Conceptual re-design of mRICH detector prototype

Strictly speaking, the ultimately optimized Gen II LAPPD-based implementation of the original mRICH concept as a *compact modular device with a reduced image size in the focal plane* (as compared to a conventional proximity focusing RICH , see e.g. Belle II implementation []) can be a complete departure from its original set of design ideas:

- The unavoidable substantial spread of the Gen II LAPPD induced signal in the readout plane *suggests increasing the expansion volume length* somewhat, rather than decreasing it, to optimize a realistically achievable charge sharing pixel size vs occupancy. This is certainly possible for EIC detector, where 10-20 cm of extra space along the beam line is not a problem in the electron endcap, see Figure 1.
- Since LAPPD can provide a continuous coverage in the readout plane with the unobstructed acceptance spot size of ~100x100 mm^2, *there is no real benefit in minimizing the ring size*. One should perhaps tune the Fresnel lens tile size and choose a focal distance in a way the ring image produced by a single lens just fits in the lens footprint, for the anticipated range of particle incident angles.
- The modularity, which requires active area segmentation and installing mirrors in the expansion volume, creates substantial dead areas in the acceptance as well as a high level of non-uniformity of response when charged particles hit aerogel tiles close to the module boundary. In the latter case the reflected light gets mixed into the directly produced rings, creating "moon shape" images [] with presumably substantially lower particle ID efficiency. As such, *mRICH modularity is not necessarily a benefit*.

With the Incom Gen II LAPPD readout in mind it may therefore be beneficial to build *large area mirror-less assemblies with the somewhat longer expansion volume*, matching the largest (currently 8-9" effective focal length) high quality aspheric Fresnel lenses, produced by Edmund Optics []. Instead of modularization, such an assembly would have three independently tiled layers: the aerogel, the Fresnel lens fragments, and the LAPPDs. If tiling and formfactor of each layer elementary units can be somewhat synchronized, in order to minimize the dead zones, this would come at a benefit. One obvious option would be tiling both the Fresnel lenses and the LAPPDs in a hexagonal shape, with the LAPPD package sides located outside of the Cherenkov ring boundaries, see Figure Q.