SINQ & SμS – Paul Scherrer Institute

ACCESS Activity presentation

by Stefan Janssen

General Assembly in Villigen, CH

March 31, 2009

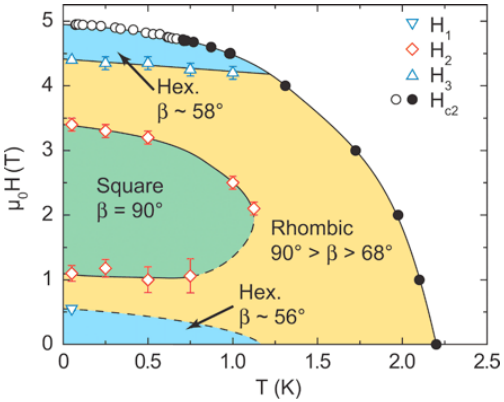
A short look back to FP6

SINQ/NMI3	2004	2005	2006	2007/08	Total	Maximum	Percent
projects	41	77	22	47	187		
days	236	403	112 (87)	273	1024	726	141
users	93	148	39	93	373		
users T&S	50	84	23	50	207		

SμS/NMI3	2004	2005	2006	2007/08	Total	Maximum	Percent
projects	17	28	24	28	97		
days	88	176	114 (18)	144	522	282	185
users	58	68	48	47	221		
users T&S	20	33	24	28	105		

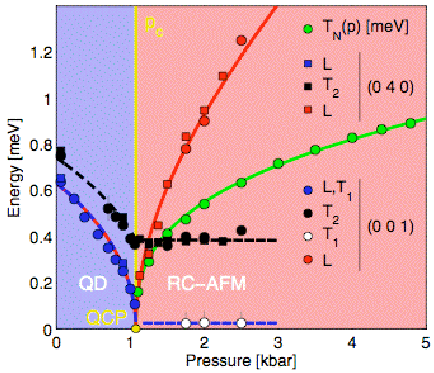
Several scientific highlights (> 80 peer reviewed publications)

Superconducting vortices in $CeCoIn_5$: Toward the Pauli-limiting field



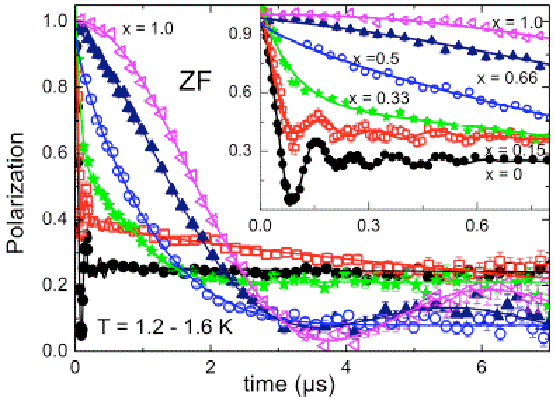
AD Bianchi et al, **SCIENCE 319, 177 (2008)**
Proposal SINQ_20061118, EM Forgan et al

Quantum Magnets under Pressure: Controlling Elementary Excitations in $TlCuCl_3$



C. Rüegg et al, **PRL 100, 205701 (2008)**
Proposal SINQ_20060514, C. Rüegg et al

Quantum Magnetism in the Paratacamite Family: Towards an Ideal Kagome Lattice



P. Mendels et al, **PRL 98, 077204 (2007)**
Proposal SmuS_20061370, P. Mendels et al

Your highlights

- Highlight uniqueness of your facility (differentiation from others)

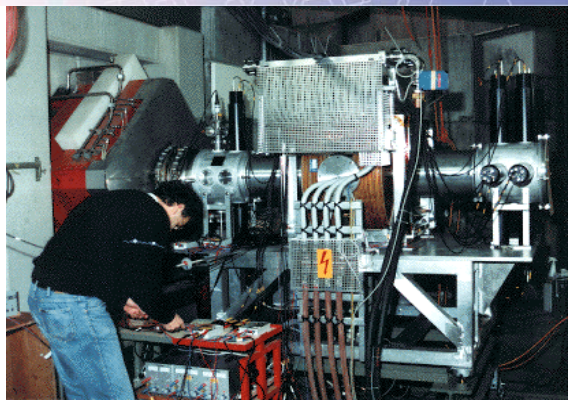
Three probes on one campus!

SLS: synchrotron X-rays

- 3rd generation synchrotron
- electron energy: 2.4 GeV
- operational: since 2001
- beamlines: 14
- under design/construction: 5

SINQ: cold and thermal neutrons

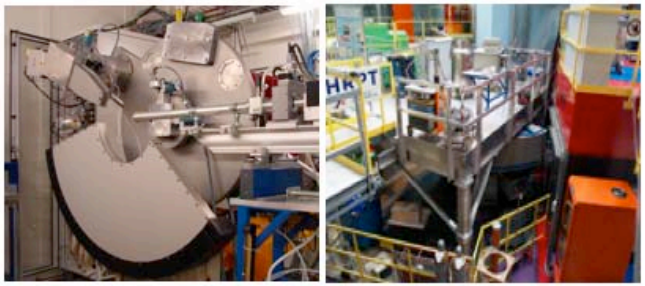
- spallation neutron source
- Thermal flux $1.5 \cdot 10^{14}$ n/cm^2/s
- operational: since 1996/**1998**
- instruments: 15
- under design/construction: 1



SμS: μ-SR facilities

- world's most intense continuous muon source
- operational: since 1974/**1989**
- instruments: 6
- under design/construction: 1

Joint proposal submission SINQ+SLS powder diffraction



Materials Science X04SA HRPT diffractometer

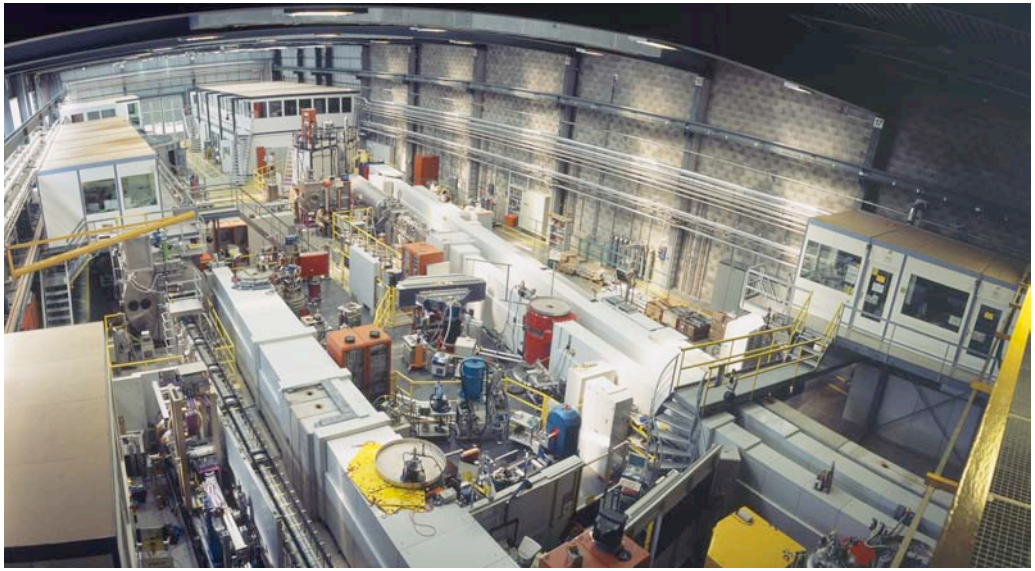
Applied Complementarity

Joint Proposals for X-ray (SLS) and neutron (SINQ) powder diffraction

In 2008 PSI launched a first call for proposals for a joint use of both X-ray and neutron powder diffraction beamlines at SLS (Materials Science Beamline X04SA) and SINQ (thermal neutron diffractometer HRPT). The call was addressed to proposals for powder diffraction experiments in the fields of condensed matter, crystallography, chemistry, magnetism etc., for which the use of both synchrotron X-ray **AND** neutron diffraction is required and adequately justified. Since this initiative was very successful it was decided to launch such calls on a regular basis once a year.

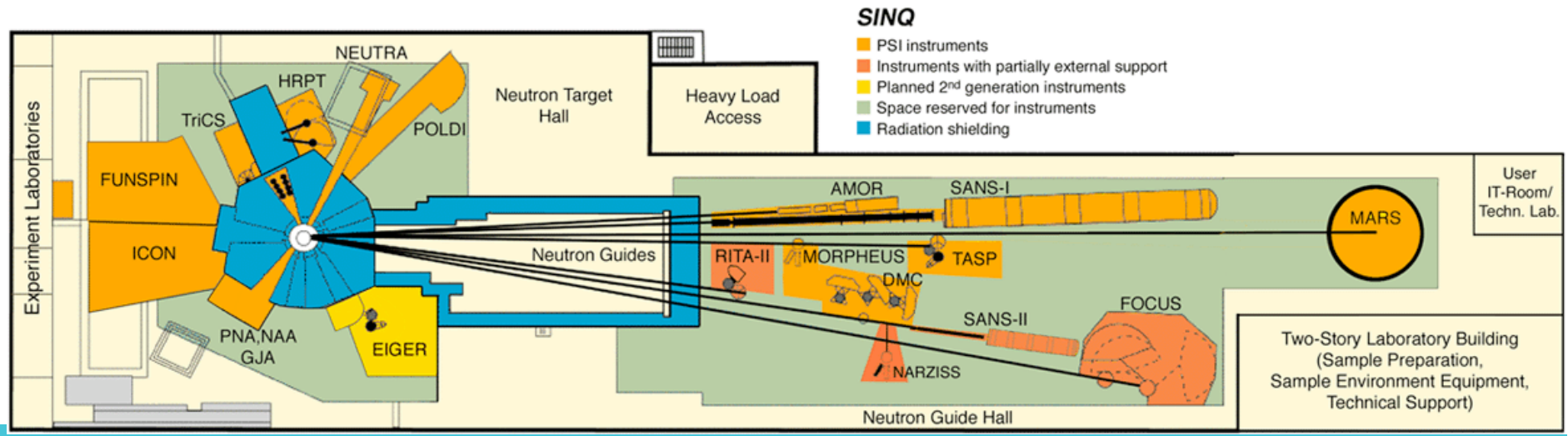
call for proposals	middle of January
submission deadline	**Feb 28**
allocation period	May-December

http://user.web.psi.ch/x+n/



Full suite of highly modern instrumentation:

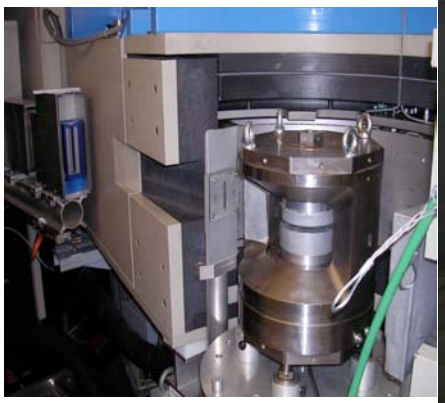
- 2 SANS facilities
- 3 reflectometers
- 2 powder diffractometers
- 1 X-tal diffractometer
- 1 strain scanner
- 2 imaging beamlines
- 2 triple-axis spectrometers
- 1 time-of-flight spectrometer
- 1 backscattering spectrometer



Sample Environment plays a central role for attracting user groups to SINQ!

Parameters:

- T_{min} = 50 mK
- T_{max} = 1800 K
- $H_{max/vert}$ = 15 T
- $H_{max/hor}$ = 11T (SANS)
- p_{max} = 10 GPa



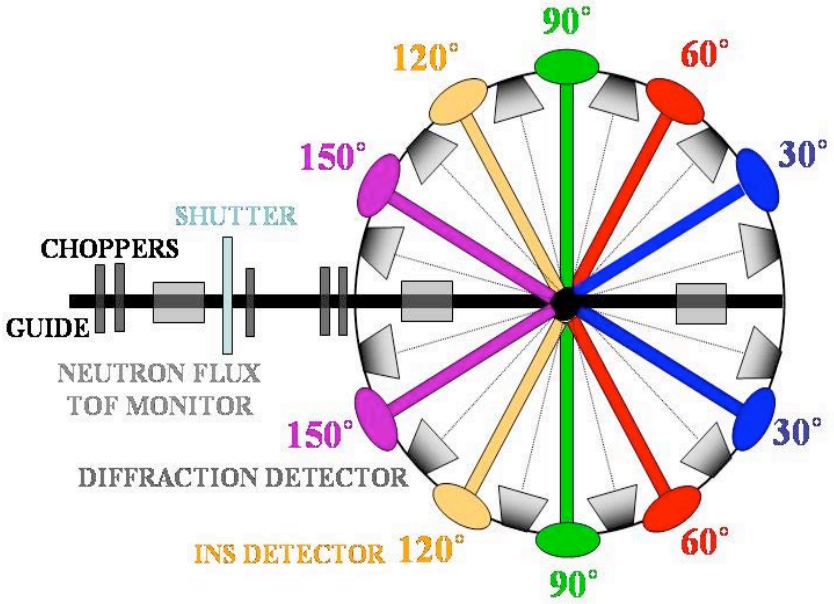
Combinations:

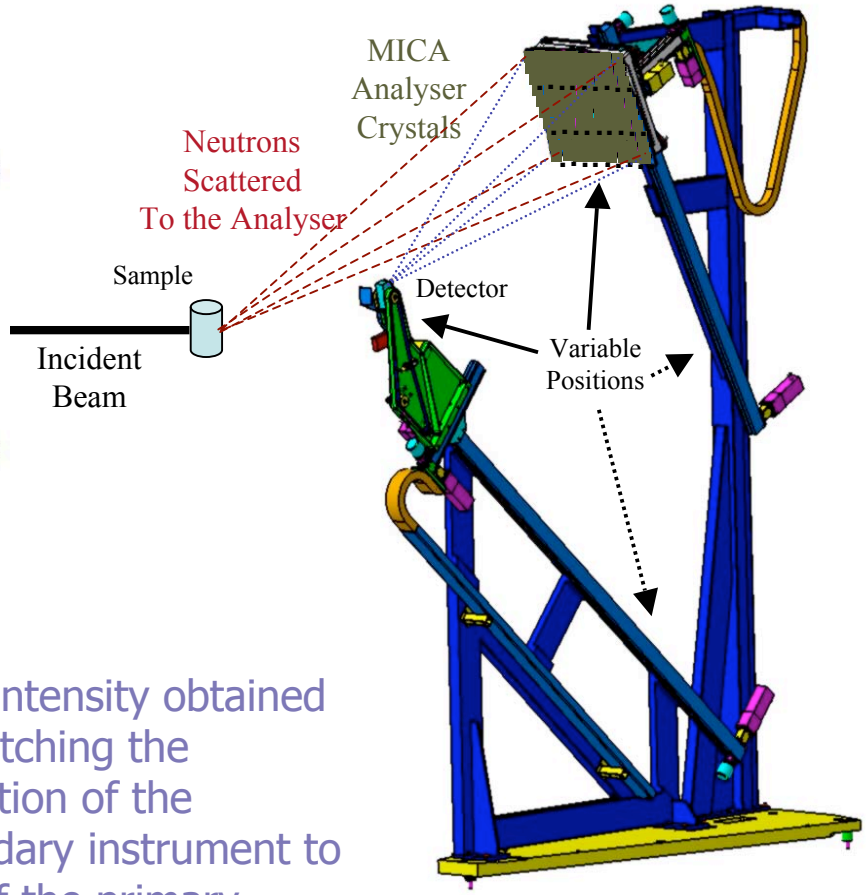
- 1400K with controlled atm
- electric field and 1.5K
- 50 mK and 11/15 T
- 5 GPa and 4.5K
- 1.5 GPa and 1.5 K
- Mupad option and 50mK

Planned 2009:

15T and 50 mK
and 1.5 GPa

MARS: **M**ICA **A**nalyser High **R**esolution Inverted Time-of-Flight **S**pectrometer

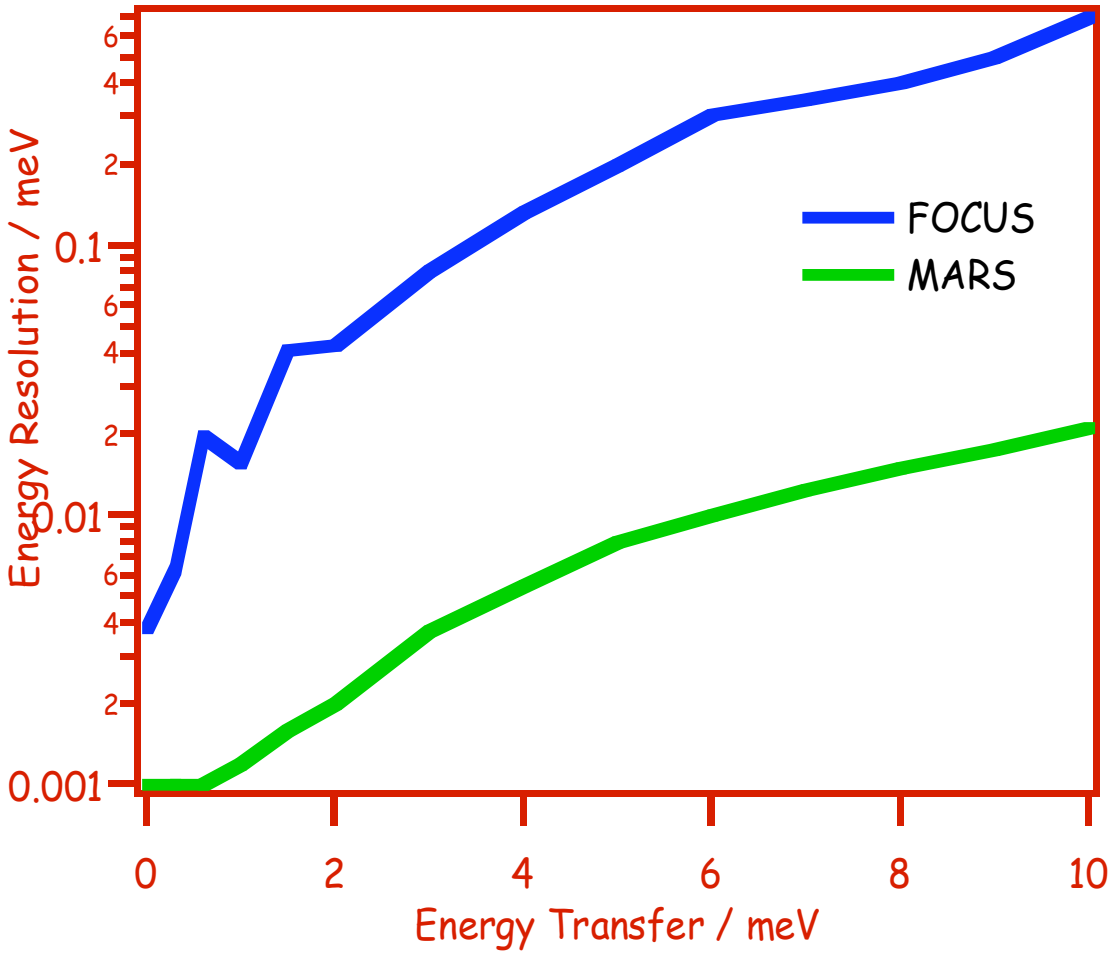




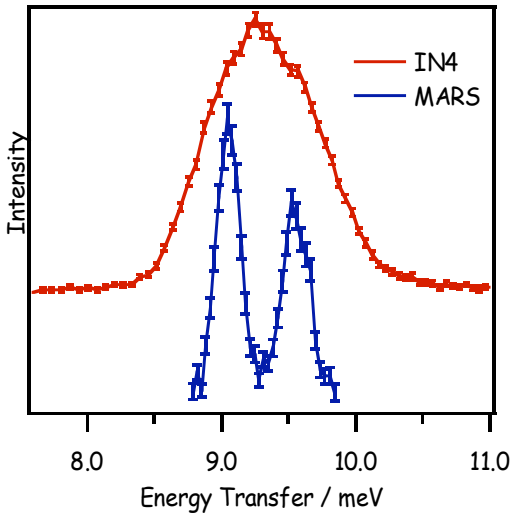
High Resolution afforded by:
(1) Long Flight Path
(2) High Chopper Speed (50 – 350 Hz)
(3) Long Wavelength of Analyser

High-Intensity obtained by matching the resolution of the secondary instrument to that of the primary.

MARS: **M**ICA **A**nalyser High **R**esolution
Inverted Time-of-Flight **S**pectrometer



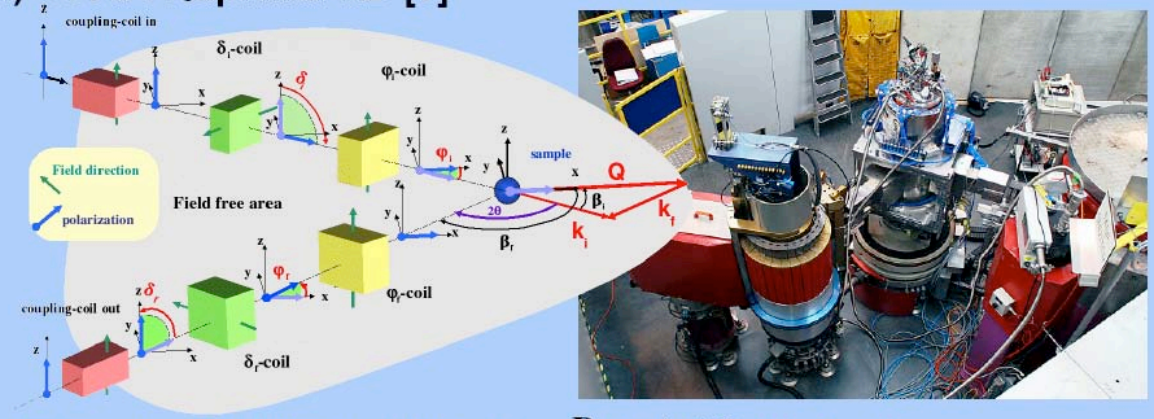
MARS is unique in offering μeV resolution deep in the inelastic regime.



Low energy doublet in $K_3Mn(CN)_6$ resolved

Spherical Neutron Polarimetry: MUPAD on TASP/SINQ
Determination of the „correct" magnetic structure

I) Used setup: MuPAD [9]



- measurement of full polarisation matrix: $P_{ij}(Q) = \frac{1}{2}(P_i^{in}\tilde{P}_{ji}(Q) + P'_j(Q))$
- maximum information about magnetic structure factor: $|M_\perp(Q)|^2 = \|[\hat{Q}\times(M(Q)\times\hat{Q})]\|^2$

II) Polarisation matrices at T = 20 K

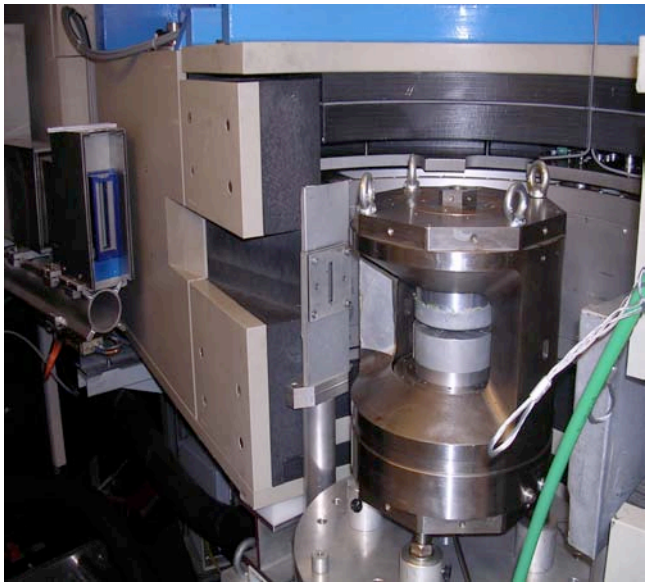
	hkl	(0.0, -2.0,-0.5)			(0.0,0.0,-1.5)			(0.0,1.0,-2.5)		
	Pout	x	y	z	x	y	z	x	y	z
Exp.	x	-0.861(3)	0.073(6)	0.042(6)	-0.87(2)	0.057(4)	0.119(4)	-0.860(8)	0.07(2)	0.10(2)
	Pin y	-0.059(6)	-0.659(4)	-0.050(6)	-0.010(3)	0.010(3)	0.019(3)	-0.04(2)	-0.08(2)	0.01(2)
	z	0.043(6)	-0.050(6)	0.655(4)	-0.032(3)	0.020(3)	-0.007(3)	-0.04(2)	-0.01(2)	0.11(2)
	Pout	x	y	z	x	y	z	x	y	z
Model	x	-0.87	0.00	0.00	-0.87	0.00	0.000	-0.87	0.00	0.00
	Pin y	0.00	-0.65	-0.07	0.00	0.02	0.02	0.00	-0.05	0.01
	z	0.00	-0.07	-0.65	0.00	0.02	-0.02	0.00	0.01	0.05

- excellent agreement between model and data!

MUPAD option on TASP

Tasset, Physica B **156&157** (1989) 627
Blume, Physical Review **130** (1963) 1670

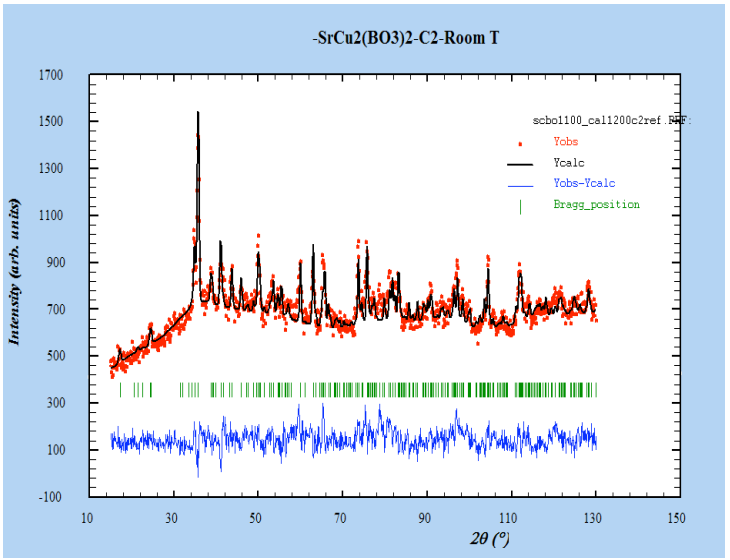
High pressure anvil cell installed at HRPT powder diffractometer



P_{max} = 10 GPa

detector shielding
+ radial collimator
+ BN anvils
+ low noise electronics
excellent peak to background ratio

p= 8 GPa: monoclinic *C2*: **the new structure solved from the HRPT data!**

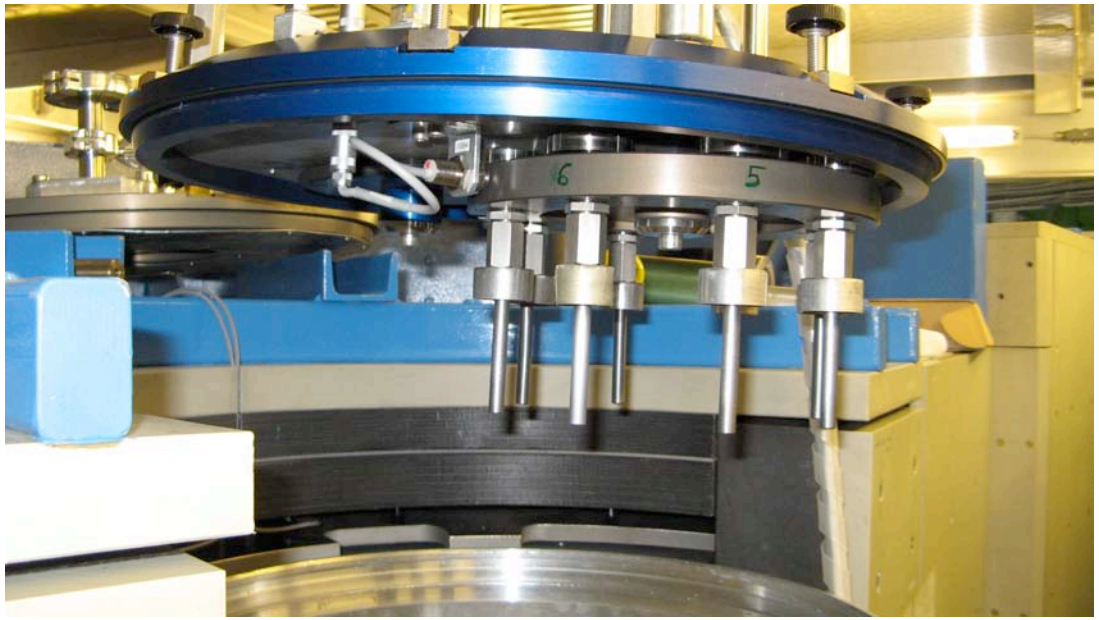


High pressure structure transition in quantum dimer system $SrCu_2(BO_3)_2$

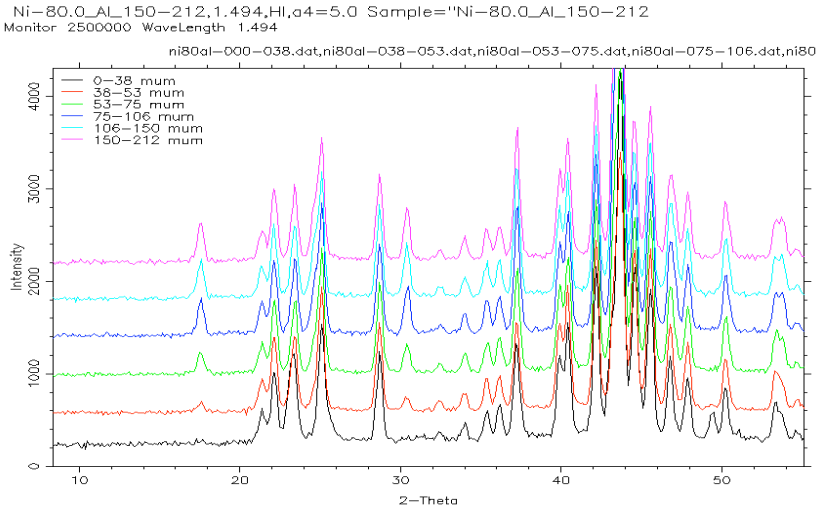
- *LNS, PSI*: V. Pomjakushin, Th. Strassle, K. Conder, E. Pomjakushina
- *EPFL:* M. Zayed, H. Ronnow

New HRPT sample changer

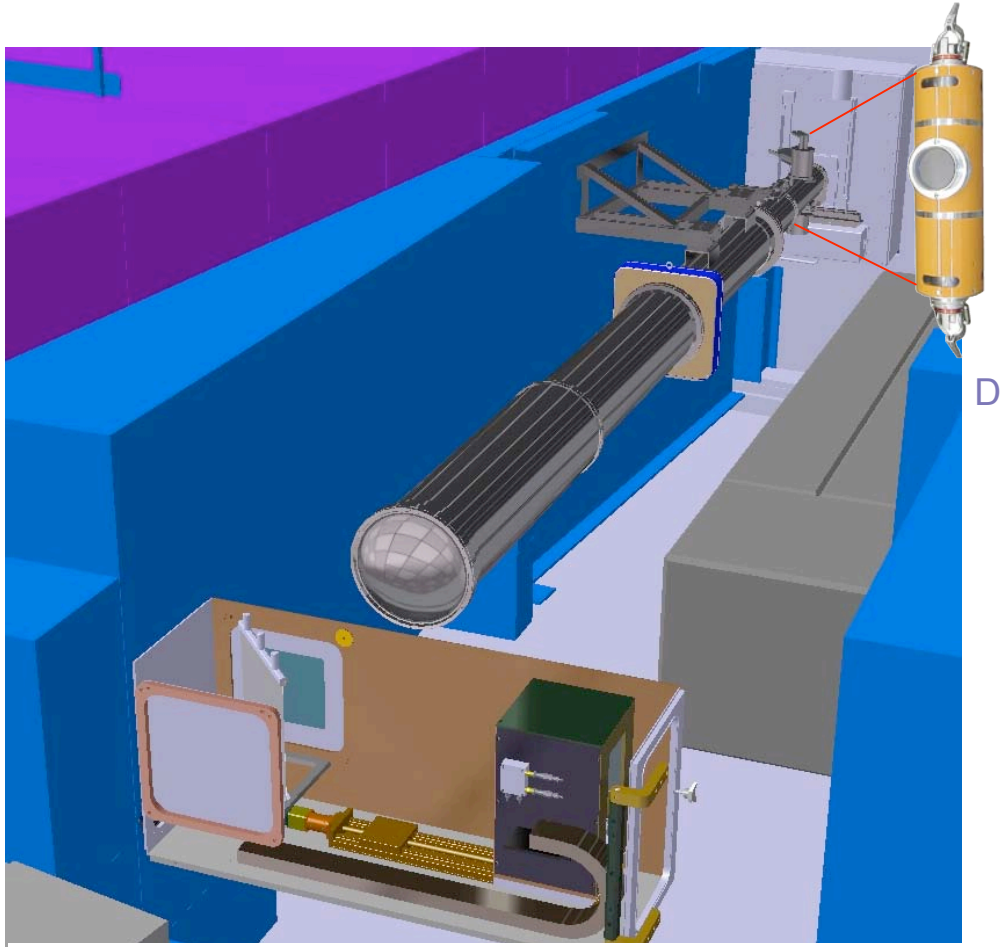
- Eight samples mounted on a carrousel
- Few seconds to bring it into the measurement position
- Independent sample rotation mechanism
  (for reducing the preferred orientation aberrations)
- Tremendous improvements in the efficiency of the beamtime usage
- Much easier life for experimentalists



User Experiment 20061119 “Structure of leached Raney Ni alloys”
~ 80 samples measured in 4 beam days



NEUTRA: thermal neutron radiography beamline



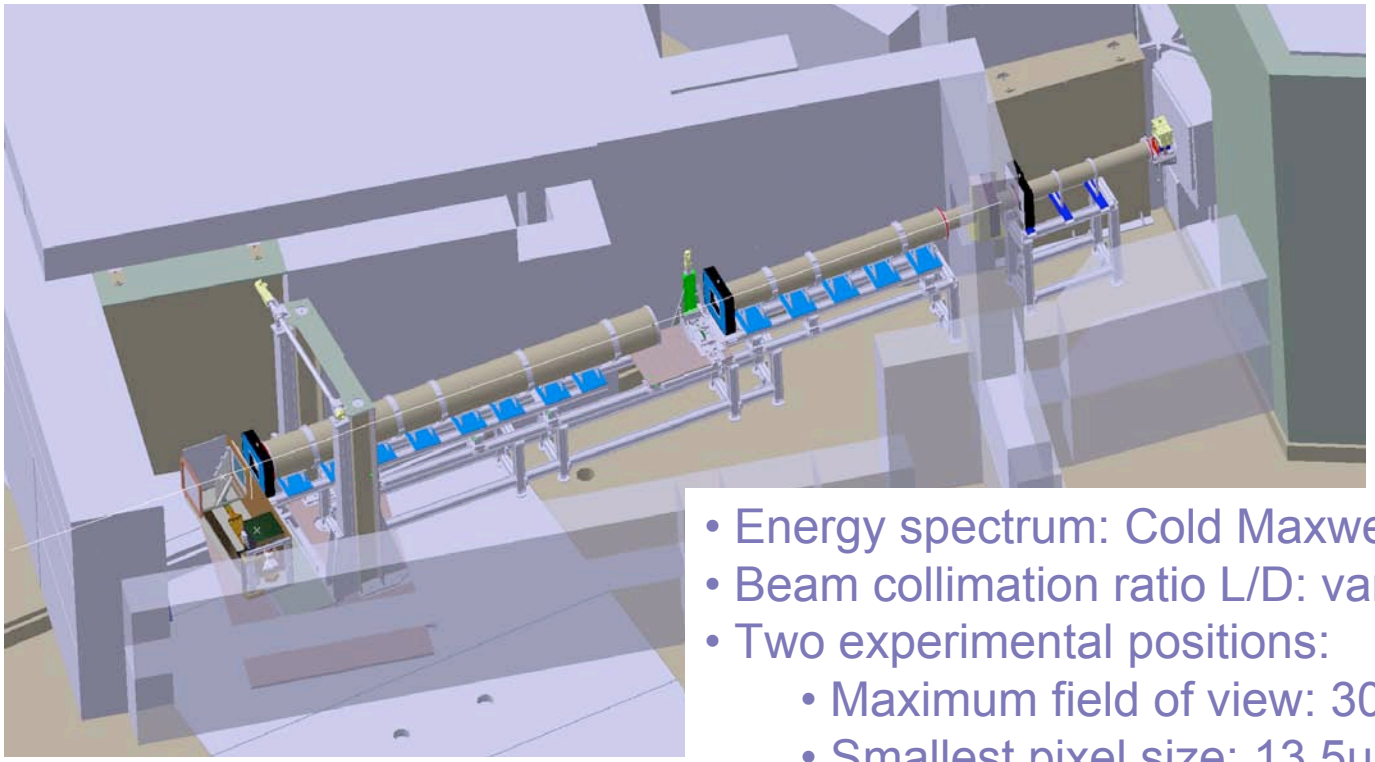
2 SINQ imaging instruments:
new in NMI3 at SINQ !!

Dual modality imaging with 320 kV X-ray tube
XTRA-option

- Energy spectrum: Thermal Maxwellian
- Beam collimation ratio L/D: 550
- Maximum field of view: 340 x 340 mm
- Radiography of highly radioactive samples

CCD camera on linear table for variable size field of view

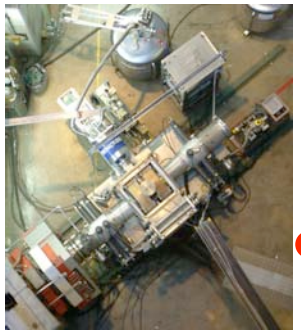
ICON: Cold neutron imaging beamline



- Energy spectrum: Cold Maxwellian
- Beam collimation ratio L/D: variable (max 10000)
- Two experimental positions:
  - Maximum field of view: 300 x 300 mm
  - Smallest pixel size: 13.5µm
- Radiography and tomography
- Energy selective imaging
- Infrastructure to handle up 500kg samples

μ-SR facilities at SμS

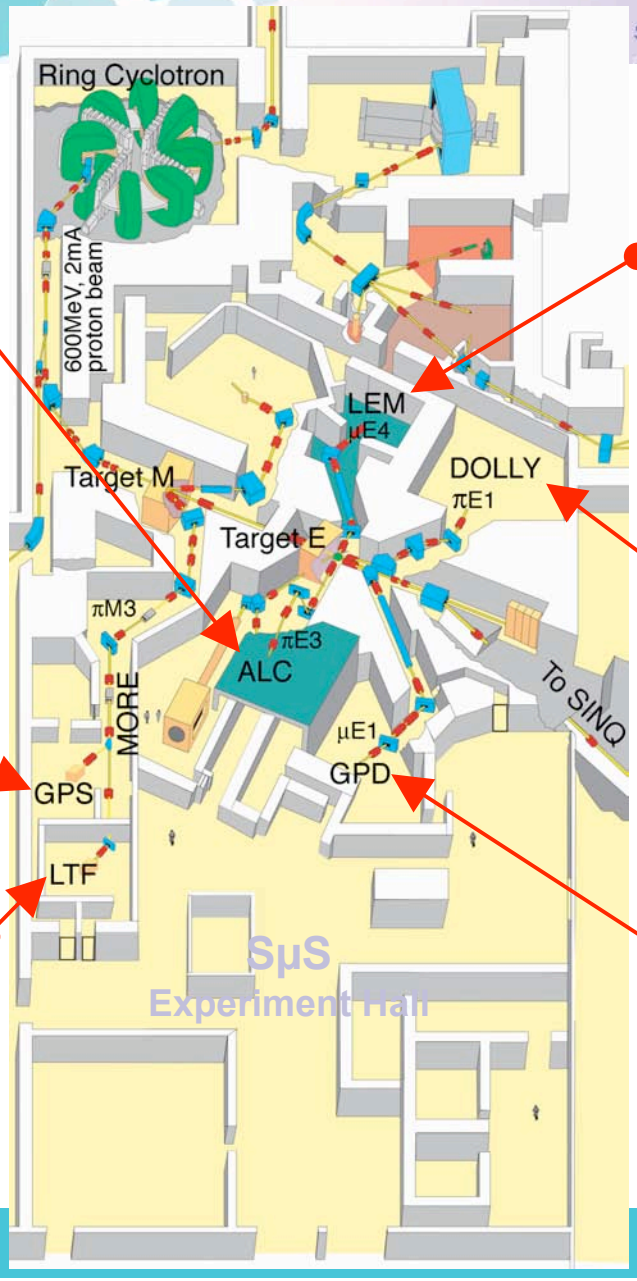
ALC
Avoided Level Crossing Resonance Instrument
Muon energy: 4.2 MeV (μ^+)

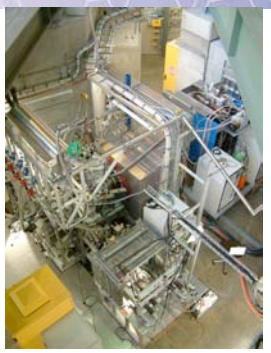


GPS
General Purpose Surface Muon Instrument
Muon energy: 4.2 MeV (μ^+)

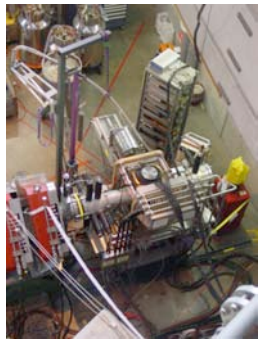
Shared Beam Surface Muon Facility

LTF
Low Temperature Facility
Muon energy: 4.2 MeV (μ^+)

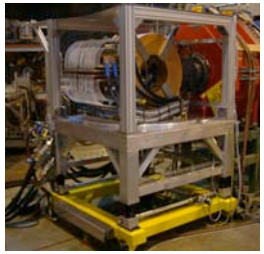




LEM
Low-energy muon beam and instrument , tunable energy (0.5-30keV, μ^+), *thin-film, near-surface and multi-layer studies (1-300 nm)*



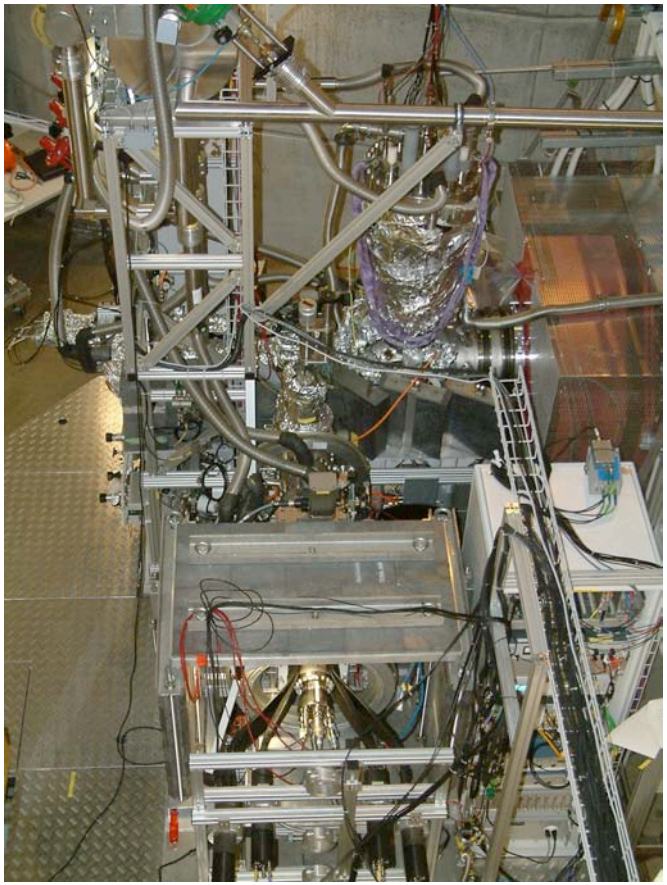
DOLLY
General Purpose Surface Muon Instrument
Muon energy: 4.2 MeV (μ^+)

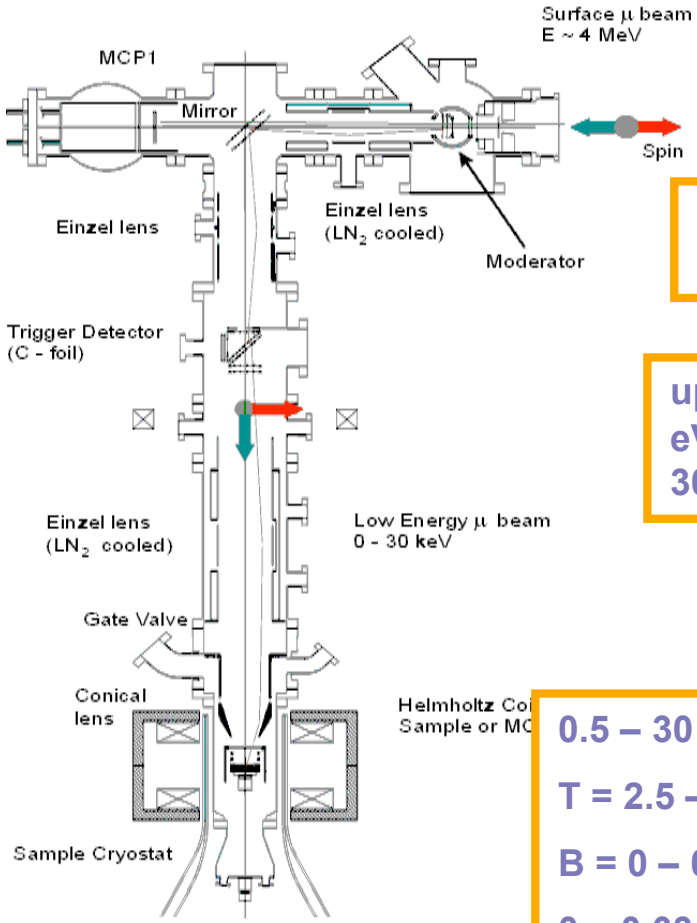


GPD
General Purpose Decay Channel
Instrument
Muon energy: 5 - 60 MeV
(μ^+ or μ^-)

LEM: World-wide unique low-energy muon beam

Low-energy μSR
(LE-μSR) spectrometer





~1.7•10^8 μ$^+$/s on moderator

up to 1.6•10^4 μ$^+$/s at 15 eV, re-accelerate up to 30 keV

0.5 – 30 keV (1 – 300 nm)

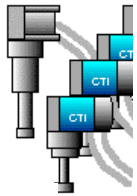
T = 2.5 – 400 K

B = 0 – 0.3 T perpendicular,

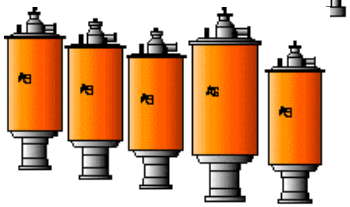
0 – 0.03 T parallel to sample surface

SμS Sample Environment

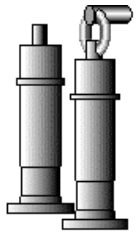
Temperature: 0.02 - 1200 K



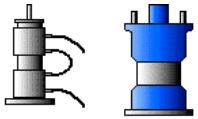
3 Closed Cycle Refrigerators



8 He-Cryostats

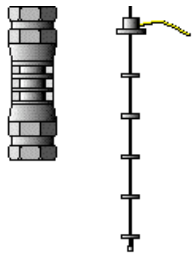


2 Dilution and ^{3}He Cryostats/Inserts



4 Furnaces

Magnetic Field: 5 T longitudinal (ALC), 3 T transverse (LTF)
0.6 T long. or transv. (standard)



Pressure: 30 kbar hydrostatic

High Energy Muon Instrument – GPD

Pressure Cell

MP35N

Babes-Bolyai Univ. Cluj-Napoca (RO)

IMNF, TU Braunschweig (D)

TU Dresden (D)

25 kbar at 240 mK

Strategy for the future

- Is there a possibility to reinforce the strength of your facility through a common strategy?
  - **We do have a common strategy at PSI based on two components:**
  - **Function as user laboratory**
  - **Strong and competent in-house research**

- Would a topical focus make sense ?
  - **Topical focus at SINQ/SμS (and also SLS) is on solid state physics, materials sciences and soft condensed matter**

- Your point of view regarding integration with other fields (eg laser)
  - **Very similar to us is the synchrotron-I3 (ELISA), that would also make sense with respect to complementarity**
  - **The case of lasers (X-FEL) is not totally clear yet, might be different**

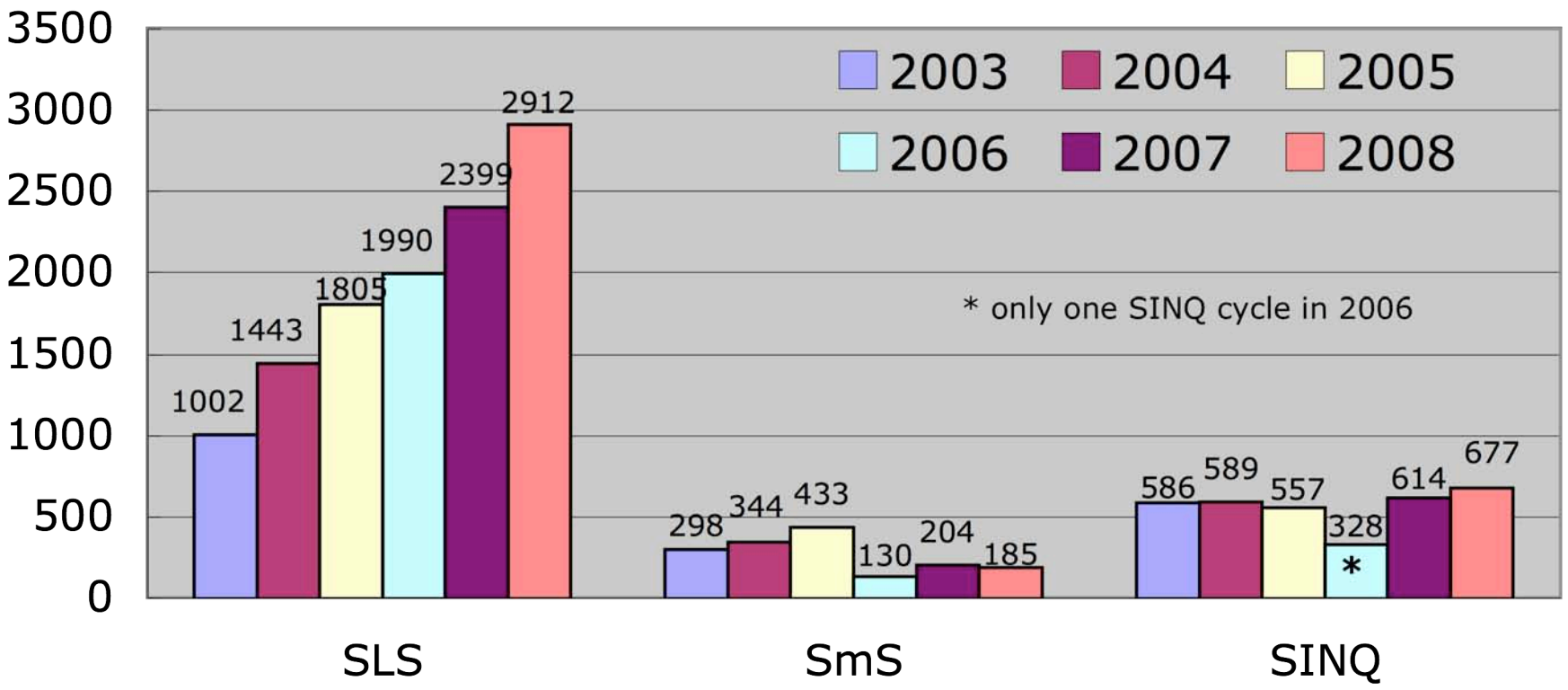
Your place in Europe

- Statistics on user frequentation / outcome in terms of publications?
- Common user data management (eg. ISIS, PSI, ILL) ?
- Neutron & Muon community management (eg. study on publications)?

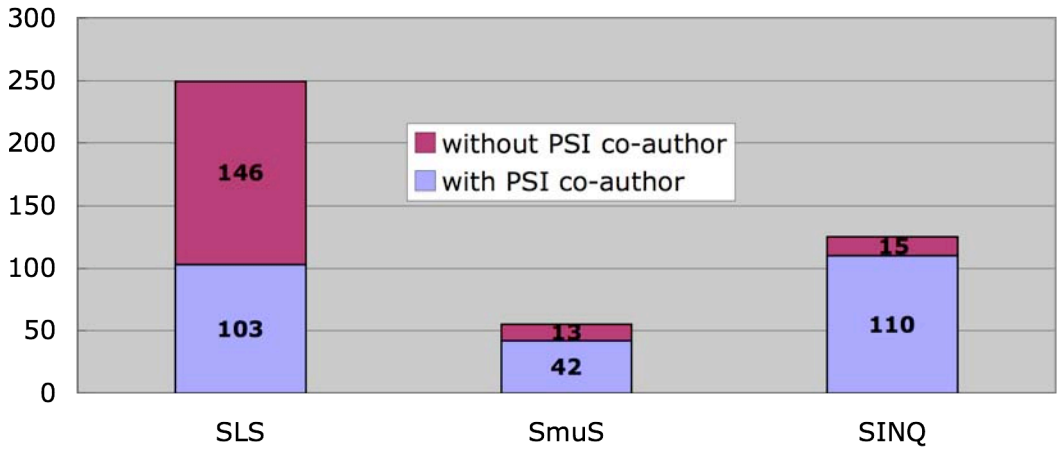
PSI user laboratory key numbers 2008

2008	SLS	SINQ	SμS	PSI total
Beamlines	14	13	6	33
Instrument Days	1657	1895	655	4207
Experiments	1036	446	168	1650
User Visits	2912	677	185	3774
Individual Users	1616	447	151	2214
New Proposals	656	275	156	1087

Development of user visits PSI user labs

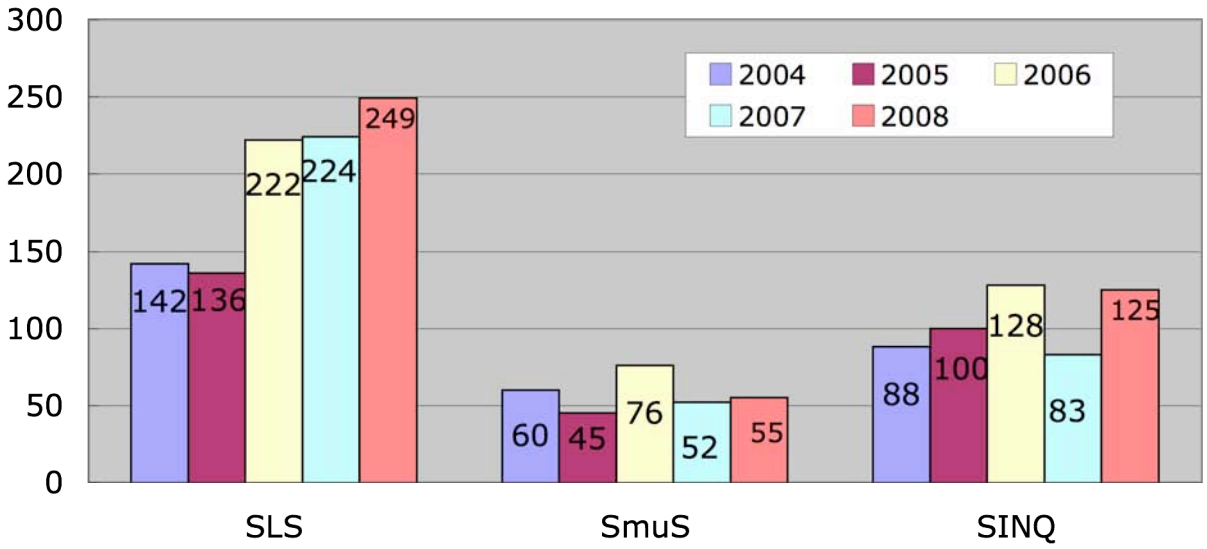


peer reviewed user laboratory publications 2008

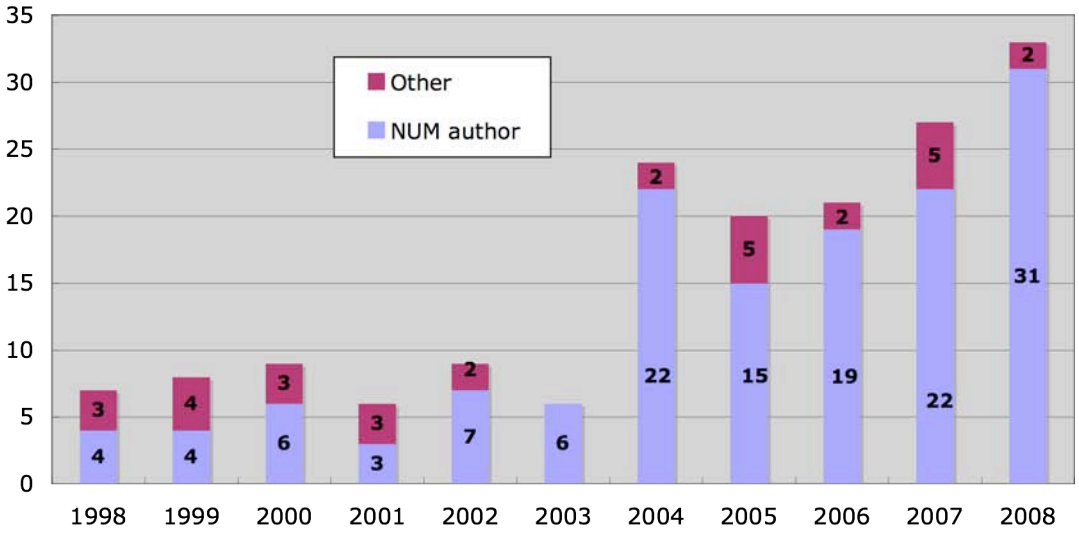


Publications resulting from experiments at PSI user facilities

peer reviewed user laboratory publications 2004-2008

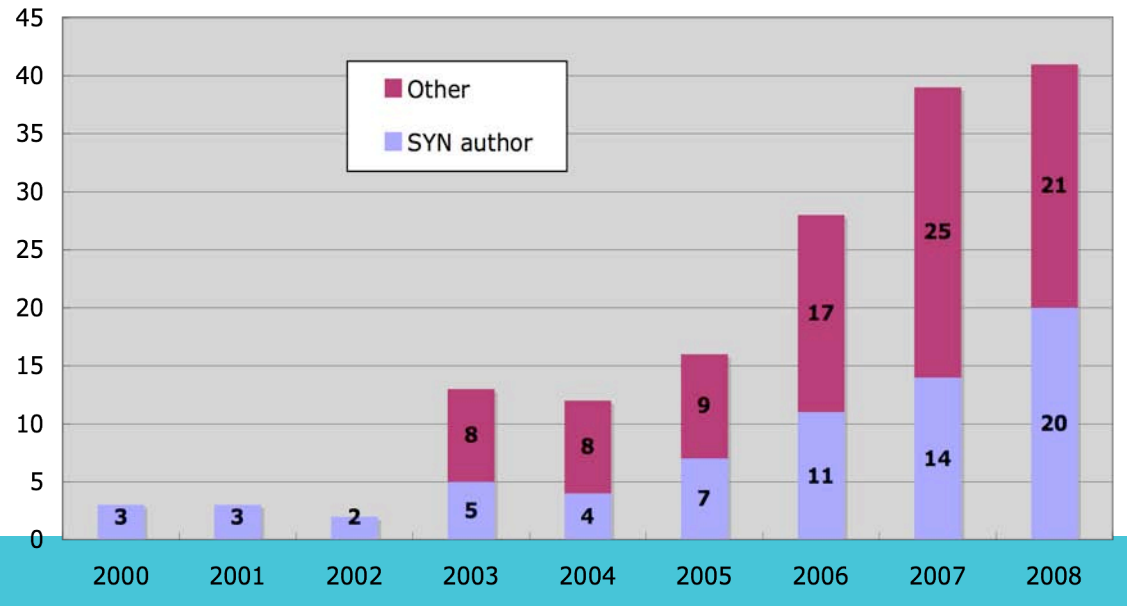


Publications in high-profile journals NUM/SINQ/SmuS (Nature, Science, Cell, PRL)



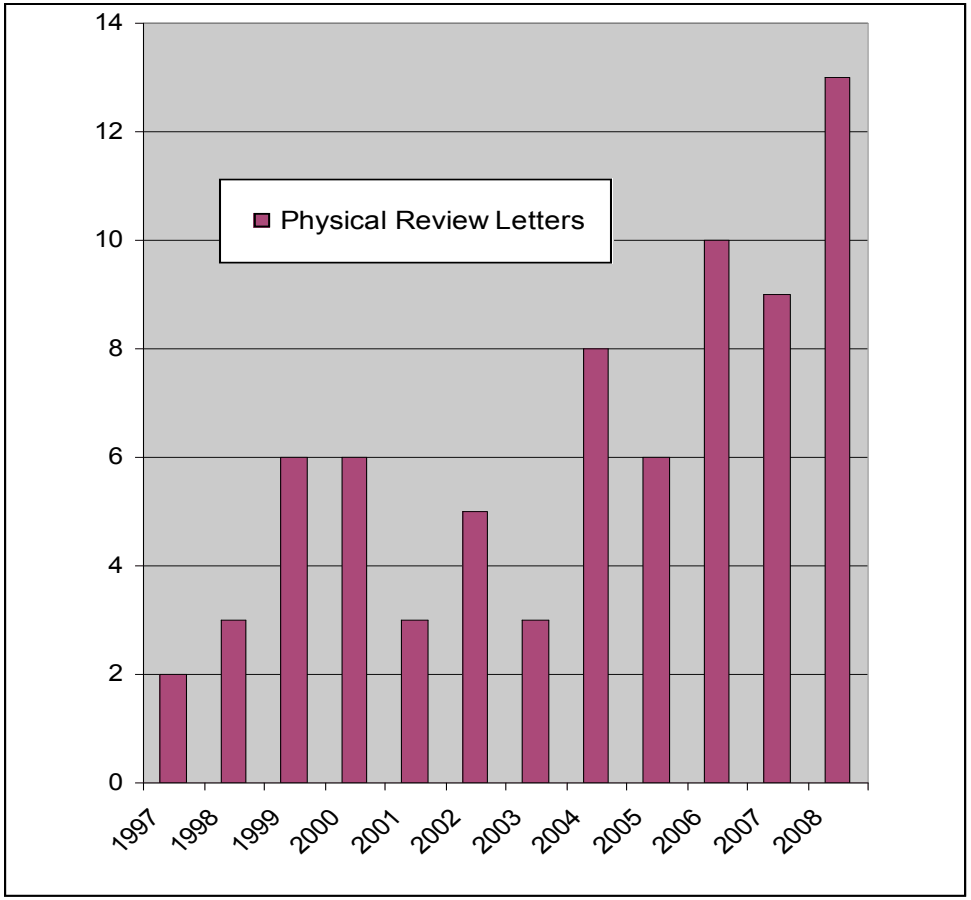
High profile papers
NUM and SYN departments

Publications in high-profile journals SLS/SYN (Nature, Science, Cell, PRL)



SμS: > 1000 articles in total since 1994

SμS:
high-impact (PRL)
articles since 1997



Common user data management

- 11.700 registered users
- 3.000 registered addresses of institutes/companies
- 6.100 proposals (editing included)
- 2.500 publications (since 2006 fully operational)
- 1.300-1.800 user clicks per day
- 40 conferences processed

PSI Digital User Office „DUO"

SLS

SINQ

SμS

One single entry portal for all PSI users

https://duo.psi.ch

PSI Digital User Office

2005 - BOAT @ BESSY (HZB):

BESSY Online Access Tool

International collaboration

2006 - SUN @ SOLEIL:

SOLEIL Users Net

MAX-lab, Lund and ALBA Bellaterra are interested

2009 - FRM-II, Munich:

Collaboration just started

2006 - DOOR @ DESY:

DESY Online Office for Research with Photons

Contact point:

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User Office
http://user.web.psi.ch
sinq@psi.ch, smus@psi.ch

Thanks for your attention!!