



## Nuclear Seminar Series

### Upcoming Talks

Tues 17<sup>th</sup> Feb, 2pm  
3.21, Physics



**David Smith**

Interface Analysis Centre  
School of Physics

*Photophoretic resonance absorption for the sorting single-walled carbon nanotubes (SWCNTs) and heavy isotopes: A new method for high purity, low energy separation.*

Tues 3<sup>rd</sup> March, 2pm  
3.21, Physics



**Aleksej Popel**

UK Spent Fuel Research Group  
University of Cambridge  
*Title TBC*



**David Tanner**

Solid Mechanics Research Group  
Faculty of Engineering

*Addressing Key Structural Integrity Challenges in the UK Nuclear Industry*

Tues 17<sup>th</sup> March, 2pm  
Mott LT, Physics



**Prof James Marrow**

James Martin Professor of Energy Materials  
University of Oxford  
*Title TBC*

Tues 31<sup>st</sup> March, 2pm  
3.21, Physics



**Rick Bradford**

EDF Energy  
RAEng visiting Professor

*Lessons from Past Plant Failures in UK Commercial Reactors*

**Contact:**

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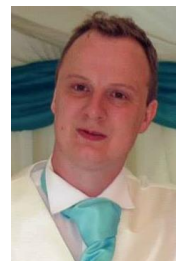


## This Week...

### Tues 17th Feb, 2-3pm, Physics 3.21

# David Smith

Interface Analysis Centre, School of Physics



## Photophoretic resonance absorption for the sorting single-walled carbon nanotubes (SWCNTs) and heavy isotopes: A new method for high purity, low energy separation.

Photophoresis is an emerging technology for processing sub-micron particles. It utilises particles differing interactions with light as mechanism for separation. These differing interactions may arise due to difference in the particles photothermal characteristics or varying degrees of photoelectric absorption. This talk will focus on photophoretic phenomena arising from photoelectric absorption. Specifically, photophoresis as an avenue for the selective chiral sorting of single-walled carbon nanotubes (SWCNTs) and heavy isotope separation.

High purity mono-chiral SWCNT samples are essential for the commercial realisation of high-speed SWCNT electronics. Current sorting techniques utilise secondary properties such as specific gravity or nucleotide affinity as recognition/separation avenues. Such techniques do not necessarily guarantee high quality electronic properties. We present a novel approach for selective chiral separation based upon innate electronic properties. Using the resonant transfer of photonic momentum as a direct method of separation it is possible selectively impose excess optical force to specific chiralities. The relevant theory is developed and potential experiments (and the associated challenges) are discussed. Computer simulations have been developed for the BlueCrystal HPC facility here at the University of Bristol. The simulations modelled the evolution of large ensembles of SWCNT due Brownian, optical and hydrodynamic forces. Subsequent results show the feasibility of potential photophoretic, opto-fluidic and optical counter propagating sorting devices. These results include investigations into optimum temperature, optical intensity flow regimes and flow velocities for fast separation. We find that an optical sorting system would be ~100x faster than the current 'Gold Standard'.

Finally, the prospect of whether a photophoretic approach could be applied to heavy isotope separation is considered. Atomic vapour laser isotope separation (ALVLIS), Molecular laser isotope separation (MLIS) and more recently Separation of isotopes by laser excitation (SILEX) utilise resonance optical absorption. However, these technologies are still relatively energy intensive as the vapour has to be maintained in an ionised state. By taking advantage of the transfer of photonic momentum it should be possible to achieve high purity separation without the currently required cascade configurations.

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