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Status and Perspectives of the COBRA-Experiment

The determination of two important properties of the neutrino is still pending: its rest mass and its nature - Dirac or Majorana particle. The observation of neutrinoless double beta decay would clarify both, but the expected half-life of more than 10^25 years for this decay is an ambitious challenge.

Recently, first experiments have been commissioned that will be able to probe this magnitude of half-lifes. If they succeed, it will be important to verify the results using different isotopes. If they do not succeed, new experimental approaches are required.

The COBRA experiment is an excellent candidate for both: it uses CdZnTe room-temperature semiconductor detectors that contain several double beta decay candidate isotopes, among them also \beta^+ emitters and two of the most promising isotopes, Te-130 and Cd-116. Cd-116 has a decay energy well above the most energetic naturally occurring gamma lines reducing its background drastically compared to e.g. Ge-76. In addition, CdZnTe can be used as a solid-state TPC combining the large advantages of a source-equals-detector approach with the possibility of decay identification via particle track reconstruction.

The COBRA collaboration comprises 12 institutes from 8 countries and currently operates detectors with two readout techniques: The commercially available Co-Planar Grid (CPG) technology was developed specifically for CdZnTe, allows the operation of fairly large crystal sizes on the order of some ccm with only one readout channel and reaches energy resolutions better than 2% FWHM @ 662 keV. COBRA operated several R&D-arrays of CPG-type detectors in ultra-low background mode at the Italian underground laboratory LNGS. Half-life limits above 10^20 years for several isotopes and decay modes have been determined with these setups. New readout electronics optimized for low-rate spectroscopy and allowing background reduction by pulse-shape analysis was developed and first results will be shown.

Using semiconductor pixel detectors is unique for a double-beta decay experiment. Three different pixelated CdZnTe/CdTe detector types have been operated in an ultra-low background environment. Results will be shown demonstrating clearly the power of background suppression with this detector type by enabling ficudial cuts, vertexing and coincidence techniques. Finally, concepts for a large-scale setup will be shown.

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