Contribution ID: **1229** Type: **Oral (Student, In Competition) / Orale (Étudiant(e), inscrit à la compétition)**

Ba-ion extraction and identification from high pressure Xenon gas for nEXO

Monday 13 June 2016 11:00 (15 minutes)

The Enriched Xenon Observatory (EXO) is searching for the lepton-number violating double beta decay ($0\nu\beta\beta$) in ^{136}Xe. If experimentally confirmed, $0\nu\beta\beta$ will require the neutrino to be its own anti-particle, i.e. Majorana particle, and shed light on the neutrino-mass hierarchy. The currently running EXO-200 experiment uses 200 kg of Xenon enriched to more than 80% in ^{136}Xe and obtained the limit of $T_{1/2}^{0\nu\beta\beta}$ 1.1×10^{25} years. In parallel, the development of nEXO has started which will deploy 5 tonnes of liquid xenon in a time-projection chamber and is expected to probe the inverted mass hierarchy of neutrino.

One of the design goals of nEXO is to unambiguously differentiate true double beta decay events from background contributions through Ba-tagging, i.e. by identifying the daughter isotope ^{136}Ba of the ^{136}Xe decay. With an efficient Ba-tagging technique, the backgrounds can be virtually eliminated which dramatically increases the sensitivity of the $0\nu\beta\beta$ search. The nEXO collaboration is developing various Ba-tagging techniques for liquid and gas phase xenon.

A setup is being developed for Ba-tagging in xenon gas. Its central component is an RF-funnel to extract Ba-ions from high pressure xenon gas (up to 10 bar) to a vacuum environment. The second stage, a linear Paul trap, cools the ions through buffer gas cooling and bunches them into a multi-reflection time-of-flight mass spectrometer to identify the Ba-ion by precision mass spectrometry. The RF-funnel has been built and tested to extract ions from xenon gas of up to 10 bar. The liner Paul trap is currently under development. The Ba-tagging setup will be presented and future works will be discussed.

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Session Classification: M1-4 Neutrinoless Double Beta Decay I (PPD-DNP-DTP) / Double désintégration beta sans neutrino I (PPD-DPN-DPT)

Track Classification: Particle Physics / Physique des particules (PPD)