Advanced Methods and Techniques

~~Ken Andersen~~

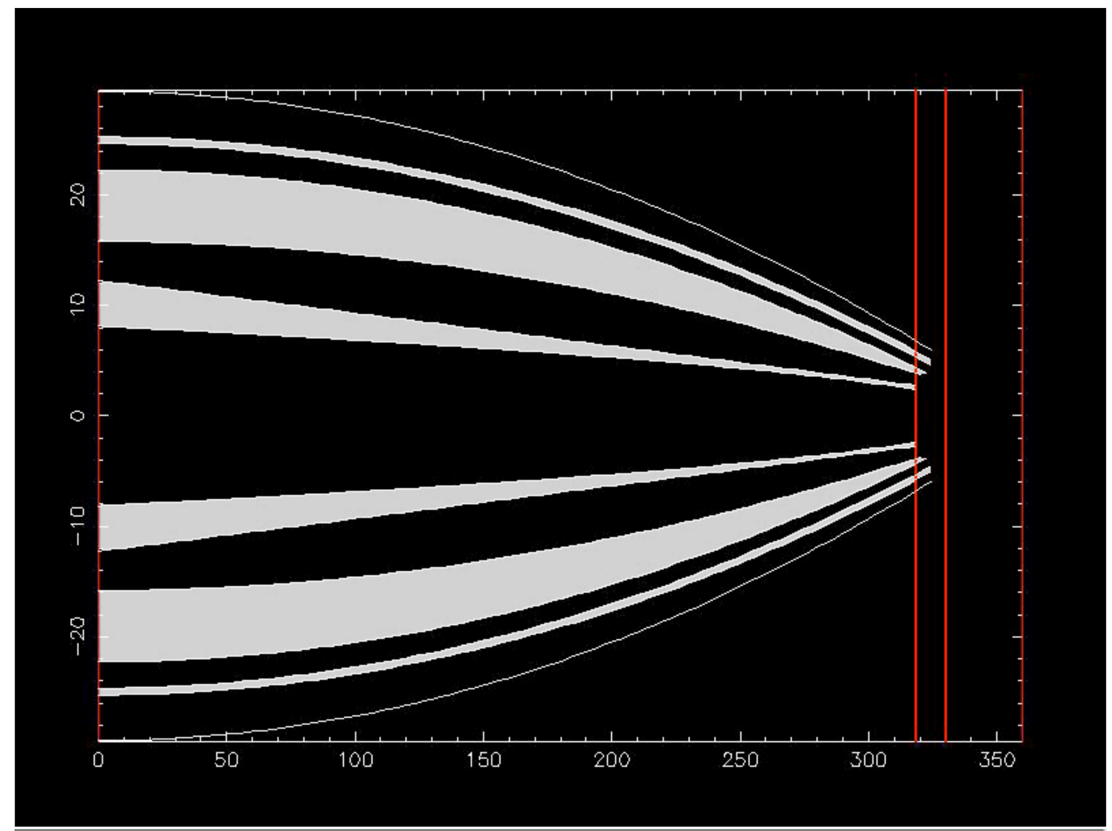
Phil Bentley
European Spallation Source
Group Leader – Neutron Optics

Task Breakdown

- Task 19.1 – Sub mm3 Samples for Extreme Environments
- Task 19.2 – Multiple-Beam SANS
- Task 19.3 – Spin Echo with Oscillating Intensity for ESS
- Task 19.4 – Choppers for ESS Instrumentation
- Task 19.5 – Polarising All Neutrons in a Beam

Task 19.1 – Sub mm^3 Samples for Extreme Environments

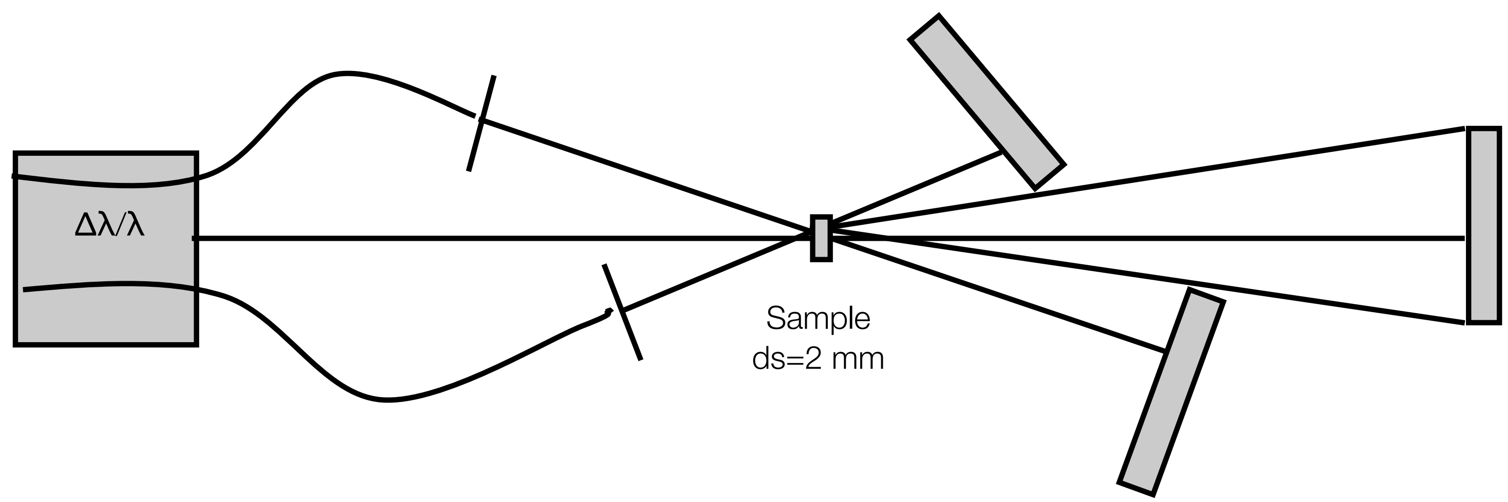
- Partners:
  - ESS (30 mo) – Design and optimisation of focussing system, simulations
  - ILL (30 mo) – Design of sample environment, fabrication of supermirrors, simulations
  - ICMA Zaragoza (30 mo) – Design of instrument, simulations



Evolution: 30% better again, 9x flux

Task 19.2 – Multiple-Beam SANS

- Partners:
  - ESS (12 mo)
  - ILL (12 mo)
- Current discussion is to redistribute this effort to spend more time at the ILL
- ESS becomes a collaborator (not yet finalised)



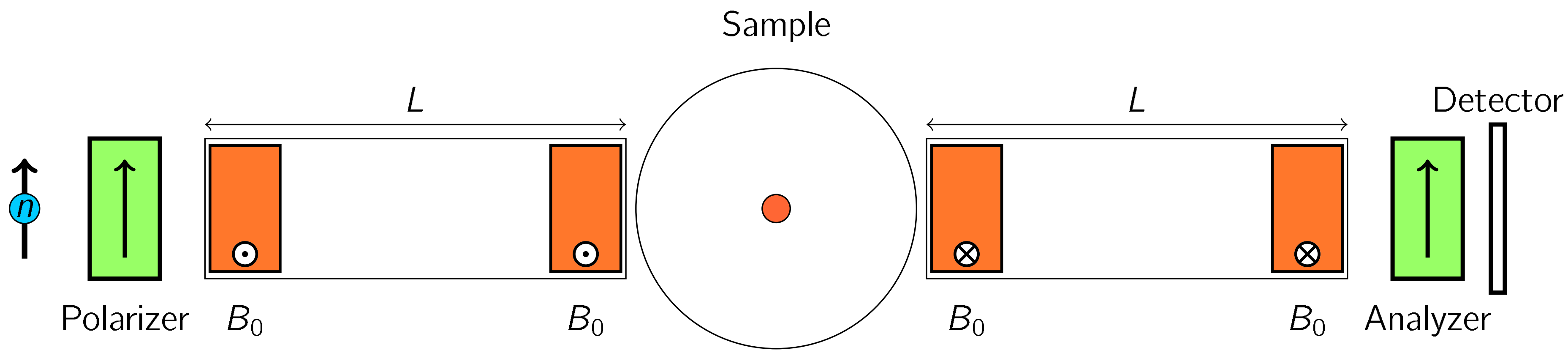
1.) How to separate beams

2.) How to avoid cross-talks

3.) How to implement options for kinetic SANS

AW,R. Gähler, K. Anderson, R. Cubitt
NOP2010, NMI3 Project 2010

Task 19.3 – Spin Echo with Oscillating Intensity for ESS



MIEZE: no precession stop

NSE: $J=\int\gamma B\cdot ds$

NRSE: $J=2\omega\cdot ds$

$\phi_0 = \lambda_0 \cdot m/h \cdot J$

$\Delta\phi = \tau_{NSE}\,\Delta E/\hbar$

$\tau_{NSE} \sim \lambda^3 \cdot \int B\,dl$

$\phi_1 = \lambda_1 \cdot m/h \cdot J$

$$p = \int \cos(\tau_{NSE}\,\omega)\,S(q,\omega)\,d\omega$$

Task 19.3 – Spin Echo with Oscillating Intensity for ESS

Development of electromagnetic resonance circuits

Design of the circuit including remote control and wavelength adapted amplitude control

Test of performance of the resonance circuits

TIME

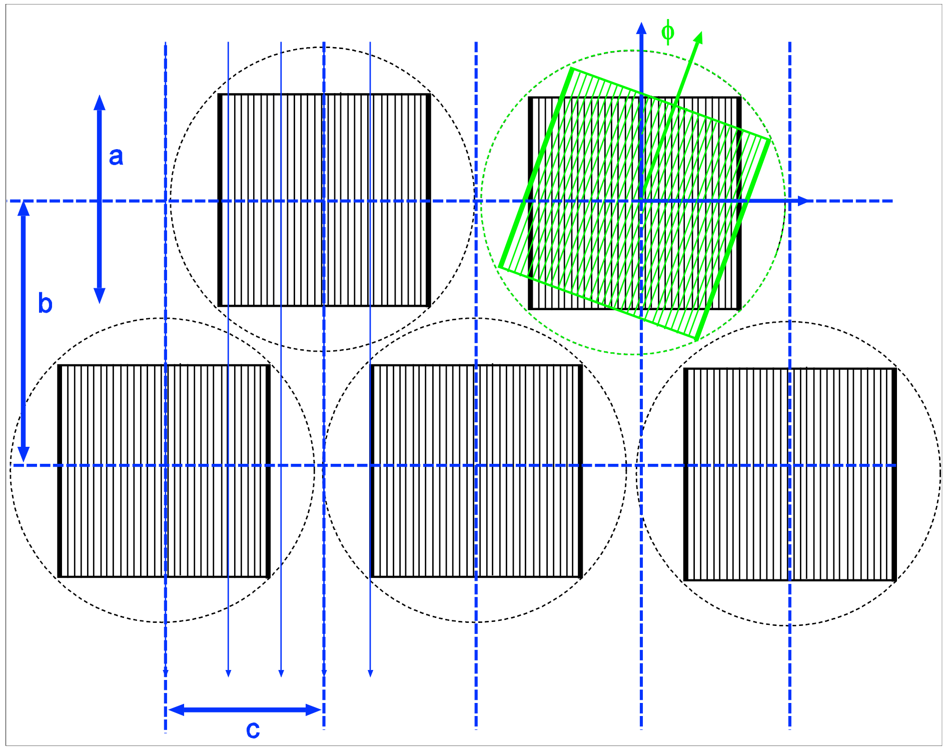
Defining the requirements for the time and position sensitive detector

Development of measurement strategies and data analysis

Proof of principle (at ISIS)

Task 19.4 – Choppers for ESS Instrumentation

- Fermi choppers that rotate very fast, cover a large area, limited stored kinetic energy
- Array of slim rotating rods each being a Fermi chopper rotor package.



Density ρ	3 g/ccm
Width ***a***	1 cm
Length ***l***	15 cm
Frequency ***f***	1 kHz
Mass/rod ***M=a×a×l***	45 g
Energy/rod	14.8 Joule
Acceleration at edge	28000 g
eff. Pressure	2.6 MPa

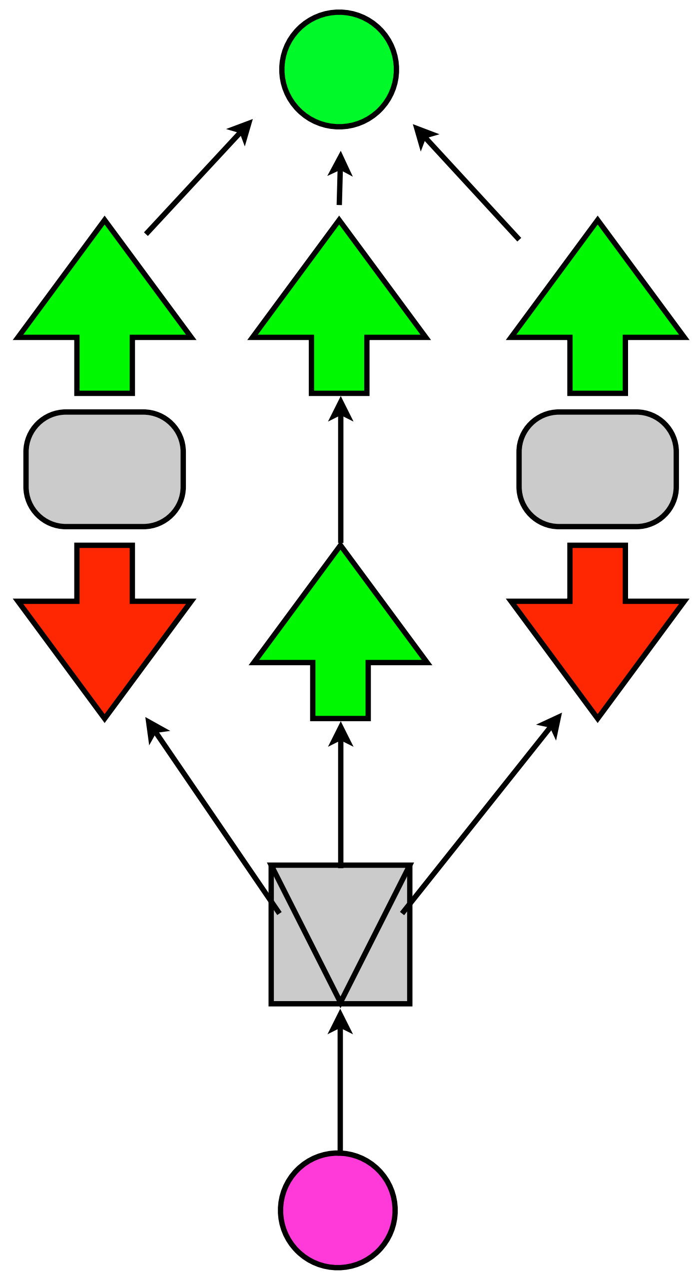
$$E_{kin} = \frac{M}{2} \times \frac{a^2}{6} \times \omega^2 = \frac{\pi^2 M a^2}{3} \times f^2$$

Task 19.4 – Choppers for ESS Instrumentation

- Planned work
    - Combination of spindle drive with one rod: stability (expt.)
    - Consider phase stability and synchronization of several rods
    - Compute absorption characteristics of potential Fermi packets
    - Realization of one rod with neutron absorbers, neutron expt. transmission
    - Consider application in various time focusing schemes
    - Conceptual design of an array of rods with drives

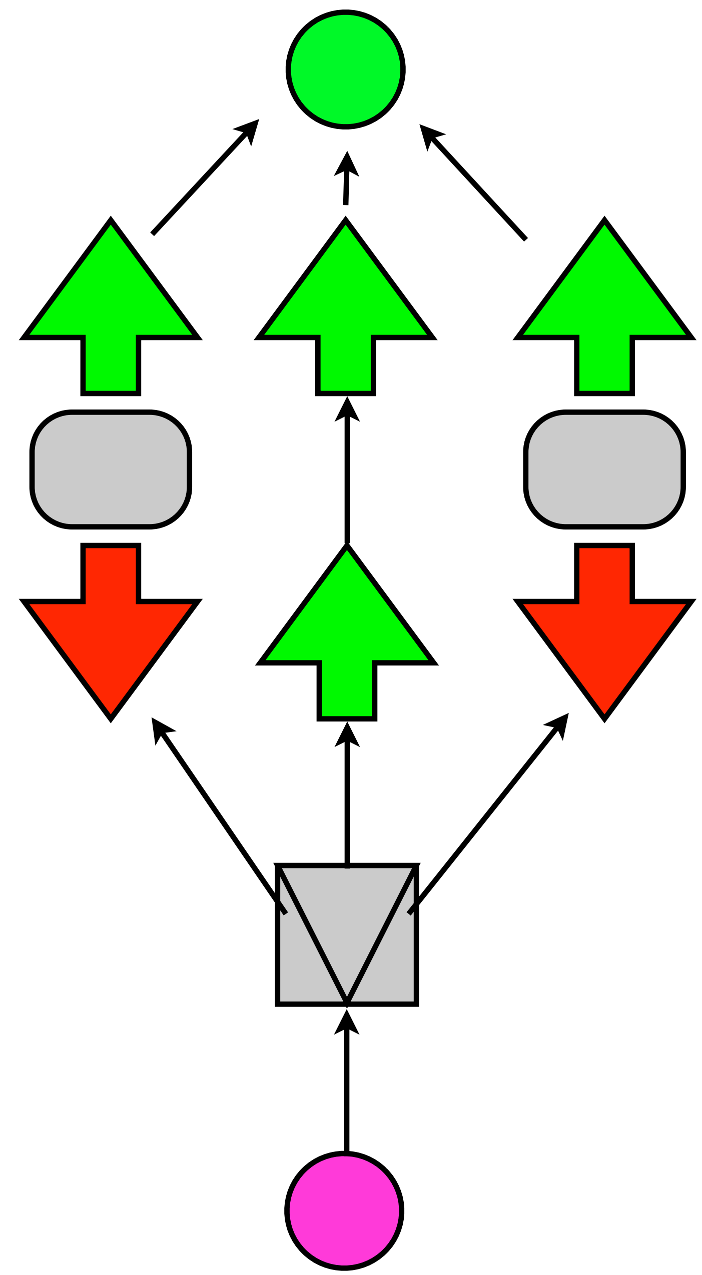
Task 19.5 – Polarising All Neutrons in a Beam

- Reflecting polariser
- Use an RF coil to reverse the wrong spin state
- Recombine the beams
- The long guides at the ESS give us the chance to realise this with existing SM.



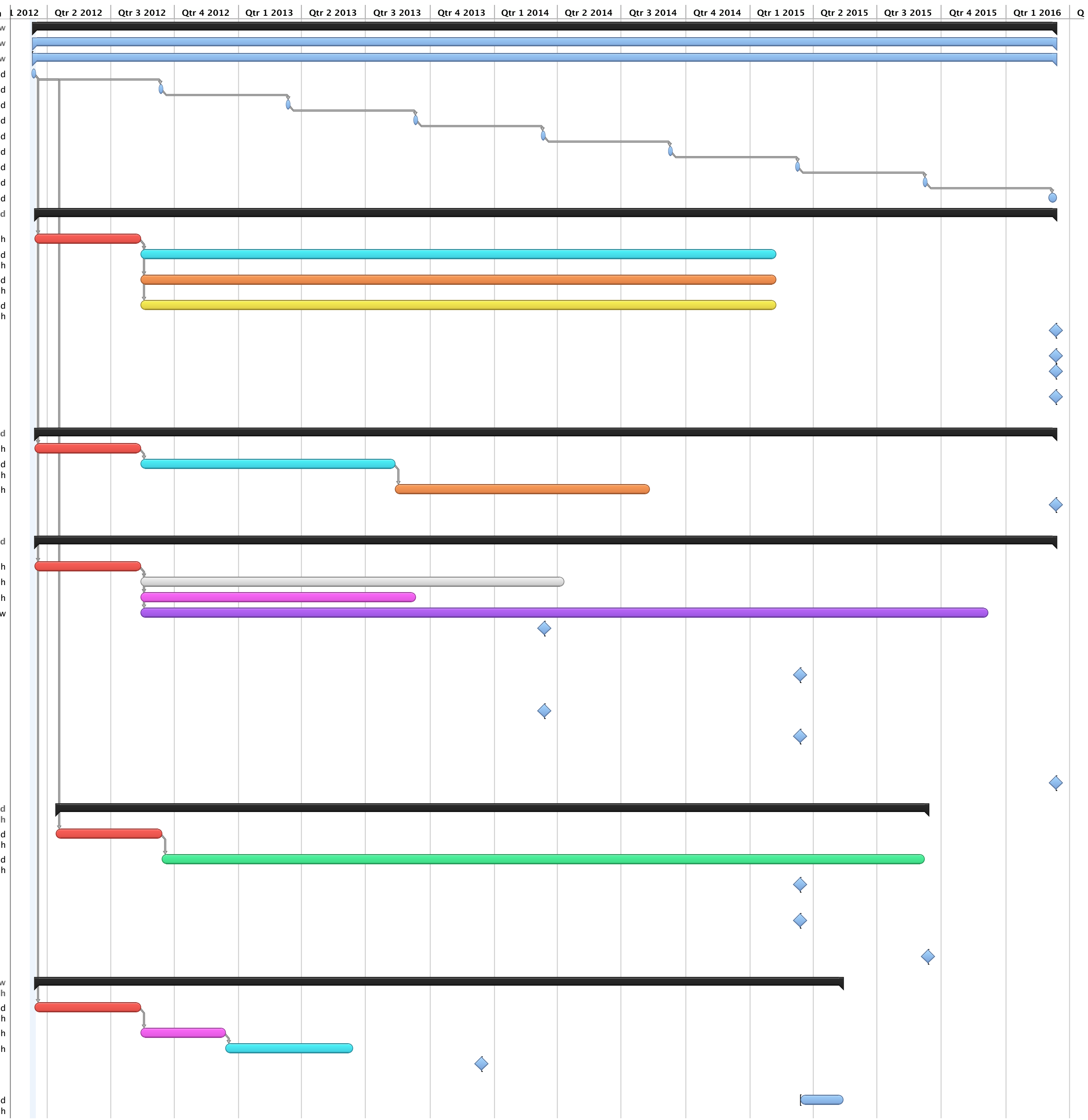
Task 19.5 – Polarising All Neutrons in a Beam

- Partners:
  - ESS (4 mo)
  - TU Delft (6 mo)
- Currently working out how to coordinate this small amount of effort



Top Down Plan

Task	Duration
1) WP19	209w
1.1) Coordination	209w
1.1.1) WP 6 Month Meetings	209w
1.1.1.1) Meeting1	2d
1.1.1.2) Meeting2	2d
1.1.1.3) Meeting3	2d
1.1.1.4) Meeting4	2d
1.1.1.5) Meeting5	2d
1.1.1.6) Meeting6	2d
1.1.1.7) Meeting7	2d
1.1.1.8) Meeting8	2d
1.1.1.9) Final Meeting	1w 3d
1.2) Task 19.1: Sub-mm3 Samples & Extreme Environments	208w 3d
1.2.1) Recruitment	21w 3d 1h
1.2.2) ESS 30m	129w 3d 6h
1.2.3) ILL 30m	129w 3d 6h
1.2.4) ICMA 30m	129w 3d 6h
1.2.5) D19.1 ILL Report on Guide Prototype	
1.2.6) D19.2 ESS Report on KB Mirrors	
1.2.7) D19.3 ESS Report on Design of long-pulse diffractometer	
1.2.8) D19.4 ESS Report on Design of long-pulse crystal analyser instrument for extreme Env	
1.3) Task 19.2: Multiple-beam SANS	208w 3d
1.3.1) Recruitment	21w 3d 1h
1.3.2) ESS 12 m	> 51w 4d 7.5h
1.3.3) ILL 12 m	51w 4d 4h
1.3.4) D19.5 ILL Report on performance of prototype multi-beam SANS	
1.4) Task 19.3: Spin Echo with Oscillating Intenisty	208w 3d
1.4.1) Recruitment	21w 3d 1h
1.4.2) STFC 20 m	86w 2d 4h
1.4.3) Tu Delft 13 m	56w 1d 1h
1.4.4) TUM 40 m	173w
1.4.5) D19.6 TUM Report on the design of the circuit including remote control and wavelength adapted amplitude control	
1.4.6) D19.7 TUM Report on performance of the resonance circtuits	
1.4.7) D19.8 TUM Report on the requirements	
1.4.8) D19.9 Report on the measurement strategies and the design of data analysis system	
1.4.9) D19.10 ISIS Report on the Proof of Principle Measurements	
1.5) Task 19.4: Choppers for ESS Instrumentation	178w 1d 2.75h
1.5.1) Recruitment	21w 3d 2.5h
1.5.2) Jülich 36 m	155w 3d 4h
1.5.3) D19.11 Jülich Report on Mechanical Layout and FE-Calculation	
1.5.4) D19.12 Jülich Report on Neutronic Layout of Single Rotor	
1.5.5) D19.13 Jülich Report on Conceptual Design	
1.6) Task 19.5: Polarising All Neutrons in a Beam	> 165w 2.5h
1.6.1) Recruitment	21w 3d 2.5h
1.6.2) TU-Delft 4 m	17w 1d 4h
1.6.3) ESS 6 m	25w 4d 6h
1.6.4) D19.14 Delft Delivery of Prototype, following design and procurement	
1.6.5) D19.15 Delft Report and Publication of Test Results	> 8w 3d 2.5h



Thank you for your attention