



UNIVERSITY OF
LIVERPOOL



UNIVERSITY OF LIVERPOOL CENTRAL TEACHING LABORATORIES EQUIPMENT BROCHURE

The Central Teaching Laboratories consolidate undergraduate teaching within the Faculty of Science and Engineering. A £28.6m investment has been made by the university towards the building and new equipment.

There are a total of 8 laboratories in the CTL which has driven curriculum redesign, with disciplines in Physics, Environmental Science and Chemistry making use of common skill modules.

The creation of the CTL has significantly increased the laboratory output of practical work within the university, hence enabling a utilisation rate of 48% compared to a 20% university average.

The CTL is a fully DDA compliant building, exceeding legislative requirements to provide an inclusive and integrated teaching experience, ensuring accessibility and useability by all.

Design of the CTL meets the BREEAM “excellent” criteria, which is extremely demanding for laboratory buildings due to the large amounts of energy consumed and the difficulty in minimising losses.

To compensate for this, CTL has constructed as a long span steel frame with precast concrete floors units, clad in Corten steel and limestone veneer. Exposed concrete surfaces provide thermal mass to improve energy efficiency, which has been paramount in the building’s design with passive ventilation where possible, solar shading, low velocity air distribution, chilled beams, high floor to ceiling heights to maximise day lighting, use of heat and power from a campus Energy Centre, and solar heating.

GROUND FLOOR

GERMANIUM DETECTOR

WHAT IS IT?

- High purity germanium gamma spectrometer
- Excellent energy resolution
- Energy ranges from 3 keV to 3 MeV combines the spectral advantages of Low Energy and Coaxial HPGe detectors
- Detection efficiencies and energy resolutions are optimized in the 3 keV to 662 keV energy region where most tightly grouped gamma lines of interest are located
- Graded shielding to reduce effects of background radiation

SAMPLE PREPARATION AND SOFTWARE

Measure the gamma spec of radioactive isotopes:

- Sealed cat 5 radioactive sources
- Neutron activated samples
- Environmental samples
- Sample size up to 60mm diameter for BEGE2825, 250 ml Marinelli beakers available
- Sample size up to approx 10cm³

ProSpect software is used for gamma spec analysis. LabSOCS for efficiency calibration and modelling and MCNP for modelling.

CONTACT AND AVAILABILITY

Marc Dunn mddunn@liverpool.ac.uk
Patricio Vasquez-Aguilar P.Vasquez-Aguilar@liverpool.ac.uk
Stephen Chappell schaps@liverpool.ac.uk

WHY YOU WOULD USE IT:

- Used for undergraduate physics teaching, Radiometrics MSc and external training courses
- Popular with project students from Physics and Environmental Sciences
- High resolution and excellent stability allow for accurate peak identification
- For Environmental samples – low activity samples can be measured for a long period of time to improve signal to noise ratio
- Quantify activity in unknown samples using energy and efficiency calibrations



SODIUM IODIDE DETECTOR

WHAT IS IT?

- Scintillation gamma detector consisting of Mirion Osprey MCA base unit and Bicron Sodium Iodide crystal
- The Osprey MCA is an all-in-one HVPS, preamplifier and digital MCA compatible with standard 14-pin scintillation detectors using 10-stage PMTs
- Powered over ethernet or USB 2.0 they are remotely accessible and portable
- The Sodium Iodide (NaI) scintillation crystals are cylindrical with diameter 51mm and length 51mm and are housed in a lead shield to reduce background
- 30 NaI detectors can be available in the radiation laboratory
- Other scintillation crystals are available including Lanthanum Chloride (LaCl), Bismuth Germanate (BGO), Lithium Glass (LiG) and Lithium Iodide (LiI)

CONTACT AND AVAILABILITY

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WHY YOU WOULD USE IT:

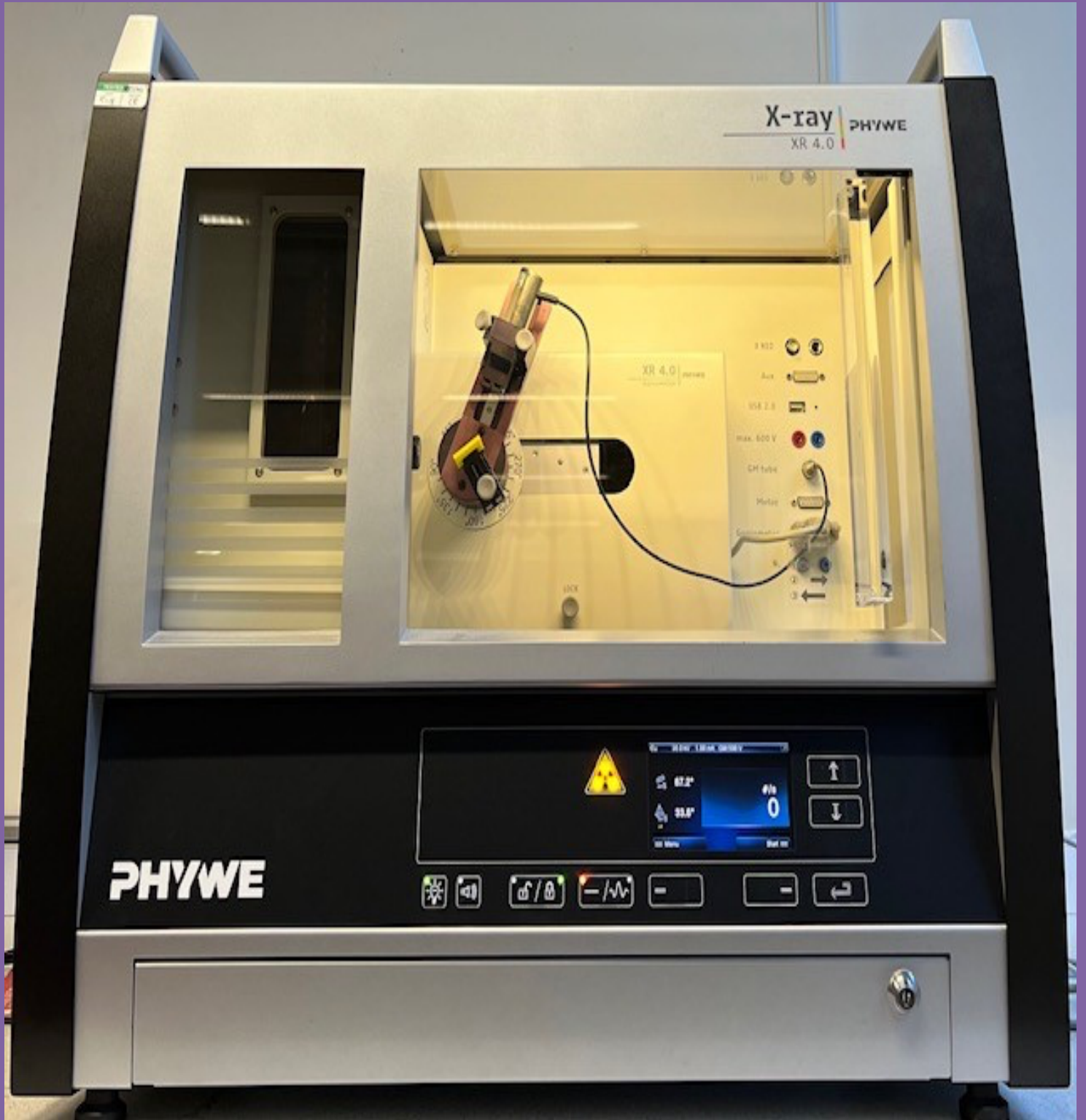
- Mainly used for undergraduate physics teaching to understand gamma radiation
- NaI detectors are easy to use, they are efficient and provide reliable data quickly from calibration sources and neutron activated metals
- Can be used in different modes to investigate gamma spectrum, radioactive half-life or coincidence measurements
- Resolution of 662keV peak from Cs-137 is approx. 8.5%
- Remotely accessible, the detectors can be controlled from anywhere
- Can be set up through USB connection to a laptop to become a portable device

SAMPLE PREPARATION AND SOFTWARE

Suitable for use with category 5 sealed calibration sources and neutron activated metal samples. Not suitable for low activity environmental samples.

C ProSpect software is used for gamma spec analysis. LabSOCS for efficiency calibration and modelling and MCNP for modelling.





X-RAY BOXES & CT SCANNER

WHAT IS IT?

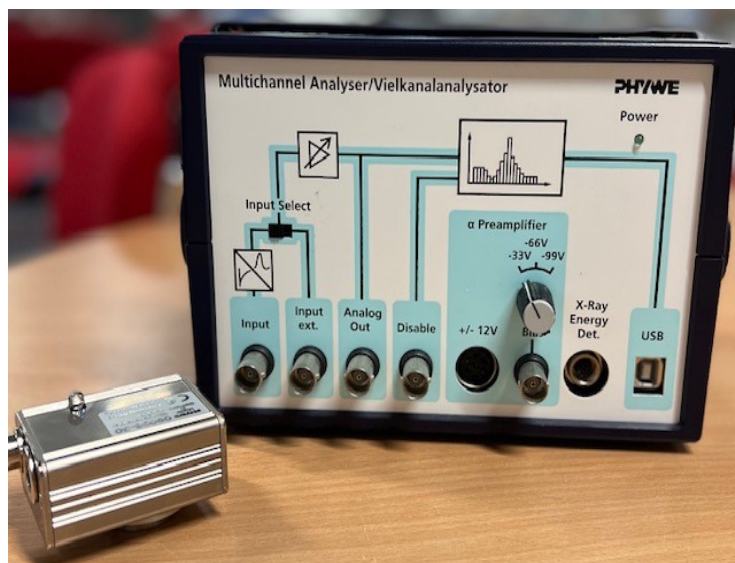
- PHYWE XR4.0 unit is a versatile teaching instrument for x-ray applications
- Quick change x-ray tubes Cu, Mo and W that can be plugged in and remain visible during operation
- Can be set up for x-ray diffraction, x-ray fluorescence or x-ray CT
- Variable current from 0 – 1mA in 0.01mA intervals and voltage from 0 – 35kV in 0.1kV intervals
- Determination of the X-ray intensity via an integrated Geiger-Müller counter tube connection with a variable counter tube voltage (0...600 V) and an integrated loudspeaker
- Experiment chamber (mm): 440 (W) x 345(H) x 354 (D)

WHY YOU WOULD USE IT:

- Used for teaching non-destructive x-ray investigation techniques
- Easy to use benchtop x-ray device that can demonstrate various techniques, the units are safe for inexperienced users with interlocks and software control
- X-ray diffraction – structural analysis of powder samples such as KCl or NaCl, characteristic x-ray investigation of Cu, Mo or W, crystal structure investigation/Laue method
- X-ray fluorescence – qualitative x-ray fluorescence of alloyed metals, solutions, ore samples
- X-ray CT – principles of CT scan, optimisation of CT scan quality

SAMPLE PREPARATION AND SOFTWARE

- Samples vary depending on the application
- For x-ray diffraction small crystals and powders such as NaCl can be used
- For x-ray fluorescence metal samples are used
- For x-ray CT samples should be no bigger than 5cm³, plastics and materials of similar density work well
- Phywe measure software, automatically detects the set-up of the unit and applies settings accordingly
- Phywe measure CT and separate image reconstruction software



CONTACT AND AVAILABILITY

Marc Dunn mddunn@liverpool.ac.uk
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FIRST FLOOR

FLUME TANK AND HYDROLOGY SYSTEM

WHAT IS IT?

Various flume tanks that allow different wave types to be generated and can demonstrate their effect on different sample mediums or explore the physics of the waves themselves.

Sediment transport demonstration channel (Flume tank)

Uses different sediment mediums to show wave effects on the sediment.

GUNT GAMBURG FLUME HM 165

Uses fluid without a sediment material and different shaped blocks to affect flow

GUNT GAMBURG FLUME HM 166

Sediment transport channel

CONTACT AND AVAILABILITY

Three flume tanks are available in CTL-5 and are manufactured by GUNT GAMBURG.

For use, please contact Sabine Hiltcher: sabineh@liverpool.ac.uk / 0151 795 9724

WHY YOU WOULD USE IT:

Useful for visually teaching about waves and bedform generation in environmental science but also cross discipline use for focusing on visual presentation of waves in both Physics and Chemistry.

SAMPLE PREPARATION AND SOFTWARE

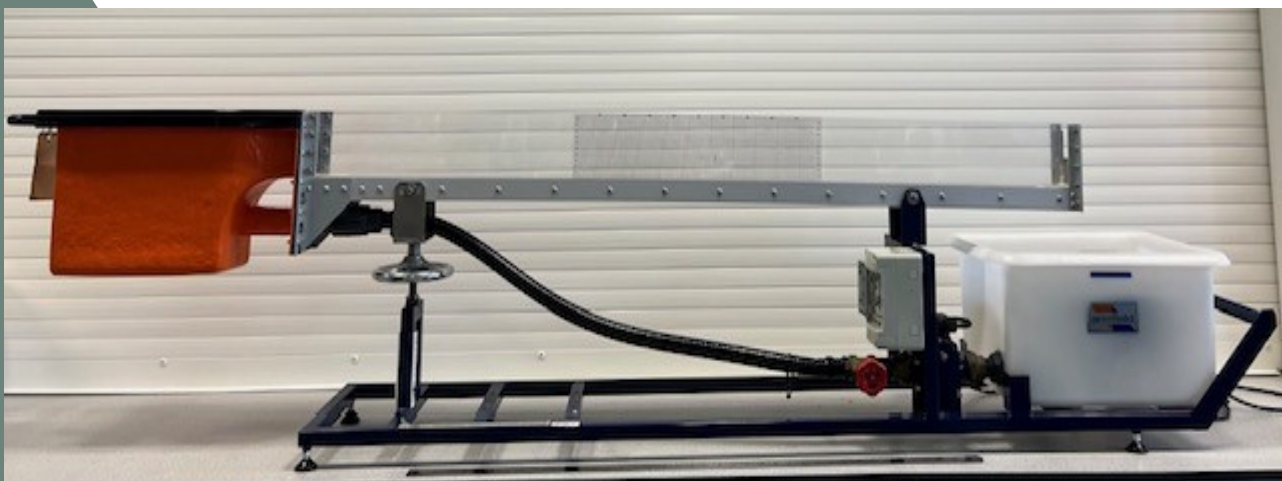
GUNT GAMBURG FLUME HM 165

Any fluids providing, they are not too viscous to flow and predesigned blocks to create under the surface interactions.

3 flow meters with point and line markers allow measuring of wave characteristics (speed, frequency, amplitude)

GUNT GAMBURG FLUME HM 166

Any fluid and material that can be made into a 'sediment bed'



CATCHMENT SIMULATOR

WHAT IS IT?

Hydrology system useful for studying water-sediment interactions.

The main tank basin measures 2x1m area with a depth of 2m allowing a max sand filling of 3m³. This can be adjusted at inclinations of 5% allowing various topographies and groundwater affects to be studied.

The water system uses 8 nozzles that work in 2x4 groups to spray water at 1-7Litres/min with the water pump providing a max flow rater 2000L/hr from a 180L storage tank.

Dimensions of total rig:
LxWxH: 2400x1100x1800mm

CONTACT AND AVAILABILITY

Training on how to use the Riverflow will be delivered by CTL technical staff contact Joshua Hicks
jhicks94@liverpool.ac.uk

Manual:
<https://gunt.de/en/products/hydraulics-for-civil-engineering/hydraulic-engineering/seepage-flow/studies-in-hydrology/070.16500/hm165/glct-1:pa-148:ca-181:pr-764>

WHY YOU WOULD USE IT:

Varied controls and monitoring equipment make this an ideal tool for investigating both steady and transient water processes i.e:

Steady processes:

- groundwater flow through soil
- effects of wells or other drainage on groundwater levels

Transient processes:

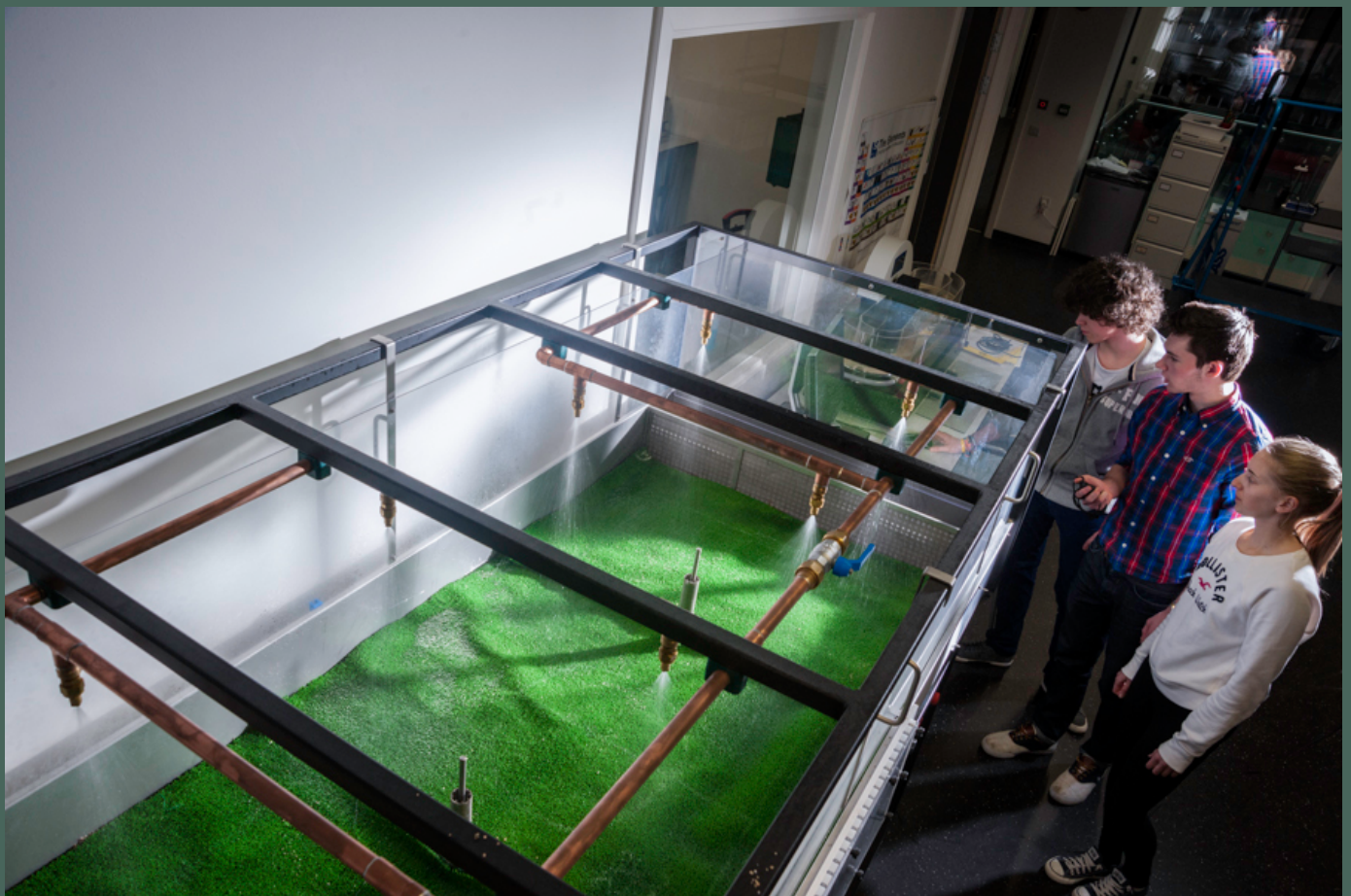
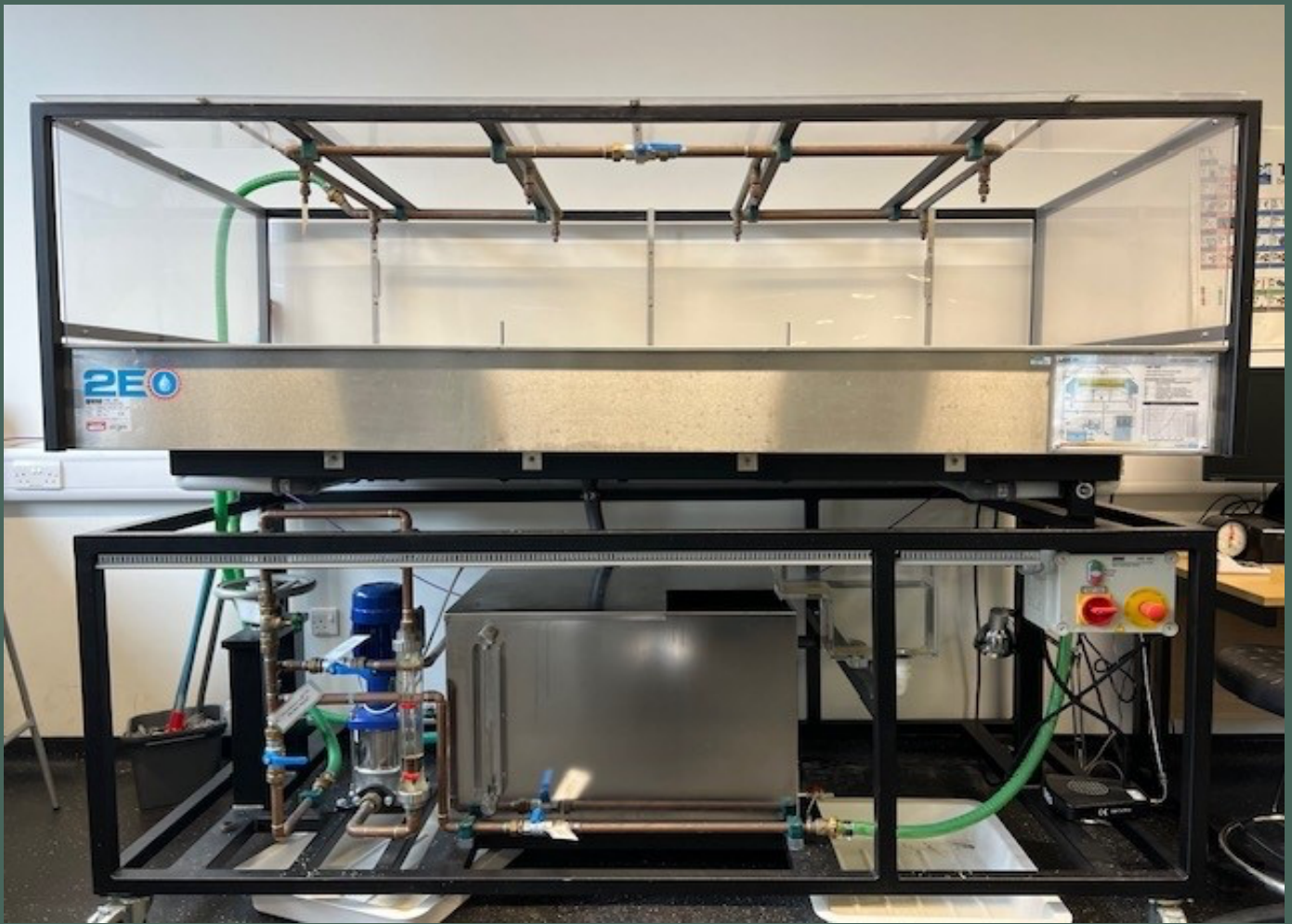
- effect of varying durations and volumes of rainfall on ground water and sediment conditions

SAMPLE PREPARATION AND SOFTWARE

1-2mm grain sand filling the basin
Sufficient water supply to fill the tank

The system has considerable measuring equipment with 19 measuring points:

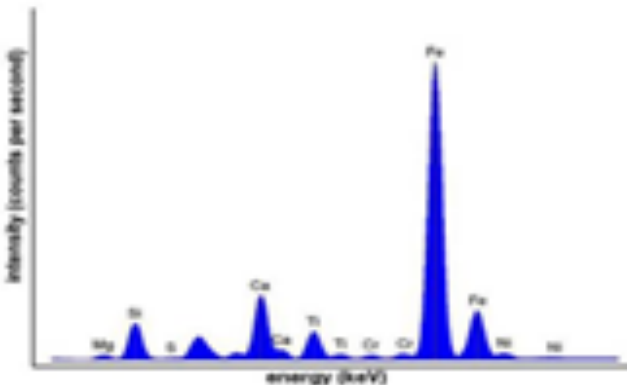
- tube manometers (measuring groundwater)
- flow meter (measuring supply water)
- tank weir meter (measuring drainage)



HANDHELD XRF

WHAT IS IT?

The NITON Handheld XRF (NITON XL3t 900 Analyzer) is a single unit, handheld, portable x-ray fluorescence (XRF) elemental analyser. This device emits radiation when in use.



CONTACT AND AVAILABILITY

Training on how to use the handheld XRF will be delivered by CTL technical staff – contact Joshua Hicks jhicks94@liverpool.ac.uk to arrange training.

WHY YOU WOULD USE IT:

Different measuring modes allow for the measurement of elements in a variety of samples. In the CTL they are mostly used to find concentrations of analytes in rock or soil, or the analysis of metals in artefacts. Some Modes need elements present at 1% or over, others are optimised for elements at less than 1%.

Examples of Measuring modes:

- General Metals
- Gold
- Metal pass/fail
- Test All Geo
- Soils
- Mining Cu/Zn
- Mining Ta/Hf

SAMPLE PREPARATION AND SOFTWARE

When using the Handheld XRF in one of the stands, the sample size is restricted to the stand chamber size.

Using out of the stand, sample size is unlimited, however certain safety measures need to be observed, as the device emits radiation when measuring.

The x-ray source in the device irradiates the sample with primary x-rays. These interact with the atoms in the sample, causing them to fluoresce secondary x-rays, which the device detects, generating x-ray spectra like the one shown. The software identifies and counts the x-rays that form these peaks.



DESK TOP MICROSCOPE

WHAT IS IT?

The laboratories house multiple microscopes with various uses: 115 Meiji Zoom function microscopes; 115 Meiji Techno's MT4000 Phase contrast microscope; 140 Meiji Polarising microscopes of which 30 have Luminera Infinity Cameras.

WHY YOU WOULD USE IT:

Multi-zoom benchtop microscopes allow analysis of materials from a lower resolution overview at x2.5 magnification to high resolution detailed analysis of isotropic and anisotropic materials at x10 and x100 magnification (for oil saturated samples). Microscopes using INFINITY 3-1 camera allow computer imaging of thin sections enabling graphics creation from thin section slides.

These microscopes are usable by people of all expertise levels allowing accessible teaching of undergraduate classes to independent research for individuals.

Providing cross-discipline use across inorganic and organic subjects including environmental science, chemistry, forensics, medical research.

SAMPLE PREPARATION AND SOFTWARE

Any sample that can be prepared into a thin section slide.

Using INFINITY 3-1 camera accessories provides live computer imaging with 1392x1040 resolution. Automatic or manual controls over settings including brightness and contrast.

INFINITY Capture software takes images in various formats i.e jpeg with detailed analysis then possible including scale notations.

CONTACT AND AVAILABILITY

Training on how to use the desktop microscopes will be delivered by CTL technical staff– contact Hicks, Joshua jhicks94@liverpool.ac.uk

Manual-
<https://meijitechno.co.uk/microscopes/polarising/>

SCANNING ELECTRON MICROSCOPE

WHAT IS IT?

The SEM TM3000 scans with a focused electron beam over a sample surface, to create an image. The electron beam interacts with the surface, this results in information about surface topography and sample composition.

SAMPLE PREPARATION AND SOFTWARE

CTL has sample holders for glass slides and sample stubs. Solid and powder samples can be mounted and observed on these. Sample size varies. Depending on how it is mounted samples can be only a few cm high.

In general, thin sections get carbon coated 20nm. A gold coating will be smoother and gives a better 3D image of the object.

Liquid or liquid state materials cannot be used in the SEM.

Insulators can build up charge resulting in brightness and contrast changes – there is a charge up reduction mode.

Magnetised samples must be demagnetized before observing under the SEM.

Backscattered electrons are high energy atoms from below the sample surface. A BSD detector is used to pick up the signal and the TM3000 software to observe this image.

X – Ray is emitted when the electron beam displaces an inner shell electron that is replaced by an outer shell electron. Each element has a unique energy difference between the inner and outer shell electron. These properties allow to identify elements with an EDS detector with the Quantax70 software.

WHY YOU WOULD USE IT:

In the SEM a sample can be observed at a magnification from x 15 to x 30000, to gather topographic and sample composition data.

The SEM has a wide array of applications, here in the CTL, it is mainly used for looking at element composition of rock thin sections, topography, and composition of archaeological artefacts, and to observe the structure of chemical compounds.



CONTACT AND AVAILABILITY

Training on how to use the SEM will be delivered by CTL technical staff – contact Hicks, Joshua jhicks94@liverpool.ac.uk

An online booking system will show availability at the time. Undergraduate teaching will be prioritised over Research use.

CATHODE LUMINESCENCE MICROSCOPE

WHAT IS IT?

The Cathodoluminescence Stage can be mounted to most optical microscopes, whether transmitted or reflected light, with a large choice of techniques available this versatility and flexibility allows quick and easy use across the labs.

WHY YOU WOULD USE IT:

Cathodoluminescence allows a low-cost solution to analyse most materials. Achieving the same information as with an Electron Microscope but at a fraction of the cost and time, as no special preparation is required for samples.

SAMPLE PREPARATION AND SOFTWARE

The chamber uses both solid (up to 15mm thick) and thin sections.

This can be enhanced by the addition of Optical Spectral Analysis (OSA) or Energy Dispersive X-Ray Spectrometry (EDX).

CONTACT AND AVAILABILITY

Training on how to use the CLM will be delivered by CTL technical staff – contact Hicks, Joshua jhicks94@liverpool.ac.uk

SLIDE SCANNER



SAMPLE PREPARATION AND SOFTWARE

Thin sections & prepared glass slides in the following size.

1 x 3 inch

1 x 2 inch

1x 3-inch-deep slide

1in round

30x 45 mm

28 x 45 mm

Freely available to download from the microscopes international site allowing you to view the captured whole slide images offsite. They can also be viewed in your browser or any other SVS viewer.

WHAT IS IT?

Whole slide scanner, quickly and easily capture high resolution whole slide images. Using Plain polarised light and cross polarised light. The scanner has 2 objective lenses which are 10x and 20x.

WHY YOU WOULD USE IT:

It can be used to capture whole slides within a matter of minutes. Can be used for geological thin sections or biological sections. These images can then be used to pick out areas of interest and allow you to decide which areas will be required more analysis.

CONTACT AND AVAILABILITY

In CTL-5 available during CTL's open hours. Booking can be made through clustermarket once training has been given by technical staff.

[uScopeGX Geological Digital Microscope Overview: Microscopes Intl. \(microscopesinternational.com\)](#)

Contact:

Josh Hicks: jhicks94@liverpool.ac.uk
01517989738

NEAR IR SPECTROMETER

WHAT IS IT?

The laboratories house 1 Spectrum Two FT-IR Spectrometer and 4 Bruker Alpha FTIR spectrometers.

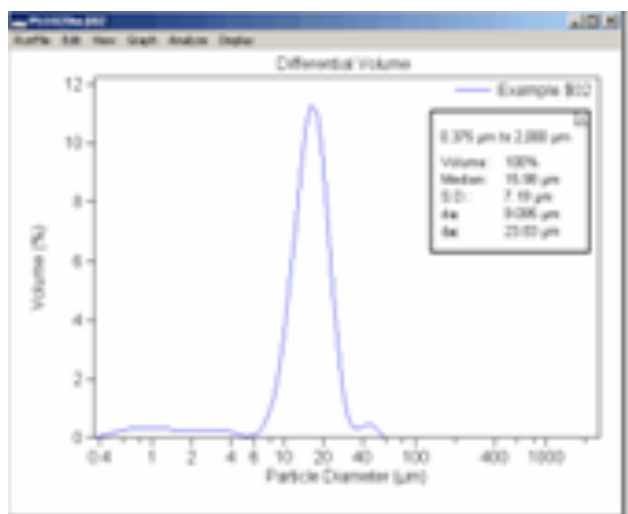
Results are obtained by an infrared spectrum of absorption or emission of a sample and collect at a high resolution across a wide spectral range, delivering results in 1 minute measurement time for returned spectra.

WHY YOU WOULD USE IT:

FTIRs are ideal for teaching small classes around and are easily usable even without scientific training generating infrared spectra and comparing obtained spectra against reference points is easy and quick.

The wide spectra covers 375 – 7,500 cm^{-1} and the resolution is adjustable from 0.8 cm^{-1} to 256 cm^{-1}

The FTIR is ideal for studying pharmaceuticals, fuels, environmental science, polymers, research, and academia.



SAMPLE PREPARATION AND SOFTWARE

Any solid, liquid or gas sample.

Spectrum 10 software allows full control of instrumentation and enables editing of spectra collected. The spectrometers can function as ratio, single-beam, or interferogram modes. Spectrum 10 NetPlus allows cloud saving of spectra and wireless PC compatibility.

CONTACT AND AVAILABILITY

Training on how to use the FTIR will be delivered by CTL technical staff – contact Joshua Hicks jhicks94@liverpool.ac.uk

Manuals

Spectrum two - <https://www.perkinelmer.com/product/spectrum-two-ft-ir-sp10-software-l160000a>

Alpha FTIR –

<https://www.jyu.fi/science/en/chemistry/research/infrastructure/kem/spectrometers/brukeralpha>

COULTER

WHAT IS IT?

LS 13 320 Laser Diffraction Particle Size Analyzer.

The Coulter measures the size distribution of particles suspended in a liquid by using the principles of light scattering.

PIDS (Polarization Intensity Differential Scattering) technology provides a dynamic range of 0.0017 μm to 2000 μm .

SAMPLE PREPARATION AND SOFTWARE

Sediment sample of grain size smaller than 2mm. A maximum of a few spatulas full of sample is needed depending on the sample composition. The sample will be lost in the measuring process.

The Coulter works by analysing the diffracted light produced when a laser beam passes through a dispersion of particles in a liquid. The angle of diffraction increases as particle size decreases, so that this method is particularly good for measuring sizes between 0.1 and 3,000 μm .

WHY YOU WOULD USE IT:

The Coulter analyser provides size distribution in volume, number and surface area in one measurement, with an overall sizing range from 17 nm to 2000 μm . When generated these particle size measurements produce a distribution that can be displayed as a frequency plot, with percentages or proportions in increasing grain size classes.

CONTACT AND AVAILABILITY

Training on how to use the Coulter will be delivered by CTL technical staff – contact Joshua Hicks jhicks94@liverpool.ac.uk .

An online booking system will show availability at the time. Undergraduate teaching will be prioritised over Research use.

CARBON COATER

WHAT IS IT?

A combined system provides both carbon coating and sputtering sample preparation. Carbon coating is achieved by evaporating carbon inside the vacuum seal chamber fixing carbon to the sample. Similarly sputtering affixes samples with non-oxidising metals.

The coater comes with premade coating recipes and the option for personal recipes for quick access next time. The touch screen system provides quick and accessible functions as well as help screens with additional information. The whole system can be easily updated by USB along with recipes exportable to USB.

CONTACT AND AVAILABILITY

Training on how to use the SEM will be delivered by CTL technical staff – contact Hicks, Joshua jhicks94@liverpool.ac.uk

Manual

<https://www.quorumtech.com/q150r-rotary-pumped-sputter-coatercarbon-coater/>

WHY YOU WOULD USE IT:

The coater is an essential for carrying out research especially when using S.E.M methods.

Materials such as silk would usually be fragmented when seen in SEM providing a poor resolution, when coated with Au using the sputtering function silk can then be analyzed by SEM as the Au binds with the silk increasing the contrast and preventing fragmentation or artefacting of the image without damaging the microscopic variations such as impurities or concentrations of materials.

SAMPLE PREPARATION AND SOFTWARE

Samples need to be on glass microscope slides

Samples can be coated with carbon evaporate or sputtering uses various non-oxidising metals: Au/Pd, Pt/Pd, Pd, and Cu (Pt is also achievable with additional hardware).

Digital display has enclosed software for fully controllable coating even mid process for protecting delicate samples.

Safety function periodically cools the chamber and prevents vacuum leaks resulting in failure or damaging of samples

CORE SCANNER

WHAT IS IT?

The MSCL-XZ: benchtop logger is an automated split core measuring system allowing advanced data collection by scanning the core with sensors along the sample.

Sampling uses several techniques to produce core analysis by X-ray fluorescence, colour spectrophotometry, high-resolution magnetic susceptibility, and core imaging.

The average scan with all sensors active at 2cm scanning intervals would enable about 50m of core to be processed through the laboratory per day.

Dimensions: 230 x 35 x 130 (cm)

Weight: approx. 70 kg

SAMPLE PREPARATION AND SOFTWARE

Sample cores can be max length up to 155 cm and diameter up to 15 cm

Results are generated in ASCII files containing all measured parameters vs. depth in section and core

WHY YOU WOULD USE IT:

The non-destructive process creates high resolution data this allows the sample to be used repeatedly without damaging the sample this is especially advantageous given the cost of core retrieval. The process is fully automated and highly accurate to 0.02mm.

The array of functions allows a full image to be generated of complex geologies.

XRF: by He-cells can detect even low energy elements such as Mg, Si and Al, elemental analysis are useful across environmental science.

Colour spectrophotometry: uses 39 colour spectra to provide accurate colour data. Accurate colour data prior to oxidization is crucial to ore mineralogy, sedimentology, and climate research.

Magnetic susceptibility: Changes in magnetic susceptibility correlate with changes in sedimentary provenance and/or diagenetic environment.

CONTACT AND AVAILABILITY

Training on how to use the Core Scanner will be delivered by CTL technical staff – contact Hicks, Joshua
jhicks94@liverpool.ac.uk

SECOND FLOOR

GAS CHROMATOGRAPHY MASS SPECTROMETRY



WHAT IS IT?

GCMS is used across several analytical areas including forensics and space exploration.

Samples can be tested by full spectrum scans returning the full range of compounds present in a sample which are then compared to the computer database producing a range of chemical peaks showing what compounds make up the sample. Selective Ion Monitoring allows the user to scan a sample for specific compounds which can be detected in smaller amounts (the certainty is lower in SIM over full scan MS)

GAS CHROMATOGRAPHY

WHAT IS IT?

Gas Chromatograph Thermo Scientific FOCUS GC with automated sampling and computer software allowing multiple processes to be used. Currently fitted with a HP-5MS solvent column. It is an analytical separation technique which analyses volatile substances in the gas phase by dissolving in a solvent and vaporizing. As a result, the analytes are separated producing separate peaks with individual retention times.

SAMPLE PREPARATION AND SOFTWARE

8 samples can be run in the GC at the same time. Samples can be solid or liquid if they are readily soluble in solvent (current solvent column is HP-5MS). Approximately 2-3mg of sample needs dissolving in 1 ml of solvent.

Focus GC analytical software accompanies the GC ready for analytical interpretation.

CONTACT AND AVAILABILITY

Mrs Lynne Chapman, Technician,
lchap@liverpool.ac.uk, 0151 795 9739
Ms Emma Coates, Technician,
ecoates@liverpool.ac.uk, 0151 795 9739

WHY YOU WOULD USE IT:

Gas chromatography can be a useful tool to provide qualitative and quantitative analysis of compounds by testing the purity and tracing impurities of samples. It is widely used by undergraduate Chemists to analyse samples and compare against pure GC samples to identify correct synthesis of products and impurities present in submitted samples.



HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

WHAT IS IT?

- High Pressure Liquid Chromatography – an analytical technique used to identify the components in a mixture and separate mixtures of very similar compounds
- The Agilent 1200 Series Gradient system is the ideal MultiSolvent HPLC Gradient System offering flexibility for teaching applications
- It is a modular system that includes: Quaternary gradient pump (including degasser), Standard Autosampler, Thermostating sub ambient to 80° C Column Compartment, Variable Wavelength Detector includes standard flow cell
- Offers good resolution and low limits of detection

CONTACT AND AVAILABILITY

Mrs Lynne Chapman, Technician,
lchap@liverpool.ac.uk, 0151 795 9739
Ms Emma Coates, Technician,
ecoates@liverpool.ac.uk, 0151 795 9739

Alternatively, please contact Konstantin
Luzyanin via email or phone:

luzyanin@liverpool.ac.uk
0151 795 8399

WHY YOU WOULD USE IT:

- Currently used as an analytical technique by chemistry undergraduate students to identify samples or to quality check products
- Potential use for chemistry or other subjects for project work identifying components in a mixture
- We work closely with analytical services in Chemistry for technical expertise in HPLC

SAMPLE PREPARATION AND SOFTWARE

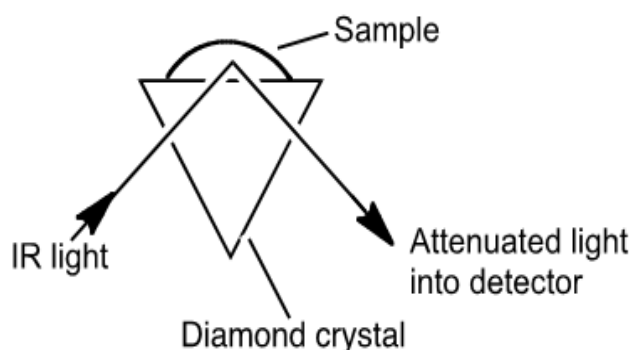
- Liquid samples of small volume – μL injection volume
- Methods can be developed for a wide range of samples from small organic molecules and ions to large biomolecules and polymers
- HPLC uses ChemStation software.



INFRA-RED SPECTROMETRY

WHAT IS IT?

Infra-red radiation is passed through the crystal and internally reflected. The internal reflection creates an evanescent wave that extends into the sample. This evanescent wave passes back into the instrument, but in regions of the IR spectrum where the sample absorbs, the wave is altered or attenuated. Known as Attenuated Internal Reflectance (ATR)- much quicker and simpler technique.



SAMPLE PREPARATION AND SOFTWARE

Samples submitted can either be solid or liquid. Minimal sample is needed to cover the IR beam. OPUS/Mentor software is used to analyse IR spectra.

WHY YOU WOULD USE IT:

An FTIR spectrum arises from interferograms being 'decoded' into recognizable spectra. Patterns in spectra help identify the sample, since molecules exhibit specific IR fingerprints.

IR is most commonly known in the identification of an unknown but also provides quantitative information about additives or contaminants. Kinetic information can be observed through the growth or decay of absorptions.

CONTACT AND AVAILABILITY

Second floor Sample room in CTL
Mrs Lynne Chapman, Technician, lchap@liverpool.ac.uk, 0151 795 9739
Ms Emma Coates, Technician, ecoates@liverpool.ac.uk, 0151 795 9739

<https://www.jyu.fi/science/en/chemistry/research/infrastructure/kem/spectrometers/brukeralpha>

UV-Vis SPECTROMETRY

WHAT IS IT?

UV-Vis spectroscopy is an analytical technique that measures the amount and wavelengths of UV or visible light that are absorbed by or transmitted through a sample in comparison to a reference or blank sample. This property is influenced by the sample composition, potentially providing information on what is in the sample and at what concentration.

GENESYS 180 features a high-resolution colour touchscreen with Wi-Fi networking and double beam operation for laboratories requiring reference cell position for kinetics applications.



WHY YOU WOULD USE IT:

UV-Vis is non-destructive, quick, and easy to use. There are many applications, such as, medicinal, and pharmaceutical analysis, study and identification of chemical compositions and kinetic properties.

SAMPLE PREPARATION AND SOFTWARE

Samples are usually measured in solution. You will use small cuvettes to hold the sample. Only 3.5 mL of solution is required to fill each cuvette. A range of different concentrations can be measured, but if the sample is too concentrated you will not get an accurate reading. The GENESYS 180 is equipped with an 8-position cell changer. Wavelength range 190-1100nm.

GENESYS 180 UV-Visible Spectrophotometers use GENESYS Software. They contain USB-A ports to export data to network or PC via USB, Ethernet, or Wi-Fi USB adaptor. Printing is also available via USB, ethernet and Wi-Fi USB.

CONTACT AND AVAILABILITY

For availability, please contact CTL 8 lab technicians:

Chris Maloney, cstalker@liverpool.ac.uk

Ann Leyden, annleyde@liverpool.ac.uk

Liz Fisher, Liz.Fisher@liverpool.ac.uk

<https://www.thermofisher.com/order/catalog/product/840-309300>

NMR ULTRASHIELD 300

WHY YOU WOULD USE IT:

NMR is an indispensable tool in Chemistry. It is used in Organic Chemistry to determine the structure of molecules. It can also be used to monitor reactions and probe molecular dynamics.

In other areas of Chemistry NMR provides rare insight into such aspects as structure of catalysts and the state and reactions of electrolytes in batteries.

NMR can also be used in biological research to examine the structure and interaction between proteins and Physics to investigate magnetism.

SAMPLE PREPARATION AND SOFTWARE

Make up a solution of your compound. Typically, 5-10 mg is required for ^1H NMR, 25-50 mg is required for ^{31}P $\{^1\text{H}\}$ NMR and 50-100 mg for $^{13}\text{C}\{^1\text{H}\}$. Accurate masses are not required. The solution must be perfectly clear with no undissolved material floating in it. Carefully transfer this to an NMR tube. If there is any solid material in the sample, filter it directly through a lightly packed, short plug of cotton wool in a Pasteur pipette. Place a cap on the tube. Ensure that the outside of your tube is spotless so that you do not contaminate the NMR using ethanol.

The Instrument is Avance Neo 300 equipped with the BBFO probe and uses Top Spin 4.0.9 software.

WHAT IS IT?

Nuclear Magnetic Resonance (NMR) spectroscopy is an analytical chemistry technique used in quality control and research for determining the content and purity of a sample as well as its molecular structure. NMR can quantitatively analyse mixtures containing known compounds.

For unknown compounds, NMR can either be used to match against spectral libraries or to infer the basic structure directly. In addition to the well-known observation of hydrogen, carbon, fluorine and phosphorous it can be used on a large number of other elements.

CONTACT AND AVAILABILITY

The NMR is used for teaching purposes but is available for use when classes are not using the machine.

For availability, please contact CTL 8 lab technicians on 0151 795 9732 or email

Chris Maloney, cstalker@liverpool.ac.uk
Ann Leyden, annleyde@liverpool.ac.uk
Liz Fisher, Liz.Fisher@liverpool.ac.uk

Alternatively, please contact Konstantin Luzyanin via email or phone:

luzyanin@liverpool.ac.uk
0151 795 8399



PLEASE ENSURE YOUR SOLVENT DEPTH IS A MINIMUM OF 5CM MAXIMUM 6CM, IF NOT YOUR SAMPLE WILL NOT RUN AND CAUSE THE NMR TO FREEZE UP.

SampleXpress

BRUKER

Sample Name	Sample Name
Position	26
10	Table ID
	1.26

SampleXpress

EMERGENCY STOP

BRUKER

ULTRASHIELD™
300



FLUORIMETER

WHAT IS IT?

A fluorometer is a piece of equipment that allows the analysis, identification, and quantification of chemical substances with molecules capable of presenting fluorescence, using the technique of fluorescence spectrophotometry or fluorometry. The equipment is a special optical device used in laboratories, capable of measuring the fluorescent quality of biological or mineral samples.

Fluorescence occurs when a substance emits visible light and glows after it has been exposed to some type of radiation, either alone or high-energy radiation such as visible light X-rays. This property is similar to phosphorescence, which is the emission of low-temperature light from an accumulation of energy or radiation from a substance. Fluorescence analysis is an analytical method related to spectrophotometry, since many molecules can emit this energy as radiation, thereby returning to the ground state, the emitted radiation is known as fluorescence.

CONTACT AND AVAILABILITY

To book please contact any Technician in Central Teaching Lab 8: 0151 795 9732

Christine Maloney, Liz Fisher, Ann Leyden, or Joshua Hicks.

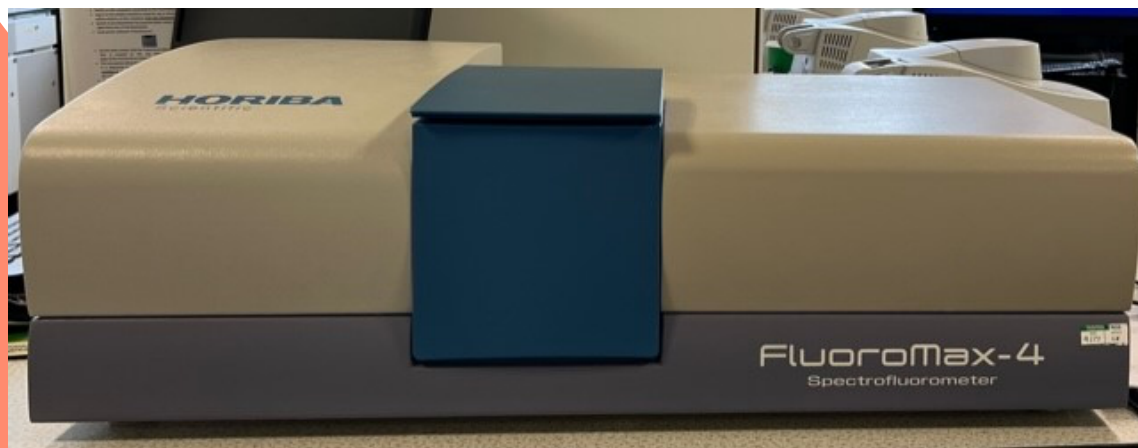
https://www.horiba.com/fileadmin/uploads/Scientific/Downloads/UserArea/Fluorescence/Manuals/Total_Fluorolog-3_Manual_J81014_rev_G__May_2014_.pdf

WHY YOU WOULD USE IT:

Can be used in biochemical, medical, chemical and research analysis of organic compounds. Additionally, protein dynamics, quantitative analysis, enzyme kinetics, nanostructures, and thermal stability experimentation.

SAMPLE PREPARATION AND SOFTWARE

The typical fluorescence or phosphorescence sample is a solution analysed in a standard cuvette. The cuvette itself may contain materials that fluoresce. To prevent interference, HORIBA Scientific recommends using non-fluorescing fused-silica cuvettes. Horiba uses FluorEssence Multigroup Software. The Hitachi fluorimeter uses FL-Solutions Software.



RAMAN

WHAT IS IT?

Raman spectroscopy is an important tool in the field of vibrational spectroscopy. It is a technique used to detect vibrational, rotational, and other states in a molecular system, capable of probing the chemical composition of materials. It is complementary to infrared absorption spectroscopy.

WHY YOU WOULD USE IT:

Raman spectroscopy can be used in all areas where non-destructive (microscopic) chemical analysis and imaging is required. It delivers answers for qualitative and quantitative analytical questions.

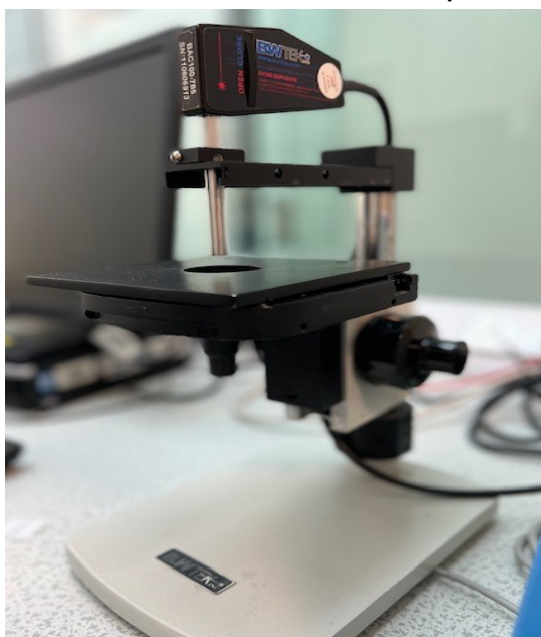
Raman is easy to use and quickly provides key information to characterize the chemical composition and structure of a sample. It matters little whether the samples are solid, liquid or gaseous.

Some applications of Raman spectroscopy are:

- Pharmaceuticals
- Geology and mineralogy
- Semiconductors
- Material research
- Life-science

SAMPLE PREPARATION AND SOFTWARE

2 Raman spectrometers are available in the CTL – B&W Tek mini-Raman and an I Raman. Samples are aqueous and can be measured through transparent containers. They can also be carbon nanomaterials. BWSpec is the technology used for instrument control and data acquisition.



CONTACT AND AVAILABILITY

Contact any technician in central teaching lab 8
0151 795 9732: Christine Maloney, Liz Fisher, Ann Leyden, or Joshua Hicks.

<https://www.manualslib.com/manual/2057161/BAndw-Tek-I-Raman-Plus.html>
<https://www.bruker.com/en/products-and-solutions/infrared-and-raman/raman-spectrometers/what-is-raman-spectroscopy.html>

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