

Open Science and reproducibility

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SKA data challenges workshop, Bologna
2 October 2019



Knowledge is open if anyone is free to access, use,
modify, and share it



**A WORLD WHERE KNOWLEDGE CREATES
POWER FOR THE MANY, NOT THE FEW.
*THIS IS THE WORLD WE CHOOSE.***

Knowledge is open if anyone is free to access, use, modify, and share it



**A WORLD WHERE KNOWLEDGE CREATES
POWER FOR THE MANY, NOT THE FEW.
*THIS IS THE WORLD WE CHOOSE.***

Open Science represents an approach to research that is collaborative, transparent and accessible

THE NORMATIVE SYSTEM OF SCIENCE

Norm

Communality
Open Sharing
Universalism
Evaluate research on own merit
Disinterestedness
Motivated by knowledge & discovery
Organized skepticism
Consider all new evidence, even
against one's prior work

Counternorm

Secrecy
Closed
Particularism
Evaluate research on reputation
Self-interestedness
Treat science as a competition
Organized dogmatism
Invest career promoting one's
own theories, findings

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Norm

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QUALITY


Collaborate

Counternorm

Secrecy
Closed
Particularism
Evaluate research on reputation
Self-interestedness
Treat science as a competition
Organized dogmatism
Invest career promoting one's
own theories, findings

QUANTITY

Compete



European
Commission

Evaluation of Research Careers fully acknowledging Open Science Practices

Rewards, incentives and/or recognition for researchers
practicing Open Science

doi: 10.2777/75255



RESEARCH ASSESSMENT

Research output

- Research activity
- Publications
- Datasets and research results
- Open source
- Funding

Research process

- Stakeholder engagement /citizen science
- Collaboration and interdisciplinarity
- Research integrity
- Risk management

Service & leadership

- Leadership
- Academic standing
- Peer review
- Networking

Research impact

- Communication and dissemination
- IP (patents, licenses)
- Societal impact
- Knowledge exchange

Teaching and supervision

- Teaching
- Mentoring
- Supervision

Professional experience

- Continuing professional development
- Project management
- Personal qualities

March 2017



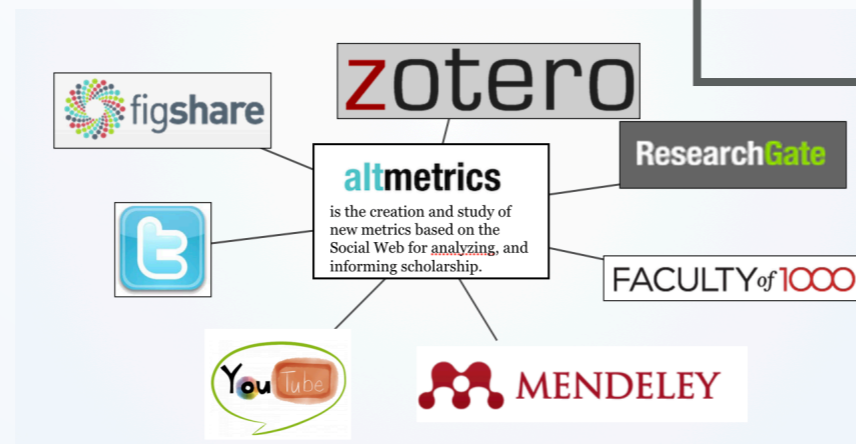
Next-generation metrics: Responsible metrics and evaluation for open science

Report of the European Commission Expert Group on Altmetrics

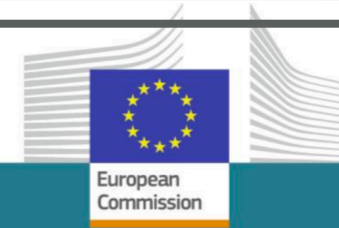
Not just citation of articles, various forms of social media shares, web-downloads, any other measure of the Q and impact of research outcomes

Community driven

- DORA declaration
- Metric Tide
- Leiden Manifesto
- etc



RESEARCH ASSESSMENT



April 2018

Mutual Learning Exercise

Open Science: Altmetrics and Rewards

Horizon 2020 Policy Support Facility

Thematic Reports:

Types

Use in the context of Open Science

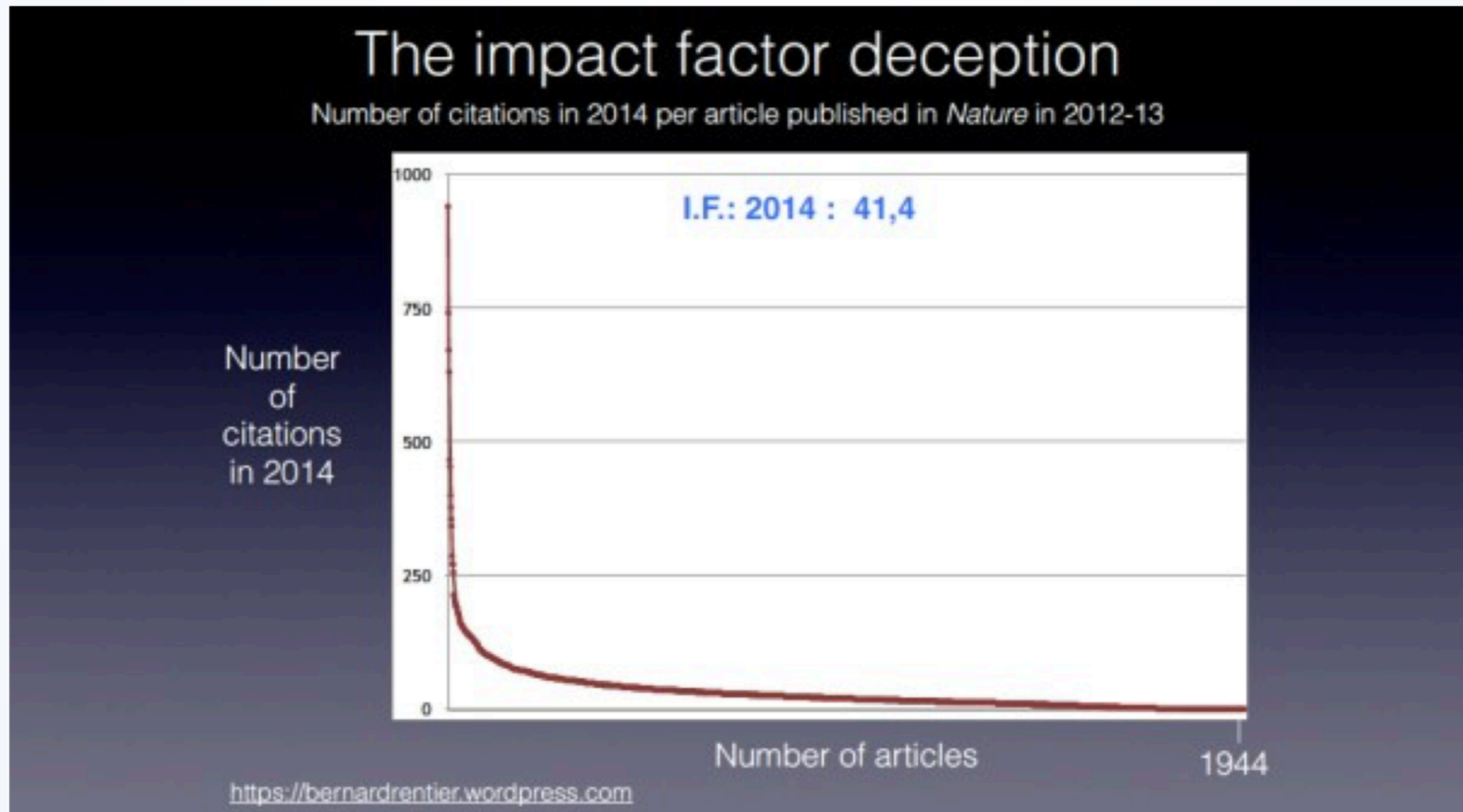
Incentives and Rewards

Strategies, Experiences and Models

Final Report

RESEARCH ASSESSMENT

- A study was carried out on all 1,944 articles published in Nature in 2012 and 2013.
- Cites in 2014.
 - 280 (14.4%) do account for half of the total citations
 - 214 (11%) get 0 or 1 citation





Plan S

Making full and immediate Open Access a reality

[Why Plan S](#)

[10 Principles](#)

[Funders & support](#)



What is cOALition S?

On 4 September 2018, a group of national research funding organisations, with the support of the European Commission and the European Research Council (ERC), announced the launch of cOALition S, an initiative to make full and immediate Open Access to research publications a reality. It is built around Plan S, which consists of one target and 10 principles.

cOALition S signals the commitment to implement, by 1 January 2020, the necessary measures to fulfil its main principle:

“By 2020 scientific publications that result from research funded by public grants provided by participating national and European research councils and funding bodies, must be published in compliant Open Access Journals or on compliant Open Access Platforms.”

Plan S: Built on strong principles

- **No** publication should be locked behind a **paywall**
- OA must be **immediate**, i.e. no embargo periods
- **No copyright transfer**; publication under a **CC BY license** by default
- **Transparency** about pricing and contracts
- Funders commit to support **publication fees** at a **reasonable** level
- **Multiple routes** to OA compliance
- Commitment to assess research outputs based on their **intrinsic merit** and NOT venue of publication

Alignment of Open Access policies

National funders



Charitable and international funders



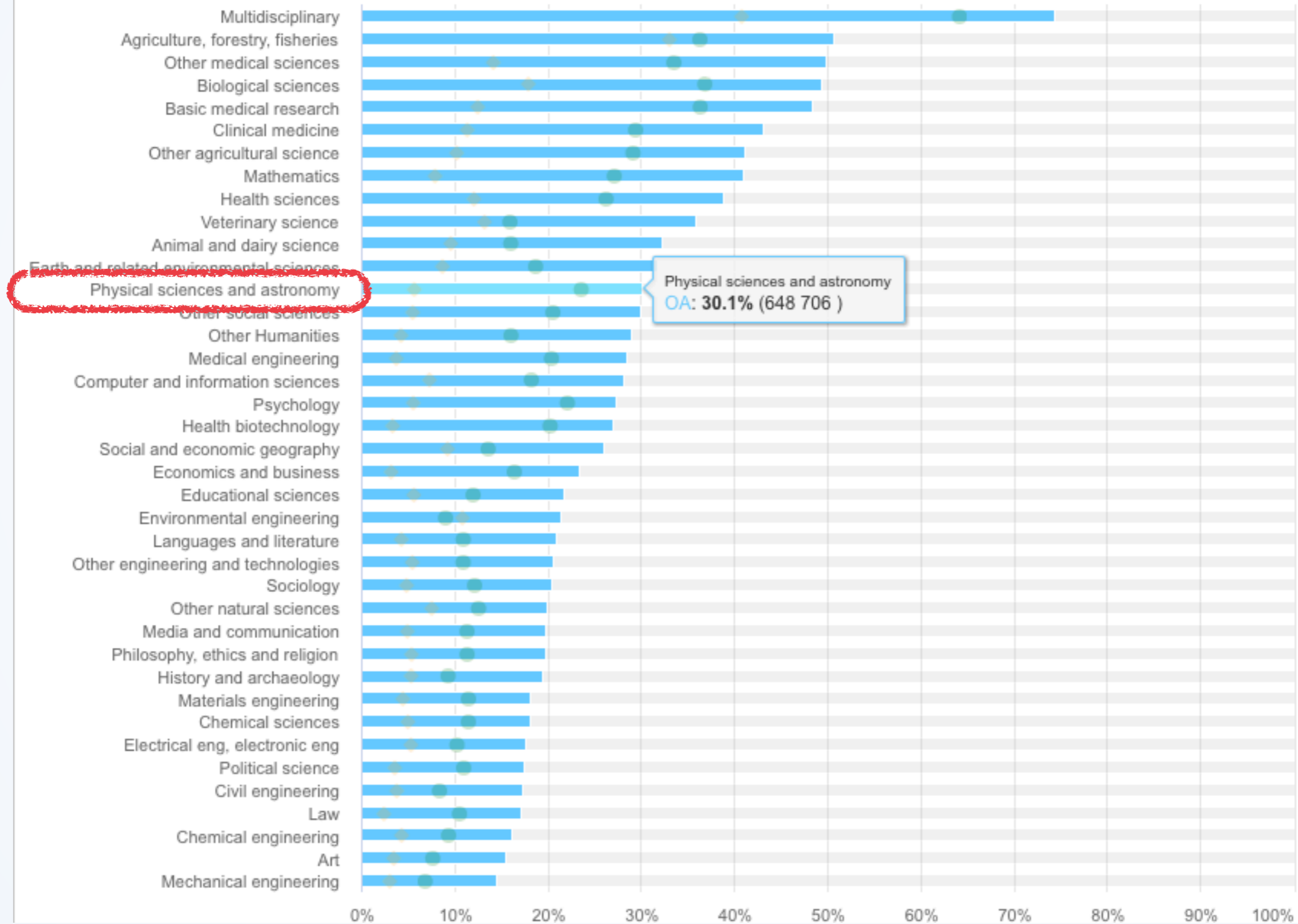
European funders



OPEN ACCESS PUBLICATIONS

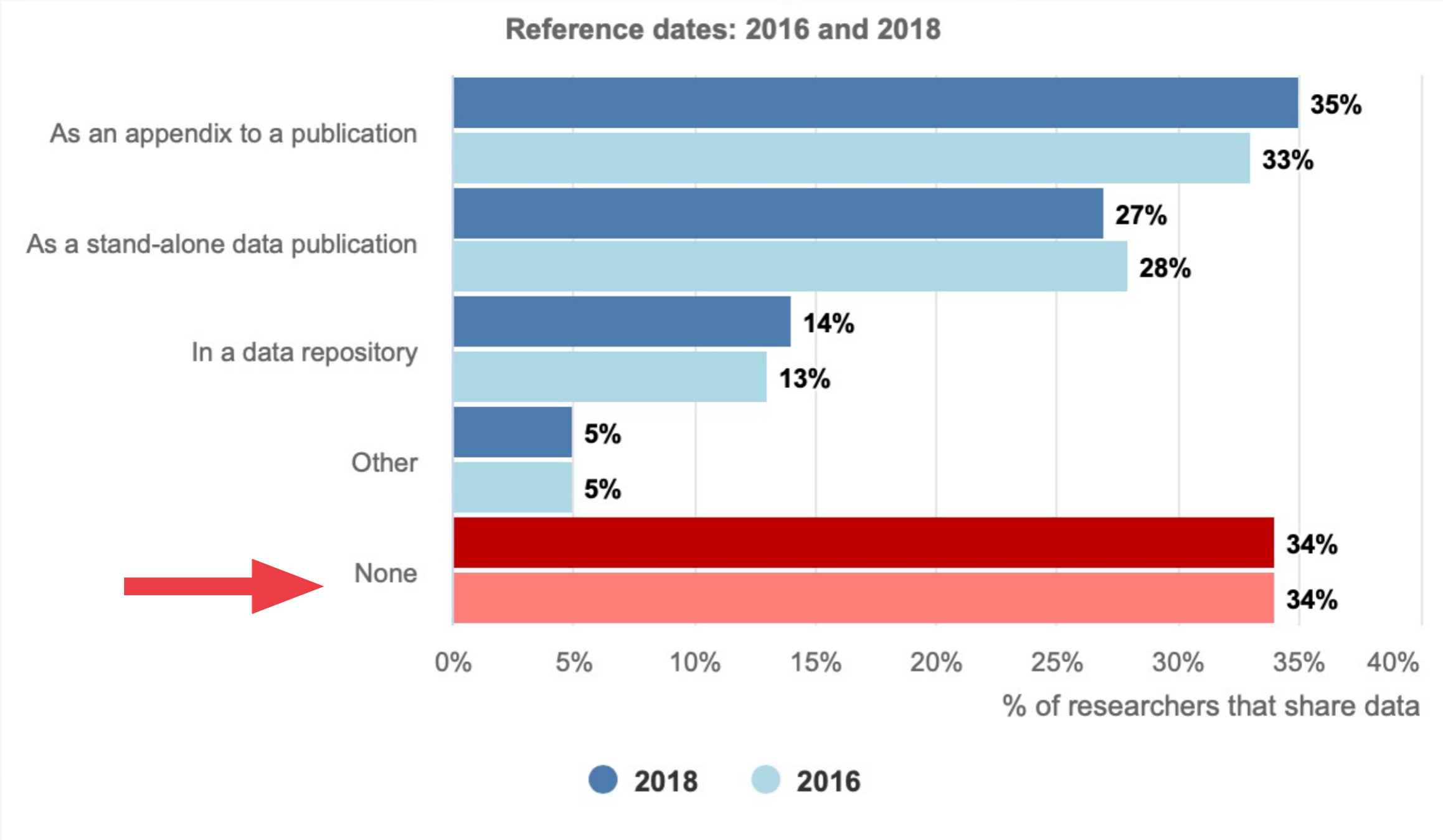
Percentage of Open Access publications (Gold and Green) by FOS (Fields of Science and Technology)

Source: Consortium's own analysis of Scopus and Unpaywall databases - Reference date: 2009-2017



ATTITUDE TOWARDS DATA SHARING

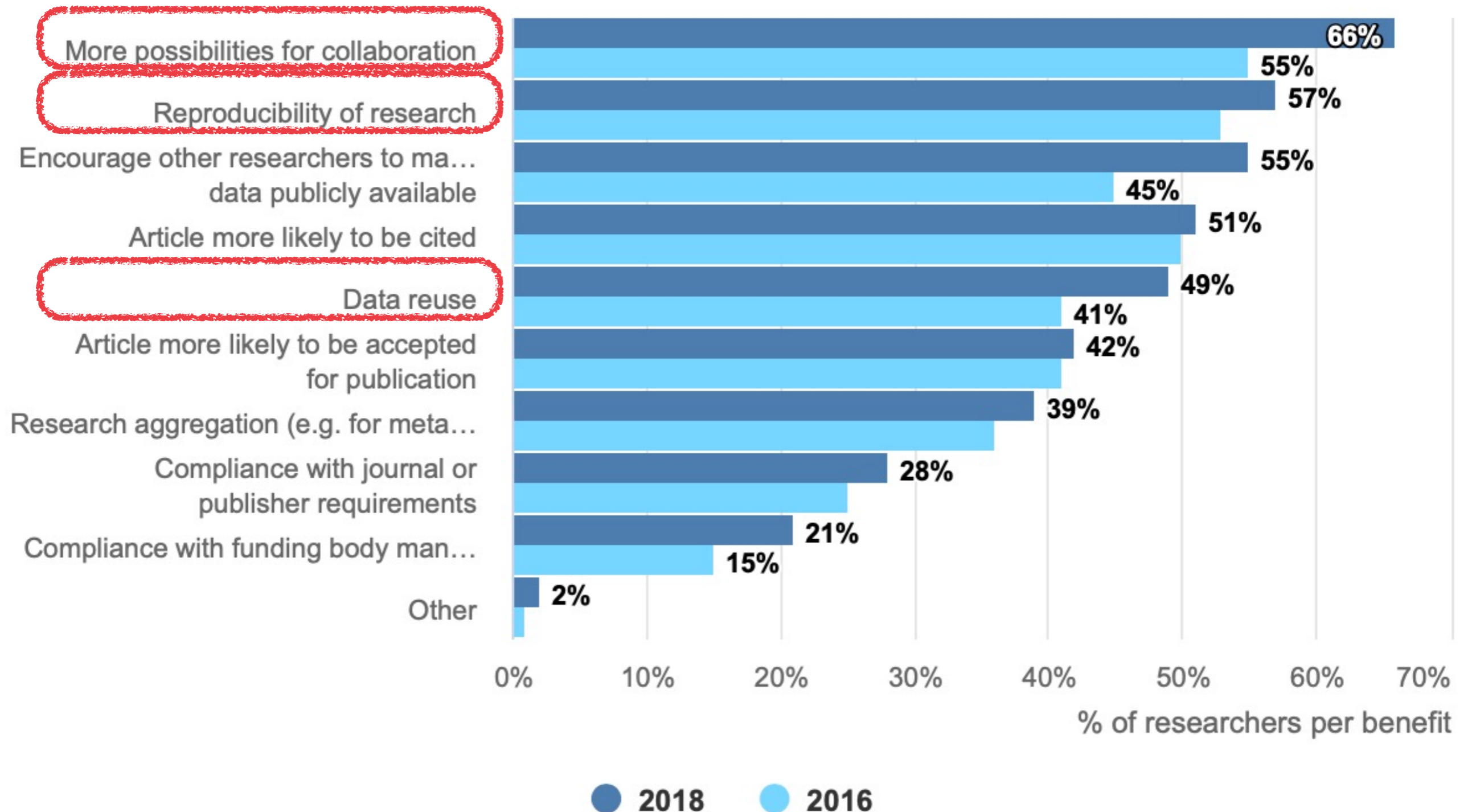
% of researchers that share data



ATTITUDE TOWARDS DATA SHARING

Benefits of sharing research data

Reference dates: 2016 and 2018

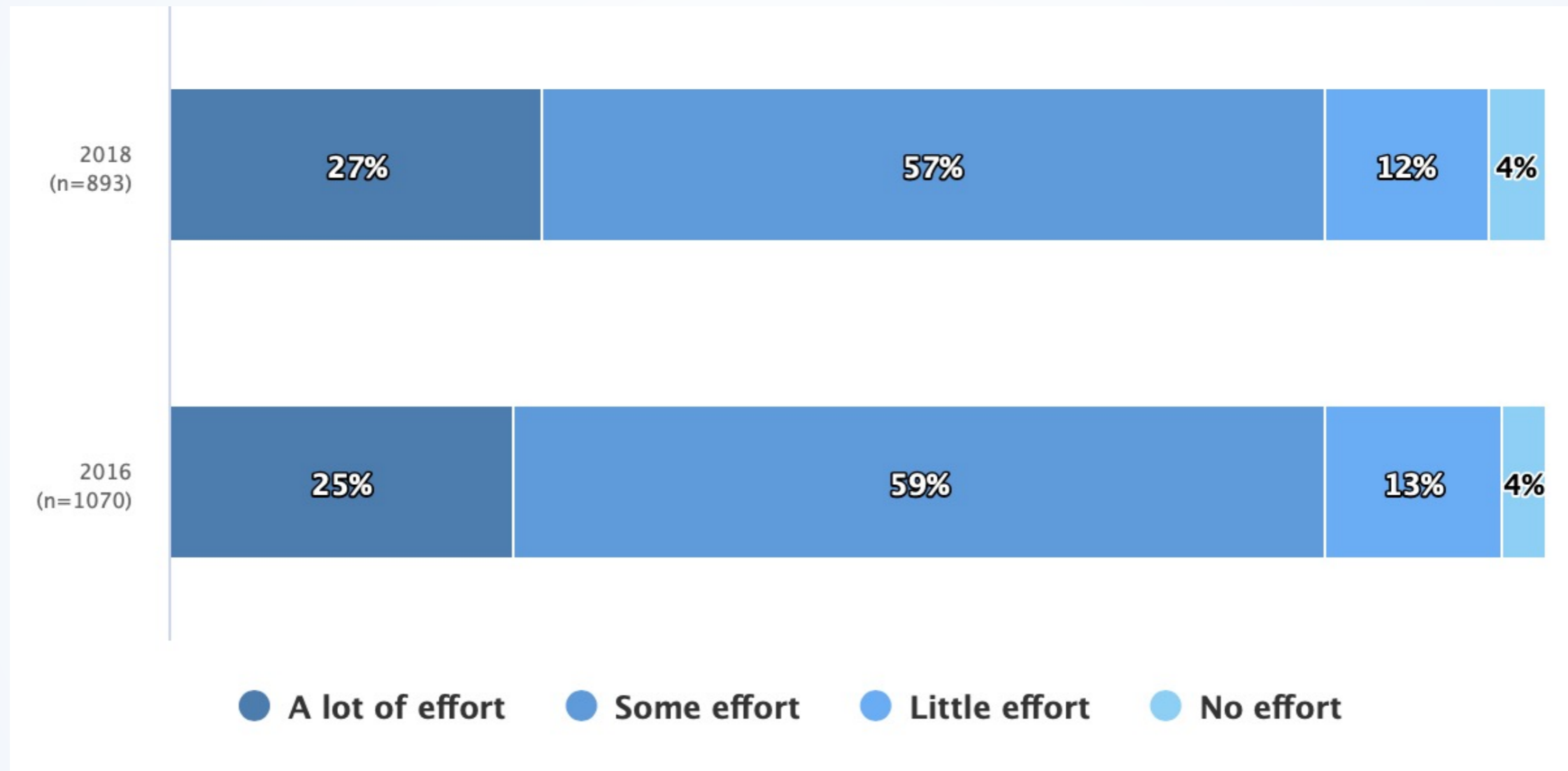


% of researchers per benefit

Source: Open science monitor

ATTITUDE TOWARDS DATA SHARING

Effort required to make research data available and re-usable by others



% of researchers per amount of effort



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AMIGA XIII



VIEW

Abstract

Citations (3)

References (93)

Co-Reads

Similar Papers

Volume Content

Graphics

Metrics

Export Citation

The AMIGA sample of isolated galaxies. XIII. The HI content of an almost "nurture free" sample

Show affiliations

Jones, M. G.; Espada, D.; Verdes-Montenegro, L.; Huchtmeier, W. K.; Lisenfeld, U.; Leon, S.; Sulentic, J.; Sabater, J.; Jones, D. E.; Sanchez, S.; Garrido, J.

Context. We present the largest catalogue of HI single dish observations of isolated galaxies to date, as part of the multi-wavelength compilation being performed by the AMIGA project (Analysis of the interstellar Medium in Isolated GALaxies). Despite numerous studies of the HI content of galaxies, no revision focused on the HI scaling relations of the most isolated L_* galaxies has been made since Haynes & Giovanelli (1984, AJ, 89, 758).

Aims: The AMIGA sample has been demonstrated to be almost "nurture free", therefore, by creating scaling relations for the HI content of these galaxies we will define a metric of HI normalcy in the absence of interactions.

Methods: The catalogue comprises of our own HI observations with Arecibo, Effelsberg, Nançay and GBT, and spectra collected from the literature. In total we have measurements or constraints on the HI masses of 844 galaxies from the Catalogue of Isolated Galaxies (CIG). The multi-wavelength AMIGA dataset includes



FULL TEXT SOURCES

Publisher

arXiv

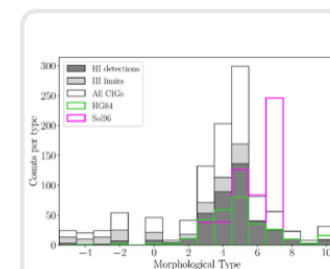


DATA PRODUCTS

SIMBAD (851)

CDS (1)

GRAPHICS



[Click to view more](#)

ASSOCIATED

WORKS (2)

[Catalog Description](#)

SAO/NASA ADS Astronomy Query Form for Thu Sep 26 03:31:44 2019

[Sitemap](#) [What's New](#) [Feedback](#) [Basic Search](#) [Preferences](#) [FAQ](#) [HELP](#)

Send Query to the new ADS

Databases to query: Astronomy Physics arXiv e-prints

Authors: (Last, First M, one per line) SIMBAD ADS Objects

Exact name matching Object name/position search

Require author for selection Require object for selection

OR AND simple logic boolean logic

Publication Date between and

(MM) (YYYY) (MM) (YYYY)

Enter **File Words** Require title for selection

(Combine with) OR AND simple logic boolean logic

Enter **Abstract Words/Keywords** Require text for selection

(Combine with) OR AND simple logic boolean logic

Return 200 items starting with number 1

Search within articles using the new ADS UI

[myADS](#): Personalized notification service

Check if your publisher allows self archiving

- Check the journal policy on the publisher's website

RoMEO Colour	Archiving policy
Green	Can archive pre-print <i>and</i> post-print or publisher's version/PDF
Blue	Can archive post-print (ie final draft post-refereeing) or publisher's version/PDF
Yellow	Can archive pre-print (ie pre-refereeing)
White	Archiving not formally supported



Journal:	Astronomy and Astrophysics (ISSN: 0004-6361, ESSN: 1432-0746)
RoMEO:	This is a <u>RoMEO green</u> journal
Paid OA:	A paid open access option is available for this journal.
Author's Pre-print:	✓ author can archive pre-print (ie pre-refereeing)
Author's Post-print:	✓ author can archive post-print (ie final draft post-refereeing)
Publisher's Version/PDF:	✓ author can archive publisher's version/PDF
General Conditions:	<ul style="list-style-type: none"> • On author's personal website or institutional website or OAI compliant website • Some journals require an embargo for deposit in funder's designated repositories (see journal) • Publisher's version/PDF may be used (see journal) • Must link to publisher version • Publisher copyright and source must be acknowledged • Non-commercial
Mandated OA:	Compliance data is available for 4 funders
Paid Open Access:	Charges and discounts for hybrid Open Ac
Copyright:	Example Policy - Preprint servers / ArXiv - Example Copyright Policy
Updated:	03-Oct-2018 - Suggest an update for this record
Link to this page:	http://sherpa.ac.uk/romeo/issn/0004-6361/

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Dissemin detects papers behind pay-walls and invites their authors to upload them in one click to an open repository.

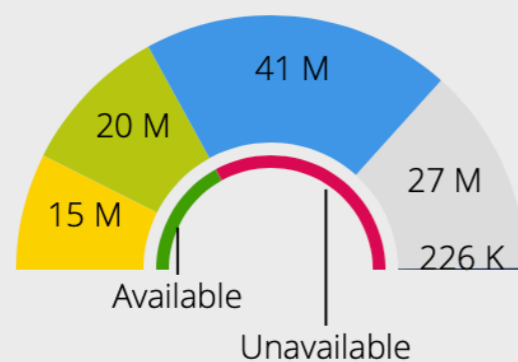


[Advanced search](#)

Green open access

Many researchers do not use their right to make their papers freely available online, in addition to the paywalled version offered by traditional publishers.

This forces libraries to buy overpriced electronic subscriptions to journals, when they can afford them at all.



- Available from the publisher 15,369,718
- Available from the author 19,877,776
- Could be shared by the authors 40,713,451
- Unknown/unclear sharing policy 27,413,492
- Publisher forbids sharing 226,134

Open repositories

Uploading your papers on your own webpage is not enough. Such copies are less stable and harder to find than documents uploaded to well-indexed repositories.

Dissemin searches for copies of your papers in a large collection of open repositories and tells you which ones cannot be accessed.

Welcome to Dissemin

Dissemin detects papers behind pay-walls and invites their authors to upload them in one click to an open

Papers



[Advanced search](#)



Julián Garrido, Ignacio Requena
Semantic model for flood

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Jesús C. Echeverría, Pablo de V.
A fiber-optic sensor to de
porous silica xerogel film

[Download](#) www.researchgate



Julián Garrido, Ignacio Requena
Towards summarizing kn

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Kristina M. Hettne , Katherine Woistencroft, Khaled Belhajjame, Carole A. Goble, Eleni Mina, Harish Dharuri, Lourdes Verdes-Montenegro, David De Roure, Julián Garrido, Marco Roos

Best Practices for Workflow Design: How to Prevent Workflow Decay

Towards summarizing knowledge: Brief ontologies

Journal article published in 2012 by Julián Garrido, Ignacio Requena



Full text: Unavailable

Publisher: Elsevier

Preprint: archiving allowed.

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Postprint: archiving allowed.

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Published version: archiving forbidden.

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[Policy details \(opens in a new window\).](#)

Data provided by SHERPA/ROMEO

[Contact authors](#)

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OPEN SCIENCE - TRAINING

Fostering Improved Training Tools For Responsible Research & Innovation

- FIT4RRI maintains a collection of RRI and Open Science training materials on the FOSTER portal.



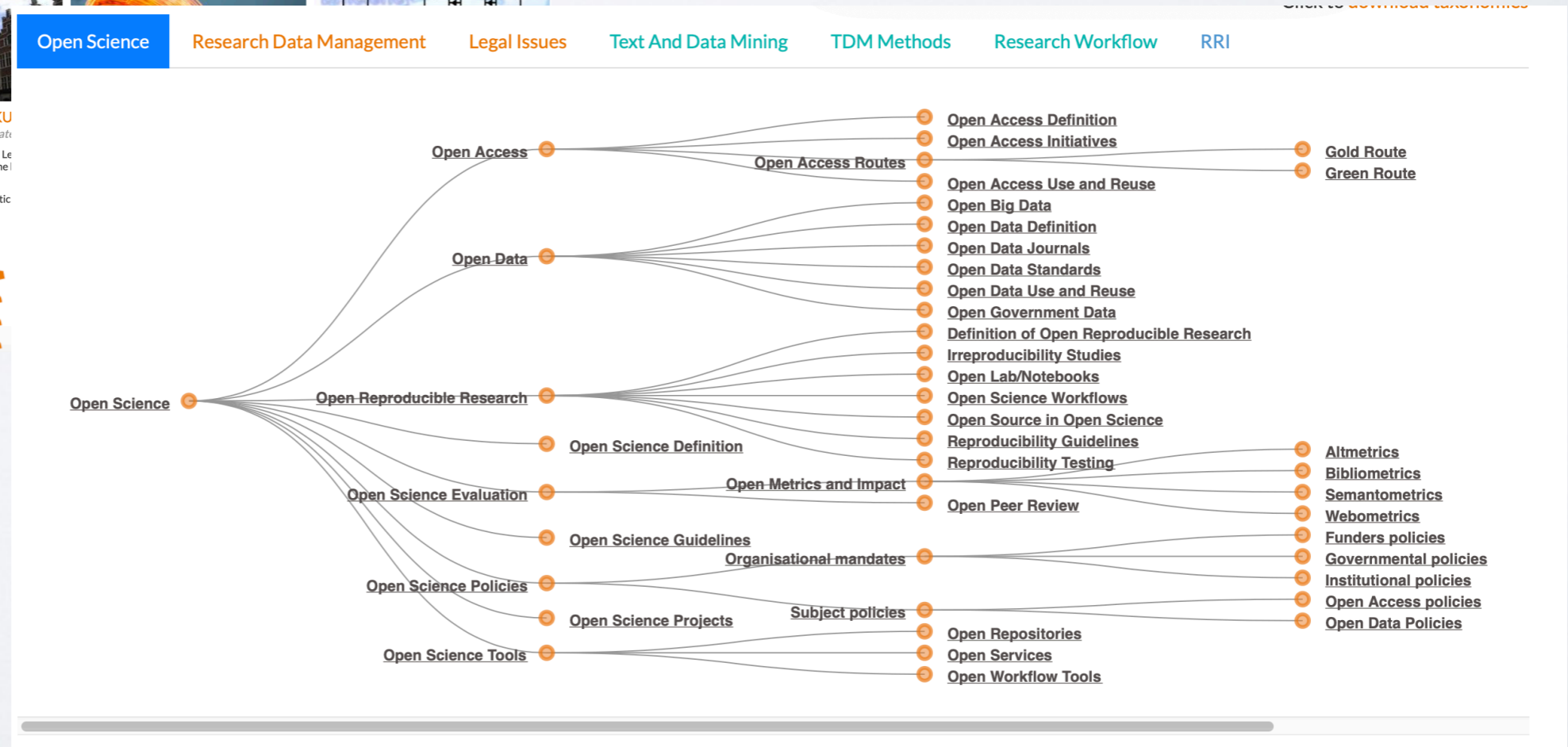
Courses

Are you interested in proposing new courses? Get in touch with us at elarning@fosteropenscience.eu and take a look at our course on "how to create a course".

Open Science | Research Data Management | Legal Issues | Text And Data Mining | TDM Methods | Research Workflow | RRI

Use Open Data in Teaching
In higher education and research, the topics of open science and research data management have gained interest. This module stimulates the use of open research data in teaching, thus f...

Open Science basics for KU Leuven library staff *Moderate*
In this course for library staff at KU Leuven participants will be introduced to the Open Science.
After completion of the course, participants will be able to:
...



OPEN SCIENCE - TRAINING

Massive Open Online Course (and Community!)

<https://opensciencemooc.eu/>

We want to help make **open** the default setting for all
global research.

Education, training, support.

Empowerment and
leadership.

Shifting power dynamics.

Building a global
community.

Massive-scale
engagement.

The screenshot displays six course categories arranged in a 2x3 grid. Each category has a circular icon, a title, and one or two buttons.

- Open Principles**: Icon of a classical building. Buttons: "Learn More" (white), "Enroll Now" (green).
- Open Collaboration**: Icon of three people in a circle. Button: "Learn More" (white).
- Reproducible Research and Data Analysis**: Icon of a stack of books. Button: "Learn More" (white).
- Open Research Data**: Icon of a line graph. Button: "Learn More" (white).
- Open Research Software and Open Source**: Icon of a computer monitor. Buttons: "Learn More" (white), "Enroll Now" (green).
- Open Access to Research Papers**: Icon of a document. Button: "Learn More" (white).



@OpenScienceMOOC



info@opensciencemooc.eu



<https://github.com/OpenScienceMOOC>

**OPEN
SCIENCE
MOOC**
FREE | OPEN | LEARNING

credit: [@pcmasuzzo](#)

Ethics and limitations

- As Open as possible and as close as necessary
 - Protect results for commercial and industrial exploitation
 - ...

GDPR and Anonymized Data

- Data describing personal information is the basis for scientific research in various fields.
- Collecting and processing personal data has been recently regulated by the General Data Protection Regulation for all EU citizens.
- The data management community has proposed data anonymization techniques to allow Open Science.



<https://amnesia.openaire.eu>

SKA Regional Centres



SKA Organization

THE SKA REGIONAL CENTRE NETWORK

Access to data products, tools and processing power to generate and analyse

Advanced Data Products (ADPs)

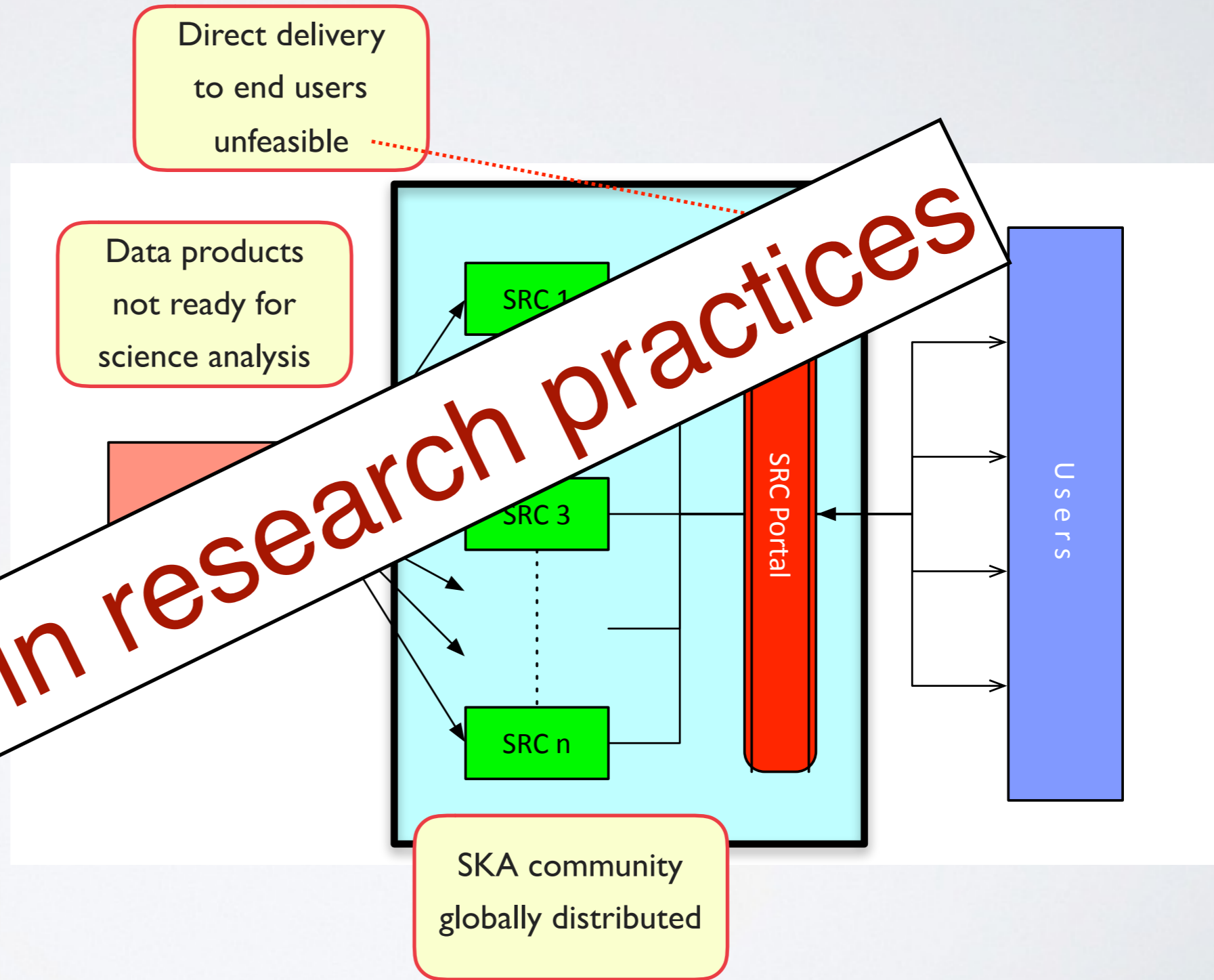
Direct delivery
to end users
unfeasible

Data products
not ready for
science analysis

The core of
SKA science

Global shift in research practices

SKA community
globally distributed



THE SRCs AS OPEN SCIENCE HUBS

Open Science** implementation will facilitate sharing data, resources and tools across the SKA community through the SRCs. The methods can be verified, reused, repurposed, so accelerating discovery and transfer of knowledge



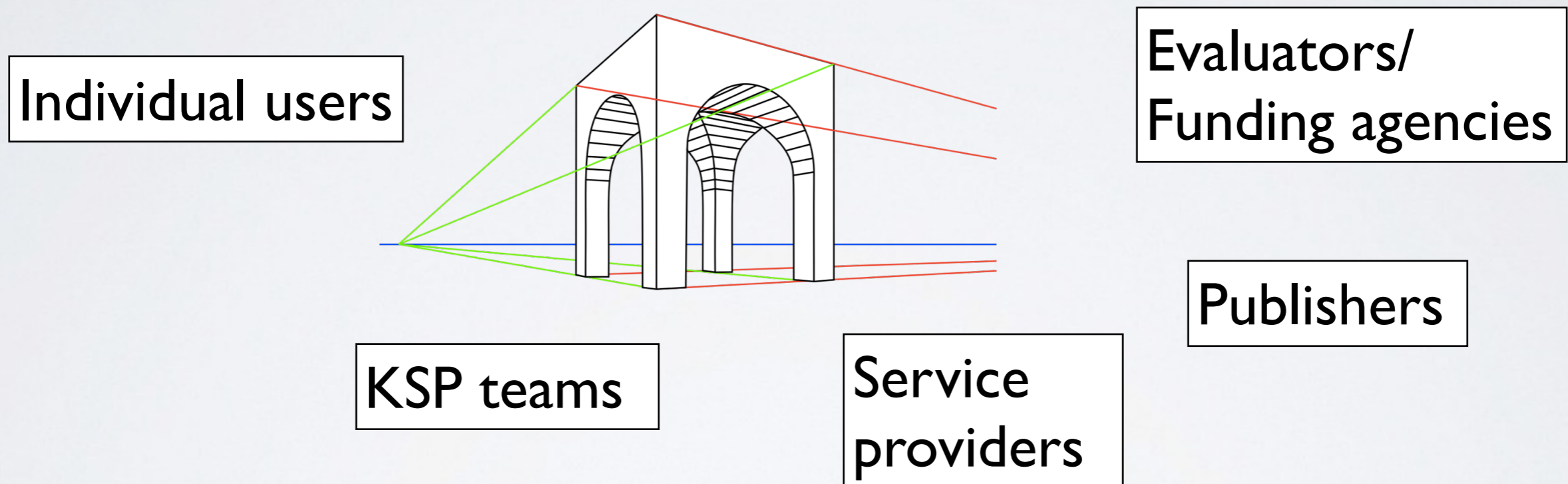
Users = scientists = we want to follow the Scientific method

** Open Science is transparent and accessible knowledge that is shared and developed through collaborative networks. Its implementation at the SRCs will facilitate sharing data, methods, resources and tools across the community, enabling verification, reusability and repurpose.

PERSPECTIVES

Implementation of Open, reproducible science is challenging, even more in this new framework:

NEW ROLES → NEW PERSPECTIVES



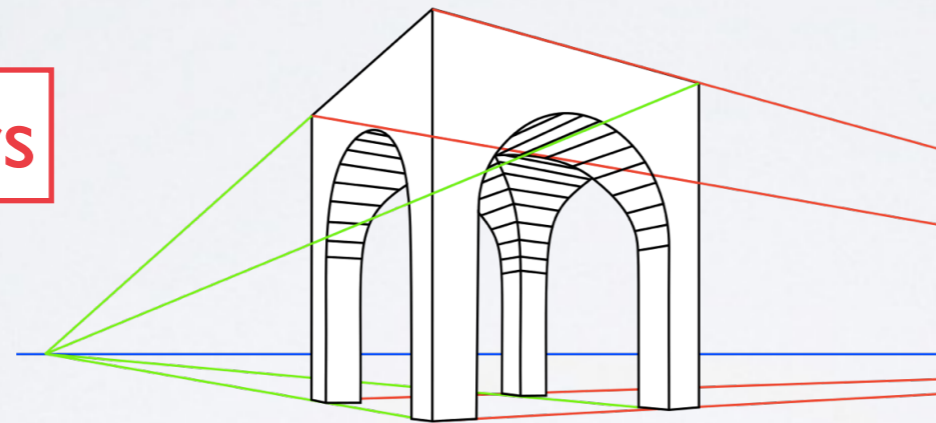
MY PERSPECTIVE

Implementation of Open, reproducible science is challenging, even more in this new framework:

NEW ROLES → NEW PERSPECTIVES

Individual users

Evaluators/
Funding agencies



Publishers

KSP teams

Service providers

SKA SWG



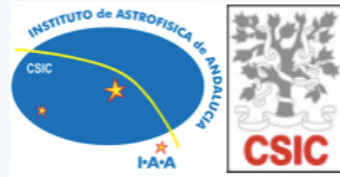
SKA SRCCG & SRCSC



A proto-SRC at IAA



SKA Organization



SRC PROTOTYPE AT IAA-CSIC

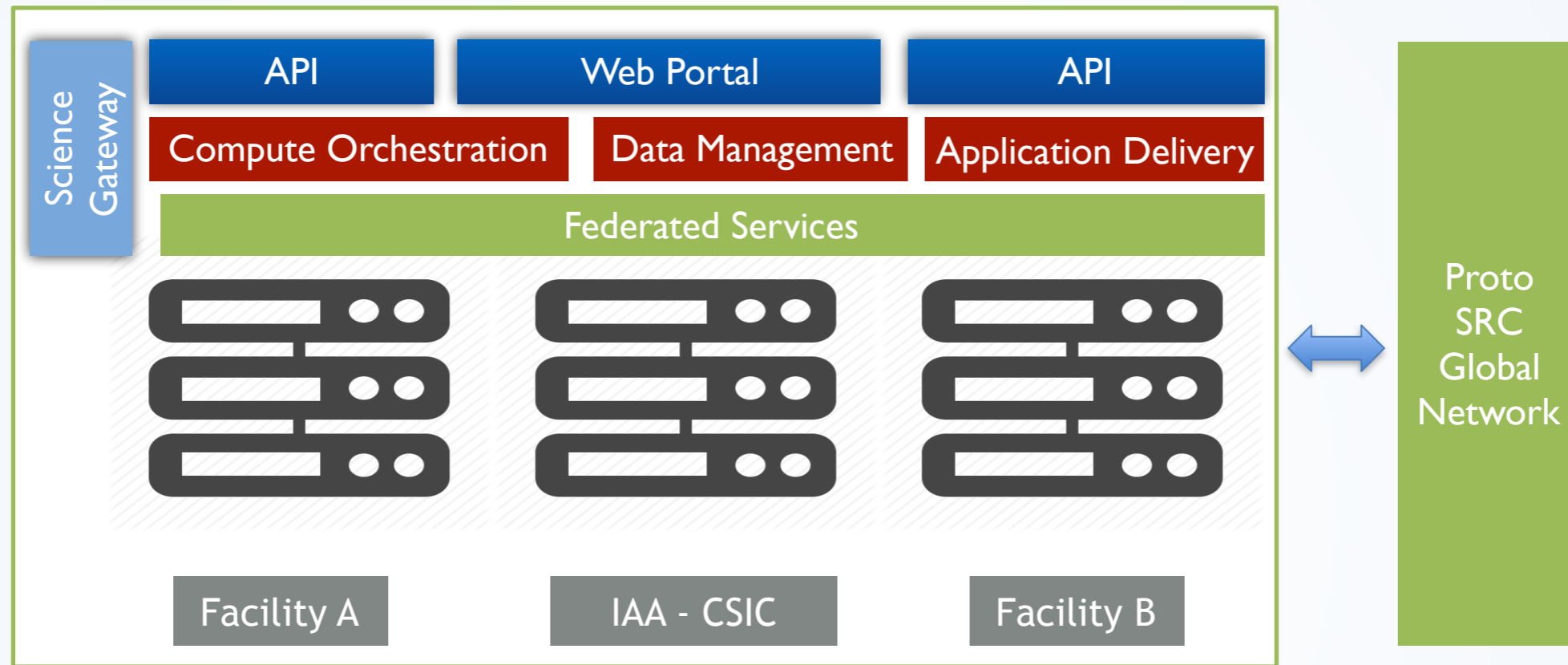
Centre of Excellence “Severo Ochoa” (S.O.) accreditation from the Spanish Ministry of Science that acknowledges the Spanish centres that carry out cutting-edge research.

- A [prototype of SKA SRC included](#) in the IAA S. O. scientific programme.

Objectives:

- Support IAA members participation in
 - SKA precursors /pathfinders
 - SKA Data Challenges
- [Embrace Open Science Principles: Data-Intensive and Reproducible Research for the SKA Regional Centres](#)
- Partnership with national HPC facilities / experts in computational science
- Collaborate with other SRC initiatives
- Innovation in analysis techniques, new algorithms

SRC PROTOTYPE AT IAA-CSIC



Science Analysis Platform

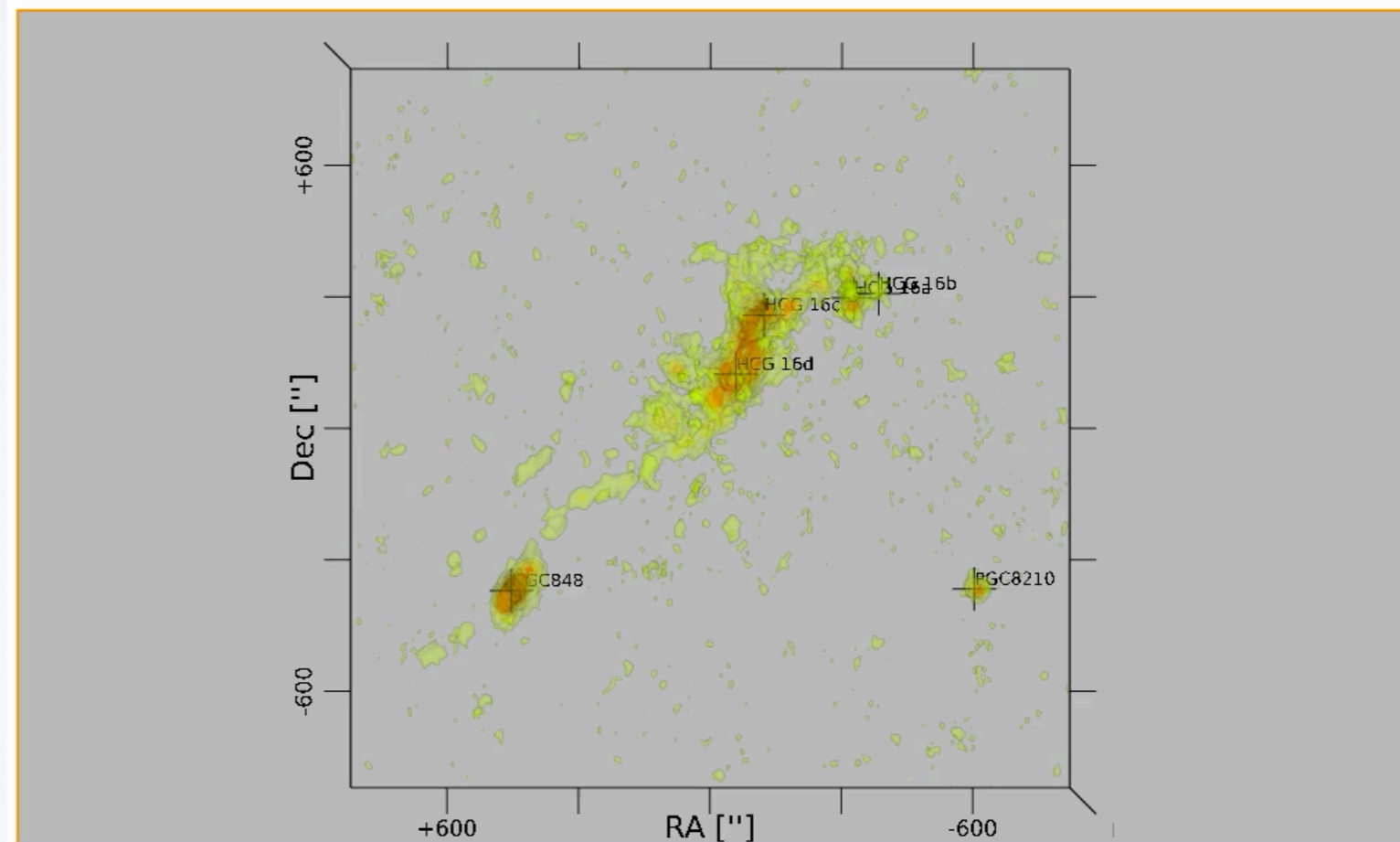
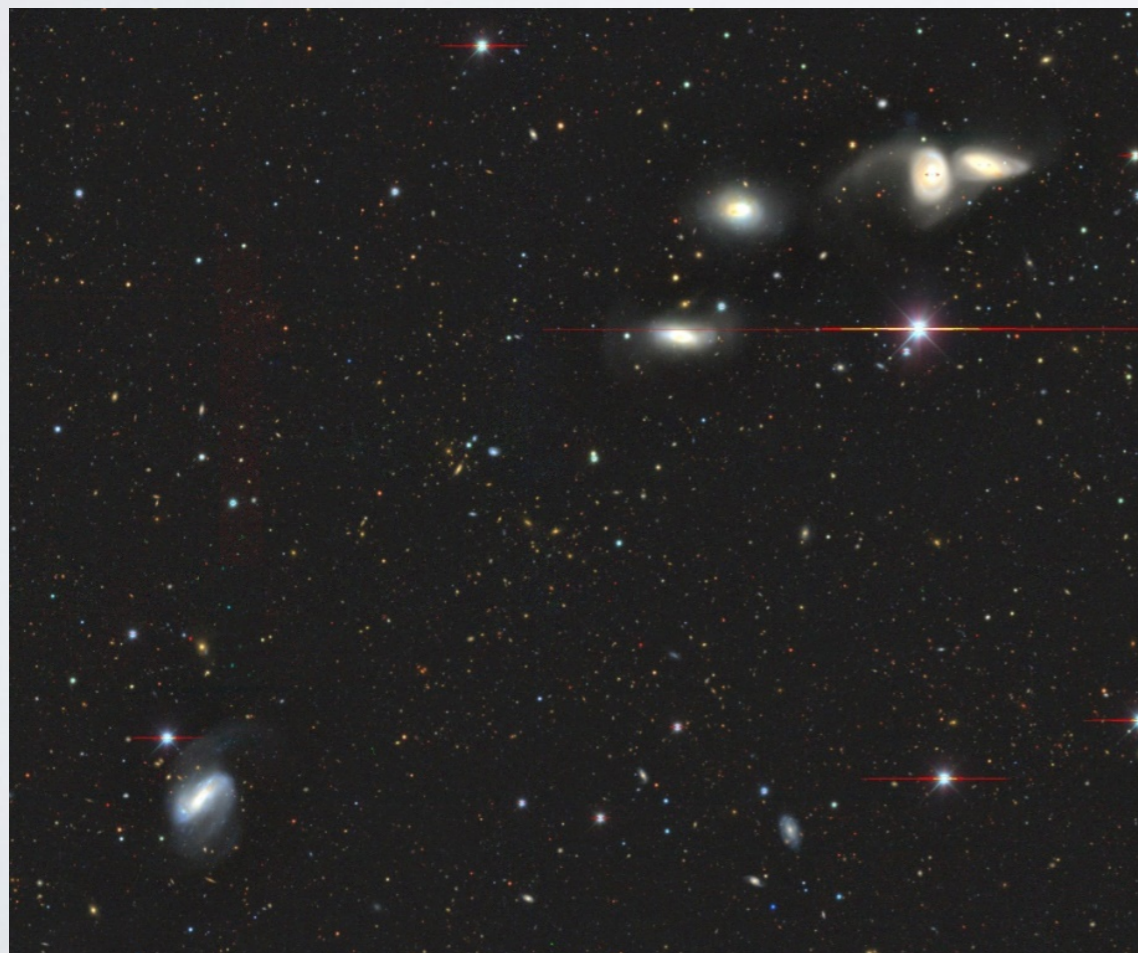
- Identify technical specifications from the use case requirements
- Set-up of the associated IAA computing/storage resources
- Partnership with national computing facilities
- Collaborations with e-Infrastructures and other SRCs prototype initiatives
- Provide a Science Gateway

Open Science in a real scientific experiment



SPECIFIC EXAMPLE: HI IN HCG 16

- HCG 16 is complex compact group with starburst galaxies, AGN, tidal tails, etc. The main goal of this project is to study the HI content of the group and to determine which on-going processes are causing it to change.
- **Collaborators:** L. Verdes-Montenegro, A. Damas, S. Borthakur, M. Yun, A. del Olmo, J. Perea, B. Williams, D. Lopez Gutierrez, F. Vogt, S. Luna, J. Román, J. Garrido, S. Sanchez, J. Cannon & P. Ramírez



Viewpoints:

HI layers:

FAIR (www.go-fair.org) is a multi-disciplinary bottom-up initiative to make scientific data reusable. The FAIR principles state that scientific data should be:

- **Findable:** Data have sufficient metadata and unique, persistent identifiers in a searchable database.
- **Accessible:** Data is stored in trusted/standard repository. Metadata and data can be understood by machines/people.
- **Interoperable:** Metadata use a standard language, external connections to other data/resources are qualified.
- **Reusable:** Data have sufficient provenance information and clear licenses.

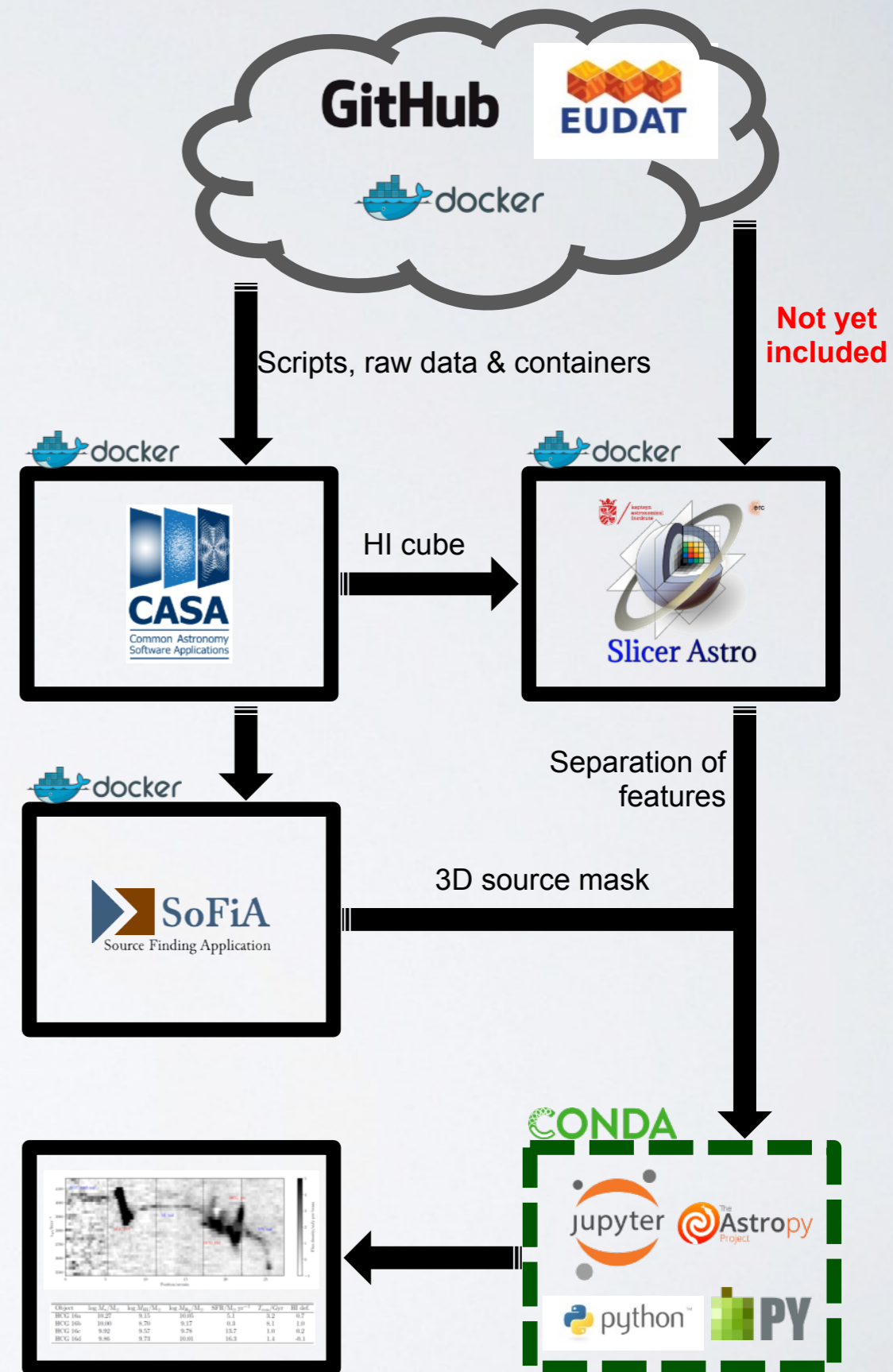
Common astronomy examples of un-FAIR practices:

- The **raw** data are in an **archive** but the final, **reduced data** and images are only publicly available in the paper **PDF**.
- The final data are “available”, but you **need to request** them by email.
- There are some **scripts** for processing the data on a server somewhere, but no one remembers how to run them.
- The code is on **github**, but good luck trying to install/execute it.

I'm not pointing fingers here, we are all guilty of these things, myself included. We need to improve as a community.

OUR WORKFLOW

- FAIR focuses on the **data**, we want to go beyond this and include also the **methods**.
- It is executed entirely within **Docker** containers and **Conda** environments. So it can be run on any platform with Docker and Conda, using a single bash script.
- The code and data are publicly available in **github** and **EUDAT**.
- The workflow can also be executed in EOSC



OUR WORKFLOW

The raw data are hosted on a the EUDAT service, which provides:

- Cloud storage
- Persistent identifiers (DOI)
- Access (can download with wget)
- Basic metadata and search functionality



hcg 16

HELP COMMUNITIES UPLOAD CONTACT

RECORDS > AF679ED67B644432AE1A5F61B9654255

HCG16 L-band VLA C+D array data

by [Unknown]

Mar 5, 2019

TechnicalInfo: The VLA D and C array data of HCG 16 were collected by the Very Large Array (<http://www.vla.nrao.edu/>) in 1989 and 1999, under PI projects of Jacqueline van Gorkom and Marcus Verheijen. The project numbers are AW234 and AW500 respectively. The full original data of these projects are hosted by the VLA Archive (<https://science.nrao.edu/facilities/vla/archive/index>).

Disciplines: 3.5.2.1.1 → Observational astronomy → Radio astronomy;

DOI: [10.23728/b2share.af679ed67b644432ae1a5f61b9654255](https://doi.org/10.23728/b2share.af679ed67b644432ae1a5f61b9654255)

PID: [11304/16c0eb14-0bb0-4ec0-9ff4-11e00033c8](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-63862-p0033-8)

OUR WORKFLOW

- All the code for the all of the workflow from raw data to final plots is stored in github and is openly accessible.

AMIGA-IAA / hcg-16

Unwatch 5 Star 2 Fork 0

Code Issues 0 Pull requests 0 Projects 0 Wiki Security Insights Settings

HCG-16 Project Edit

Manage topics

130 commits 3 branches 0 releases 3 contributors MIT

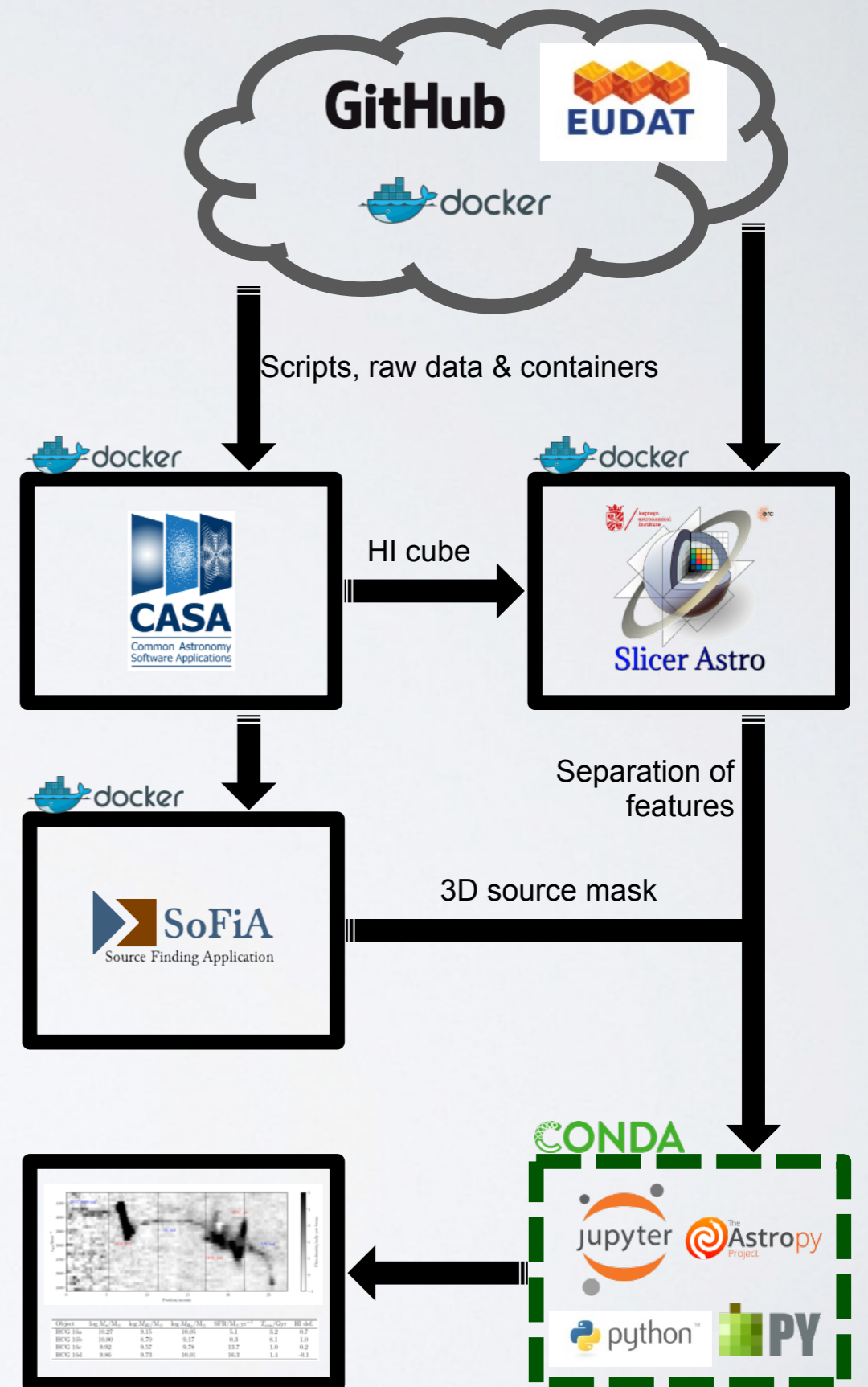
Branch: master New pull request Create new file Upload files Find File Clone or download

jonesmg Merge branch 'master' of github.com:AMIGA-IAA/hcg-16 Latest commit ef70764 6 days ago

casa	Added NW clump to moments generation task.	3 months ago
cgatcore	Update pipeline.py	10 days ago
docker	bugfix docker/Dockerfile.sofia	7 months ago
plot_scripts	Changed plot range to include NW clump.	6 days ago
sofia	Added HIPASS cube SoFiA step to pipeline.	12 days ago
LICENSE	Initial commit	7 months ago
README.md	edit README file to explain how to run ipynb files from local	6 days ago
environment.yml	change plotting task	4 months ago
postBuild	Added HIPASS mask to tar	10 days ago
run.sh	jupyter nbconvert --to python	2 months ago

OUR WORKFLOW

- run.sh will do automatically the following steps:
 - download and install conda
 - download and install cgatcore, a workflow management system
 - construct a conda python environment with which to run the code
 - download the source code
 - download the input data
 - run the pipeline



REPRODUCIBLE FIGURES

 binder



Starting repository: AMIGA-IAA/hcg-16/master













 jupyter

Quit

Files Running Clusters

Select items to perform actions on them.

Upload New ↕

<input type="checkbox"/> 0	/ plot_scripts	Name ↓	Last Modified	File size
<input type="checkbox"/>	..		seconds ago	
<input type="checkbox"/>		Fig1-DECaLS_grz_image.ipynb	2 hours ago	3.45 kB
<input type="checkbox"/>		Fig12-Absorption_profile.ipynb	2 hours ago	4.24 kB
<input type="checkbox"/>		Fig16-TDG_candidates_moments.ipynb	2 hours ago	8.25 kB
<input type="checkbox"/>		Fig2-Moment0_overlay.ipynb	2 hours ago	6.67 kB
<input type="checkbox"/>		Fig3-Moment1.ipynb	2 hours ago	4.91 kB
<input type="checkbox"/>		Fig4-Integrated_spectrum.ipynb	2 hours ago	10.1 kB
<input type="checkbox"/>		Fig5-6_Tab2-Separated_spectra.ipynb	2 hours ago	16.5 kB
<input type="checkbox"/>		Fig8-11_13-14-Galaxy_moment_maps.ipynb	2 hours ago	23.4 kB
<input type="checkbox"/>		FigC1-C2-Channel_maps.ipynb	2 hours ago	10.2 kB
<input type="checkbox"/>		cd_bridge.fits	3 months ago	1.56 MB
<input type="checkbox"/>		cd_bridge_mask.fits	4 months ago	3.11 MB
<input type="checkbox"/>		E_clump.fits	3 months ago	43.2 kB

```
In [ ]: import matplotlib, aplpy
        from astropy.wcs import WCS
        from astropy.io import fits
        from general_functions import *
        import matplotlib.pyplot as plt
```

```
In [ ]: font = {'size' : 14, 'family' : 'serif', 'serif' : 'cm'}
        plt.rc('font', **font)
        plt.rcParams['image.interpolation'] = 'nearest'
        plt.rcParams['lines.linewidth'] = 1
        plt.rcParams['axes.linewidth'] = 1

        #Set to true to save pdf versions of figures
        save_figs = True
```

The files used to make the following plot are:

```
In [ ]: moment0_casa = 'HCG16_CD_rob2_MS.mom0.pbcor.fits'
        moment0_sofia = 'HCG16_CD_rob2_MS_mom0.fits'
        r_image_decals = 'HCG16_DECaLS_r_cutout.fits'
```

1. A moment 0 map of HCG 16 generated using a simple 3σ threshold in each channel (made with CASA). This file was generated in the *imaging* step of the workflow, which is described in the script [imaging.py](#).
2. A moment 0 map of HCG 16 generated using 3.5σ mask made with SoFiA after smoothing over various kernel sizes. This file was generated in the *masking* step of the workflow. The SoFiA parameters file which makes this file is [HCG16_CD_rob2_MS.3.5s.dil.session](#).
3. An *r*-band DECaLS fits image of HCG 16. This file was downloaded directly from the [DECaLS public website](#). The exact parameters defining the region and pixel size of this images is contained in the [pipeline.yml](#) file.

<https://mybinder.org/v2/gh/AMIGA-IAA/hcg-16/master>



- Define Conda environments or containers and your co-authors will be able to run your code (but not only them).
- Release vs publish:
 - Code: GitHub, bitbucket
 - Papers, Documentation, data, ...
 - Zenodo (DOIs,)
- Publish:
 - Papers: pre-prints in arxiv, open repositories and journals
 - Code: GitHub, bitbucket
 - Data: Astronomy archives (e.g. CDS) vs open Repositories
- CV and career assessment:
 - Your CV can be something more than a list of papers.
 - Altmetrics as supplement (not a replacement) to highlight research products that might otherwise go unnoticed

- SKA will be a game changer in the way we do science
 - Large international teams
 - Limited data movement
 - New methods to share computational resources
 - Sharing the tools (reinventing not affordable), doing reproducible science
- Reproducibility in the Big Data era: Data providers moving to service providers

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Will we forget about reproducibility since we need to “efficiently” exploit large datasets?

- You may find this talk at:

- <https://zenodo.org/record/3466662>

- DOI:

- Latest version: |0.528|/zenodo.346666|

- This version: |0.528|/zenodo.3466662



