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Very Forward Calorimetry at the FCC

The success of any particle detector at a collider experiment depends on its ability to measure both the trajectories and energies of particles exiting the interaction point. Especially important and difficult is measuring the trajectories and energies of particles in the very forward region - particles that exit the detector with very shallow angles compared to the beam line. The difficulty with measuring these particles with high precision is related to the high radiation this area is exposed to, making robust instrumentation a challenge. This area becomes more important with increasing beam energy.

We propose a radiation hard, precise, and highly resolved tracking calorimeter that addresses all of these challenges. The design uses highly segmented radiation resistant quartz tiles coupled to replaceable radiation resistant photomultiplier tubes. Charged particles entering the quartz array will generate Cherenkov light in proportion to their energy, and this light will be measured with photomultiplier tubes. Tracks can be drawn between coinciding signals, and trajectories measured. Neutral particles will leave no initial track in the quartz, but layers of absorber between the quartz tiles will initiate a shower, making it possible to measure all types of particles and energies using this detector. Neural nets can be used to identify particles and tracks. Our simulations show that this detector has excellent tracking, excellent electromagnetic energy resolution, and excellent hadronic energy resolution. Its radiation tolerant materials make it well suited for high radiation environments, but its energy resolution properties mean it can used in varying geometries at any location around the interaction point.

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