TEACHING STATEMENT

TEACHING HISTORY

Tutorials for Undergraduate Students

At the time of my post-graduate studies at the University of Oxford I took up three separate teaching duties. As part of my teaching responsibilities I had the opportunity to prepare and adapt course material, provide tutorials, mark problem papers solved by the students and set up exams for the beginning of term.

The first of my teaching duties was at Pembroke college during the first year of my post-graduate studies, where I taught physics to biology students whose courses required additional physics training. Though the syllabus was set by the University, the tutorials I provided were specially tailored by myself around the students background knowledge of the subjects and focusing extra attention on their weaknesses.

During the second year of my post-graduate studies I taught cosmology and astroparticle physics to American students visiting the University.This course was independently developed by myself and a fellow postgraduate at the University, specifically adapted to the interests and needs of the visiting students.

In the course of the third (and final) year of my post-graduate studies, I received a half-lectureship at Queen's college (University of Oxford) where I taught electromagnetism to first and second year students, and astrophysics and cosmology to third year students. The structure of these courses were designed entirely by the University, with my role being to provide tutorials on the topics. During tutorials the pupils would go through problems they had solved during the week (and which I had already marked), concentrating on those points which had proved troublesome. Following the custom of the University, I set exams for the students for the *beginning* of each term. The aim of these exams was to ensure that students remained familiar with the topic they had learned previously.

Lectures for Undergraduate Students

During my post-doctoral research activities in Heidelberg in 2008, I was invited to the "Third South American Cosmic Ray School" in Peru to give a series of four lectures on multi-messenger approaches to ultra-high energy cosmic rays. This provided me with the opportunity to pool together the different areas I have carried out research in. Slides of the lectures can be found at:

- http://homepages.dias.ie/~taylora/Talks/Peru_Lec1.pdf
- http://homepages.dias.ie/~taylora/Talks/Peru_Lec2.pdf
- http://homepages.dias.ie/~taylora/Talks/Peru_Lec3.pdf
- http://homepages.dias.ie/~taylora/Talks/Peru_Lec4.pdf

In 2011, I was invited to the "High Energy Astrophysics Summer School" in Dublin to provide two lectures on the origin of UHECR. In these lectures I outlined recent revelations in the field of high energy astrophysics, which are overturning previously held assumptions about the nature of UHECR and their sources. Slides of these lectures can be found at:

- http://homepages.dias.ie/~taylora/Talks/Dublin_2011.pdf
- http://homepages.dias.ie/~taylora/Talks/Dublin_2011_2.pdf

Additionally, I gave a series of 2 Lectures on Extragalactic Cosmic Rays at the "Ultra High Energy Cosmic Rays Workshop" in Sao Carlos, Brazil.

During my time in Dublin (2013), I have also given course lectures to first year Physics students on Astrophysics at Maynooth University. My responsibilities involved preparing the course material following the University syllabus, setting/discussing problems at the start/end of each lecture, and marking exams.

Masters Students

I have provided in 2014 a series of guest lectures on Astrophysics to fourth year students for the course provided by Masha Chernyakova at Dublin City University.

In 2015 I supervised a fourth year (masters) student on a high energy astrophysics project. This involved the student investigating the diffusion and interaction of particles in extragalactic space. The student successfully completed the project and acchieved the second level masters degree.

PhD Students

During my time in Geneva I had the opportunity to be the co-supervisor of PhD student Celine Tchernin. Her project involved investigating the origin of gamma ray light curves and their growth and decay rate. My duty was to guide the student to develop a numerical description of the observational data and to frame this within a broader astrophysical setting.

Presently, my PhD student in Dublin Carlo Romoli is working on the temporary evolution of bright AGN flares. Carlo has also played a key role in developing the analysis tools of the new HESS-II instrument CT5. My role has been to guide and advise Carlo throughout his PhD acting as the main scientific adviser.

PEDAGOGICAL APPROACH

My teaching style has been inspired by my Pembroke College tutors who repeatedly emphasized the importance of "keeping it simple": *simplification is the key to understanding.* This is most easily applied in astrophysics by following three guiding ideas:

- Knowing the order of magnitude in astrophysical calculations facilitates fluid thought.
- Find analogies in everyday life (or in other areas of Physics) with the astrophysical processes.
- Play with the mathematics and the physics of a system to get a feel for how it reacts in different situations.

These guides can be applied through the construction or either numerical or a real physical models which capture the essence of the system.

Through frequent interaction with the students, at both undergraduate and graduate level, a natural feedback can be set up to allow for the tailoring of the teaching methods according to the pupil's strenghts and weaknesses.

Undergraduate Level

In the past I have found that it is important for a subject to be clearly introduced before any physics problems on that topic be addressed. In my experience undergraduate students benefit through the development of their own intepretation of the physical situation through both reading and lectures. Subsequent to this, problem sets refined the students ideas allowing them to develop and prune their interpretation. Finally, a discussion on the subject in which the students are thrown into a seemingly unfamiliar (but connected) problem proved an effective method to solidify this model into a concrete framework. Furthermore, the comparison of the physical system to others previously analised helped the students to connect this fresh learning to their background knowledge, facilitating the formation of a coherent (self-consistent) understanding of the physical world.

Postgraduate Level

Compared to undergraduate level, graduate students benefit from a larger degree of independence. My graduate studentsprofited from the fragmentation of the complete problem being addressed into intermediate scale problems. Independent exploration of these problems has frequently lead the student to the development of a whole ensemble of tactics and to the finding of interesting new solutions. Developing

their personal ensemble of tactics for tackling problems prepares the student for future independent research. After several months of encouraging such intermediate scale problem solving, both the speed and size of the problems being tackled by the student improve, along with the understanding of the physics involved.