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Target challenges for the next generation of neutrino facilities

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High energy physics experiments often require a target to produce subatomic particles of scientific interest. In a typical particle accelerator, a high energy particle beam is fired at the target and the interaction results in the emission of neutrons or other particles of interest which in the case of charged particles are often refocused with magnetic fields. Many existing and proposed targets are designed to dissipate a significant amount of energy deposition that results from the incident particle beam. The trend has been for the incident beam power and in parallel the deposited power in the target to increase, so increasingly elaborate target designs have been proposed.
At lower power densities such as those experienced by the target of the T2K facility, a peripherally cooled solid target is employed. As deposited power density increases examples of internally cooled segmented targets such as those used in ISIS, CNGS and Numi-MINOS facilities demonstrate how segmentation provides a means to increase the heat transfer surface area and also reduce the thermal stresses. At the highest power densities as that expected for a future Neutrino Factory, rotating or flowing targets are proposed to reduce the peak power density experienced by constantly renewing the target material. Rotating and flowing targets bring significant additional complexity, reliability, safety, handling and cost issues. In some cases they may be the only solution, however where it is possible to employ a stationary target that must be a preferable option.

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