Progress report and future plan of the PandaX experiment

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The PandaX (particle and astrophysical xenon) observatory uses xenon as target and detector to search for WIMP particles as well as neutrinoless double beta decay (NLDBD) in ^{136}Xe. At present, the PandaX-II experiment is completed and the PandaX-4T experiment is under installation. The future PandaX program will focus on the following two main directions:

1. Develop PandaX-4T into a multi-purpose liquid xenon experiment, to push further the dark matter search and other physics topics;
2. Develop and operate a 100-kg high pressure gas TPC (HpgTPC), PandaX-III, as a pathfinder for a tracking calorimeter to search for NLDBD in 136Xe.

Progress in several fronts are reported below:

PandaX-II: full exposure data analysis

During the PandaX-II end-of-run, multiple R&D studies were performed to better understand the detector performance and background contributions, and to develop new techniques for the next generation detectors. We made a direct measurement of radon daughters by injecting Rn222 into the detector, and observed a “depletion” effect for daughters along the chain [1].

The PandaX-II dark matter exposure reaches 131.7 ton-day. The full nuclear recoil (NR) data analysis result on the spin-independent dark matter nucleon scattering model was released in 2020 [2]. Searches based on electronic recoil (ER) events for solar axions and anomalous neutrino magnetic moment was performed [3] with full data set, where all the dominant background spectra were measured directly from calibrations. Although not as sensitive as XENON1T, PandaX-II puts independent and interesting constraints on

potential signals in the low energy electron recoil region.

PandaX-4T installation

The PandaX-4T experiment has a sensitive target of 4-ton liquid xenon, the expected sensitivity with 6 ton-year exposure is at the level of 10^{-47}cm^2 for the spin-independent WIMP-nucleon scattering cross section. The PandaX-4T detector is housed in a large ultrapure water pool in CJPL-II Hall B2. On-site assembly of PandaX-4T started late in 2019. Due to the pandemic and access control to Jinping site, the PandaX-4T schedule encountered some delay, but we still expect data taking to start by 2021.

PandaX-III project

To search for NLDBD, PandaX-III project is using 136Xe HpgTPC with the ability of identifying the event topology to discriminate signal from background. Details of the PandaX-III project can be found in the conceptual design report [5]. We have been working on design and construction of a 100-kg scale prototype TPC in the last couple of years. We have sourced low background stainless steel and have a pressure vessel with 4 m3 inner volume. The engineering design of low background front end electronics has been finished. We have also compared performance of different readout schemes, including Microbulk Micromegas fabricated by CERN, bulk Micromegas from CEA Saclay, and thermal bonding Micromegas from USTC. A final decision about the readout will be made by the end of this year and production will follow right afterwards. Onsite infrastructure is also been prepared at CJPL-II and we will start onsite detector assembly before the end of the year.

References

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