

What makes students more employable?



David Cole-Hamilton



Quality Assurance Agency (Scotland)
Enhancement theme - Employability

What is Employability

“A set of achievements, understandings and personal attributes that make individuals more likely to gain employment and be successful in their chosen careers”.

or

How to help students get a good job

Major Themes

Subject specific Expertise

Project work

Transferrable skills

Work Placement

Personal development Planning

Student Enterprise

Embedded within the curriculum

Project work



Project work

A significant piece of original research leading to a thesis

- Independent thought
- Deductive reasoning
- Literature abstracting
- Research planning
- Research skills and instrumentation
- Communication (Colloquium, poster, writing)
- Publications or patents

Transferable skills Embedded in the Curriculum

Posters

Oral presentations

Essays

Chemical Newspaper

Miniproject

All involve

Teamwork

Posters

Continuous motion of interference patterns using the angular Doppler effect

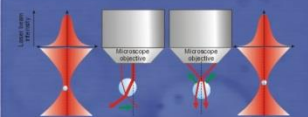


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Introduction

Interference patterns are used in optical tweezers to enhance trapping and manipulation of microscopic objects.
Creating motion in an interference pattern requires a frequency difference of a few Hertz between the co-propagating beams.
We create this very small frequency difference in the optical domain using the angular Doppler effect* (also known as the rotational frequency shift).
This frequency shift is 14 orders of magnitude smaller than the laser oscillating frequency.

Optical Tweezers



Optical tweezers make use of the gradient force of light and can trap transparent, microscopic objects in three dimensions.
Refraction of photons and conservation of momentum means that particles are drawn into the region of highest light intensity.
A single beam trap has its limitations and novel laser beam can be used to enhance manipulation of microscopic objects in optical tweezers.

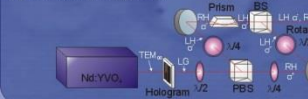
The angular Doppler effect

Circularly polarized light has its handedness reversed as it passes through a half wave plate (P to V).
If the half wave plate is rotating at rate Ω , the transmitted frequency is shifted by 2Ω .
The frequency is shifted up if the wave plate is rotating in the opposite sense to the incident field, or down if they are rotating in the same sense.
How does the frequency shift arise?
Rotating $\lambda/2$ plate: $\hbar\omega + \hbar\Omega = \hbar\omega' + \hbar\Omega'$
Angular momentum of wave plate: $L_z = \hbar\omega L_z = \hbar\omega' L_z'$
Conservation of energy: $\hbar\omega + \hbar\Omega = \hbar\omega' + \hbar\Omega'$
Frequency shift: $\Delta\omega = \omega' - \omega = 2\Omega$
Rotation of a half wave plate is an inexpensive and simple way to produce small frequency shifts without using AOMs.

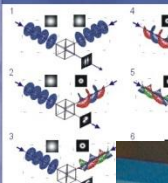
Experimental Set-up

To create the LG - LG interference patterns* a TEM₀₀ mode beam of 1064 nm from an Nd:YVO₄ laser is passed through a computer generated hologram to make an LG beam.
The linearly polarised LG beam (at 45° to the horizontal) is split by a polarising beam splitter.
Each LG beam is then incident on a $\lambda/4$ plate that makes them circularly polarised with opposite handedness (σ^+ , σ^-) to each other.
One of the beams is passed through a rotating $\lambda/2$ plate, and the handedness of the two beams becomes the same, meaning that they can form an interference pattern when they are recombined at the 50/50 beam splitter.
The other beam is passed through a dove prism which reverses the helicity, but not the polarisation of the LG beam ($\sigma^+ \rightarrow \sigma^+$).

RH, LH = Right and Left Handed Helicity of LG beam
 $\sigma^+ \sigma^-$ = Handedness of circular polarisation



Interference patterns



We have created various Gaussian beams and a few Gaussian (LG) beams. We used the resulting in here.
The azimuthal index (l) den of phase going around the beam used determines the trapping ability in the result.
Pattern

1. Shows the pattern of the Gaussian beams are interference.
2. The two armed spiral of a Gaussian beam.
3. The three armed spiral of LG $l=3$ and a Gaussian beam.
4. An LG $l=1$ and $l=-1$ and $l=2$ and $l=-2$ and $l=3$ and $l=-3$.

Particle manipulation



Future Applications

A single atom conveyor belt frequency shift created by the optical conveyor belt is counter-propagating beams. An atom can be transferred determined position.

ELEMENTS OF A SMARTPHONE

ELEMENTS COLOUR KEY: ALKALI METAL ALKALINE EARTH METAL TRANSITION METAL GROUP 13 GROUP 14 GROUP 15 GROUP 16 HALOGEN LANTHANIDE

SCREEN

49 In Indium
50 Sn Tin
8 O Oxygen

Indium tin oxide is a mixture of indium oxide and tin oxide, used in a transparent film in the screen that conducts electricity. This allows the screen to function as a touch screen.

ELECTRONICS

Copper is used for wiring in the phone, whilst copper, gold and silver are the major metals from which microelectrical components are fashioned. Tantalum is the major component of micro-capacitors.

29 Cu Copper
47 Ag Silver
79 Au Gold
73 Ta Tantalum

50 Ni Nickel
56 Dy Dysprosium
59 Pr Praseodymium
65 Tb Terbium
60 Nd Neodymium
64 Gd Gadolinium
14 Si Silicon
8 O Oxygen
51 Sb Antimony
33 As Arsenic
15 P Phosphorus
31 Ga Gallium
50 Sn Tin
82 Pb Lead

CASING

6 C Carbon
12 Mg Magnesium
35 Br Bromine
28 Ni Nickel



Miniproject

- Not research
- Students (team of 5 or 6) given a project
- Research Literature
- Allocate tasks
- Design experiments
- Do Risk Assessments
- Conduct experiments
- Write Individual and group reports
- Give a joint presentation
- Peer assess one another

Oral Presentations



Chemical Newspapers



Put together by a team of 5-6 students

Work Placement

Period spent working outside the University
Usually in a company or Research Institute

Huge change in maturity after Placement

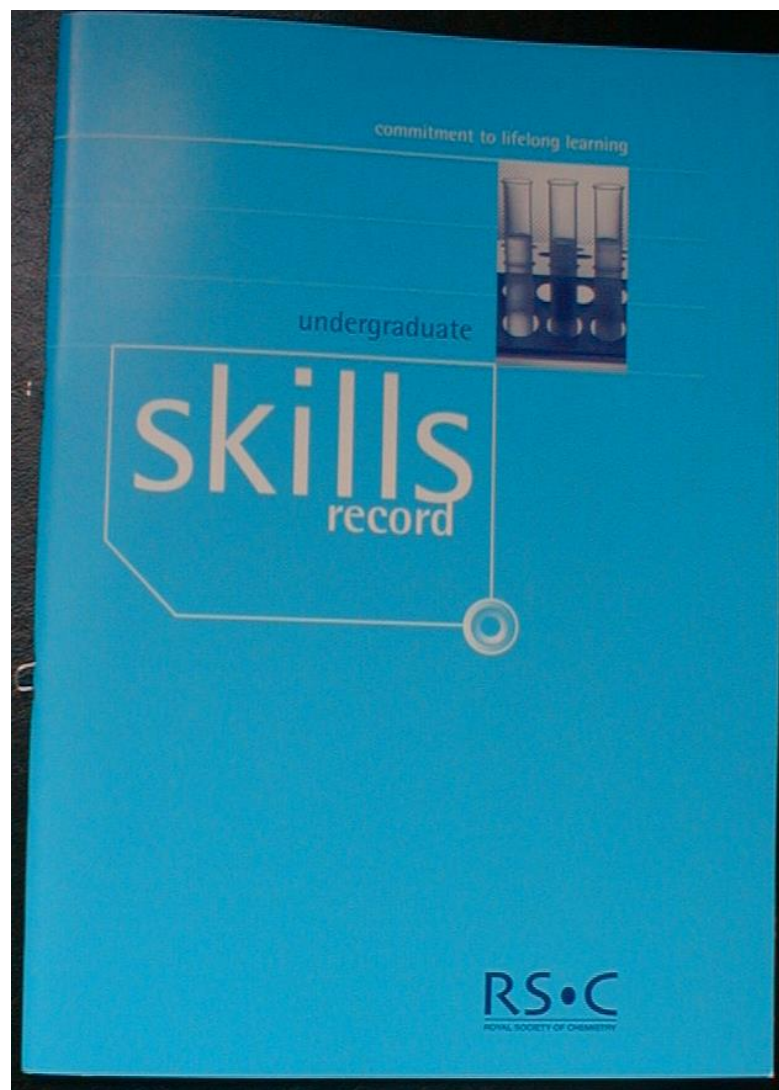
- Company focussed research
- Patents
- Increased profits or decreased costs
- Team work
- Reports Oral and Written
- Often students receive job offers
- Paid as an employee

Integrated into programme
8 months – 1 year

Vacation job
1-3 months

Undergraduate Skills Record

Royal Society of Chemistry



Why do Personal development Planning

If I ask a student at interview –

“Did you do any group work during your undergraduate degree?”

and they think for a while before saying

“I seem to remember putting a poster together with some other students in Second year”

I am not impressed.

If they can reply immediately with details of various activities, they are much more likely to get the job

Recruitment Officer, Quintiles, Edinburgh

Nine Key Skills

- Planning and Organisation
- Study Skills
- Handling Information
- Communication Skills
- Teamwork
- Scientific / Practical Skills
- Improving Learning and Performance
- Information/Communication Technology
- Problem Solving

Showing PDP is worthwhile

- Personal Development planning is for the benefit of the students
- They need to see it as worthwhile
- Senior students acting as mentors help because they can give practical examples of where it was important (Industrial Placement or job interviews)
- A staff member committed to the scheme makes the scheme work.

Undergraduate skills record

- Student centred
- Regularly updated
- Read over before interviews etc.
- Covers academic and non-academic activities
- Paper, on-line and downloadable formats available

Student Enterprise

Business Plan competition

- Work in groups to create a business plan
 - Idea
 - Market research
 - Costing
 - Timescale
- Substantial prizes
- Legal assistance in setting up a spin-out company

How you can help

- Raise awareness of employability issues within your department
- Think how you can include transferable skills within the modules you teach
- How can external placements be introduced into your department?
- Help and encourage students with personal development planning
- Encourage students to become involved in Student Enterprise

Teach your own subject brilliantly