Nuclear Physics Institute (NPI), Řež near Prague, Czech Republic

Neutron Physics Laboratory

ACCESS Activity presentation

Pavel Strunz

NMI3-II Kick-off meeting, ILL Grenoble

March 12-13, 2012

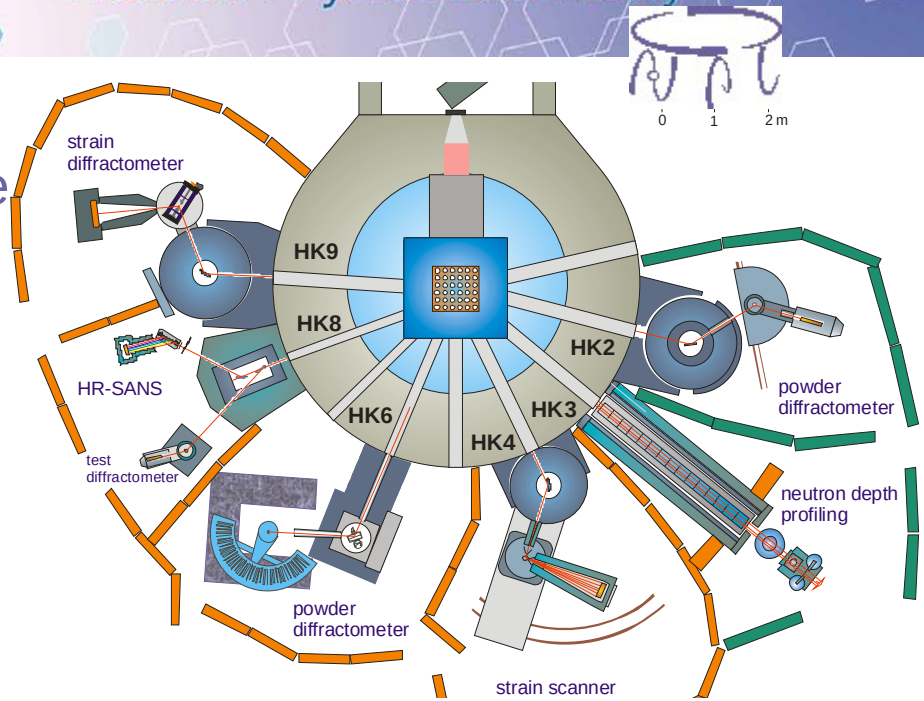
http://neutron.ujf.cas.cz/en/instruments/user-access/nmi3

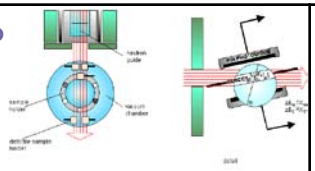
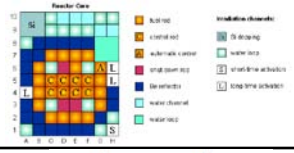
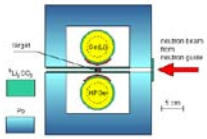
NPL highlights

- NPL: small lab compared to the large neutron-physics centers =>

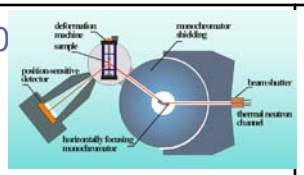
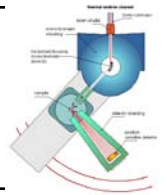
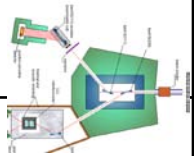
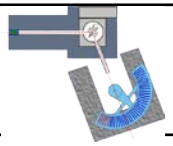
  => focus on couple of fields where unique facilities can be provided

- Access: 8 facilities
  - 3 nuclear-analytical techniques
  - 5 diffraction techniques



T-NDP		Neutron Depth Profiling: non-destructive analysis of concentration profiles of light elements (diffusion, sputtering, corrosion, electronics, optronics, life sciences)
NAA		Neutron Activation Analysis: low-level elemental characterization - biology, biomedicine, environment, geology, metallurgy
NG		Thermal neutron facility for study of γ-γ coincidences from (n,γ) reactions: photon–strength functions, nuclear structure

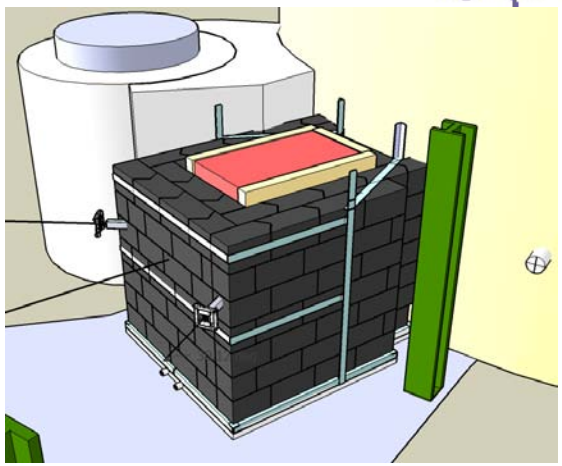
NPL highlights: diffraction

TKSN-400		High-resolution diffractometer: macro- and microstrains in polycrystals, in-situ, thermo-mechanical processing, phase transformations in steels, SMA etc.
SPN-100		Diffractometer for macrostrain scanning of polycrystalline materials (welds)
MAUD (formerly DN-2)		Double crystal small-angle neutron scattering: microstructural studies (precipitation in alloys, porosity in ceramics) – currently beeing upgraded
NOD		Neutron optics diffractometer for tests of neutron optics and imaging
MEREDIT		Medium resolution powder diffractometer: standard diffraction experiments with sophisticated sample environment (e.g. deformation +**B**)

- Neutron optics based on bent Si
- In-situ deformation experiments at high resolution

NPL news: upgrades

- DN-2 upgrade finished => MAUD
  (Double crystal small-angle neutron scattering)
- TEXDIF upgrade finished => NOD
  (Neutron optics diffractometer)



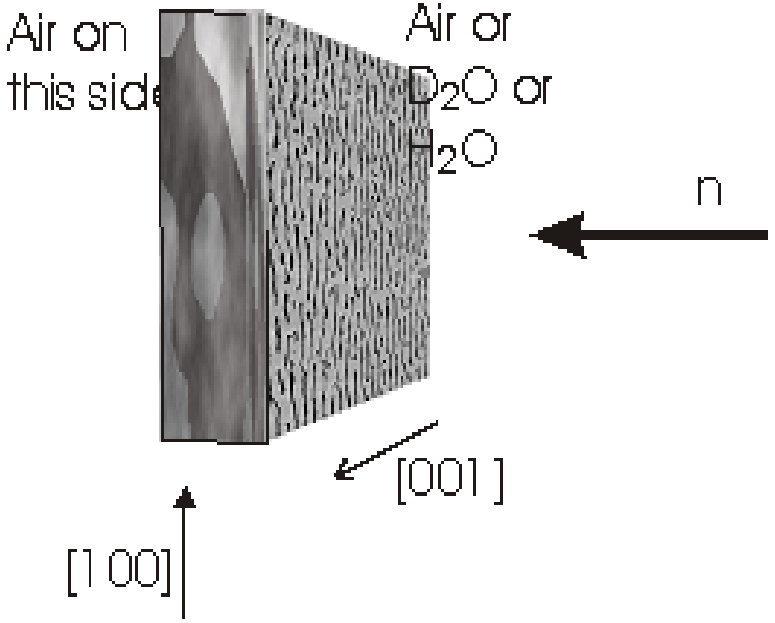
- saphire filter in primary beam
- new shielding of monochromator units
- => suppressing background
- new floor
- new beam shutters
- new positioning system – monochromator

MAUD: Pore structure characterization in nanoporous metallic membrane using SANS

Porous membrane prepared by electrochemical selective phase dissolution from superalloy

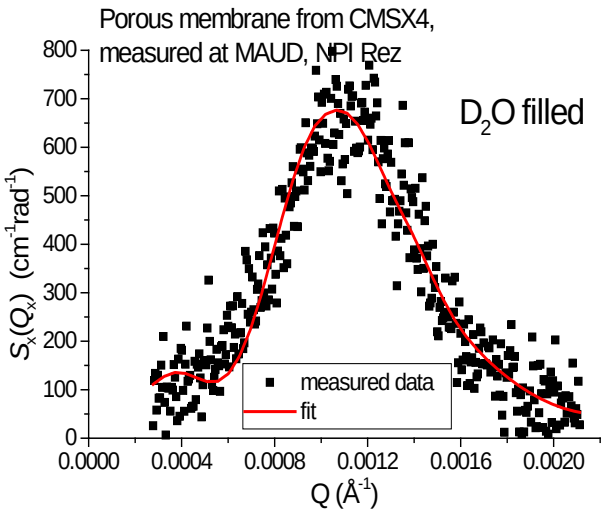
- **Prospective applications: separation processes, catalytic substrate, miniature heat exchangers, gas permeable membranes**

- **fabrication optimization =>**
- **=> knowledge of microstructural parameters needed**

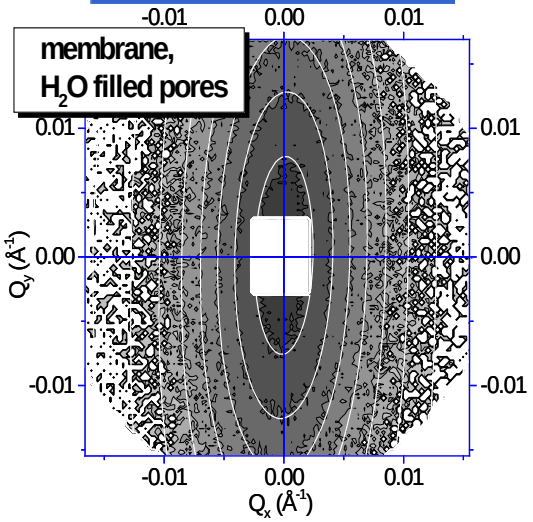


SANS, contrast variation

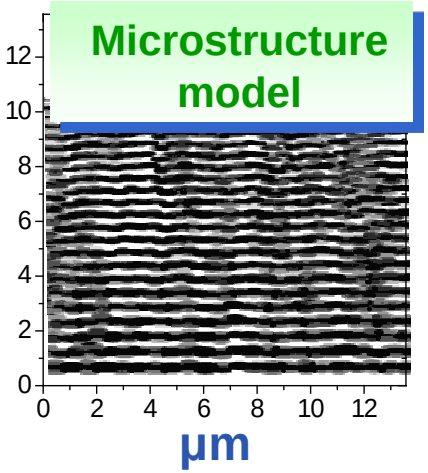
MAUD



V4 (HZB)



Microstructure model



Combining contrast variation data from both facilities:

- average distance between pores: 4800 Å
- the average thickness of the rafts 2700 Å
- volume fraction of the rafts (64%) and pores (36%)
- specific interface between γ' phase and the pores: 49000 cm^2/cm^3.
- SLD of γ' rafts: 73.0×10^9 cm^{-2}
- back-calculated SLD of the γ matrix: 57.3×10^9 cm^{-2}

P. Strunz, D. Mukherji, J. Šaroun, U. Keiderling, J. Rösler: Pore structure characterization and in-situ diffusion measurement in nanoporous membrane using SANS, Journal of Physics: Conference Series 247 (2010), 012023

NPL news: upgrades

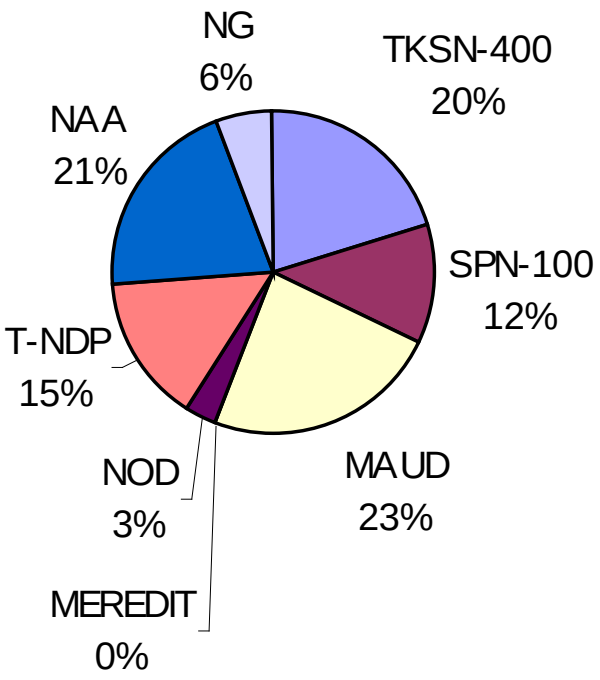
- TKSN-400 upgrade running (High-resolution diffractometer)
  - mainly: background suppression (saphire etc.)
- New position sensitive detectors (1D, 2D)
- Sample environment
  - Close cycle cryostat (10 - 298 K)
  - Mirror furnace (up to 1000ºC)
  - new positioning system – MAUD and MEREDIT samples
  - New deformation rig
- Control software (ReMeSys) upgrades
- Motor Controllers upgrade

NMI3 – FP6+FP7 experiments – statistics 04/2004 - 01/2011

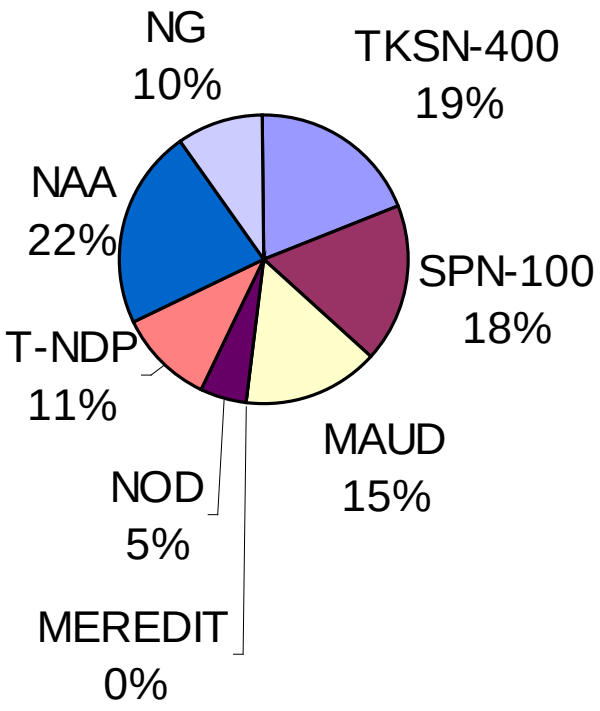
Access beamtime (facility distribution)

Distribution among facilities	Experiments	Days
TKSN-400	7	59
SPN-100	4	54
MAUD	8	47
MEREDIT	0	0
NOD	1	15
T-NDP	5	33
NAA	7	70
NG	2	30
sum	34	308

Experiments



Days



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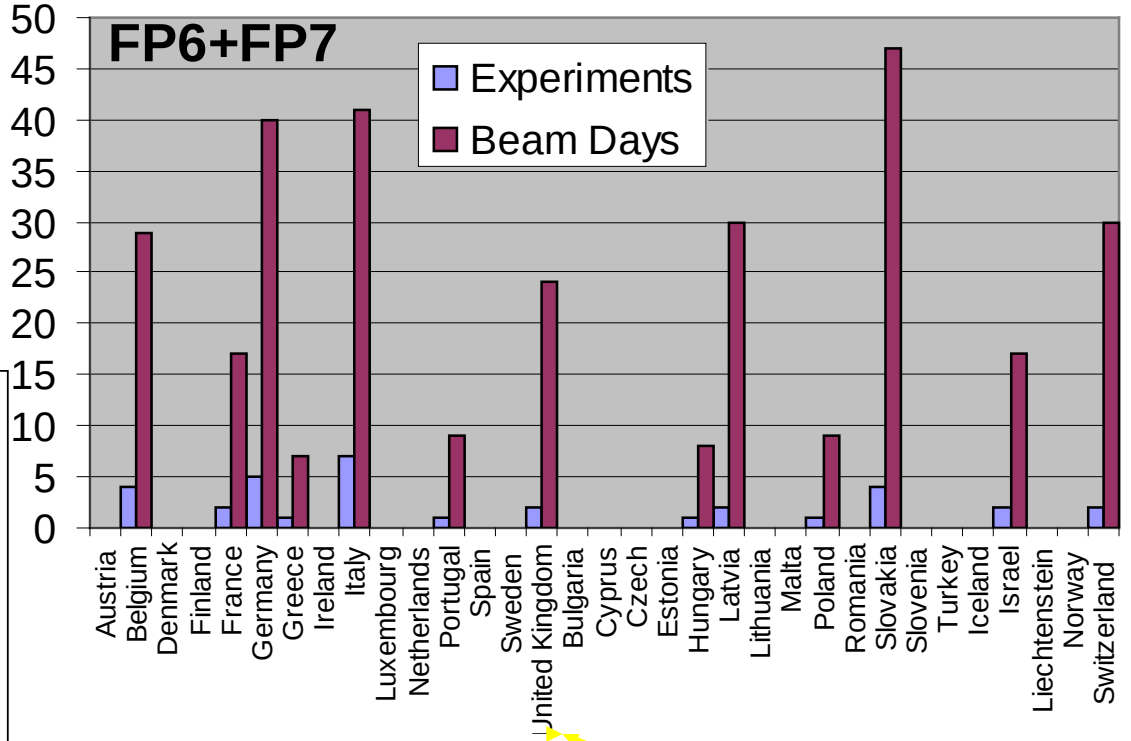
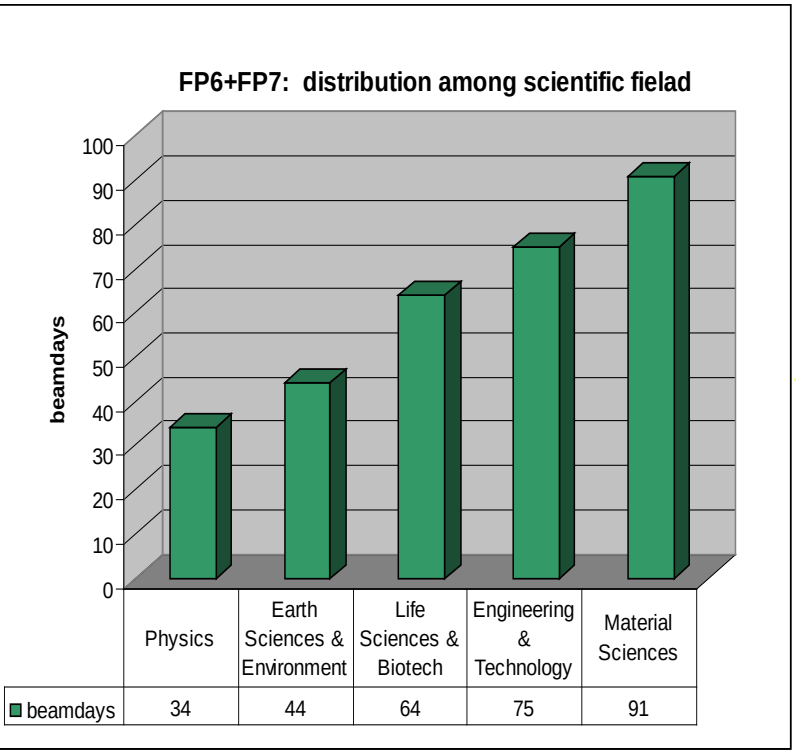




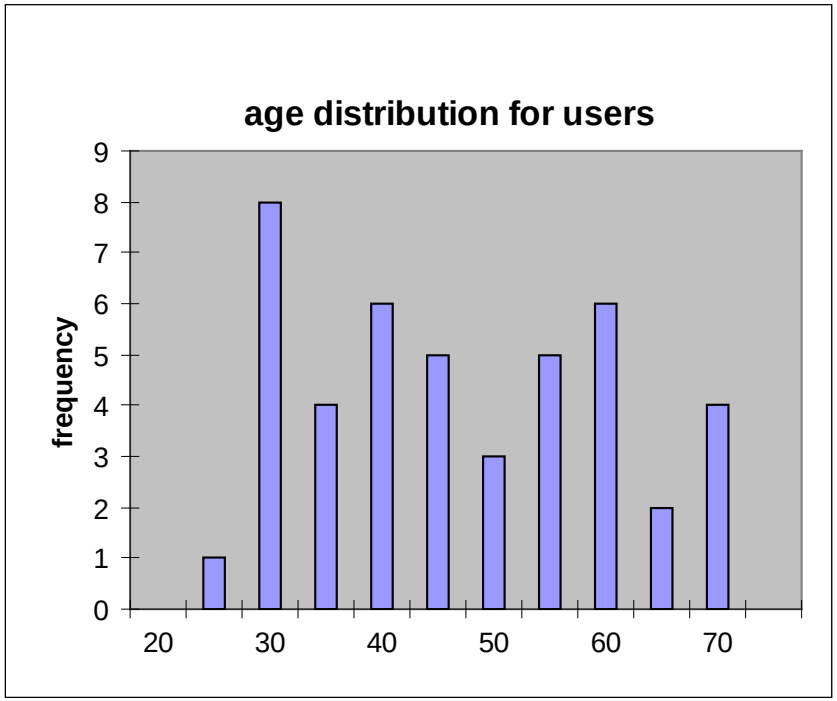
Country of proposal origin (accepted and carried out)

Access beamtime (scientific field distribution)

NMI3 – FP6+FP7 experiments – statistics

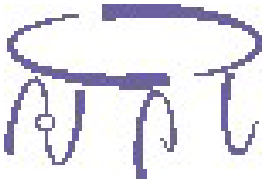
04/2004 - 01/2011

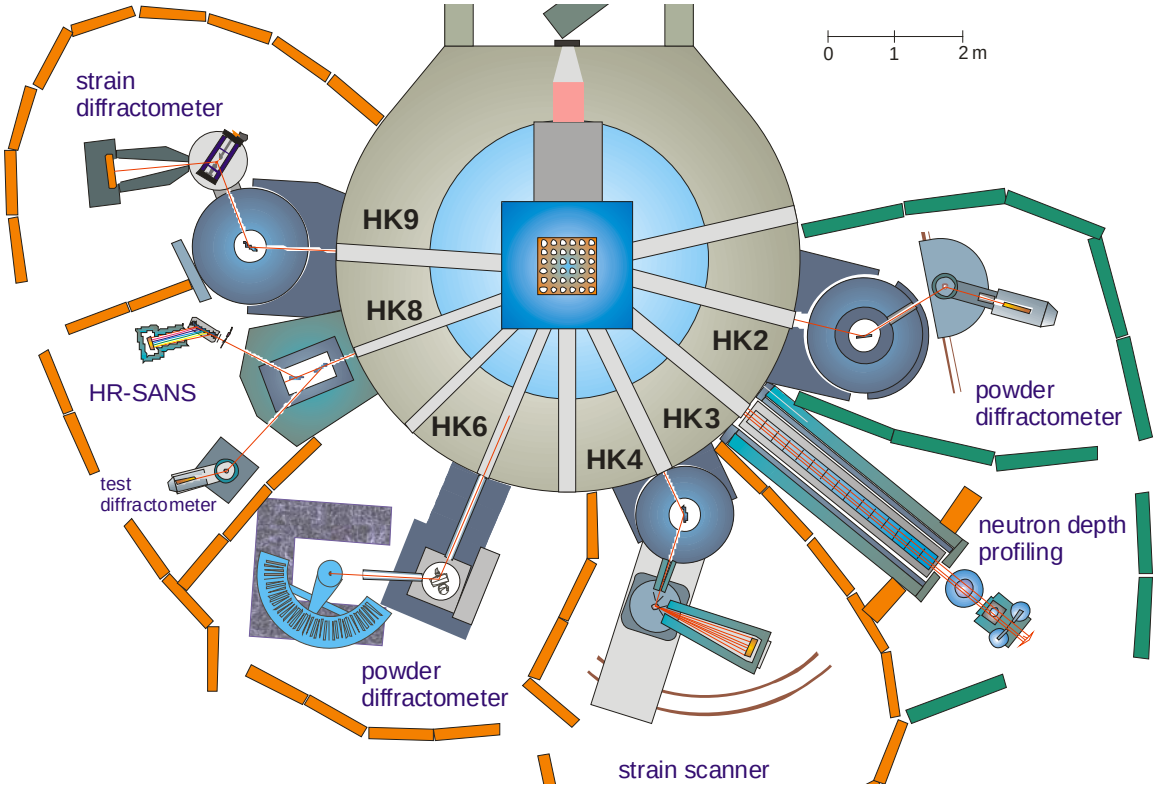
- 44 users
- Age distribution => mixture of professors, post docs and PhD students



Future:

- Stable user community
- Gradual upgrade of facilities





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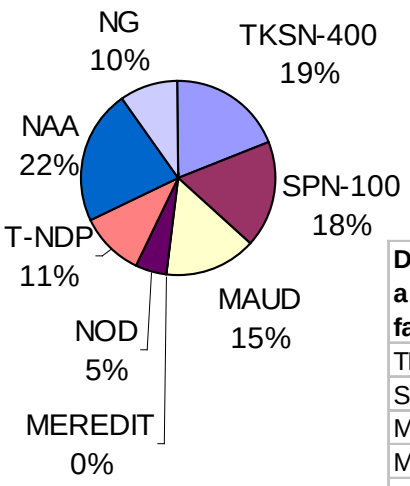

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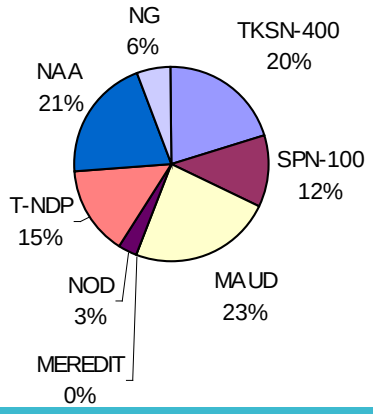

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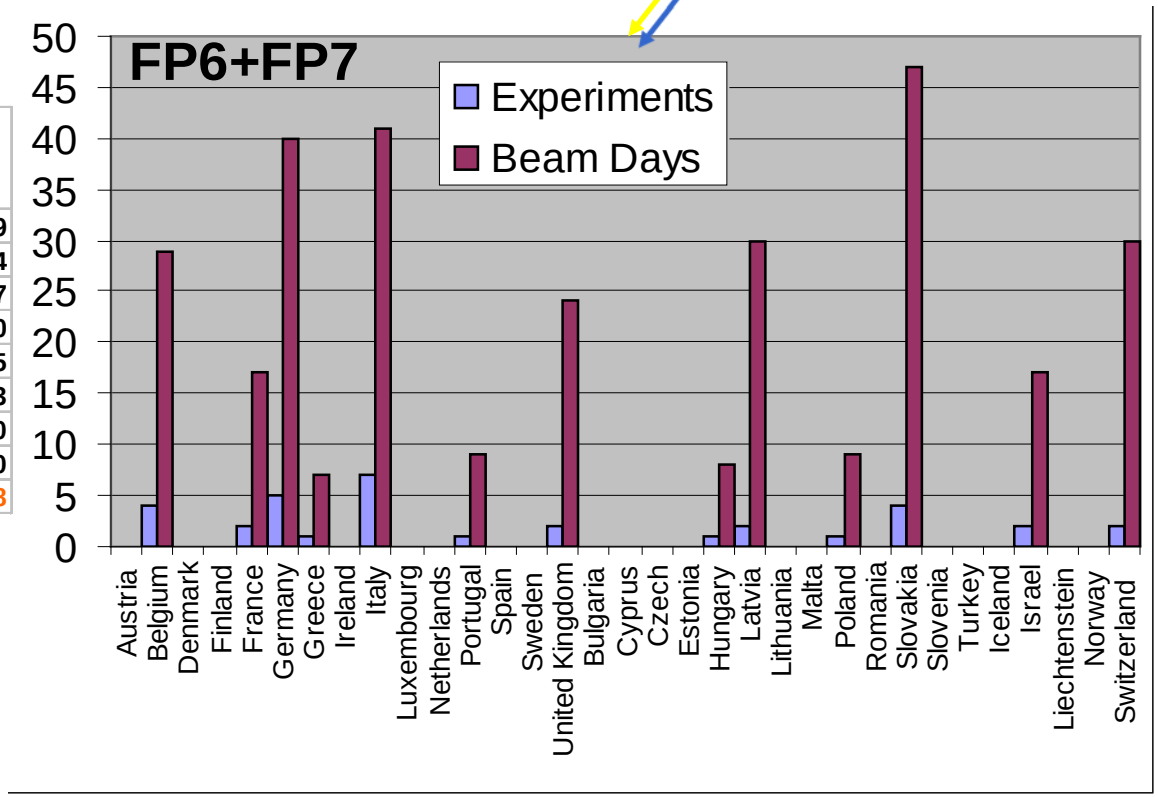

- Statistics on user frequentation / outcome
  - NMI3 in FP7:
    - 7 experiments, 86 beamdays
    - 43 days per year
    - 2 papers (5 with FP6, still not reported)
- Techniques not frequently offered at other research centres
  - elemental analytical techniques (NAA, T-NDP)
  - basic nuclear physics facility (NG)
  - high-resolution SANS (MAUD)
  - high-resolution diffraction in connection with in-situ thermo-mechanical tests