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## Showering Muons in Super Kamiokande

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Super-Kamiokande (SK), the world's largest underground water Cherenkov detector, observes about 2 muons a second passing through it at a depth of 1 km. A fraction of these muons shower, and sometimes create radioactive isotopes (spallation). Those isotopes live anywhere from microseconds to several seconds, forming a dominant background to neutrino searches above 6 MeV and below 20 MeV. Detection of Cherenkov light from the showers points to the location of potential spallation products. Spallation is predominantly produced by neutrons and pions interacting with oxygen in the water. Therefore the detection of neutrons produced by muons serves both as an effective tag as well as an independent position measurement of spallation production. Recently, these neutrons were successfully detected in SK. The development of this technique may prove critical for future water Cherenkov detectors with less overburden, such as Hyper Kamiokande. The addition of water soluble gadolinium salt will improve the neutron detection efficiency and muon time correlation.

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