Astrophysics & Cosmology WG: Final Report

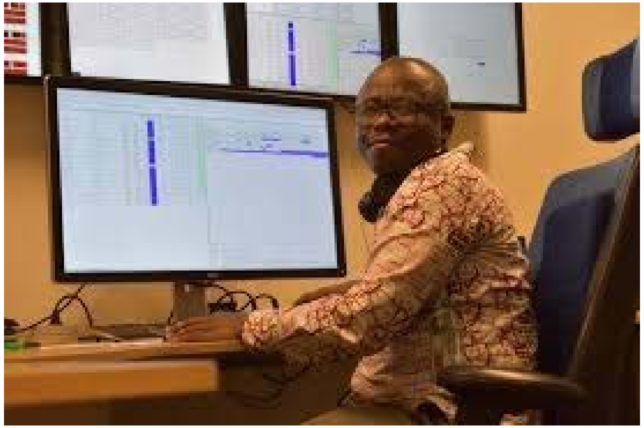
Mirjana Pović (on behalf of Astro&Cosmo WG)

SSGI, Ethiopia; IAA-CSIC, Spain; MUST, Uganda

Lerothodi Leeuw (UWC, SA), Bernard Asabere (ASTRON, The Netherlands), Priscilla Muheki (MUST, Uganda) and Sivuyile Manxoyi (SAAO, SA)

ASFAP - Towards the Final Report Meeting, Cairo, Egypt
15–17 Dec 2024

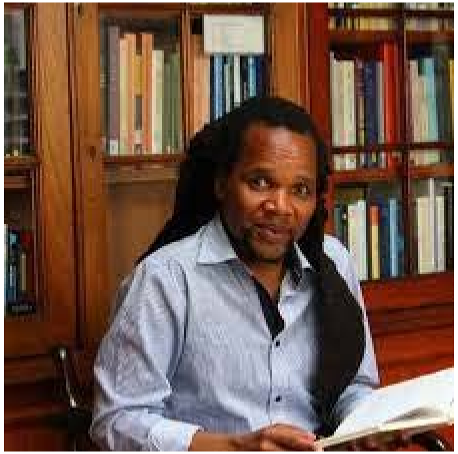
Astrophysics and Cosmology Working Group conveners



Bernard Asabere
GSSTI/AVN, Ghana
ASTRON-Netherlands

Lerothodi Leeuw
UWC, South Africa

Mirjana Pović
SSGI, Ethiopia
IAA-CSIC, Spain
MUST, Uganda



Priscilla Muheki
MUST, Uganda

Sivuyile Manxoyi
SAAO, South Africa

Content of the talk:

- P1. What has been done?

- P2. The current status of the report.

- P3. What is remaining to be done?

P1. What has been done?

Requested letters of support:

- African Astronomical Society
- European Astronomical Society
- Spanish Astronomical Society

eas

received

SEA

received

AfAS
African Astronomical Society

pendent

IAU OAD
International Astronomical Union | Office of Astronomy for Development

to be requested (from both)

Join African Strategy for Fundamental and Applied Physics (ASFAP) Astrophysics and Cosmology Working Group

ASFAP aims to strengthen the innovation, education, and research infrastructure in Africa through physics, including astrophysics and cosmology. In the coming 2 years, ASFAP will be working under > 15 working groups in different fields of physics to come up with the African Strategy that will be able to contribute in the long-term to the socio-economical benefits of the continent. Please fill the form below if interested in joining the Astrophysics and Cosmology Working Group.

*Obligatorio

Developed a form to inform the community about ASFAP and invite people to join one or more working sub-groups.

Included info:

- full name
- active email
- country of origin
- current country of work
- affiliation
- current position
- gender
- reserach interests
- subgroups for participation

Form distributed among different networks, including: the African Astronomical Society list, Astronomy in Africa email list, African Network of Women in Astronomy email list, etc.

→ ~ 130 members
(from 21 African countries
and 14 Europe/S. America/Asia)

Subgroups created under the Astro&Cosmo WG

- Solar physics
- Solar system, planetary sciences, astrobiology
- Stellar astronomy
- Galactic and extragalactic astronomy
- Cosmology and gravitational astronomy
- Transients and pulsars
- High-energy astrophysics and astro-particle physics
- Astronomical instrumentation and infrastructure
- Astronomical methods and data
- Ethno-archeoastronomy (cultural astronomy)
- Astronomy for development

Astrophysics & Cosmology WG
created subgroups and planned coordination for possible WP

Priscilla
- Solar physics
- SS, planetary sciences, astrobiology
- Stellar astronomy

Mirjana
- Galactic and extragalactic astronomy
- Cosmology and gravitational astronomy

Lerothodi
- Transients and pulsars
- High-energy astrophysics and astro-particle physics

Bernard
- Astronomical Instrumentation and infrastructure
- Astronomical methods and data

Sivuyile
- Cultural astronomy

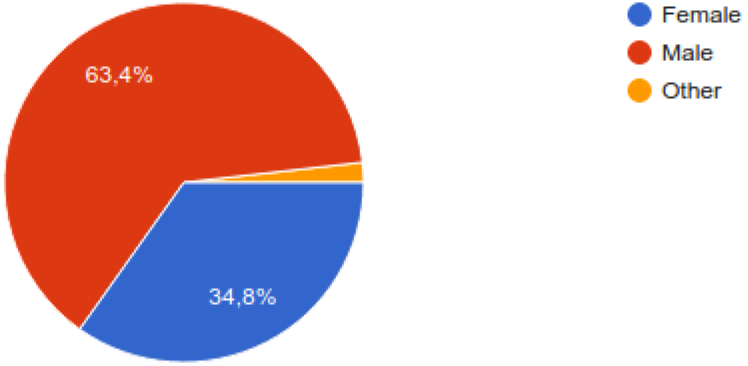
Bernard Mirjana
- Astronomy for development

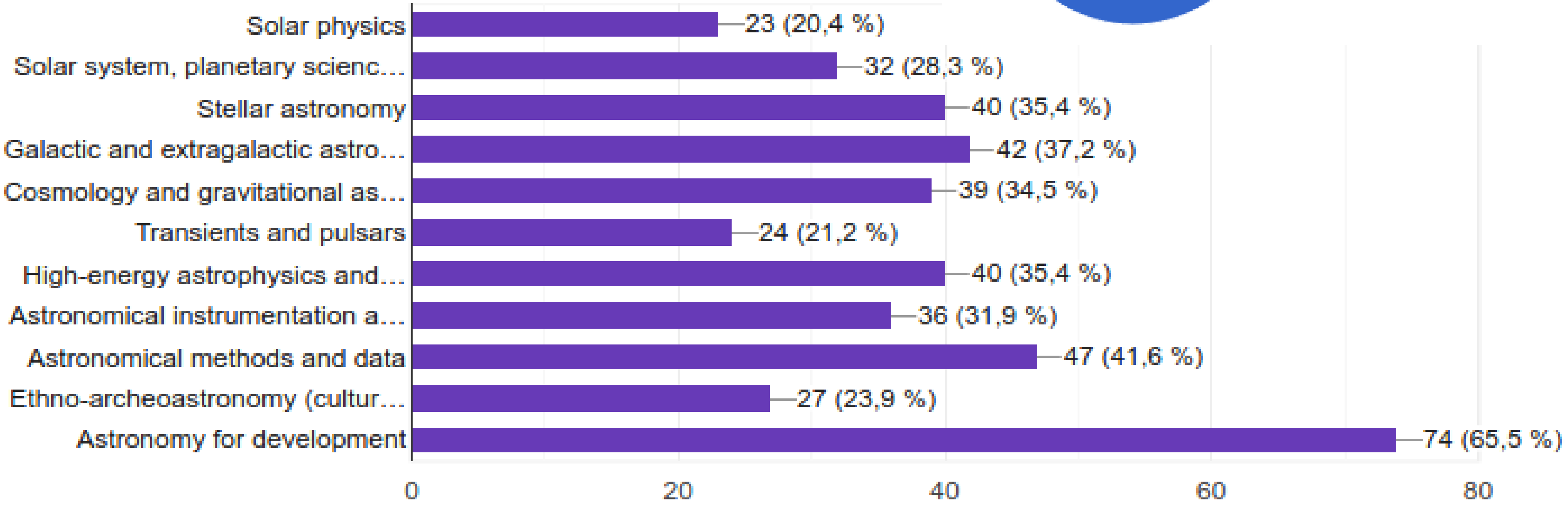
→ initial idea, work on White Papers still to be done

Link to the form for joining Astro&Cosmo WG:

https://docs.google.com/forms/d/e/1FAIpQLSeGblR09qHUDikGiK0UG-SY1ZFX0pVGV-ChThClrZhLqHJroA/viewform?vc=0&c=0&w=1&flr=0

Distribution of participants per working subgroup, and gender





Strong visibility is given to ASFAP since 2021!!

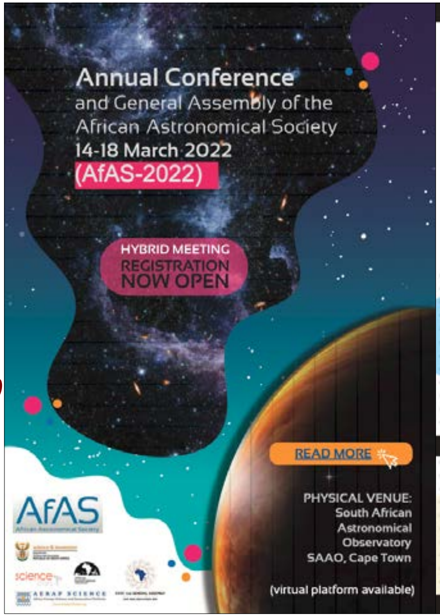
→ <u>online meeting</u> for introducing members with ASFAP (2021)

→ ASFAP Astro&Cosmo WG presented at approx. **30 international conferences** and meetings (e.g., EAS 2021 plenary talk, IAU GA FM1 invited talk, several EU–AU invited talks, several UN interventions, WSF 2022 invited talk)

→ presented during **postgraduate courses** (Ethiopia, Uganda), and international **African schools of astronomy** (Algeria, Botswana, Ethiopia, Morocco, Uganda)

ASFAP Astro&Cosmo **special sessions** during AfAS annual conference in 2022 and 2023

ASFAP Astro&Cosmo during the Young Physicists Forum meeting (2022)



Work on LoIs

→ shared several times info about LoIs, including <u>individual invitations</u>

Information about LoIs distributed among:

- African Astronomical Society (AfAS, different committees)
- Astronomy in Africa email list
- African Network of Women in Astronomy (AfNWA)
- Development in Africa with Radio Astronomy (DARA)
- Africa Initiative for Planetary and Space Sciences (AFIPS)
- 5A – Arising Astronomy and Astrophysics Across Africa collaborators
- IAU GA 2024 Science Committee members
- Close collaborators connected with astronomy in Africa
- All ASFAP Astro&Cosmo members

LoI status:

→ received 13 LoI related to Astro&Cosmo WG (~20% of all received letters)
→ covered areas: radio astronomy, gamma-rays and optical, cosmology, and astronomy for development

<u>→ LoIs presented during the online Astro&Cosmo meeting in Nov 2022</u>

Work on ASFAP is supported through the 'Astronomy in Africa' survey under AfAS Science Committee

AfAS
African Astronomical Society

Astronomy Survey

Detailed info requested about:

- Institutional development in A&A
- Research in A&A
- Human capacity development in A&A
- Instrumentation/Infrastructure development in A&A

… including future plans

→ ~ 60 feedbacks received (senior researchers)

→ from 18 countries

Work on the Interim Report

ASFAP Astrophysics and Cosmology Working Group: Current Status and Future Plans

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[6]Netherlands Institute for Radio Astronomy (ASTRON), Dwingeloo, The Netherlands
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Abstract

This report summarises the current status and future plans of the Astrophysics and Cosmology Working Group (WG) under the African Strategy for Fundamental and Applied Physics (ASFAP). It gives a brief introduction to astronomy developments in Africa in the last ten years, showing that astronomy is one of the emerging fields of science on the continent. It describes the structure of the ASFAP Astrophysics and Cosmology WG, its objectives, and the activities carried out. It finally describes the received Letters of Interest and the way forward in the development of the Strategy.

P2. The current status

Astro&Cosmo final report - 1st draft - is now ready for discussion and commenting, including:

- Authorship
- Introduction:
  - Current status of astronomy in Africa
  - Astronomy for development
- High-priority current and future initiatives
- Major challenges and needs
- Systemic inequalities and recommendations
- Conclusions
- Acknowledgements

Authorship → towards astro-community strategy

Astrophysics & Cosmology Working Group

Main editors: Mirjana Pović[1,2,3], Lerothodi Leeuw[4], Bernard Asabere[5,6], Priscilla Muheki[3], and Sivuyile Manxoyi[7],

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LoI editors:
Rob Adam[8], Michael Backes[9], Markus Boettcher[10], James Chibueze[11], Melvin Hoare[12], Kevin Govender[13], Ragil Ndongmo[14], Fairouz Malek[15], George Miley[16], Patrice Okouma[17], Yasmine Sara Amhis[18], and Mourad Telmini[19]

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center [8]SARAO, South Africa; [9]UNAM, Namibia; [10]NWU, South Africa; [11]UNISA, South Africa; [12]University of Leeds, UK; [13]OAD-IAU, South Africa; [14]University of Yaounde I, Cameroon; [15]CNRS, France; [16]Leiden University, The Netherlands; [17]Rhodes University, South Africa; [18]IJCLab, France; and [19]University of Tunis El Manar, Tunisia

4.1 Abstract

+ People who send comments,

+ people who showed an interest to paricipate

to be added

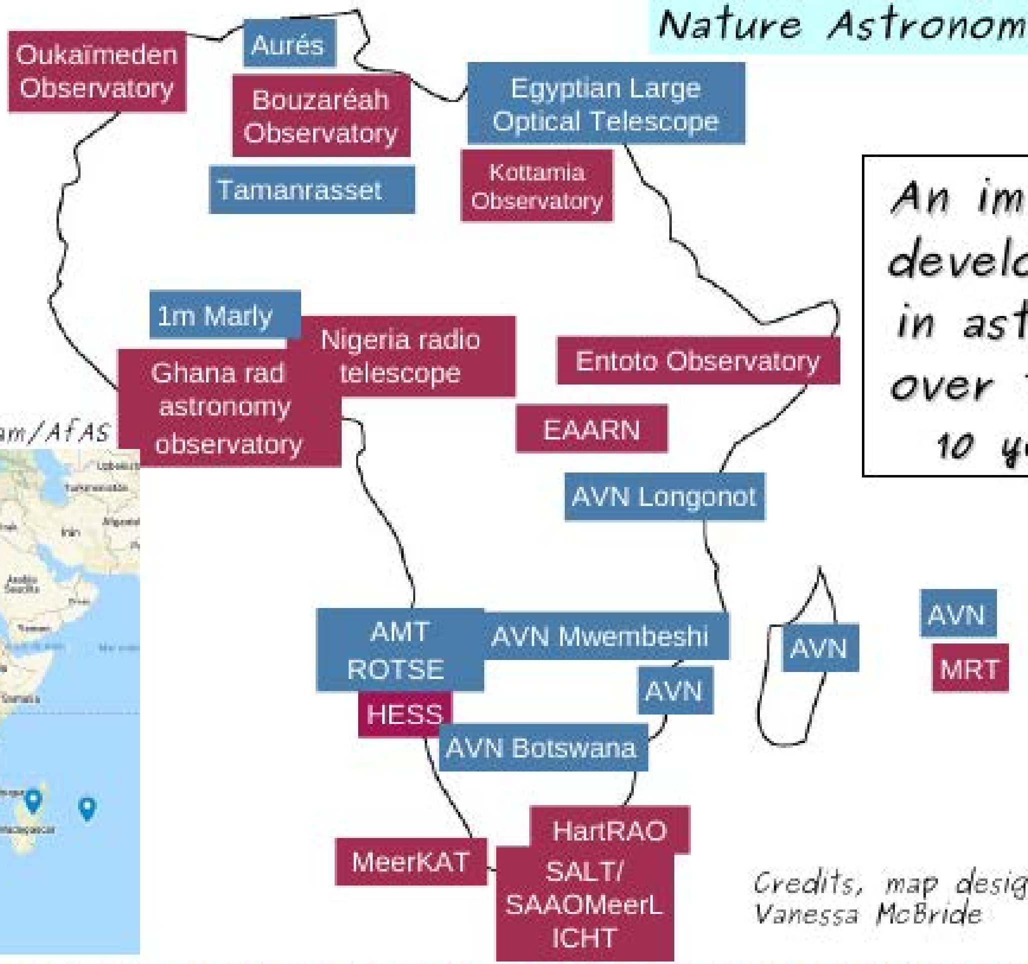
– Introduction:
Current status of astronomy in Africa

Summarised an amazing progress over the last 10–15 years in:

– infrastructure development (radio, optical, gamma-rays)

Astronomy as an emerging science in Africa

Pović et al. 2018, Nature Astronomy, 2, 507



An important development in astronomy over the last 10 years!!

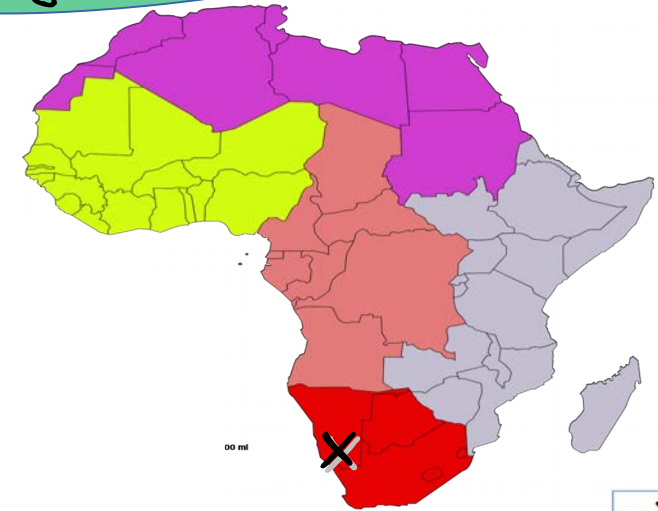
Map of amateur astronomical societies.
Credits: Niruj M. Ramanujam/AfAS

Credits, map design: Vanessa McBride

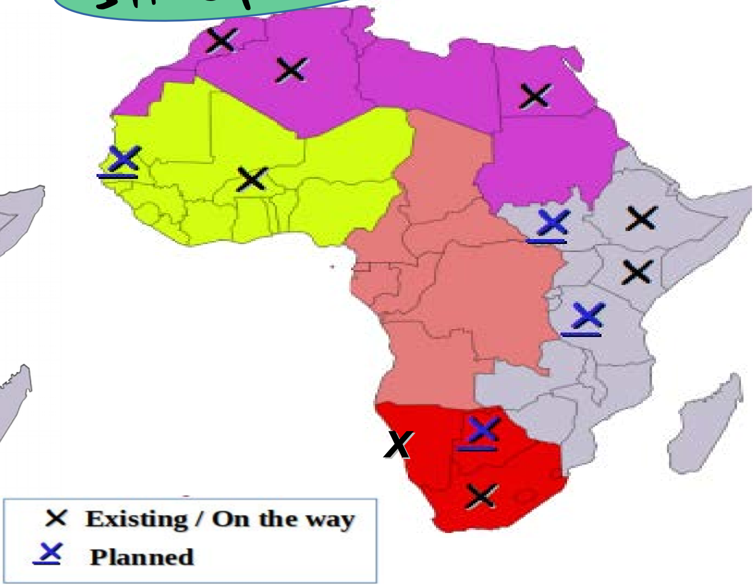
Main infrastructure developments

In radio

In gamma-rays



In optical



SKA AFRICA
SQUARE KILOMETRE ARRAY

AVN
AFRICAN VLBI NETWORK

Credits: MeerKAT

Credits: HESS team

Credits: SAAO team

- Introduction:
Current status of astronomy in Africa

Summarised an amazing progress over the last 10–15 years in:

- infrastructure development (radio, optical, gamma-rays)
- developments in astrophysics research (research publications, post-graduate programs, institutional development, etc.)

Status in research (peer-reviewed) papers (source: SJR)

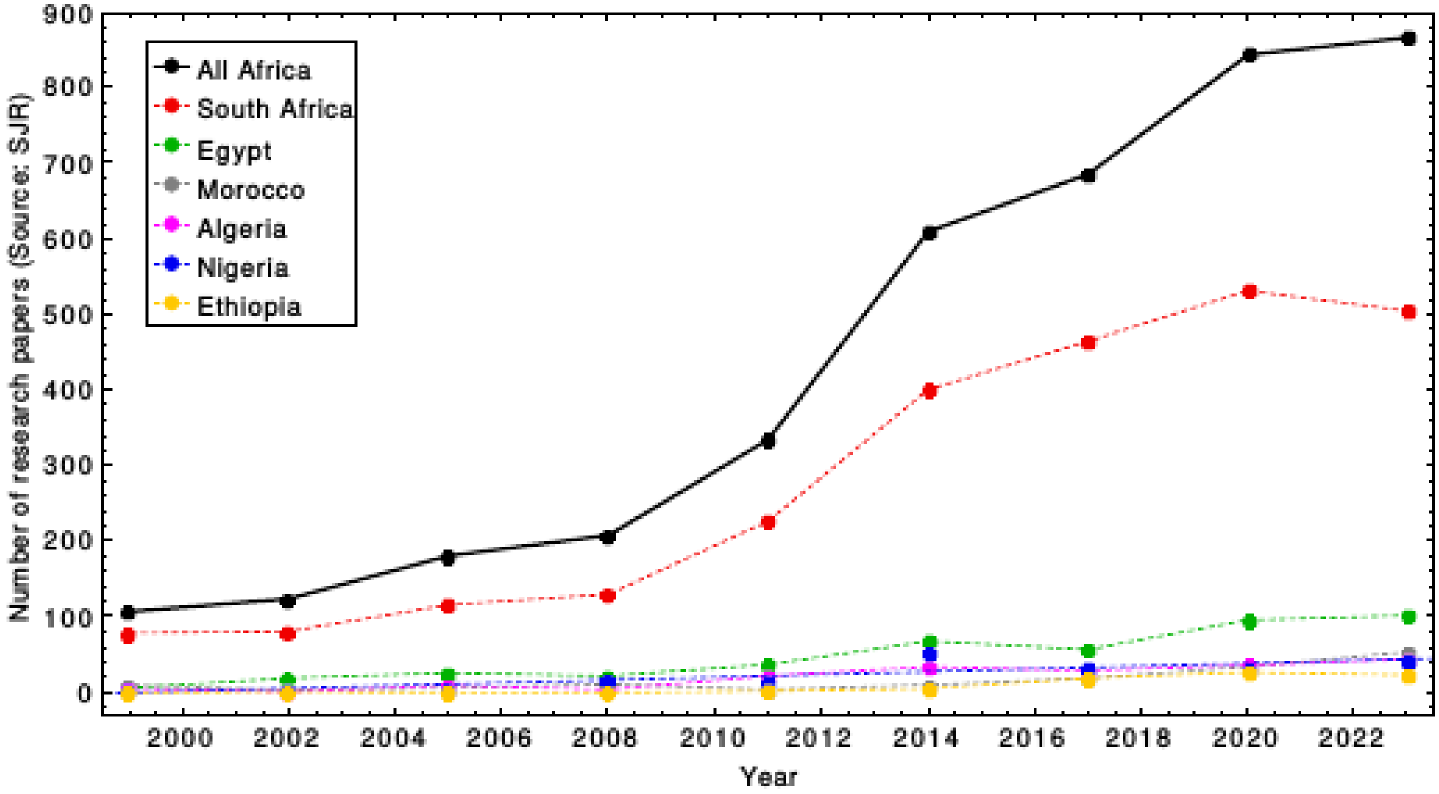


Figure 4-2. *Number of publications in astronomy and astrophysics in the last 25 years in all African countries (black), and in six countries with the highest number of published research papers. These are South Africa (red), Egypt (green), Morocco (grey), Algeria (pink), Nigeria (blue) and Ethiopia (yellow). The data were obtained from the Scimago Journal Country Rank (SJR).*

Status in research interests

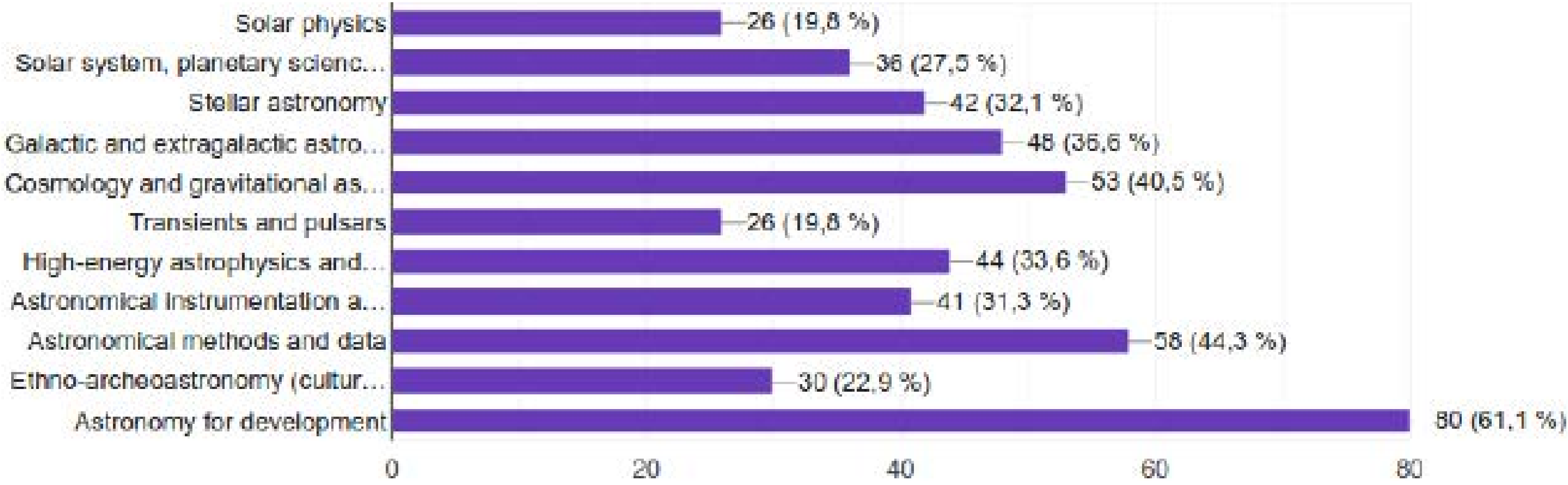


Figure 4-3. *Interest in different fields of astronomy among the professional community in Africa. This figure was derived from the feedback of 130 professional astronomers in Africa.*

Professional astronomy in Africa (including HCD and post-graduate programs, institutional development, infrastructure, site testing, etc.)

Figure 4-4. *African countries with professional astronomy present, including research, human capacity building, institutional development, infrastructure development with new observatories and telescopes, and site testing.*

- Introduction:
  Current status of astronomy in Africa

Summarised an amazing progress over the last 10–15 years in:

- infrastructure development (radio, optical, gamma-rays)

- developments in astrophysics research (research publications, post-graduate programs, institutional development, etc.)

- signs of astronomy developments:
  - new initiatives (DARA, AFIPS, PAPSSN…),
  - professional meetings (IAU symposiums, IAU GA…)
  - astronomy schools in Africa
  - AfAS re-launching
  - networks (AfNWA, APA, AERAP…)
  - outreach, amateur astronomy…

SUMMARY: Signs of astronomy growth in Africa

– New post-graduate programs in A&A across the continent (e.g., Egypt, Ethiopia, Ghana, Kenya, Morocco, Namibia, Nigeria, Rwanda, South Africa, Sudan, Uganda, etc.)

– Strong increment in the number of professional astronomers and research (e.g., number of research papers tripled in 10 years – source SJR)

– Significant infrastructure development in observational astronomy and many site testings

– Strong institutional development (new research centers, space agencies, astronomy departments under the universities)

– Establishment of the African Astronomical Society (AfAS) with different committees (science, education/outreach, AfNWA, etc.)

– Public awareness and outreach increased everywhere, > 70 amateur astronomical societies

– Change in the political engagement (e.g. AU post-development agenda, African Space Agency, new policies and strategies, etc.)

"A blueprint to achieve a better and more sustainable future for <u>all people</u> and the world by 2030."

(Mission Statement)

Astronomy contributes to all SDGs!!

The SDGs 4, 5, 8, and 9 play a fundamental role in the world agenda and astronomy is in a heart of all of them.

– Introduction:
Astronomy for development

Mentioned and given examples on:

4 QUALITY EDUCATION

5 GENDER EQUALITY

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

13 CLIMATE ACTION

17 PARTNERSHIPS FOR THE GOALS

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

3 GOOD HEALTH AND WELL-BEING

→

1 NO POVERTY

10 REDUCED INEQUALITIES

- High-priority current and future initiatives

- Summarised 13 received LoIs (for now)

SKA SQUARE KILOMETRE ARRAY

AFRICA MILLIMETRE TELESCOPE

OAD OFFICE OF ASTRONOMY FOR DEVELOPMENT

LOFAR in North Africa

High-energy astrophysics development in Africa through HESS and CTA

- Reference given to sec 1, where many more initiatives are mentioned (in particular DARA, AFIPS, AfNWA, APA…)

- This section may slightly change after receiving a feedback from the community

Major challenges and needs

- Astronomy development from scratch

- Limited number of human resources + limited qualified sector to meet all needs

- Lack of supportive infrastructure for scientific development

- Lack of funding (secured in the long-term) and support from local governments + many day-to-day difficulties (including uninterrupted power, internet…)

- Astronomy in Africa is still not accessible to all countries!!

Major challenges and needs

- Work overload, including teaching, and lack of time for research

- Lack of funding for contracting MSc and PhD students, or postdocs, for establishing a research group, for facilities including computers

- Attracting new students, how much students are prepared

- Uncertainty due to non-permanent positions

- Administration of higher institutions has grown exponentially in the last decades, taking away a lot of time that could be better used

- Limited telescope time available for African researchers

Major challenges and needs

- Mobility of African researchers, visa problems even when the funding is secured

- Living far from the country of origin

- Low salaries

- High publishing rates of prestigious international journals, high subscription fees

- Need to raise awareness among the general public and policy- and decision-makers about the importance of astronomy and science for African growth and inclusion

- Political instability, conflicts

– Systemic inequalities and recommendations

1. <u>Global perception</u> of importance of astronomy for development and for achieving the UN SDGs.

2. <u>Systemic funding inequalities</u> in astronomy at all levels between Africa and other continents, and more generally between the global south and north.

3. <u>Systemic inequalities in human resources</u> and number of qualified experts in the fields of astronomy and cosmology.

4. <u>Systemic inequalities in the quality</u> of the activities carried out, and in <u>metrics</u> used to measure the quality of work done in astronomy and cosmology between Africa and the rest of the world.

5. Inequalities in the <u>means of communicating astronomy</u> (problems with publishing in Q1 journals).

– Systemic inequalities and recommendations

6. Systemic inequalities in access to basic infrastructure (power cuts, internet connectivity, computers, etc.).

7. Systemic inequalities in access to world-class infrastructure and data.

8. Systemic inequalities in a fraction of under-represented groups such as women, minorities and the astronomical community in conflict- and crisis-affected areas.

- Conclusions
- Acknowledgements

"We acknowledge the hard work and efforts of all colleagues and students who in one way or another contributed to the development of education, science and technology in Africa through astronomy, and all those who will continue to do so in the future."

P3. What is remaining to be done?

Remaining:

- Improve referencing, footnotes, add links in the list of references.
- In Astronomy for Development section, mention also the African 2063 Development Agenda.
- Add for all figures, the date when they have been produced, in particular for Fig 2.
- Re-adjust the size of figures, fit the size of report into 8-10 (12) pages in total.
- Highlight more Astronomy in Africa survey.
- More comparison on astronomy in Africa vs. sstronomy worldwide (e.g., astronomical observatories, number of members in professional societies, etc.)

→ all above by 10 Jan

- Share the report with all community (LoI editors, AfAS EXCO, AfAS SC, Astro&Cosmo members, the rest of community..) → by 10 Jan

- Introduce all received comments/suggestions → by the end of Jan, mid Feb

It's time for Africa!!

Investing in astronomy and in science is not a question of luxury, it is a fundamental need!

Thank you!