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BINGO: Bi-Isotope 0nBB Next Generation Observatory

The observation of neutrinoless double beta decay ($2\beta0\nu$) would be a breakthrough in our understanding of particle physics. It could give an answer on the nature of neutrinos (Dirac or Majorana Particles), prove the violation of the lepton number, and explain the asymmetry matter/antimatter. This is why, since many years, physicists are thinking and building huge experiments with the goal to detect this theoretical process and prove one more time the limitation of the Standard Model of particle physics.
In case of the so-called mass mechanism, the half-life of the $2\beta0\nu$ is directly linked to the so-called Majorana effective mass m that depends strongly on the neutrino mass eigenstate hierarchy. So, putting a limit on the half-life is equivalent to explore a region of the possible values for m. Three challenging requirements are important for those experiments to enhance the sensitivity to the detection of this process: A large isotope mass, an excellent energy resolution and finally almost zero background events in the region of interest. Current generation experiments are using different detection methods combined with different isotopes each of them having their advantages/disadvantages. The best limits for the half-life of the order of 10^{26} years corresponding to m < 100 meV. Experiments like CUPID (using bolometers and ^{100}Mo as isotope) foresee to improve this sensitivity down to m < 10 meV allowing for the full exploration of the inverted hierarchy in the next decade. However, neutrino oscillation experiments suggest that the normal hierarchy is more likely, and It is in this context that the BINGO project takes its place: to develop and test new methods to improve further the sensitivity to the half-life of the bolometric experiments and be able to detect $2\beta0\nu$ even in this case.
The bolometric technique has already proved its excellent energy resolution, detection efficiency and reproducibility to large scales. But the main sensitivity limitation is due to the background level: knowing the extreme rarity of the searched process, all the radioactivity in the detector environment is a major problem and several techniques are used to get rid of it. For example, using a scintillator crystal as a principal bolometer coupled to another smaller Ge bolometer acting as a light detector allows for the rejection of alpha particles events by reading in coincidence the scintillation light and the heat signals.
The main goal of BINGO is then to reduce further the rate of background events by using innovative methods and technologies.
For the first time in bolometric experiments, a large cryogenic active veto surrounding closely the detector will be developed and studied. It will be composed of ZWO or BGO scintillating crystal bars where the light emitted will be read by bolometric light detectors at their extremities. The main expected improvement coming from this veto is the rejection of γ's from outside the detector structure (i.e from the remaining natural radioactivity of the surrounding) leading to important background events rejection in the region of interest.
The second main innovation will be the development of new bolometric light detectors sensitive to only a few photons per event. At this purpose, the Neganov-Luke effect will be used: electrodes are added to the surface of a regular bolometric Ge light detector in order to establish an electrical field in the absorber. The charges created by an event will then be drifted to the electrodes, leading to an amplification of the signal. The performances of such a detector are then much better than the ones of those currently used. It will allow to reach a low threshold, really interesting when coupled to the veto to maximize its efficiency. Moreover, it allows detecting the Cherenkov light in the case of a poor scintillating crystal making, like TeO_2, which is one of the most promising compounds for $2\beta0\nu$ search thanks to the high natural abundance of ^{130}Te.
In this talk (and poster), I will present the first results obtained in the BINGO project on the veto and light detectors.

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