Visit to the Central Laser Facility at RAL – 10/05/12

Visit to the Central Laser Facility (CLF) at the Rutherford Appleton Laboratory, Harwell. This was a General Public Access Day when members of the public allowed in to have guided tours of the different departments on the site. We chose the CLF and a particle physics lecture by a physicist working on the LHC at CERN.

Three of us went on the tour, Robert, Marius and myself, for the afternoon Robert was known as Steve as his place was originally booked in Steve's name and it was too late to change the details.

It was a longish walk from the car park to the reception area and it started to rain, you might think that members of a science club would have foreseen this possibility and taken an umbrella – No.

We got to the reception building and signed in and dried off, before setting off to the CLF building, in the rain, as part of a group of about a dozen.

The CLF is run by the Science and Technology Facilities Council (STFC) to enable many different kinds of research using lasers. Among the most recent projects are:

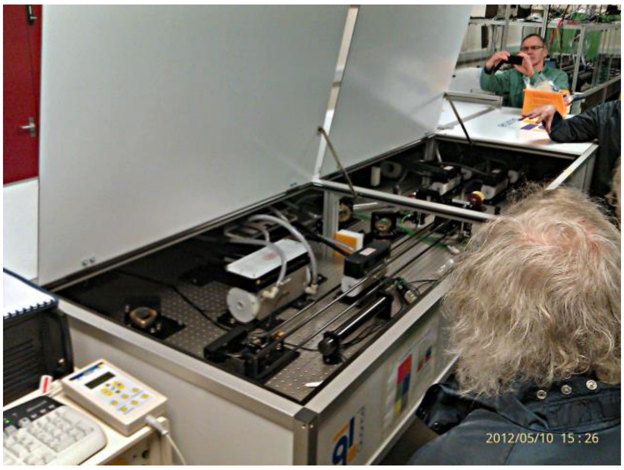
- Novel Raman spectroscopy techniques to "see through" opaque materials (e.g. plastic, skin) for non-invasive detection of diseases, drugs and explosives.
- Acceleration of subatomic particles to high energy for medical, security and other applications
- Understanding photosynthesis.
- Studying the chemistry inside cells for improving treatment of disease.
- Climate change chemistry measured on the surface of laser trapped cloud droplets
- New concepts in laser fusion energy.

CLF's laser facilities include:

- Vulcan — for science in extreme conditions
- Gemini — for applications of intense lasers
- Artemis — for ultra short x-rays for chemistry and materials science
- Ultra — for ultrafast molecular dynamics
- Octopus — for advanced biological imaging

The piece of kit that we were viewing was Gemini but before that we were given a short introduction to laser (light amplification by stimulated emission of radiation) technology by one of their boffins.

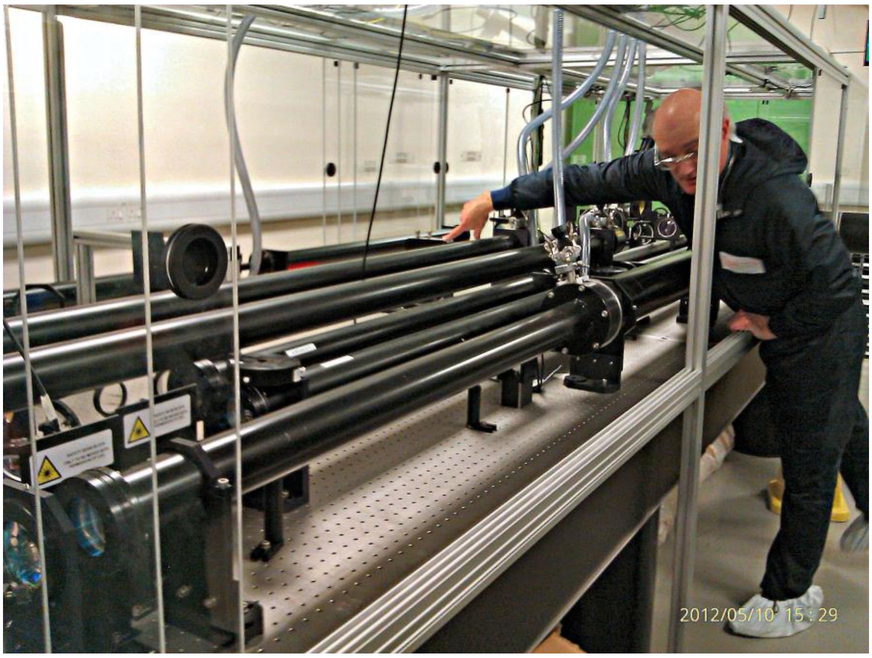
Laser light is produced in either a continuous beam or a high energy pulse. The ruby laser was first invented in 1960. Ruby is an aluminium oxide in which some aluminium atoms have been replaced by with chromium atoms. Chromium gives ruby its red colour. Chromium atoms absorb green and blue light and emit only red light. For a ruby laser, a crystal of ruby is formed into a cylinder. A fully reflecting mirror is placed at one end and a partially reflecting mirror on the other. A high-intensity lamp is spiralled around the ruby cylinder to provide a flash of white light that triggers the laser action. The green and blue wavelengths in the flash excite electrons in the chromium atoms to a higher energy level. Upon returning to their normal state, the electrons emit their characteristic ruby-red light. The mirrors reflect some of this light back and forth inside the ruby crystal, stimulating other excited chromium atoms to produce more red light, until the light pulse builds up to high power and drains the energy stored in the crystal.



We were shown a sapphire which is used in Gemini and other lasers instead of rubies because they can be tuned to the infra red and near infra red end of the spectrum. Those who expected the sapphire to be blue were surprised to see it was pink; this is due to it being doped with titanium.

The rubies and sapphires used in the lasers are synthetic and not natural gemstones, even so the one we were shown cost £45,000 and the chap made sure he got it back after we had had a good look at it.

We then proceeded to a changing room where we donned over shoes and coats, not for our protection, but to prevent us from contaminating the equipment. Once inside we saw a bench top laser about a metre long but the main one was Gemini. In my ignorance I had assumed that the laser would be one long straight tube, but no, each section would amplify the pulse and it would be turned 90° by special mirrors into the next section. Each amplification increases the diameter of the pulse until the final section when it is reduced down to two microns of incredibly high energy when it enters the target area. The target area is in the floor below surrounded by 2M thick concrete walls and huge lead sliding doors. We were told that they have been trying to hit a two micron target with their two micron pulse but have so far failed. When they have a larger target and hit it the energy released is enormous hence the need the high levels of protection.



Astra is a high power, ultra-short pulse, high repetition-rate laser. It uses titanium-doped sapphire (TiS) as its active material, and works at 800 nm in the near infra-red part of the spectrum, just outside the region visible to the human eye

The pulses from Astra are so short that they are like sheets of light energy thinner than a human hair, which in addition can be focused to a spot a few thousandths of a millimetre across. The energy they contain is thus delivered to a very small target extremely quickly, allowing experimenters to study the way matter behaves under extreme conditions of temperature and pressure.

Tony Bates.

Science & Technology Facilities Council

Rutherford Appleton Laboratory

General Public Access Days

Our General Public Access Days offer you the opportunity to discover what 'Big Science' really is at our Rutherford Appleton Laboratory in Didcot. You will have the opportunity to see unique and inspirational facilities which include ISIS, Particle Physics, RAL Space, e-Science and the Central Laser Facility. You can meet and experience the enthusiasm of our dedicated scientists as they guide you around the facilities on specially tailored tours for the general public.

A few things you should know…

- The site covers over 2 hectares and a lot of walking outside between departments will be involved so sensible shoes and clothing is advised.

- If you wish to visit ISIS you will enter a classified radiation area with strict health and safety guidelines that should be considered (full details on request). ***This tour should be avoided if you have a pace maker, a hearing aid, are pregnant or are under 16 years of age.***

- The facilities are all working laboratories and some facilities have a lot of open stairs to climb so please ask us before signing up for a tour if you have any concerns.

- A wide range of literature on STFC and all its departments at the Rutherford Appleton Laboratory will be available.

- Refreshments will be supplied.

- The visit, onsite parking, refreshments and literature are provided free of charge, the only cost to you is for the journey to the laboratory.

There are two structured tour programmes available, one in the morning and another in the afternoon. There are 100 places available in each session, offered on a 'first come first registered' basis, so please book early to avoid disappointment.

The next General Public Access Day is on:

Thursday 10th May

To book please contact:

Heather Davies – STFC Visits Coordinator

Tel: 01235 778346

Email: heather.davies@stfc.ac.uk

Please note: Tours are available to a maximum of two departments; please specify your preferred departments when booking.

For more information visit: www.stfc.ac.uk

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