Approximately 85% of the protons interact with the solid target, producing pions and kaons that subsequently get focused by a set of magnetic horns into a decay pipe where they decay into muons and neutrinos (Figure 3.17). The neutrinos form a wide-band, sign-selected neutrino or antineutrino beam, designed to provide flux in the energy range of 0.5 to 5 GeV. This energy range will cover the first and second neutrino-oscillation maxima, which for a 1,300-km baseline are at approximately 2.5 and 0.8 GeV, respectively.

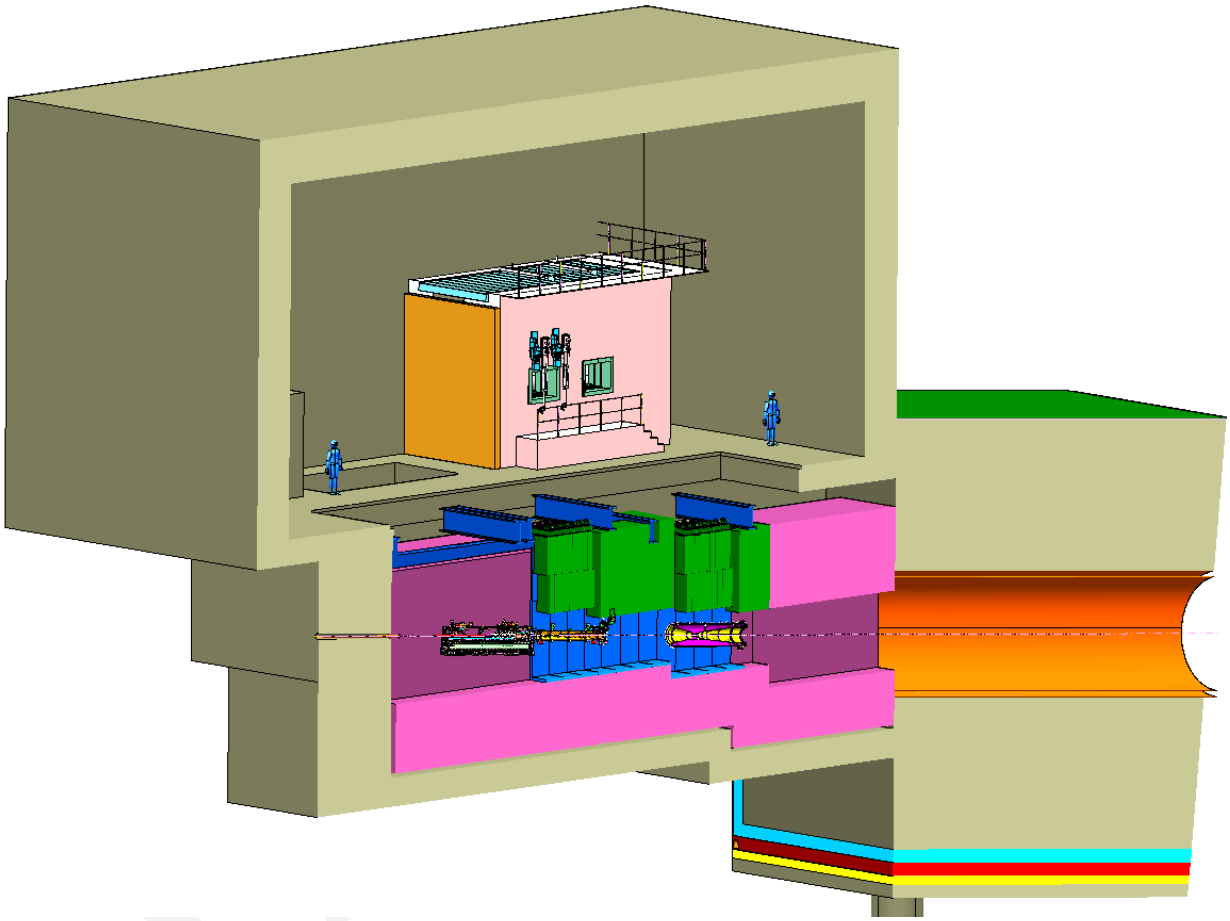

Figure 3.17: Schematic of the upstream portion of the LBNE neutrino beamline showing the major components of the neutrino beam. The target chase bulk steel shielding is shown in magenta. Inside the target chase from left to right (the direction of the beam) pointing downwards: the beam window, horn-protection baffle and target mounted on a carrier, the two toroidal focusing horns (the green custom shielding blocks are part of the horn support modules that are not shown) and the decay pipe (orange). Above the chase and to the right is the work cell for horn and target system repairs. The beige areas indicate concrete shielding.

The reference target design for LBNE is an upgraded version of the NuMI-LE (Low Energy) target that was used for eight years to deliver beam to the MINOS experiment. The target consists of 47 segments, each 2 cm long, of POCO graphite ZXF-5Q. Focusing of charged particles is achieved by two magnetic horns in series, the first of which partially surrounds the target. They are both NuMI/NOνA-design horns with double-paraboloid inner conductor profiles. The NuMI/NOνA-