

Gender Gap in Natural Sciences

How to measure it, how to solve it?

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Chair of the IAU WG Women in Astronomy





The International Astronomical Union

Founded in 1919

Mission: To promote the science of astronomy in all its aspects through international cooperation.

Members: PhD and above, active in research
Above 12000, from 100 different countries

June 2018	12354	IAU Members	
	2064.	Female	~17%
	10290.	Male	~83%

Structure: Divisions, Commissions and Working Groups

Key roles: Organization of scientific meetings*;
Promote astronomical education, research and public outreach

*General Assembly: 6 Symposia, 25 Joint Discussions and Special Sessions

IAU WG Women in Astronomy

Established by the IAU Exec Committee in 2003, reports directly to the EC

Mandate

To collect information, propose measures, and initiate actions in support of, or to advance equality of opportunity for achievement between women and men in astronomy, in the IAU and in the world at large.

Role/Tasks

- Monitor the status of WiA and recommend future actions;
- Liaise with other committees and WGs on WiA;
- Responsible for organising WG sessions at IAU General Assemblies;

A global approach

Gender Gap in Natural Sciences: How to measure it, how to solve it?

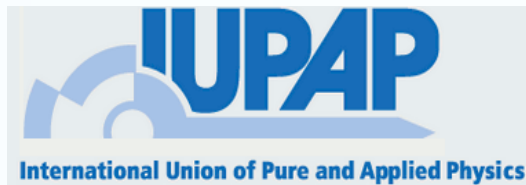
Submitted in response to the ICSU Grants Programme Call 2017
Approved in February 2017 (lifetime: 2017-2020)

Requirements

- **Data-based advice and actions** for all 3 key areas of ICSU's strategic plan:
 - International Research Collaboration
 - Science for Policy
 - Universality in Science (ICSU Statute No. 5)
- It supports UN Sustainable Development Goal #5

*A very ambitious, inter-disciplinary project that involves several “Unions”, from **mathematics, chemistry** to **physics, astronomy, biology**, including **computing mechanics, history of science** and beyond ... with the support of UNESCO and OWSD.*

The project team



Association for
Computing Machinery



ORGANIZATION
FOR WOMEN IN
SCIENCE FOR THE
DEVELOPING WORLD



United Nations
Educational, Scientific and
Cultural Organization

AIP | American Institute of Physics

Main goals

Provide evidence and reliable data

via a **joint global survey** and a study of **publication patterns**

Collaborate with social scientists

working in gender and science obtaining **contrasts and commonalities** across regions and cultures, less and more highly developed countries and different disciplines.

Provide easy access to materials

to encourage young women to work in our fields, including information about career and salaries, directed at parents, schools, and others who influence the careers of girls, especially in the developing countries.

Recommend practical policies and actions

to reduce the gender gap.

With an important focus on developing countries

Project work-plan

Tasks

I. Develop and conduct a joint global survey

- I. Expanding on the 2010 IUPAP/AIP survey
- II. Reaching outside the academic world
- III. With special feedback from ICSU Regional Offices areas

II. Conduct a data-backed study on publication patterns

III. Establish a database of good practices for girls and young females, parents and organizations

IV. Communication & dissemination

- | | |
|--------------|---|
| Year1 | Planning, preparation and conception |
| Year2 | Implementing data collection and analysis |
| Year3 | Final analysis, integration of results, recommendations |

Task1: the Joint Global Survey

Launched on May 1, 2018

- **Implemented and hosted by the American Institute of Physics**
 - 2017: 3 Regional meetings (Taipeh, Bogota`, Cape Town)
 - Available in 7 languages
 - Snowballing scheme
- **Audience:** everybody who works, has worked or was educated in one of the research fields covered by the partner unions.
- **Available at:** statisticalresearchcenter.org/global18
- **Goal:** 45,000 respondents in half a year (8,000 so far)

This is not a women-only survey!

Publications' patterns

Bibliometric statistics → one of the top KPI world-wide



explicit or implicit

Very competitive in terms of scientific productivity
number and impact of papers – especially for 'excellence' grants

Comparative contributions

✓ 31% of publications had a woman corresponding author [EU28: 2011-2013]
+3.9% in S&E since 2007

✓ Women and men publish in comparably influential journals
Similar participation in international scientific co-publications

✗ Women lag behind men in terms of size and impact

✗ Smaller portfolio are typically perceived as being of a lower quality → lower impact



perception bias

Scientific publications

Mathematics

Mihaljević-Brand et al. (2016)

zbMATH database, scholarly output of ~150,000 mathematicians, 1970-2013

→ **Less pubs in early years**

→ Leave academia more frequently within first 10yrs

→ **High-impact journals have less female 1st authors**

Biology

Bonham & Stefan (2016)

Primary publications, 1997-2014, general vs computational biology

→ **Less female 1st authors** in both

→ Female principal investigator influences positively participation of more women

→ Marginal but significant negative correlation between impact factor and gender

Astronomy

Caplar et al. (2017)

150,000 publications, 1950-2015, 5 main journals

→ Papers authored by women receive 10.4% ($\pm 0.9\%$) **fewer citations**

Task2: the GG publications study

- **Expand** the existing study of the effect of gender on publication patterns **to other natural sciences**, in particular to physics and astronomy.
- **Include geographical information** such as countries and regions into our analyses.
- Provide our results to the public in form of reports and visualizations, allowing for **easy integration with other projects and actions**

Where are we now

- Classification of journals (mainstream, conference proceedings, local, etc)
- Authors' disambiguation (to train the algorithm)

Task3: database of good practices

Aims

To gather and make available information and resources on effective practices for enhancing the participation of girls and women in science at all levels.

To gather and generate evidence about effectiveness of the collected practices.

To develop, translate, and disseminate selected practices worldwide, focusing on context where participation of girls and women is particularly low.

Challenges

- Many similar initiatives (→ SAGA Toolkit; GENERA)
- Evidence of effectiveness and impact are difficult to identify
- Keep categories simple

What will 2019 bring

Joint Global Survey:	Analysis of the results
Publications:	Completion of the study on publication patterns
Good practices:	Set-up of database
Other activities:	One final meeting (OWSD)

Thank you



Women hold up half of the sky

Thank You





**International
Mathematical
Union (IMU)**



**International
Union of Pure
and Applied
Chemistry
(IUPAC)**



**International
Union of Pure
and Applied
Physics
(IUPAP)**



**International
Council for
Industrial and
Applied
Mathematics
(ICIAM)**



**International
Astronomical
Union (IAU)**



**United
Nations
Educational,
Scientific and
Cultural
Organization
(UNESCO)**



**International
Union of
Biological
Sciences (IUBS)**



**Gender in
Science,
Innovation,
Technology
and
Engineering
(GenderInSITE)**



**International
Union of
History and
Philosophy of
Science and
Technology
(IUHPST)**



**Organization
for Women in
Science for
the
Developing
World (OWSD)**



**Association
for Computing
Machinery
(ACM)**

Telescope time allocations.I

HST

Reid (2014)

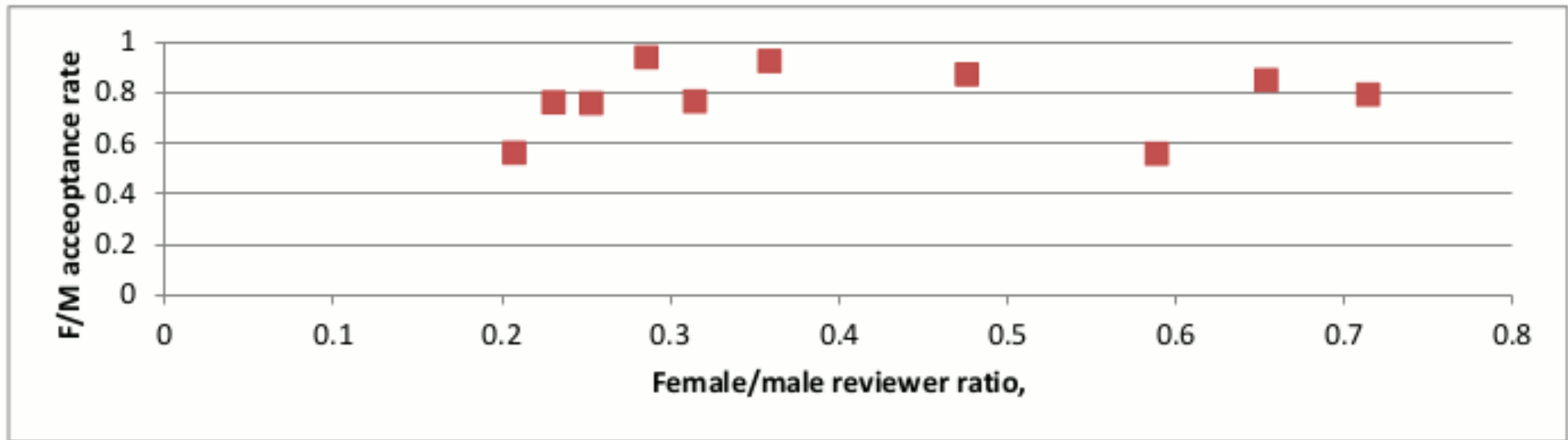


Figure 6: The relative acceptance rate for proposals with female PIs relative to proposals with male PIs plotted against the overall female/male reviewer ratio for Cycles 11 to 20; there is no evidence for a significant correlation.

Cycles 11-21 (10yrs period)

1. Success rates of female PIs astronomers are consistently lower than those of male PIs
2. # female PIs submitting HST proposals has increased (from 19% to 24%)

Age effect → Younger generation seems to perform much better
→ Panels with younger astronomers produces a more balanced outcome

Telescope time allocations. II

Patat (2016)

ESO

Overall:

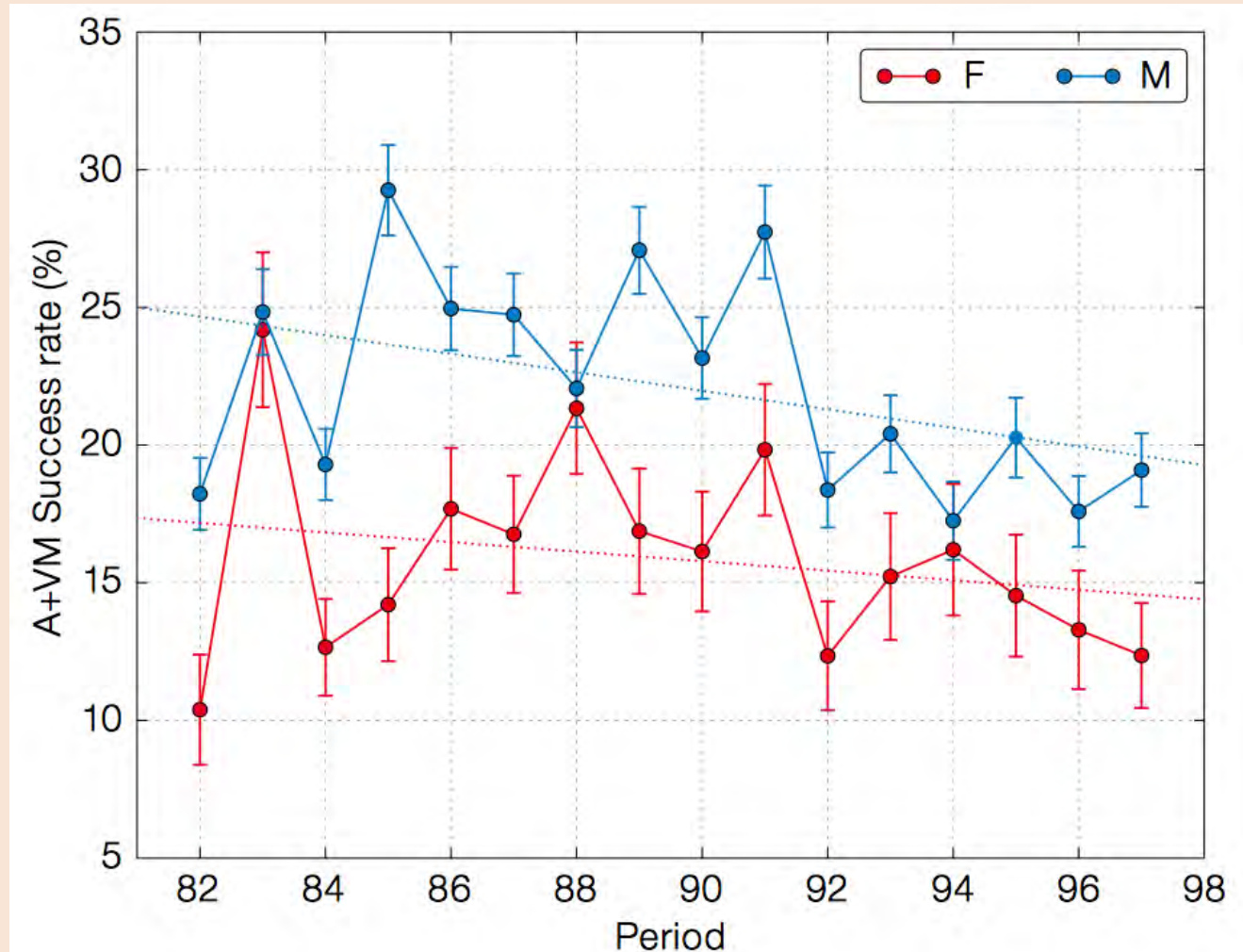
22.2% (M) vs. 16% (F)

Top-rank:

29.4% (M) vs. 27.1% (F) **M**

28.0% (M) vs. 23.5% (F) **W**

→ Prestige bias



ALMA (overall)

Strong trends seen as well – men outperform women

Where we are, what comes next

Now

Global Survey: Preliminary version ready
Feedback being collected from regional centres

Publications: Connections established with reference databases
Questions and final approach are being discussed

Gender identification: a challenge!

Other activities: 3 regional workshops

Taipeh	7–8 Nov
Bogota`	22–24 Nov
Cape Town	1–2 Dec

Next

Finalise the global survey (including translation in 10+ languages)
Analyse survey results

Publication patterns analysis (per field, per geographical area, etc)

Final conference (2019)

Astronomy equality champions



Maria Mitchell
Vassar College Observatory
1865-1888

Harvard's computers
(The Pickering Harem)
1881-1950



Charters & Recommendations

1992 **Baltimore Charter**

Equally capable
Diversity brings excellence
Communal responsibility & engagement

2003 **Pasadena Recommendations for Gender Equality in Astronomy**

Equity Now

Equal talent $\leftrightarrow$ Equal opportunity
When % female at level A = % female in pool
Concerns: Hiring, Advancement & Recognition,
Policies, Career paths

2009 **IAU Resolution B4**

For all IAU Members: encouragement and support
For members/National Representatives: to break down barriers and ensure equal opportunities