to the wider issue of Open Access, it is a particularly interesting one: HEP has a long tradition of innovations in scholarly communication and Open Access, which have then

spread to other fields, and the lessons learned by the momentum gathered by the SCOAP^3 initiative can inform the evolution of Open Access publishing in other fields.

A few words are in order to give the scale of the endeavors of HEP, and its strong collaborative texture, which is inspiring its position in the Open Access debate. The scientific goals of HEP are to attain a fundamental description of the laws of physics, to explain the origin of mass and to understand the dark matter in the universe. Any of these insights would dramatically change our view of the world. To reach these scientific goals, experimental particle physicists team in thousand-strong collaborations to build the largest instruments ever, to reproduce on Earth the energy densities of the universe at its birth. At the same time, theoretical particle physicists collaborate to formulate hypotheses and theories, based on complex calculations, to accommodate and predict experimental findings. These goals are at the edge of current technology and drive developments in many areas, from engineering to electronics, from information technology to accelerator technology. The crowning jewel in HEP research is CERN's Large Hadron Collider (LHC), which will start accelerating particles in 2008, after more than a decade of construction. This 27km-long accelerator will collide protons 40 million times a second. These collisions will be observed by large detectors, up to the size of a five storey building, crammed with electronic sensors: think a 100MegaPixel digital camera taking 40 million pictures a second.

This contribution is structured as follows: Section 2 traces a short history of Scholarly Communication and Open Access in HEP; Section 3 presents the HEP publication landscape and the way this has inspired the construction of the SCOAP^3 model; Section 4 outlines the details of the SCOAP^3 model; Section 5 discusses the transition from a model to reality, presenting the status of the initiative and debriefing the lessons learned in recent months, with an outlook for the future evolution of the SCOAP^3 initiative.

2. Scholarly Communication and Open Access in HEP

HEP has long pioneered a bridge between scholarly communication and Open Access through its widespread *preprint culture* [2,3]. For decades, theoretical physicists and scientific collaborations, eager to disseminate their results in a way faster than the distribution of conventional scholarly publications, took to print and mail hundreds of copies of their manuscripts at the same time as submitting them to peer-reviewed journals. This *ante-litteram* form of "author-pays" or rather "institute-pays" Open Access assured the broadest possible dissemination of scientific results, albeit privileging scientists working in affluent institutions. These could afford the mass mailing and were most likely to receive a copy of preprints from other scientists eager to advertise their results. At the same time, for research-intensive institutions, preprint dissemination came at a cost: as an example, in the '90s the DESY (Deutsches Elektronen-Synchrotron) HEP research centre in Hamburg, Germany, used to spend about 1 Million DM a year, (500'000€ of today, not corrected for inflation) for the production and mailing of hard-copies of these preprints, while CERN used to spend about twice as much [2].

Against this background, three revolutions mark crucial advances in scholarly communication in HEP.

1. **1974, IT meets HEP libraries.** The SPIRES database, the first grey-literature electronic catalogue, saw the light at the SLAC (Stanford Linear Accelerator Center) HEP laboratory in Stanford, California, in 1974. It listed preprints, reports, journal articles, theses, conference talks and books and it now contains metadata for about 760'000 HEP articles, including links to full-text. It offers additional tools like citation analysis and is interlinked with other databases containing information on conferences, experiments, authors and institutions [4]. A recent poll of HEP scholars has shown that SPIRES, in symbiosis with arXiv, is an indispensable tool in their daily research workflow [5].
2. **1991, the first repository.** arXiv, the archetypal repository, was conceived in 1991 by Paul Ginsparg then at LANL (Los Alamos National Laboratory) in New Mexico [6]. It

evolved the four-decade old preprint culture into an electronic system, offering all scholars a level playing-field from which to access and disseminate information. Today arXiv has grown outside the field of HEP, becoming the reference repository for many disciplines: from mathematics to some areas of biology. It contains about 450'000 full-text preprints, receiving about 5'000 submissions each month, about 15% of which concern HEP.

3. **1991, the web is woven.** The invention of the web by Tim Berners-Lee at CERN in 1991 is a household story [7], and April 30th, 2008 saw the 15th anniversary of the day CERN released the corresponding software in the public domain [8]. What is less known is that the first web server outside Europe was installed at SLAC in December 1991 to provide access to the SPIRES database, as an example of the "killer-app" for the web [9]. HEP scholars imagined the web as from its inception as a tool for scholarly communication. The interlinking of arXiv and SPIRES in summer 1992 eventually offered the first web-based Open Access application.

Thanks its decade-old preprint culture, HEP is today an almost entirely "green" Open Access discipline, that means a discipline where authors self-archive their research results on repositories which guarantee their unlimited circulation. Posting an article on arXiv, even before submitting it to a journal, is common practice. Even revised versions incorporating the changes due to the peer-review process are routinely uploaded. Publishers of HEP journals are all allowing such practices and, in some cases, even hosting arXiv mirrors! It is interesting to remark that this success of "green" Open Access in HEP originates without mandates and without debates: very few HEP scientists would not take advantage of the formidable opportunities offered by the discipline repository of the field, and the linked discovery and citation-analysis tools offered by SPIRES. The speed of adoption of arXiv at large in the field is presented in Figure 1, which plots the evolution with time of the submissions to arXiv in the four categories in which HEP results are conventionally divided. The number of preprints that are subsequently published in peer-review journals is also indicated. The difference between the numbers of submissions and the published articles is mostly due to conference proceedings and other grey-literature material that is routinely submitted to arXiv, but which does not usually generate peer-reviewed publications.

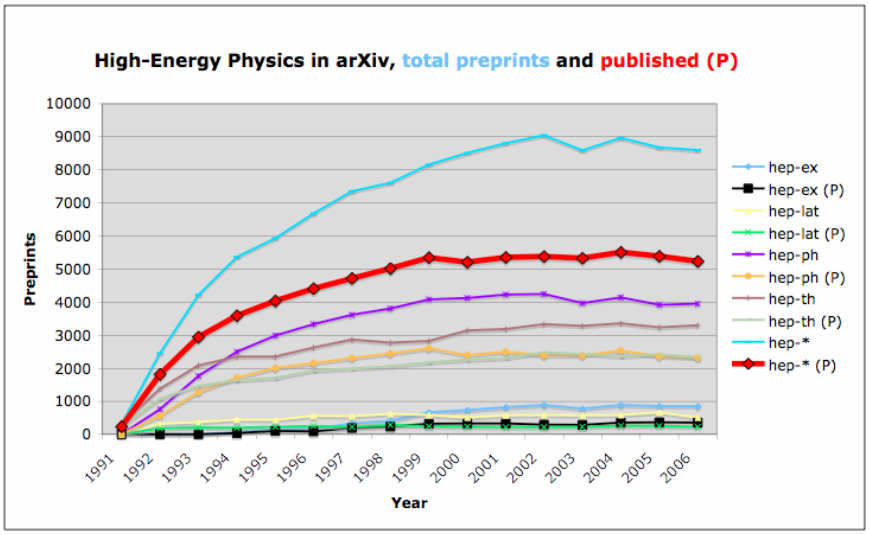

Figure 1. HEP preprints submitted to arXiv in four different categories (hep-ex, hep-lat, hep-ph and hep-th) as well as total numbers (hep-*). Preprints subsequently published in peer-reviewed journals are indicated with a "P". After a phase of adoption of the arXiv system, corresponding to the rise of all curves, present outputs are constant. Data from the SPIRES database.

As a consequence of the widespread role of arXiv in scholarly communication, it can be argued that HEP journals have to a large extent lost their century-old role as vehicles of scholarly communication. However, at the same time, they continue to play a crucial part in the HEP community. Evaluation of research institutes and (young) researchers is largely based on publications in prestigious peer-reviewed journals. The main role of journals in HEP is mostly perceived as the one of "keeper-of-the-records", by guaranteeing a high-quality peer-review process. In short, it can be argued that the HEP community needs high-quality journals as its "interface with officialdom".

The synergy between HEP and Open Access extends beyond preprints, into peer-reviewed literature. In 1997, HEP launched one of the first peer-reviewed Open Access journals: the *Journal of High Energy Physics* (*JHEP*), published by the International School of Advanced Studies (SISSA) in Trieste, Italy. It then became a low-cost subscription journal, and it is now offering a successful institutional membership scheme where for a small additional fee, all articles originating from a contributing institution are Open Access. It was followed in 1998 by *Physical Review Special Topics Accelerators and Beams*, published by the American Physical Society (APS), which operates under a sponsorship scheme, with 14 research institutions footing the bill for the operation of this niche journal. Another example is the *New Journal of Physics*, published by the Institute of Physics Publishing (IOPP), which carries HEP content in a broader spectrum covering many branches of physics. This journal also started in 1998 and is financed by author fees, under the so-called "author-pays" model. In 2007, PhysMathCentral, a spin-off of BioMedCentral, started a new "author-pays" HEP journal, *Physics A.* Most HEP publishers, Springer first and APS and Elsevier later, offer now the possibility to authors to pay an additional fee on top of subscription to make their single articles Open Access, under the so called "hybrid model".

The "author-pays" and "hybrid" schemes, however, are not very popular: the total number of HEP articles that appear as Open Access under these two schemes is below 1% of the yearly HEP literature. In comparison, the volume of Open Access articles financed by the institutional membership fee in *JHEP* is about 20% of this journal, corresponding to about 4% of the total volume of HEP articles.

After preprints, arXiv and the web, a transition to Open Access journals appears to be the next logical step in the natural evolution of HEP scholarly communication, and the following sections of this contribution will be describing the publishing landscape in HEP and how such a transition can be achieved, beyond the present experiments.

3. Bibliometric Facts

The aim of the SCOAP[3] initiative is to convert the entire HEP literature to Open Access. In-depth studies have been performed to assess the HEP publication landscape and have informed the design of this model. The most relevant findings of these studies are summarised in the following, and in particular the volume of HEP publishing, the journals favoured by HEP authors and the geographical distribution of the HEP authorship [10,11,12].

Five numbers set the scale of HEP scientific publishing:

- 20'000; a lower limit to the number of active HEP scholars;
- 6'000; an upper limit to the HEP articles submitted to arXiv yearly, and subsequently published in peer-reviewed journals; Figure 1 shows that this yearly HEP output is constant.
- 80%; the fraction of HEP articles produced by theoretical physicists;
- 20%; the fraction of these articles authored by large collaborations of experimental

physicists;

- 50:50; the ratio of active experimental and theoretical HEP scholars.

Figure 2 presents the journals favoured by HEP authors in 2006. The large majority of HEP articles are published in just six peer-reviewed journals from four publishers. Five of those six journals carry a majority of HEP content. These are *Physical Review D* (published by the APS), *Physics Letters B* and *Nuclear Physics B* (Elsevier), *JHEP* (SISSA/IOPP) and the *European Physical Journal C* (Springer). The sixth journal, *Physical Review Letters* (APS), is a "broadband" journal that carries only about 10% of HEP content. These journals have been since long time favourite by HEP scholars, albeit with varying fortunes. Figure 3 presents the percentage of HEP articles published in each of these six journals in the last 17 years. Only the articles published in these journals are considered in this graph, which allows to assess the relative popularity of these titles with time. Periods of stability are followed by fast rise of some titles and corresponding decline of others.

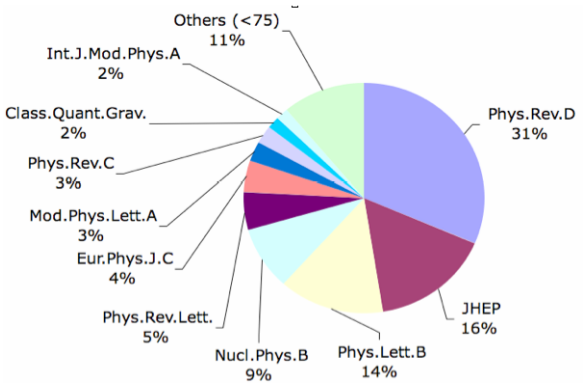

Figure 2. Journals favoured by HEP scientists in 2006. Journals that attracted less than 75 HEP articles are grouped in the slice named "Others". Data from the SPIRES database.

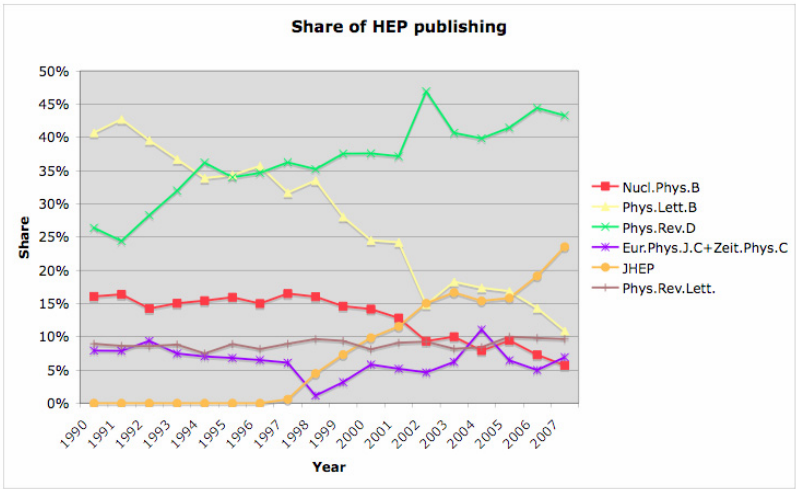

Figure 3. Journals favoured by HEP scientists in the last 18 years. For each year, only articles published in these six journals are considered, and the relative fractions are displayed. Articles published in *Zeitschrift für Physik C* and the *European Physical Journal C* are aggregated, as the latter is a successor of the former. Data from the SPIRES database.

It is interesting to remark that in a discipline as HEP, with traditionally strong cross-border collaborative links, journals published in the United States or in Europe attract contribution from all geographical regions, as presented in Figure 4. Any Open Access initiative, therefore, can only succeed if it is truly global in scope.

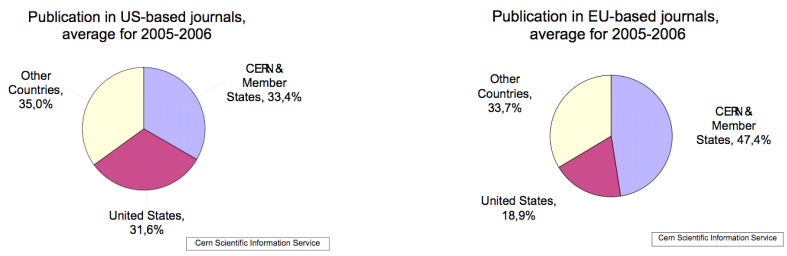

Figure 4. Geographical origin of publications in HEP journals based in the United States and in Europe. Co-authorship is taken into account on a pro-rata basis, assigning fractions of each article to the countries in which the authors are affiliated. This study is based on all articles published in the years 2005 and 2006 in five HEP "core" journals: Physical Review D (US), Physics Letters B (EU), Nuclear Physics B (EU), Journal of High Energy Physics (EU) and the European Physical Journal C (EU), and the HEP articles published in two "broadband" journals: Physical Review Letters (US) and Nuclear Instruments and Methods in Physics Research A (EU) [12]. The European contribution is well represented by CERN and its Member States, which are: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland and the United Kingdom.

Country	Share of HEP Scientific Publishing	Country	Share of HEP Scientific Publishing
United States	24.3%	Netherlands	0.9%
Germany	9.1%	Portugal	0.9%
Japan	7.1%	Taiwan	0.8%
Italy	6.9%	Mexico	0.8%
United Kingdom	6.6%	Sweden	0.8%
China	5.6%	Belgium	0.7%
France	3.8%	Greece	0.7%
Russia	3.4%	Denmark	0.6%
Spain	3.1%	Australia	0.6%
Canada	2.8%	Argentina	0.6%
Brazil	2.7%	Turkey	0.6%
India	2.7%	Chile	0.6%
CERN	2.1%	Austria	0.5%
Korea	1.8%	Finland	0.5%
Switzerland	1.3%	Hungary	0.4%
Poland	1.3%	Norway	0.3%
Israel	1.0%	Czech Republic	0.3%
Iran	0.9%	Remaining countries	3.1%

Table 1: Contributions by country to the HEP scientific literature. Co-authorship is taken into account on a pro-rata basis, assigning fractions of each article to the countries in which the authors are affiliated. The last cell aggregates contributions from countries with a share below 0.3%. This study is based on all articles published in the years 2005 and 2006 in five HEP "core" journals: *Physical Review D*, *Physics Letters B*, *Nuclear Physics B*, *Journal of High Energy Physics* and the *European Physical Journal C*, and the HEP articles published in two "broadband" journals: *Physical Review Letters* and *Nuclear Instruments and Methods in Physics Research A*. A total sample of about 11'300 articles is considered [11,12].

Table 1 and Figure 5 present the contribution by country to the HEP scientific literature. Co-authorship is taken into account on a pro-rata basis, assigning fractions of each article to the countries in which the authors are affiliated. This study is based on all articles published in the years 2005 and 2006 in five HEP "core" journals: *Physical Review D*, *Physics Letters B*, *Nuclear Physics B*, *JHEP* and the *European Physical Journal C*, and the HEP articles published in two "broadband" journals: *Physical Review*

Letters and *Nuclear Instruments and Methods in Physics Research A*. A total sample of almost 11'300 articles is considered [11,12].

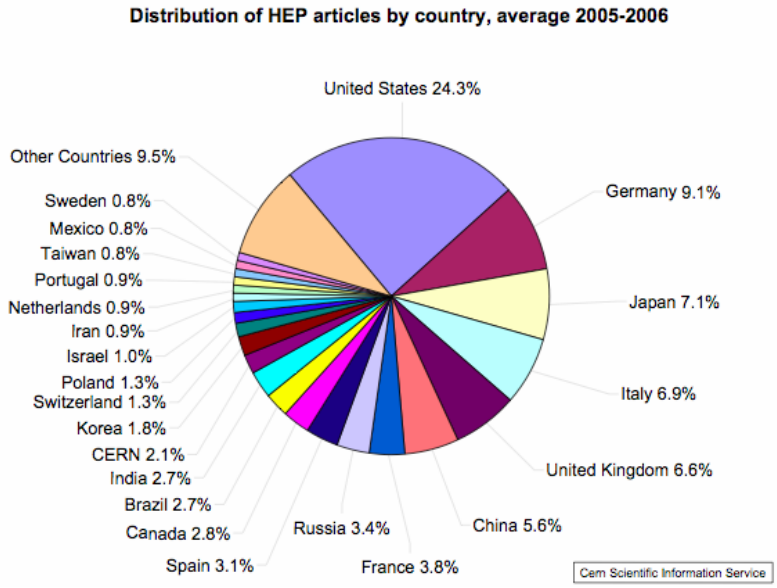

Figure 5. Contributions by country to the HEP scientific literature published in the largest journals in the field. Co-authorship is taken into account on a pro-rata basis, assigning fractions of each article to the countries in which the authors are affiliated. Countries with individual contributions less than 0.8% are aggregated in the "Other countries" category. This study is based on all articles published in the years 2005 and 2006 in five HEP "core" journals: *Physical Review D*, *Physics Letters B*, *Nuclear Physics B*, *Journal of High Energy Physics* and the *European Physical Journal C*, and the HEP articles published in two "broadband" journals: *Physical Review Letters* and *Nuclear Instruments and Methods in Physics Research A*. A total sample of almost 11'300 articles is considered [11,12].

4. The SCOAP³ model

The call for Open Access journals in HEP is not only originating from librarians frustrated by spiralling subscription costs and shrinking budget, but is a solid pillar of the scientific community. At the beginning of 2007, the four experimental collaborations working at the CERN LHC accelerator, ATLAS, CMS, ALICE and LHCb, counting a total of over 5'000 scientists from 54 countries, declared: *"We, [...] strongly encourage the usage of electronic publishing methods for [our] publications and support the principles of Open Access Publishing, which includes granting free access of our publications to all. Furthermore, we encourage all [our] members to publish papers in easily accessible journals, following the principles of the Open Access paradigm"* [11].

SCOAP³, the Sponsoring Consortium for Open Access Publishing in Particle Physics, aims to convert to Open Access the HEP peer-reviewed literature in a way transparent to authors [11,13], meeting the expectations of the HEP community for peer-review of the highest standard: administered from the journals which have served the field for decades, while leaving room for new players. The SCOAP³ business model originates from a two-years debate involving the scientific community, libraries and publishers [11,14]. The essence of this model is the formation of a consortium to sponsor HEP publications and make them Open Access by redirecting funds that are currently used for subscriptions to HEP journals. Today, libraries (or the funding bodies behind them) purchase journal subscriptions to implicitly support the peer-review and other editorial services and to allow their users to read articles, even though in HEP the scientists mostly access their information by reading preprints on arXiv. The SCOAP³ vision for tomorrow is that funding bodies and libraries worldwide would federate in a consortium that will pay centrally for the

peer-review and other editorial services, through a re-direction of funds currently used for journal subscriptions, and, as a consequence, articles will be free to read for everyone. This evolution of the current "author-pays" Open Access models will make the transition to Open Access transparent for authors, by removing any financial barriers.

The SCOAP^3 model offers another advantage for libraries and funding bodies over the present "author-pays" model. Disciplines with successful "author-pays" journals often see publication costs met either by libraries or by funding bodies. At the same time the costs of the subscriptions to "traditional" journals do not decrease following the reduced volume of articles that these publish, due to the drain towards "author-pays" Open Access journals. Conversely, in the SCOAP^3 models all literature of the field could be converted to Open Access, keeping the total expenditure under control.

In practice, the Open Access transition will be facilitated by the fact that the large majority of HEP articles are published in just six peer-reviewed journals from four publishers, as presented in Figure 1. Five of those six journals carry a majority of HEP content and the aim of the SCOAP^3 model is to assist publishers to convert these "core" HEP journals entirely to Open Access and it is expected that the vast majority of the SCOAP^3 budget will be spent to achieve this target. Another journal, *Physical Review Letters*, is a "broadband" journal that carries only 10% of HEP content: it is the aim of SCOAP^3 to sponsor the conversion to Open Access of this journal fraction. The same approach can be extended to other "broadband" journals. Of course, the SCOAP^3 model is open to any other, present or future, "core" or "broadband", high-quality journals carrying HEP content, beyond those spotlighted here. This will ensure a dynamic market with healthy competition and a broader choice.

The price of an electronic journal is mainly driven by the costs of running the peer-review system and editorial processing. Most publishers quote a price in the range of 1'000–2'000€ per published article. On this basis, given that the total number of HEP publications in high-quality journals is between 5'000 and 10'000, according to how one defines HEP and its overlap with cognate disciplines, the annual SCOAP^3 budget for the transition of HEP publishing to Open Access would amount to a maximum of 10 Million Euros per year [11]. The costs of SCOAP^3 will be distributed among all countries according to a fair-share model based on the distribution of HEP articles per country, as shown in Table 1 and Figure 5. In practice, this is an evolution of the "author-pays" concept: countries will be asked to contribute to SCOAP^3, whose ultimate targets are Open Access and peer-review, according to their use of the latter, measured from their scientific productivity. To cover publications from scientists from countries that cannot be reasonably expected to make a contribution to the consortium at this time, an allowance of not more than 10% of the SCOAP^3 budget is foreseen.

SCOAP^3 will sponsor articles through a tendering procedure with publishers of high-quality journals. It is expected that the consortium will invite publishers to bid for their peer-review and other editorial services, on a per-article basis. The consortium will then evaluate these offers as a function of indicators such as the journal quality and price and attribute contracts, within its capped budget envelope. SCOAP^3 has therefore the potential to contain the overall cost of journal publishing by linking price, volume and quality and injecting competition into the market.

In the SCOAP^3 model, libraries will not be paying twice for the journals to be converted to Open Access, in case these are part of journal licence packages. Indeed, in the case of a "core" HEP journal (where an entire journal is converted to OA) that is part of a large journal licence package, the publisher will be required to un-bundle this package and to correspondingly reduce the subscription cost for the remaining part of the package. For "broadband" journals (where only the conversion of selected HEP articles is paid by SCOAP^3), the subscription costs will be required to be lowered according to the fraction supported by SCOAP^3. For journals of this kind that are part of a licence package, the reduction should be reflected in a corresponding reduction of the package subscription cost. In the case of existing long-term subscription

contracts between publishers, libraries, and funding agencies, publishers will be required to reimburse the subscription costs pertaining to OA journals or to the journal fractions converted to OA.

It appears at first glance to be a formidable enterprise to organize a worldwide consortium of research institutes, libraries and funding bodies that cooperates with publishers in converting the most important HEP journals to Open Access. At the same time, HEP is used to international collaborations on a much bigger scale. As an example, the ATLAS experiment, one of the four detectors at the LHC, has been built over more than a decade by about 50 funding agencies on a total budget of 400 Million Euros (excluding person-power), placing about 1000 industrial contracts. In comparison, the SCOAP³ initiative has about the same number of partners, but a yearly budget of only 10 Million Euros, and will handle less than a dozen contracts with publishers. SCOAP³ will be operated along the blueprint of large HEP collaborations, profiting from the collaborative experience of HEP.

5. Conclusions and Outlook

SCOAP³ is now collecting Expressions of Interest from partners worldwide to join the consortium. Once it will have reached a critical mass, and thus demonstrated its legitimacy and credibility, it will formally establish the consortium and its governance, it will issue a call for tender to publishers, aimed at assessing the exact cost of the operation, and then move quickly forward with negotiating and placing contracts with publishers.

SCOAP³ is rapidly gaining momentum. In Europe, most countries have pledged their contribution to the projects. In the United States, leading libraries and library consortia have pledged a redirection of their current expenditures for HEP journal subscription to SCOAP³, and a call for action has originated from many associations, among which ARL, the Association of Research Libraries [15]. In total, SCOAP³ has already received pledges for about a third of its budget envelope, with another considerable fraction having the potential to be pledged in the short-term future, as presented in Figure 6 [13]. This consensus basis is not restricted to Europe and North America: Australia is part of the consortium and advanced negotiations are in progress in Asia and in Latin America.

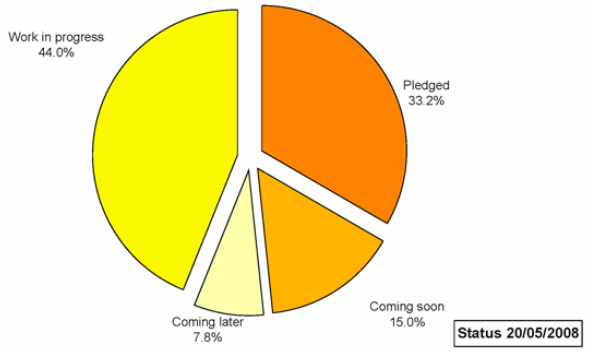

Figure 6. Status of the SCOAP3 fund-raising at the time of writing. A third of the funds have already been pledged, 15% are expected to be pledged in the coming weeks, while discussions and negotiations are in progress for another 44% [13].

In conclusion, SCOAP³ is a unique experiment of "flipping" from Toll Access to Open Access all journals covering the literature of a given disciplien. Its success so far and its eventual fate, will be important to inform other initiatives in Open Access publishing for several reasons:

- The contained publication landscape of HEP, with less than 10'000 articles appearing in

half a dozen journals from few publishers simplifies a possible transition of the entire literature of the field to Open Access.

- HEP is a scientific discipline which has since long embraced, and actually pioneered, "green" Open Access, with a long tradition of unrestricted circulation of preprints via mass mailing first and arXiv later. SCOAP^3 can be interpreted as an experiment in a controlled environment of possible future evolutions in Open Access publishing, or "gold" Open Access, in the light of the present acceleration of "green" Open Access, or self-archiving of research results in many other fields of science, both on an institutional and disciplinary basis.
- Some of obstacles met by "gold" Open Access publishing so far are related to justified authors' concerns about financial barriers for the paiment Open Access fees and their reluctance to submit articles to new, Open Access, journals. The SCOAP^3 initiative benefits from a strong consensus from the researchers side as it addressed both points: it does not imply any direct financial contribution from authors and aims to convert to Open Access the high quality of peer-reviewed journals which have served the community for decades.
- By construction, the SCOAP^3 model implies a large worldwide consensus first, and financial commitment later. As Open Access is a global issue, the success of this initiative, in a well-organised discipline with strong cross-border links like HEP, can signify the potential of international cooperation in addressing the global problems of scholarly communication.

6. Notes and References

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