

A novel water-Cherenkov detector design with retro-reflectors to produce antipodal rings

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Since Kamiokande, the basic design of water-Cherenkov detectors has not changed: the walls of a water tank are lined with photodetectors that capture Cherenkov photons produced by relativistic particles. However, with this design the majority of photons are lost in insensitive regions between photodetectors, while at the same time most photodetectors are outside the ring and remain dark. To fix both issues at once, we propose fixing retro-reflectors between all photodetectors. These devices will reflect uncollected photons back through their emission point onto photodetectors at the other side of the tank, producing a secondary, delayed Cherenkov ring. Numerical simulations show that, due to the parallax effect of this antipodal ring, our system can yield up to 2x improvement of detector vertex and angle resolutions. This improvement would be beneficial for kinematic selection of multi-ring events and would lower detector costs by decreasing the number of required photodetectors.

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