



Australian Government



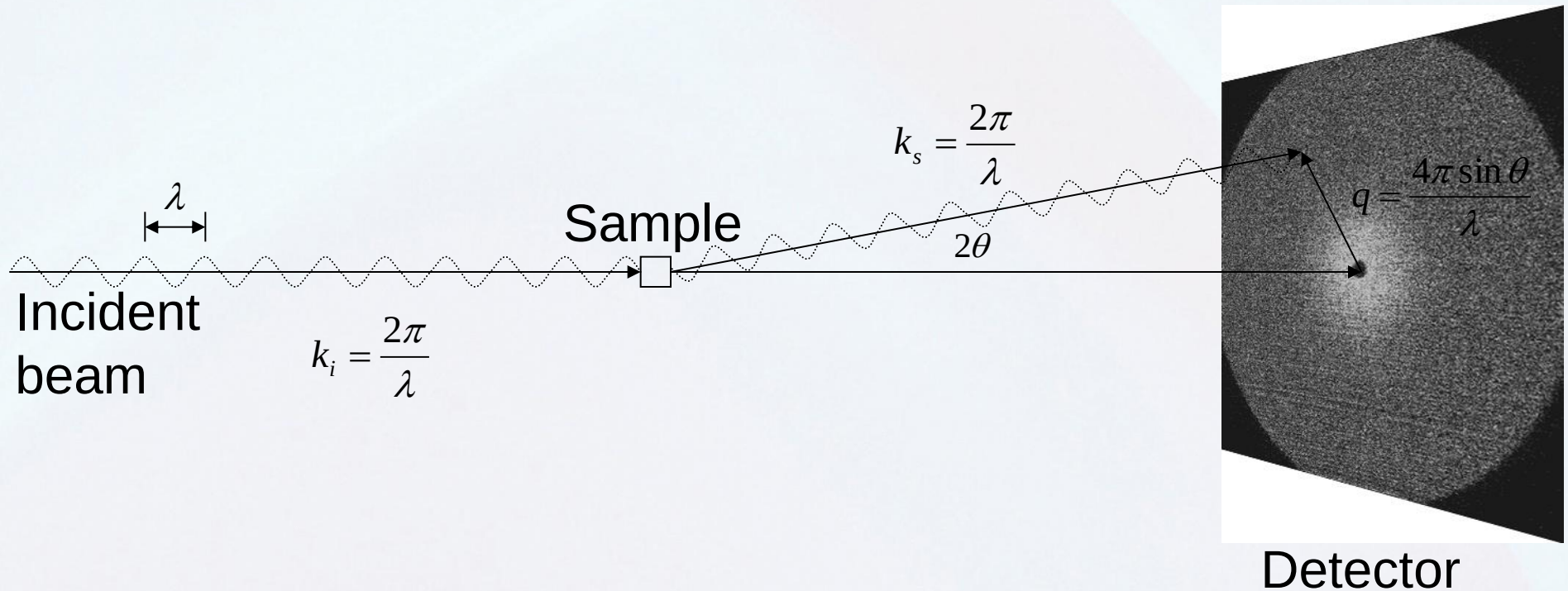
Nuclear-based science benefiting all Australians

Bilby: The Time-of-Flight Small-angle Neutron Scattering Instrument

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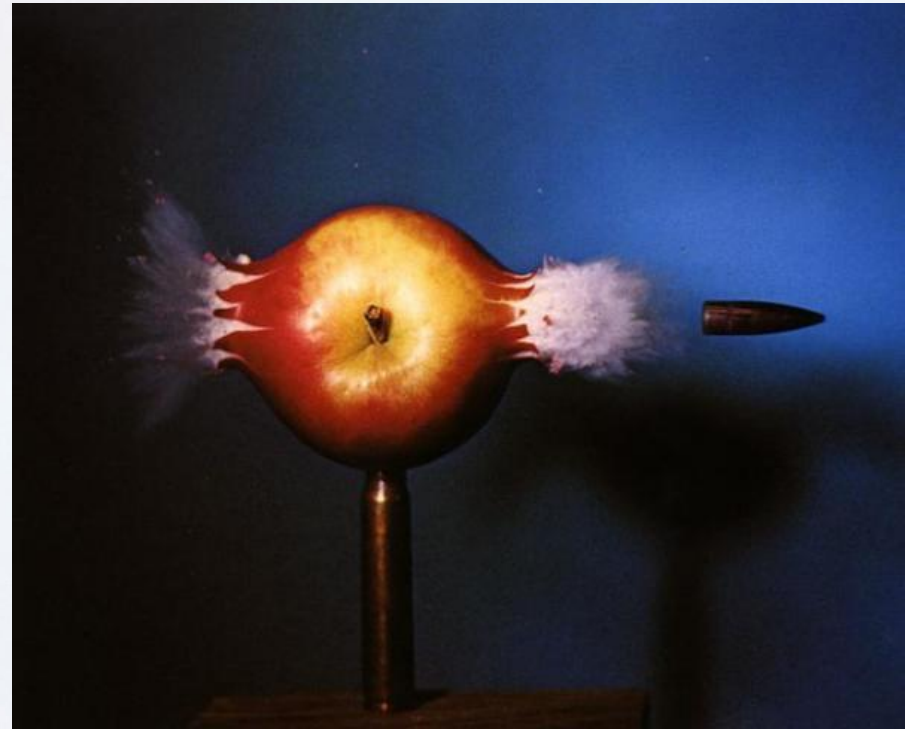
ANSTO

The Small-Angle Scattering Experiment



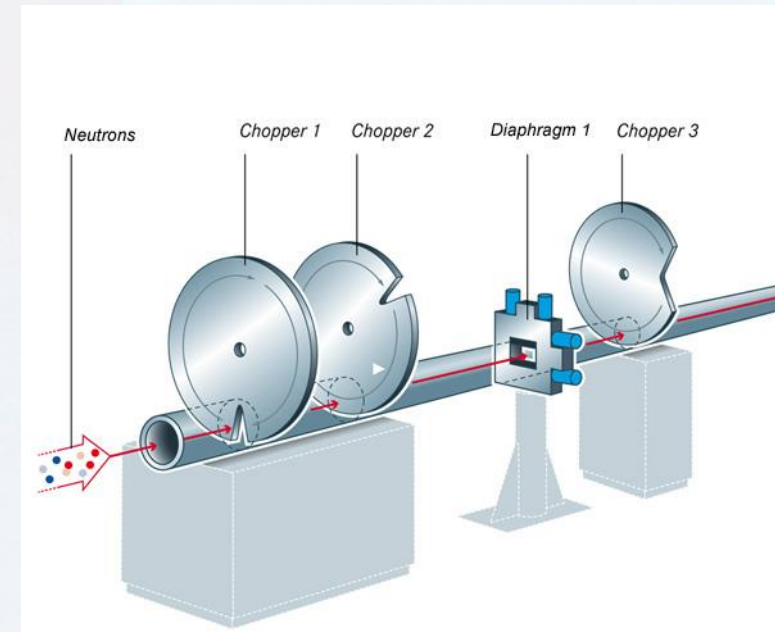
Time-of-flight

- Neutron wavelength is related to velocity
 - $2\text{\AA}$ neutrons have a velocity of $\sim 2000\text{m/s}$
 - $20\text{\AA}$ neutrons have a velocity of $\sim 200\text{m/s}$
- Wavelength can be calculated by measuring the time it takes to travel a certain distance.

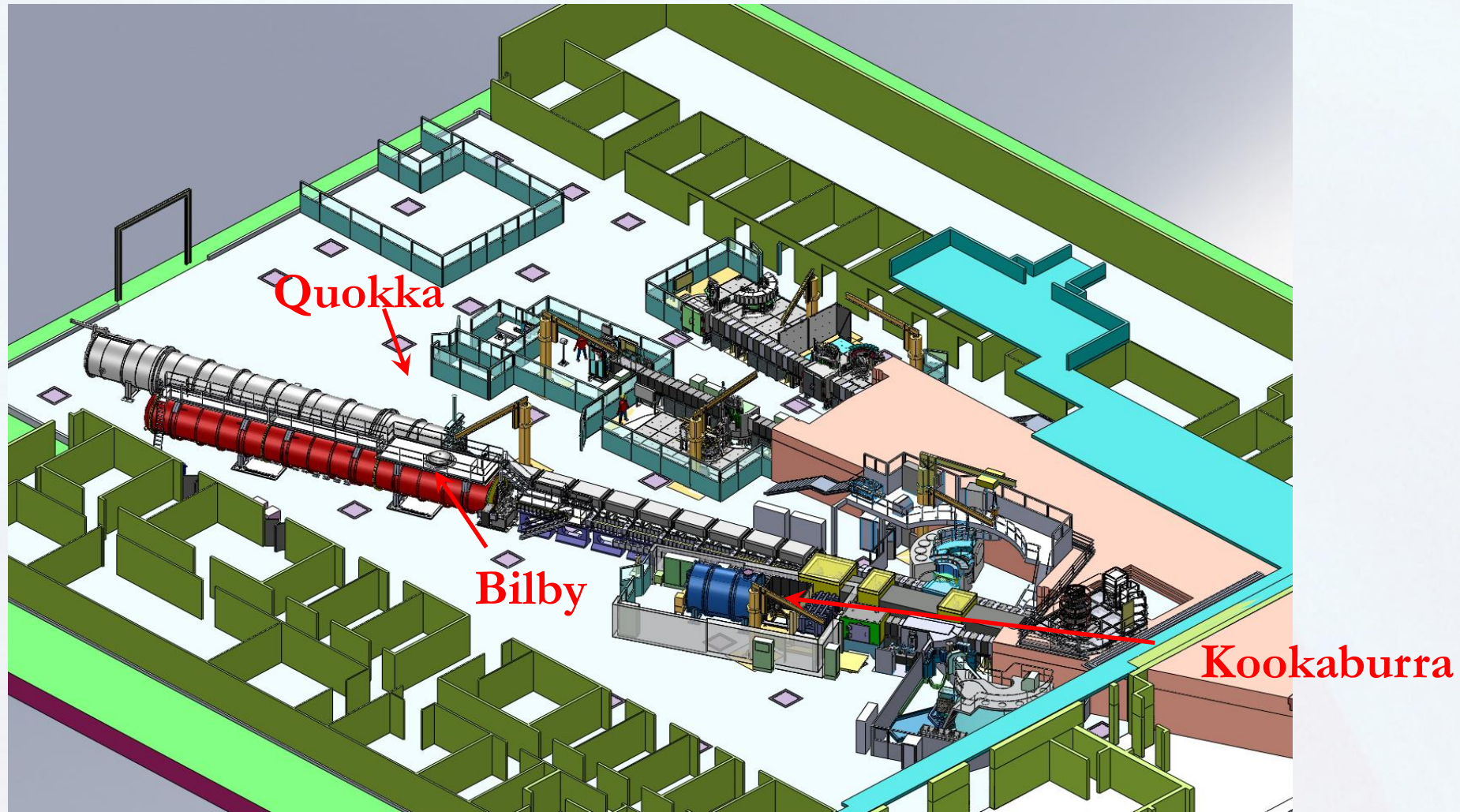


Time-of-flight

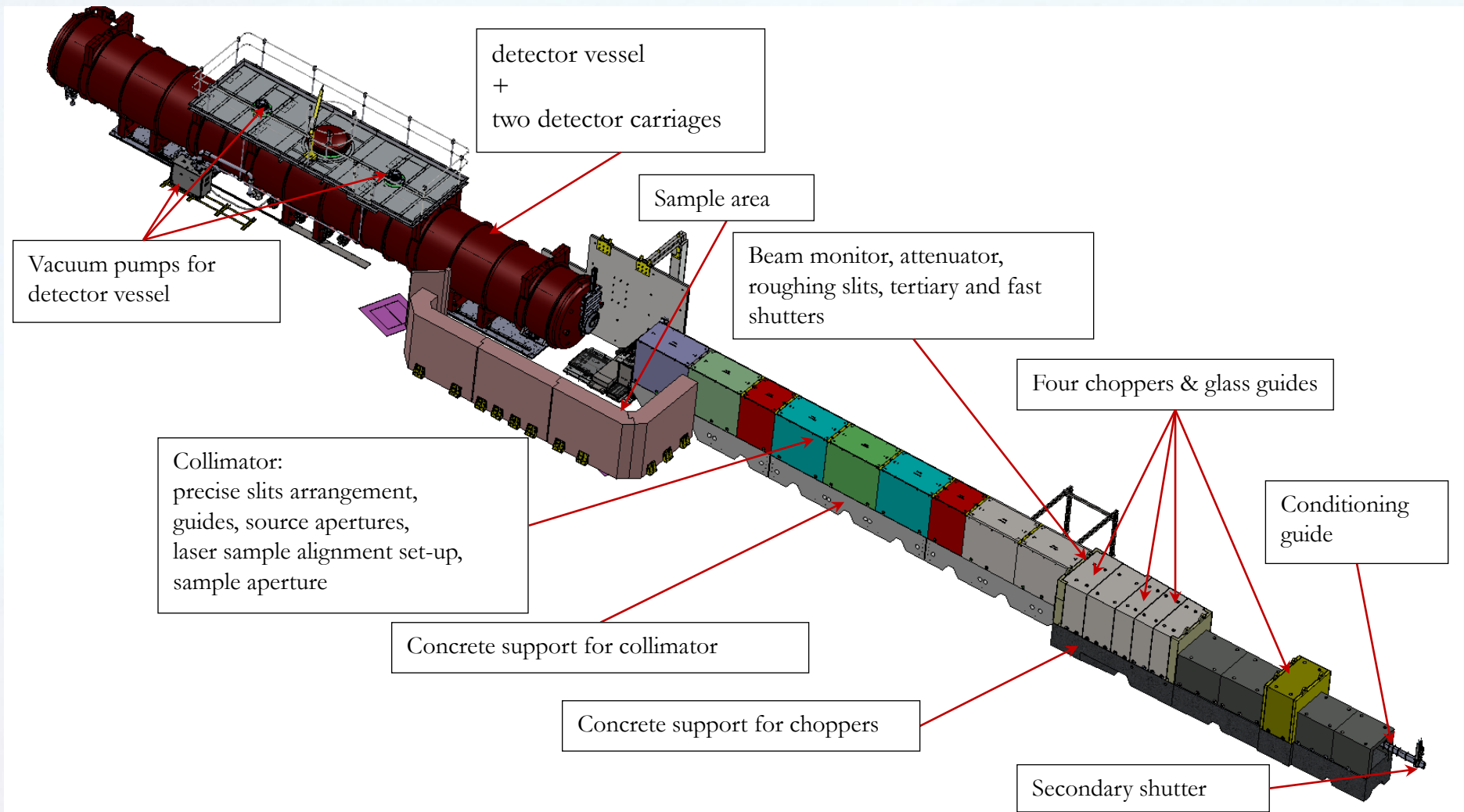
- Choppers define a “packet” of neutrons with a spectrum of wavelengths
 - A signal is sent from the choppers to the detectors to tell them to start the clock
 - Allows measurements with a large q-range without moving the detector



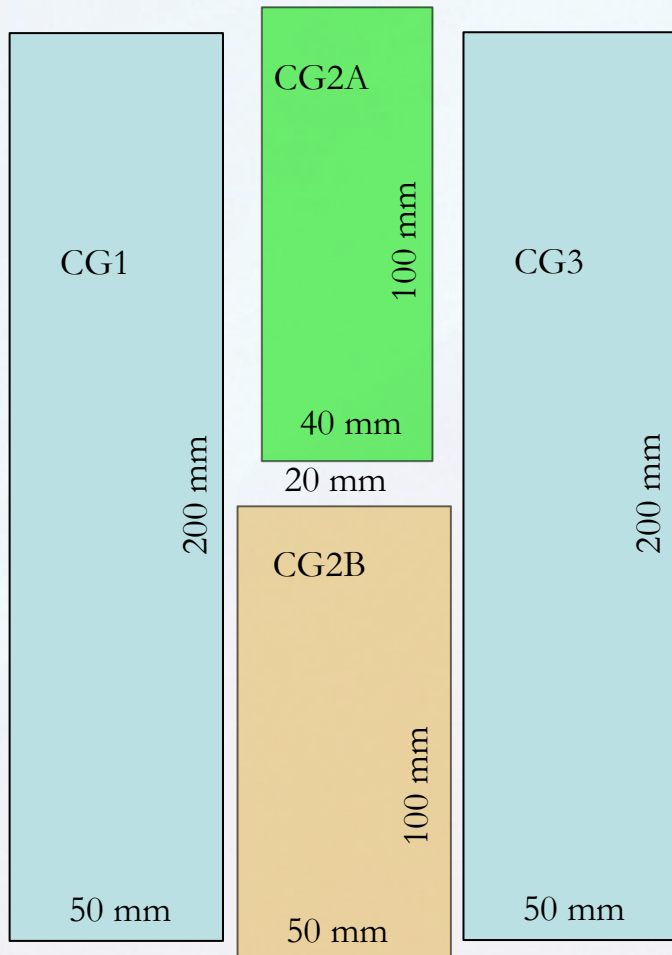
Where is Bilby in the guide hall?



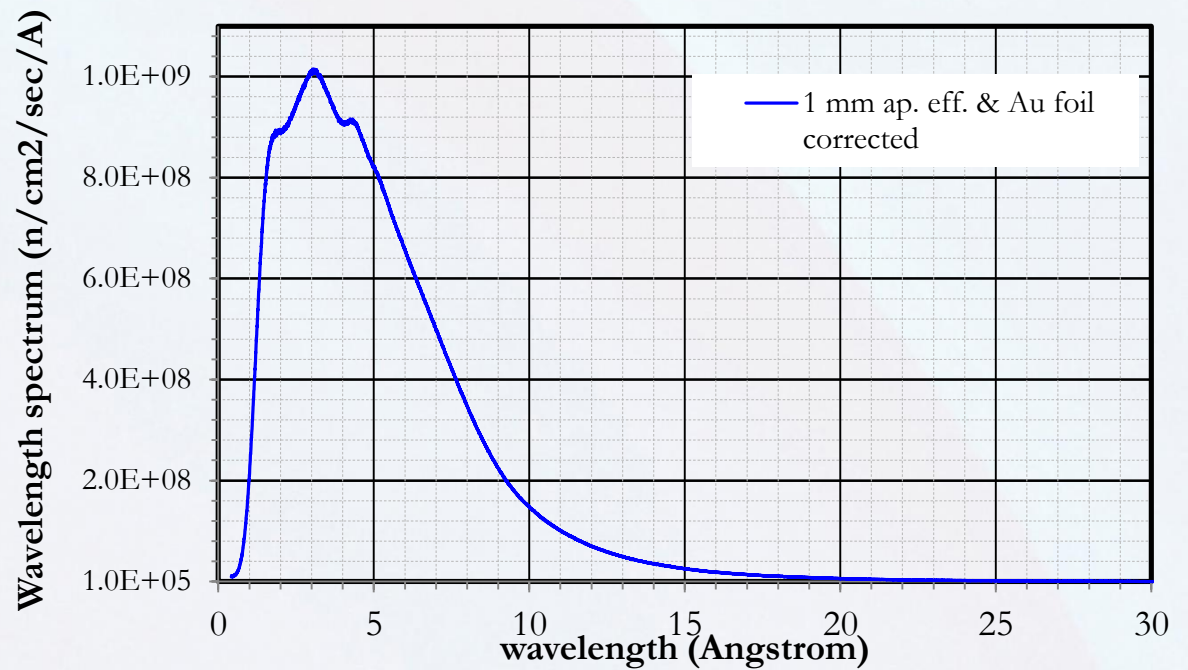
Instrument Layout for Bilby



CG2a

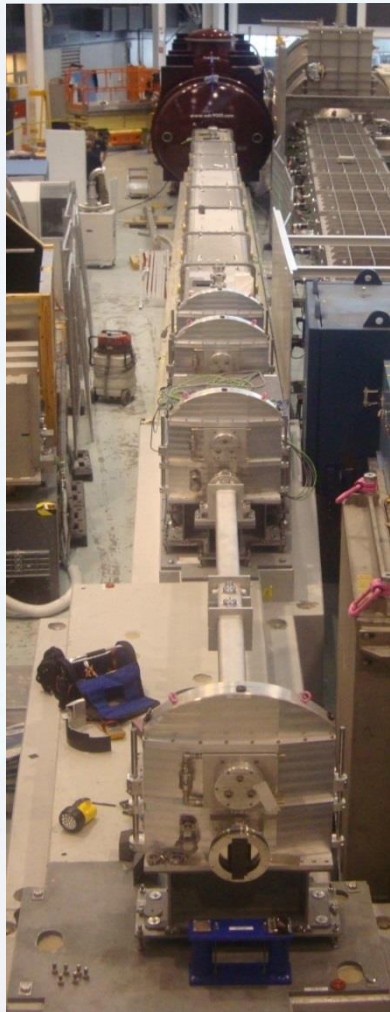
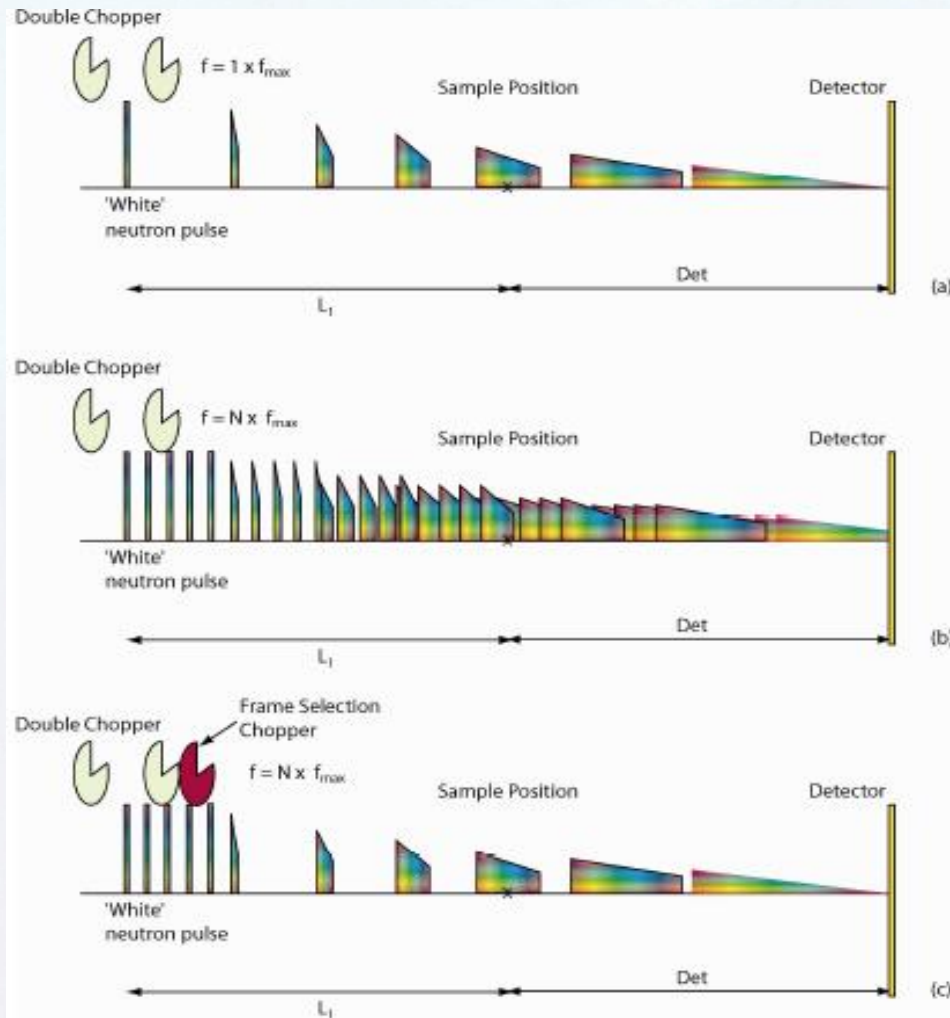


Bilby TOF runs 11-16 April 2014; with detector efficiency and gold foil corrections



The choppers

$$\frac{\Delta\lambda}{\lambda} = \frac{\Delta t}{t} = \frac{\Delta D}{D}$$

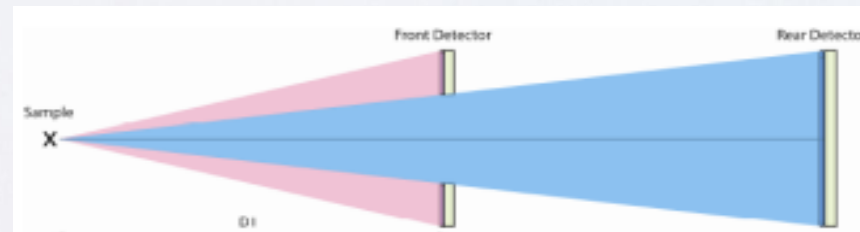
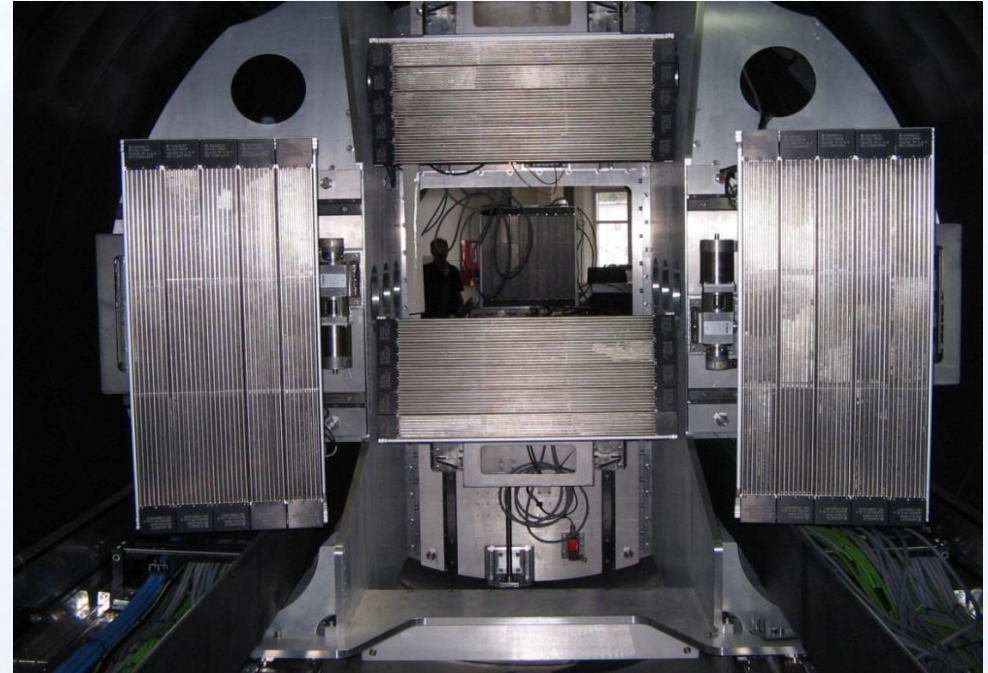
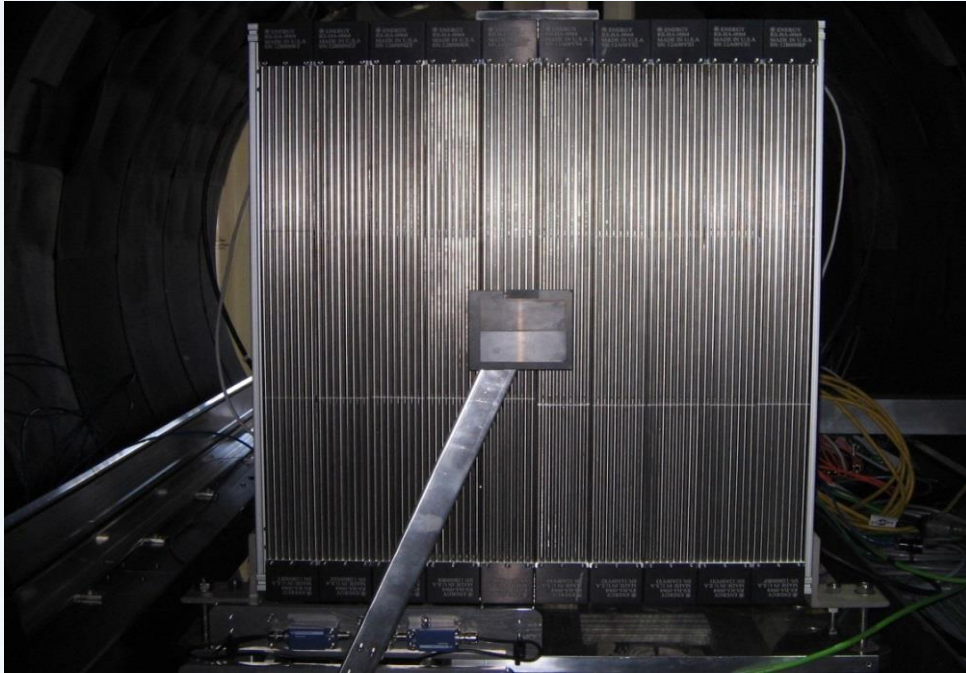


The collimator

- Neutron guides bring the “source” closer to the sample to increase flux (and divergence)
- Each of the 8 guide sections has a 40x40mm cross section and is 2000mm in length
- There are also a range of apertures that can be inserted in place of the guides (low divergence)

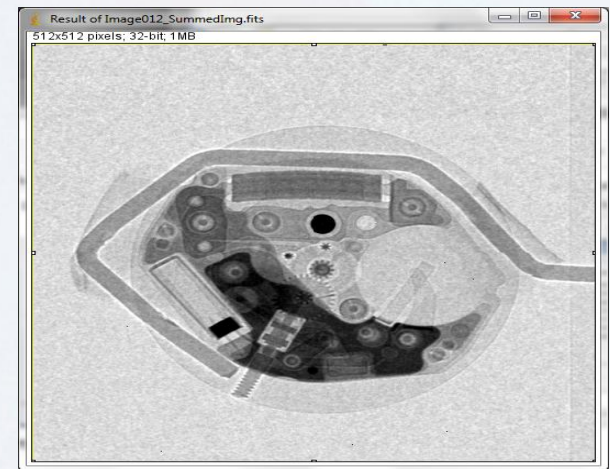
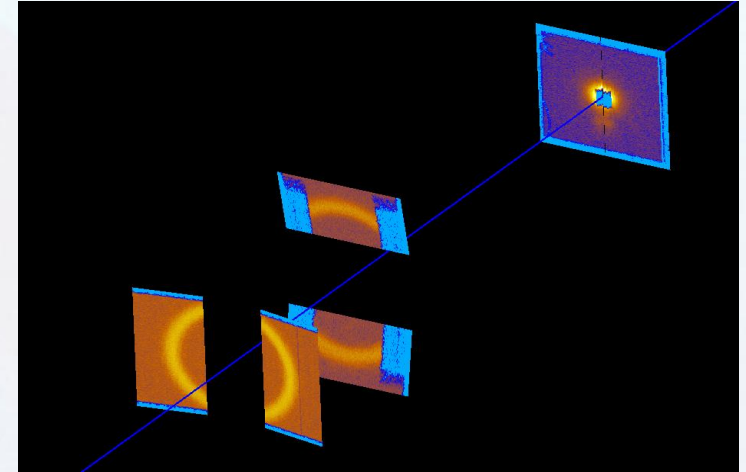


The detectors



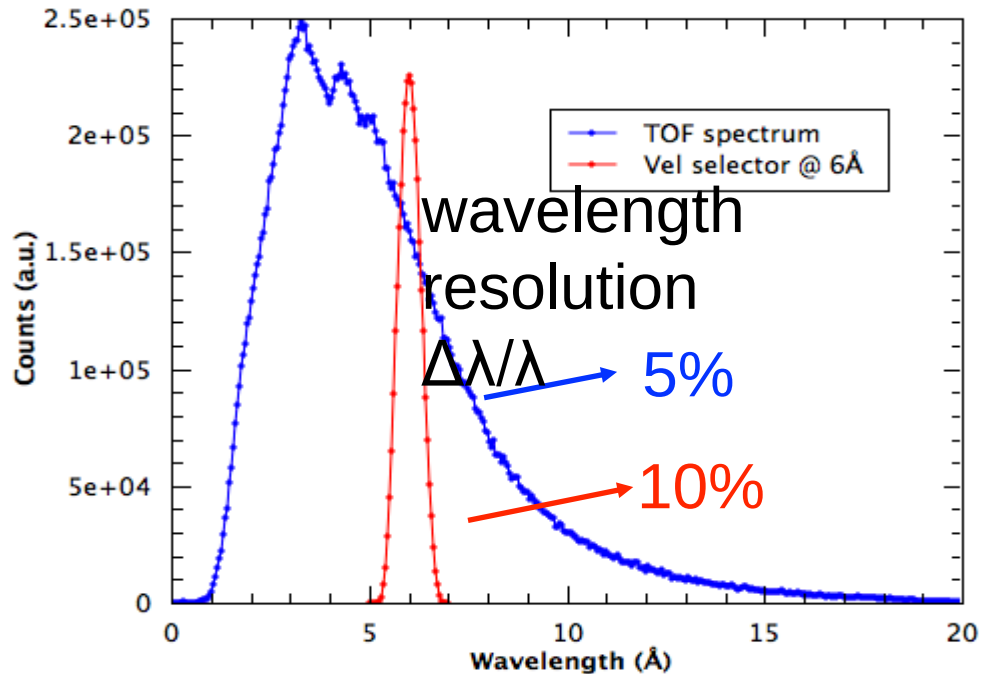
First data from Bilby

- Silver Behenate data (single time-slice corresponding to $\sim 5\text{\AA}$)
- Anton Tremsin (UC Berkley) and Henry Kirkwood (Latrobe) used the cold neutron spectrum and Bilby's highly collimated beam to perform imaging experiments

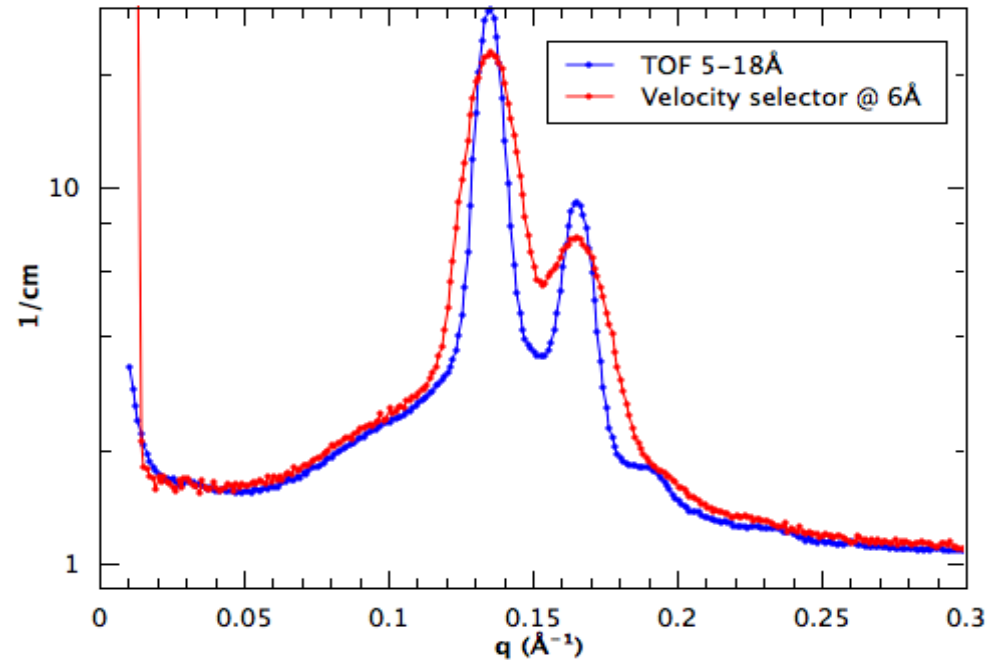


Resolution in ToF SANS

Bilby TOF Spectrum



Compare TOF - Velocity Selector

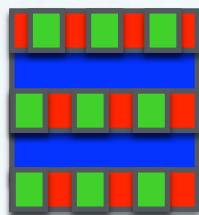


Bicontinuous Cubic
Diamond Phases

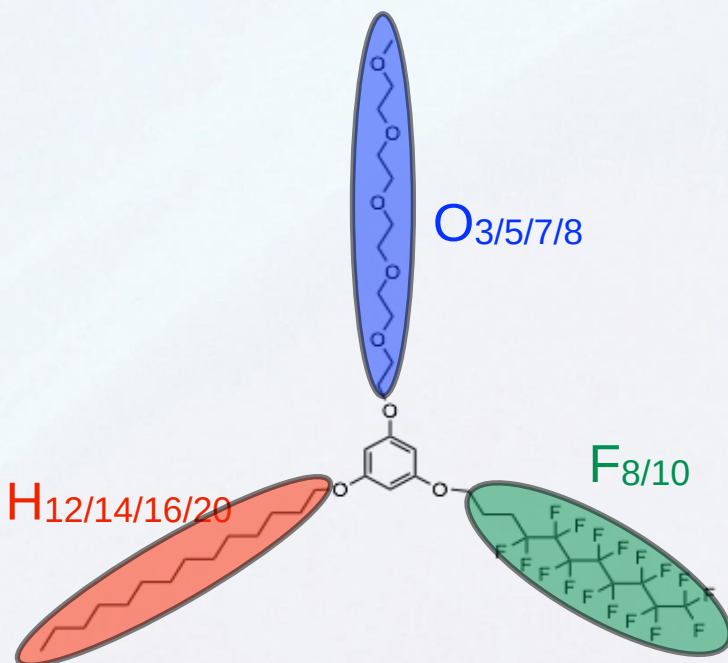
Starting with the Lamellar structure

SANS

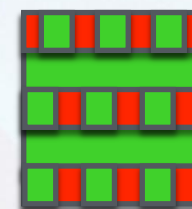
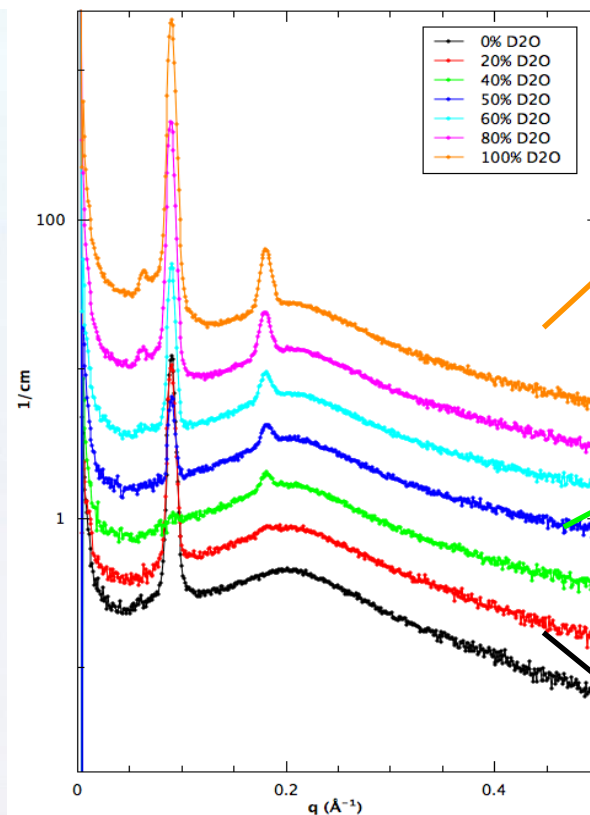
Ph-O₉-C₁₄-F₈



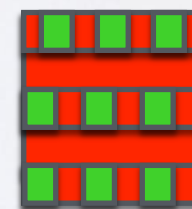
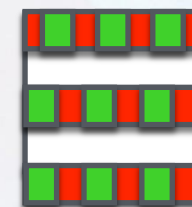
+ 25% water



SANS Contrast Variation - offset



100% D₂O



100% H₂O

=> from the intensity we know that all three domains are segregated
=> the broad feature signifies HC/FC correlations

Strengths of Neutron Scattering

- Nanoscale structure
 - Materials science (inclusions in alloys)
 - Chemistry (polymer mixtures)
 - Biology (protein complexes)
 - Physics (superconductors/magnetic structure)
- Bilby will:
 - extend the q-range measurable in a single measurement (nominally $0.0003 - 1.3 \text{ \AA}^{-1}$)
 - Simplify kinetic measurements (don't need multiple configurations)



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