

Upgrade of the Neutron Spin Echo Spectrometer at the NIST Center for Neutron Research: A World Class Instrument for the Nation



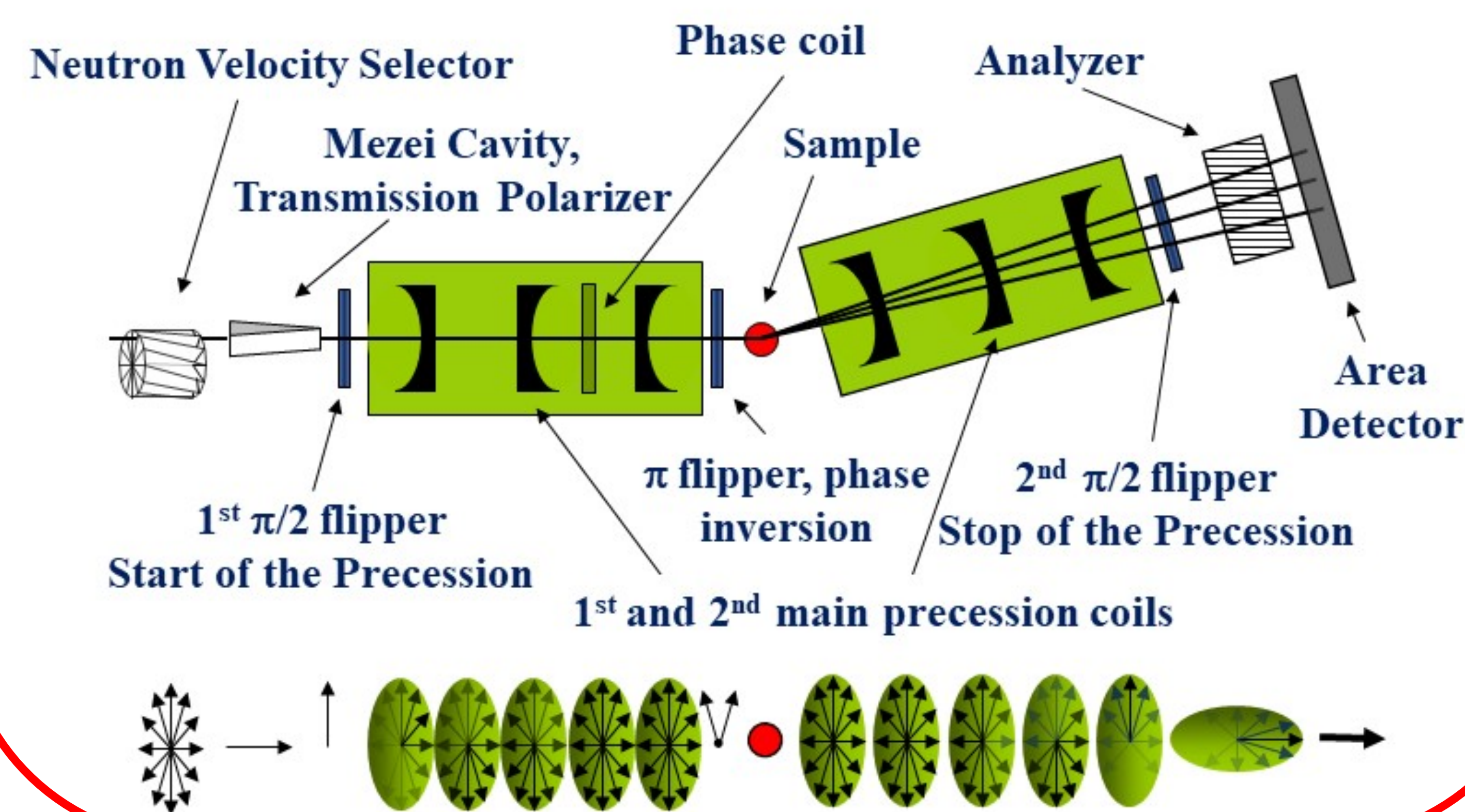
The University of Delaware, in collaboration with the NCNR and University of Maryland, has received funding from the NSF through the Mid-scale Research Infrastructure-1 program to acquire, assemble and commission a new NSE spectrometer employing optimally designed superconducting precession coils, increasing the maximum Fourier time 2.5x. The installation of the new instrument is planned for 2023 during an outage of the NCNR to install a new D_2 cold source, thus minimizing down time. Taking advantage of the new design, the increased flux provided by the new cold source, and a number of instrument elements optimized for long wavelength operation, a Fourier time of 300 ns should be achieved routinely, with the possibility of reaching 700 ns for strongly scattering samples. For a given time window, about an order of magnitude increase in data acquisition rate is expected for most experiments.



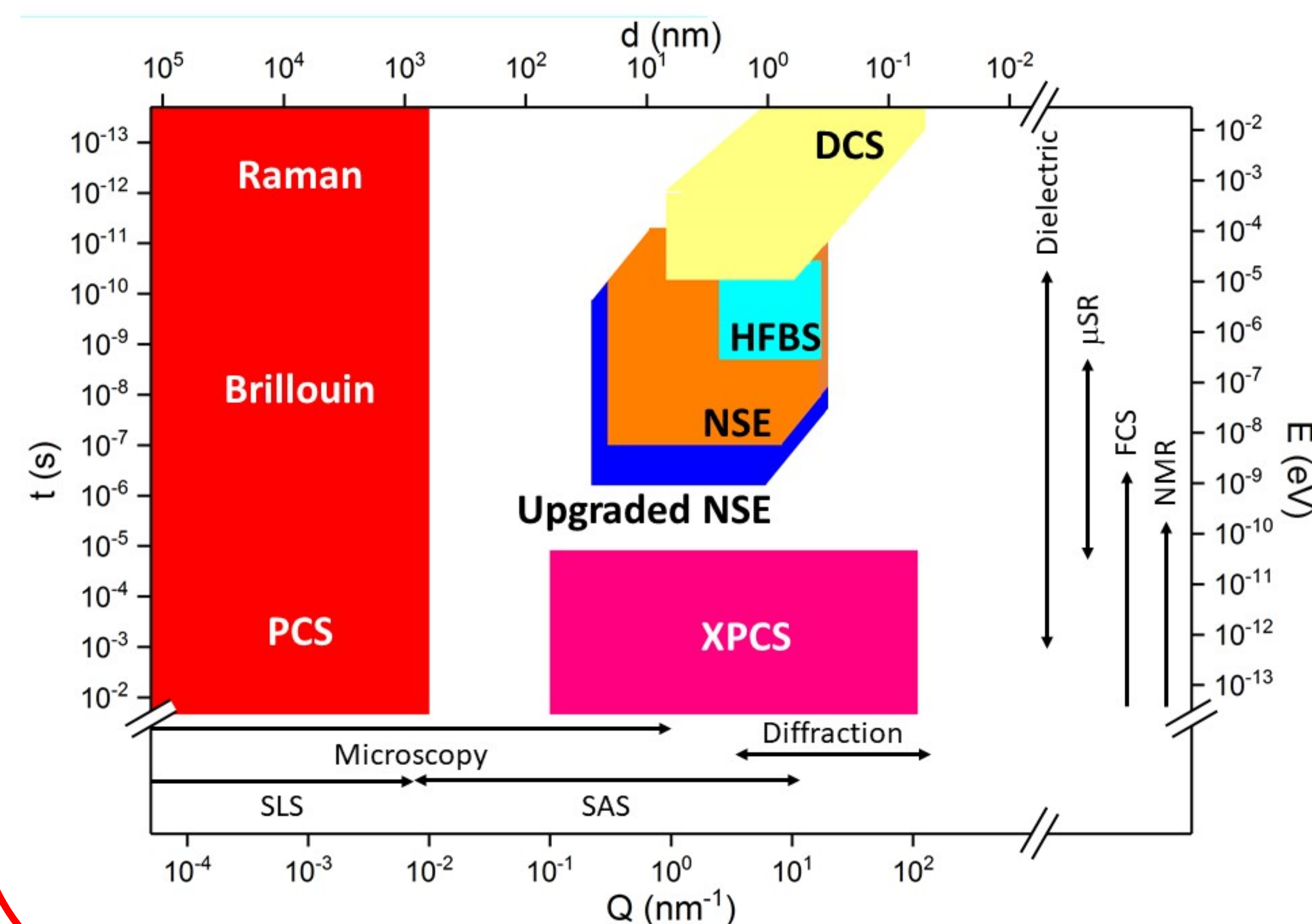
NSE
on NG-A at the NCNR



NSE main components and Principle of Operation



Unique Dynamic Range: Highest Energy Resolution Among Neutron Spectrometers



The Upgrade Team



Principal Investigator:
Prof. Norman J. Wagner,
University of Delaware,
Chemical & Biomolecular Engineering



Prof. Robert M. Briber,
University of Maryland,
Material Science & Engineering



Principal Engineer & Project
Manager: Christoph W. Brocker



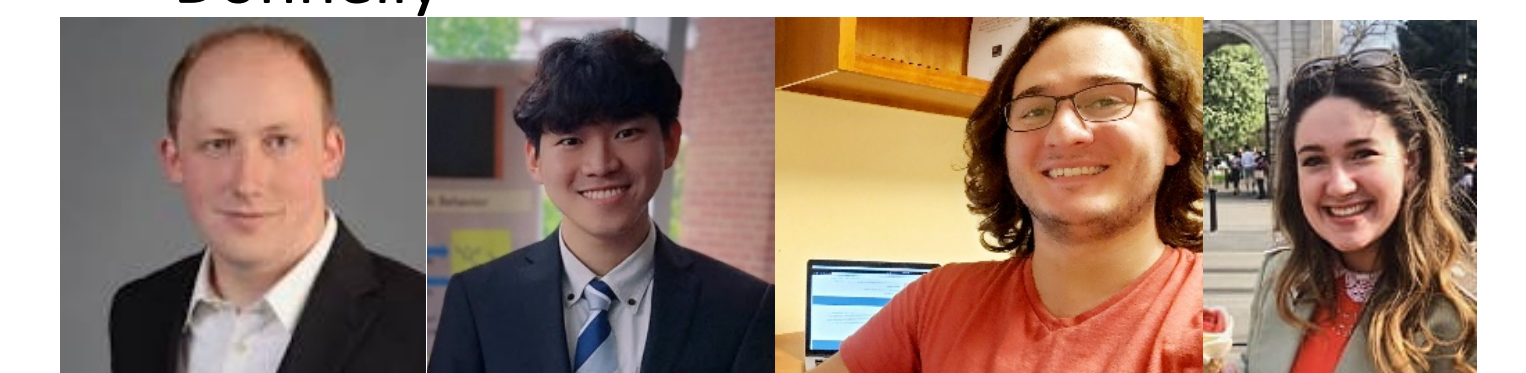
NCNR CHANS NSE team:
Antonio Faraone & Michihiro Nagao



Instrument Control Systems &
Electronics:
Nicholas C. Maliszewskyj

Education and Outreach (through UD)

- Post-doc: Oliver Wrede
- 3 students:
Jihyuk Kim, James Shea Fitzgerald, Roisin Donnelly

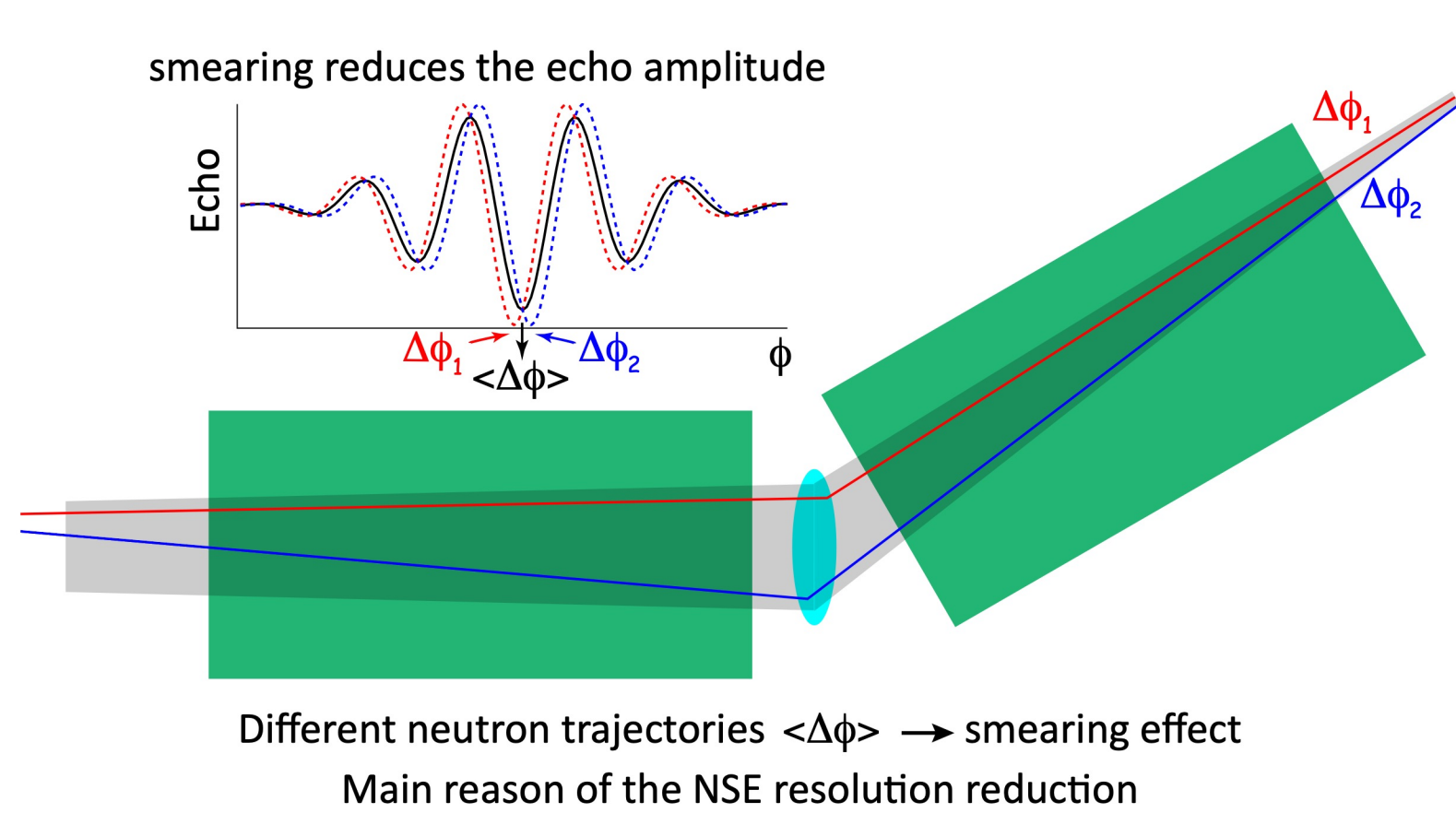
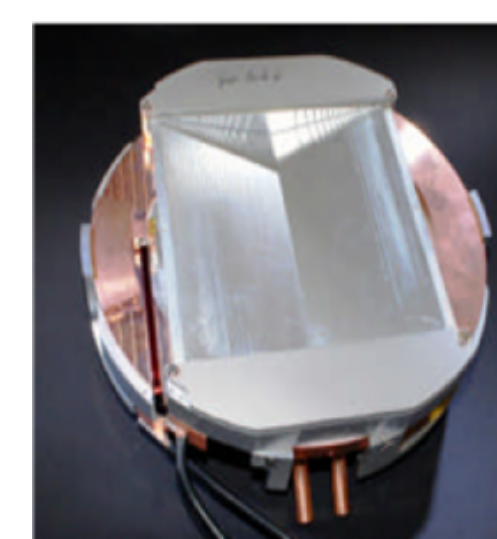


- Short courses: every other year

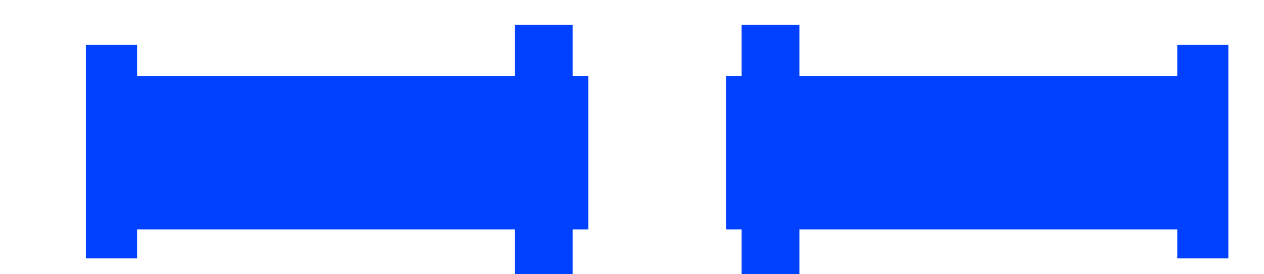
NSE Resolution and Optimally Shaped Precession Coils

Optimally designed precession coils, coupled with state of the art Pythagoras correction coils, allow for an increase of the maximum field integral, i.e. Fourier time, by $\approx 2.5 \times$

New Pythagoras Correction Coils

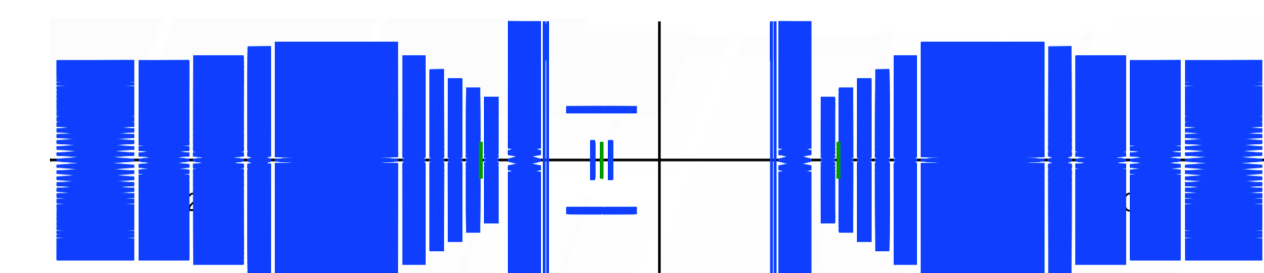


Current CHANS-NSE (the same design as the J-NSE @ MLZ)

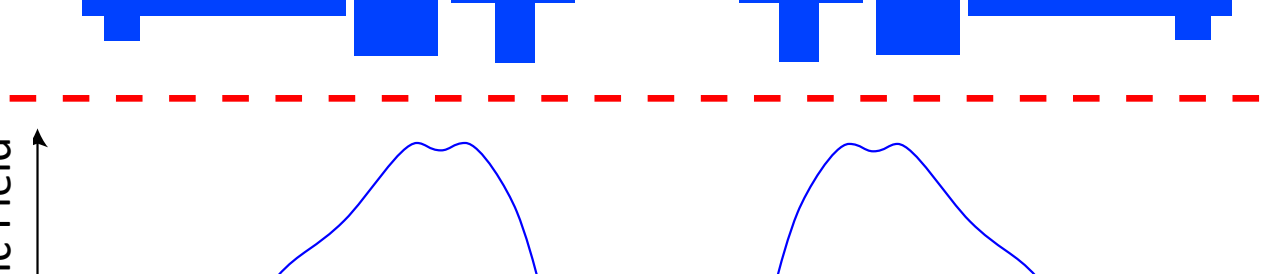
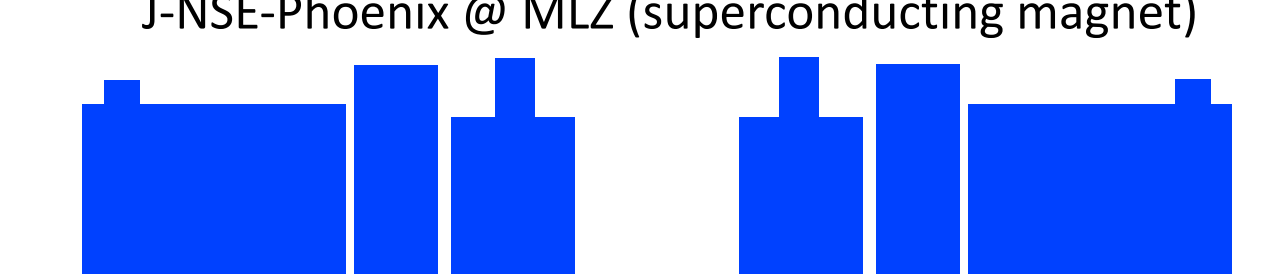


Optimized Precession Coils for NSE

New IN15 @ ILL (normal conducting magnet)

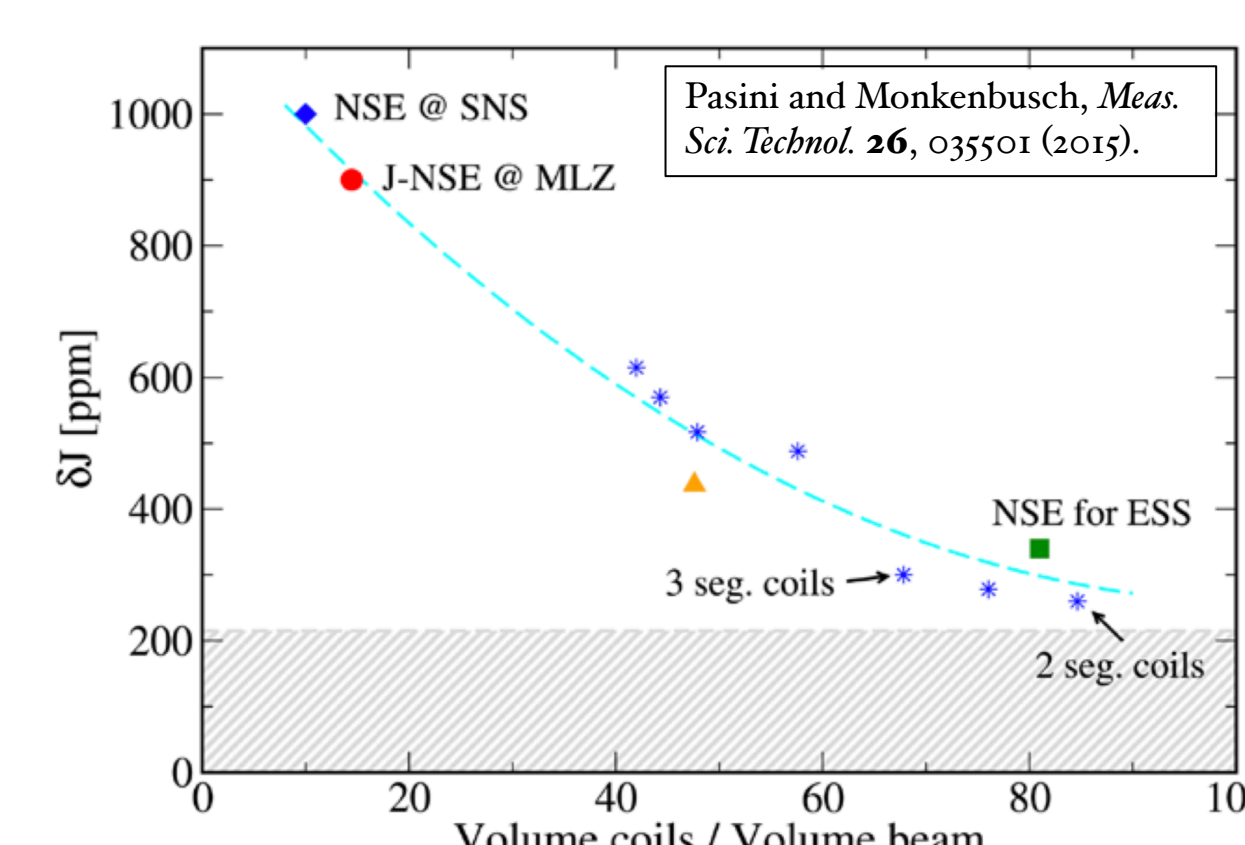


Courtesy of B. Farago

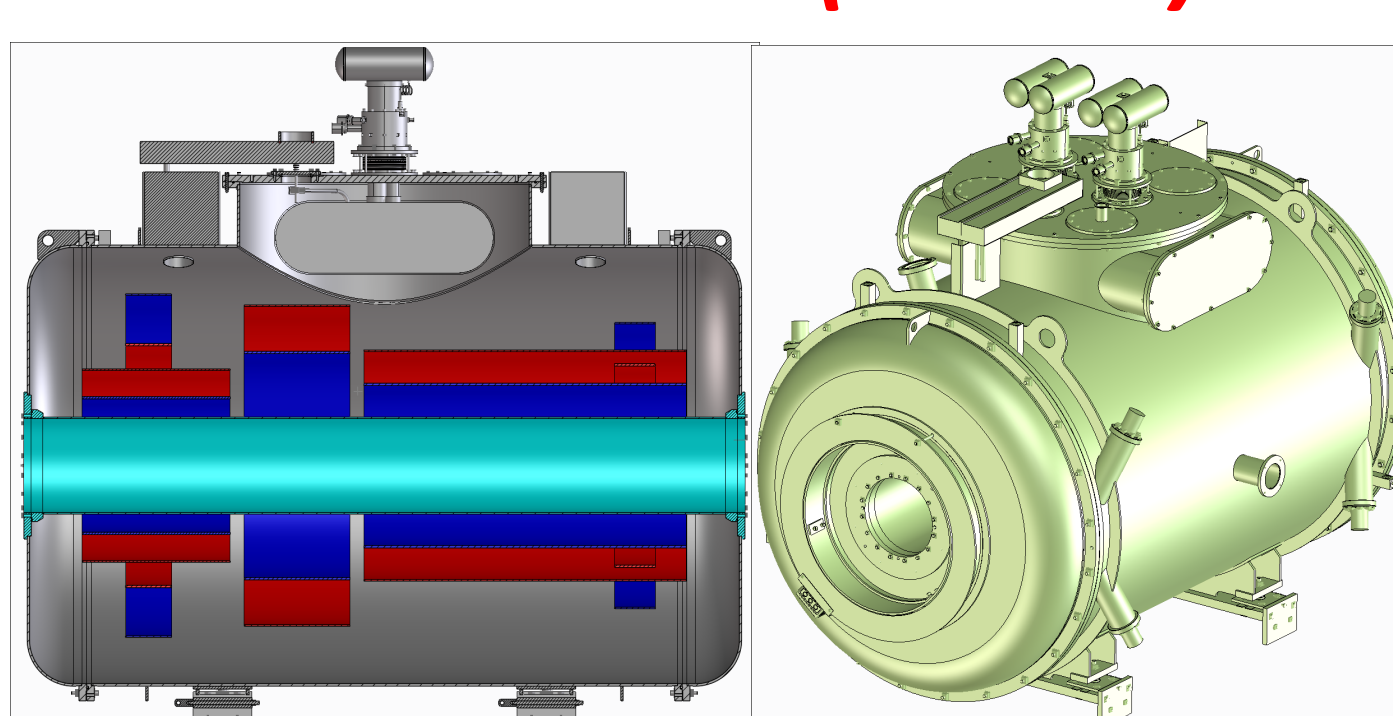


Magnetic Field

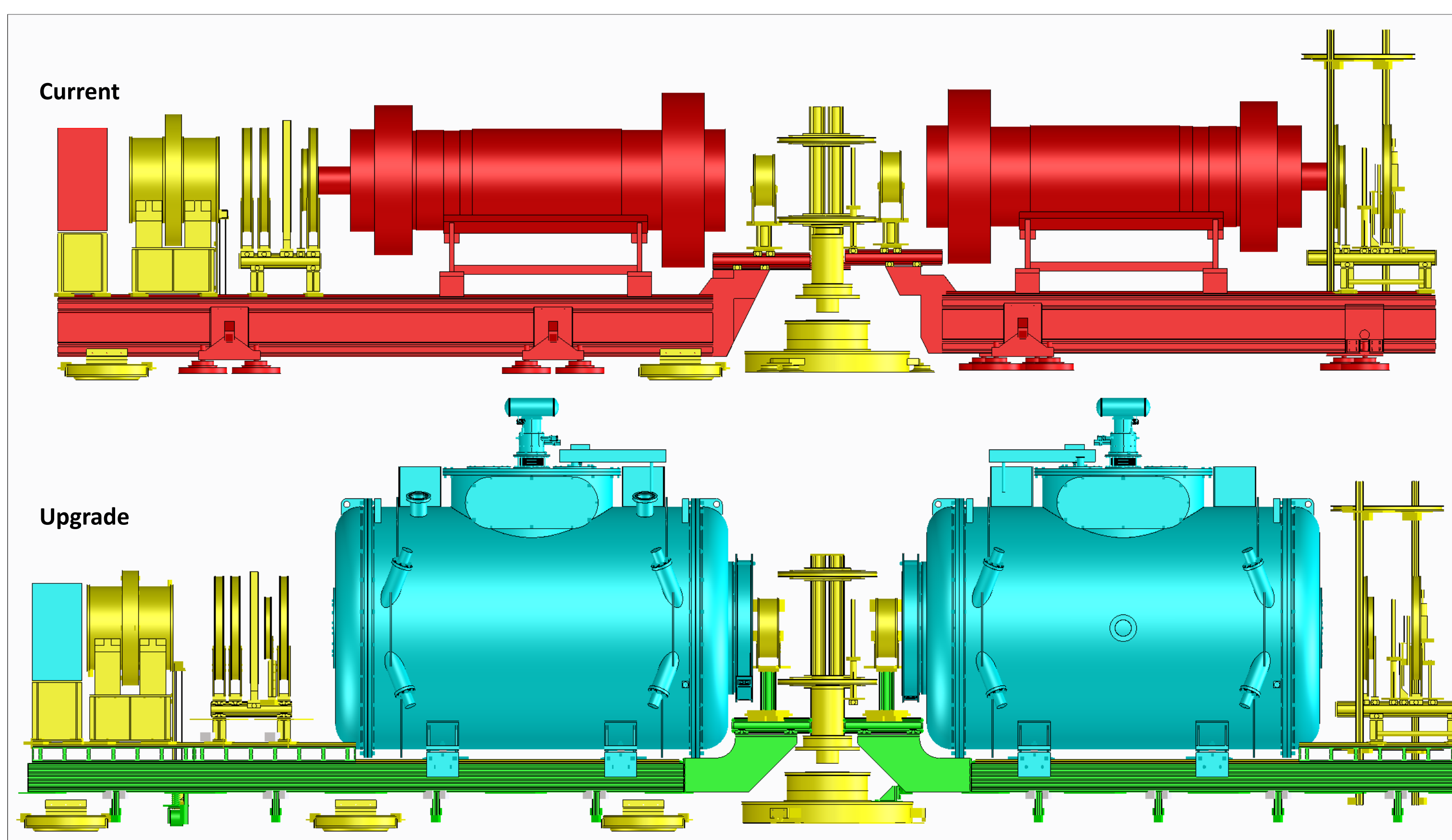
Considering a large detection area, an asymmetric shape is beneficial so that most of the precession is accumulated near the sample, before the spreading of the neutron trajectories.



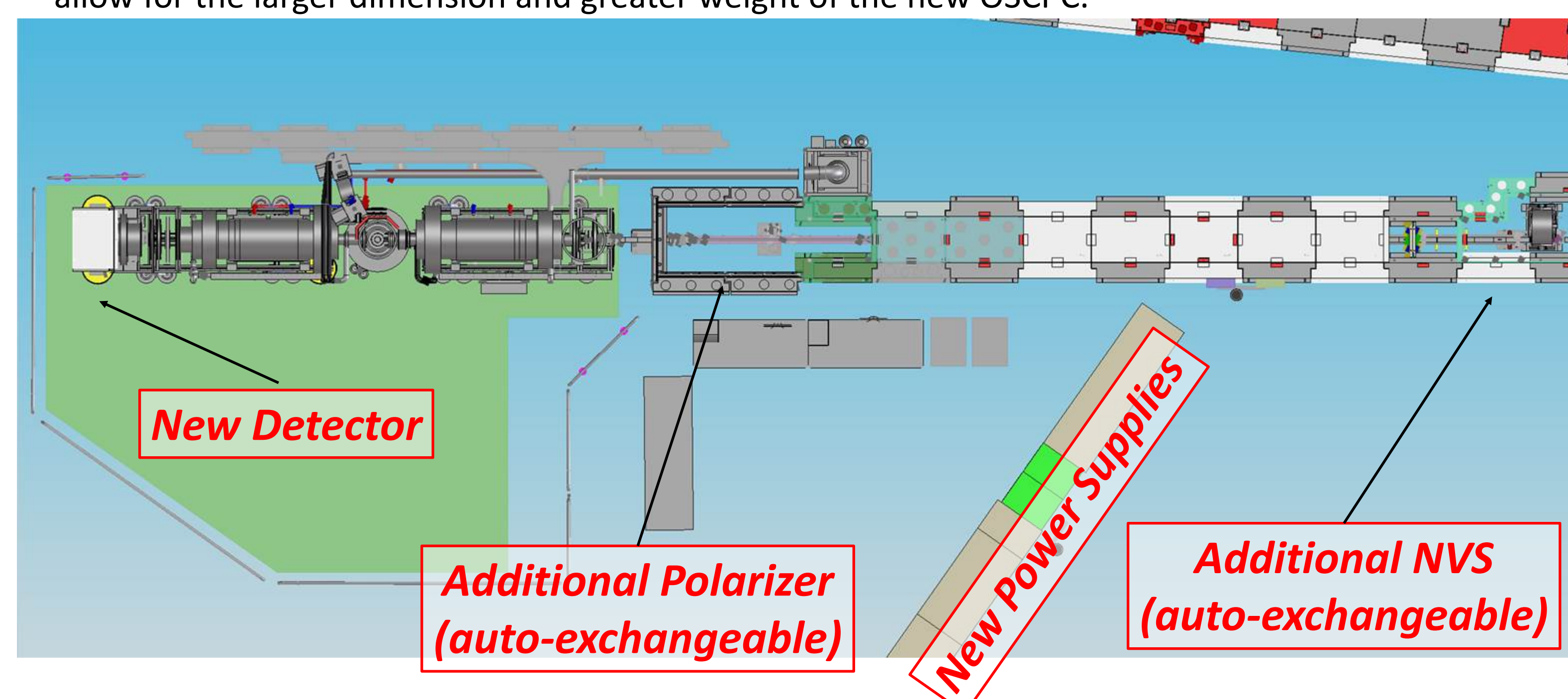
Optimum Super-Conducting Precession Coil (OSPC)



Bilfinger design

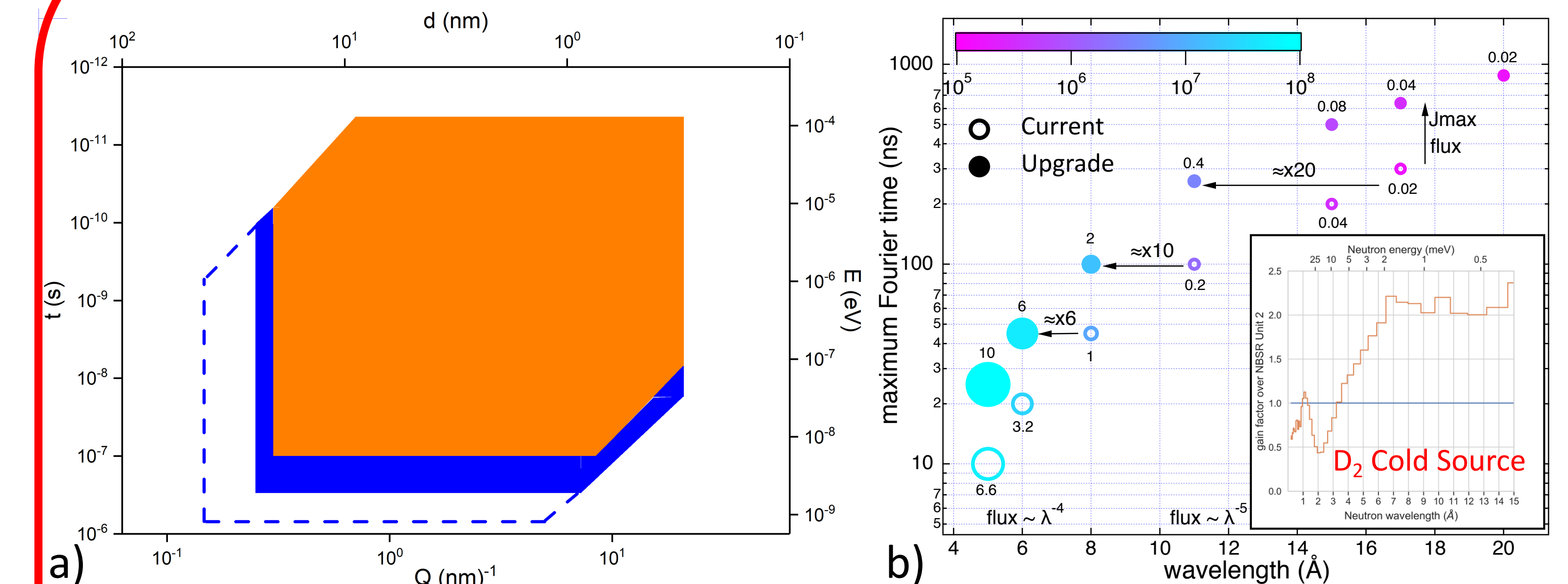


The most important components of the NSE, i.e. the precession and compensation coils, will be replaced but most of the rest of the other coils will be maintained. The carrier will need changing to allow for the larger dimension and greater weight of the new OSCPC.



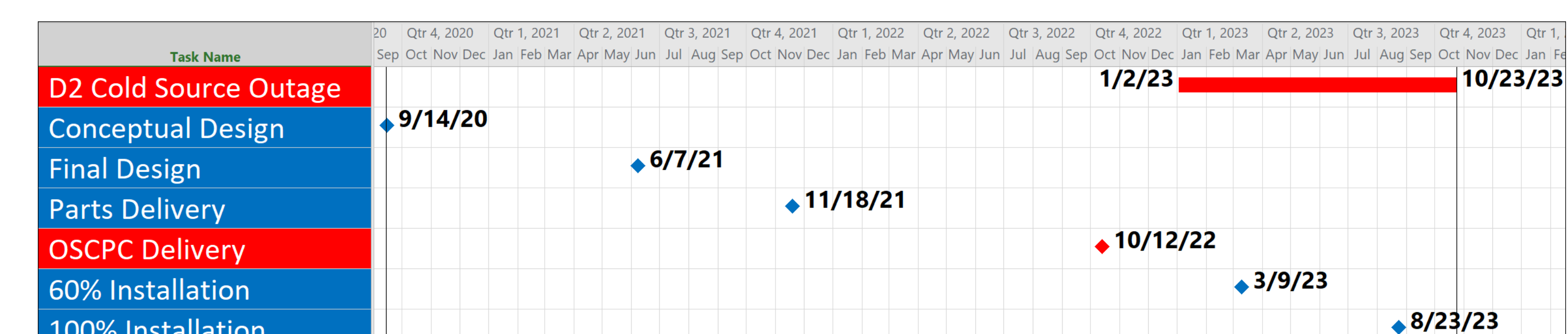
To take advantage of the D_2 cold source, a new 'single V' polarizer will improve transmission at longer λ . A new NVS optimized for operation at longer λ , will be added, as well. New power supplies will be needed for the requirements of the new Pythagoras CC. A new detector, employing ^3He tubes will accommodate increase in counting rates.

Goals



a) The dynamic range will widen because of the $\approx 2.5 \times$ increase of the maximum field integral, as well as for the possibility of operating at longer λ (dashed lines indicate the $\lambda=20$ Å boundary). b) Accounting for the increased flux at long λ of the D_2 cold source and the optimization of the polarizer, a ≈ 10 increase of the flux for a given time range is envisaged.

Timeline



Major Purchases			Total $\approx \$4,500,000$			
#	Component	Delivery	Type	Estimate	Company	Status
1	OSPC	10/12/22	Sole Source	\$2,640,000	Bilfinger Noell GmbH	Under Procurement
2	Warm Zone & Support Structure	06/30/22	Sole Source	\$823,000	JCNS	
3	Position Sensitive Detector	04/11/22	Open	\$148,042	BHGE - Baker Hughes / GE	RFQ out
4	Polarizer	01/10/22	Sole Source	\$92,679	Swiss Neutronics	
5	Neutron Velocity Selector	10/08/21	Sole Source	\$271,524	Airbus - Defense and Space	Under Procurement
6	Power Supply	06/07/21	Sole Source	\$166,425	CAENels	
7	Pythagoras Coils Positioning System	02/04/21	Sole Source	\$269,961	PI - Physics Instruments	