The ILL Diffraction Group
www.ill.fr/dif/

- Largest of the 5 instrument groups at ILL
- 10 permanent staff scientists
- Total of ~30 scientists, students and technicians
- Building 3 of the first 5 new “Millennium” projects
- 2 more Millennium projects in the second tranche.
New or Improved Diffraction Group Instruments:

- D20 - microstrip powder diffractometer for chemical kinetics...
- D2b - high resolution powder diffractometer with linear PSDs
- D4c - microstrip detector for liquids & amorphous materials
- Strain Scanner - for mapping strain using microstrip detectors
- D19 - an array of 2D-microstrips for protein/fiber diffraction
- T-LADI - Laue Diffractometer & neutron Image plate detector
- D3c - He3 neutron spin filters and magnetic polarimetry
Other Existing Diffraction Group Instruments:

- D1a - first high resolution powder diffractometer
- D1b - first high flux position sensitive detector (CNRS-CRG)
- D9  - first hot source, 4-circle machine (PSD, lifting detector)
- D10 - 4-circle, 3-axis diffractometer (Garry McIntyre et al.)
- D15 - 2-axis/4-circle diffractometer (CENG-CRG)
- D23 - new 2-axis polarised neutron machine (CENG-CRG)
- S42 - Laue camera for crystal alignment (Marmeggi)
The Millennium Programme at ILL
-> New Neutron Detectors

Investment in reactors & other neutron sources is necessary,

but...

Investment in *detecting* more neutrons is very cost effective

and we need...

Microstrip detectors, neutron image plates, detector arrays...
Powder Diffractometers are Simple

- A continuous neutron source
- Incident collimation
- A Monochromator
- The Sample & environment
- Scattering collimation
- A Detector
Alternative TOF techniques

- Time-of-flight diffractometers (E. Steichele, Munich)
  - J. Jorgensen, Argonne (SEPD, GPPD)
  - B. Fender & A. Hewat, Rutherford Lab.

- HRPD ISIS (High Resolution Powder Diffractometer)
  W. David et al.
Early Days at ILL Grenoble (1972)

First ILL Powder Diffractometer D1a

- Small soller collimator
- Single detector
- Shared monochromator
- High Resolution, BUT
- Very Low Intensity
Early Days at ILL Grenoble (1974)

- Orders of Magnitude Improvement - D1A
  - Multiple detectors
  - Large efficient collimators
  - Focussing Monochromator
Early Days at ILL Grenoble (1974)
Comparison of D1A with D2 (1974)

- The same Al2O3 sample on D1A (top) and the old D2 at ILL.
Second Generation Machines (1984)
High Resolution with Very Large Detector bank (D2B)

- 64 High Resolution Plastic Foil Collimators
- Large Composite Focusing Monochromator
- High Resolution
- Good Intensity

A. Hewat, China Nov/Dec 2000
The Future - Big Detectors

Large pseudo-2D PSD (array of linear-wire detectors)

- 2D detector allows both high efficiency & high resolution
The Future - Big Detectors

Prototype super-D2B 5’ mylar foil collimator

300 mm high
15 mm wide
5 mm front side plates
New Munich Reactor FRM-II
SPODI Structure Powder Diffractometer cf super-D2B

- Source distance 14.5m
  - Neutron supermirror guide

- Monochromator
  - Ge [551] vertical focus
  - Angle 90°, 135°, 155°
  - Mosaic 20'

- 80 Mylar 10' collimators

- 80 He3 detectors
  - 300 cm high
  - Linear wire PSD

- cf ILL super-D2B project.
The Future - Big Detectors

- HRPD & GEM, ISIS
- New scintillator detector element.
- Project for new 90° (medium resolution) detector bank

A. Hewat, China Nov/Dec 2000
Early Days at ILL Grenoble (1973)

- New types of PSD's
  - Position Sensitive Detector used for the first time
  - Very Fast machine (Faster than X-rays)
  - Moderate Resolution
- In-situ Chemistry with RR (Convert, Riekel ...)

A. Hewat, China Nov/Dec 2000
The Second Generation (80's)

- DMC high efficiency PSD powder diffractometer PSI (Zurich)
  P. Fischer et al.
An Inexpensive but Effective PSD

The liner wire PSD powder diffractometer at Kjeller, Norway.

A. Hewat, China Nov/Dec 2000
An Inexpensive but Effective PSD

The liner wire PSD powder diffractometer at Kjeller, Norway.

A. Hewat, China Nov/Dec 2000
State of the Art Powder Machines

- HRPT 1600 cell PSD powder diffractometer at PSI (Zurich)
  P. Fischer et al.
State of the Art Powder Machines

- HRPT 1600 cell PSD powder diffractometer at PSI (Zurich)
  P. Fischer et al.
State of the Art Powder Machines

1600 wire PSD on a continuous spallation neutron source

- Radial Collimator for new HRPT diffractometer at PSI Zurich (Fast, medium-high resolution machine) Peter Fischer et al.

A. Hewat, China Nov/Dec 2000
Microstrip Detectors - Printed Circuits

ILL Detector Group:
- Bruno Guerard (head)
- Jean-Francois Clergeau
- Dominique Feltin
- Michel Gamon
- Giuliana Manzin
- Alexandre Sicard
- Fabrice Horst
- Anton Oed (retired)

“Mr Microstrip” Anton Oed with admirer
(Giovanna Cicognani, ILL Science Secretary)

A. Hewat, China Nov/Dec 2000
Microstrip Detectors

- The wires are replaced by a printed circuit on a glass substrate.
- A high electric field is produced around the thin anodes.
- The glass substrate is electrically conducting to remove charge build-up.

- PSD for 1600 element microstrip detector D20 at ILL Grenoble (Fast medium-high resolution machine) Pierre Convert et al.
What is a Microstrip Detector?

Instead of wires, a printed circuit is used. This allows high resolution, mechanical stability...
The 160° D20 Microstrip Array

25 plates of 64 electrodes are assembled to produce a 1600-wire detector covering 160°.
High Flux Powder Diffractometer D20

Pierre Convert, Thomas Hansen, Jacques Torregrossa

D20 in action with
Jacques Torregrossa,
Pierre Convert
& Thomas Hansen

A. Hewat, China Nov/Dec 2000
High Flux D20
High Resol D2B
Applications of large fast detectors
Real-time Phase Diagrams

Sue Kilcoyne, Bob Cywinski et al.

Crystallisation of amorphous alloys $Y_{67}Fe_{33}$ with increasing temperature

Complete diffraction pattern in minutes or seconds, scan through temperature

A. Hewat, China Nov/Dec 2000
New Diffraction Group Instruments:

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