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Neutron Scattering Division

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ABSTRACT

In Small-Angle Scattering experiments, accurate distance information between sample and the detector is important. During the winter outage, January 2021, positions of detector, especially along the beam direction, were measured with the laser alignment tool to confirm values regularly deduced from silver behenate measurements. The results show that the current detector-z position of the EQ-SANS is accurate at all typically used detector positions.

1. Summary of measurements

1.1 Detector-Z

Using reference points available around the building, the exact center of the flange of the sample chamber was located. The location of the center detector tube was also located in reference to the detector module. Three reference points were assigned to the back of the detector module which maintained line of sights to the measuring tool sitting outside the tank at all detector-z positions. Table 1 presents the results of the various distance measured after homing the detector. The detector distances were selected by specifying the detectorZ value in the EPICS control interface which are calculated based on the encoder-determined motor position and previously determined physical offset values for the motors (detectorZ=1300, 4000, 9000). An additional measurement of the detector position was performed at the homed position. In Table 2, the relative difference with respect to the EPICS input values are provided.

Table 1. Distances measured from the center of the flange at the beam level.

Name	Begin			End			Delta		
	X1	Y1	Z1	X2	Y2	Z2	dX	dY	dZ
	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
after Homing, flange-detector 1.3m	-0.000032	0.680207	9.450688	-0.000463	-0.012389	10.817135	-0.000431	-0.692596	1.366447
after Homing, flange-detector 4m	-0.000032	0.680207	9.450688	-0.000395	-0.012461	13.516281	-0.000363	-0.692667	4.065592
after Homing, flange-detector 9m	-0.000032	0.680207	9.450688	-0.000263	-0.012724	18.515126	-0.000231	-0.69293	9.064437
Homing position, flange-detector	-0.000032	0.680207	9.450688	-0.000406	-0.012421	10.733086	-0.000374	-0.692628	1.282397

Table 2. Differences between the input (set values) and the measured distances.

EPICS input (mm)	Measured flange-detector (mm)	Difference (mm)
1300	1366.447	66.447
4000	4065.592	65.592
9000	9064.437	64.437

Table 2 reveals a 64-66 mm difference between the values selected with EPICS and measured with the laser position determination method. This difference is understandable since the *sample-to-detector* distance also includes an additional offset that must be determined through measurement of a silver behenate diffraction standard that results from the actual position of the sample environment within the sample enclosure that is not necessarily the center of the flange. This distance is also supplied as an offset during the data reduction to produce the correct sample-to-detector distance. Two offsets are therefore supplied during the data reduction: the *sample_offset* and *detector_offset* values. From the EPICS input distances, the sample-to-detector distance is calculated by

$$D_{sample-to-detector} = D_{EPICS} - [sample\ offset] + [detector\ offset],$$

where D_{EPICS} is the EPICS input in Table 2, *sample_offset* = 314.5, and *detector_offset* = 80. In order to experimentally measure the sample-to-detector distance, we first measured distance from the center-of-flange of the sample change to the blue concrete surface where the sapphire window is mounted. This distance (normal to the concrete surface) was measured to be **368.143 mm**. (Figure 1) Since the distance from this surface to the sample position was approximately 60mm (measured with tape-measure), the sample-to-detector distance using the measured center of the flange to detector distance can be estimated by $D_{sample-to-detector,measured} = D_{flange-detector,measured} - 368.143 + 60$.
The results presented in Table 3 confirm that the differences between the set and measured values are less than a cm (thus comparable to the precision of different tape measurements and to the thickness of the active component of the detector) and are less than 1% in all cases. We conclude that the values supplied during the data reduction as determined from the silver behenate calibration are appropriate.

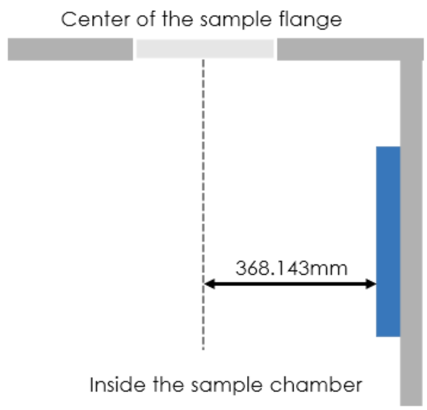

Figure 1. Distance from the center of the flange to the surface of the blue concrete was measured.

Table 3. Comparison of the sample-to-detector distances.

EPICS input (mm)	$D_{sample-to-detector}$ (using AgBe) (mm)	Measured flange-detector (mm)	$D_{sample-to-detector,measured}$ (mm)	Difference (mm)	Difference (%)
1300	1065.5	1366.447	1058.447	7.053	0.66
4000	3765.5	4065.592	3757.592	7.908	0.21
9000	8765.5	9064.437	8756.437	9.063	0.10