

# Developments in instrumentation and science at the ISIS pulsed neutron source

W.S. Howells ISIS Facility, Rutherford Appleton Laboratory, Chilton, Didcot, UK



## ISIS

## **Overview**

- Instrumentation
  - GEM
  - IRIS
  - OSIRIS
- Science
  - quasicrystals
  - polymer electrolytes
  - fast-ion conducting glasses
- Future of RAL
  - ISIS second target station
  - new synchrotron

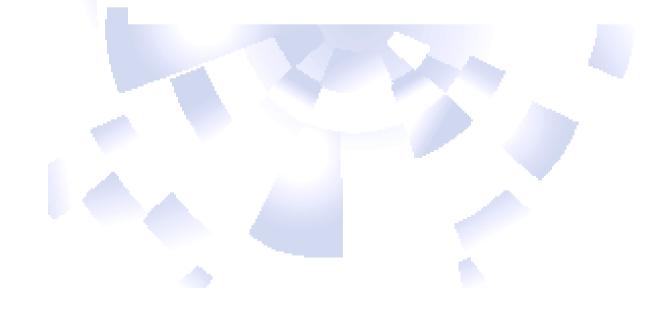


## GEM

Second generation - replaced LAD Dual function : Powder diffraction - high resolution, high scattering angles Disordered materials - wide Q range, lower scattering angles

High count rate

➡ spectra in 1 min





## **OSIRIS**

Project will explore the instrumental horizons available with the cold neutrons from a pulsed source and especially the totally new avenues available to polarised neutrons on these sources

International collaboration : India, Italy, Spain, Sweden, Switzerland and UK

Phase I

Large d-spacing powder diffraction Incident beam polarised powder diffraction

#### Phase II

High resolution spectroscopy  $\Delta E = 25 \ \mu eV$ , -0.8 < E < 5 meV Spectroscopy polarisation analysis coh/incoh separation Diffraction polarisation analysis





## Quasicrystals

Dynamics in quasiperiodic alloys or quasicrystals (QC)

Investigate  $AI_{50}Cu_{35}Ni_{15}$  alloy considered as 1-D QC think of as CsCI structure with vacancies

Aim : investigate if atomic hopping at a large rate is restricted to taking place in systems with QC local order or if it exists more generally in metallic alloys at high temperatures

3 isotopic samples : n-n-n <sup>N</sup>Al<sup>N</sup>Cu<sup>N</sup>Ni n-n-0 <sup>N</sup>Al<sup>N</sup>Cu<sup>0</sup>Ni n-65-0 <sup>N</sup>Al<sup>65</sup>Cu<sup>0</sup>Ni

QENS on IRIS





#### **Quasicrystals : Conclusions**

Both space and time evolvement of atomic motions are very similar to what has been found in alloys with QC or QC-like local order.

Frequent atomic jumps between interstitial positions are likely to take place on a ps time scale in any alloy above a certain relative vacancy concentration.

It is not a characteristic feature of QC. Mechanism of atomic motions, at least in AI-based ternary compounds, is independent of their periodic or aperiodic structure.



## **Polymer electrolytes**

Relation between mechanical and electrical relaxation in polymer/lithium-salt Important bearing on the viability of such materials for use as electrolytes in lithium batteries.

Samples : PEO, P(EO)<sub>7.5</sub>LiClO<sub>4</sub> and P(EO)<sub>7.5</sub>LiTFSI

 Structure
 using SANDALS
 PRL 84 5536 (2000)

 lithium ions coordinated with groups of ether oxygen atoms
 Nature 405 163 (2000)

 Dynamics
 using IRIS
 Nature 405 163 (2000)

 two processes :
 slow process with translational character

 one or two fast processes with rotational character





### Fast-ion conducting glasses

Structure using neutron & x-ray diffraction and RMC modelling

• mixed alkali effect in  $A_x B_{1-x} PO_3$  (A,B=Li,Na,Rb)

natural consequence when 2 kinds of alkali ions have distinctly different local environments which are preserved in mixed glass

#### immobile salt doping in (Pbl<sub>2</sub>)<sub>0.19</sub> - (AgPO<sub>3</sub>)<sub>0.81</sub>

dramatic increase in conductivity immobile  $Pb^{2+}$  ions almost entirely coordinated to non-bridging O introduced salt ions (particularly I) push neighbouring  $PO_4$  chains apart more pronounced migration pathways for silver ions



## **RAL future prospects**

#### **ISIS Second Target Station**

optimised for cold neutrons & high resolution spectroscopy repetition rate 10 Hz (1 pulse in 5) suite of 18 instruments

#### **New Synchrotron**

Funded by Wellcome Trust, British and French Governments 'Diamond' design - build by 2006 energies between 3 and 3.5 GeV ring circumference about 400-500 m up to 22 positions for insertion devices

World centre for condensed matter science

