

Photo-detector development for maximizing the overall photon detection efficiency

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The baseline Hyper-K concept relies on 99,000 20" photomultiplier tubes (PMTs) to provide 20% photo-coverage. We are investigating solutions that would enhance the photo-coverage without compromising either contrast or timing resolution. Contrast roughly quantifies the fraction of photons detected that retain the Cerenkov light directional information over the total number of photons detected including photons having scattered, been reflected or reemitted. Numerous observables, for example low energy neutrino would benefit from enhanced photo-coverage. A large fraction of the photons missing the PMTs could be detected by either using wavelength shifters to guide them towards either the primary PMT or additional PMTs or by using light concentrators to focus the light towards the primary PMTs. Wavelength shifters will worsen the contrast unless the reemitted light can be prevented from entering the active water volume. Dichroic mirrors may do just that by allowing the UV and blue light to be absorbed in the wavelength shifting material and then reflecting the reemitted green light. In general, we are planning to investigate possible applications of interference filters in Hyper-K whether they are used coupled to wavelength shifters, as broadband mirrors for the light collectors, or as anti-reflective films to maximize contrast. We will report our recent investigation of solutions that maximize the detection efficiency.

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