

DARWIN: a next-generation liquid xenon observatory for dark matter and neutrino physics

DARWIN



Universität
Zürich ^{UZH}

F. Girard, on behalf of the DARWIN Collaboration

DARWIN

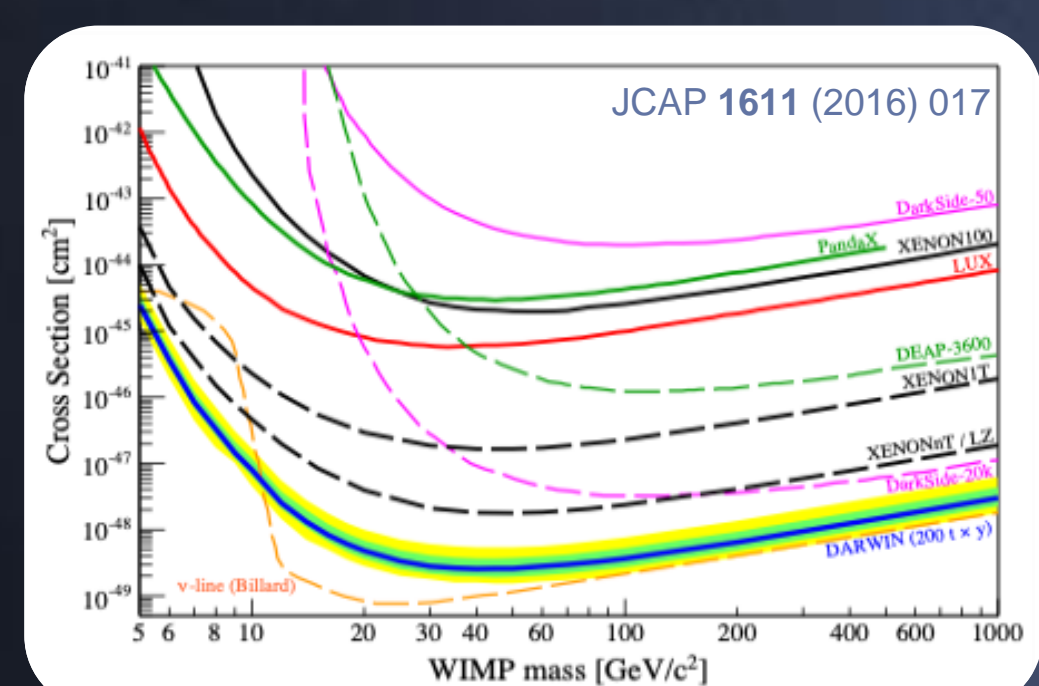
DARWIN is a next-generation astroparticle observatory, based on a 2.6 m height by 2.6 m diameter dual-phase time projection chamber. With 50 ton of liquid xenon (40 ton active), it will probe the WIMP phase space, down to the irreducible neutrino background. But DARWIN is much more than just a dark matter detector.

WIMPs Dark matter

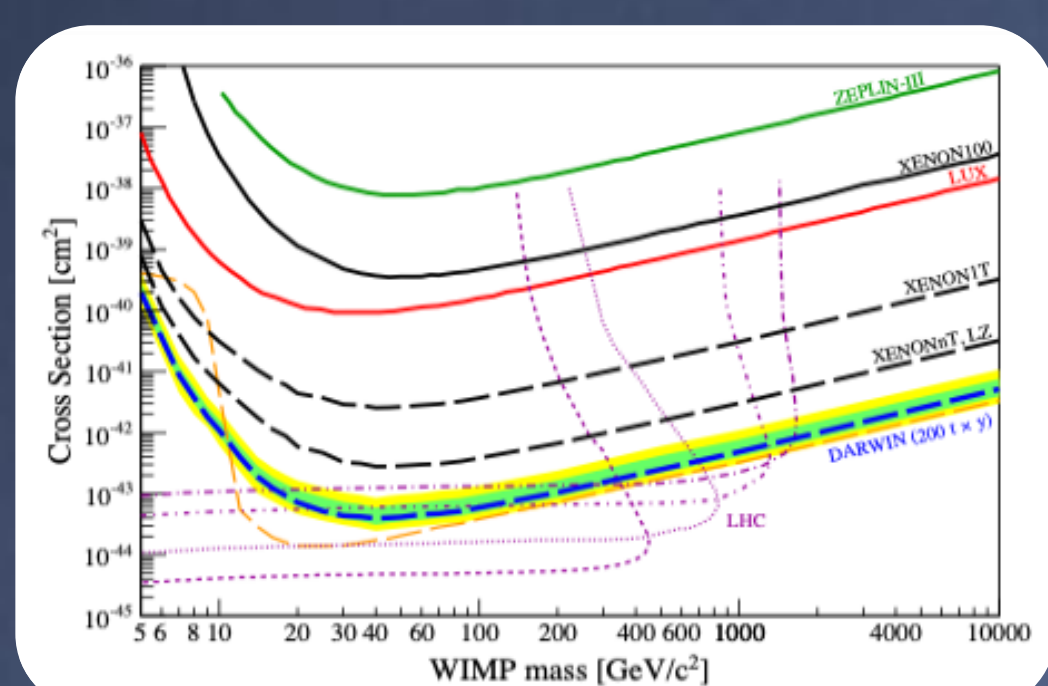
- Exposure: 200 ($t \times y$)
- 99.98% ER rejection (30% NR acceptance)
- Combined (S1+S2) energy scale
- Energy window 5-35 keV_{NR}
- Light yield: 8 PE/keV
- Also search for: ALPs, solar axions, dark photons

Neutrinoless double beta decay

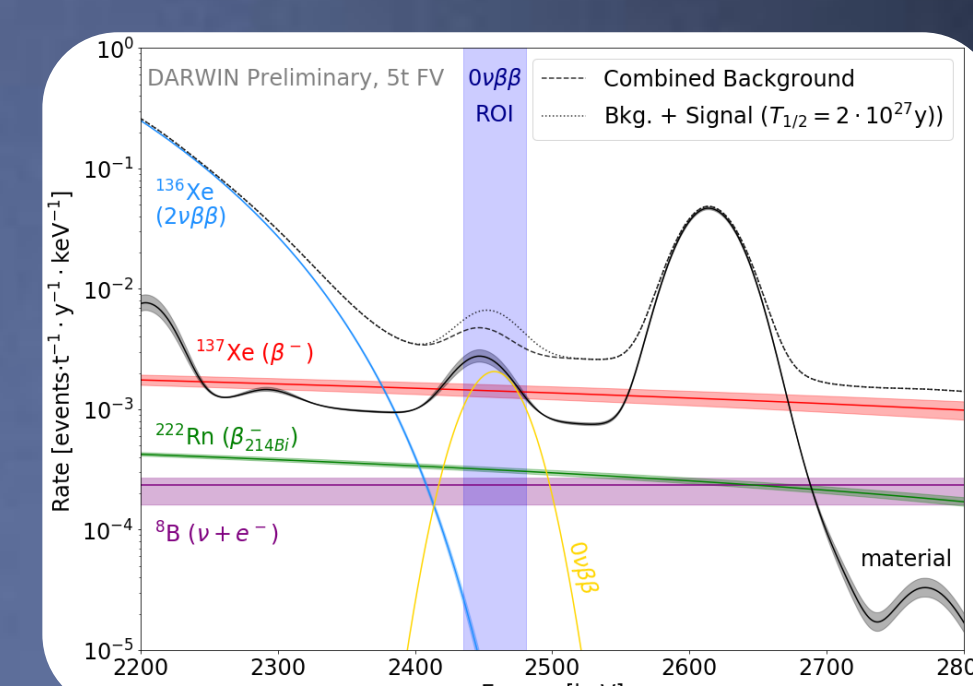
- ¹³⁶Xe abundance of 8.9% in natural Xe.
→ 3.5 t of active ¹³⁶Xe
- Q-value = 2.458 MeV
- Dominating intrinsic backgrounds: ²²²Rn, ¹³⁷Xe, 2νββ decays of ¹³⁶Xe and solar ⁸B neutrinos.



Spin Independent

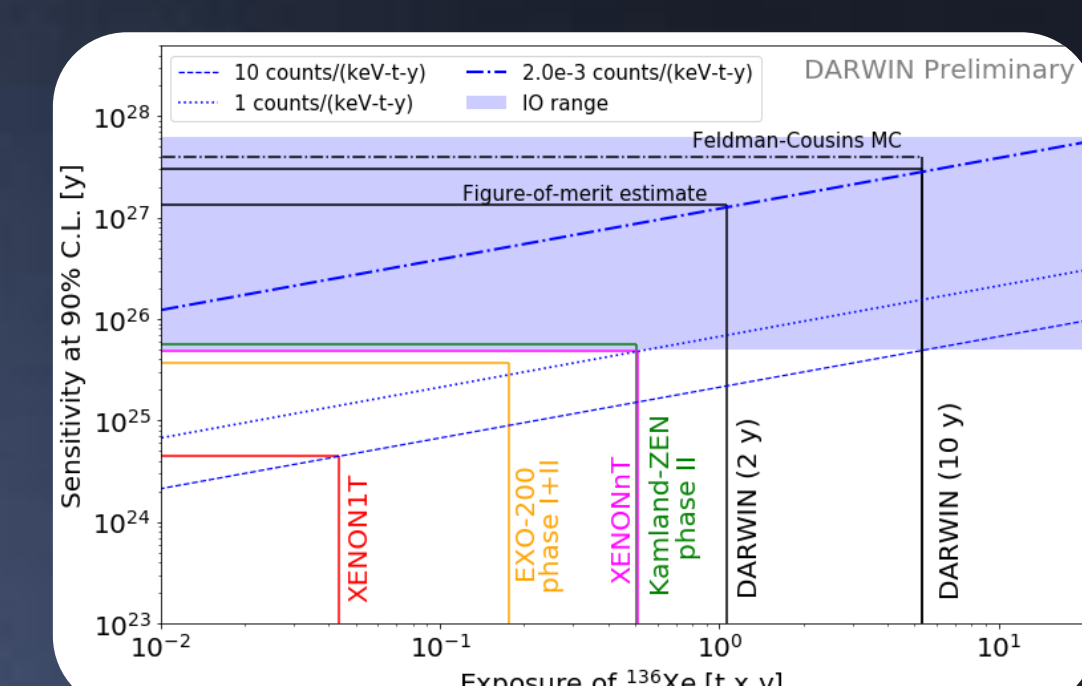


Spin Dependent

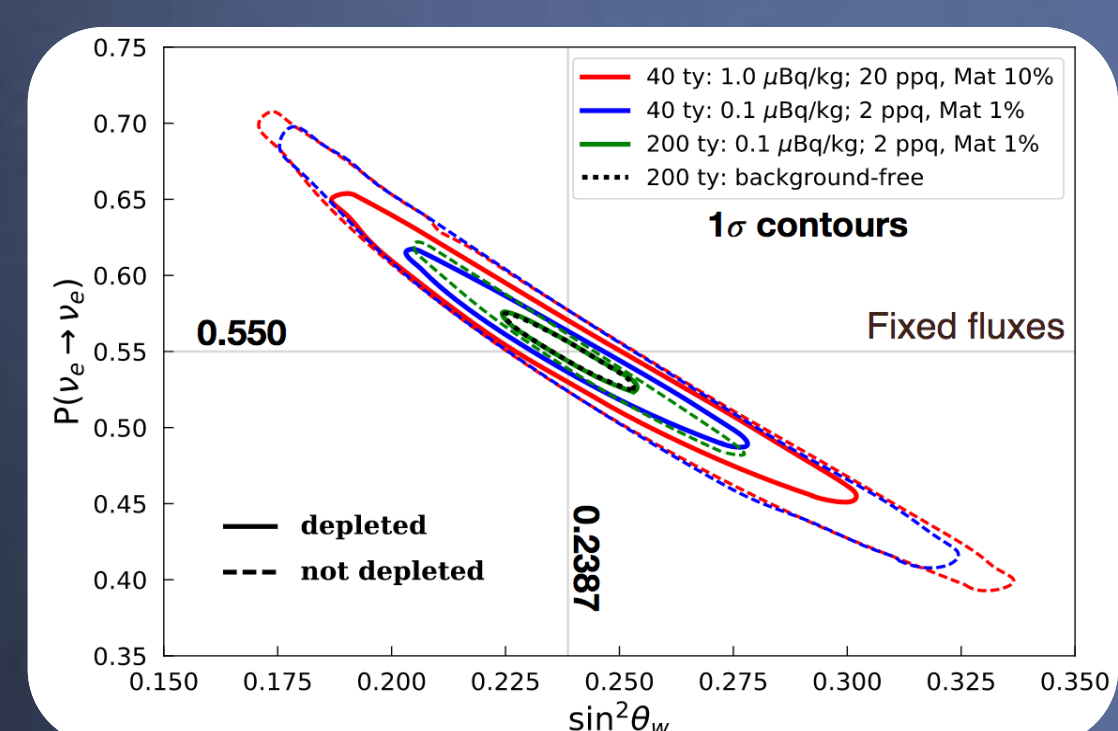
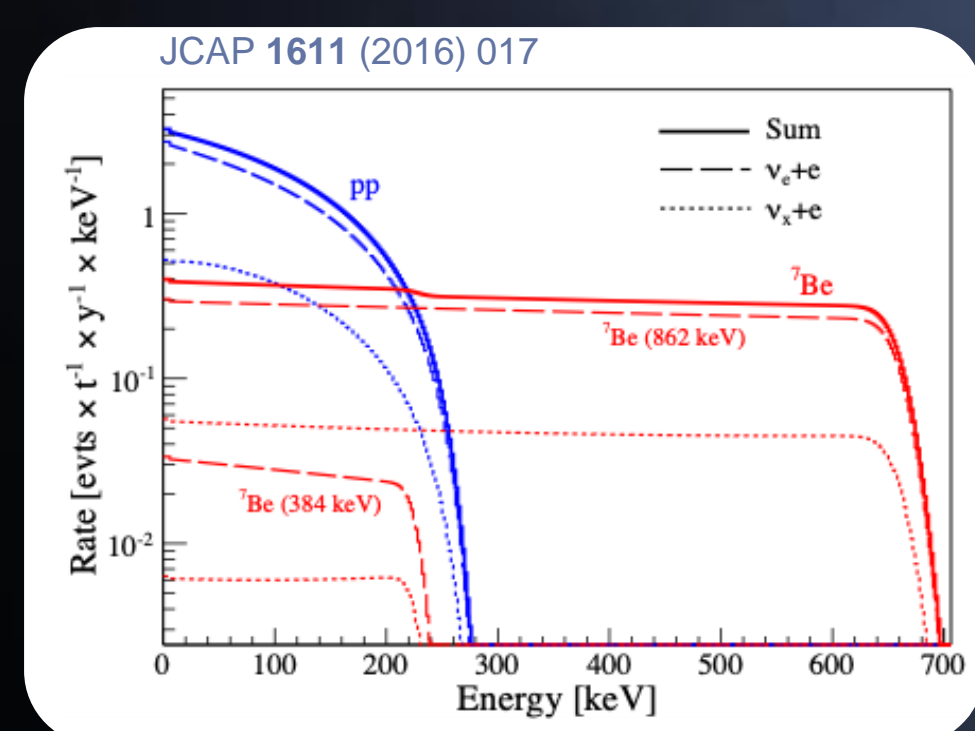


Preliminary sensitivity at 90% C.L.

12 txy → T_{1/2} > 1.3 × 10²⁷ yr
60 txy → T_{1/2} > 3.0 × 10²⁷ yr



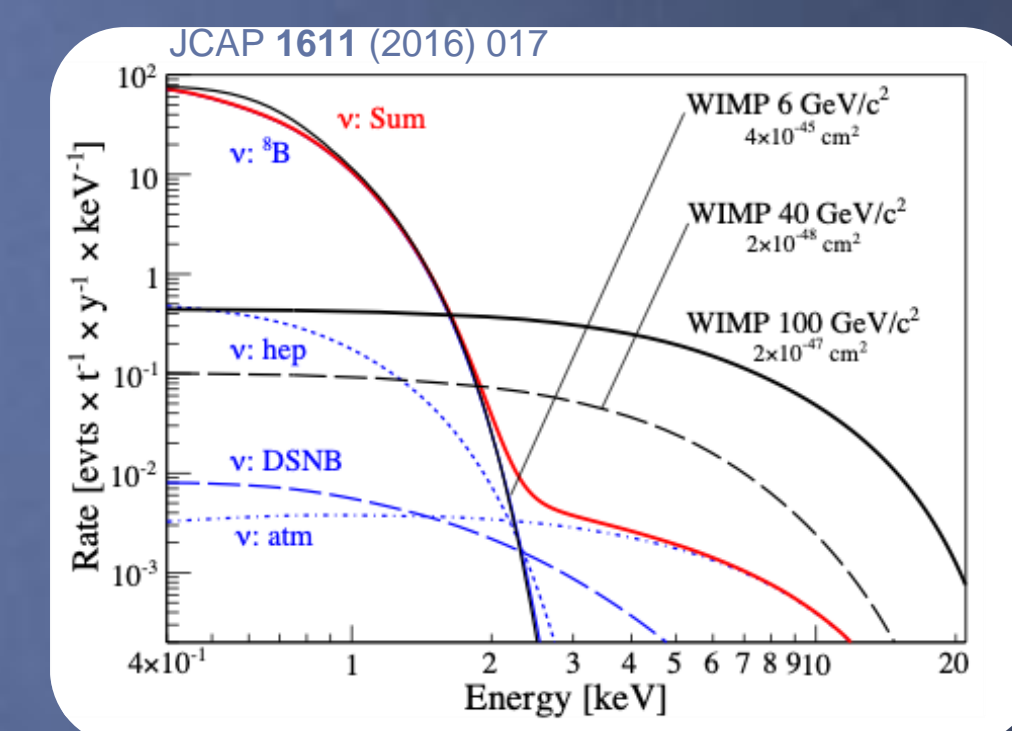
Solar neutrinos



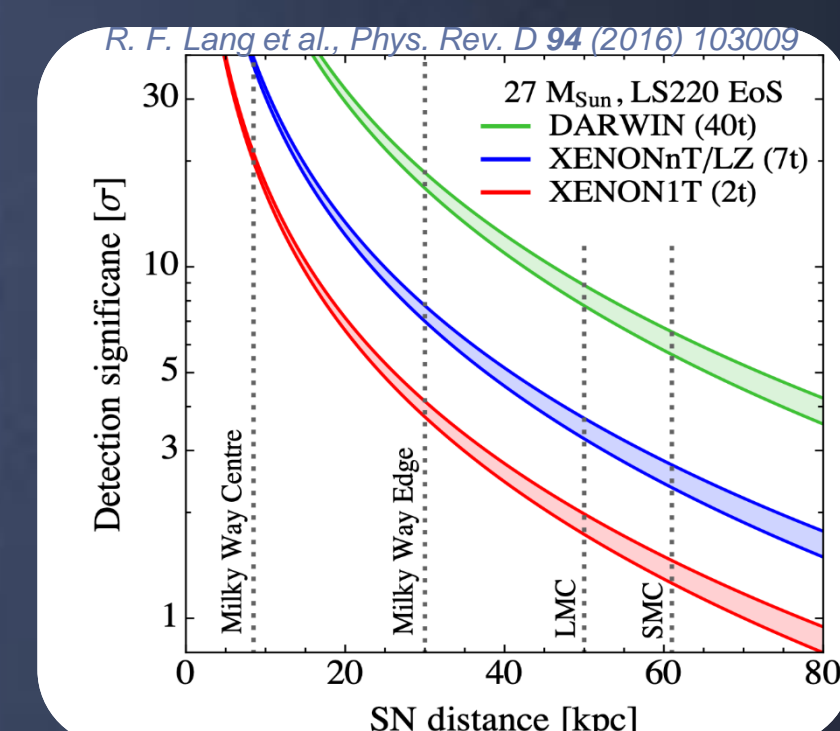
Credit: S. Reichard

- Measure pp-neutrinos to test main energy production models of the Sun
- ν_x + e → ν_x + e
- 361 events/(t × y)
- Also measurements of:
 - P(ν_e → ν_e)
 - θ_w

CEνNS



⁸B solar neutrinos



Supernova neutrinos

- Irreducible background → Physics Channel
 - ν + A → ν + A, all flavors
 - Solar ν_B: E_{th} > 1 keV_{nr}
→ 90 events/(t × y)
 - SN burst detection up to 65 kpc from Earth (5σ)
 - 700 events from a 27 M_⊙ SN at 10 kpc

Current R&D

DARWIN full-height demonstrator



Demonstration of electron drift over the full height of DARWIN

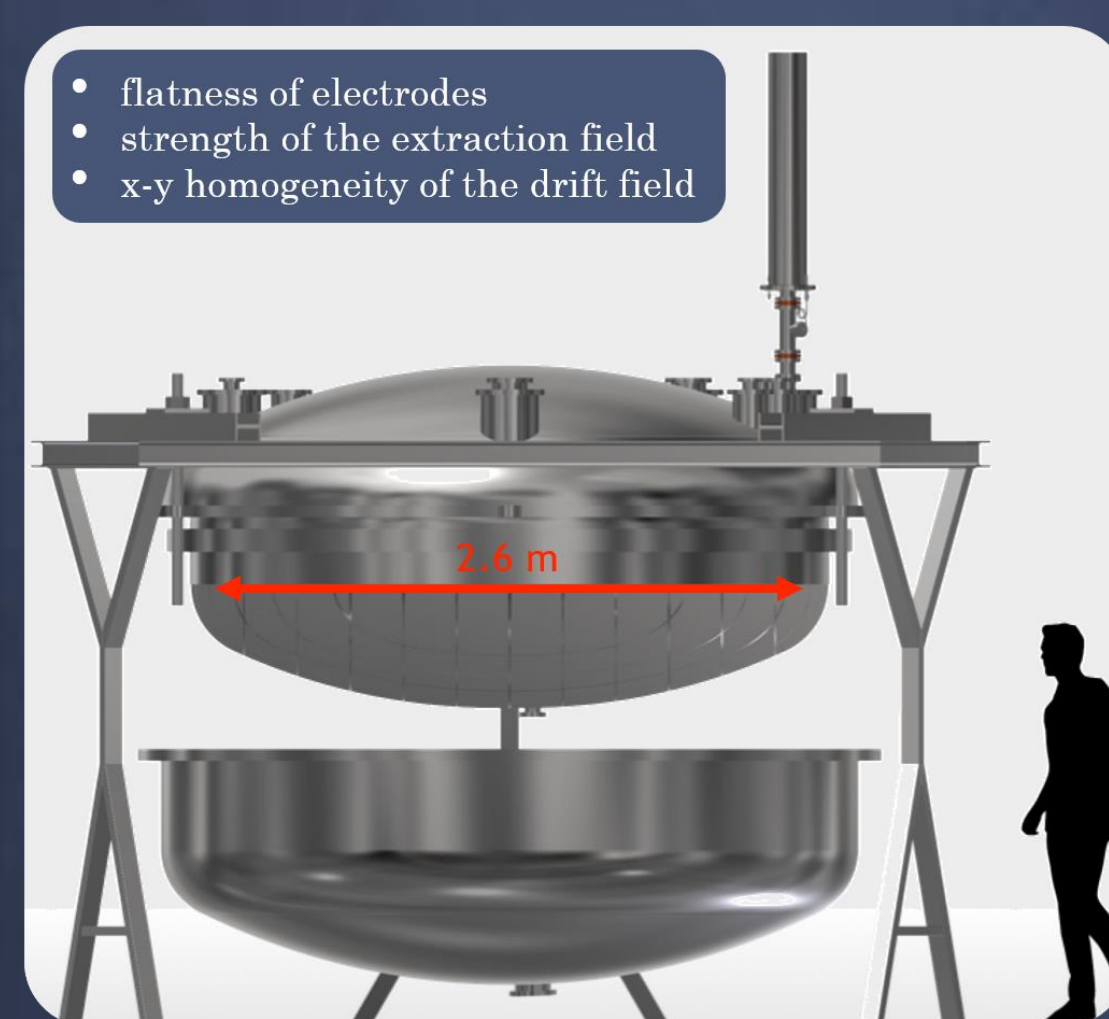


- 2.6 m height
- 20 cm diameter
- ~300kg LXe

DARWIN full-(x,y) scale demonstrator



Test components at real diameter under real conditions



- flatness of electrodes
- strength of the extraction field
- x-y homogeneity of the drift field

credit: Florian Tonnies

Photosensors R&D

Several groups are testing novel photosensors as replacements for PMTs, such as SiPMs, LHM and the ABALONE technology.

The Collaboration



The DARWIN Collaboration, Zürich, 12.2018

- 29 research groups
- 12 countries
- Working towards a CDR and a TDR
- DARWIN is part of the APPEC roadmap

