



Early Science:
Solid State and Nuclear Physics

The ILL site in 1970

Bill Stirling (ILL 1973-87; 2014-16)

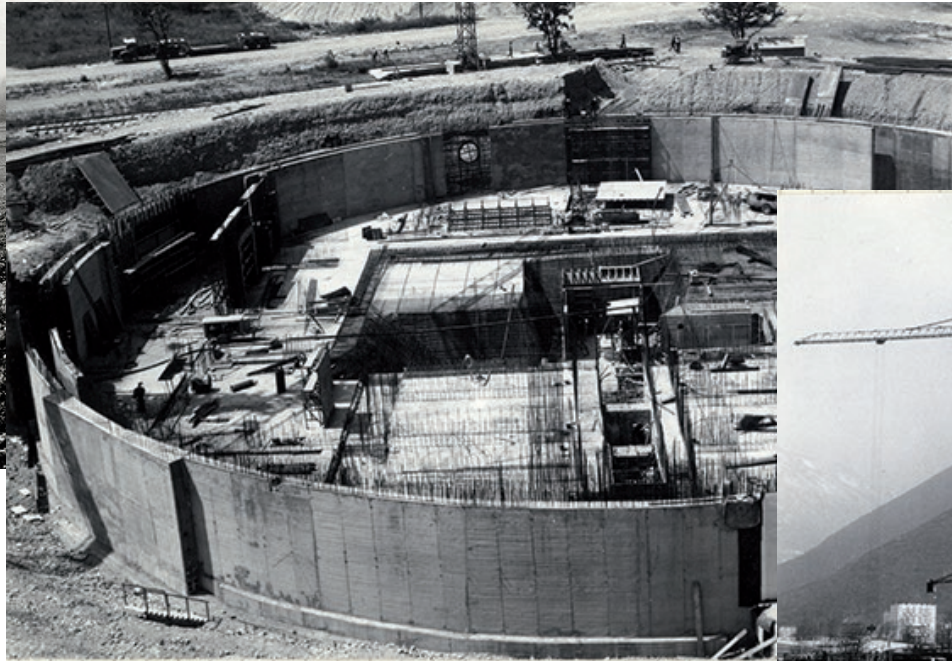


Construction of the ILL's extraordinary reactor

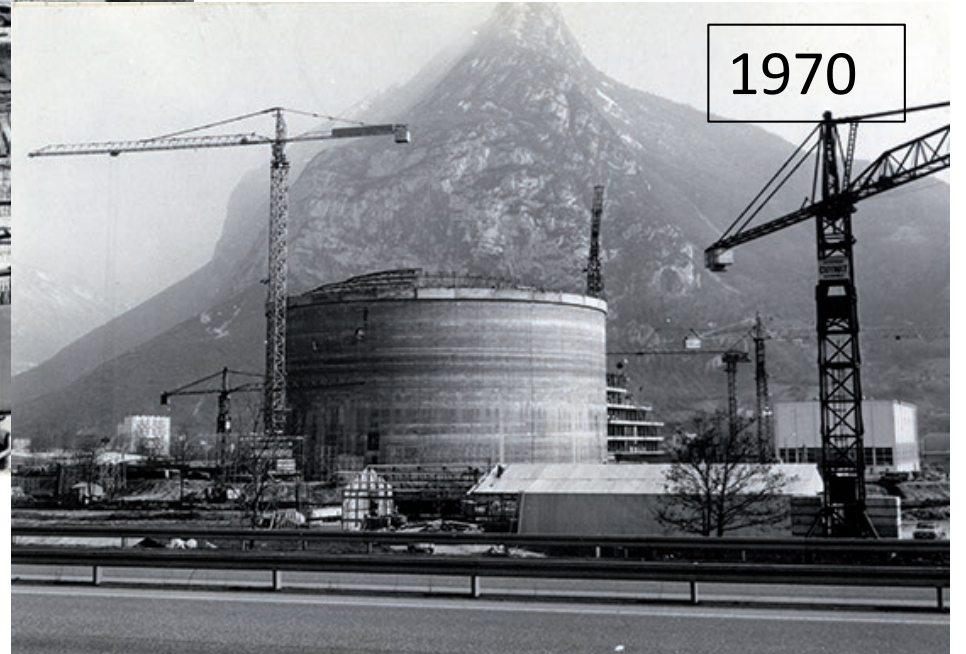
1968



1969



1970

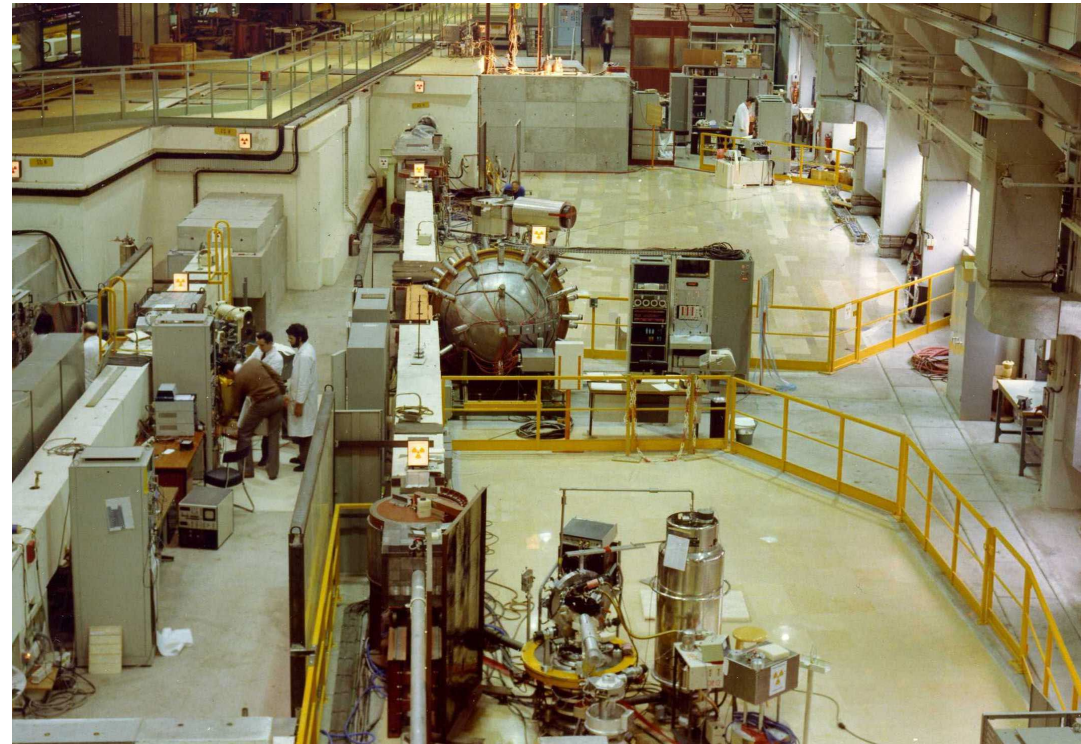


The empty guide hall : ~1970





IN5, D11: 1970



D10, D6 (Hedgehog): 1974

**ILL Annual Report Annex 1974
Solid State, UK**

- Phase Transitions
 - TMMC: Pawley, Hutchings ...

- Magnetic Excitations
 - KCoF_3 : Hutchings
 - $\text{MnF}_2/\text{ZnF}_2$: Cowley
 - NiS: Lowde, Hutchings
 - RbMnF_3 : Windsor, Saunderson
 - Pd_3Fe : Cowley, Smith et al

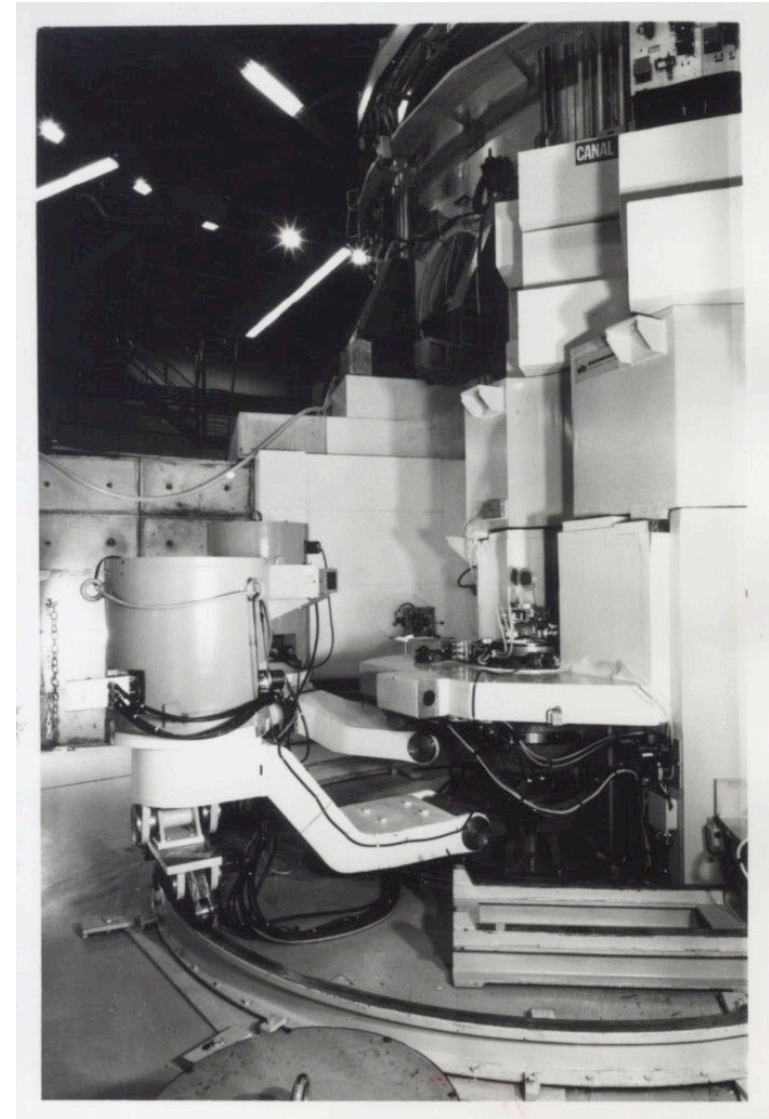
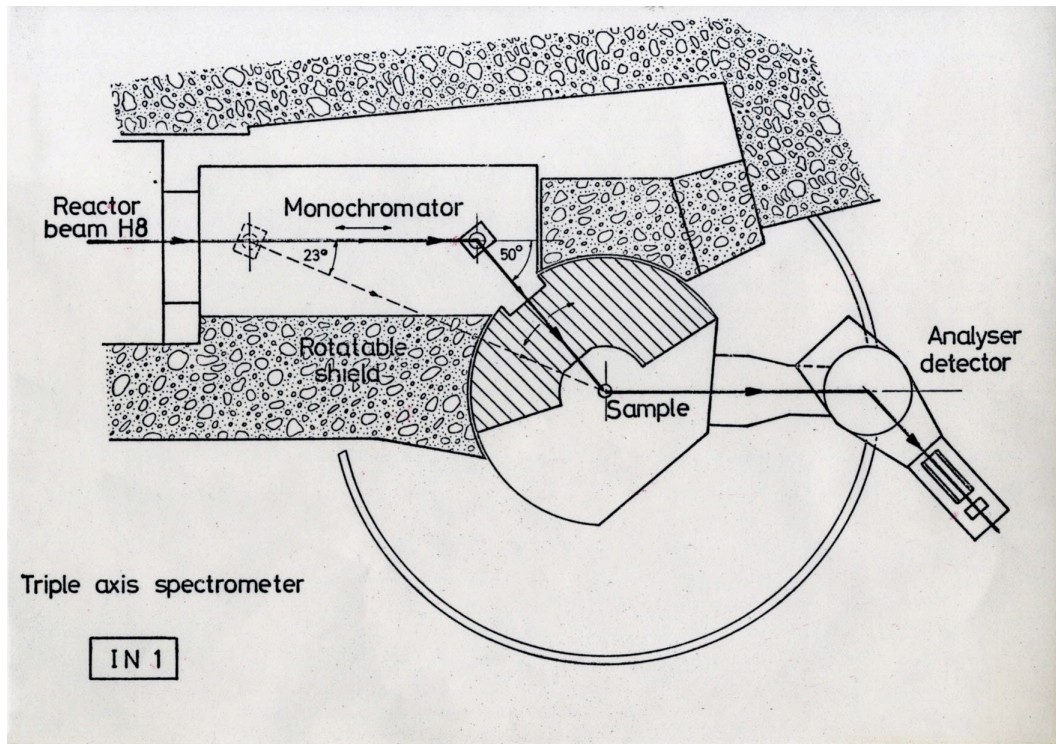
- Phonons
 - TbVO_4 : Hutchings
 - LiNbO_3 : Saunderson, Peckham

**ILL Annual Report Annex 1974
Liquids, UK**

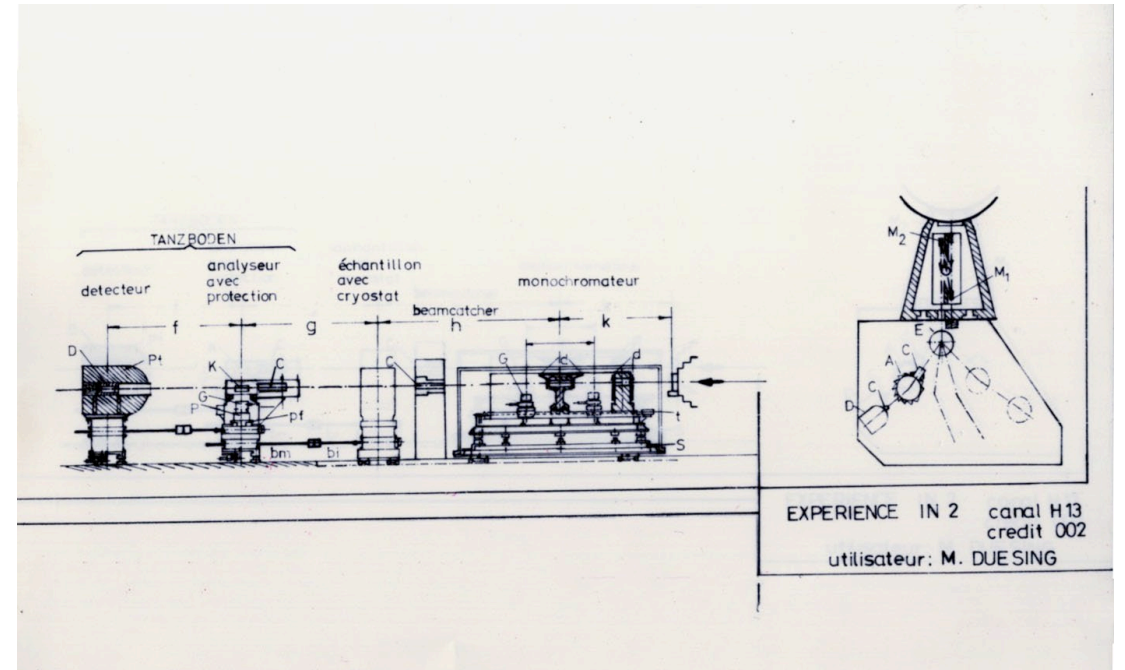
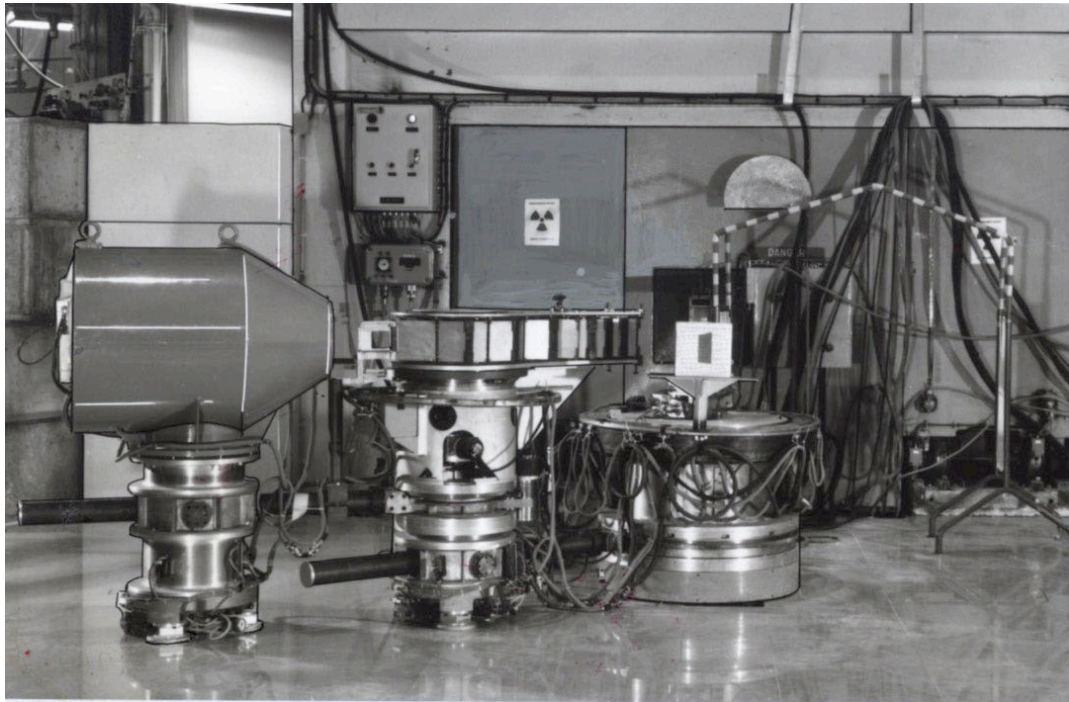
- Liquid Structure and Dynamics
 - CH_2Cl_2 : Brier, Perry, Wright
 - Rb and N_2 : Eglestaff et al
 - Aqueous solutions: Enderby, Nielsen, Soper, Howe
 - Liquid Crystals: Leadbetter, Richardson
 - Liquid ^3He : Scherm, Cowley et al

- AERE Harwell, Birmingham, Bristol, Edinburgh, Essex, Imperial College, Kent, Leicester, Oxford ...

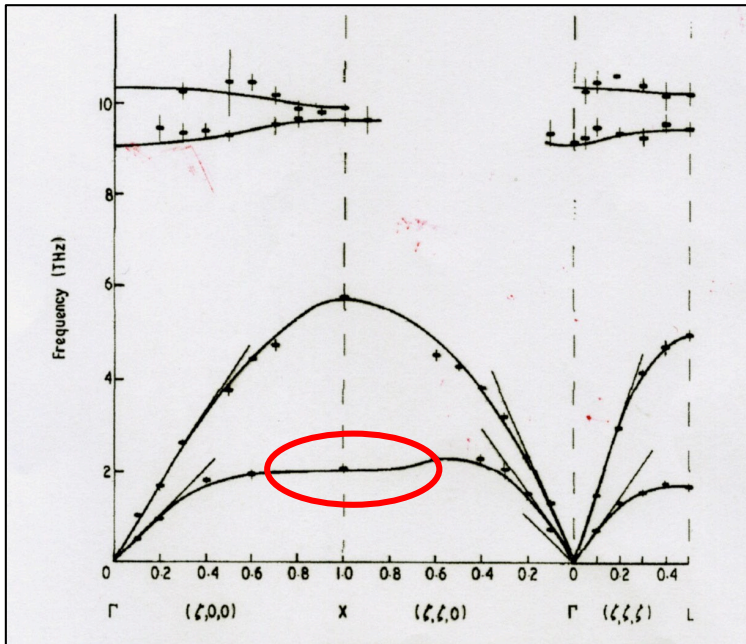
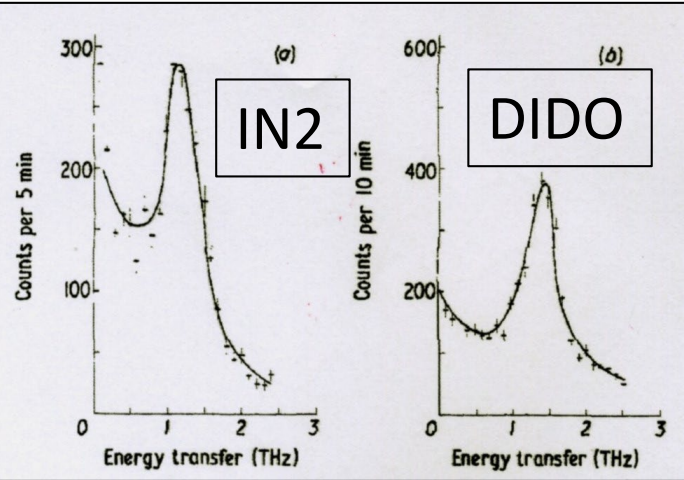
Early Instruments: IN1
Hot Source TAS



Early Instruments: IN2
Thermal Source TAS
Double Monochromator

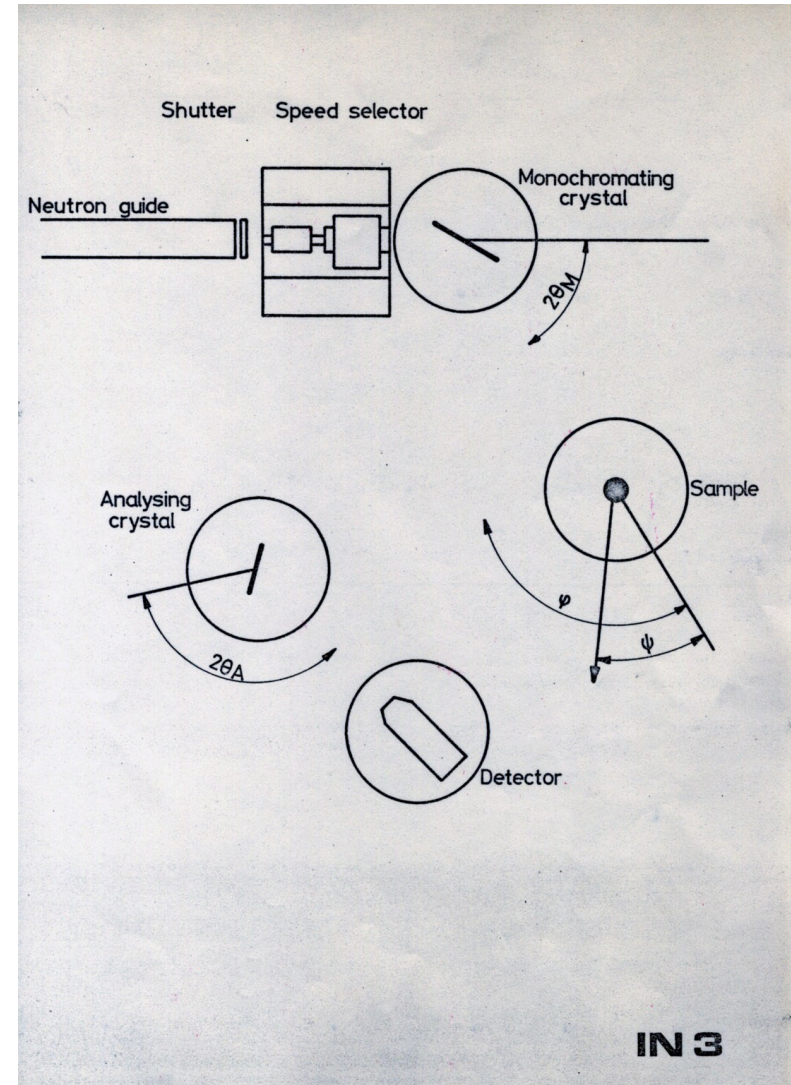
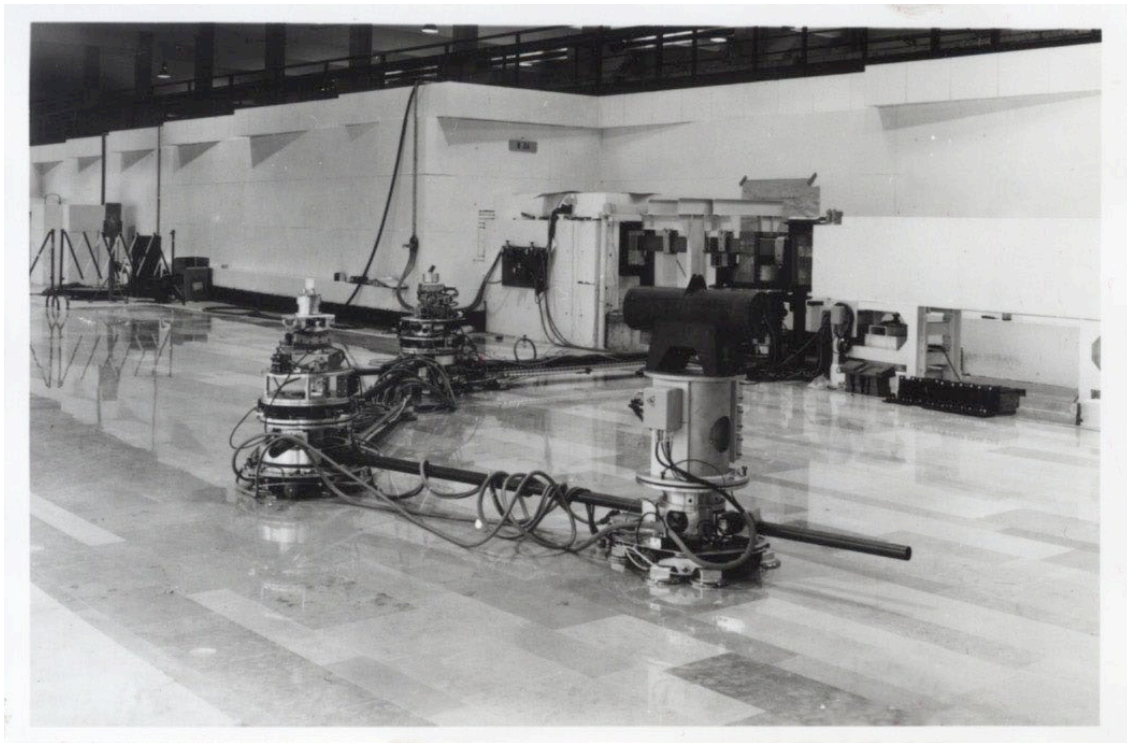


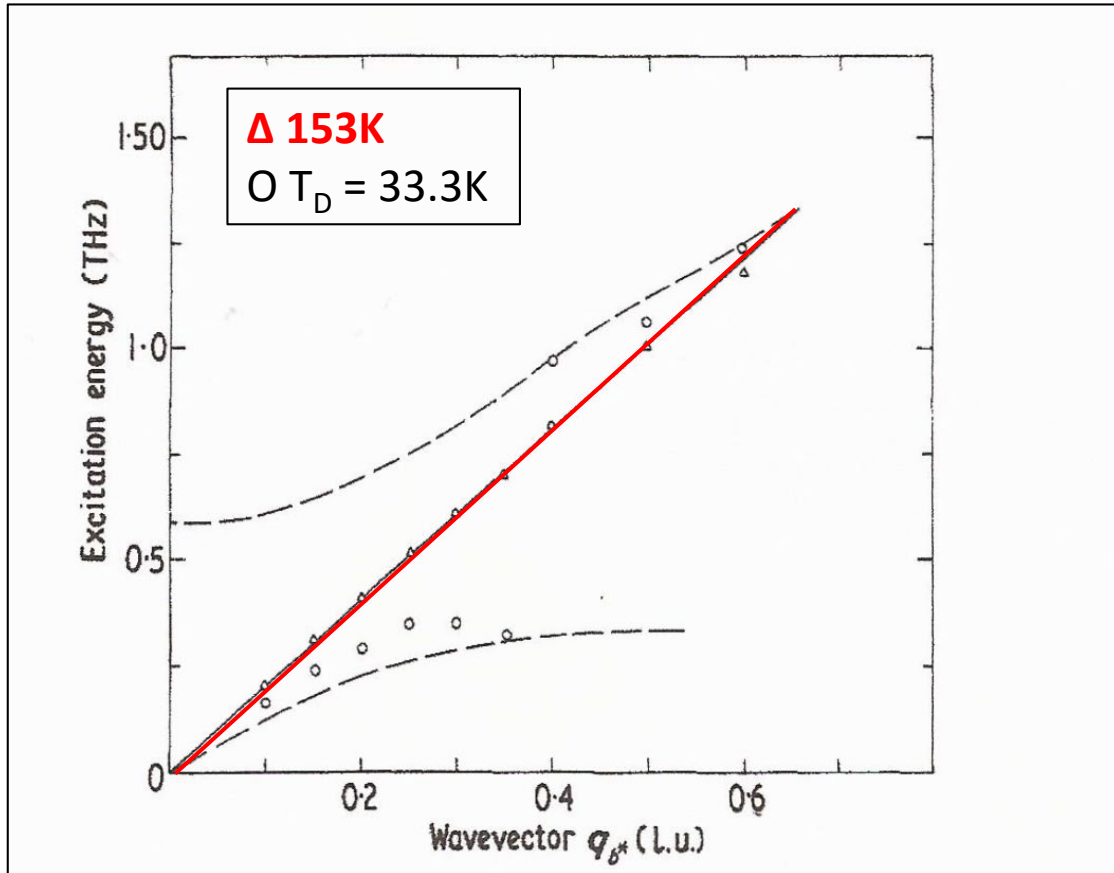
Early Science: Phonons in Indium Phosphide



- InP, direct-gap III-V semiconductor
- *Borchards, Alfrey, Saunderson and Woods, J Phys C8, 2022, 19757 (Birmingham, Harwell, ILL)*
- Measurements at IN2 (PG and Cu mono/analyser), and DIDO (AERE)
- Acoustic modes and optic modes (~ 10 THz)
- Flat acoustic modes due to phonon-phonon interactions arising from anharmonicity of nearest-neighbour forces

Early Instruments: IN3
Thermal Source TAS
Adjustable distances



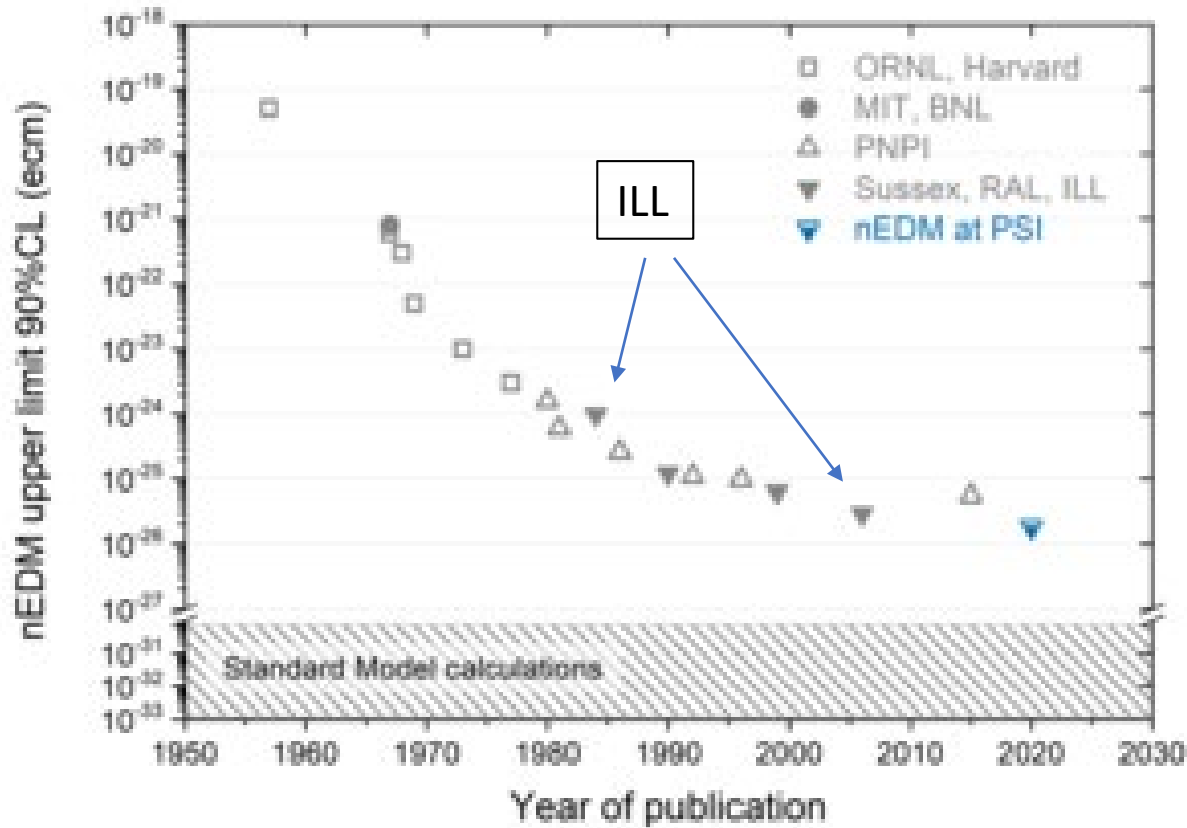


- Jahn-Teller phase transition at 33K (T_D) arising from electron-phonon coupling between the Tb³⁺ ion and the lattice (phonons)
- *Hutchings, Scherm, Smith and Smith, J Phys C8, L393, 1975 (Harwell, Oxford, Essex, ILL)*
- Measurements at IN3 and PLUTO
- **Normal acoustic phonon at 153K**
- Anti-crossing (splitting) at T_D
- Dashed lines are theoretical prediction

ILL Annual Report Annex 1974 and 1975 Nuclear Physics UK

- $\beta - n_D - \gamma$ phenomena (delayed neutron excited states; and related experiments and developments on Lohengrin, PN1): Crawford et al
 - $n - \gamma$ reactions (Gams spectrometers): Gelletly et al
 - Neutron electric dipole moment: Pendlebury, Ramsay et al
- Glasgow, Sussex, Manchester ...

Early science: measurement of the neutron electric dipole moment



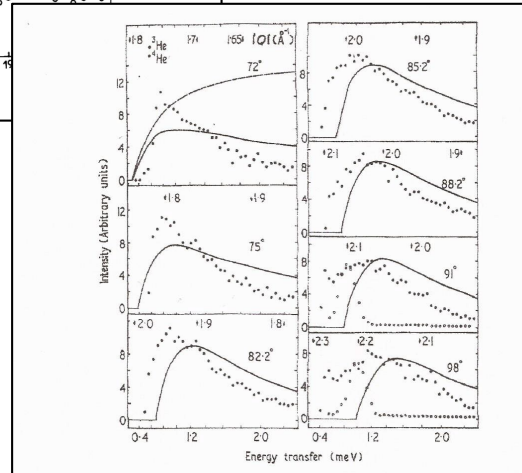
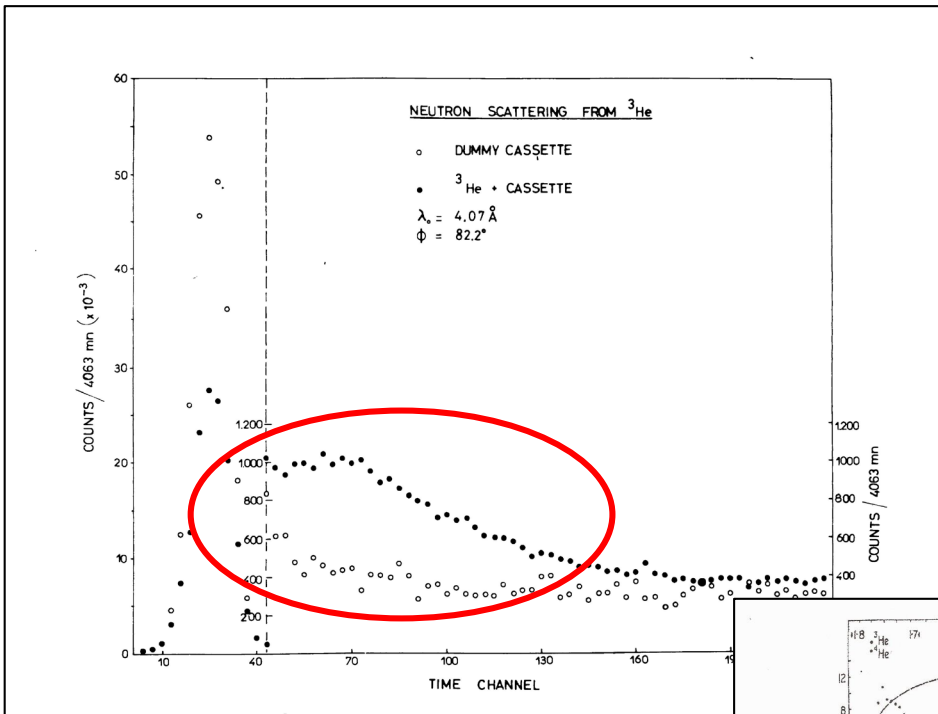
Source: Wikipedia

- Neutron electric dipole moment: measure of charge distribution in neutron
- If d_n is non-zero then important implications (Standard Model etc etc); both parity(P) and time-reversal(T) symmetries violated (and CP)
- Experiments since ~ 1950 : ORNL, Leningrad, ILL, PSI ...
- Neutron beam and ultra-cold neutrons
- At ILL, Ramsay, Pendlebury et al
- $|d_n| < 1.8 \times 10^{-26}$ e·cm (PSI, 2020)
- Measurements continuing: PSI, TRIUMF, SNS, ILL



- and 50 years later, ILL is still setting the standard for neutron science and technique development

Thank you



- Are there phonon-roton excitations in liquid ^3He (fermion) as in ^4He (boson)?
- Absorption ~ 10000 barns at 4 \AA
- IN5 at 4 \AA and 6 \AA
- Liquid ^3He at 1.3K + dummy cassette (cadmium)
- First observations: broad distributions of scattering – particle-hole continuum
- Zero-sound mode at small Q : Skold and Pelizzari (ANL) and later Scherm, Fåk et al (ILL)
- *Scherm, Cowley, Coombs, Woods, wgs, J Phys C7, L341, 1974 (ILL, Edinburgh)*