Design of possible PARIS@SPIRAL2 setups

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The initial ideas for the PARIS mechanical design are reasonably well advanced. At the outset, PARIS was conceived of comprising two concentric shells of scintillator – the inner shell comprising lanthanum bromide and an outer shell of a standard scintillator like sodium iodide or barium fluoride. GEANT4 simulations were carried out for this basic geometry and showed that an appropriate frontage for the individual detectors comprising such an array would be 2” X 2” given the manner in which energy is deposited in the array, Doppler broadening and in view of reconstructing events. Given the radius foreseen to allow the discrimination of fast neutrons from gamma rays, this leads to an array with about 200 individual elements.

The second key design feature stems from the research and development on PARIS and the validation of a phoswich detector as forming an individual detector element. The phoswich detectors comprise a cubic lanthanum bromide with linear dimensions of 2” coupled to a caesium iodide or sodium iodide crystal with the same face area but 6” long (see figure 1). Discussion with Saint Gobain Crystals revealed that they were unhappy with cutting the crystals into complex shapes and so we were left either with a cylindrical detector element or the square geometry described above.

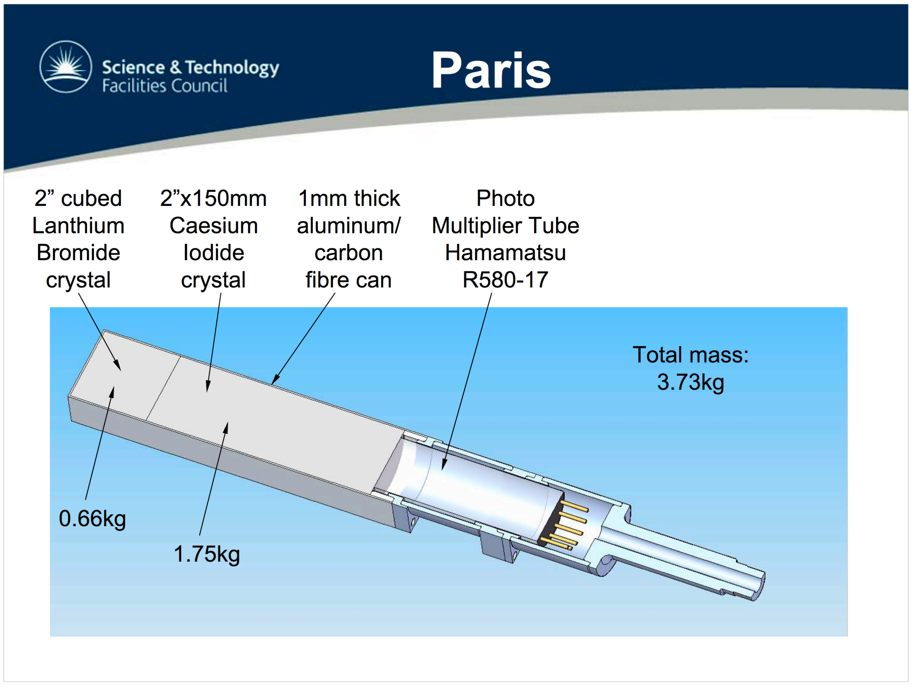

Figure 1: Initial concept of a phoswich detector element

Two natural geometries emerge for the overall array – a spherical design or a cubical design. Naturally, the spherical design is elegant and would allow the easy study of angular distributions (see figure 2). Since the radius is effectively fixed, this would be a very inflexible arrangement, especially in view of the desire to couple PARIS to other apparatus such as S^3, NEDA, AGATA and so on.

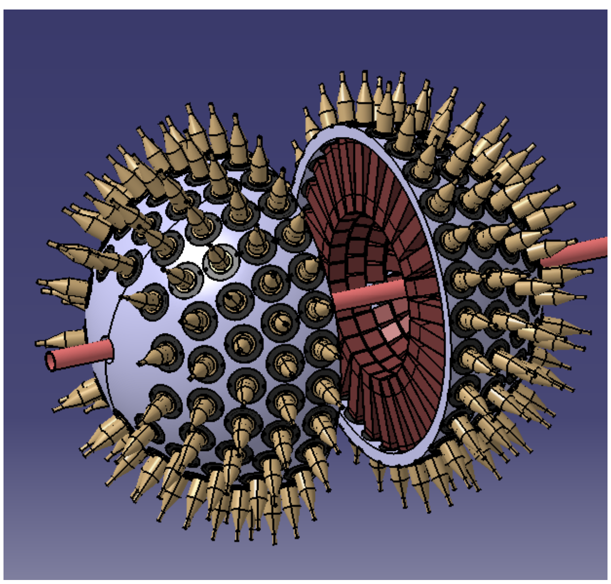

Figure 2: Spherical array of 200 phoswich detectors with minimum 5 mm between modules

On the other hand, a cubical arrangement of detectors is very flexible and can be deployed in full or in part, and coupled to different apparatus. Figure 3 shows an attempt to square the circle with individual detector modules. It is clear that it is hard to reach an arrangement that gives an ideal solid angle coverage. The situation can be improved by shuffling each individual detector to a different radius as shown but this would entail a very complex mechanical support structure where each detector is independently variable.

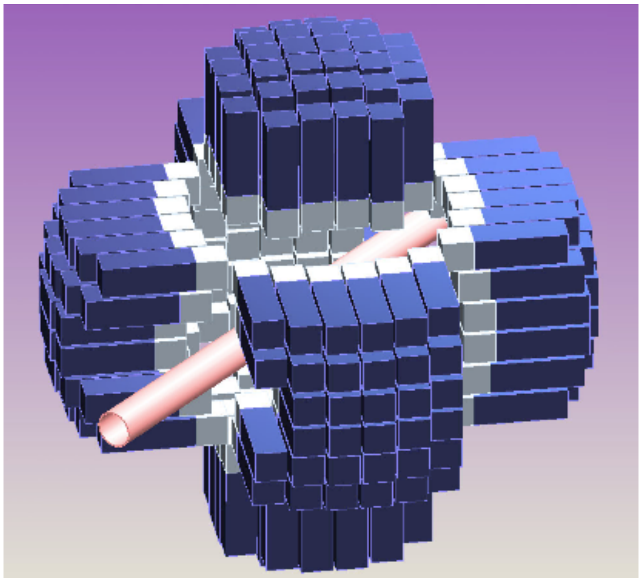

Figure 3: Phoswich detectors arranged in a cubical geometry

Latterly, the concept has changed to that of a cluster geometry. Phoswich detectors would be ganged together in a cluster of nine (see figure 4). This allows the inter-detector distance to be minimised and also makes for a simple (albeit quite heavy) mechanical arrangement. Different geometries for the arrangement of these clusters are foreseen (see figure 5). The work described here is ongoing and a final solution for the geometry is not yet arrived at.

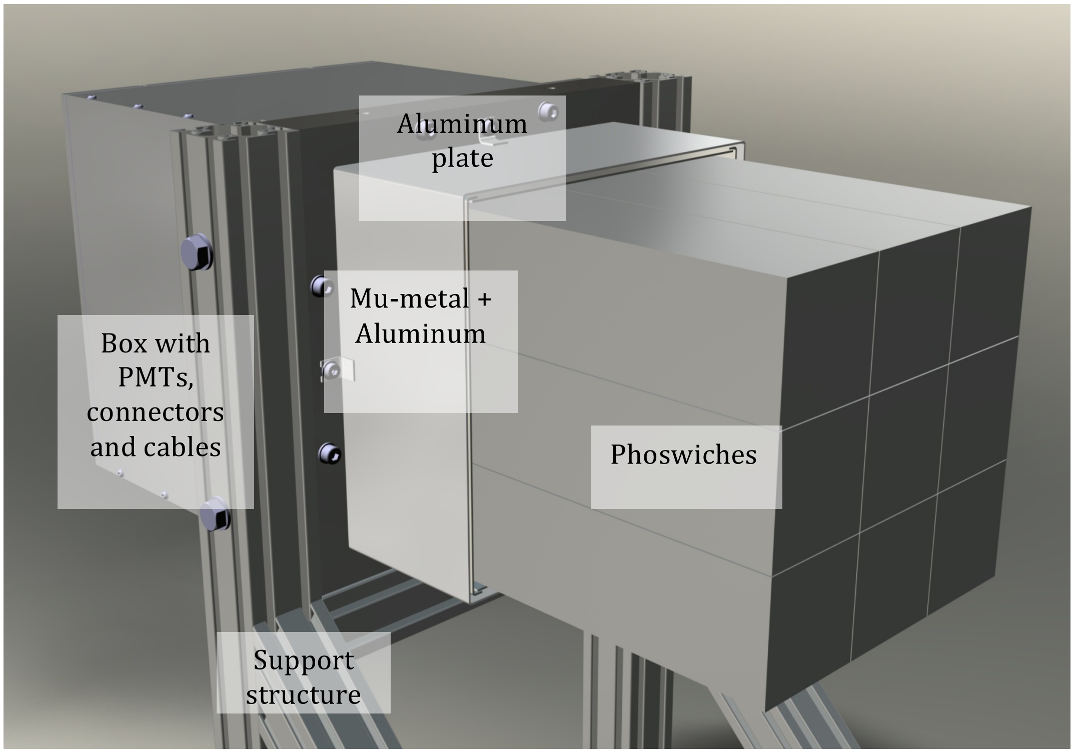

Figure 4: A cluster module comprising nine phoswich detectors

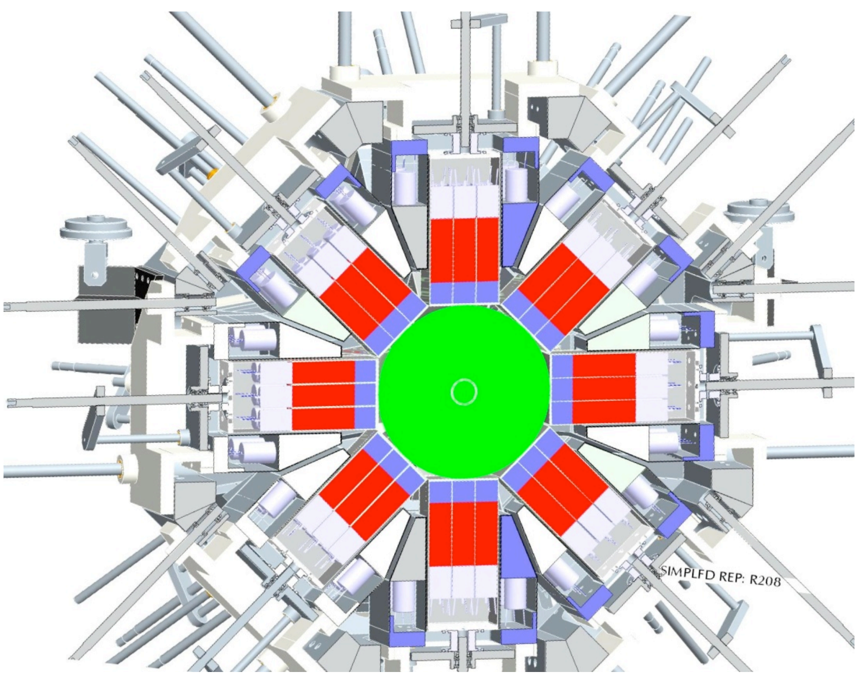

Figure 5: Clusters of phoswich detectors arranged in an EXOGAM-like geometry