Quantitative Analysis of the

Geographical Distribution of High-Energy Physics Publications in 2022-2023

And Calculation for SCOAP³ Phase 4 "Fair Share" Contributions

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1. Executive Summary

The Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP³) is a partnership of more than three thousand libraries, key funding agencies and research centers in 45 countries, and 3 intergovernmental organizations, with a mission to ensure the ongoing provision of peer-reviewed open access publication services for the benefit of the global high energy physics community. Participating countries contribute towards a central fund managed by CERN who manages and executes contracts with publishers to deliver open access publishing services. Each contractual cycle--or Phase--of SCOAP³ is typically 3 years in duration (with the exception of Phase 3 which was extended by two years due to the financial uncertainty of the COVID-19 pandemic). For each respective Phase, financial contributions from partners are calculated through a consistent methodology that considers the relative share of authorship of researchers in a country across the body of literature in the discipline across a two-year reference period. For the upcoming Phase 4, contributions from partners will be based on the proportional fair-shares calculated for the years 2022-2023.

2. Introduction

The Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP³) is a partnership of more than three thousand libraries, key funding agencies and research centers in 45 countries, and 3 intergovernmental organizations. Since its launch in 2014, it has supported the Open Access (OA) publishing of more than 62,500 articles across 11 leading journals in the discipline of high-energy physics.

Each participating country in the collaboration contributes a “fair share” to a central fund managed by CERN to compensate participating publishers for the service of publishing HEP journal articles OA. In addition, as part of its mission, CERN contributes in-kind all resources for the operation of the consortium and guarantees the contracts with publishers, effectively absorbing shortfalls in contributions (e.g. for countries not yet participating). These contributions[1] were agreed through the SCOAP³ Memorandum of Understanding (MoU) signed by all participants between 2013 and today.

The first set of “fair share” contributions for Phase 1 of SCOAP³ (covering the years 2014-2016) were calculated based on a 2007 study [1] underpinning the SCOAP³ Working Party Report [2]. The SCOAP³ MoU indicates in its Clause 4.3 that for each subsequent phase of SCOAP³, the “fair share” contributions will be recalculated reflecting changes in the HEP publishing landscape: ”…taking into account the volume of articles published in the SCOAP³ framework over a specified two-year reference period (e.g. contribution for 2017-2019 calculated from SCOAP³ articles in 2014 and 2015).”

In accordance with the MoU, the "fair share" contributions were thus recalculated using data from 2014 and 2015 for Phase 2 of SCOAP³ (covering the years 2017-2019) and were presented

[1] http://scoap3.org/contributions

to the Governing Council on February 25th, 2016. With the inclusion of the journals of the American Physical Society (APS) journals, a similar analysis based on 2014 and 2015 data was performed and presented to the SCOAP³ Governing Council on March 23rd, 2017, which included the fair share contributions across the wider corpus of research articles which would take effect from the start of 2018. In January 2019, a new analysis was performed for the Phase 3 of SCOAP³ (initially covering the years 2020-2022), using data from articles published in 2017 and 2018.

This document presents an analysis of the "fair share" calculation for SCOAP³ partners for an upcoming Phase 4 of SCOAP³ (covering the years 2025-2027). As Phase 3 of SCOAP³ was extended by two years (i.e. until the end of 2024) through a unanimous vote of the SCOAP³ Governing Council in 2020--to provide the collaboration with stability due to the uncertainty caused by the COVID-19 pandemic--this analysis of the Phase 4 fair-share contributions is based on data from 2022 and 2023.

3. The Analysis

2.1. Data sample

This analysis is based on 14,997 articles[2] published in SCOAP³ journals from January 1st, 2022 to December 31st, 2023. The metadata used in the analysis (such as journal name, publisher, publication year, author affiliation) were extracted from the SCOAP³ Repository.

The entire corpus published under SCOAP³ in the years 2022 and 2023 has been covered, as stipulated in the MOU.

[2] According to the SCOAP³ Tender Technical Specifications [4] article is defined as a peer-reviewed document identified in Clarivate Web of Science as 'article' or 'review'. Documents with any additional classification, such as, but not limited to, 'proceedings paper' are not considered as 'research articles'. Consequently, material not covered by SCOAP³ (e.g. proceedings, editorials, errata, addenda, corrigenda, obituaries and retracted articles) are explicitly excluded even if present in the SCOAP³ repository.

SCOAP3 Journal Name (Publisher)	Number of articles
Acta Physica Polonica B (Jagiellonian University)	31
Advances in High Energy Physics (Hindawi)	55
Chinese Physics C (IOP Publishing / CAS)	226
European Physical Journal C (Springer / SIF)	2'267
Journal of High Energy Physics (Springer / SISSA)	4'858
Nuclear Physics B (Elsevier)	600
Physics Letters B (Elsevier)	1'493
Progress of Theoretical and Experimental Physics (OUP / JPS)	158
Physical Review C (APS)	174
Physical Review D (APS)	4'578
Physical Review Letters (APS)	557
Total	**14'997**

Table 1: Number of articles for each SCOAP^3 journal considered in the analysis.

2.2 Co-authorship

Research in the discipline of HEP is a collective undertaking, both in its experimental and theoretical branches. While large-scale collaborations in experimental HEP are well known (e.g. the large author lists from articles originating from the CERN LHC program), most articles in theoretical HEP are also the outcome of global collaboration. Figure 1 presents the distribution of articles according to their number of authors. Only 11% of all articles have a single author. The vast majority of publications in the sample (83,4%) are co-authored by between 2 and 100 researchers. The remaining articles are the result of a cooperation of a larger group of scientists including the above-mentioned large experimental collaborations.

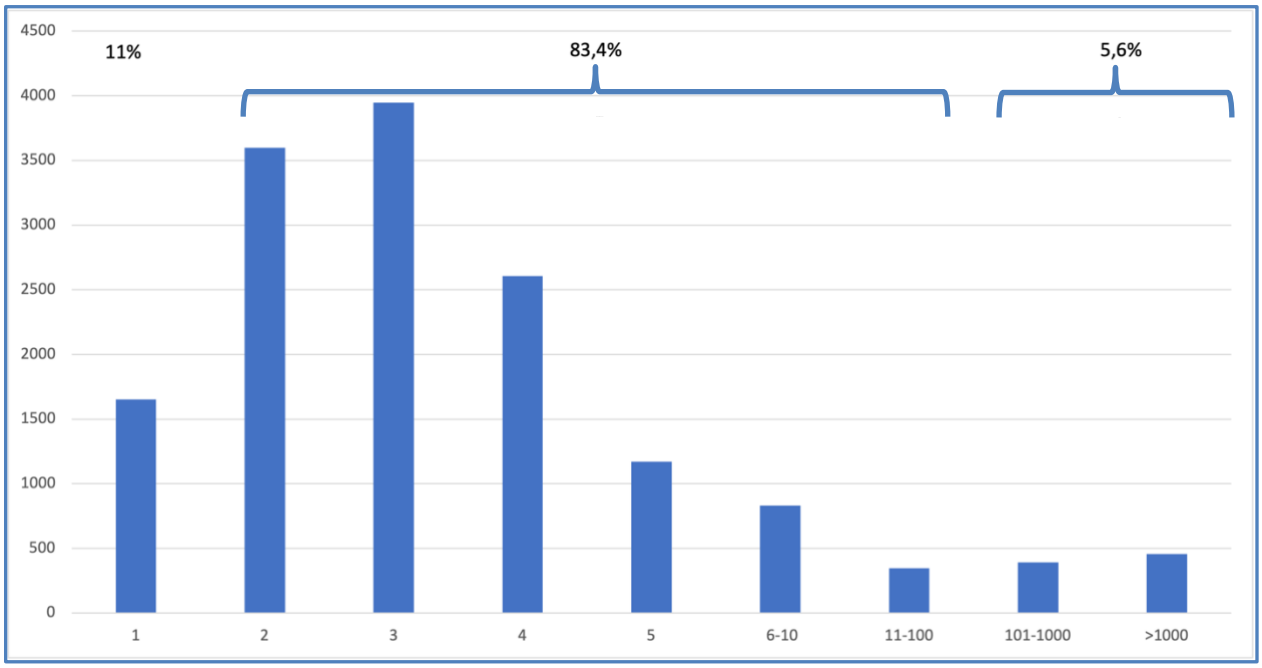

Figure 1: Distribution of number of authors for the HEP articles in the sample

2.3. Methodology

The fair share contributions for Phase 4 SCOAP³ are calculated by applying the same principles adopted for prior Phases of the initiative. Consequently, the methodology used here follows that of Reference [1].

Two main parameters are used for this analysis: the number of authors of an article, and the country of their affiliation. Four steps are sequentially followed to determine the share of a given country in the HEP literature, as sketched in Figure 2:

1. Each article is "assigned" to its authors proportionally, so that for *n* authors, each of them receives a *1/n* "share" of the article. Multiple affiliations are resolved as discussed in points a-d below.

2. Every author is "assigned" to one country/region/territory according to the location of the institution they are affiliated to. For this analysis, two of the intergovernmental organizations in the collaboration–the European Organization for Nuclear Research (CERN) in Geneva, Switzerland and the Joint Institute for Nuclear Research (JINR) in Moscow, Russia–are considered as individual regions irrespective of their geographical location.

3. For each article, a pro-rata share is attributed to a country/region/territory so that if *x* authors of the article are affiliated with it, the pro-rata share for the country/region/territory is *x/n*.

4. The overall share of HEP authorship of each country/region/territory is calculated by summing up the pro-rata shares of each individual article of the country/region/territory and dividing this number by the total number of articles in the sample.

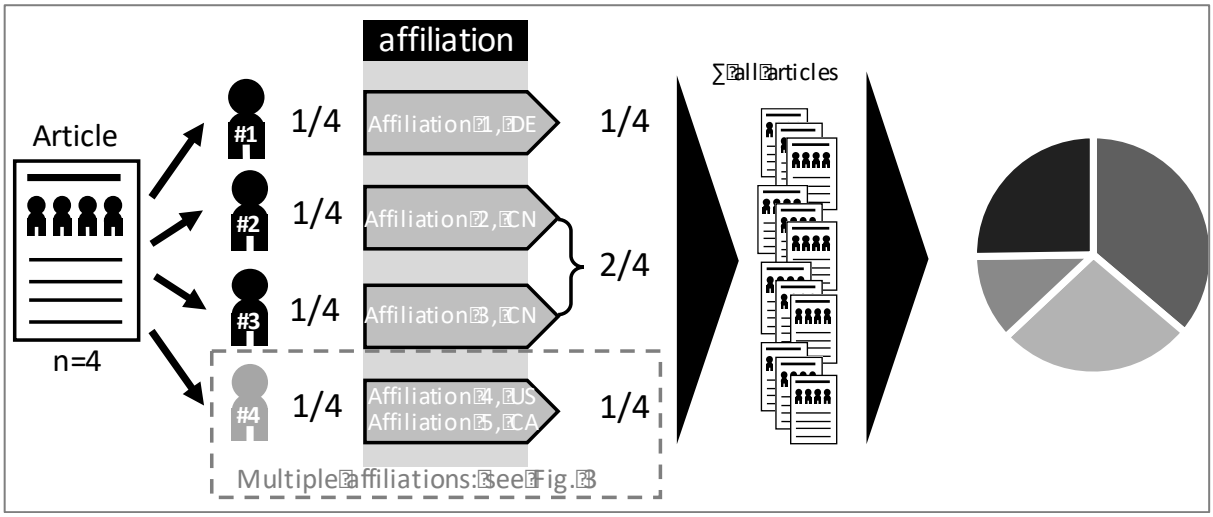

Figure 2: Schematic overview of the methodology used to calculate the "country" shares

Given the global scope of HEP research, 10% of authors in the sample have at least two affiliations in different countries/regions/territories. To resolve this ambiguity for the calculation of the SCOAP[3] "fair shares", the following criteria are sequentially applied. The process is stopped and an author with multiple affiliations is assigned to a unique country/region/territory, according to which of criterion is first met:

a. If one of the multiple affiliations is CERN, the author is affiliated to CERN as a region.
b. If one of the multiple affiliations is JINR, the author is affiliated to JINR as a region.
c. If one of the multiple affiliations is a HEP laboratory, the author is affiliated to the country/region/territory of the HEP laboratory and in particular:
    - Deutsches Elektronen-Synchrotron (DESY), to Germany
    - Fermi National Accelerator Laboratory (FNAL) or SLAC National Accelerator Laboratory to the USA
    - The High Energy Accelerator Research Organization (KEK), to Japan

If two or more of the multiple affiliations are HEP laboratories, rule d is used to determine the country amongst the list of countries of the HEP laboratories.

d. For the remaining multiple-affiliation cases, the author is affiliated with the country/region/territory with the highest per capita gross domestic product, calculated with purchasing-power-parity (GDP PPP) [3].

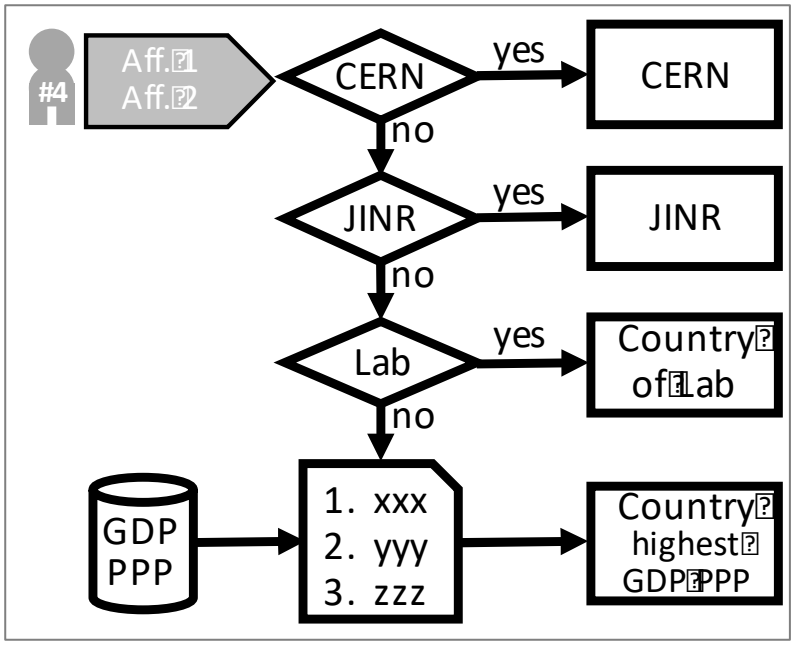

Figure 3: Resolving multiple affiliations

5. Results

The distribution of HEP authorship in the period covered by the data sample is shown in Table 2. The table also provides the new "fair share" contributions to the SCOAP³ fund (in Euro), following the approval of the final budget for SCOAP³ Phase 4 (total of EUR € 31'666'500) by the Governing Council at its meeting on December 7th 2023. It is calculated in accordance with the SCOAP³ MoU, by multiplying the share of HEP publications with the total budget envelope, including an additional 10% 'solidarity contribution', to *"…to cover publications from scientists from countries that cannot be reasonably expected to contribute to the consortium…".*

Country/Region/Territory	***Share (in %) of HEP Authorship (2022-2023 YTD)***	***SCOAP³ annual "fair share" (in €) Budget 2025-2027: € 31'666'500***	***For info: Share (in %) of HEP Authorship as used for Phase 3 (2017-2018)***
Algeria	0.05%	6'000.00	0.05%
Argentina	0.50%	58'000.00	0.70%
Armenia	0.05%	6'000.00	0.00%
Australia	0.70%	81'000.00	0.80%
Austria	0.50%	58'000.00	0.70%
Azerbaijan	0.05%	6'000.00	0.00%
Bangladesh	0.02%	2'000.00	0.02%
Belarus	0.02%	2'000.00	0.00%
Belgium	0.90%	104'000.00	1.10%
Brazil	2.50%	290'000.00	3.10%
Bulgaria	0.10%	12'000.00	0.10%
Canada	2.00%	232'000.00	2.40%
CERN	1.20%	139'000.00	1.70%
Chile	1.10%	128'000.00	1.20%
China	16.00%	1'858'000.00	9.70%
Chinese Taipei	0.60%	70'000.00	0.90%
Colombia	0.20%	23'000.00	0.20%
Croatia	0.20%	23'000.00	0.20%
Cyprus	0.05%	6'000.00	0.10%
Czech Republic	0.60%	70'000.00	0.60%
Denmark	0.40%	46'000.00	0.60%
Ecuador	0.10%	11'000.00	0.05%
Egypt	0.10%	11'000.00	0.05%
Estonia	0.20%	23'000.00	0.20%
Finland	0.50%	58'000.00	0.40%
France	2.60%	302'000.00	2.60%
Georgia	0.05%	6'000.00	0.00%
Germany	7.60%	882'000.00	8.90%
Greece	0.50%	59'000.00	0.50%
Hong Kong	0.20%	23'000.00	0.10%
Hungary	0.30%	35'000.00	0.30%

Iceland	0.05%	6'000.00	0.01%
India	6.10%	708'000.00	5.00%
Indonesia	0.10%	12'000.00	0.02%
Iran	1.40%	163'000.00	2.00%
Ireland	0.20%	23'000.00	0.20%
Israel	0.90%	104'000.00	1.20%
Italy	5.30%	615'000.00	4.80%
Japan	5.30%	615'000.00	6.50%
JINR	0.60%	70'000.00	1.20%
Jordan	0.02%	2'000.00	0.00%
Kazakhstan	0.05%	6'000.00	0.00%
Kuwait	0.02%	2'000.00	0.02%
Lebanon	0.05%	6'000.00	0.05%
Lithuania	0.05%	6'000.00	0.05%
Luxembourg	0.02%	2'000.00	0.00%
Macedonia	0.02%	2'000.00	0.01%
Malaysia	0.02%	2'000.00	0.01%
Malta	0.02%	2'000.00	0.05%
Mexico	0.70%	81'000.00	0.80%
Morocco	0.20%	23'000.00	0.10%
Netherlands	0.80%	93'000.00	1.20%
New Zealand	0.02%	2'000.00	0.02%
Norway	0.20%	23'000.00	0.30%
Oman	0.05%	6'000.00	0.05%
Pakistan	0.40%	46'000.00	0.50%
Peru	0.02%	2'000.00	0.02%
Philippines	0.02%	2'000.00	0.00%
Poland	1.50%	174'000.00	1.30%
Portugal	0.60%	70'000.00	0.80%
Puerto Rico	0.01%	1’000.00	0.00%
Romania	0.30%	35'000.00	0.20%
Russia[3]	2.60%	302'000.00	3.00%
Rwanda	0.01%	1'000.00	0.00%
Saudi Arabia	0.05%	6'000.00	0.05%

[3] Russia fair share includes the share of Russian-affiliated authors that could be easily identified from CERN collaborations stored with no affiliation in the repository.

Serbia	0.10%	12'000.00	0.10%
Singapore	0.10%	12'000.00	0.10%
Slovak Republic	0.05%	6'000.00	0.05%
Slovenia	0.10%	12'000.00	0.10%
South Africa	0.40%	46'000.00	0.30%
South Korea	2.20%	255'000.00	2.50%
Spain	3.30%	383'000.00	3.10%
Sweden	0.90%	104'000.00	0.90%
Switzerland	1.50%	174'000.00	1.60%
Syria	0.01%	1'000.00	0.00%
Thailand	0.30%	35'000.00	0.20%
Turkiye	0.90%	104'000.00	0.80%
Ukraine	0.20%	23'000.00	0.00%
United Arab Emirates	0.10%	12'000.00	0.05%
United Kingdom	5.30%	615'000.00	5.20%
United States	16.30%	1'893'000.00	18.20%
Uruguay	0.02%	2'000.00	0.05%
Uzbekistan	0.10%	12'000.00	0.00%
Venezuela	0.02%	2'000.00	0.01%
Vietnam	0.40%	46'000.00	0.00%
Authors not affiliated[4]	0.12%	N/A	0.00%

Table 2: Distribution of HEP authorship for Phase 4.

For information only, results of the previous calculation of the distribution of HEP authorship. Shares of HEP authorship are rounded to one decimal place. Results are based on 14,997 articles published in SCOAP[3] journals from 1st January 2022 to 31st December 2023. Co-authorship has been accounted for, by counting articles on a prorate basis to the countries of all involved authors.

6. Conclusions

The preparation of SCOAP[3] Phase 4 and the SCOAP[3] MoU called for a renewed bibliometric analysis to calculate updated "fair share" financial contributions. This document presents the results of the new geographical distribution of HEP authorship. The analysis captures data from

[4] A small fraction of authors has no affiliation in the metadata. For BELLE and BELLE II collaborations, there were 59 articles where none of the authors had an affiliation. For those papers, the country share has been extrapolated from the data of the articles where the affiliation was present. All other authors without an affiliation are included in this category. This share certainly contains authors affiliated with a Russian institute with no affiliation indicated in the metadata.

the SCOAP³ Repository[5] for the two-year reference period (1st January 2022 to 31st December 2023) as per the MoU specifications and is based on the same methodology used for all prior Phases of SCOAP³.

The full data set used in this analysis, and the corresponding results, will be made available on the SCOAP³ website in the restricted section for Governing Council members[6].

References

[1] J. Krause, C.M. Lindqvist, S. Mele, *Quantitative Study of the Geographical Distribution of the Authorship of High-Energy Physics Journals*, CERN, Geneva, July 2007. https://cds.cern.ch/record/1033099/files/cer-002691702.pdf

[2] Towards Open Access Publishing in High Energy Physics - Report of the SCOAP3 Working Party, CERN, Geneva, April 2007. https://cds.cern.ch/record/1034368/files/open-2007-015.pdf

[3] World bank, GPP per capita index, PPP (current international $), December 2018. https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD?end=2022&start=2022

[4] SCOAP³ – Technical Specifications of the Tender. Available on the SCOAP³ partners restricted area of the SCOAP³ website

[5] http://repo.scoap3.org

[6] http://scoap3.org/governing_council_documents