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CAMBRIDGE

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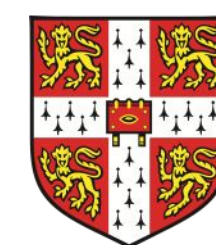
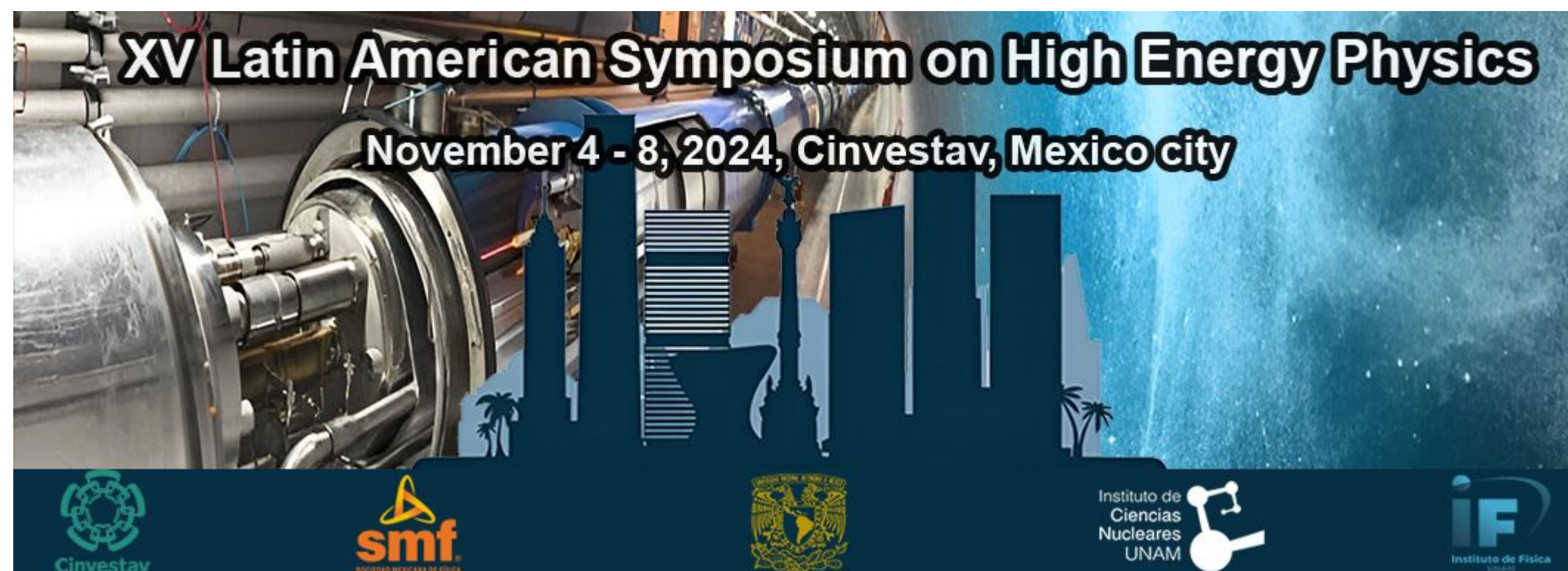


European Research Council
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HEP STATISTICS IN LATIN AMERICA

MANUEL MORALES ALVARADO



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HEP STATISTICS IN LATIN AMERICA

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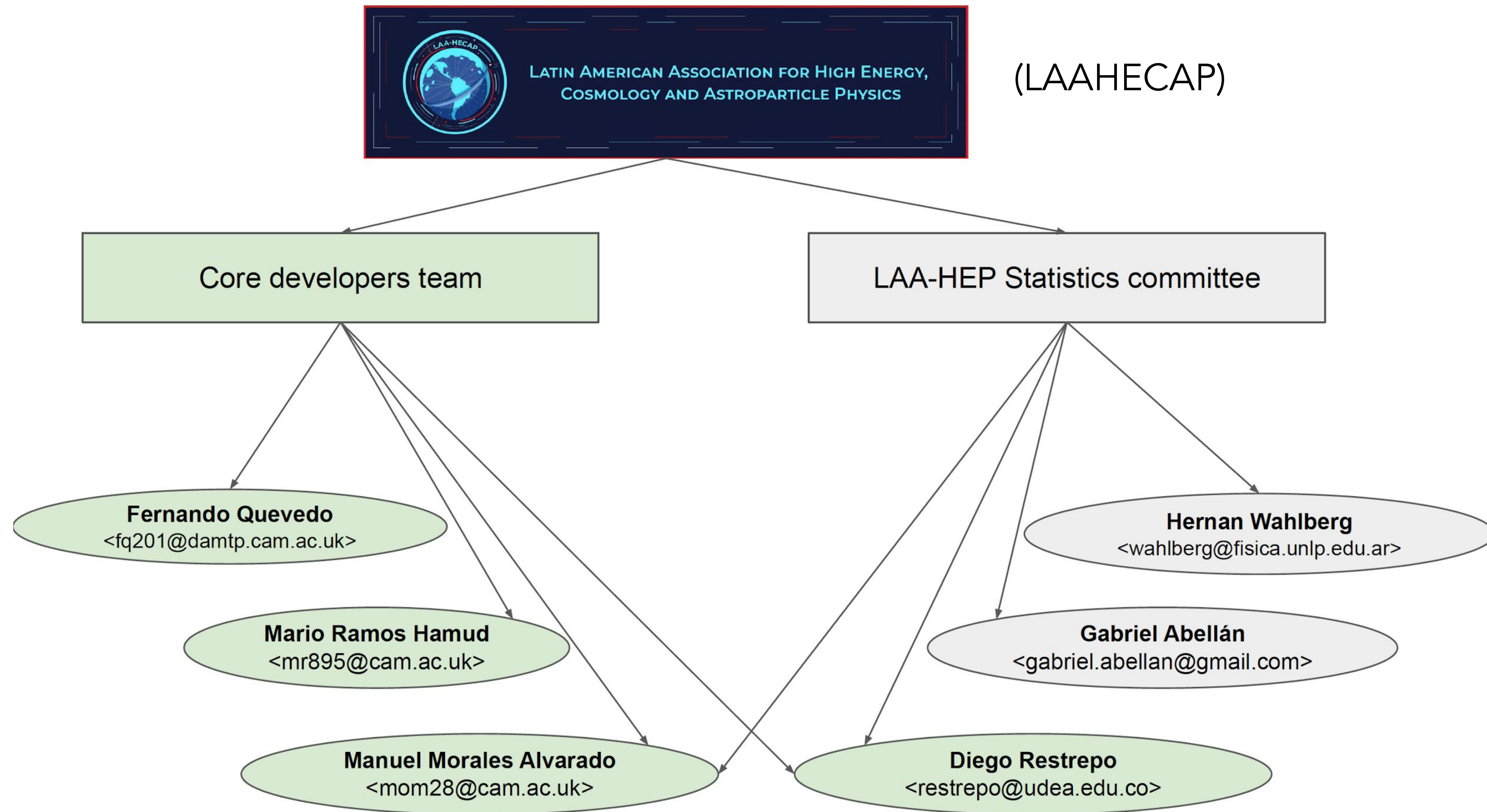
Thanks to D. Restrepo (U. de Antioquia)
for some of the slides!

OBJECTIVE

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

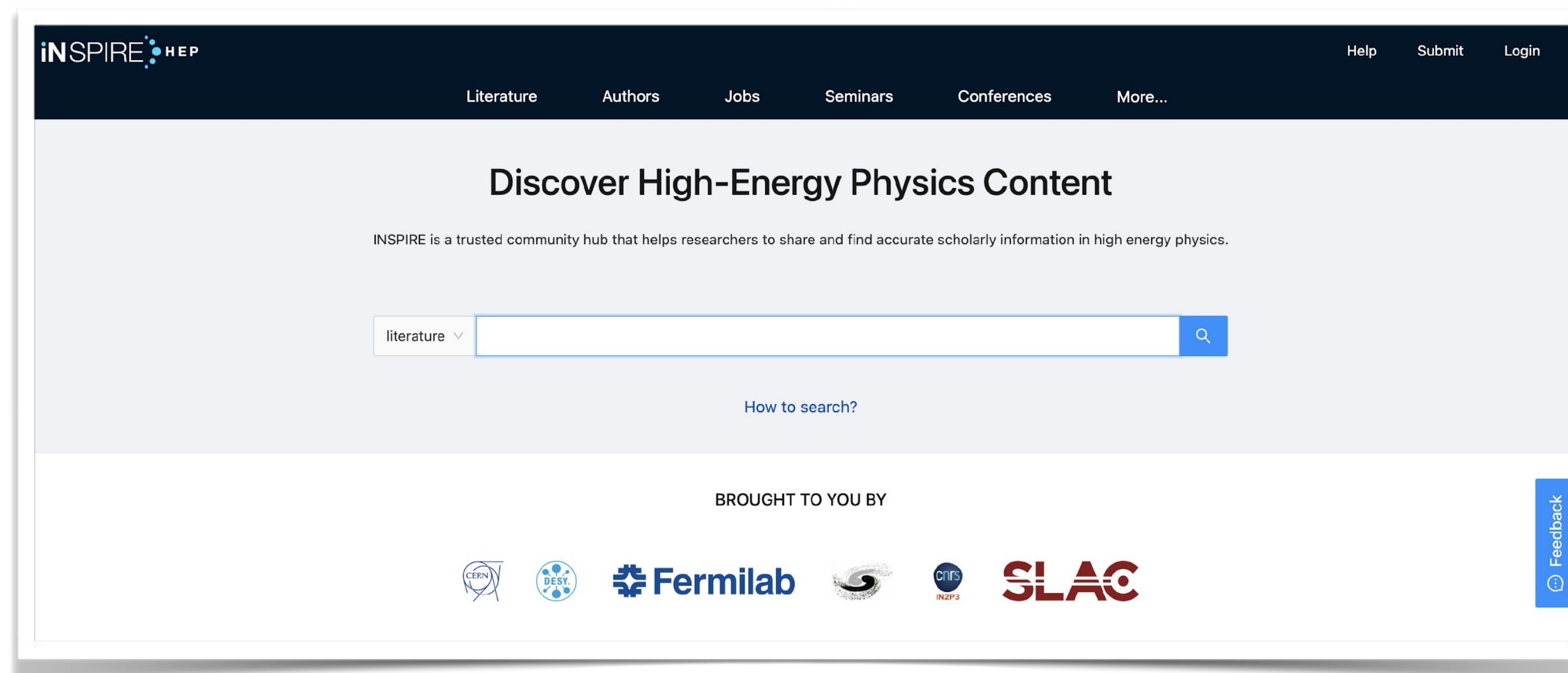


ORGANISATION



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



DATA STRUCTURES

Lists = []

```
[2]: l=['cat','dog','cow']  
l[1]
```

```
[2]: 'dog'
```

Dictionaries = {key, value}

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

```
[3]: 'mango'
```

They can be nested!

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

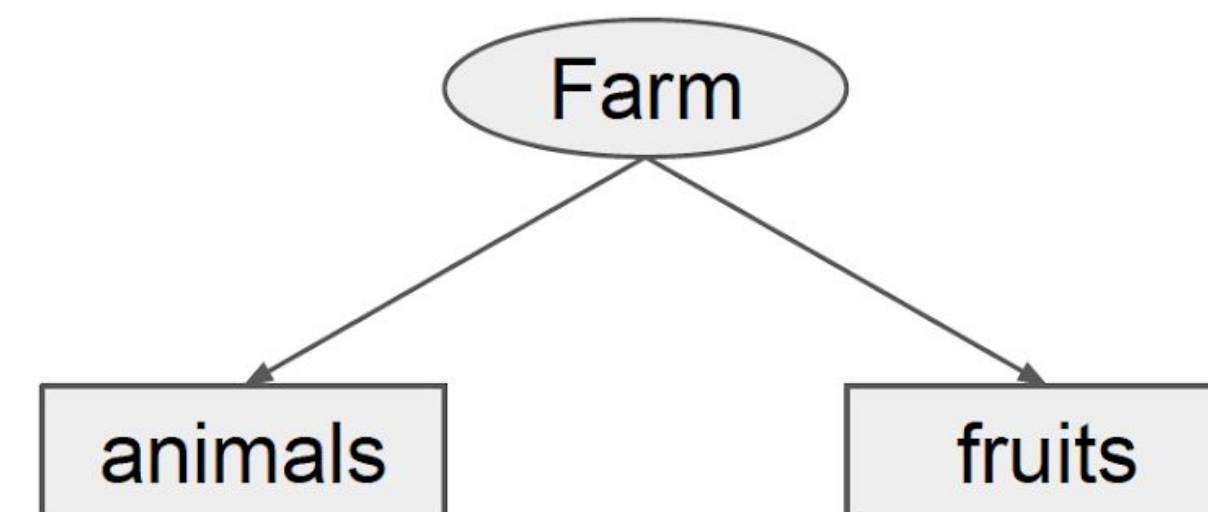
```
[4]: 'dog'
```

```
[5]: from IPython import display
```

```
[6]: display.JSON(ds)
```

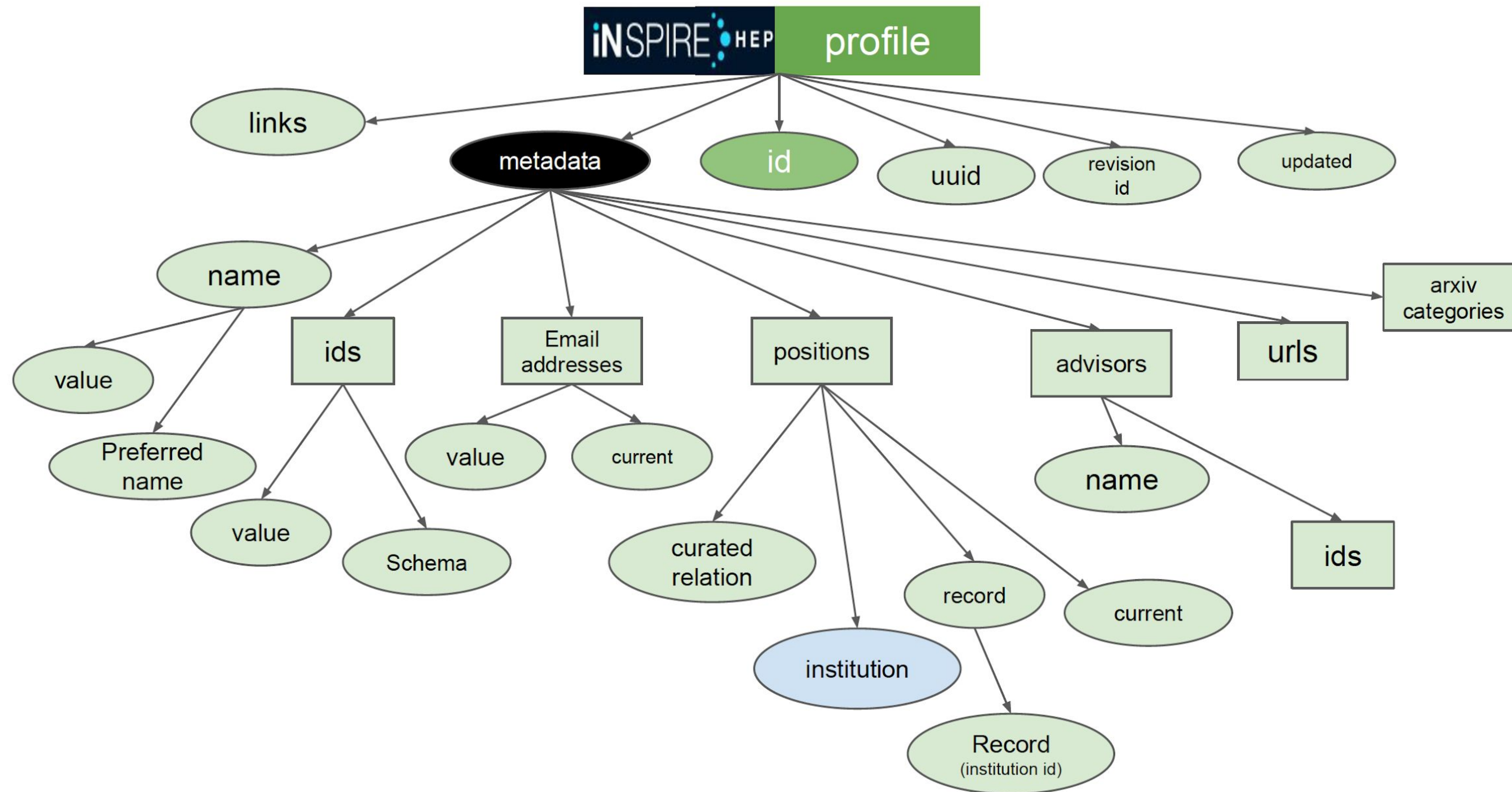
```
[6]: ▼ root:  
    ▼ animals: [] 3 items  
        0: "cat"  
        1: "dog"  
        2: "cow"  
    ► fruits: [] 2 items
```

```
[ ]:
```



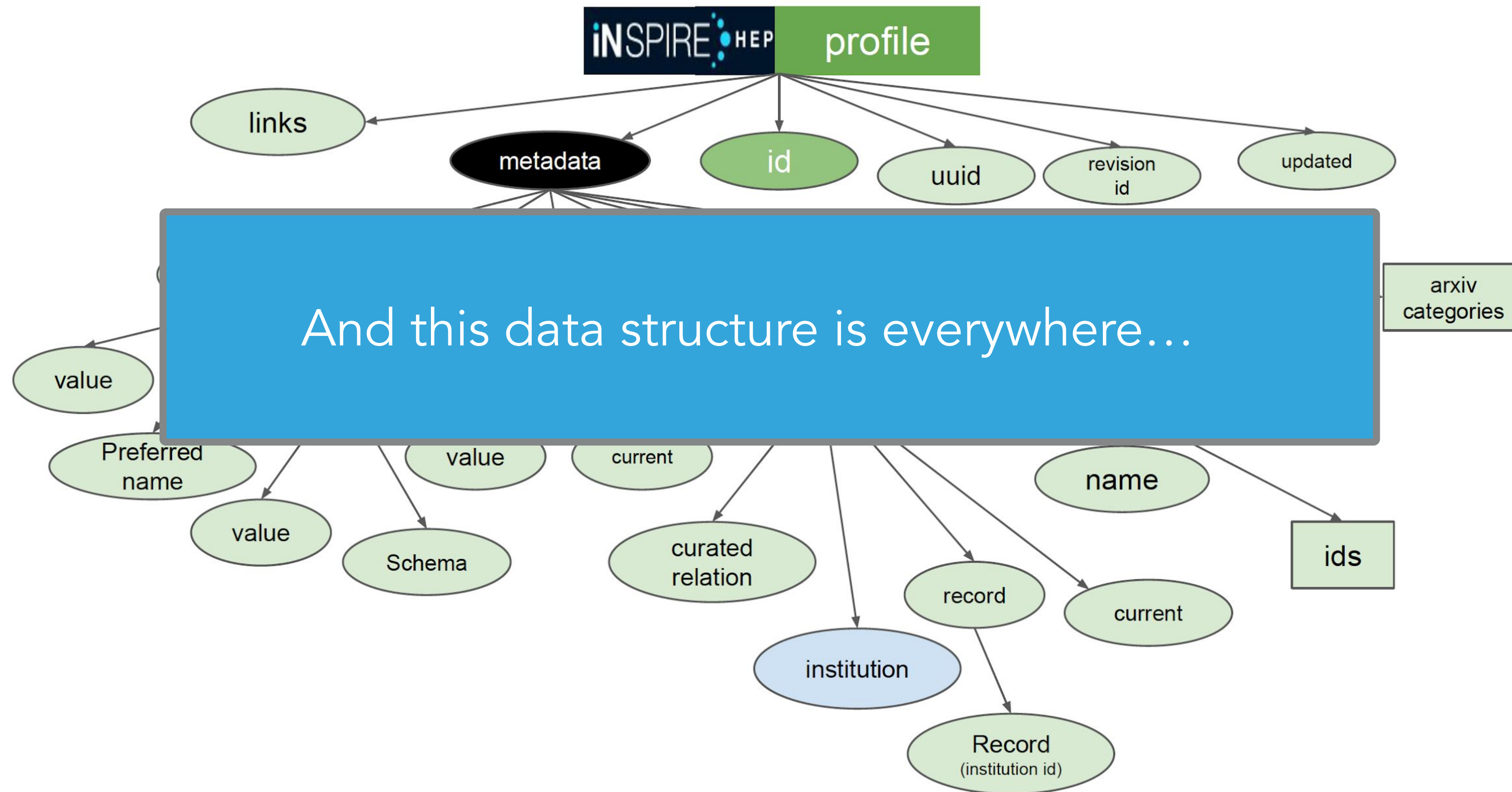
INSPIRE-HEP APPLICATION PROGRAMMING INTERFACE (API)

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

9

This is us



With this we have
generated ...

INSPIRE-HEP API FOR THE PHYSICS COMMUNITY

1
0

This is us

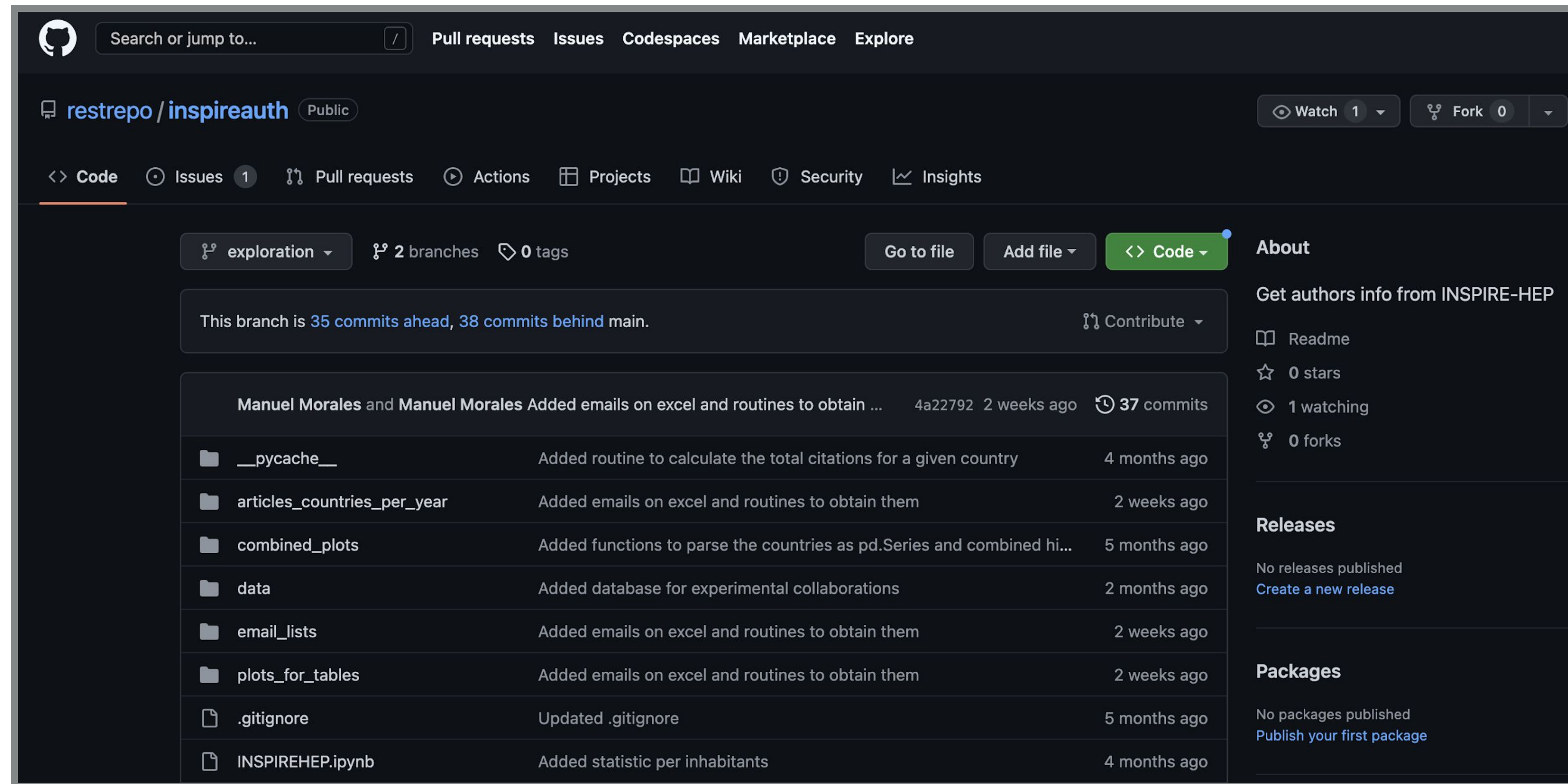


With this we have
generated ...

DATABASE AND CODE

Completely open source!

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



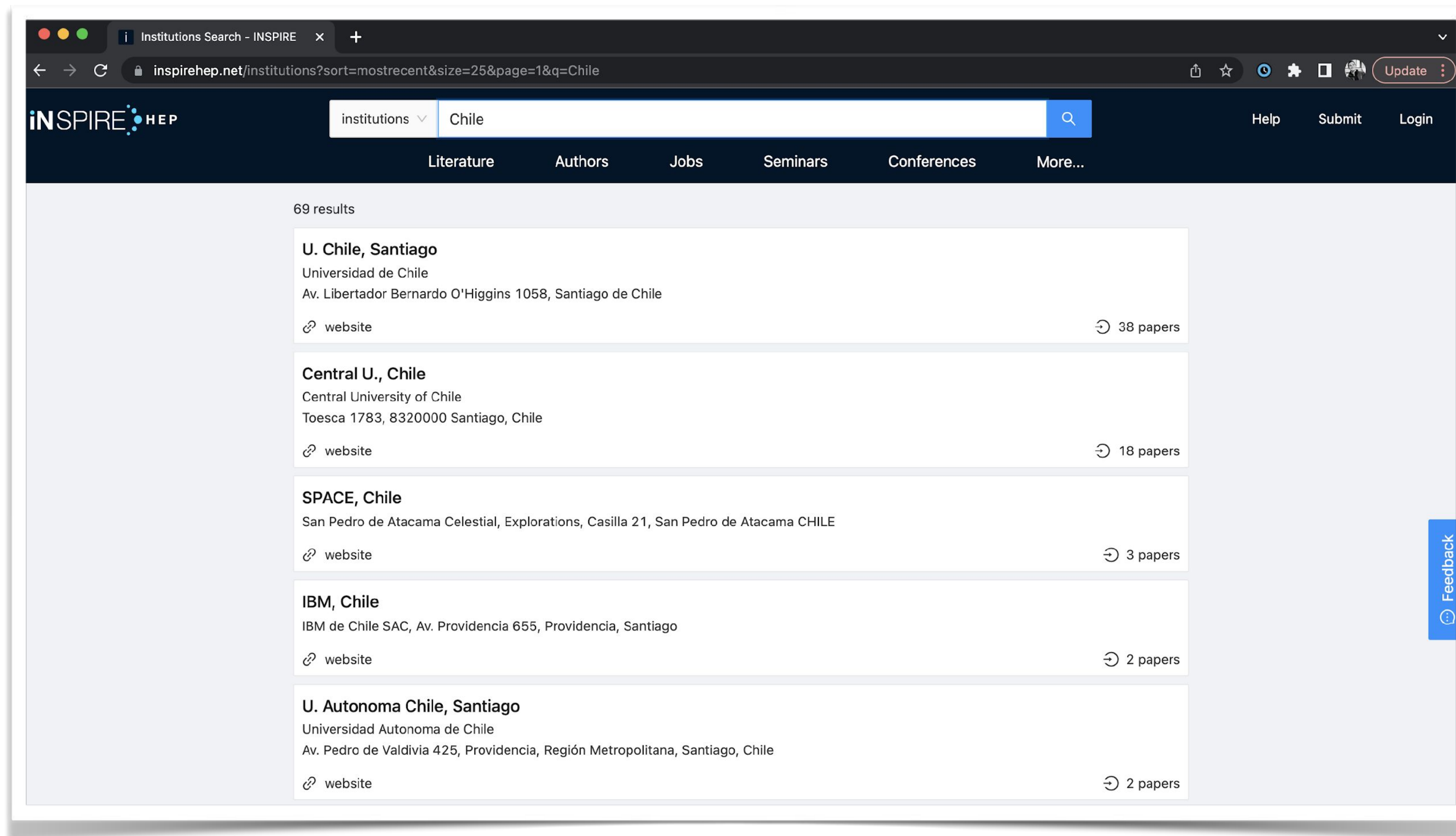
A short overview of the logic of the database...

A SHORT EXERCISE

1
2

“Extract the list of all the authors from Chile from INSPIRE-HEP”

1 - Access the institutions from Chile

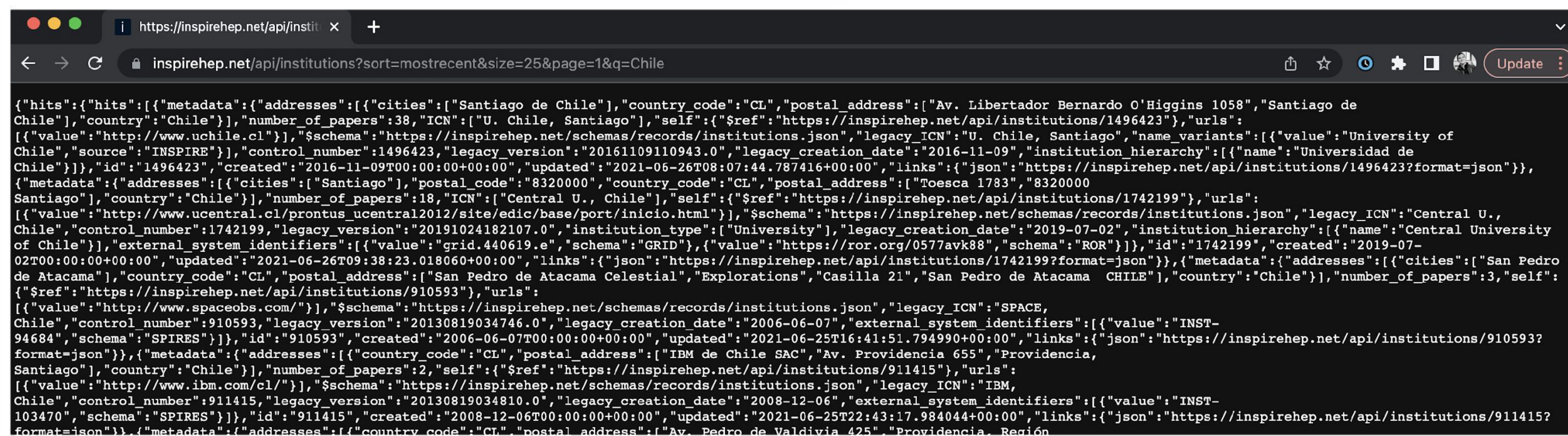


A SHORT EXERCISE

2 - Access the API

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

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



```
{
  "hits": {
    "hits": [
      {
        "metadata": {
          "addresses": [
            {
              "cities": "Santiago de Chile",
              "country_code": "CL",
              "postal_address": "Av. Libertador Bernardo O'Higgins 1058",
              "Santiago de Chile",
              "country": "Chile"
            }
          ],
          "number_of_papers": 38,
          "ICN": [
            "U. Chile, Santiago"
          ],
          "self": {
            "$ref": "https://inspirehep.net/api/institutions/1496423"
          },
          "urls": [
            {
              "value": "http://www.uchile.cl",
              "$schema": "https://inspirehep.net/schemas/records/institutions.json",
              "legacy_ICN": "U. Chile, Santiago",
              "name_variants": [
                {
                  "value": "University of Chile",
                  "source": "INSPIRE"
                }
              ],
              "control_number": 1496423,
              "legacy_version": "20161109110943.0",
              "legacy_creation_date": "2016-11-09",
              "institution_hierarchy": [
                {
                  "name": "Universidad de Chile"
                }
              ],
              "id": "1496423",
              "created": "2016-11-09T00:00:00+00:00",
              "updated": "2021-06-26T08:07:44.787416+00:00",
              "links": {
                "json": "https://inspirehep.net/api/institutions/1496423?format=json"
              }
            }
          ],
          "metadata": {
            "addresses": [
              {
                "cities": "Santiago",
                "postal_code": "8320000",
                "country_code": "CL",
                "postal_address": "Toesca 1783",
                "8320000 Santiago",
                "country": "Chile"
              }
            ],
            "number_of_papers": 18,
            "ICN": [
              "Central U., Chile"
            ],
            "self": {
              "$ref": "https://inspirehep.net/api/institutions/1742199"
            },
            "urls": [
              {
                "value": "http://www.uchile.cl/prontus_ucentral2012/site/edic/base/port/inicio.html",
                "$schema": "https://inspirehep.net/schemas/records/institutions.json",
                "legacy_ICN": "Central U., Chile",
                "control_number": 1742199,
                "legacy_version": "20191024182107.0",
                "institution_type": [
                  "University"
                ],
                "legacy_creation_date": "2019-07-02",
                "institution_hierarchy": [
                  {
                    "name": "Central University of Chile"
                  }
                ],
                "external_system_identifiers": [
                  {
                    "value": "grid.440619.e",
                    "schema": "GRID"
                  },
                  {
                    "value": "https://ror.org/0577avk88",
                    "schema": "ROR"
                  }
                ],
                "id": "1742199",
                "created": "2019-07-02T00:00:00+00:00",
                "updated": "2021-06-26T09:38:23.018060+00:00",
                "links": {
                  "json": "https://inspirehep.net/api/institutions/1742199?format=json"
                }
              },
              {
                "metadata": {
                  "addresses": [
                    {
                      "cities": "San Pedro de Atacama",
                      "country_code": "CL",
                      "postal_address": "San Pedro de Atacama Celestial, Explorations, Casilla 21",
                      "San Pedro de Atacama CHILE",
                      "country": "Chile"
                    }
                  ],
                  "number_of_papers": 3,
                  "self": {
                    "$ref": "https://inspirehep.net/api/institutions/910593"
                  },
                  "urls": [
                    {
                      "value": "http://www.spaceobs.com/",
                      "$schema": "https://inspirehep.net/schemas/records/institutions.json",
                      "legacy_ICN": "SPACE, Chile",
                      "control_number": 910593,
                      "legacy_version": "20130819034746.0",
                      "legacy_creation_date": "2006-06-07",
                      "external_system_identifiers": [
                        {
                          "value": "INST-94684",
                          "schema": "SPIRES"
                        }
                      ],
                      "id": "910593",
                      "created": "2006-06-07T00:00:00+00:00",
                      "updated": "2021-06-25T16:41:51.794990+00:00",
                      "links": {
                        "json": "https://inspirehep.net/api/institutions/910593?format=json"
                      }
                    },
                    {
                      "metadata": {
                        "addresses": [
                          {
                            "country_code": "CL",
                            "postal_address": "IBM de Chile SAC, Av. Providencia 655",
                            "Providencia, Santiago",
                            "country": "Chile"
                          }
                        ],
                        "number_of_papers": 2,
                        "self": {
                          "$ref": "https://inspirehep.net/api/institutions/911415"
                        },
                        "urls": [
                          {
                            "value": "http://www.ibm.com/cl/",
                            "$schema": "https://inspirehep.net/schemas/records/institutions.json",
                            "legacy_ICN": "IBM, Chile",
                            "control_number": 911415,
                            "legacy_version": "20130819034810.0",
                            "legacy_creation_date": "2008-12-06",
                            "external_system_identifiers": [
                              {
                                "value": "INST-103470",
                                "schema": "SPIRES"
                              }
                            ],
                            "id": "911415",
                            "created": "2008-12-06T00:00:00+00:00",
                            "updated": "2021-06-25T22:43:17.984044+00:00",
                            "links": {
                              "json": "https://inspirehep.net/api/institutions/911415?format=json"
                            }
                          },
                          {
                            "metadata": {
                              "addresses": [
                                {
                                  "country_code": "CL",
                                  "postal_address": "Av. Pedro de Valdivia 425",
                                  "Providencia, Regi\u00f3n"
                                }
                              ]
                            }
                          }
                        ]
                      }
                    }
                  ]
                }
              }
            ]
          }
        }
      }
    ]
  }
}
```


A SHORT EXERCISE

3 - Extract the list of institutions of Chile

```
In [35]: 1 list_legacyes_ICN
```

```
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',
```


A SHORT EXERCISE

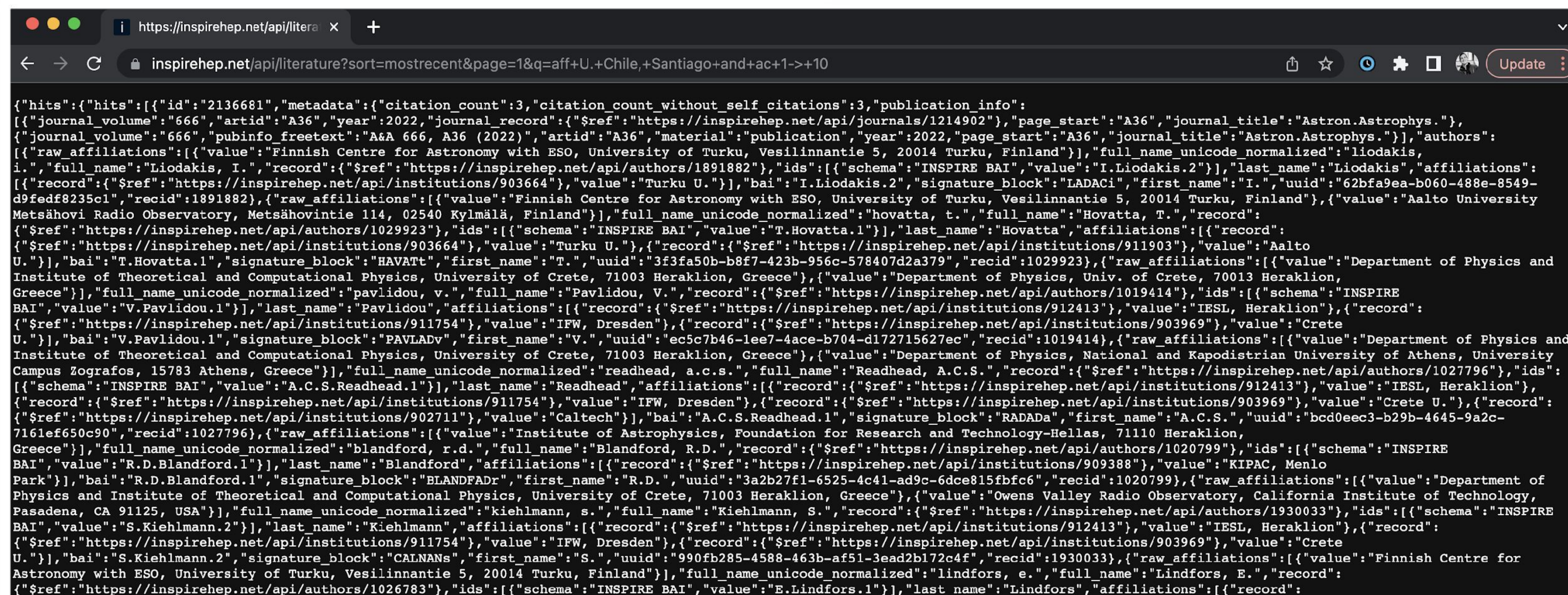
4 - Access the papers published by an institution. Then, iterate over institutions

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

aff: use `legacy_ICN`

and: logical operator

ac: defines number
of authors



A SHORT EXERCISE

5 - For each article of each institution, extract the profile URL of the authors

In each entry:



```
File Edit View Insert Cell Kernel Help
+ ✂ 📄 📄 ⬆ ⬇ ▶ Run ■ ↺ ▶▶ Code ▼ 🖨
Out[152]: [['https://inspirehep.net/api/authors/1973718',
            'https://inspirehep.net/api/authors/1403047',
            'https://inspirehep.net/api/authors/1477164',
            'https://inspirehep.net/api/authors/2013953',
            'https://inspirehep.net/api/authors/1413660',
            'https://inspirehep.net/api/authors/999090'],
            ['https://inspirehep.net/api/authors/1993758',
            'https://inspirehep.net/api/authors/1993759',
            'https://inspirehep.net/api/authors/995374',
            'https://inspirehep.net/api/authors/1037240'],
            ['https://inspirehep.net/api/authors/1017586',
            'https://inspirehep.net/api/authors/1875153',
            'https://inspirehep.net/api/authors/996257',
            'https://inspirehep.net/api/authors/993295',
            'https://inspirehep.net/api/authors/1287459',
            'https://inspirehep.net/api/authors/985110'],
            ['https://inspirehep.net/api/authors/1037240',
            'https://inspirehep.net/api/authors/1987711',
            'https://inspirehep.net/api/authors/995374']]
```

We have obtained all the authors from Chile



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*†}

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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:

Country	Population
Argentina	45,606,000
Bolivia	11,833,000
Brazil	213,993,000
Chile	19,212,000
Colombia	51,266,000
Costa Rica	5,139,000
Cuba	11,318,000
Ecuador	17,888,000
Guatemala	18,250,000
Honduras	10,063,000
Mexico	130,262,000
Paraguay	7,220,000
Peru	33,359,000
Uruguay	3,485,000
Venezuela	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...

Latin American publications compared to global publications

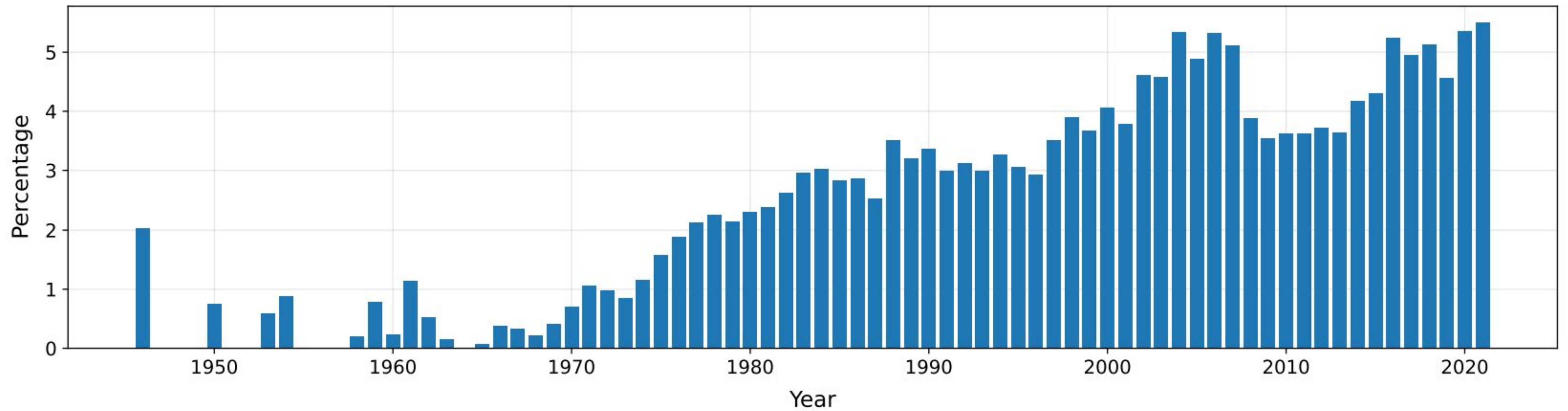


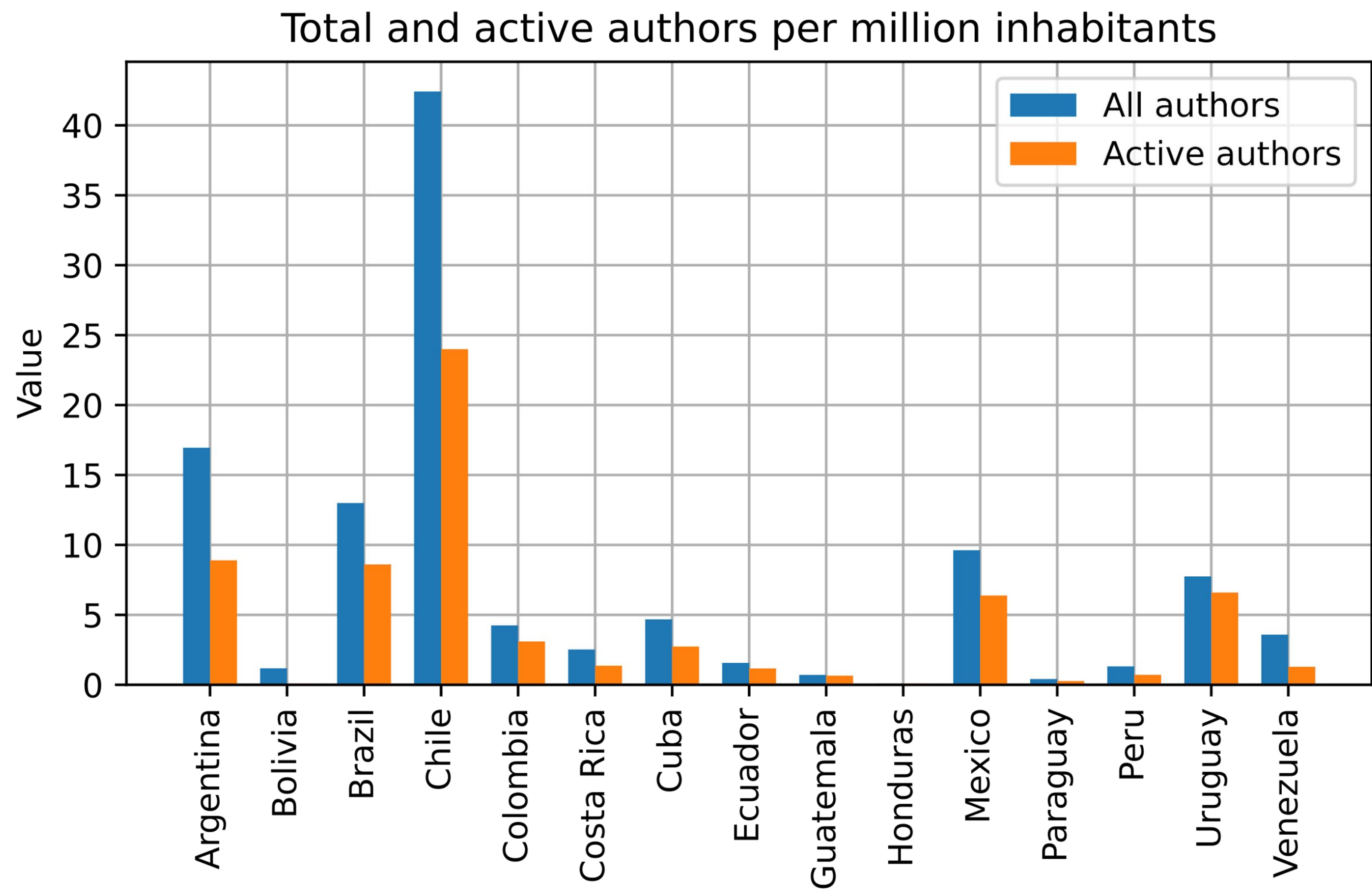
Fig. 1: Percentage of Latin American publications compared to global publications per year.

TOTAL AND ACTIVE AUTHORS

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

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

AUTHORS NORMALISED BY POPULATION



PUBLICATIONS VS YEAR

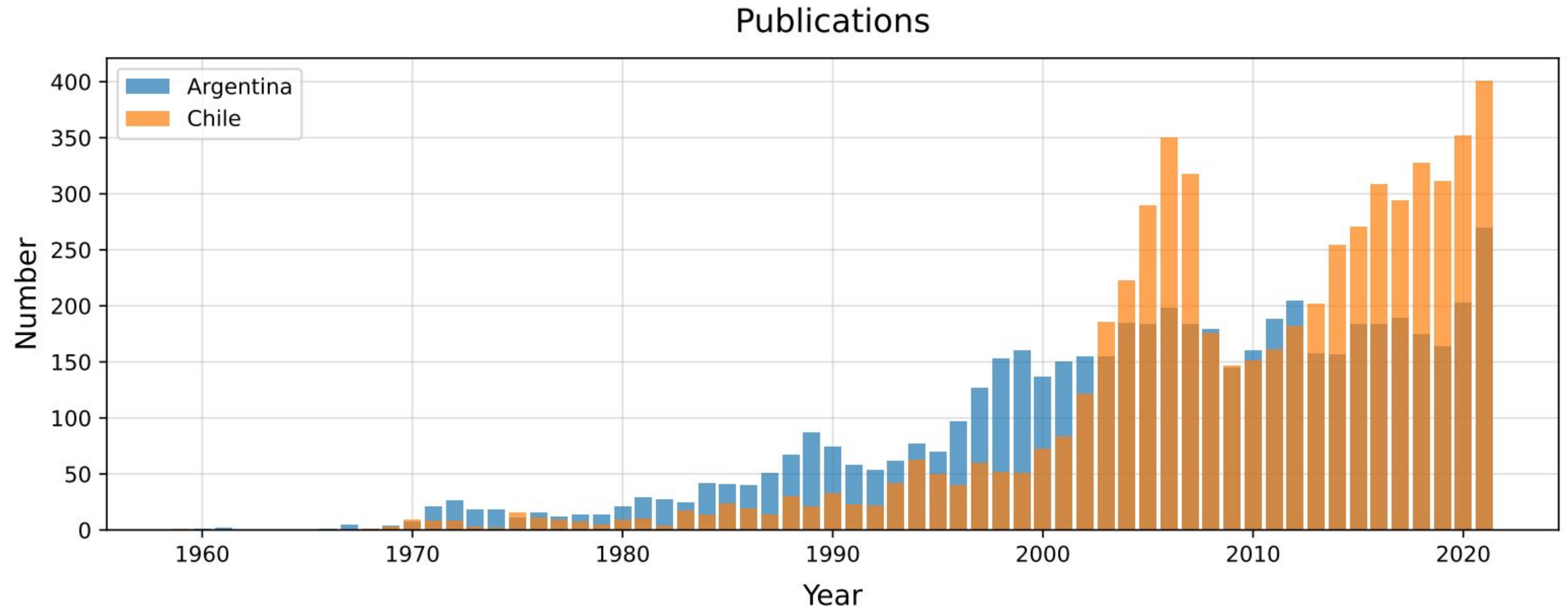
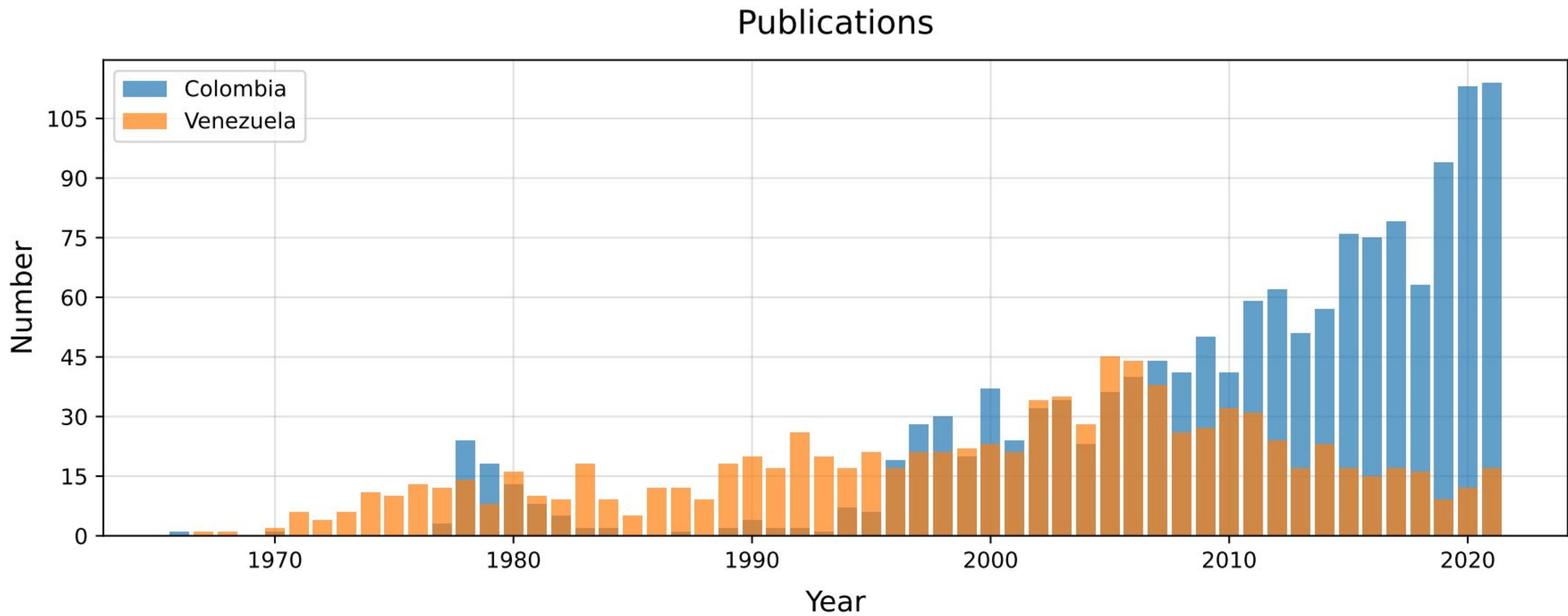


Fig. 7: Articles per year of Argentina and Chile.

PUBLICATIONS VS YEAR



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)

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

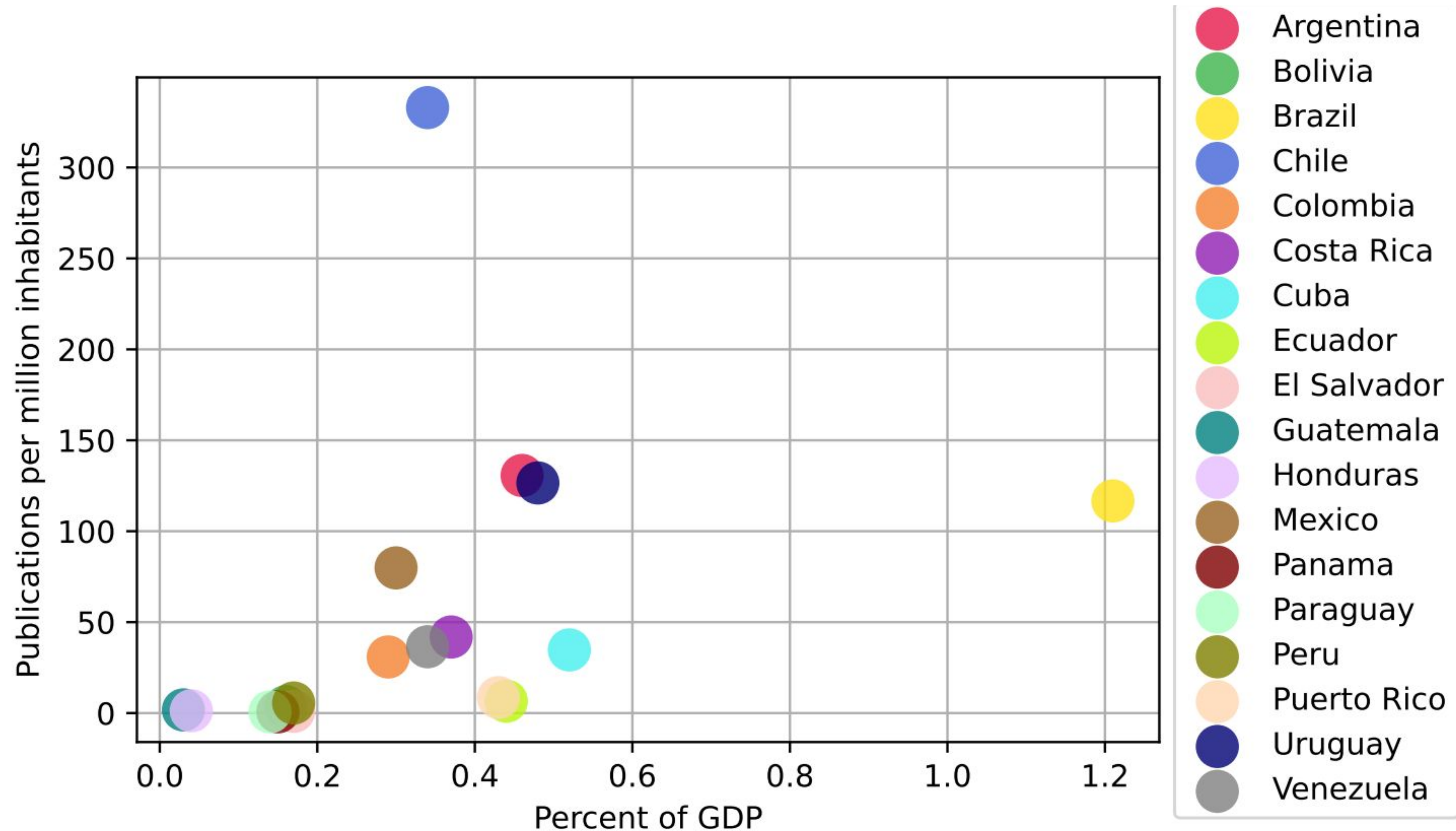
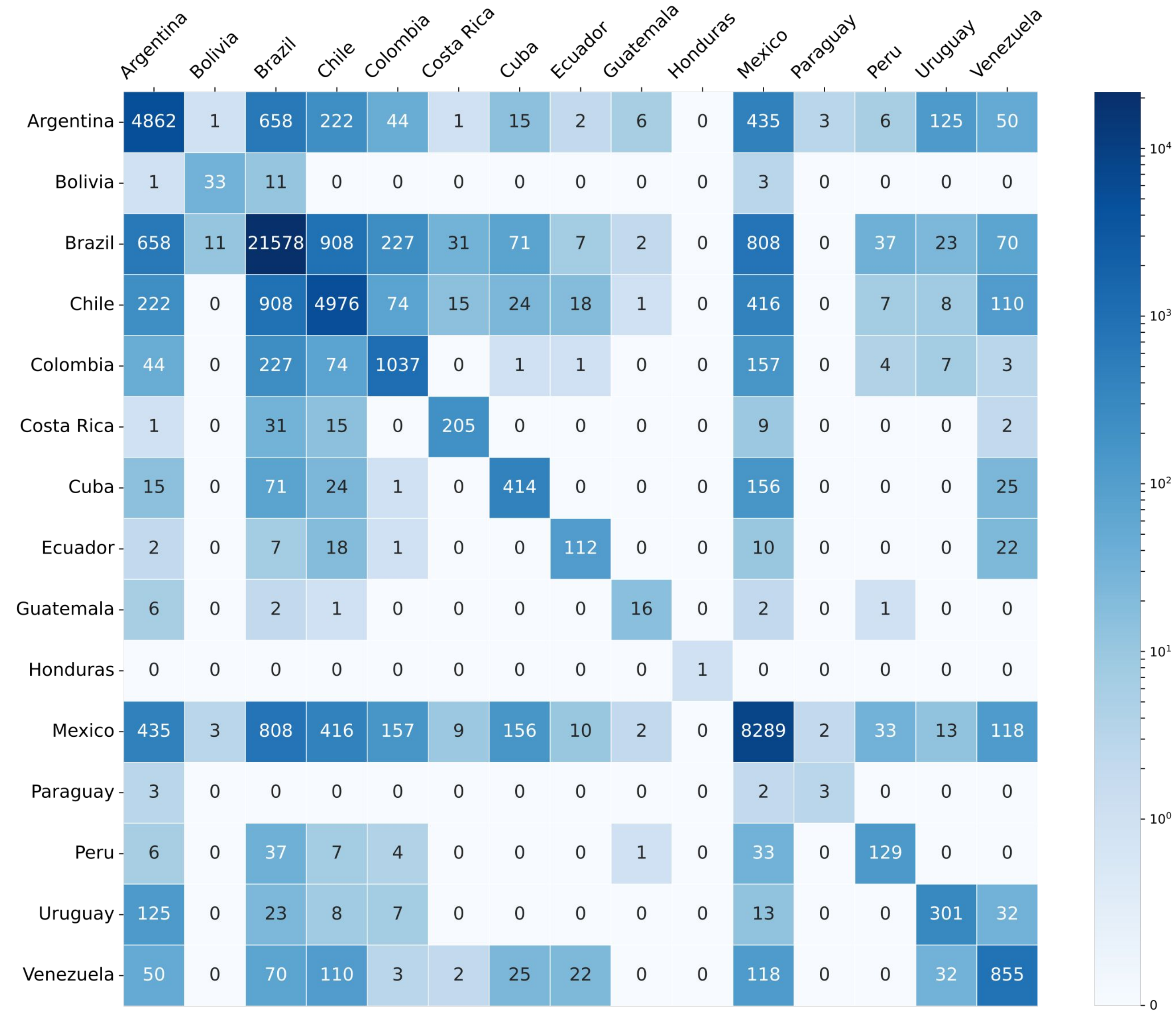


Fig. 15: Number of publications per million people versus the percentage of GDP invested in R&D for each country.

NUMBER OF COLLABORATIONS WITHIN LATIN AMERICA



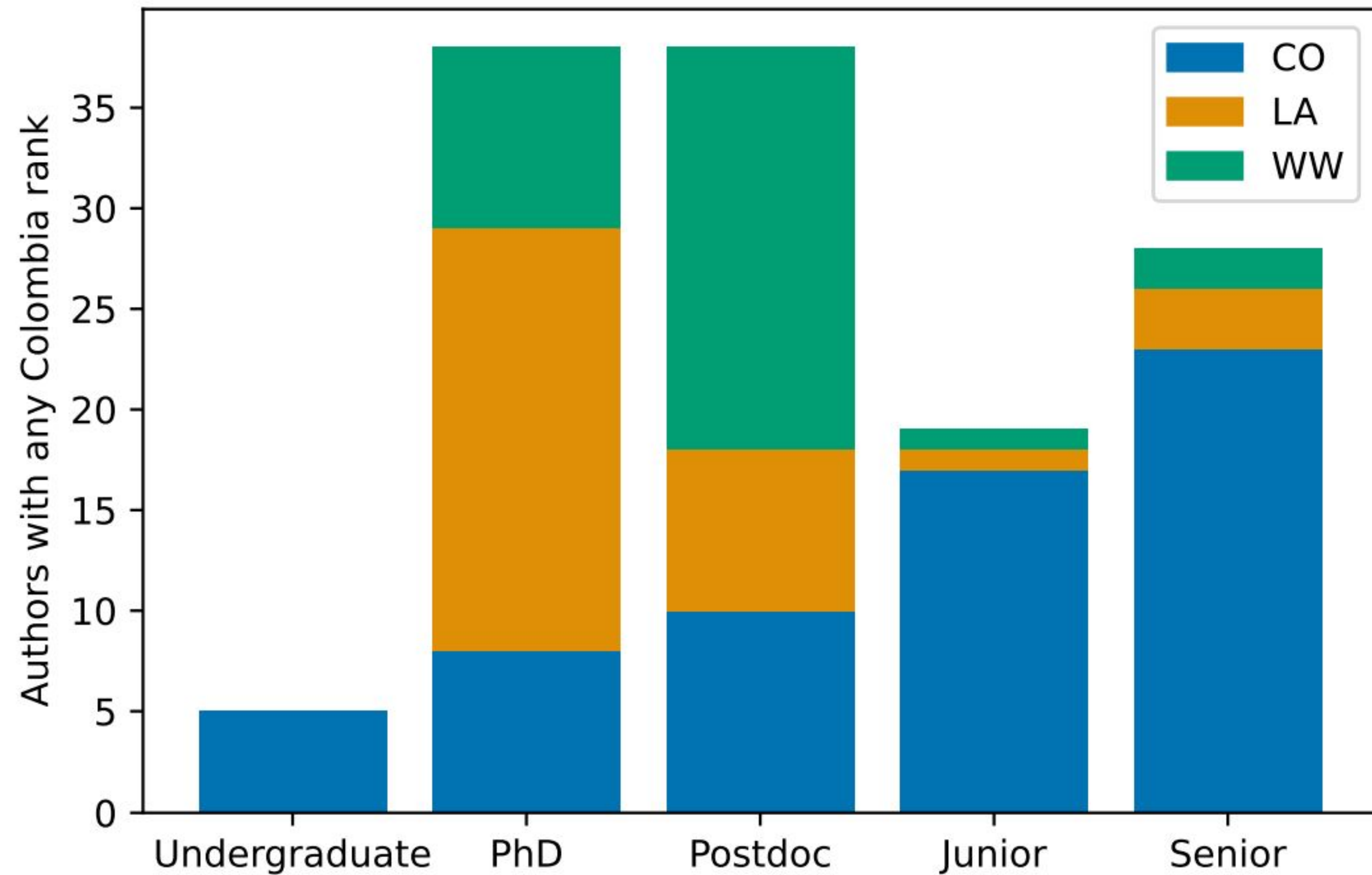
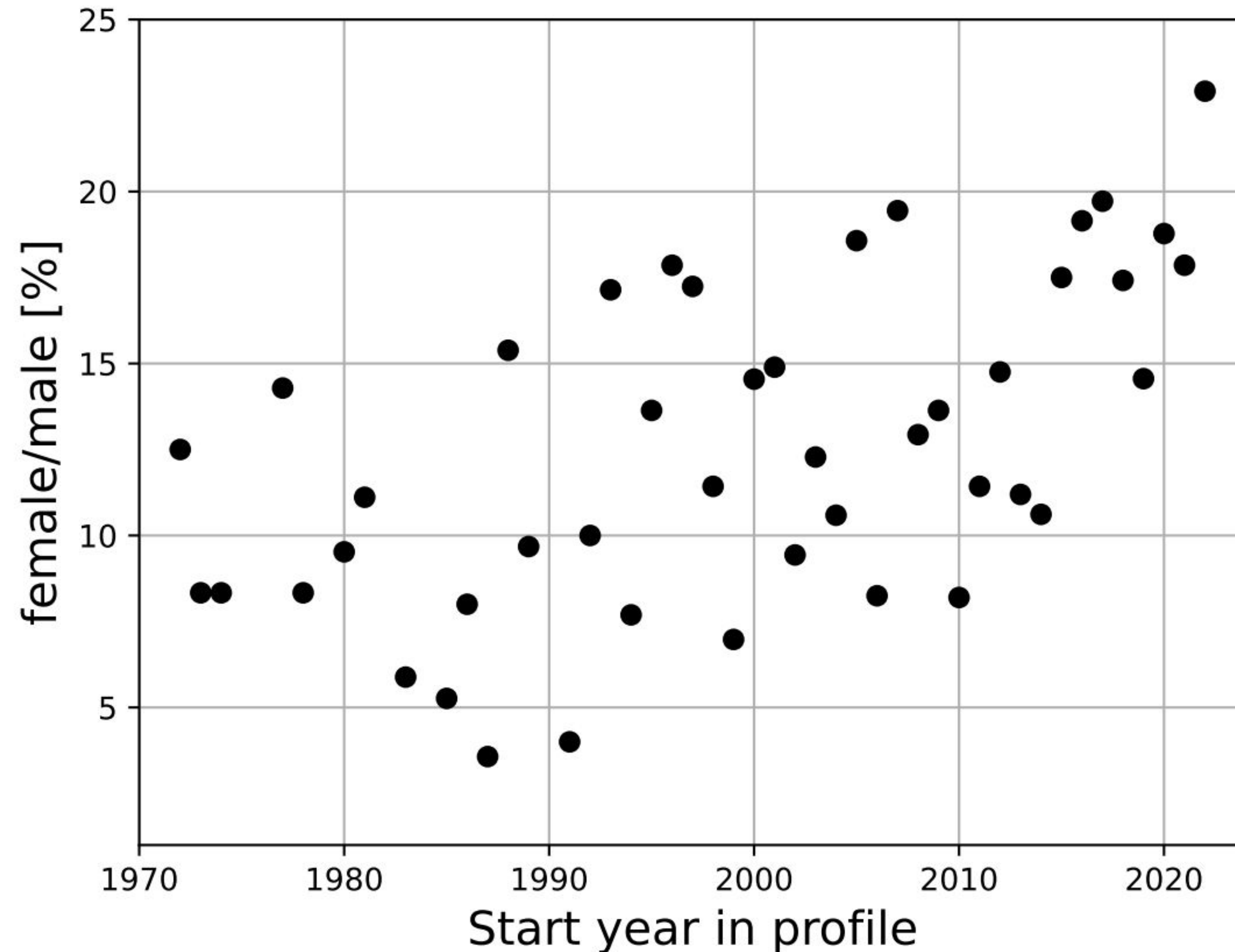


Fig. 4: Number of authors with Colombia ranks as in table 7 who published a paper under a given rank in Colombia, Latin America or elsewhere worldwide.


Percentage of female authors in publications



CAN YOU HELP US?

Yes, by completing your INSPIRE-HEP profile

Author

(Cambridge U., DAMTP) 

hep-ph

Author Identifier: Identifier

PhD Advisor: Advisor

2021-present

POSTDOC, Cambridge U., DAMTP

2017-2021

PHD, Louvain U., CP3




2014-2017

MASTER, U. Bologna, DIFA

2011-2014

UNDERGRADUATE, U. Bologna, DIFA

Hide

   edit

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 developed a database to study HEP research in Latin America
- 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