Bilby and Quokka: Instrument comparison

To benchmark the small angle neutron scattering instruments Quokka and Bilby several samples have been measured on both instruments*. The data show that both instruments are capable of measuring data of similar quality in similar measuring times. A strict comparison of data collection times is difficult as data are recorded differently (e.g. transmission measurements are significantly longer using the time-of-flight (TOF) mode on Bilby; collection of data over the full Q range on Quokka requires measurements at two or three detector positions) but the data presented are all measured with minimal difference in data collection times.

*The data have been collected in year 2018, when Quokka has been equipped with Ordela detector which is currently replaced.

Bilby and Quokka similarities and differences

In TOF mode, Bilby uses the full spectrum of neutrons between 2 Å and 20 Å, however for some data reduction a smaller bandwidth is selected. For some samples with high hydrogen content, background subtraction may become difficult using Bilby in TOF mode so long wavelengths might be discarded. Multiple scattering effects at longer wavelengths may also need to be considered.

When needed, a neutron velocity selector (NVS) can be used on Bilby. The latter mode is similar to Quokka operation but with the advantage of two detector banks.

Quokka can access low Q (4 x 10^{-4} $Å^{-1}$) with relatively high Q resolution by using a focussing lens configuration. Bilby can access 1 x $10^{-3}Å^{-1}$ using long wavelength neutrons, on the order of 18 Å. In TOF mode, Bilby has the ability to tune wavelength resolution to enable sharp structural peaks to be resolved. Both instruments have the ability to perform measurements at high magnetic field due to its non-magnetic construction. Quokka has capacity to perform incident beam polarisation and polarisation analysis measurements.

Both instruments can utilise the same pool of the sample environment devices.

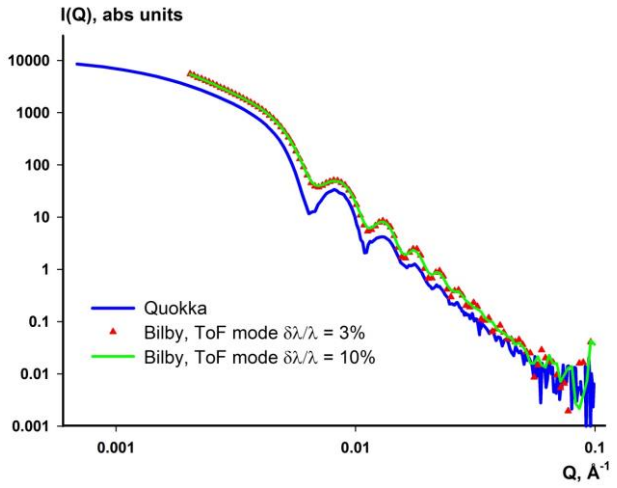
Below we present a comparison of data collected on a set of standard samples illustrating performance of both instruments. Please refer to the list of publications for each instrument (see Quokka and Bilby website-pages) to find more detailed information about various science cases.

It is important to note that a lot of experiments can be performed on either instrument, but only some specific ones require certain instrument. It is highly recommended to talk to the instrument scientists to seek advice prior to a proposal submission.

Latex spheres – Q resolution differences between the instruments

A sample of monodisperse spheres shows the differences in wavelength resolution achievable on Quokka and Bilby. At Q > 0.01$Å^{-1}$, Bilby using a wavelength spread of 10% and Quokka have similar Q resolution. BILBY in TOF mode has been used to get a narrower resolution of 3% and an increased number of oscillations in the data are observed at high Q. The Quokka data are measured below 0.01$Å^{-1}$ using the lens configuration where a better Q resolution is achievable.

Data sets on both instruments measured for an hour. Quokka data has been collected using two detector positions; Bilby data has been collected at a single set-up.



Latex spheres scattering; not scaled to concentration

Bilby and Quokka: Instrument comparison

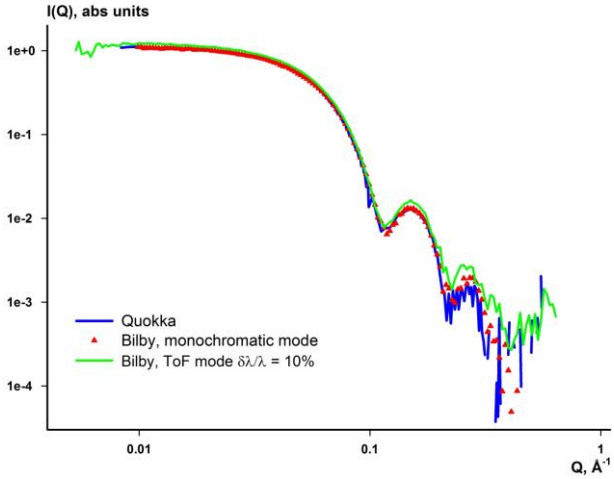
Glucose isomerase: in H_2O and D_2O solvents

Protein concentration for D_2O and H_2O samples is ca. 6.6 mg/ml.

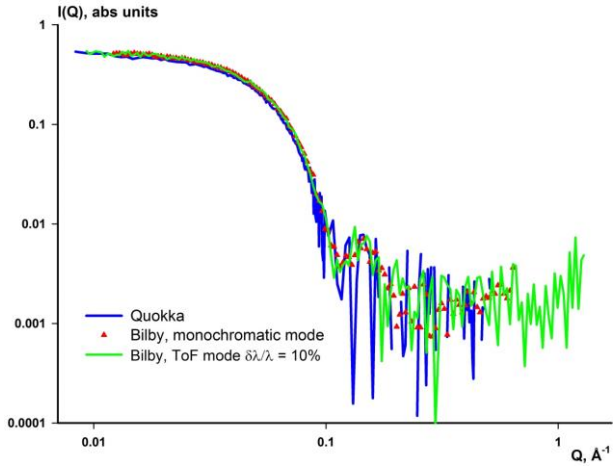
Quokka data for H_2O sample have been collected for two hours, at two detector settings.
Bilby data have been collected for one and a half hours, using one instrument set-up, in TOF and monochromatic mode, at one instrument setting.

Quokka data for D_2O sample have been collected for about 20 min at two detector settings. Bilby data have been collected for one hour, using one instrument set-up, in TOF and monochromatic mode, at one instrument setting.

The data are shown on the absolute scale without applying any further scaling factors, without correction to concentration.



Glucose isomerase scattering, D_2O buffer; scattering is not scaled for concentration



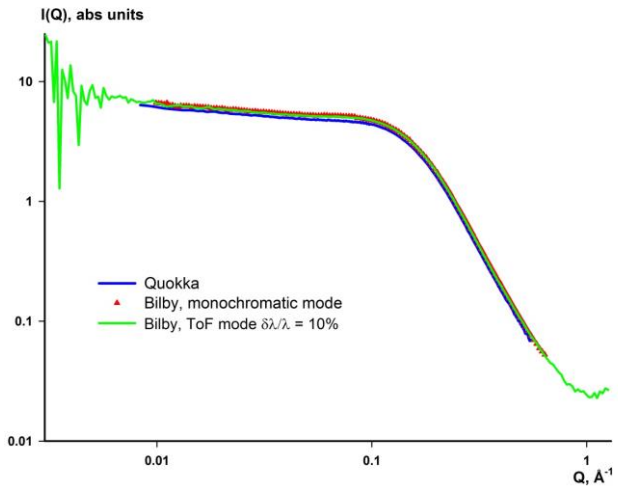
Glucose isomerase scattering, H_2O buffer; scattering is not scaled for concentration

Bilby and Quokka: Instrument comparison

Glassy carbon – absolute scale and Q standard

Quokka data have been collected for 40 min at two detector settings with no offset.
Bilby data have been collected for one hour, using one instrument set-up, in TOF and monochromatic mode, at one instrument setting.

The data are shown on an absolute scale without applying any further scaling factors. Currently Bilby and Quokka differ in their absolute scale by 7%; we are working to understand the differences observed.



Glassy Carbon scattering