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R&D of a high pressure gas TPC detector for reactor neutrino spectrum

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Recently, reactor neutrino experiments have found that the measured reactor antineutrino spectrum disagrees with the reactor flux model prediction. In the energy range of 4-6 MeV, an excess of 10% found in the measured spectrum suggests the prediction of the reactor antineutrino spectrum is incorrect. The reactor antineutrino spectrum and the origins of the disagreement with prediction becomes a hot topic in the neutrino and nuclear physics. We plan to construct a high-pressure gas TPC detector nearby a reactor to precisely measure the reactor antineutrino spectrum utilizing the features of high spatial resolution and high energy resolution. The antineutrino energy can be determined using the reaction of antineutrino-electron scattering with precise measurement of the electron scattering angle and the kinetic energy. The expected energy resolution of the reconstructed antineutrino energy is better than 3% at 1 MeV. The precise antineutrino energy spectrum provides model-independent inputs for other reactor neutrino experiments, such as JUNO which aims to determining the neutrino mass hierarchy. Additionally, the gas TPC experiment has other physics potentials, such as measurement of the neutrino magnetic moment, the weak mixing angle and the search for sterile neutrino.

The poster focuses on the R&D of a prototype detector with an effective volume of about 4.5 L for the high pressure gas TPC detector. This prototype detector will be used to verify the selection of target material and the detector design. And the detector is equipped with a gas circulation and purification system that can withstand a working pressure of 10 atm. The spatial resolution of the prototype detector reaches a level of 100 um with the 600 strips readout. At present, we have finished the detector assembly and preliminary measurement, such as drift velocity, attachment and so on. And the preliminary measurement results of the 600-channels readout will be also introduced.

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