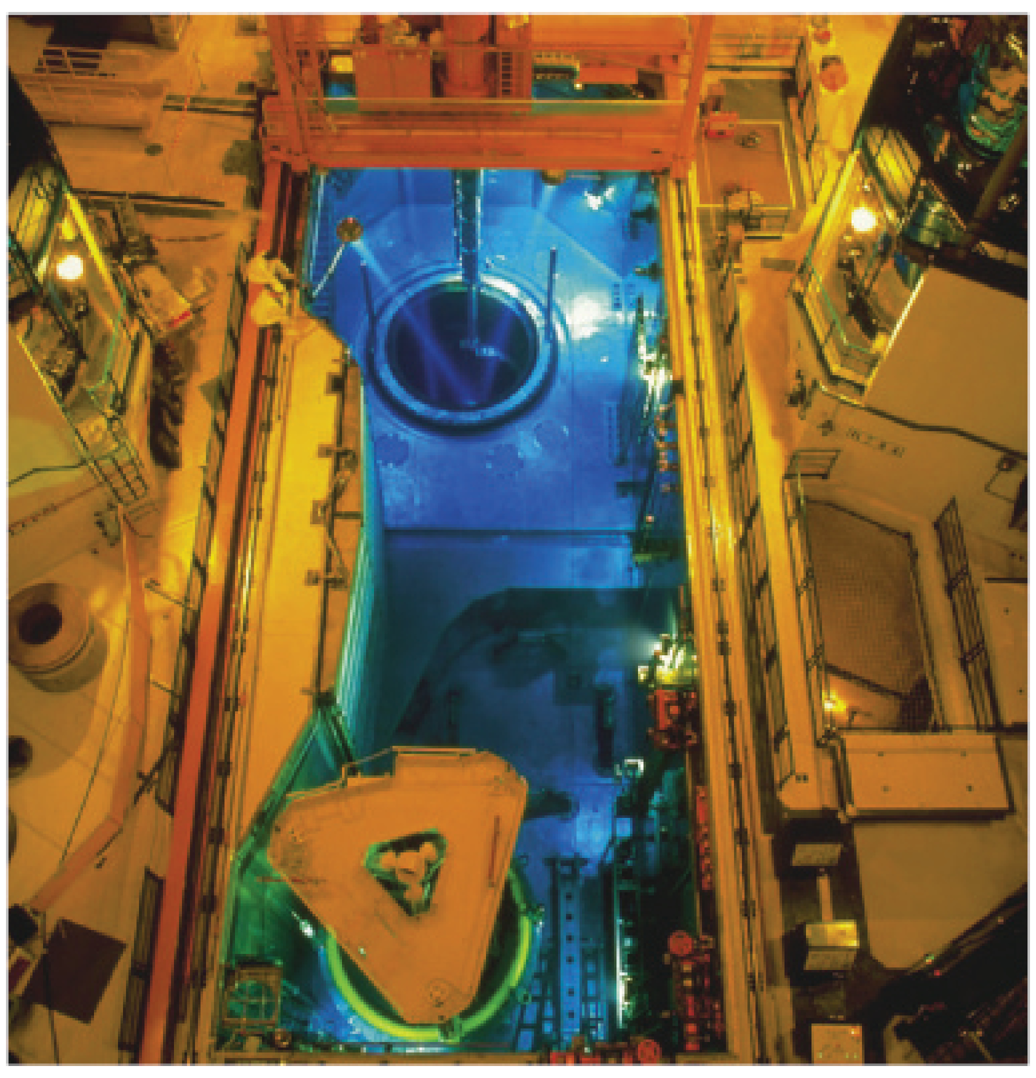
The MiniBooNE Detector

- on the trail of the elusive neutrino

You've probably heard that the velocity of light is the ultimate speed limit: nothing can move faster than light. However, light slows down when it travels through a medium like glass or water (or, for MiniBooNE, 250,000 gallons of mineral oil). You can see this when you stand in a swimming pool and look down; your feet appear to be closer to you than they really are. Light moves slower in water than it does in air; as a result, the light bends and your legs look shorter.

This speed change is also behind what's called Cerenkov light. When one of the neutrinos from the Booster beam line encounters a particle in the mineral oil, charged particle products come zipping out. It happens that these particles are moving faster than the speed of light in the oil, so they produce a cone of blue light, a photon "shock wave," much like a bow wave from a speedboat or the thunder-like boom from a supersonic aircraft. The photograph above shows the blue glow of Cerenkov light in the water around a nuclear reactor.

The Cerenkov light signals in the MiniBooNE tank are very faint indeed, so we use extremely sensitive "light amplifiers" called photomultiplier tubes (PMTs) to detect and magnify them. When the cone of Cerenkov light intersects the PMT-lined wall of the MiniBooNE sphere, the photomultipliers fire in a ring-shaped pattern. Recognizing and analyzing these patterns allows MiniBooNE to unravel what particles were produced in the interaction.



Blue light special: Cerenkov light in the water around a nuclear reactor

vital statistics:
- steel spherical tank 12 m (40 ft) in diameter
- filled with 250,000 gallons (800 tons) of ultrapure mineral oil
- lined with 1520 8-inch diameter Hamamatsu photomultiplier tubes
- 30 miles of cables from tank to electronics crates

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