TEACHING STATEMENT

As a teacher of Physics at tertiary level I believe, for two reasons, that I have the most fortunate position of all academic staff. Firstly, the fundamental technique of science - the scientific method - is the best tested and most successful thought process in existence. Independent of course content, the underlying goal of every science course must be to impress this method upon the students. Secondly, Physics, to me, is a subject area where a student who is purely good at being examined will be outperformed by a student who fully understands the fundamentals. Combine the principals and the scientific method, and Physics can be understood instead of just purely learned.

TEACHING IN THE SCHOOL OF PHYSICS AT TRINITY COLLEGE.

I am passionate about teaching all areas of physics and astrophysics in Trinity College. Astrophysics, like all specialist subjects, requires a fundamental understanding of the core subjects - quantum mechanics, atomic physics, nuclear physics, newtonian mechanics, relativity and plasma physics. This makes these areas particularly rewarding to teach in freshman years. I would also enjoy teaching the history of physics and astrophysics (course 1007), as this an area I find fascinating to study. I would like to include an extra section on the description of the scientific methods and concentrate on how the major advances in science mostly originated from wondering about the skies. In the senior freshman year I would like to extend the module on chaos and complexity (course 2002) and make this available to astrophysics students. My own research on active region complexity and studies of the fractal behaviour of X-ray emission demonstrates how this course is relevant to the modern astrophysicist. My background in detecting waves on the Sun also makes me suited to expanding the oscillations module (course 2003) for astrophysicists. My background in teaching for Astronomy Ireland would also be suited to the astrophysics modules at this level (course 2008).

It is in the Sophister years and beyond where I feel I can contribute most to the degree course. My background in operating solar imaging systems and working with algorithms make me particularly suitable to teach and expand the course in astronomical instrumentation (course 3021) or astronomical spectroscopy (course 3020). I will also contribute to astrophysics laboratory projects, especially in increasing the number of astrophysics and solar physics projects available at this junior Sophister level. I would also like to expand the successful ‘Computing for Astrophysics’ course as I feel this makes the senior Sophister project more rewarding for the students. I will offer several new final year research projects to students in tracking solar storms, magnetic complexity, and waves in the solar corona. In addition I would like to offer more projects using the solar telescope and AWESOME monitor at Trinity College. Projects at final year level should consist, to some extent, of new research and at NASA I was successful in expanding the research of all my summer student’s work to the level of publication in a major journal. In this final year of study I would like to introduce more of the major recent advances in astrophysics, possibly expanding the Planetary systems course to explain the different planet finding techniques (course 4022), and to teach an advanced course on ‘The effects on earth’ to include subjects popular in the media - e.g., space weather effects, near earth objects and collisions, the possible effects of solar climate forcing.

The first year for a PhD student is a period of transition to research, and I believe this is a vital stage to teach students some advanced science. I will contribute to this by offering a complete course in magnetic reconnection to all astrophysics PhD students in the surrounding col-
leges. This would reinforce all the basics from Maxwell's equations, to equations of motion, to chaos and complexity. It would reinforce the importance of the induction equation and Lorentz force, and would include a discussion on high energy particles and plasma physics. My expert knowledge in applying these principals in solar physics will allow me to teach this in a general format, and so can be used by everyone researching in solar system, stellar or galactic projects. I would also like to expand the existing school seminar program to strongly encourage more discussion and collaboration with PhD students and PDRAs in the surrounding colleges. As part of PhD training I would contribute to the existing TCD course on writing research papers, scientific ethics, national and international grants, and presentation skills for scientists.

TEACHING PHILOSOPHY

At all levels I find it is useful to start every course with a description of why I choose to study this subject. Personally, I choose to study Physics and Astrophysics because the vast size and time-scales over which I can research - from milliseconds to Gigayears, from subatomic structures to the distribution of galaxies - can mostly be described by a few basic principals. I approach each class by finding out why each student decided to take the course and researching what the students plan to gain from it. Individual students have different abilities and needs: physics students require a fundamental grasp of the basics of the subject to advance; other science majors (e.g., chemistry) need to achieve a level of understanding to complement their degrees; perhaps non-science majors are taking an introductory course. Each class will contain a vast range of ability and each student must obtain a positive experience and achieve their own level of comfort with Physics. My role as a teacher means I must facilitate this learning by using every means available, including classical lecturing, audio-visual aids, demonstration and group discussions.

I believe the classical didactic method - the teaching of facts - is the natural basis for all teaching, but I supplement this by expecting Physics students to take an active role in each class. I find that only by adopting the ‘Pose, Pause, Pounce’ approach can I ensure all students follow the material. This involves asking a question on the subject matter, waiting a few seconds for everyone to consider it, and asking someone at random for an answer. The question is posed in such as way that there is no exact correct answer - the important part is that the thought process reinforces the subject matter for the student. In designing and teaching the Astronomy Ireland evening classes I found that constant questions were necessary to ensure everyone was following each segment of each lecture. This is especially true in serial-type teaching where each part of the course must be understood before advancing to the next segment. I found it useful to break lectures into 20 minute segments, with ample opportunity for students to ask questions at the end of each segment. I also strongly advocate a degree of future planning on the students behalf by assigning discussion topics at the end of each lecture. These become the subject of a ‘pair and share’ discussion at the start of the next class. I found this method worked extremely well when I lectured for the University of Maryland and the Catholic University of America. I believe it is vital to hand out properly prepared lecture notes for each class. As well as ensuring each lecture is structured, this allows the students to concentrate on the actual lecturing, instead of constantly writing. To ensure the students do play an active role however, I omit many equations, proofs and figures from any handouts. I write down and explain every step of any derivation or important experimental result. I find this is preferable to just reading from a full set of notes or clicking through a powerpoint presentation. At the end of each course I always adopt anonymous feedback surveys a means of collecting data so I am constantly improving my teaching for future classes.

I find that when teaching more specialist subjects in the 3rd and 4th year of undergraduate, it is important to work with smaller groups of 10-15 students. With small numbers it is possible to employ more non-traditional methods and earning the captivation of a few motivated students is one of the most rewarding parts of any academic year. The same principals apply to the small group tutorials in freshman years. In my role as a summer student advisor at NASA I discovered how teaching a small group size became most rewarding when the students started debating science between themselves. In the ‘Computing for Astrophysics’ course I teach at TCD, it is instantaneously evident when a student combines components of logical thought to form a coherent piece of software. These personal breakthroughs for each student are made possible because of the small class sizes. This idea of letting students discover their own personal breakthrough is also true for the mentoring of post graduate students. I take pride in managing a project by securing funding, supplying the basic knowledge, and initially posing the questions. However I believe the most important role of a mentor is to supervise the student training until they
start asking their own questions of themselves and others. At this stage the student is capable of completing their PhD by fully defending their own work in journal articles and at major international conferences. Like at all levels of teaching, the goal must not be for students to solely complete the work or answer the questions I have thought of, rather it must be to train the students to a level of independent thinking whereby they will answer questions which have yet to be posed.