INTC-I-236 Letter of clarification

Commissioning of a Double Frisch-grid Bragg Detector for Fission Measurements and Determination of n-induced Background at EAR1 and EAR2

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Below are clarifications in response to the comments of the INTC:

'It is not clearly highlighted what will be the added value of this kind of instrument in the panorama of the fission measurements field and especially compared to what exists today (for example the STEFF instrument already used at n_TOF). More quantitative information of the expected improvements of the device should be given and then compared, for example, with the accuracy target requested in the HPRL':

The Double Frisch-grid Bragg Detector (DGBD) does not have the fragment time-of-flight section that is present in STEFF. This increases the solid angle dramatically (by more than two orders of magnitude) but reduces the mass resolution to (at best) 3% due to variation in the number of emitted neutrons. The DGBD will therefore be suitable in cases where only small quantities of target material are possible but where some information on the fragment mass and energy distributions is required. This makes it distinct from all available fission detectors at the n_TOF facility. When augmented with neutron or gamma-ray detectors, measurements will directly complement the existing work of prompt gamma and neutron multiplicity and energy studies currently ongoing in the Manchester fission group in addressing the requirements outlined in the HPRL.

Furthermore, the DGBD is distinct from the other routinely used fission detectors at n_TOF in that with this detector, both fission fragments deposit their full energy and the differential energy loss along the ionisation track is fully digitised. When combined with the analysis technique developments mentioned in the LOI, this capability may allow for the measurement of charge yields, in coincidence with mass split measurement.

Finally, the use of fission fragment detectors with close to 100% efficiency at n_TOF such as this proposed setup have been shown to be suitable to perform measurements that meet the HPRL accuracy requirements, for example ^{241}Am(n,f).

'The need of two measurements, one at EAR1 and one at EAR2 is not well motivated and the lower number of protons requested for the EAR1 measurements (where the neutron flux is lower than at EAR2) is questionable regarding the aim of the tests':

The proton request for the tests in EAR1 and EAR2 were unfortunately transposed in the LOI; we ask for $\mathbf{1 \times 10^{18}}$ **protons at EAR1** and $\mathbf{2 \times 10^{17}}$ **protons at EAR2**. It is known that the effects of the highest energy neutrons on gas filled fission detectors varies between the two experimental areas due to the differences in the nature of the 'gamma-flash'. If the advantages that a higher instantaneous flux brings are to be exploited (the ability to measure smaller mass samples, and samples of higher alpha activity), the response of the chamber in both experimental areas should ideally be tested before committing to a physics proposal. On the other hand, a test at a single experimental area would still be extremely valuable in terms of understanding the response of the detector and devising methods to mitigate any undesirable behaviours.

'The proponents have also to keep in mind that running in parasitic mode at n_TOF is only possible in the case of "fission experiments" being the main experiment':

We are aware that extra in-beam materials are highly undesirable for capture measurements. We are however flexible as to the beam collimation; the use of either fission or capture collimator would be suitable for this test since it is envisaged that the magnitude of any backgrounds will scale linearly with the flux for both experimental areas. Since it is the background associated with high energy neutrons which is of primary interest, a test near to the beam-dump of EAR1 in the 'rack area' would also be a suitable test in the event that the request for a parasitic test inside either experimental bunker can not be fulfilled due to the constraints placed by the 'main experiments'.