

## **CURRICULUM VITAE. William John O'Brien**

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**Date of Birth:** 30 January 1976.

**Marital Status:** Single

**Employment History** February 2001-November 2006. **Design engineer at Cryogenic Ltd.**

Cryogenic Ltd ([www.cryogenic.co.uk](http://www.cryogenic.co.uk)) is a small company which manufactures superconducting solenoid magnets (<20T) and other equipment for low-temperature research, serving research institutions worldwide. For most type of instrument on offer there is a standard range but, at extra cost, the company will create systems to suit customers' special requirements.

My main responsibilities were to monitor the overall progress of particular orders, produce a design for winding the coil, produce part drawings and testing the systems when ready. As part of my legacy, I set up a number of template assemblies, so that complicated systems could be designed and adjusted very quickly by editing a list of parameters. This was done so that adjusting dimensions to suit customer requirements (or other constraints) could be done quickly and efficiently.

**Postgraduate Degrees** **PhD November 2006-present, Cranfield University Thesis title: A Spectroscopic study of a Reactive Atom Plasma torch.**

Since November 2006 I have been investigating the RAP process, an atmospheric plasma chemical etching process. This is a novel technique which is planned to be used for the fine figuring large optics and is envisaged as replacing incumbent technique (ion beam figuring). The process uses an inductively coupled argon plasma. A chemically reactive gas, which contains fluorine, is injected into the plasma and atomised so that fluorine atoms can react with the surface material to produce volatile products, thus material is removed from the surface. I took temperature measurements of the plasma (mostly in the plume) using atomic emission spectroscopy so to understand how much heat the plasma delivers to the surface (material removal rate is temperature dependent). I also took temperature measurements of the surface of samples that were being etched, mostly of ULE (Ultra-Low Expansion) glass and of silicon, using RTD sensors and by thermal imaging. I have also taken some preliminary measurements on the removal rates and the evolution of the surface roughness of ULE and silicon. The measurements were taken using simple phase shift and white light interferometers. [www.wjobrien.com/PhD%20thesis.docx](http://www.wjobrien.com/PhD%20thesis.docx)

**October 1999 - September 2000 MRes Telecommunications, University College London.**

Details are on page 3. This course is a research masters course. 60% of course is taken up by the research project. 20% was made up by taught modules and 20% by the generic and transferable skills modules. **Result: Pass**

**Undergraduate Degree** September 1995 - July 1999 **MPhys (Hons) Physics with Astrophysics**, University of Manchester. Details are on page 4. The astrophysics element took up roughly 25% of the course. **Result upper second (2:1) class.**

<b>A Level</b>	June 1994	Physics	A	Mathematics	A	Chemistry	A
<b>GSCE results</b>	June 1991	Mathematics	B				
	June 1992	English	C,			English Literature	C,
		Latin	B,			French	A,
		Geography	B,			Additional Mathematics	A,
		Science	B (2 GCSES).				

I also completed the first half of a biology A-level course, but had to withdraw due to a change in circumstances.

## Publications

“**Ion Beam, Focused Ion Beam, and Plasma Discharge Machining**”, D. M. Allen, P. Shore, R.W. Evans, C. Fanara, W. J. O’Brien, S. Marson and R. Jourdain. Ion beam, focused ion beam, and plasma discharge machining, *Annals of CIRP*, 58/2, pp 647-662 (2009).

“**Reactive Atom Plasma Technology (RAP<sup>®</sup>) etching of ULE<sup>®</sup> and SiC optics.**” Fanara C, O’Brien W, Shore P, Nicholls JR, Sommer R, TPW, 5<sup>th</sup> Technological Plasmas Workshop, Belfast (2007).

**Computing Experience:** While working as a design engineer, I gained considerable experience in using the CAD software **AutoCAD** and **Autodesk Inventor 8**. Using the latter, I helped set up a series of template assemblies, to help quickly produce part drawings for some of the more commonly built systems. By changing the numbers in a table in an Excel file, such systems can be resized to suit customer requirements. I have had some basic training in **LabVIEW**. When designing magnets I have used some in-house software called 'Fieldworks' for making field calculations and on occasions I have used **Vectorfields** for more complex magnet designs.

I studied the **C** and **C++ programming** languages during my degree course. I used C++ for data analysis during my PhD and MRes research project. I studied some of the basics of **JAVA** in the Software Tools and Techniques module of the Mres course as an example of object oriented programming.

In the Software Tools and Techniques module I learned how to write web pages using **HTML**.

**Other professional experience:** in October and November 1994 and had some work at the physiology department of the University of Louvain in Brussels. I took some measurements of the amount of calcium that was in the muscles mice, using absorption spectroscopy. I wrote a report and gave presentation to the research group.

**Memberships:** I'm a member of the **Institute of Physics (IoP)** and the **British Astronomical Association (BAA)**.

**Other activities:** Over the last 10 years I have been involved with many amateur operatic companies. I have performed in many operas, light operas and musicals. I have directed some operatic scenes for 'workshop' productions. I have been taking regular singing lessons since 2001. I regularly play tennis and have been **skiing** on many occasions. I have been very interested in **astronomy** for a long time. I own an 8" Schmitt-Cassegrain telescope with which I observed various stellar objects and have taken photographs of some of the planets and brighter deep sky objects (a few photographs are shown on my webpage <http://www.willobrien.com/space/page4.html>). I am a member of the **West of London Astronomical Society (WOLAS)**.

The aforementioned **web site**, which I have created, includes photographs and information about my family, friends, holidays, stage productions are some humorous items (<http://www.willobrien.com>.) I have designed an extensive board game in which a person assumes the role of a fantastical character and solve a huge labyrinth, having to deal with various monsters and pitfalls on the way. In 1999 I wrote a program in C++ to help make the progress of the game much swifter. I have also written a web site advertising my professional qualifications (<http://www.wjobrien.com/>) and another for my parents' piano retailing business.

## RESEARCH MASTERS COURSE DETAILS

RESEARCH PROJECT, 60%, the use of polarisation interleaving to reduce the level of crosstalk in fibre mm-radio systems.

For my research project I looked into a possible means of broadband communications, a hybrid fibre millimetre radio network. The core of such a network is made up by fibre optic connections with the last drop to the customer provided by a wireless link at millimetre wavelengths. The mm-wavelength range is currently under-utilised due to high atmospheric attenuation. To overcome this a large concentration of remote antenna units, linked to a central office, could be used to deliver the modulated mm signal to the customer. Each antenna unit might serve an area of about 50m in diameter.

Dense wavelength division multiplexing could be used to utilise the optical bandwidth in the fibre most efficiently. Imperfect filtering at the demultiplexer leads to crosstalk between channels. One way to reduce the amount of crosstalk might be to use a scheme known as polarisation interleaving, where adjacent channels are launched at orthogonal polarisations. Plane polarised light in an optical fibre does however become depolarised due to residual birefringence in the fibre's glass. This limits the potential benefit of polarisation interleaving. I have performed calculations to show how the power in the crosstalk varies as parameters such as the mm-frequency, the fibre length, the channel spacing and the width of the filter function are varied. **Mark 50%**

To read my dissertation, go to <http://www.wjobrien.com/mresthesis.pdf>

TAUGHT MODULES, 5% each.

Introduction to Telecommunications Networks, assessed by examination. **Mark 55%**

Public Telecommunications Networks.

The assignment for this module was an essay based on Local Loop Unbundling, Digital Subscriber Line and voice over IP. **Mark 65%**

Telecommunications Transmissions Systems, assessed by examination. **Mark 50%**

Mobile and Personal Communications, assessed by examination. **Mark 50%**

GENERIC AND TRANSFERABLE SKILLS, 20%

Statistical Modelling and Data Analysis, assessed by examination.

This course covered probability, Fourier transforms and convolution. The principles of simulation were also covered in this course.

Software Tools and Techniques

Included tuition of HTML, MS Word, MS Excel and C programming and an assignment involving C.

Software for Network Services and Design

This included an introduction to Object Orientated Programming and exercises in JAVA. The assignment included some of the JAVA exercises, the drawing of UML diagrams for those JAVA exercises and a written exercise in threading.

Research Processing and Practice

This included a set of lectures and exercises based on project management, teamwork and presentation skills. The assessment involved

- 1 A report and presentation of the research project plan in November 1999.
- 2 The design of a poster about the research project for the department's presentation day at the end of March 2000.
- 3 A paper and presentation at the London Communication symposium in September 2000 about the research project.
- 4 Students are also required to design a web site to provide an on-line guide to the project.

**Overall mark for generic and transferable skills courses 66%**

**Overall Mark 54%**

## DEGREE COURSE DETAILS

**FIRST YEAR. (0% of final mark)** All of the marks shown are percentages.

**Semester 1** - Dynamics 86, Rays, Waves and Photons + Special Relativity 84, Gases, Liquids and Solids 82, Calculus and Complex Numbers 72, Mathematical Methods 1 72. Introductory Astronomy 84.

**Semester 2** - Vibrations and Waves 89, Electricity and Magnetism 82, Introduction to Thermal Physics 70, Physics of the Solar System 76, Mathematical Methods 2 82.

First Year Laboratory (equivalent to 4 modules) 61  
**Overall mark for first year** 75.5

### SECOND YEAR. (15% of final mark)

**Semester 3** - Fundamentals of Quantum Mechanics 72, Electromagnetism 58, Mathematical Physics 66, The Galaxy 66, Lagrangian Dynamics 68, Electronics 61.

**Semester 4** - Quantum Mechanics 82, Wave Optics 48, Thermal & Statistical Physics 86, Introduction to Observational Astronomy 68, Complex Variables and Integral Transforms 76, General Physics 69.

Second year Laboratory + Vacation Essay\* (4.5 modules) 65  
**Overall mark for second year** 67.7

### THIRD YEAR. (35% of final mark)

**Semester 5** - Particles, Nuclei and cosmology 48, Solid State Physics 40, Electromagnetic Radiation 44, Galaxies 52, Advanced Quantum Mechanics 40.

**Semester 6** - Statistical Mechanics 56, Stars and Stellar Evolution 80, High Energy Astrophysics 86, Particle Physics 86, General Physics I 64, General Physics II 72.

Combined mark for vacation essay\*, Design Study\* and Laboratory (6 modules) 60  
**Overall mark for third year** 60.5

### FOURTH YEAR. (50% of final mark)

**Semester 7** - Radio Astronomy 56, Superconductors and Superfluids 76, Physics of the Interstellar Medium 40, MPhys project 1 (4 modules)† 56, Group Project†† 59.

**Semester 8** - Introduction to General Relativity and Cosmology 46, Frontiers of Astrophysics 57, Photonics 68, Programming in C++ 66, General Physics 75, MPhys Project 2 (4 modules)† 68.

**Overall mark for fourth year** 61.7

**RESULT - 62.2% upper second.**

To read reports on my 3<sup>rd</sup> and 4<sup>th</sup> year degree projects, go to <http://www.wiobrien.com/degree.html>

\* The subject of my first vacation essay was "**Electron Degeneracy**". The subject of my second vacation essay was "**The Conduction of Electricity in Solids**".

\*\* My third year Design study was an essay about **Gravitational Wave Detectors**. In this essay I first briefly discussed the sources and properties of gravitational radiation. I went on to discuss existing resonant mass and interferometric detectors and proposed a possible design for resonant mass detector consisting of 5 metallic spheres.

† MPhys projects were carried out as a partnership between two students. My first MPhys project was an experimental project which involved the use of a **Mach-Zehnder fibre optics interferometer** for measuring temperature changes in water. In the second MPhys project we were presented with a **shadowgraphic lens set-up for observing convection in a cylinder of water** of low aspect ratio that a former MSc student had put together. Our tasks were to add two additional lenses to the set-up that would produce bigger images on a CCD without losing contrast and also to produce as many different convection patterns as we could.

†† The Group project is the only non-scientific module in the course. Within a group of seven I worked on an essay entitled "The State of Education" which discussed how a person's career choice is influenced by his or her education. We looked at how public exam results varied geographically in the UK and how they differed between comprehensive and public schools, and between single sex and mixed schools. We also talked to employers to find out whether they felt that today's education system is sufficient to their needs. We made some recommendations as to how the education system might be improved. The main part of the assessment was the 10000-word essay. We were also required to give a 30-minute presentation to the rest of the class. I give the first half of that presentation. The presentation included some piece of interview footage with teachers at schools of various types and with some university students.

**REFEREES****Dr Roger Mitchell** (production manager at Cryogenic)

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