DARWIN: a next generation multi-tonne xenon observatory

Patricia Sanchez-Lucas on behalf of the DARWIN collaboration

— University of Zurich —

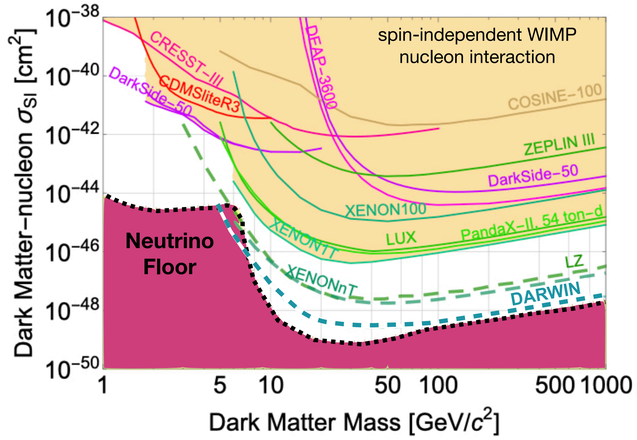
INTRODUCTION

Many unknowns in physics call for the use of multi-tonne scale xenon detectors. In this context, DARWIN, with its 40t active target (50t total), will be able to explore the parameter space for dark matter particles in a wide mass range down to the to date irreducible neutrino floor. Furthermore, with its low energy threshold and low background level, DARWIN will be also a powerful tool to probe neutrino physics and look for other rare interactions.

DARWIN will increase 100-fold the current sensitivity on WIMP searches

- Cross section sensitivity ~10^{-49} cm^2 (for an exposure of 200 t×y).
- Assuming 99.98% electron recoil rejection.

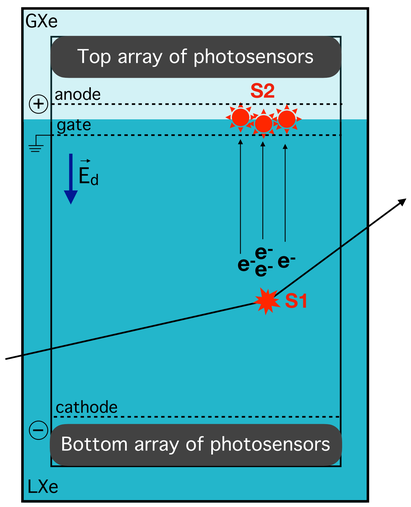
DARWIN, JCAP 1611 (2016) 017

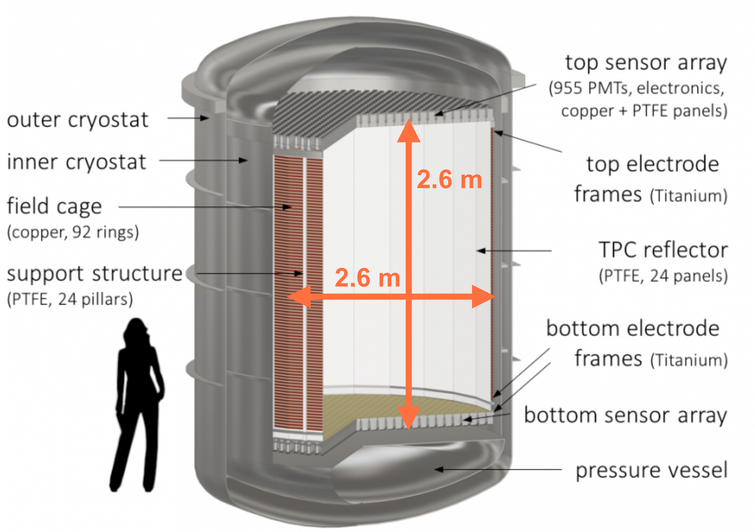


DARWIN TPC BASELINE DESIGN

Working principle of a two-phase TPC: The prompt scintillation light (S1) and the delayed proportional scintillation light signal from the charge (S2) are measured.

- Dimensions of the TPC: 2.6 m diameter x 2.6 m height.
- Two arrays of PMTs (other photosensors under consideration).
- Low-background double-wall Ti cryostat.
- Outer shield with Gd doped water (veto μ & n).



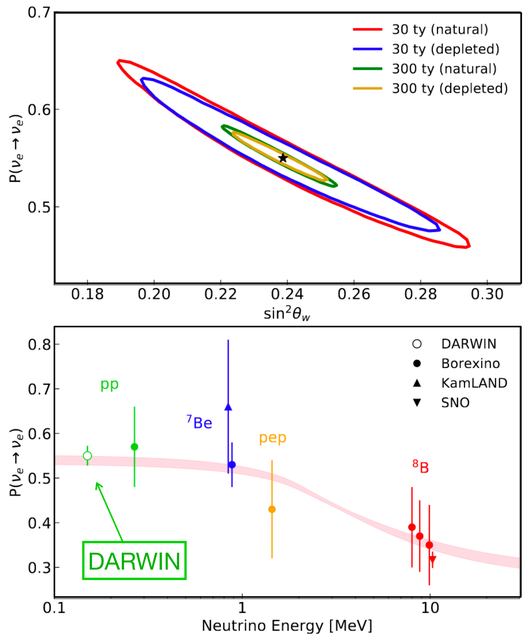


TWO NEUTRINO CHANNELS

Solar neutrinos

DARWIN, EPJ. C 80, 1133 (2020)

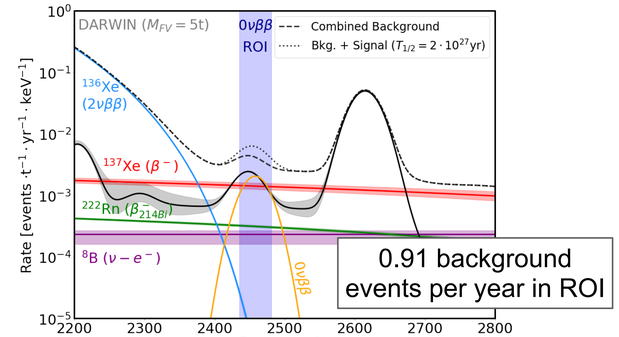
- Detection through elastic scattering:
  $\nu_x + e \longrightarrow \nu_x + e$
- With a 30t FV, DARWIN will observe 365 *pp*-neutrinos/(t×y) above 1 keV
- **P_{ee} and $\sin^2\theta_w$ for the fist time below 200 keV**

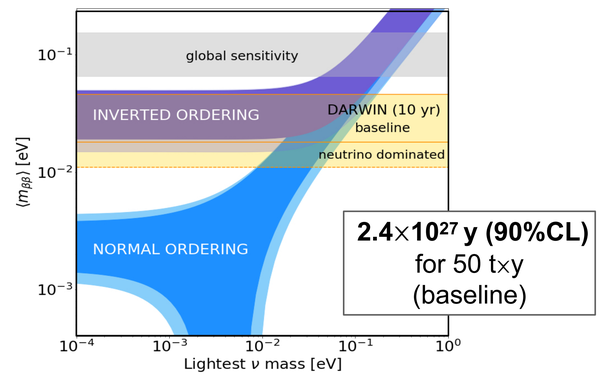


Neutrinoless double-beta decay

DARWIN, EPJ. C 80, 808 (2020)

- ^{136}Xe: 8.9% in natural xenon. *Q*-value = 2.458 MeV (0.8% resolution)
- **Sensitivity comparable to future dedicated experiments**





ONGOING DARWIN R&D

DARWIN full-length demonstrator (Xenoscope)

Electron drift over 2.6 m for the first time

- Purification & homogeneous drift field

DARWIN full-(x,y) scale demonstrator (Pancake)

Test components of 2.6 m diameter

- Electrodes & homogeneous extraction field

Testing novel photosensors as an alternative for PMTs