

The First ESO Astronomy Research Training – Ghana 2018

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Designed by ESO astronomers, the Astronomy Research Training (ART) provides an intensive introductory course in astronomy to university-level students with no prior education in astronomy. The aim is to expand the astronomical community by empowering the participants to conduct research projects with open-source data. The first ESO ART was successfully conducted in Ghana in April 2018. We provide an overview of this new initiative here.

Motivation

One of ESO's missions is to foster cooperation in astronomical research. In an era of globalisation of knowledge and resources, ESO — with its ambitious telescopes and instrumentation, together with its multinational nature — is uniquely positioned to facilitate the dissemination of astronomical research worldwide. Currently, there are countries which are under-represented within the astronomical community despite their strong interest in developing the field, mainly due to a lack of available opportunities and resources. The ESO Astronomy Research Training (ART) aims at bridging this gap: it is conducted with the hope to encourage the growth not only of astronomy, but also to inspire youth to develop careers in science, technology, engineering, and mathematics.



Figure 1. Group photo of the ESO ART instructors together with the students of the undergraduate group and our hosts, Nana Ama Browne Kluste and Francis Kudjoe (front), and the head of the Physics Department at UCC, Benjamin Anderson (center, white shirt).



Figure 2. The Galaxies course: after exploring the Virgo cluster of galaxies using the GOLDMine database, the students discuss together with the facilitators the importance of galaxy morphological changes. In the background a slide on the future scenario of a Milky Way-Andromeda collision is visible.



Figure 3. The facilitators of the ESO ART together with the head of the Physics Department at UCC, Benjamin Anderson, and the head of the Mathematics and Statistics Department at UCC, Nathaniel K. Howard (front row) during the closing ceremony of the ESO ART.

The Astronomy Research training

The first ESO ART was conducted at the University of Cape Coast (UCC) in Ghana, in collaboration with the Ghana Space Science and Technology Institute¹

(GSSTI). Founded in 1962, the UCC is among the largest universities of the country with over 70 000 students. Despite this, the UCC does not currently offer astronomy classes. ESO ART has thus been a great opportunity for UCC

and GSSTI to assess the interest for astronomy among its students and local communities. Our course was attended by about 40 highly motivated participants, split in two groups: undergraduate students, and graduate students enrolled in Masters and PhD programmes.

For each group, we designed a two-day workshop centred on “Stars” and “Galaxies”. The courses followed an enquiry-based approach as used by the West African International Summer School for Young Astronomers², where Allison and Wolfgang had previously taught. Students learn by observing a particular image, posing questions, and discussing their ideas in groups. This approach is similar to the way we conduct research, by promoting critical thinking and knowledge-sharing.

The Stars course comprised basic knowledge about stars: their composition, structure and evolution. Furthermore, it introduced spectroscopy and how it is used to extract stellar properties. The lectures were interspersed with hands-on exercises. Using Jupyter Notebooks Online³ written in Python⁴, the students made back-of-the-envelope calculations addressing questions such as: how long would the Sun burn if it was made of coal? The course concluded with an introduction to the ESO archive, providing the students with Jupyter notebooks to analyse archival stellar data.

The Galaxies course began with a brainstorming exercise on what galaxies are made of, linking each component to its portion of the electromagnetic spectrum. We then introduced basic notions of observational astronomy such as celestial coordinates, distances, and our position within the Local Supercluster. Students then zipped through the Virgo Cluster using the interactive galaxy database GOLDMine⁵, discovering variations in galaxy properties. They compared and discussed the differences seen in their images and spectra. By referring to the Stars course, we discussed how to identify spectral features and how to use them in deriving properties of the stellar populations in galaxies.



Figure 4. Sharing astronomical knowledge at a fishing village. Wolfgang was drawing the Solar System on the soil, and explaining the relevant sizes and distances to a very attentive audience of fishermen.



Figure 5. Group photo of the ESO ART instructors together with the director Jacob Ashong (centre), staff and volunteers of the Ghana Planetarium.



Figure 6. The “crater factory”. Children at the Ghana Planetarium learnt about the moon and its craters together with Lisa.

A flexible teaching method with adaptive teachers

ART teaching is centred on frequent interactions with the students, to ensure they stay motivated and engaged. We encouraged students to be curious, to

raise questions and to think critically. As the approach differs from traditional teaching methods, the students were initially quite shy. Eventually they eased into an open, collaborative atmosphere where any idea, doubt or thought was shared, and lively discussions took place.

The overall flow of ESO ART was also dictated by unforeseen events — a limited number of computers, power outages, bad internet connectivity, and other delays. These circumstances obliged us to improvise. One example was the set up of a parallax experiment in the classroom. A student questioned how astronomers could measure distances to objects that we cannot travel to. We hung a poster of a galaxy on the other side of the classroom and asked the students — divided into small groups — to measure its distance. Eventually, all groups used parallax and learnt how it can be applied to distance measurements in astronomy. Overall, the use of a flexible and adaptive teaching approach, together with help from our hosts and the enthusiastic students — “we don’t need breaks!” — contributed to the success of the first ESO ART.

Connecting and expanding the astronomical community

ESO ART fostered communication between European and Ghanaian scientists. During the ART programme, our host Nana Ama Browne Klutse (GSSTI), and her PhD student Theophilus Ansa-Narh gave an overview of astronomy development and education opportunities in Ghana. She presented the Ghana Radio Astronomy Observatory in Kuntunse with its capability in Very Long Baseline Interferometry⁶, as well as Ghanaian involvement in projects like the Square Kilometre Array.

In addition, ESO astronomers — Jason Spyromilio and Xavier Barcons — connected via Skype from Garching and the ALMA Operations Support Facility to give brief lectures, which engaged the participants and led to numerous questions about supernovae, black holes, ESO facilities, and the connection between astronomical findings and our daily life on Earth.

Local engagements and outreach activities

Aside from the ART programme, we presented astronomy to locals on two occasions. Nana prepared an excursion to a fishing village near Cape Coast,

close to where she grew up. Thanks to her translating for us, we learnt how the fishermen use the stars to navigate and to find different types of fish. In return, we explained our understanding of stars and how the Sun is one of them. We described the Solar System by drawing on the soil, clarifying that the brightest objects in the night sky — like Venus and Jupiter — are actually planets and not stars.

Finally, we conducted an outreach event at the Ghana Planetarium⁷ in Accra. This educational centre allows children to learn science through dedicated experiments. We designed hands-on activities for 40 participants, including young children and their parents. They assembled a puzzle of the Moon, learned about its phases, and observed how craters form by launching small stones into sand. Using hand-made CD-spectrographs, they learned that light is made up of different colours and discovered absorption and emission lines by looking at the Sun or artificial lights. In addition, the participants were introduced to ESO science releases by matching pairs of cards in a memory game designed by us. Two talks about colliding galaxies and exploding stars and a quiz based on the day’s activities concluded the event. The latter was led by the volunteer Sarah Abotsi-Masters and the children competed to win ESO souvenirs.

Prospects of the ESO ART programme

This pilot programme demonstrated that ESO can contribute to developing research skills and encouraging interest in the sciences amongst young people all over the world. The various elements of the ART programme include:

- 1) engaging with students in countries that are under-represented in astronomy, disseminating astronomical knowledge;
- 2) connecting ESO with educational institutions globally and promoting collaborations, and promoting visibility for ESO and its member states;
- 3) facilitating the establishment of astronomy education in universities;
- 4) encouraging motivated students to pursue an education in astronomy and introducing them to research;

- 5) providing mentorship opportunities from ESO astronomers;
- 6) providing ESO astronomers the opportunity to develop teaching skills through instructing a diverse audience;
- 7) encouraging and increasing the use of ESO archival data, potentially enhancing the science return of ESO facilities.

In light of these benefits, and the strong demand for such a programme, we hope that the ESO ART will continue annually with support from the astronomical community in Europe and beyond.

Acknowledgements

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We also thank the Ghana Planetarium staff and volunteers for helping us to organise the outreach event.

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Links

- ¹ Ghana Space Science and Technology Institute (GSSTI): <https://gssti.gaecgh.org>
- ² West African International Summer School for Young Astronomers (WAISSEA): www.astrowestafrica.org/
- ³ Project Jupyter: jupyter.org
- ⁴ Python is an open-source programming language: <https://www.python.org/>
- ⁵ Goldmine: <http://goldmine.mib.infn.it>
- ⁶ African Very Long Baseline Interferometry Network: <http://www.ska.ac.za/science-engineering/avn/>
- ⁷ The Ghana Planetarium: <http://www.ghanascience-project.net/>