

Chopper options for FREIA – ESS response

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NSS management had requested the FREIA team at the scope-setting meeting to evaluate the impact of removing one disk in each of the three bandwidth (BW) chopper pairs as a cost-saving measure. After a thorough study, the FREIA team proposes instead to keep the first two BW chopper pairs as they are and remove the third BW chopper pair, for a possible future upgrade.

The argument made by the FREIA team for keeping the BW choppers as pairs rather than single disks is that it makes their opening tuneable, providing more flexibility, which can be used for two purposes:

- 1) increasing the BW slightly towards longer wavelengths in case measurement during the prompt pulse turns out to be possible.
- 2) decreasing the BW to avoid long wavelengths on very small samples or to tune the wavelength for GI-SANS measurements

The FREIA team proposes to keep this flexibility rather than reducing each of the BW chopper pairs to single disks, and makes an alternative cost-saving proposal of removing the 3rd BW chopper pair entirely, which has the effect of removing the capability of operating in pulse-skipping mode.

We do not share the concerns of the FREIA team regarding the loss of flexibility in BW when reducing the 3 chopper pairs to single disks. We consider it to be a significantly better cost-saving compromise for day one capability than the proposed alternative of removing the 3rd BW chopper pair.

Our arguments against the flexibility to increase the BW are as follows:

- A. Extending the BW slightly towards longer wavelengths would add less than 5% to the Q-range and would decrease the lowest Q for a specific setting only by about 15%.
- B. If such a BW extension is deemed sufficiently useful, it can be incorporated into the design of the single disks of the BW chopper system from the outset. If it turns out that measurement during the prompt pulse is not possible, the data acquired during that time can then simply be discarded. There seems to be no particular advantage to removing it physically rather than in software.
- C. Alternatively, if such a BW extension is not deemed sufficiently useful initially, it could be implemented later on as an upgrade. It is not critical for the world leading day-1 performance set as initial scope.

Our arguments against the flexibility to decrease the BW are as follows:

- A. Being able to measure very small samples is a key part of the ESTIA science case, not the science case of FREIA
- B. GI-SANS is not a priority for FREIA, given its timeline and the potential of a dedicated instrument. In the best case, it is an upgrade path for FREIA, which could be achieved by a later upgrade to the chopper system, among other things.

Our argument against removing the 3rd BW chopper pair entirely is that it would remove the capability of operating in pulse-skipping mode, which can be important for the fast kinetic measurements at the heart of the FREIA science case.

On the other hand, the proposal from NSS management of keeping the 3 BW choppers, but reducing them from pairs to single disks will allow pulse-skipping and works for both low resolution and high resolution modes without any compromise on performance, as also found by the FREIA team in their report.

We therefore propose to make the savings in the budget corresponding to the elimination of one disk from each of the initial double disk choppers. As stated in the cost setting meeting we expect this to constitute a saving of 448 k€.

Discussion with the chopper group informs us that this solution can allow for simple addition of the second disks later on, provided that this upgrade path is considered in the design of the initial supports and housings. This is understood to not add significant additional cost.