

# Globalisation: The physics landscape today

**John Wheeler**

Department of Physics, University of Oxford, Parks Road, Oxford, OX1 3PJ, UK

E-mail: john.wheater@physics.ox.ac.uk

**Abstract.** This paper discusses how physics has become globalised in the context of the Oxford Department of Physics and its permanent academic staff over the period from 1987 to 2017. Modern émigrés move to new institutions for scientific opportunities and a physicist will typically work in several over the course of their career.

## 1. Big Science and Small Science

This paper will focus on relatively modern times and the relationship between the nature of science and modern émigrés. One of the most striking aspects of science today is the emergence of so-called Big Science and one of the projects that Oxford Physics has been most involved with is the ATLAS multipurpose detector at the CERN Large Hadron Collider (LHC)<sup>1</sup>. ATLAS and CMS discovered the Higgs Boson in 2012. The collaboration comprises 5,000 scientists from about 180 institutions in 38 countries; outside wartime emergencies such as the Manhattan Project there has been nothing like this in earlier times. The original Oxford collaboration members started work on ATLAS in 1992, so the timescale is also enormous compared to science in previous eras. ATLAS is truly international in its operation with membership of groups working on particular topics drawn from across the globe and interacting with each other on a daily basis; in other words each aspect of ATLAS is conducted by groups of physicists which are truly multi-national.

What about Small Science? There is still a great deal of physics that is done in traditional university laboratories, but that is changing too. A good example is the Networked Quantum Information Technology (NQIT) project which involves eight universities led by Oxford. This is building on the development of quantum computing technology in the Clarendon Laboratory and elsewhere over the past twenty five years to construct a real demonstrator modular quantum compute engine called Q20:20. Including post-doctoral and permanent staff the Oxford NQIT team contains 37 UK, 17 EU and 16 overseas (non-EU) nationals.

The two examples described above are not unusual. Oxford Physics currently has nine research themes: Particle Physics, Accelerator Science, Astrophysics and Planetary Physics, Semiconductor Devices, Quantum Information, Quantum Materials, Biophysics, Climate Physics and Plasma Physics. There are theorists and experimentalists/observers working in each of these areas and all are pursued in a highly collaborative international environment by groups with similar profile to NQIT.

The landscape of research activity is well illustrated by publication metrics; as ever one should be careful because bibliographic databases are invariably incomplete and contain errors which tend to be

---

<sup>1</sup> Oxford Physicists played a big role in making the LHC happen; Chris Llewellyn Smith as Director General of CERN and Roger Cashmore as Research Director.

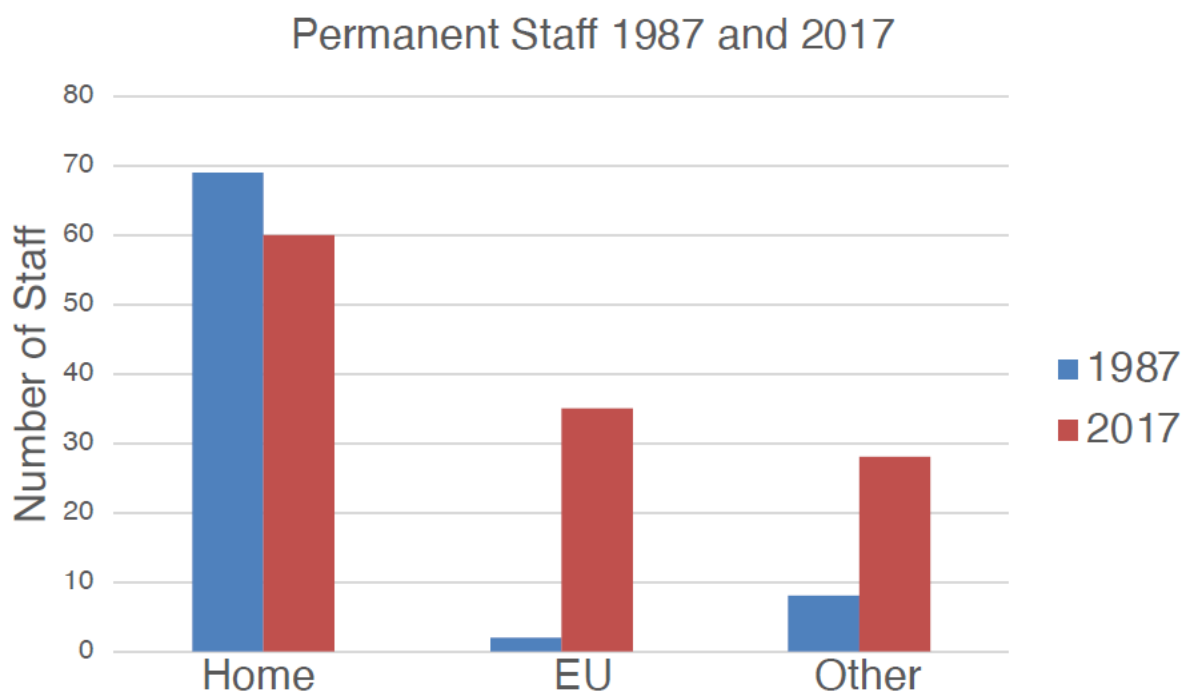
corrected over time but they should be reliable enough for this purpose. Of the 4,364 papers published by Oxford Physics during 2008-2013 (collective h-index 88 at 31st December 2013) 75% have at least one co-author outside the UK and Éire. Even excluding astrophysics and particle physics where large collaborations are normal, this decreases by only 5% to 70%. Altogether papers co-authored with over 100 institutions worldwide were written (again excluding experimental particle and astrophysics).

In a sense the way physicists work has not changed all that much. The creators of quantum mechanics were scattered around Europe. They worked together in various combinations, wrote detailed letters to each other, visited each other and learned from each other; this still happens today, although email, pads and pdfs are used, and travel is quicker and cheaper.

## 2. Demography of Oxford Physics

Figure 1 shows the origin of permanent academic staff, defined by location of their first degree institution, in 1987 compared with 2017. The 1987 data comes from the 1987-1988 Oxford University Calendar which can be consulted in most libraries in Oxford. Several easy observations can be made:

1. There are many more staff in 2017, 123 versus 79 in 1987;
2. In 1987 the number of staff from continental Europe was tiny (in fact the individuals were from countries now in the EU although they were not in 1987);
3. The 2017 distribution is roughly similar to the numbers seen above for NQIT – it does not matter which science area is looked at or whether postdocs are counted as well as staff; the proportions do not change much.



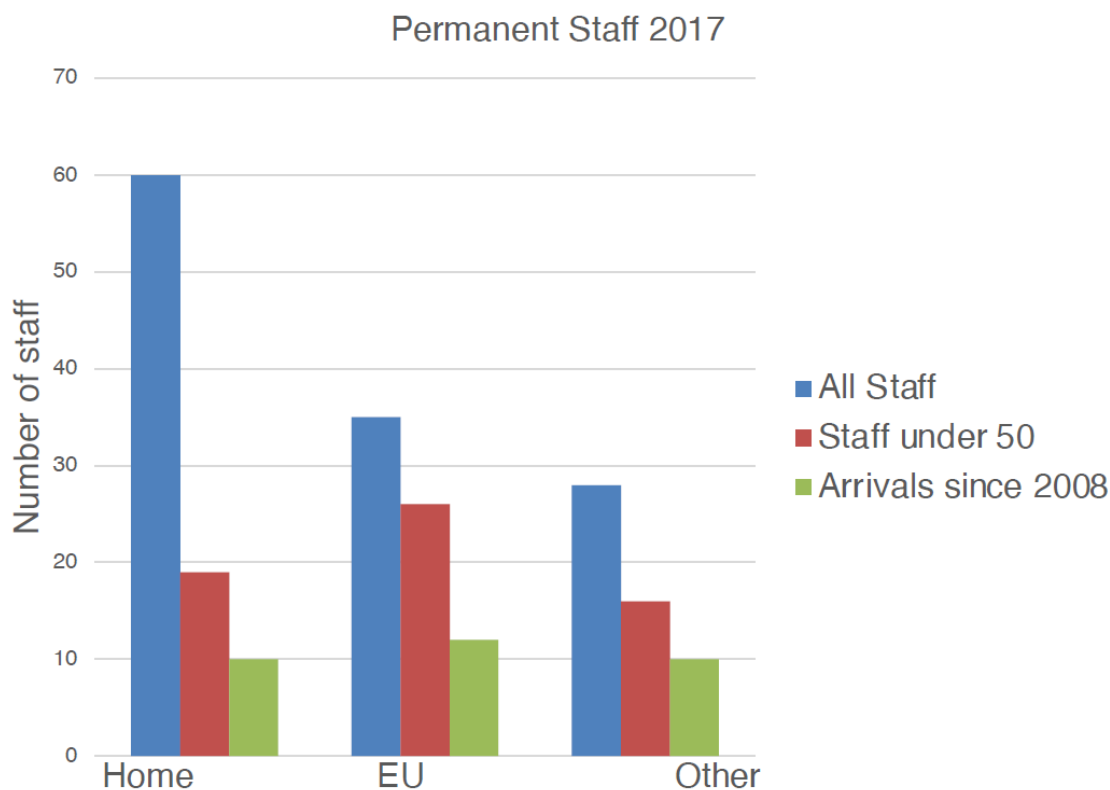
**Figure 1.** The permanent staff in 1987 and 2017 categorised by the country where they obtained their first degree. Home means UK and Eire.

The 1987 staff members from non-EU overseas were in fact all anglophone. The émigrés from the European continent who arrived here in the 1930s had all retired, although several including Rudolf Peierls and Nicholas Kurti were still very much around. Strangely to modern eyes the cosmopolitan faculty of the 1950s and 1960s had largely appointed British (and Irish) people as their successors. Looking more carefully at the Calendar reveals that in 1987 the longest-standing member of staff was appointed in

1950, but the next not until 1958. This is a huge gap for a body of some seventy people. It would be very interesting to delve further into this history.

Among the list of full Professors given in the 1987 Calendar appears Chris Llewellyn Smith with a note that he was a Professor only for so long as he was Chairman of Physics. Even in 1987 Oxford University must have been unique in planning to take a Chair away from someone! The note reveals a very important change that took place at that time. In 1986 there were five departments doing physics research, although everyone belonged to the Physics Sub-Faculty which was responsible for teaching the undergraduate Physics degree. The research departments operated at arm's length and there was rather little interaction between them. This was bad for science and meant that there was no single voice arguing for Oxford physics research in the University, the funding agencies and the corridors of power. In 1987-1988 the process of unifying them into one Physics Department began and the appointment of the Chairman of Physics was the first step. This development played a significant part in the growing strength of Oxford Physics and in particular in the changes being discussed here.

Another person in the 1987 Calendar is Neil Tanner (1930-2008), who was one of the few non-British permanent staff at that time. He grew up in Melbourne and is probably mostly remembered by people either for smoking enormous numbers of cigarettes or as the architect of the 'Tanner Scheme', the aim of which was to encourage applications from comprehensive schools at a time when such endeavours were unusual. In the 1990s he worked on the Sudbury Neutrino Observatory (SNO) experiment and made essential contributions to its design. SNO was built to detect solar neutrinos and discovered neutrino oscillations but sadly Neil did not live to enjoy the proper acknowledgement of its achievements. SNO's spokesperson Arthur B. Macdonald and Takaaki Kajita, spokesperson for the Super-Kamiokande detector, won the 2015 Nobel Prize in Physics and SNO itself won the 2016 Breakthrough Prize for the discovery of neutrino oscillations.



**Figure 2.** The permanent staff in 2017 categorised by the country where they obtained their first degree and by career stage.

The University Calendar does not mention the postdoctoral community but in 1987 it was definitely cosmopolitan (I was there) and was typical of university departments worldwide. In due course that generation became permanent staff and moving the clock forward to 2017, it can be seen that 30% of the staff are from non-English speaking countries. Figure 2 shows the breakdown by career stage. The distribution of staff over 50 and under 50 is very different. The over 50s still mirror the situation in the late 1980s whereas the under 50s reflect the modern recruitment pattern and staff appointed in more recent times are predominantly not British. The gap in recruitment date has disappeared and the longest-standing member, James Binney was appointed in 1981 with the next most longstanding in 1983, which is much more what one would expect. The overall proportion of women staff has increased from 5% to 16%, but among recent recruits it is much higher.

Statistics tell a story but scientists are individuals so it is interesting to understand the nature of a modern scientific career by looking at a few cases. Laure Zanna works on climate dynamics and the challenges of predicting climate change and understanding the associated uncertainties. She did her BSc in 2001 at Tel Aviv, an MSc at the Weizmann Institute, her PhD at Harvard and then joined Oxford Physics as a James Martin Fellow in 2009 before becoming an Associate Professor and Fellow of St Cross in 2011.

Ramin Golestanian is a theorist working on the physical and structural properties of both synthetic and biological soft matter, understanding how things work at the nanoscale, for example to propose designs for machines that could do useful mechanical tasks. He did his BSc in 1993 at Sharif University, Tehran followed by a MSc and PhD at Zanjan (his PhD advisor was Mehran Kardar of MIT). He was a postdoctoral researcher at the Kavli Institute, Santa Barbara, USA, and held faculty positions at Zanjan and Sheffield before joining Oxford as Professor of Physics and Fellow of St Cross in 2010.

Daniela Bortoletto is an experimental particle physicist who now leads the Oxford ATLAS group and pixel detector development, and is Chair of the Fermi National Accelerator Laboratory Program Advisory Committee. She did her BSc in 1982 at Pavia, her PhD at Syracuse, USA, and she was a postdoctoral researcher, then faculty member at Purdue, ultimately becoming EM Purcell Distinguished Professor. She joined Oxford as a Professor in 2013 and is a Fellow of Brasenose College.

### 3. Conclusion

Have physicists really been much more mobile in the last thirty years? From a global perspective the answer is ‘probably not’ – as seen, scientists have moved around for a long time and in the 1980s the faculty of major US universities, for example, was highly cosmopolitan. However, Oxford Physics has changed a great deal; people who start here now end up all over the world and vice versa. It can be seen in retrospect that the mid-1980s were the era of least diversity in the permanent staff since the 1920s.

Is the rise of ever bigger science associated with mobility? Again, probably not. The operation of the big collaborations would be more difficult without mobility, but impossible without the internet. The changing demography is not just in Big Science but pretty much across all areas of physics represented in Oxford. Is the present an Era of *Émigrés*? Yes, but scientists move around the globe mainly for scientific opportunity rather than fleeing, for want of a better word, a political situation – we have lived in benign times, but that could easily change.

### Acknowledgements

This paper presents the talk and conclusions as I gave them in 2017 at the HAPP Conference on “*The Émigrés in Oxford Physics*”. Subsequently the COVID pandemic showed that indeed science could function without mobility for a couple of years – and that the internet was crucial to enabling that. Laure Zanna is now a Professor at NYU, Ramin Golestanian also holds a Max Planck Institute directorship jointly with his Oxford position and Daniela Bortoletto is Head of Experimental Particle Physics.