LLB CRG Inelastic instruments at ILL: from IN6 to SHARP then SHARP+

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[1] Laboratoire Léon Brillouin , Saclay, France
[2] IRIG/SyMMES , Grenoble, France

SHARP: Up and Running !

SHARP (Spectromètre Hybride Alpes Region Parisienne)
LLB CRG "A" at ILL


IN6 : 28/09/2020


Design : 2018-2019


Before delivery : 27/10/2020


Delivery : 30/11/2020


Delivered : 30/11/2020


Detectors : 11/03/2021

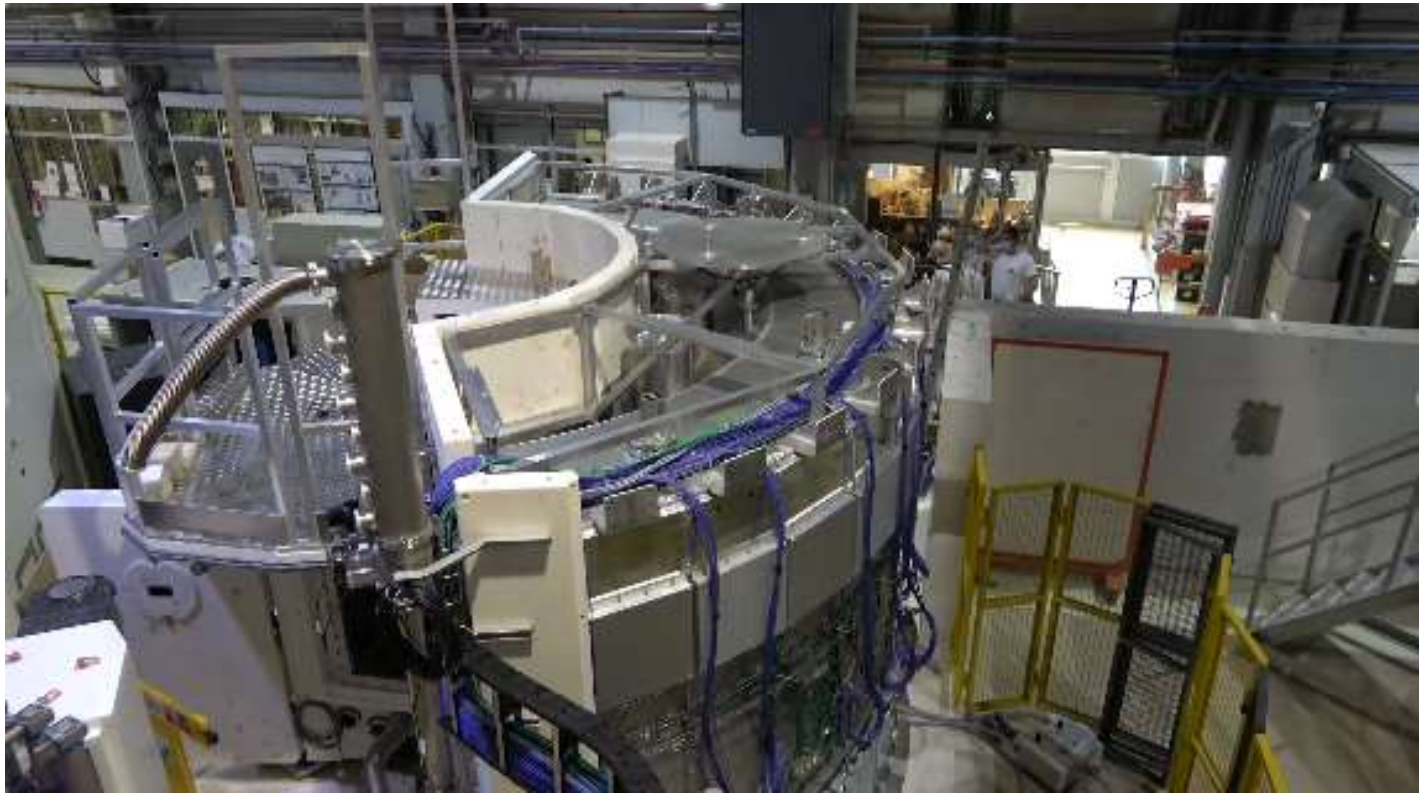

Sample Env. : 19/03/2021

On line : 21/03/2021

SHARP (Spectromètre Hybride Alpes Region Parisienne)
A LLB CRG "A" at ILL

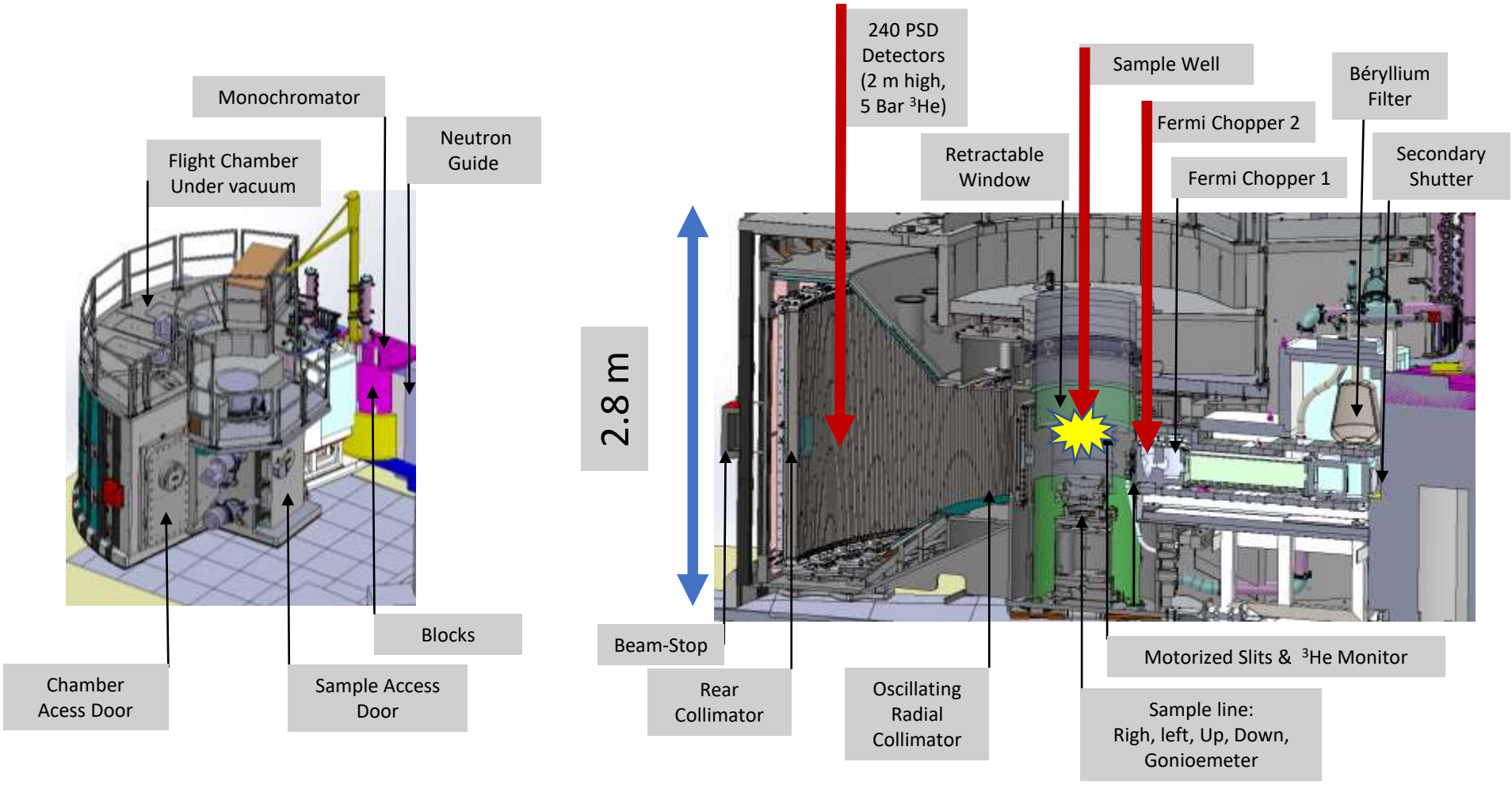
- Cycle 1: January 27 to March 30 : Construction & first neutrons (March 21)
- Cycle 2 : May 11 to July 14 : Commissioning
- Cycle 3: August 24 to Oct. 13 Back to users granted beam time (50% 2FDN /50 %ILL)

NB: First neutrons in less than 5 months from the delivery of the "naked" chamber



Credit: Amélien Genelle, CEA/DRF/IRIG/SyMMES

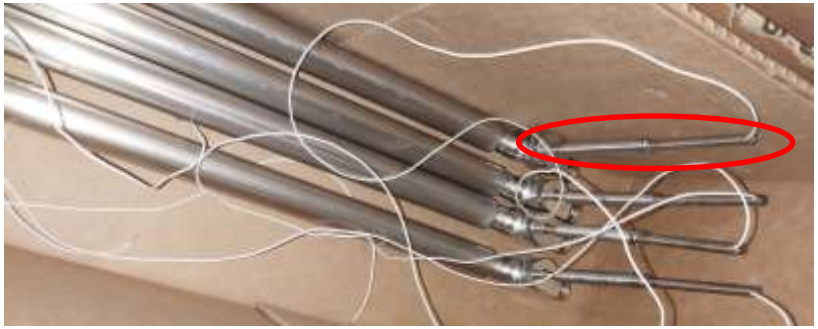
Sharp:
A state of the art ToF Spectrometer



More on « time-of-flight » :
J. Ollivier et J.-M. Zanotti, Diffusion Inélastique de Neutrons par temps de vol. J. Phys. IV, Société Française de la Neutronique,10, 379

IN6 ToF Chamber under He Flow --> Background
SHARP ToF chamber under vacuum: 25 m³

Electronics outside of the ToF chamber



240*2 vacuum feed through (minimize leaks)

Efficient Pumping System: 2 primary pumps and a root

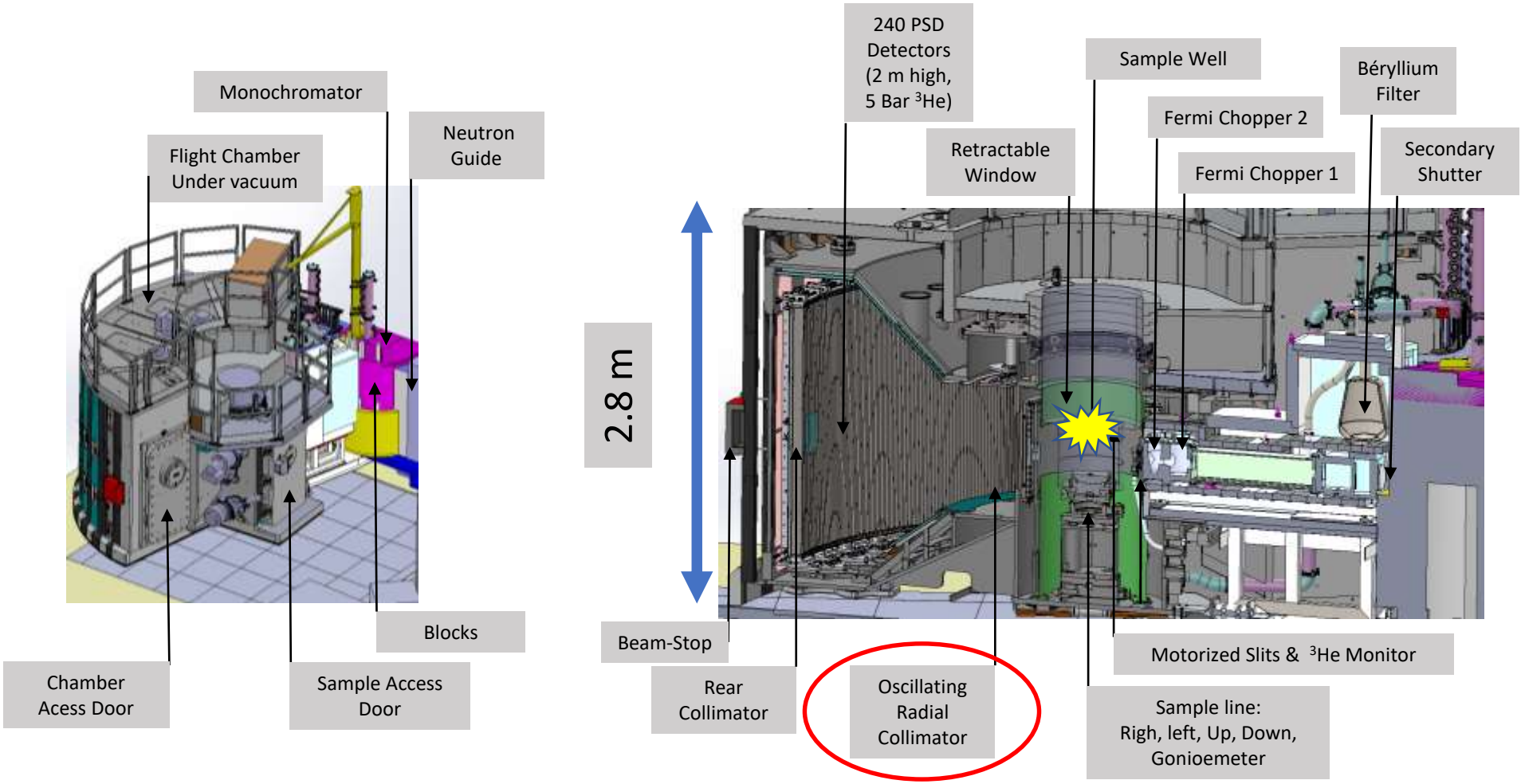
ILL Vacuum Team:

E. Lampasona
A. Girault
G. Bonnet
E. Courraud

Vacuum gauge
TofFChamber+ Sample environment

ILL funding

Sharp:
A state of the art ToF Spectrometer

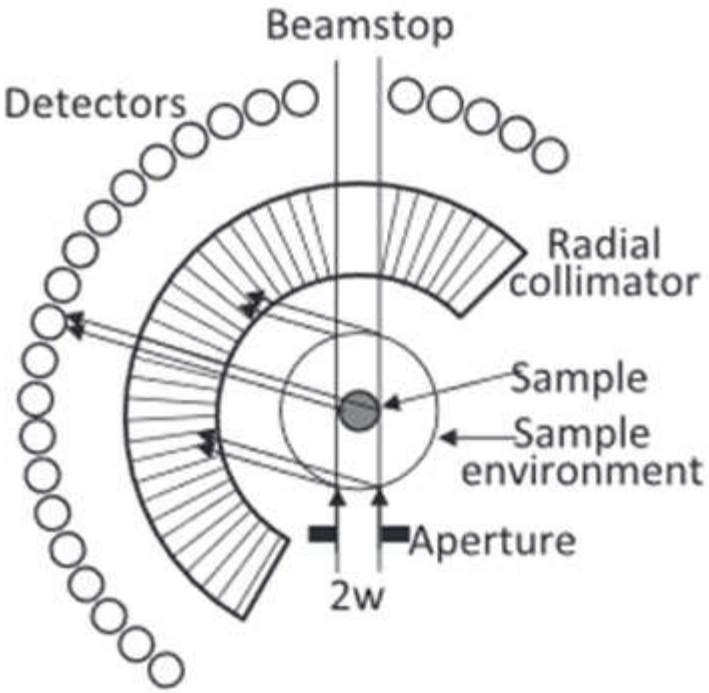


More on « time-of-flight » :
J. Ollivier et J.-M. Zanotti, Diffusion Inélastique de Neutrons par temps de vol. J. Phys. IV, Société Française de la Neutronique,10, 379

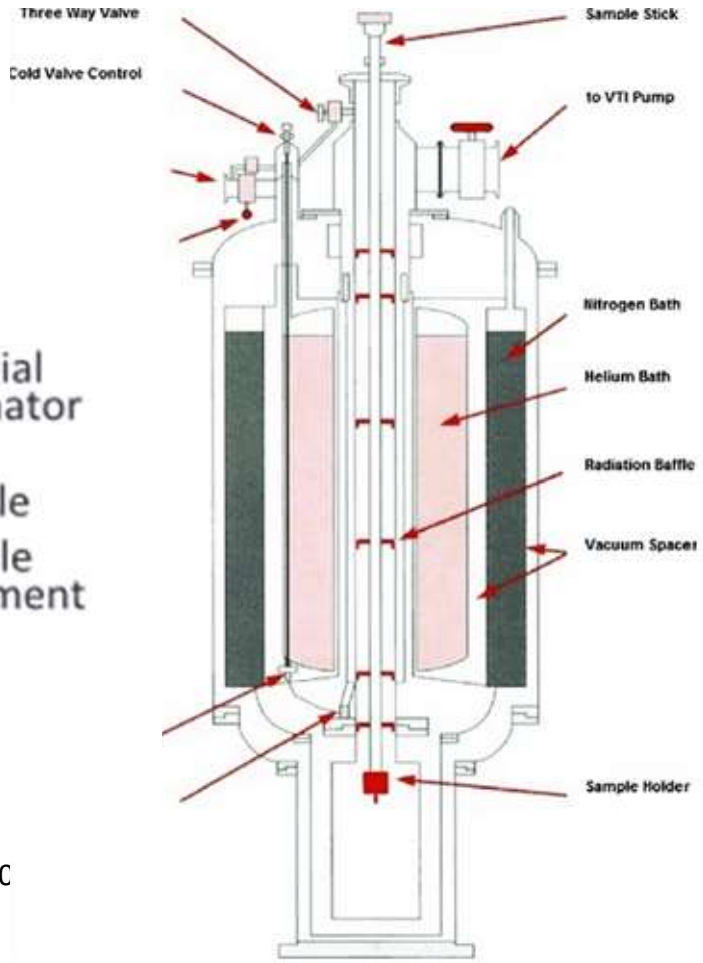
Key Brand New Equipment: Radial Collimator

SHARP

Streched Mylar + Gd_2O_3



Stone *& al.*, Rev. Sci. Instrum. 85, 085101 (20



Take-Home message:

A radial collimator defines

an ‘”Exclusion” zone around the sample

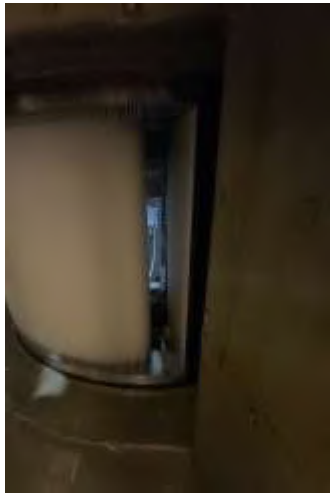
so that the neutron scattered away from the sample are absorbed

Key Brand New Equipment: Radial Collimator

LLB design & slits Provider and mounting : Euro-collimators

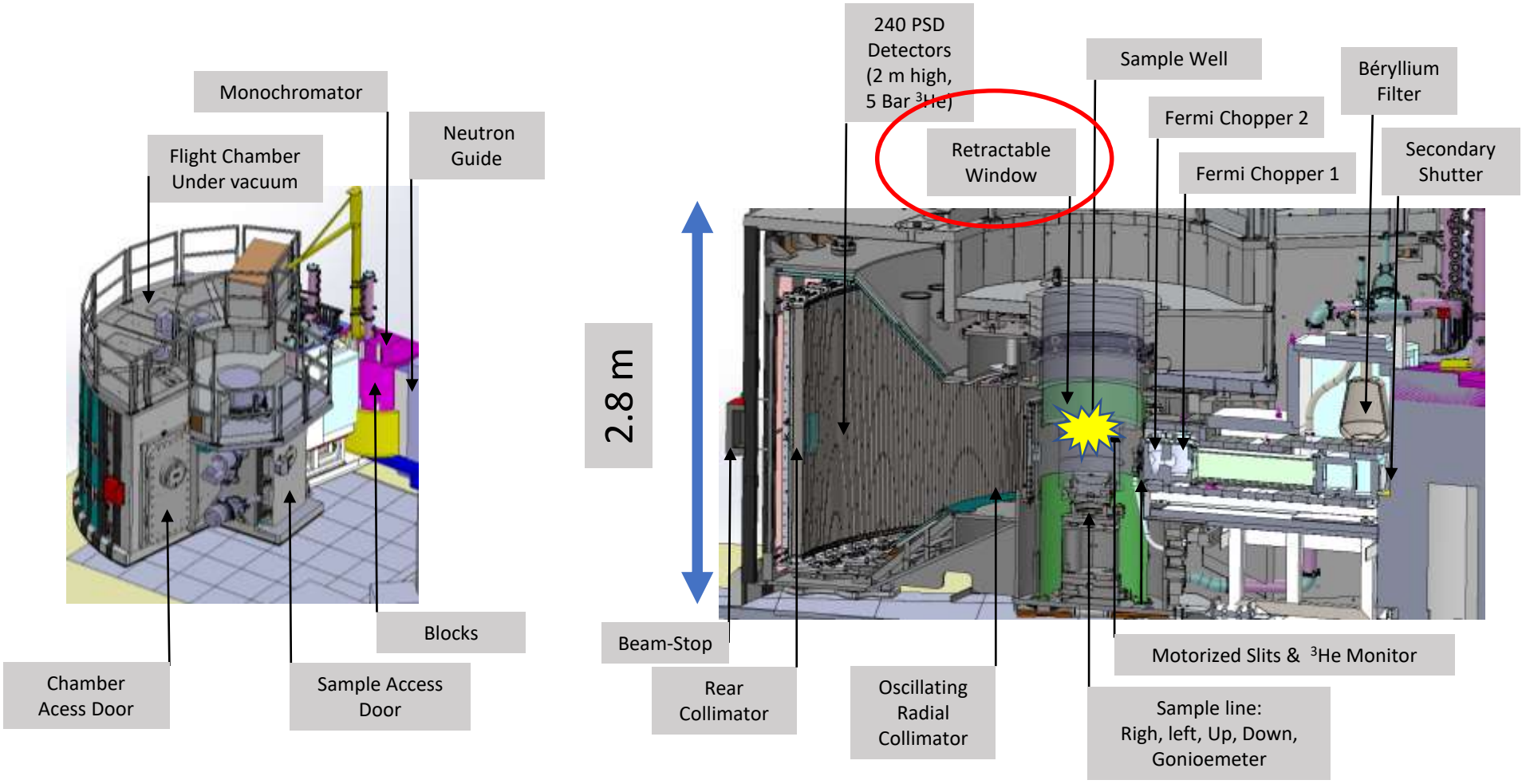
As seen from the detectors position

90°



0°

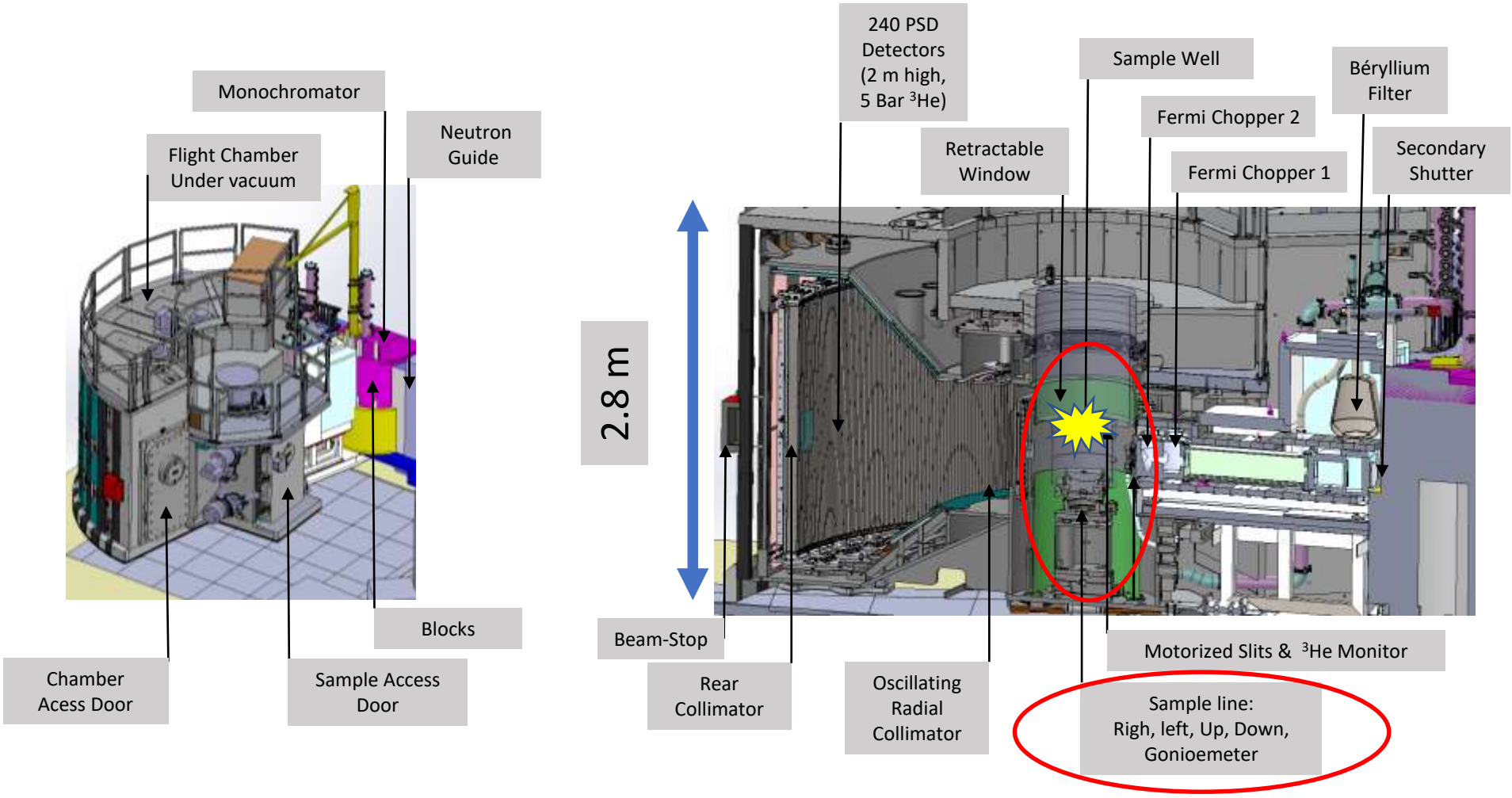
Sharp:
A state of the art ToF Spectrometer



More on « time-of-flight » :
J. Ollivier et J.-M. Zanotti, Diffusion Inélastique de Neutrons par temps de vol. J. Phys. IV, Société Française de la Neutronique,10, 379

Detector chamber under vacuum but Sample environment under controlled atmosphere: Retractable Window

Sharp:
A state of the art ToF Spectrometer



More on « time-of-flight » :
J. Ollivier et J.-M. Zanotti, Diffusion Inélastique de Neutrons par temps de vol. J. Phys. IV, Société Française de la Neutronique,10, 379

A specifity of IN6 and SHARP: Sample accessible from the side of the instrument

Levitation of supercooled liquids:

Avoid heterogeneous nucleation in sample holder.

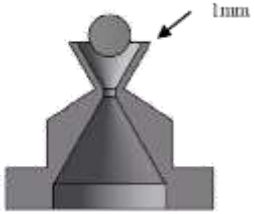
Levitation of a sample in the beam with a air flow.

Needs : - Sample heated by a laser (metal, Glasses)

Laser: higher Temp. than Furnaces.

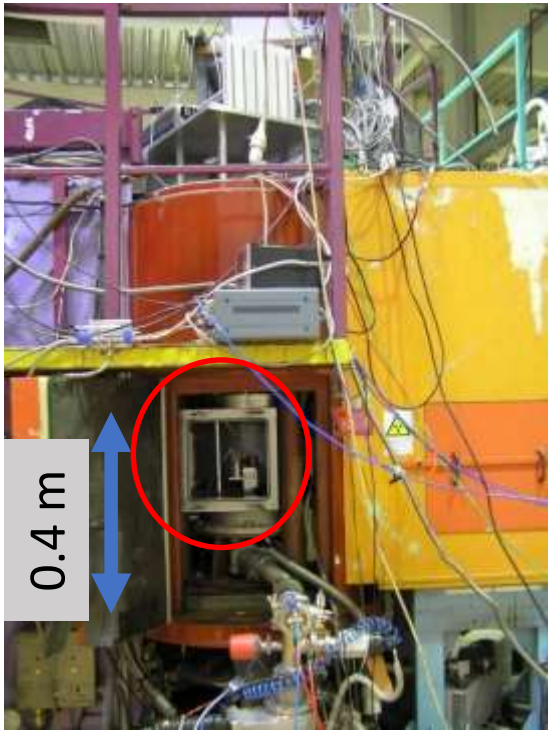
- Sample in controlled atmosphere /air.

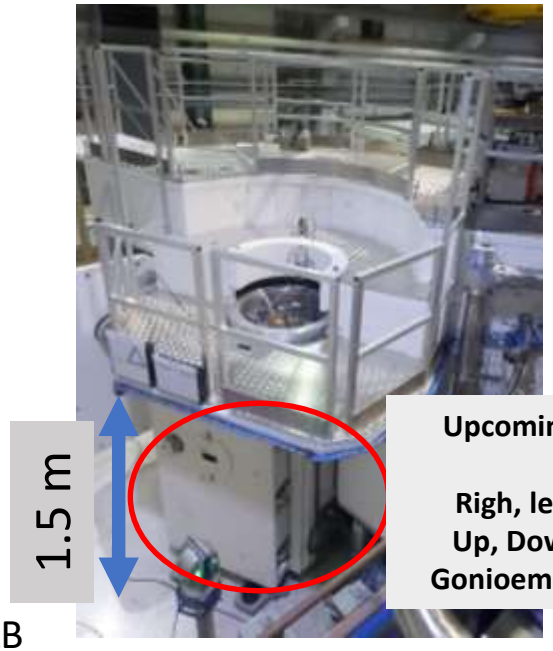
4mm samples



Al nozzle

J.Kozaily, L.Hennet, H.E.Fischer, M.Koza, S.Brassamin, S.Magazu, F.Kargl, *Levitation apparatus for Time-Of-Flight inelastic neutron scattering investigations on high-temperature liquids*, Phys. Stat. Solidi C, 8 3155-3158 (2011)



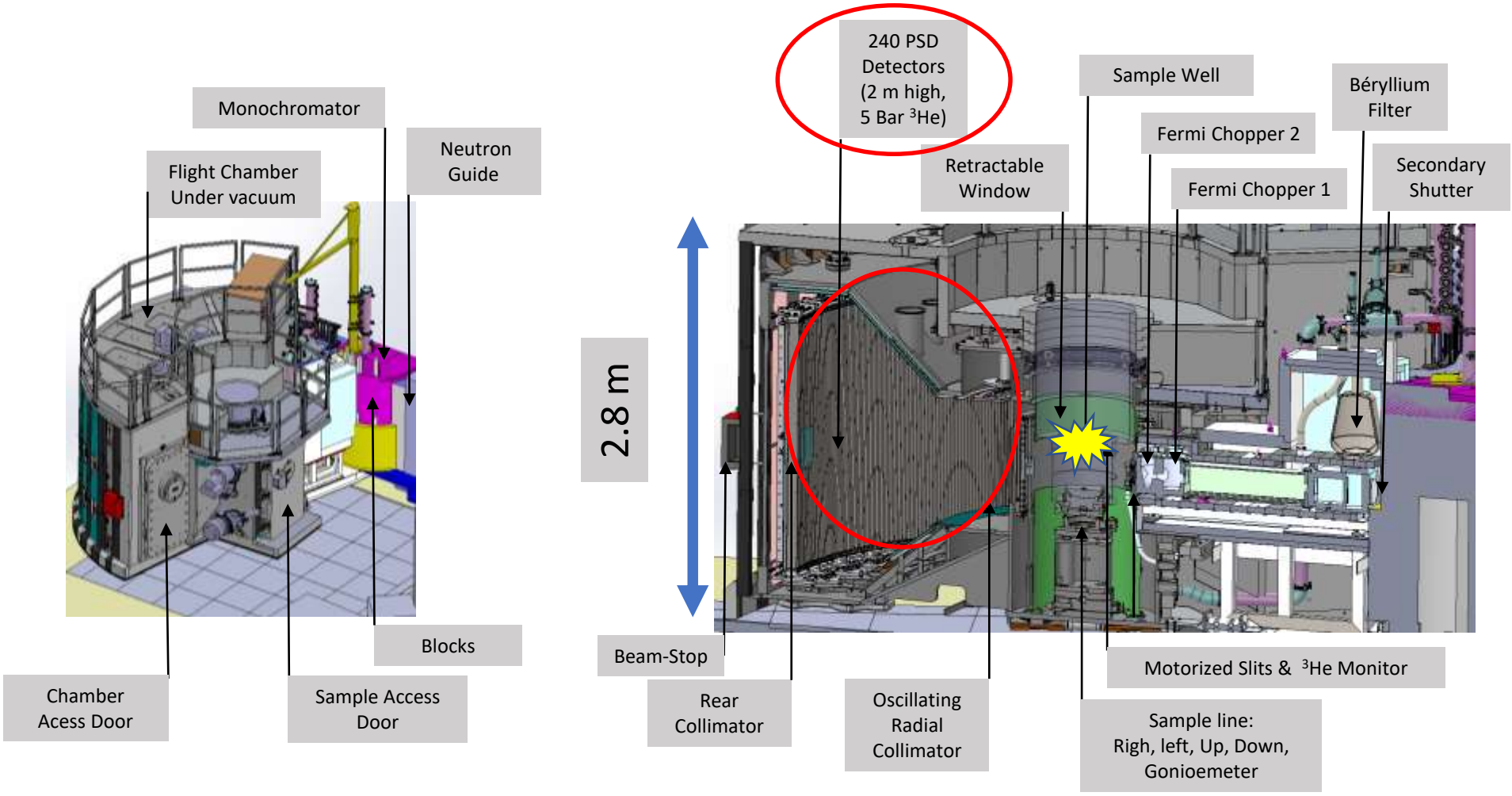


Upcoming:

Righ, left
Up, Down
Gonioemeter

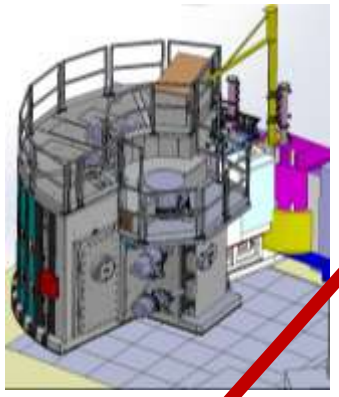
Courtesy L. Hennet, ICMN, Orléans, France & LLB

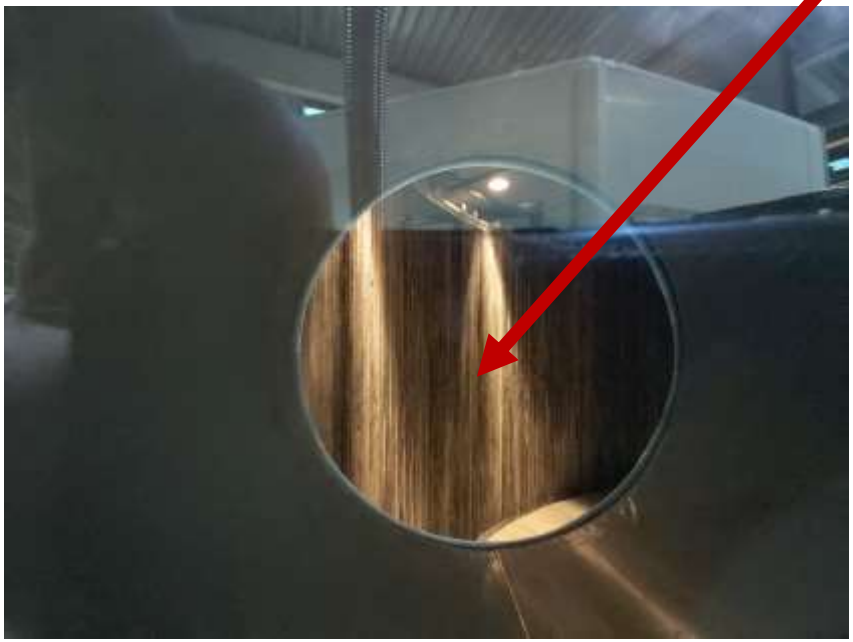
Sharp :
A state of the art ToF Spectrometer



More on « time-of-flight » :
J. Ollivier et J.-M. Zanotti, Diffusion Inélastique de Neutrons par temps de vol. J. Phys. IV, Société Française de la Neutronique,10, 379

240 Position Sensitive Detectors (5 bars ^{3}He, 2 m) 4-144° and Rear Collimator (No cross talks)

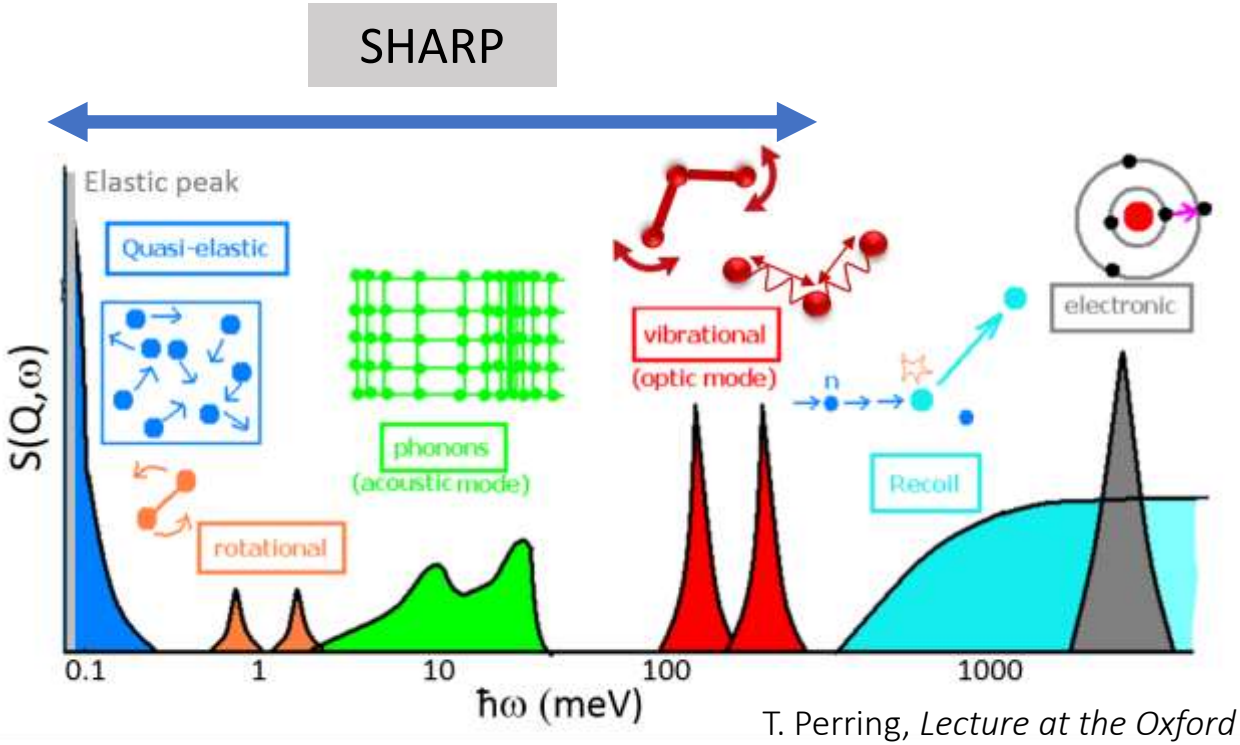




Scientific Fields on the SHARP playground

Study of dynamics and relaxation properties in condensed matter:

- Dynamics of soft condensed matter such as polymers, proteins, biological membranes and gels
- Local and long range diffusion of liquids, solutions and confined systems
- Vibrational density of states of crystalline and amorphous solids
- Properties of quantum liquids, Fermi and non-Fermi systems
- Phase transitions and quantum critical phenomena in polycrystals and single crystals
- Spin dynamics in high-T_c superconductors
- Properties of crystal field splitting



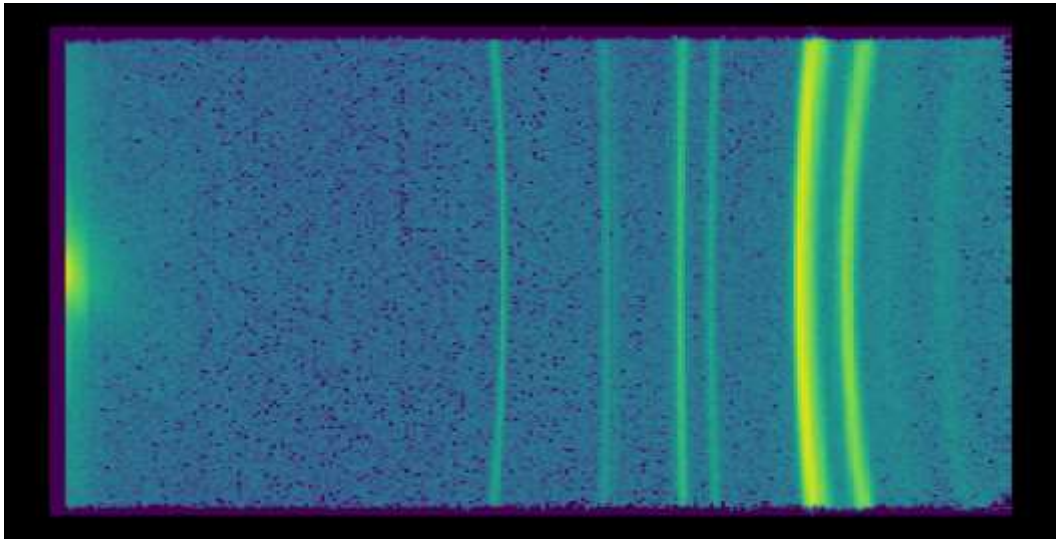
T. Perring, *Lecture at the Oxford Neutron School* (2007)

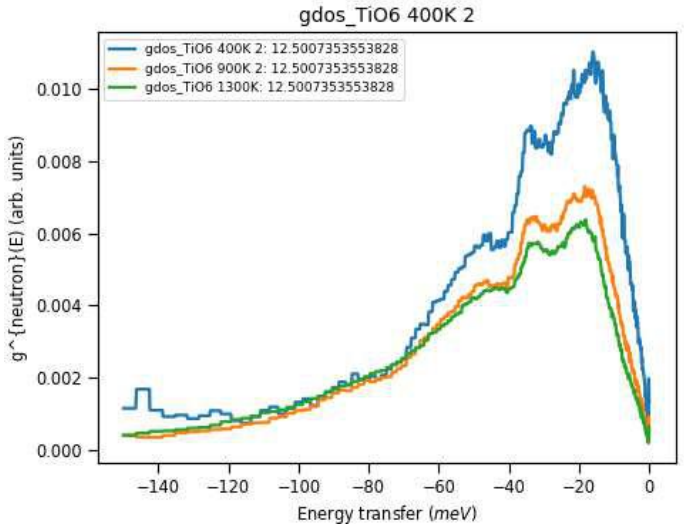
PSD Detectors:
High Definition of the Reciprocal Space

Mark SENN & Dashnor BEQIRI
UNIVERSITY OF WARWICK
Dept. of Chemistry
Material Science / Remote Experiment

Scientific Issue:

- Perovskites showing Negative Thermal Expansion (NTE) that seem related to soft modes.
- How soft mode phase transitions can be controlled in order to enhance functional properties?
- Temperature dependence of soft modes 300 K- 1300 K





Upcoming later today: a second sample with different composition/structure.

Exotic quantum states in anisotropic triangular antiferromagnets

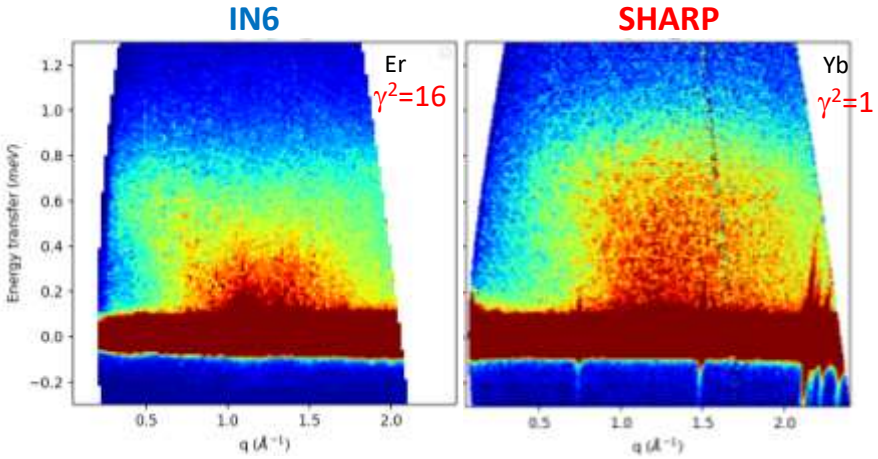
Université Paris Saclay / LLB CEA-Saclay S. Bhattacharya, S. Petit and E. Kermarrec
McMaster University, Ontario (Canada) S. Huang, Z. Conkwright and B. D. Gaulin
IN6-SHARP team Q. Berrod and J.-M. Zanotti

SHARP: September 13-16

Investigation of exotic magnetic quantum states:

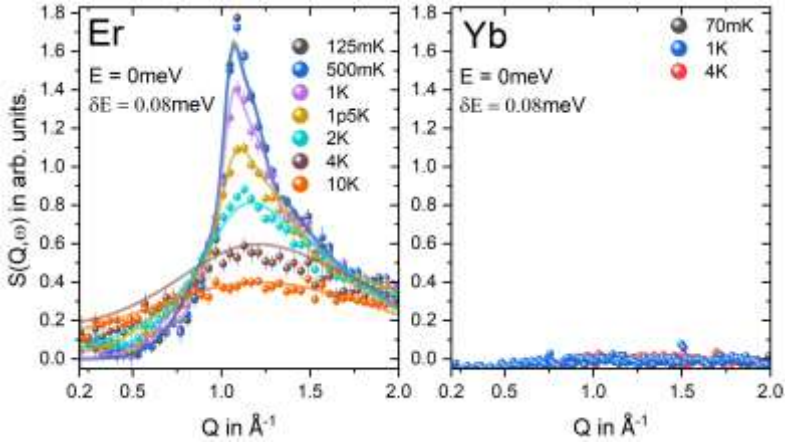
New rare-earth-based triangular antiferromagnetic compounds: Quantum Spin Liquid (QSL).

The SHARP: **low-energy inelastic, quasi-elastic and elastic contributions** in low exchange interactions.



2D anisotropic magnetic ordering

No order but Fluctuations: "Real liquid"

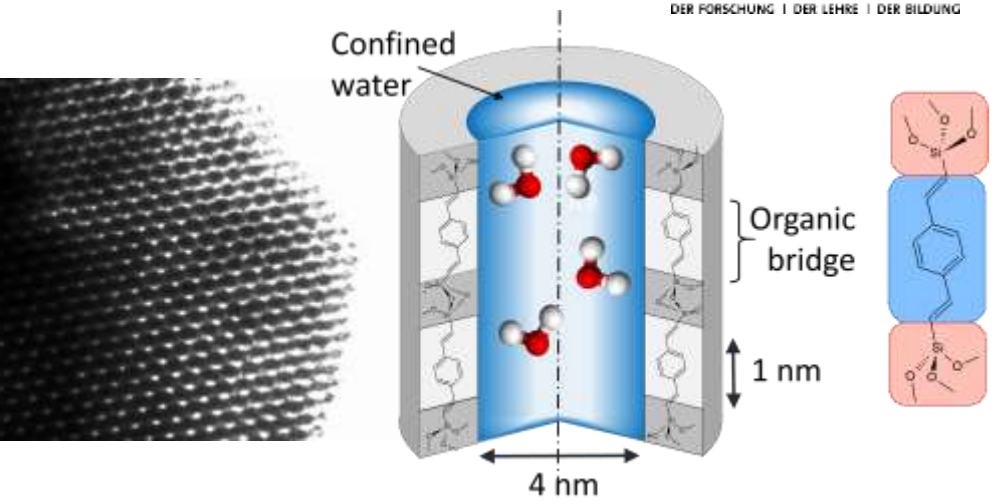


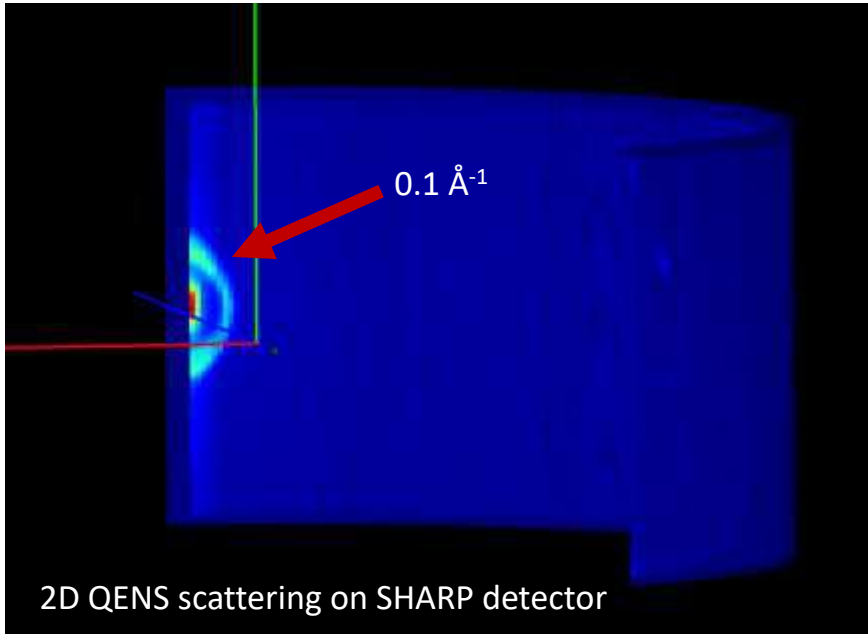
IN6-SHARP recent experiment shows the influence of the rare-earth anisotropy when substituting Yb^{3+} by Er^{3+} in the *R*$MgGaO_4$ family: the appearance of a striped-ordered phase in $ErMgGaO_4$ strongly contrasts with the purely dynamical QSL behavior of $YbMgGaO_4$!

Water dynamics in periodically ordered nanopores

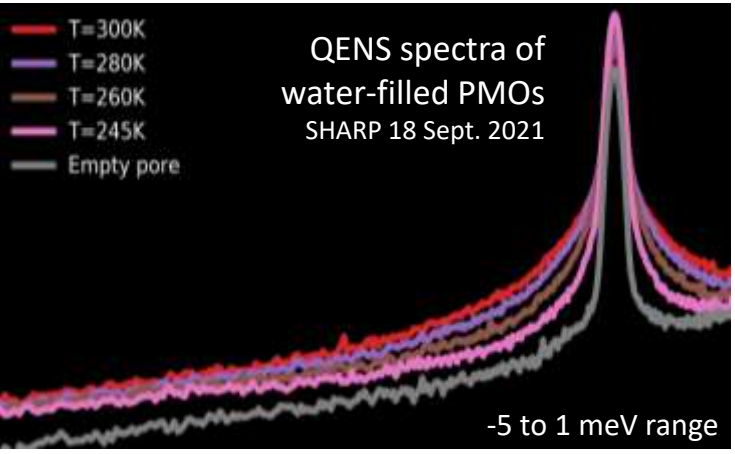
D. Morineau P. Huber et al.

SHARP: September 16-20





D. Morineau *et al.*



Objective: Induce a spatial modulation of the pore surface chemistry via the periodically ordered organic bridges of mesoporous organosilicas.

Issue : Relate interfacial water dynamics to local surface interaction.

e.g. - Hydrophilic / Hydrophobic
- Charged / Neutral

Funding

- French-Swedish (CEA - CNRS - Swedish Research Council) agreement for design, construction of neutron spectrometer. Protocol initiated within the framework of the European Spallation Source.

- Conception
- Design
- Building de of the instrument

- Vacuum System of the ToF Chamber
- Detectors Electronics
- Nuclear related Regulations and Safety

- Funding for sample « lift »

The Actors: professionalism, expertise and involvement


Nicolas Pautrieux


Pablo Abad


Sylvain Rodrigues


Frédéric Legendre


Pascal Lavie


Benoît Homatter


Quentin Berrod


Thomas Robillard


JMarc Zanotti


Pascal Lachaume


Franck Cécillon


Christophe Monon


Franck Rey


Emmanuel Courraud


Martin Platz

But also:

- **Bureau d'étude :** L. Didier, P. Permingeat, B. Giroud
- **Hall :** B. Jarry
- **Aménagement :** P. Coggo
- **Mécanique / Usinage :** J. Beaucourt, F. Lapeyre, O. Tessier
- **Détecteurs :** J.-C. Buffet, B. Guérard, J. Marchal, F. Pinet, J. Pentenero, S. Cuccaro
- **SCI :** J.-M. Delpierre, J. Blanc-Pacques, S. Sallaz-Damaz
- **Vide :** E. lampasona, A. Girault
- **Automatismes :** C. Mounier, B. Sornin
- **Electronique & DAS :** P. Mutti, Y. Le Goc
- **Monochromateur :** P. Courtois
- **Sécurité :** I. Perbet, G. Bonnet
- **Radio-Protection :** F. Rencurel, S. Grimaud, P. Cochet
- **Administratifs :** A. Verdier, S. Même, O. Sineau, E. Colas, P. Combrisson
- **Service Commercial CEA :** A. Rozier, C. Berthon
- **Planning :** M. Plassard
- **Groupes Spectroscopie :** B. Farago, S. Petit
- **CEA/DRF & IRAMIS :** H. Desvaux, F. Daviaud, M. Faury, V. Berger
- **CNRS INP & DAS :** E. Lacaze, E. Solal, S. Ravy
- **Management :** E. Eliot, G. Chaboussant, A. Menelle, C. Alba-Simionesco, A. Brulet, H. Schober, M. Johnson, J. Estrade, J. Jestin

From SHARP to SHARP+
Future LLB CRG A Instrument

G. Manzin[1] --> S. Roux (Project Engineer)
G. Pastrello[1] (Mechanical Design Responsible)
M. Koza[1] (ILL Scientific Advisor)
J.-M. Zanotti[2] (Scientific Responsible)

[1] Institut Laue Langevin , Saclay, France
[2] Laboratoire Léon Brillouin , Saclay, France

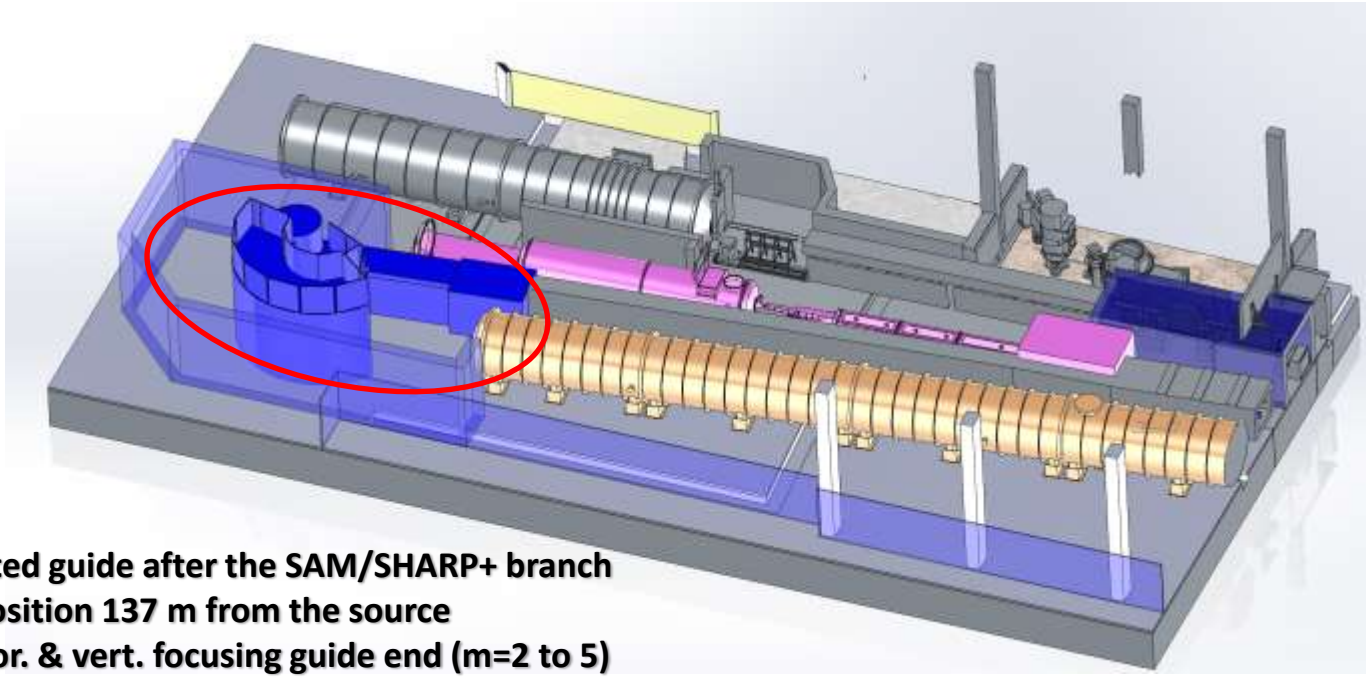
The future of SHARP: SHARP+
Counting rate *15 compared to IN6

Focusing Monochromators (20*30 cm²)	/	Wavelength	/	Energy Resolution
HOPG	/	2.0 - 6.3 Å	/	1.20 meV – 0.070 meV
Fluorinated Mica (project)	/	6.0 - 12 Å	/	0.12 meV – 0.025 meV

An "Hybrid" Spectrometer with a 4.5 m retractable guide nose

1- Nose OUT : "IN6 like" **(Time-Focusing Mode) --> Improved energy resolution on a narrow desired energy range.**

2- Nose IN : "IN5 like" **(Monocromatic Mode) --> constant energy resolution on extended energy transfer range.**



*** A 60 m dedicated guide after the SAM/SHARP+ branch**
*** A guide-end position 137 m from the source**
*** Elliptic 14 m hor. & vert. focusing guide end (m=2 to 5)**
*** No Be Filter but instead 3 anti-harmonics 200 Hz disk choppers cascade**
*** Brand new 400 Hz Fermi Chopper**

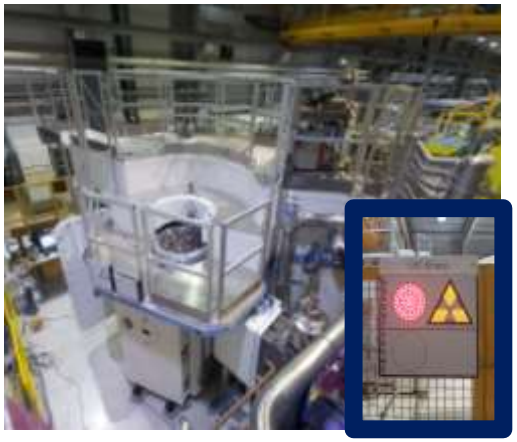
Conclusion

The path to SHARP+ a world leading inelastic ToF instrument: 15 time (McStas) the IN6 counting rate

IN6

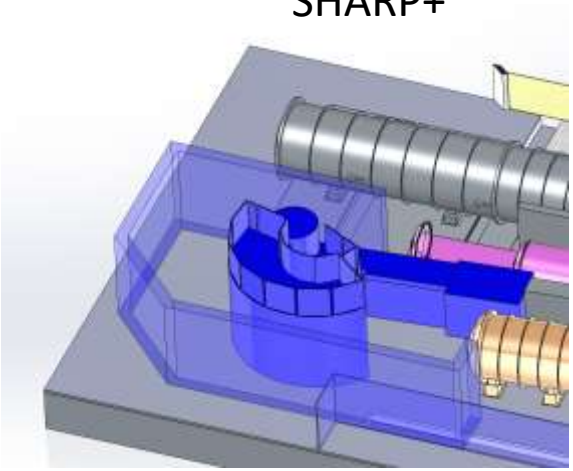
A Glorious and Successful Origin

SHARP



A key mutation :
a brand new state of the art secondary instrument

SHARP+



A Bright Future.
Full complementarity and integration into the ILL
ToF instruments suite:
IN5 and Panther.

Be patient up to April 2024 !