

HEP STATISTICS IN LATIN AMERICA

MANUEL MORALES ALVARADO



UNIVERSITY OF CAMBRIDGE

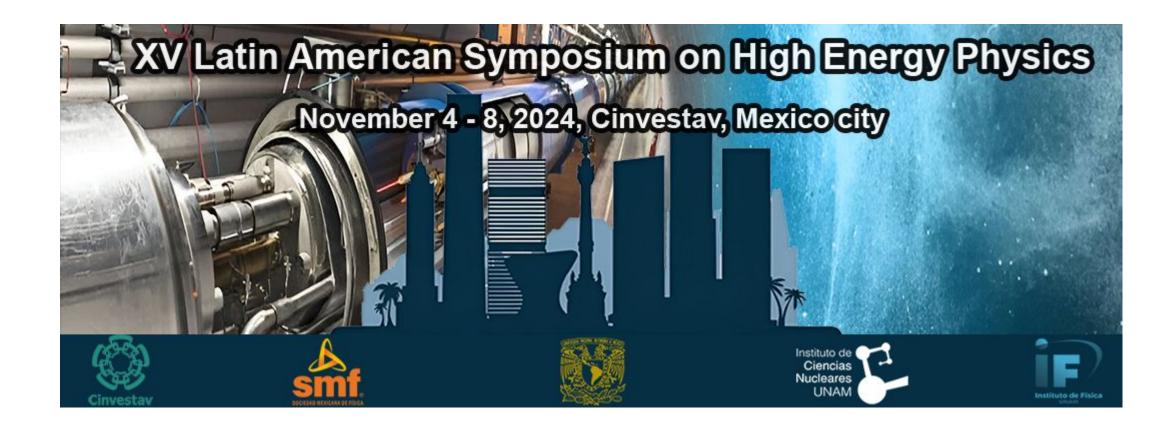






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HEP STATISTICS IN LATIN AMERI

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European Research Council Established by the European Commission



Thanks to D. Restrepo (U. de Antioquia) for some of the slides!



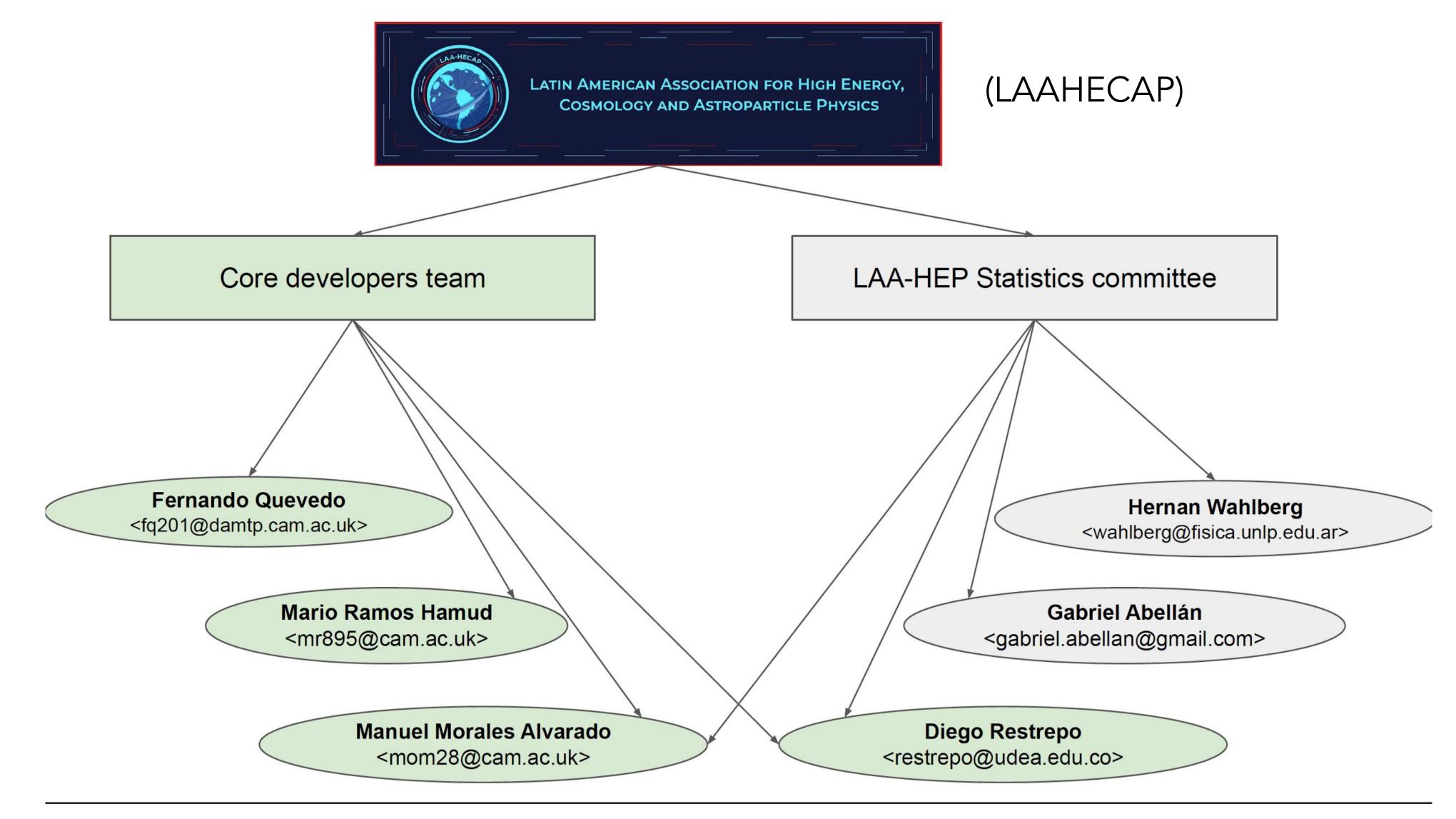
OBJECTIVE

Generate a public database, analysis, and report to assess the status of HEP research and researchers in Latin America





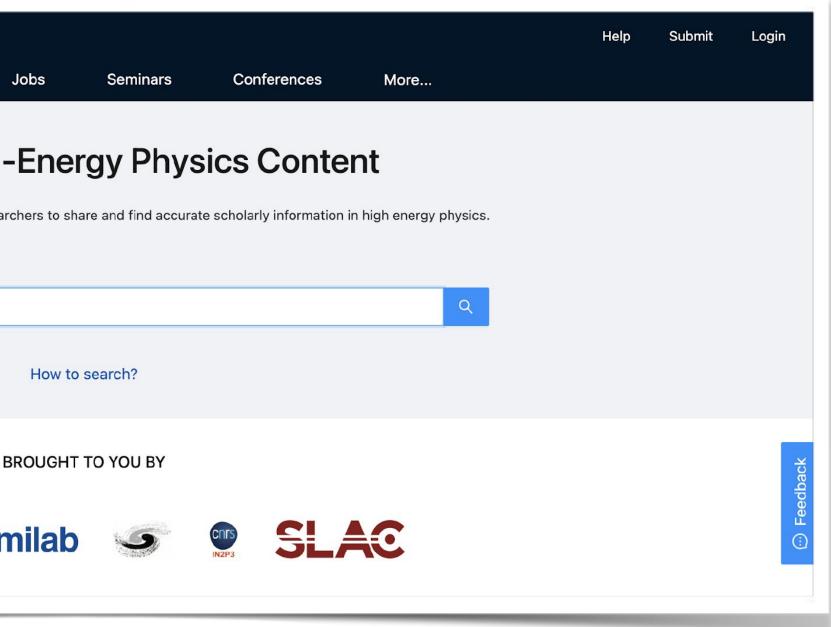
ORGANISATION



INSPIRE-HEP

- We use the https://inspirehep.net/ data for this analysis
- INSPIRE-HEP is an open access database
- First design conceived in 1967: SPIRES (Stanford Physics Information Retrieval System)
- SPIRES-HEP: the first website in America, and the first WWW dabatase

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DATA STRUCTURES



- [2]: 'dog'

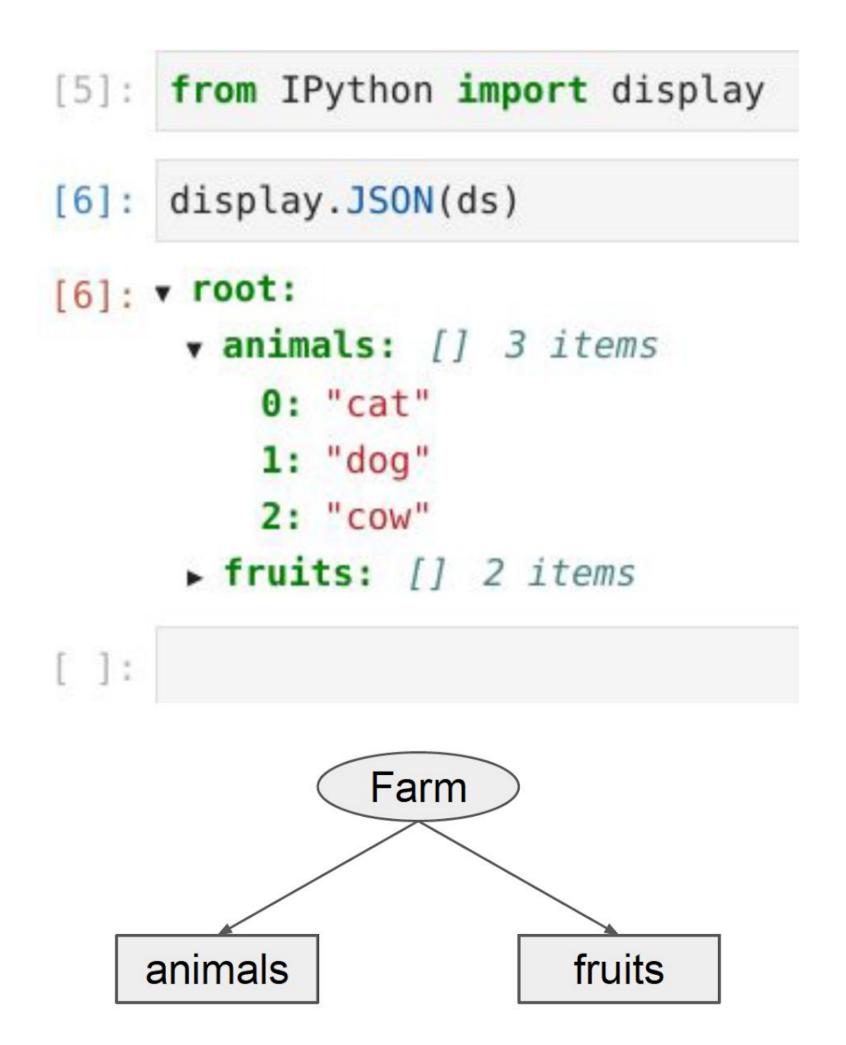


- [3]: d={'animal':'cat','fruit':'mango'}
 d['fruit']
- [3]: 'mango'

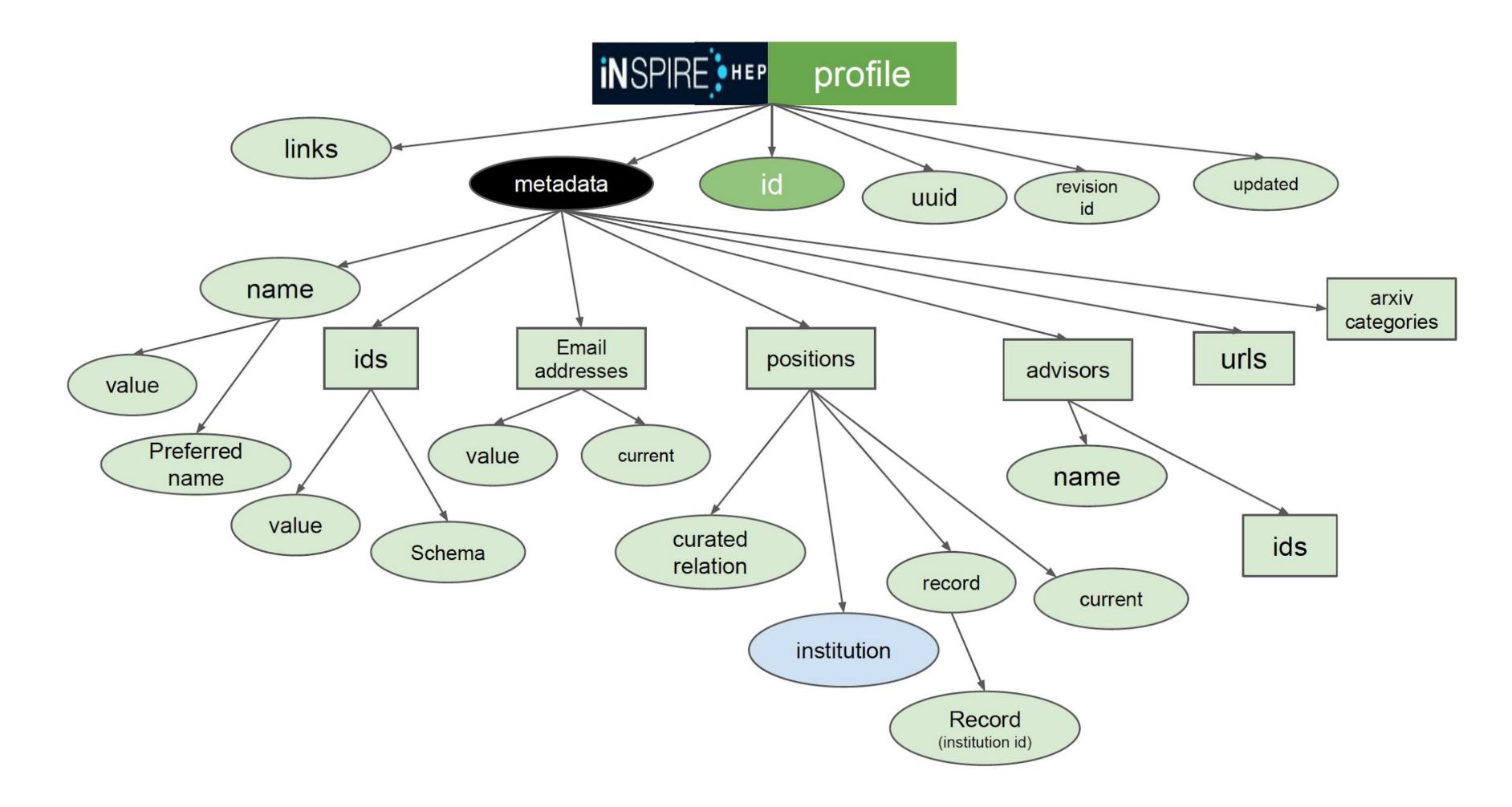
They can be nested!

[4]: ds={'animals':l,'fruits':['mango','banana']}
ds['animals'][1]

[4]: 'dog'

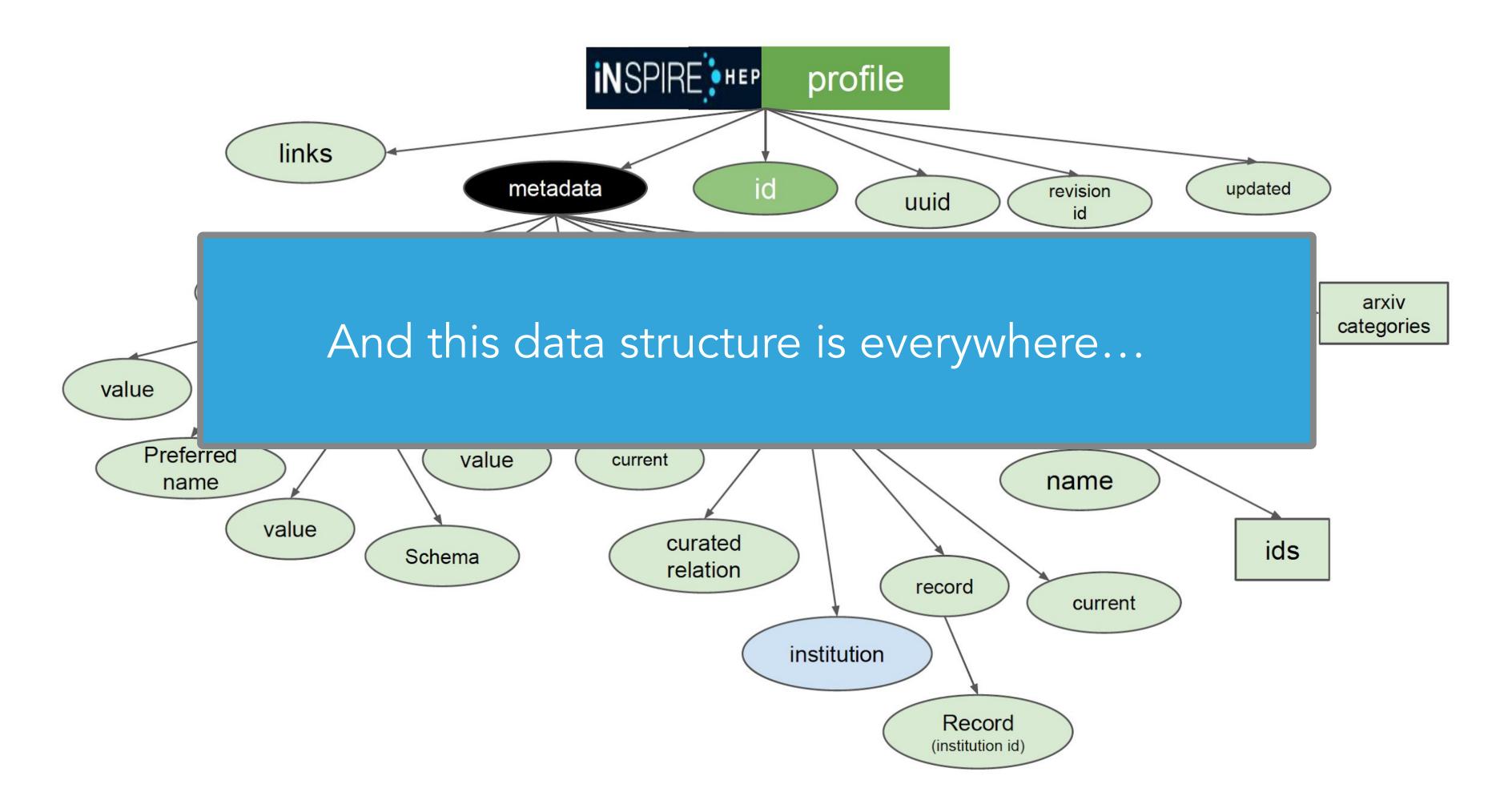


INSPIRE-HEP APPLICATION PROGRAMMING NTERFACE (API) A profile on INSPIRE-HEP gives us access to different information



INSPIRE-HEP API

A profile on INSPIRE-HEP gives us access to different information



INSPIRE-HEP API FOR THE PHYSICS COMMUNITY

This is us



Manuel Morales Alvarado - HEP Statistics in Latin America

generated ...



INSPIRE-HEP API FOR THE PHYSICS COMMUNITY

This is us



Manuel Morales Alvarado - HEP Statistics in Latin America

generated ...



DATABASE AND CODE

Completely open source!

Search or jump to / Pull request	s Issues Codespaces Marketplace Explore		
🖵 restrepo / inspireauth Public			ⓒ Watch 1 ▾ 약 Fork 0 ▾
<> Code Issues Issues Pull requests Actions 	s 🖽 Projects 🖽 Wiki 😲 Security 🗠 Insights		
្រី exploration 👻 អ្វី 2 branches 🕟 🕻	O tags Go to file Add file -	<> Code -	About
This branch is 35 commits ahead, 38 comm	nits behind main.	🕻 Contribute 👻	Get authors info from INSPIRE-HEP
Manuel Morales and Manuel Morales	Added emails on excel and routines to obtain 4a22792 2 weeks ago	• 37 commits	 ☆ 0 stars ⊙ 1 watching
pycache	Added routine to calculate the total citations for a given country	4 months ago	ប៉ o forks
articles_countries_per_year	Added emails on excel and routines to obtain them	2 weeks ago	Delegeo
combined_plots	Added functions to parse the countries as pd.Series and combined hi	5 months ago	Releases
data	Added database for experimental collaborations	2 months ago	No releases published Create a new release
email_lists	Added emails on excel and routines to obtain them	2 weeks ago	
plots_for_tables	Added emails on excel and routines to obtain them	2 weeks ago	Packages
🗋 .gitignore	Updated .gitignore	5 months ago	No packages published Publish your first package
INSPIREHEP.ipynb	Added statistic per inhabitants	4 months ago	

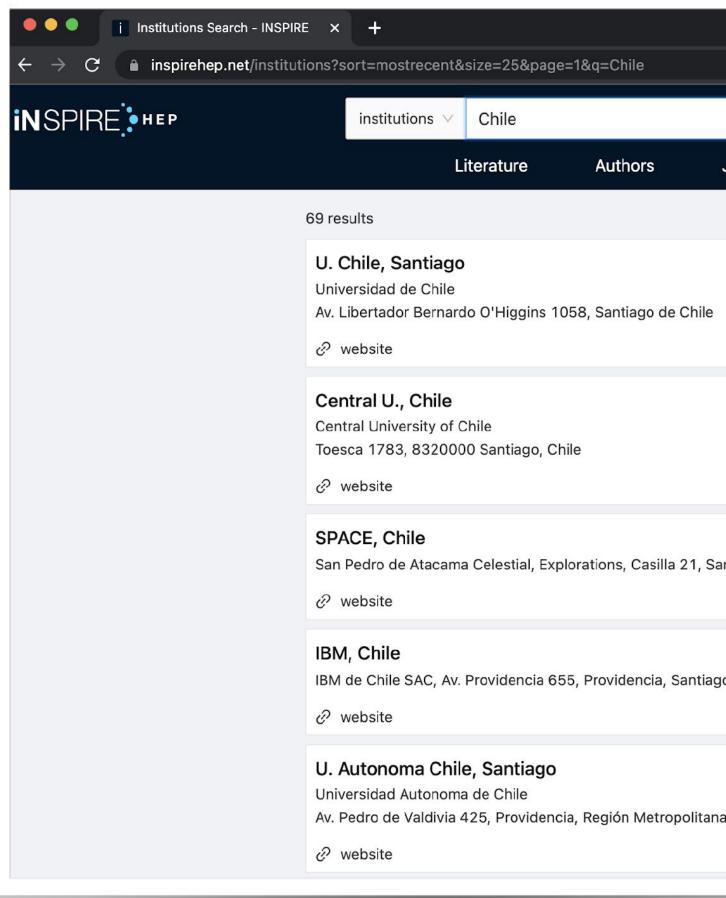
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https://github.com/restrepo/inspireauth/tree/main

A short overview of the logic of the database...

"Extract the list of all the authors from Chile from INSPIRE-HEP"

1 - Access the institutions from Chile



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2 - Access the API

https://inspirehep.net/api/instit × + - - -

inspirehep.net/api/institutions?sort=mostrecent&size=25&page=1&q=Chile

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https://inspirehep.net/institutions?sort=mostrecent&size=25&page=1&q=Chile

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d":"2021-06-25T22:43:17.984044+00:00","links":{"json":"https://inspirehep.net/api/institutions/911415? ro de Valdivia 425","Providencia, Región



3 - Extract the list of institutions of Chile

```
list_legacies_ICN
In [35]:
Out[35]: ['U. Chile, Santiago',
           'Central U., Chile',
           'IBM, Chile',
           'SPACE, Chile',
           'European Southern Obs., Chile',
           'U. Autonoma Chile, Santiago',
           'San Sebastian U., Chile',
           'Santiago de Chile U.',
           'Unlisted, CL',
           'Pontificia U. Catol. Chile, Santiago',
           'Chile U., CMM',
           'Chile U., Beauchef',
           'Chile U., Santiago',
           'Chile Austral U., Valdivia',
           'Chile U., Catolica',
           'U. Arturo Prat, Iquique',
           'INI, Santiago',
           'CIDCA, Santiago',
           'Valparaiso U.',
           'Cerro Calan Observ.',
           'Concepcion Catolica U.',
           'Catolica del Norte U.',
           'Valparaiso U., Catolica',
           'CECS, Valdivia',
           'Temuco U., Catolica',
```



4 - Access the papers published by an institution. Then, iterate over institutions

https://inspirehep.net/api/literature?sort=mostrecent&page=1&g=aff+U.+Chile,+Santiago+and+ac+1->+10

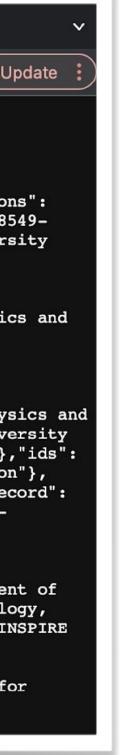
aff: use `legacy_ICN` and: logical operator ac: defines number of authors

```
i https://inspirehep.net/api/litera 🗙 🕂
               ■ inspirehep.net/api/literature?sort=mostrecent&page=1&q=aff+U.+Chile,+Santiago+and+ac+1->+10
{"hits":{"hits":[{"id":"2136681","metadata":{"citation_count":3,"citation_count_without_self_citations":3,"publication_info":
```

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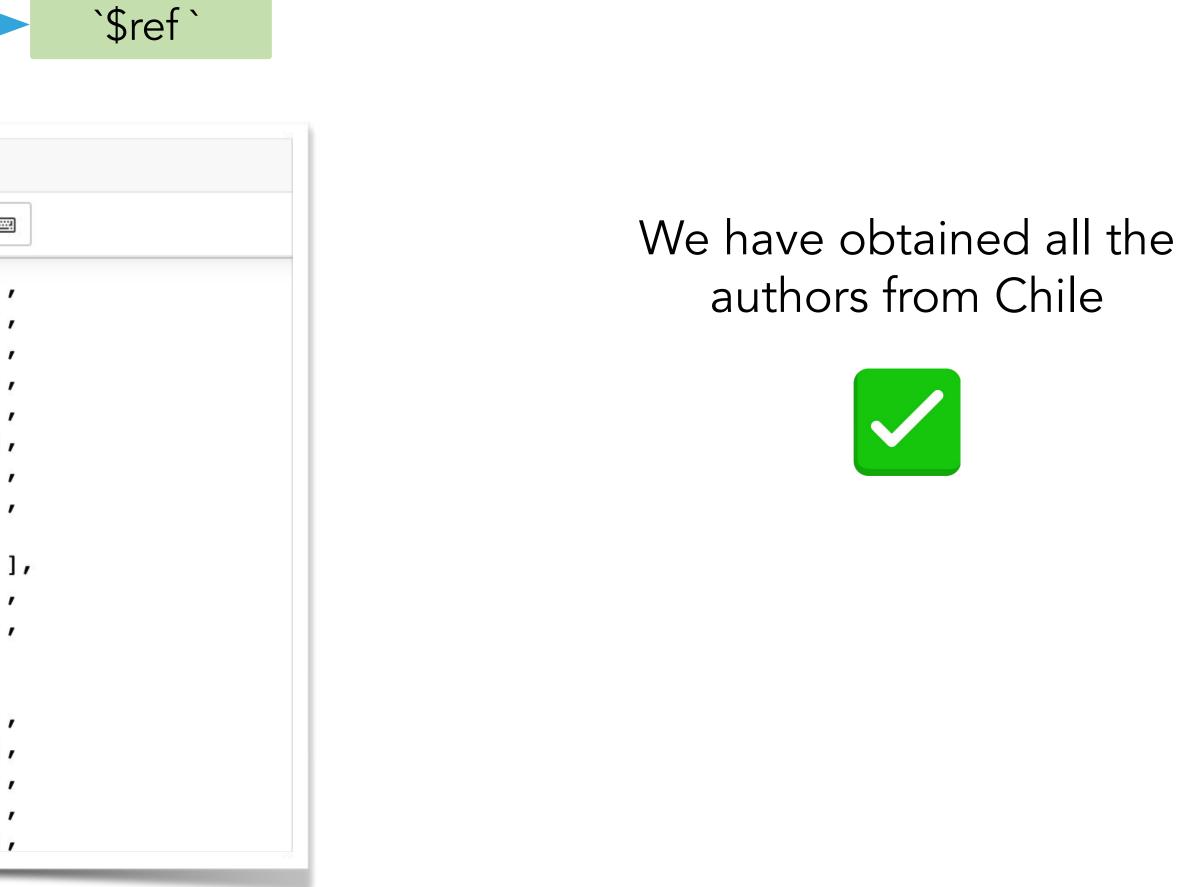
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for Astronomy with ESO, University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, Vesilinnantie 5, 20014 Turku, Finland"}, {"value": "Aalto University of Turku, 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Greece"}],"full_name_unicode_normalized":"pavlidou, v.","full_name":"Pavlidou, V.","record":{"\$ref":"https://inspirehep.net/api/authors/1019414"},"ids":[{"schema":"INSPIRE BAI", "value": "V.Pavlidou.1"}], "last_name": "Pavlidou", "affiliations": [{"record": {"\$ref": "https://inspirehep.net/api/institutions/912413"}, "value": "IESL, Heraklion"}, {"record": {"\$ref": "https://inspirehep.net/api/institutions/912413"}, "value": "IESL, Heraklion"}, {"ref": "https://inspirehep.net/api/institutions/912413"}, "value": "IESL, Heraklion", "https://inspirehep.net/api/institutions/912413"}, Heraklion", "https://inspirehep.net/api/institutions/912413"}, "https://inspirehep.net/api/institutions/912413"}, "https://inspirehep.net/api/institutions/912413"}, "https://inspirehep.net/api/institutions/912413"}, "https://inspirehep.net/api/institutions/912413"}, "https://inspirehep.net/api/institutions/912413"}, "https://inspir {"\$ref":"https://inspirehep.net/api/institutions/911754"},"value":"IFW, 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U.","value":"Crete U.","v {"\$ref":"https://inspirehep.net/api/institutions/902711"},"value":"Caltech"}],"bai":"A.C.S.Readhead.1","signature_block":"RADADa","first_name":"A.C.S.","uuid":"bcd0eec3-b29b-4645-9a2c-7161ef650c90", "recid": 1027796}, {"raw_affiliations": [{"value": "Institute of Astrophysics, Foundation for Research and Technology-Hellas, 71110 Heraklion, Greece"}],"full name unicode normalized":"blandford, r.d.","full name":"Blandford, R.D.","record":{"\$ref":"https://inspirehep.net/api/authors/1020799"},"ids":[{"schema":"INSPIRE BAI", "value": "R.D.Blandford.1"}], "last_name": "Blandford", "affiliations": [{"record": {"\$ref": "https://inspirehep.net/api/institutions/909388"}, "value": "KIPAC, Menlo Park"}], "bai": "R.D.Blandford.1", "signature_block": "BLANDFADr", "first_name": "R.D.", "uuid": "3a2b27f1-6525-4c41-ad9c-6dce815fbfc6", "recid": 1020799}, {"raw_affiliations": [{"value": "Department_of Physics and Institute of Theoretical and Computational Physics, University 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5 - For each article of each institution, extract the profile URL of the authors In each entry:

`autho	rs`	`rec	ord`	
File Edit	View Insert	Cell Kernel	Help	
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Out[152]	'https://i 'https://i 'https://i 'https://i 'https://i 'https://i 'https://i 'https://i 'https://i 'https://i 'https://i 'https://i 'https://i	Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net Inspirehep.net	<pre>/api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/ /api/authors/</pre>	<pre>/1403047', /1477164', /2013953', /1413660', /999090'], /1993758', /1993759', /995374', /1037240'], /1017586', /1875153', /996257', /996257', /993295', /1287459', /985110'], /1037240', /1987711',</pre>





SOME COMMENTS

- In this way we have obtained the list of all papers of a given country with up to 10 authors
- This means that the papers of experimental collaborations are left out of this analysis (we have another database for them!)
- The database was obtained in June 2022, and has to be updated after some time
- The actual nationality of the author is irrelevant. It counts as an author of a given country by being affiliated to an institution of that country

Now some results ...





A statistical analysis of scientific metrics in high energy, cosmology, and astroparticle physics in Latin America

- Manuel Morales-Alvarado^{1,2†}, Fernando Quevedo^{1,3†}, Mario Ramos-Hamud^{1†}, Diego Restrepo^{4*†}
- ¹Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Wilberforce Rd, Cambridge, CB3 0WA,
 - Cambridgeshire, United Kingdom.
- ²INFN Trieste, International School for Advanced Studies (SISSA), Via
 - Bonomea 265, Trieste, 34136, Italy.
- ³New York University Abu Dhabi, Saadiyat Island, Abu Dhabi, PO Box 128199, UAE.
 - ⁴University of Antioquia, Medellín, Colombia.



COUNTRIES IN THE DATABASE

We include the following countries in our study:

Population
$45,\!606,\!000$
$11,\!833,\!000$
$213,\!993,\!000$
$19,\!212,\!000$
$51,\!266,\!000$
$5,\!139,\!000$
$11,\!318,\!000$
$17,\!888,\!000$
$18,\!250,\!000$
10,063,000
$130,\!262,\!000$
$7,\!220,\!000$
$33,\!359,\!000$
$3,\!485,\!000$
28,705,000



- The population of the countries is useful to find "metrics per capita".
- They have been obtained from https://data.un.org/en/index.html (checked in September 2022)

- Why are some countries missing?
- They simply do not have indexed entries on INSPIRE-HEP

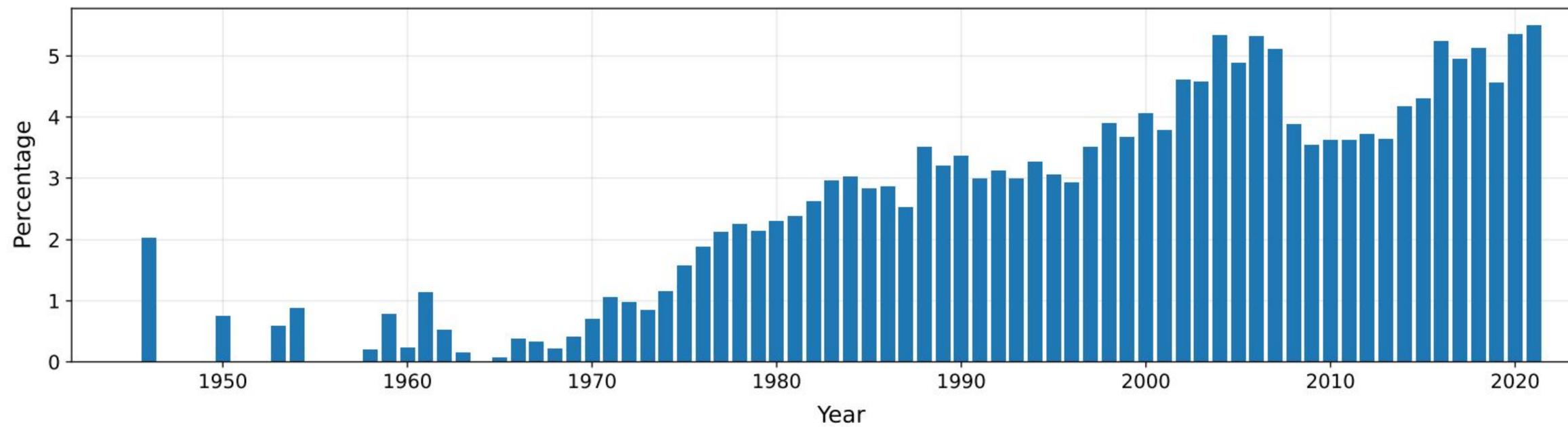


METRICS FOR EACH COUNTRY

- After generating the database we have obtained:
- -Name and email of all active authors (with publications in the last 5 years)
- -Number of total and active authors
- -Number of publications
- -Number of citations
- -H-index
- -Collaborations with other countries in Latin America
- -And more...







Percentage of Latin American publications compared to global publications **Fig. 1:** per year.

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Latin American publications compared to global publications



TOTAL AND ACTIVE AUTHORS

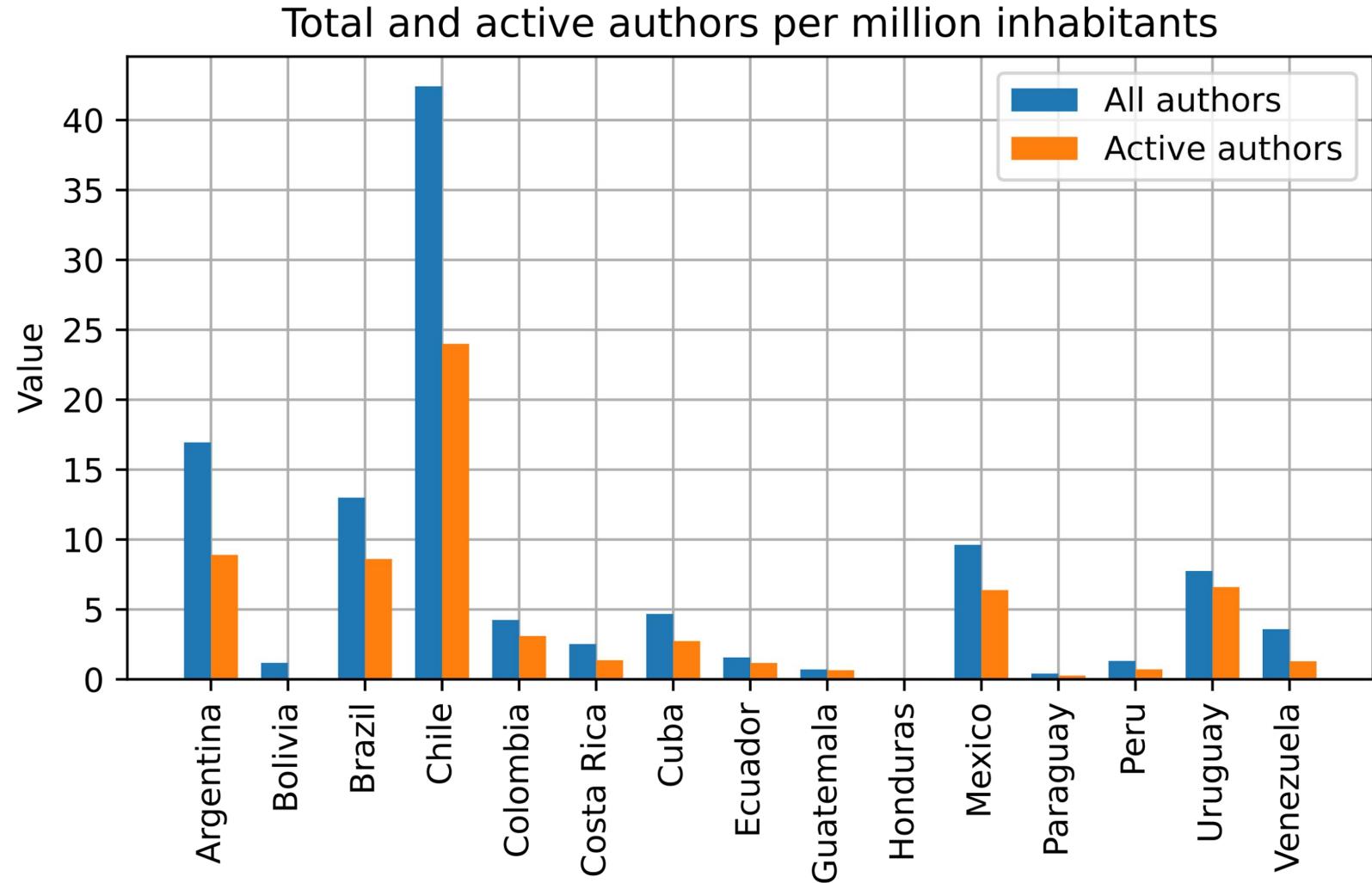
Country	Total authors	Active authors	Total authors p.m.i.	Active authors p.m.i
Argentina	773	406	17	9
Bolivia	14	1	1	0
Brazil	2782	1843	13	9
Chile	815	461	42	24
Colombia	218	159	4	3
Costa Rica	13	7	3	1
Cuba	53	31	5	3
Ecuador	28	21	2	1
Guatemala	13	12	1	1
Honduras	1	1	0	0
Mexico	1253	832	10	6
Paraguay	3	2	0	0
Peru	44	24	1	1
Uruguay	27	23	8	6
Venezuela	103	37	1	1

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(p.m.i. = per million inhabitants)



AUTHORS NORMALISED BY POPULATION





PUBLICATIONS VS YEAR

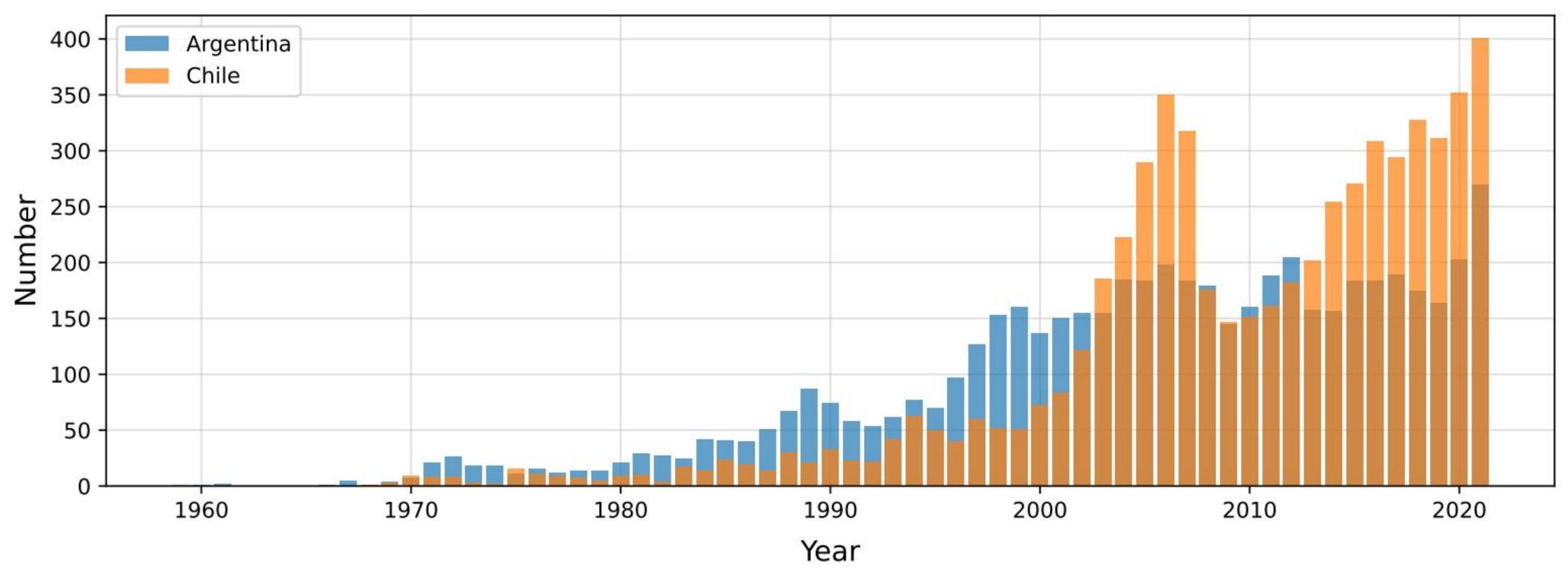


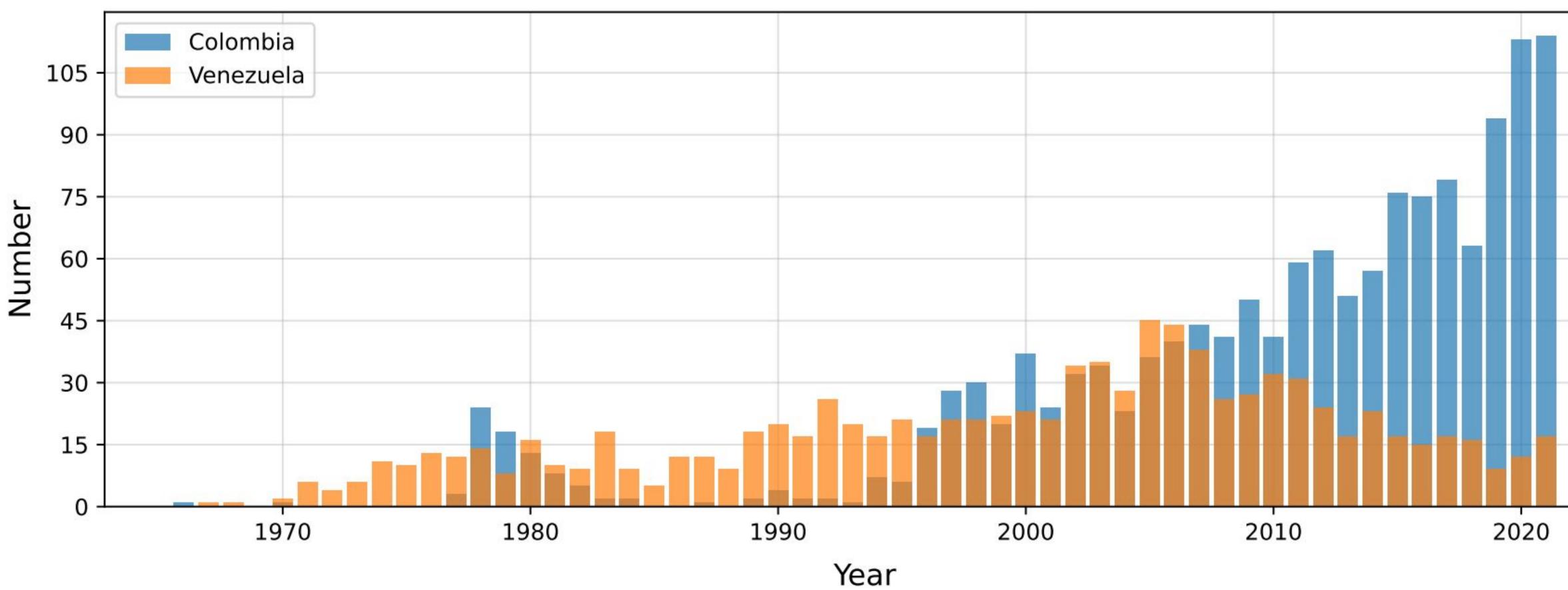
Fig. 7: Articles per year of Argentina and Chile.

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Publications

PUBLICATIONS VS YEAR



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Publications



CORRELATIONS WITH GDP

Country	Percentage of GDP
Argentina	0.46
Bolivia	0.28(2002)
Brazil	1.21
Chile	0.34
Colombia	0.32
Costa Rica	0.37(2018)
Cuba	0.55
Ecuador	0.44(2014)
Guatemala	0.03
Honduras	0.04(2004)
Mexico	0.28
Paraguay	0.14
Peru	0.16
Uruguay	0.48
Venezuela	0.34(2014)

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GDP = gross domestic product (invested in research and development)

Data obtained from https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS (checked in September 2022)

Some references (and issues):

Entity	Percentage of GDP
China	2.24
European Union	2.22
OECD	2.67
United Nations	2.33
United States	3.17





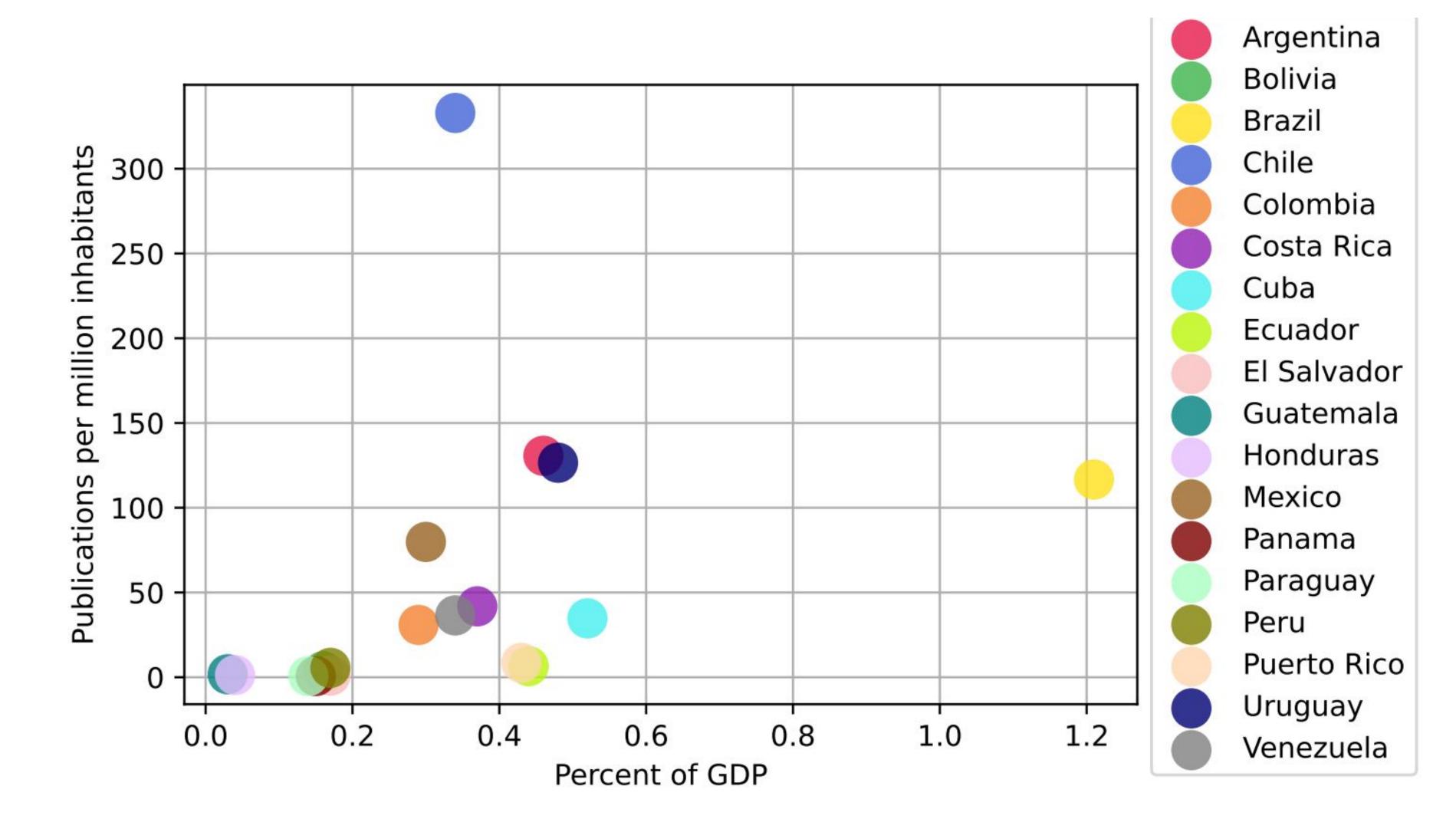
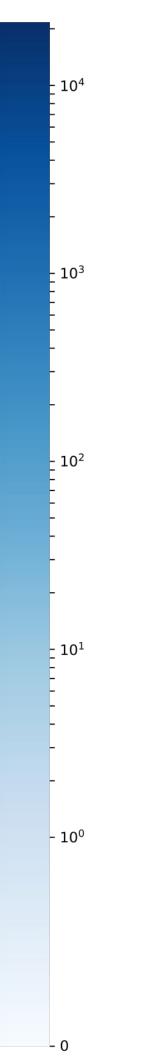


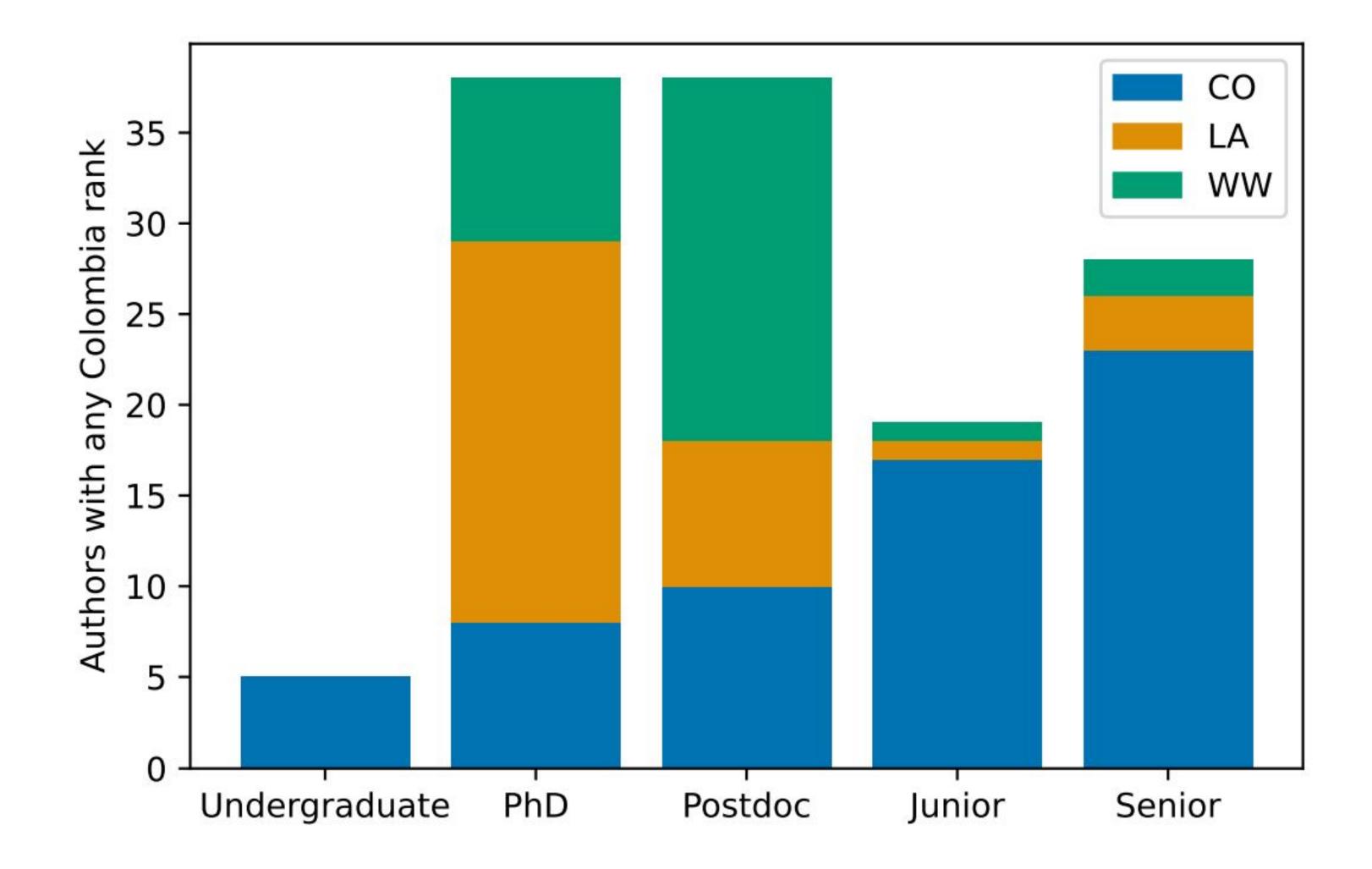
Fig. 15: Number of publications per million people versus the percentage of GDP invested in R&D for each country.



,	Argentin	Bolivia	Brazil	chile (colombic	ostaRiv	Cupa	ECURDON (juaterne	Honduro	Metico	Paradila	Peru	Uruquay	Jenezue
Argentina -	4862	1	658	222	44	1	15	2	6	0	435	3	6	125	50
Bolivia -	1	33	11	0	0	0	0	0	0	0	3	0	0	0	0
Brazil -	658	11	21578	908	227	31	71	7	2	0	808	0	37	23	70
Chile -	222	0	908	4976	74	15	24	18	1	0	416	0	7	8	110
Colombia -	44	0	227	74	1037	0	1	1	0	0	157	0	4	7	3
Costa Rica -	1	0	31	15	0	205	0	0	0	0	9	0	0	0	2
Cuba -	15	0	71	24	1	0	414	0	0	0	156	0	0	0	25
Ecuador -	2	0	7	18	1	0	0	112	0	0	10	0	0	0	22
Guatemala -	6	0	2	1	0	0	0	0	16	0	2	0	1	0	0
Honduras -	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mexico -	435	3	808	416	157	9	156	10	2	0	8289	2	33	13	118
Paraguay -	3	0	0	0	0	0	0	0	0	0	2	3	0	0	0
Peru -	6	0	37	7	4	0	0	0	1	0	33	0	129	0	0
Uruguay -	125	0	23	8	7	0	0	0	0	0	13	0	0	301	32
Venezuela -	50	0	70	110	3	2	25	22	0	0	118	0	0	32	855





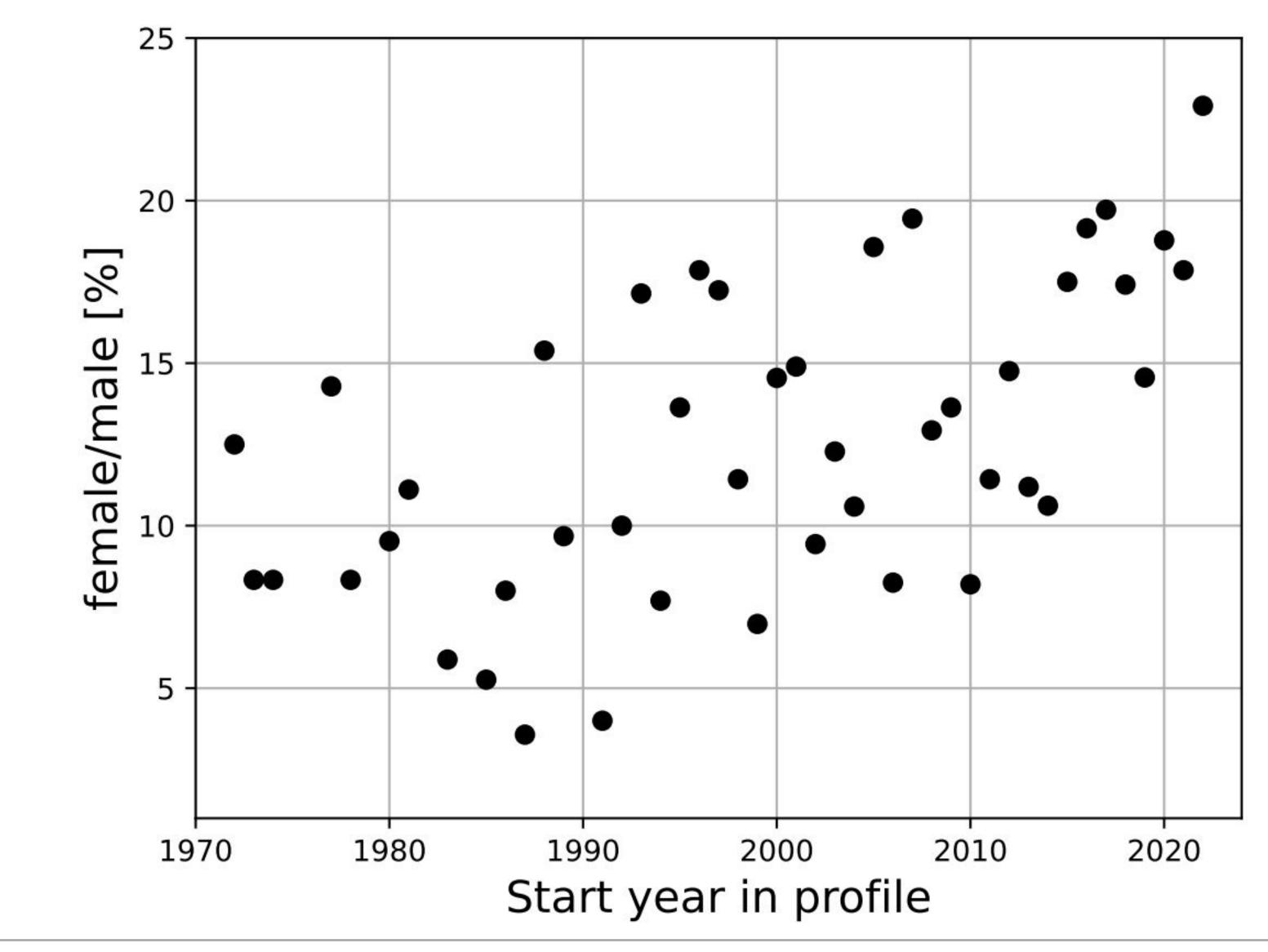


under a given rank in Colombia, Latin America or elsewhere worldwide.

Fig. 4: Number of authors with Colombia ranks as in table 7 who published a paper



Percentage of female authors in publications



CAN YOU HELP US?

Yes, by completing your INSPIRE-HEP profile

Author (Cambridge U., DAMTP) (D
hep-ph Author Identifier: Identifier
PhD Advisor: Advisor
🗹 🎐 🙋 edit

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0	2021-present POSTDOC, Cambridge U., DAMTP	
0	2017-2021 PHD, Louvain U., CP3	
0	2014-2017 MASTER, U. Bologna, DIFA	
0	2011-2014 UNDERGRADUATE, U. Bologna, DIFA	
Hide		

Updated on Feb 10, 2022



FOR THE FUTURE

- Obtain collaborations with the rest of the world
- Explore the mobility of Latin American researchers
- Extra coordination with other LAAHECAP committees (JEDI, for example)
- Extend this analysis to other areas of physics and/or science in general



CONCLUSIONS AND OUTLOOK

- We discussed HEP Statistics in Latin America
 - We have a developed a database to study HEP research in Latin America \bullet
 - We have developed a code to study different metrics (authors, publications, citations, etc)
 - We are currently working in a extended report on the subject
- In the future:
 - Study the experimental collaborations in Latin America
 - Coordinate analysis with other committees in LAAHECAP
 - Explore Latin American collaborations with the rest of the world
 - ...





Thank you for your attention