

Report on the DIAS Summer School 2018

Summary

This summer saw the return of the “DIAS Summer School in High Energy Astrophysics,” directed by Felix Aharonian and hosted at DCU, running from 19-29th of June. A group of 28 lecturers taught and trained a cohort of 57 students representing the next generation of high-energy astrophysicists from all over the world. Lecturers included Xavier Barcons, Director-General of the European Southern Observatory, Joseph Silk, Homewood Professor of Physics and Astronomy at Johns Hopkins, Marica Branchesi, Assistant Professor at the Gran Sasso Science Institute, and former DIAS scholars and researchers such as Valenti Bosch-Ramon, Andrew Taylor and Stefano Gabici, and long-time DIAS board member Professor Alan Watson.



Figure 1: Participants and lecturers at the DIAS Summer School on High-Energy Astrophysics 2018.

Report

The DIAS Summer School on High-Energy Astrophysics was organised by DIAS with Prof. Felix Aharonian of the DIAS Centre for Particle Physics and Astrophysics (CAPPA) as School Director, and an organising committee of current and former DIAS members: Felix Aharonian, Jonathan Mackey, Masha Chernyakova and Andrew Taylor. Local organisation was very efficiently run by Anne Grace and Eileen Flood of DIAS, with valued support from the DIAS Registrar’s office and Finance office, and with help from local PhD students Sam Green, Samuel McKeague and Maria Moutzouri.

We decided to host the school at DCU, with students and lecturers staying in the on-campus residences for the duration of the school. The concept was to have a series of lectures by international experts in their sub-field, with a mix of older and younger speakers, including one lecture by a PhD student. Every day the students encountered a new lecturer with a different style and focus, creating a stimulating learning environment, and keeping the school interesting for the full 10 days duration.

We had 31 lectures (including the Saturday talks at Dunsink Observatory) from 30 lecturers representing 11 countries: Italy, Germany, France, United Kingdom (including two from Northern Ireland), United States of America, Japan, Canada, Denmark, Russia, Spain and Switzerland.

The registration fee of €950 included accommodation at DCU for 10 nights, breakfast every day, lunch and coffee breaks on weekdays, and the excursion to Powerscourt House and Gardens and Dunsink Observatory. Registration was open from February until April, and we were aiming for 50-60 students (based on the size of the community and previous experience with running similar schools). The school website is at <https://www.dias.ie/cappa/SummerSchool2018/>.

We were very pleased to have 57 participants from all over the world, mainly from Europe but also a few from all continents. The 15 countries represented were Italy (13), Germany (11), France (6), Ireland (5), Austria, Turkey, United Kingdom (3 each), Czech Republic, Japan, Poland, Sweden (2 each), Australia, Chile, India, Spain, and the United States of America (1 each). This was especially good considering that the School was first advertised in January 2018, and there were a number of other summer schools on related topics. Most participants were PhD students working in high-energy astrophysics in both theory, observation and instrumentation. Many are working on the Cherenkov Telescope Array (CTA) project, which is gathering significant momentum as it moves to the construction phase and towards first operations in a few years.

Most of the students are also working on data from existing Cherenkov Telescopes such as H.E.S.S, MAGIC and VERITAS, space telescopes such as FERMI, XMM-Newton and Chandra, Gravitational Wave detectors (LIGO and VIRGO), and neutrino detectors such as Ice-Cube and the upcoming KM3NET. In preparation for the next generation of telescopes and detectors, many students are working on theoretical predictions for high-energy emission from black holes, neutron stars, binary systems, supernovae and their remnants, and stellar-wind bubbles. Of the Irish participants, we had two from DIAS and one from each of DCU, UCD and UCC.

Lectures

The school began with a welcome from the Registrar and CEO of DIAS, Dr. Eucharía Meehan and from Prof. Greg Hughes, the DCU Vice President for Research, followed by a short introduction and welcome by Prof. Aharonian. In the year when Ireland finally joins the European Southern Observatory (ESO) we were honoured that the first day finished with a lecture on Multi-Wavelength Astronomy by the director general of ESO, Xavier Barcons. The first day covered a wide range of topics, from Gravitational Waves (Branchesi), Neutron Stars and Black Holes (Khlopov), to cosmology (Silk).

From this starting point, the lectures went into great detail on the sources of high-energy cosmic rays (Bykov), the physics of plasmas and particle acceleration (Malkov, Blasi, Lemoine) and high-energy radiation processes (Khangulyan, Aloisio). The first week finished with the propagation of cosmic rays (Gabici) and an overview of the highest energy cosmic rays (Watson).

On Saturday June 23rd, the students spent the morning visiting the scenic Powerscourt House and Gardens in the foothills of the Wicklow Mountains, and then came to DIAS Dunsink Observatory for an afternoon of science, food and drinks. Dunsink Observatory had earlier this day sealed its status as one of Ireland's most important scientific sites when it was recognised by the European Physical Society as a "site of historical significance". The Observatory is the first location in Ireland to receive this accolade, joining similarly significant locations across Europe, such as Einstein's house in Bern and Marie Skłodowska Curie's laboratory in Paris. A plaque to commemorate the



Figure 2: Marica Branchesi (GSSI, Italy) delivering the opening lecture at the 2018 DIAS Summer School in High-Energy Astrophysics.

designation was unveiled at Dunsink Observatory by Mary Mitchell O'Connor TD, Minister of State for Higher Education, and Professor Rüdiger Voss, President of the European Physical Society. The programme of events at Dunsink also included a ceremony to mark the retirement of Professor Luke Drury, outgoing Head of Astronomy and Astrophysics at DIAS.



Figure 3: Dmitry Khangulyan (Rikkyo University, Japan) during his lecture at the 2018 DIAS Summer School in High-Energy Astrophysics.

In the afternoon we had a programme of informal lectures related to high-energy astrophysics for the students. Alan Watson spoke about his career and his experience of the construction of the Pierre Auger Observatory, from conception to its current operation in Argentina. In the process he reflected on the key moments in his career, and the important qualities needed to be successful in scientific research. Julie McEnery, FERMI project scientist at NASA, then spoke about a decade of discoveries made by the FERMI gamma-ray space observatory. It was fascinating to hear the range of scientific results and fields in which FERMI has made a big impact, and inspiring to see an Irish woman advance to such a key role in an international space mission. The afternoon was rounded off by Malcolm Longair, who gave a very entertaining and insightful talk on Black Holes and Gravitational Waves.

The discovery of Gravitational Waves has opened up a new window for observing the Universe, and especially black holes and other stellar remnants.

The second week opened with lectures on gamma-ray astronomy (Uchiyama, Hinton), intergalactic radiation and magnetic fields (Neronov) and high-energy neutrino detectors (Celli, Ackermann). We moved on through the interstellar medium (Burton), binary systems (Bosch-Ramon), pulsars (Buciantini), Supernova remnants (Safi-Harb), Galaxies (Tuffs) and galaxy clusters (Brunetti), together with an alternative view on particle acceleration theory (Reville). The final day's programme was on Starburst Galaxies (Taylor), Supermassive black holes (Coppi), Radio Galaxies and their jets (Rieger) and Future Gamma-ray Projects (Tavani).

Reflections

It was great to see such a wide range of international experts coming to give lectures in Ireland, and we were especially pleased to have students come from all continents (except Antarctica) to participate in the School. It was a real bonus for the Irish participants to be able to attend such a school and make contacts with other students from all over the world. The consensus afterwards was that DIAS should run more of these schools, to take a leadership role in educating our PhD students to become experts in their field, and to attract the highest quality speakers and students to Ireland for building collaborations into the future.