PROCEEDINGS OF SCIENCE

Engaging the University of Johannesburg's Centre for Astro-Particle Physics in Outreach Activities

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As scientists, it is essential to engage with the wider community to promote science education and inspire the next generation of scientists. Science faculties, and their respective departments, can play a significant role in outreach by organising various activities that cater to students from high school through university, and even the general public. Outreach activities that have been well received are activities such as mentorship programmes, creating online resources that can be shared, and organising trips to scientific organisations of interest. Some of the examples that will be discussed are the University of Johannesburg's Faculty of Science 'Take a child to work day' initiative; the Centre for Astro-Particle Physics (CAPP) led HartRAO excursion; and the Soweto Science Centre, Department of Physics and CAPP physics revision boot camp for Grade 11 learners. By organising these activities and engaging with the wider community, we can make science more accessible to everyone and motivate high school learners to pursue a career in science.

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1. Introduction

The Centre for Astro-Particle Physics (CAPP) is a research centre at the University of Johannesburg (UJ). CAPP focuses on research areas centred around "Gamma-ray Astrophysics, Neutrino Astrophysics, Neutrino Physics, and Gravitational Wave Physics" [1]. For the year 2023, one of the goals of CAPP was to organise and take part in outreach activities to help inspire the next generation of astro-particle physicists and scientists. According to [4] outreach activities, within the scope of science outreach, can be defined as the activity of engaging with students and the general public to share knowledge and expertise on a specific topic. [4] further states that these activities make science more accessible to these individuals and help to explain the benefit of scientific research. Outreach activities can take several different forms, such as school presentations, workshops, public talks, mentorship programs etc. [4].

Outreach activities are also a crucial component to meet NRF requirements for funding. The NRF states that researchers are required to take part in and engage in science engagement programs and to report these events in the progress reports of their projects [2]. The NRF [3] underlines the importance of outreach activities as they state that "increasingly, an awareness and understanding of why science and research are critical to our lives is essential for developing an innovation culture". An important aspect of all the outreach activities that CAPP has been involved in is the need to promote STEM careers as these fields are much needed in South Africa to help grow the country's economy. In the next section, we will give some examples of specific outreach activities that the staff and students of CAPP have been involved in this year, and what we have learned from those.

2. Investing in the future: CAPP outreach activities 2023

2.1 Exploring HartRAO – A CAPP undergrad excursion

In March 2023, CAPP organised an excursion to the Hartebeesthoek Radio Astronomy Observatory (HartRAO) for the 3rd year undergraduate physics students. Mr. Heystek Grobler, a PhD research fellow at the University of Pretoria (UP) and HArtRAO at the time, hosted and facilitated the excursion. This immersive experience included a site tour of the HartRAO facilities, an exploration of the telescopes available, an educational talk on the type of data collected, and advice on career paths available to the students. The students engaged well with Mr Grobler and asked many questions. The students were also very excited by the opportunity to get close to the telescopes, especially the VGOS (*Very Long Baseline Interferometry* Global Observing System) telescope.

Excursions like this are such a good outreach activity as they not only motivate students to continue their studies, but help to bridge the gap between their studies and the realities of the career options that are available to them. It also helps to motivate students to continue their studies and gives them an opportunity to explore a scientific site of interest that they might not otherwise have had. We should also keep in mind that we too often focus on high school learners when we organise outreach activities. While outreach that targets high school learners is essential, it is equally important to also include and engage our current undergraduate and postgraduate students through targeted outreach activities.

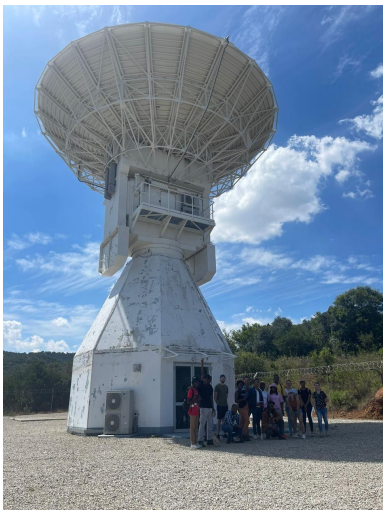

Figure 1: UJ undergraduate physics students with the VGOS telescope.

2.2 Take a child to work program – An inspiring mentorship program

Another outreach activity that the staff and students from CAPP took part in this year was the annual 'Take a child to work program' that was organised by the Faculty of Science and the Department of Chemistry. This insightful program invites high school learners to spend a day at the UJ and explore the various departments in the Faculty of Science. The learners are treated to a site tour, as well as the opportunity to spend some time with a mentor in one of the departments that they are interested in. The mentors that volunteer their time may be administrative staff, academic staff, as well as postgraduate students. The learners spend some time with their mentor so that they have the opportunity to see what is involved in their mentor's career, and so that they can ask questions that will help them choose a degree and career option for themselves.

This year, girls from the UJ Metropolitan School were invited to come to UJ. The learners had a wonderful time spending time with their mentors and were very impressed with the facilities available at the Department of Physics. Dr. Susan Jacobs treated the learners with a behind-the-scenes look at one of the experimental labs in the department. They were very excited by this tour and had many questions. The postgraduate students at CAPP also volunteered their time as mentors, giving the learners a glimpse into the life of a theoretical physicist. We rounded off the day with a fun practical experiment demonstration. The greatest hit by far was the liquid nitrogen demonstration. The learners truly enjoyed this demonstration which included freezing a balloon and a juice box.

The benefits of this type of school outreach are:

- By being able to observe their mentors' and discuss career options with them, the learners were able to picture a career in physics and other STEM fields, and it made these careers seem more attainable.
- Being able to engage with a mentor in a comfortable environment boosted the learner's confidence and helped to encourage them to pursue an undergraduate education.

- Exposing these learners to an immersive experience like this helps to foster a passion for science, especially in physics and astro-particle physics.
- Activities like this help the various science departments and CAPP connect with learners from the local community and contribute to encouraging more learners to pursue a career in science.

Figure 2: Exploring the experimental labs with Dr. S Jacobs.

2.3 Physics revision boot camp – Inspiring future physicists

Our most exciting event this year was the physics revision boot camp which was organised and sponsored by CAPP, the Department of Physics, and the Soweto Science Centre (SSC). The SSC was established by the Faculty of Science at UJ. The centre provides extra science and mathematics lessons to learners from Soweto. We welcomed 30 Grade 11 learners from the SSC for a three-day intensive physics revision boot camp.

The boot camp focussed on revising topics that had been identified as problematic for the learners, some practical revision sessions, and a fun practical demonstration to keep the learners motivated. We were very fortunate to have academic staff that are experienced with the Curriculum Assessment Policy Statement (CAPS) and as such could incorporate exam preparation into the revision lessons. They shared advice on typical exam questions, as well as the common mistakes learners make when answering them. The CAPS curriculum is a National Curriculum and Assessment Policy Statement which gives teachers in-depth guidance on what they should teach and how to assess [5]. This document was introduced by the Department of Basic Education "for all the subjects in the National Curriculum Statement for Grades R – 12" [5].

We also had a few inspiring guest speakers who spoke to the learners about their career journeys and offered guidance on potential degree and career paths. These guest speakers were: Dr Elizabeth Hays from the NASA Goddard Space Flight Center (pre-recorded talk), Dr Gopolang Mohlabeng from the Simon Fraser University (pre-recorded talk), and Dr. Sthabile Kolwa from UJ.

The boot camp was a huge success, and we received a lot of positive feedback from the learners. The most encouraging feedback we received was that the learners thought that we should make the boot camp a week-long event in 2024. We have also been asked by the SSC to make this boot camp

an annual event. Outreach initiatives like this are a wonderful way to give back to the community and to make a truly positive impact on the lives of high school learners.

Figure 3: Mr. Molefe presenting a revision lesson to Grade 11 learners from the SSC.

Figure 4: Mr. Murei Mulibana presenting a fun practical experiment session.

Figure 5: Dr. Gopolang Mohlabeng (pre-recorded guest speaker at the physics revision boot camp).

3. HEASA conference presentation

At the HEASA conference 2023, I presented the talk entitled "Engaging Physics Departments and Science Faculties in Outreach Activities". At the end of the presentation, the audience was asked if they had any suggestions for outreach activities that they would like to share that have worked well in their experience. We were given the following suggestions:

- We could create physics quizzes for high school learners and invite the top performers to come to the department.
- We could arrange for groups of learners to come and complete a whole experiment, not just the normal short practicals'.
- We could create a comic book, or use one that is provided on the IceCube website and distribute these to schools. These are a fun way to communicate scientific information to learners through a comic book story.
- We could use virtual reality glasses so that learners could explore space with the IceCube VR interactive experience.

All of the ideas given are very helpful, and we hope to be able to implement some of these suggestions in the CAPP outreach plan of 2024.

4. Conclusion and ideas going forward

Outreach activities are crucial to help empower young minds to pursue STEM careers. Our experience shows that immersive programs like mentorship programs and revision sessions are very successful and are well-received by learners. Learners thrive when they have the opportunity to ask questions, learn by doing, and discover their potential. Outreach activities also help to make

science more accessible to learners.

Going forward, we would like to involve more postgraduate students from the rest of the Department of Physics, not just those at CAPP. We would also like to collaborate more with some of the academic staff in the department that often goes to high schools to give revision sessions and exam preparation. We will also be hosting the physics revision boot camp again in 2024, and we will hopefully be able to organise a week-long boot camp to improve the impact factor. We would also like to focus more on our current undergraduate students in 2024. We hope to organise an activity where the students can connect with CAPP and learn more about pursuing astronomy and astrophysics for their postgraduate studies.

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