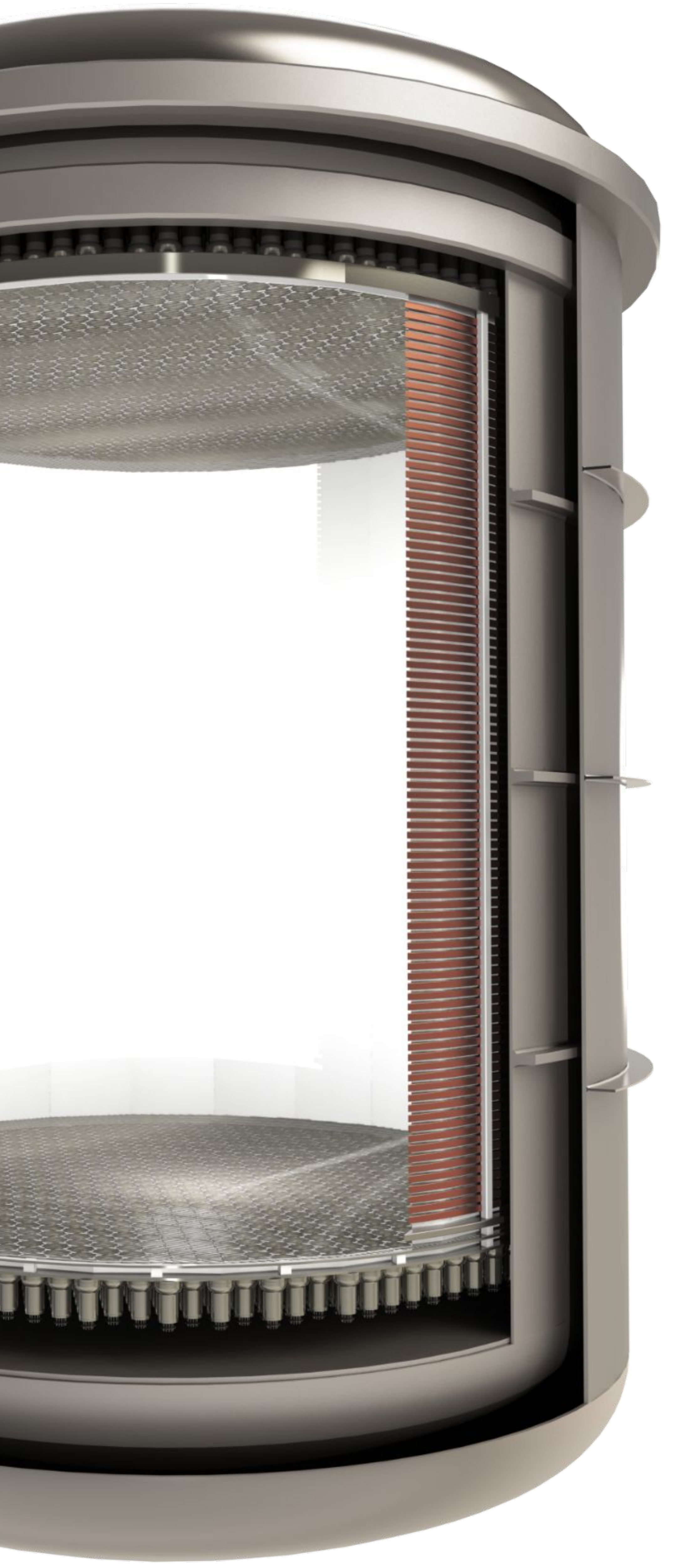
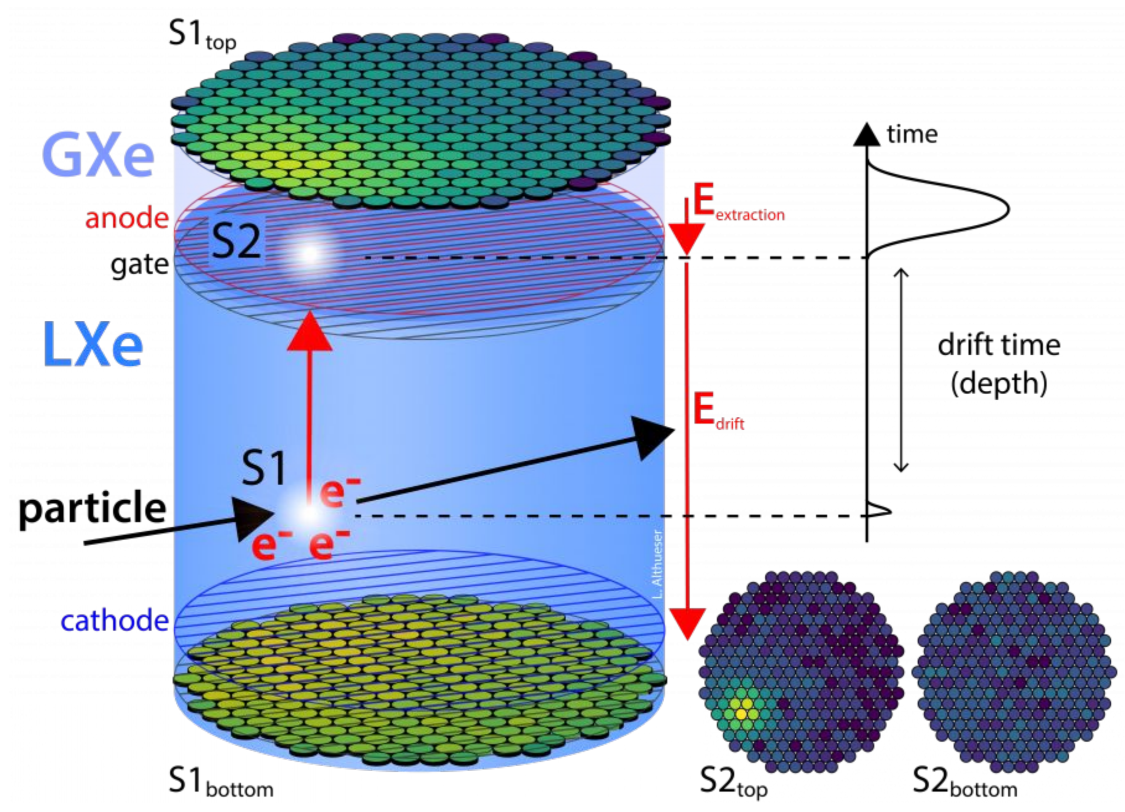
Neutrino physics with the DARWIN observatory

Diego Ramírez García and Ricardo Peres (University of Zurich),
on behalf of the DARWIN collaboration

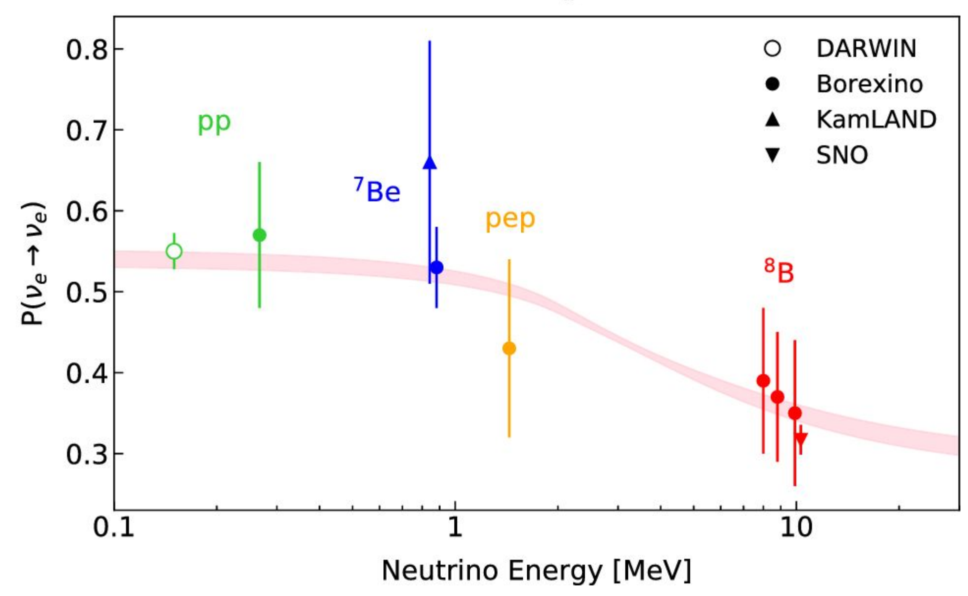


- Dual-phase xenon time projection chamber
  - Energy reconstruction
  - 3D position reconstruction
  - Discrimination between interaction types
- Next generation dark matter detector, with a 2.6 ∅ x 2.6 height active volume (~40 tonnes)
- Designed to reach spin-independent sensitivity to weakly-interacting massive particle (WIMP) dark matter down to the neutrino fog [1]

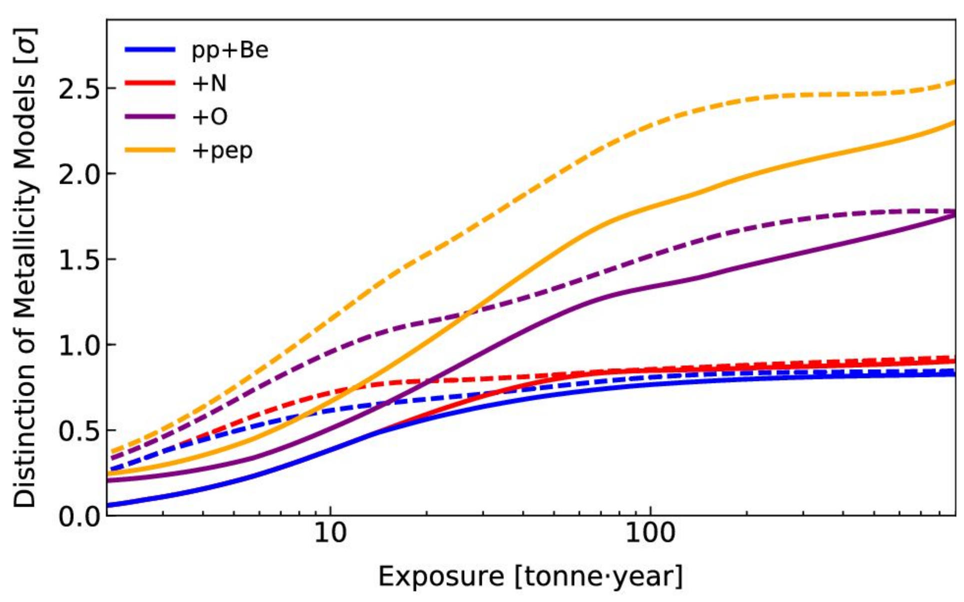


Solar neutrino detection via electronic recoils [2]

- Neutrino scattering off electrons in the xenon atomic cloud
- Multi-flux measurement: *pp*, ^{7}Be, ^{13}N, ^{15}O, *pep*
- Constrain the weak mixing angle from pp neutrinos
- Distinguish between high and low metallicity solar models

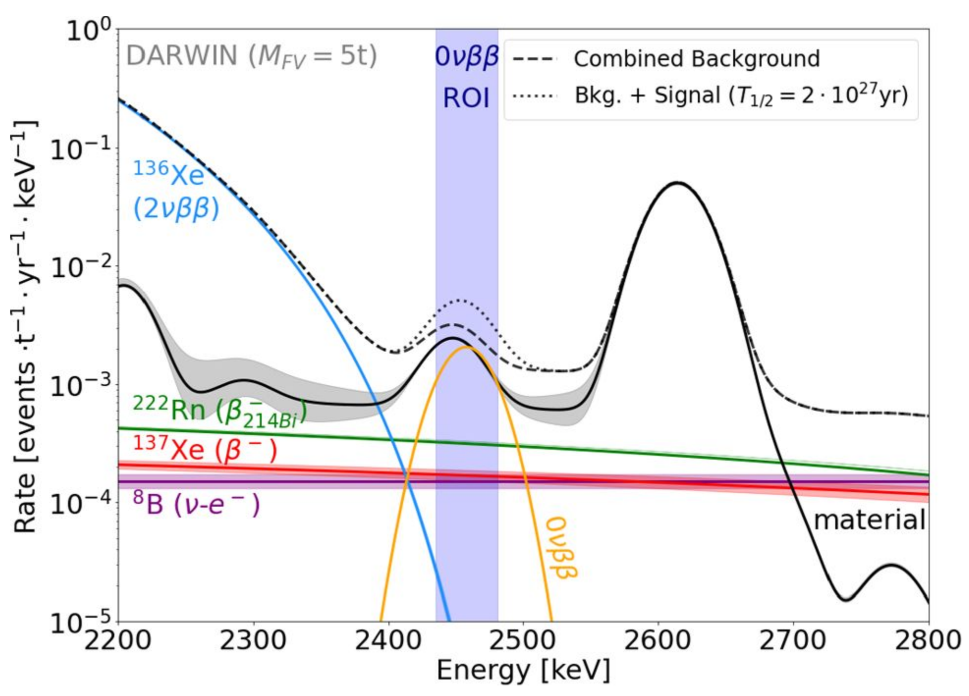


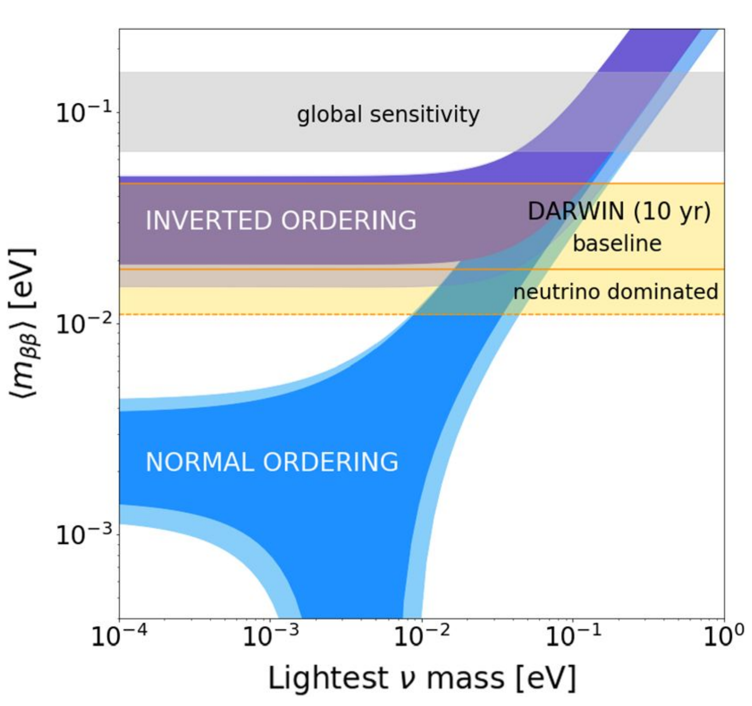
dashed – depleted of ^{136}Xe by two orders of magnitude
solid – ^{nat}Xe



Neutrinoless double-beta decay of ^{136}Xe [3, 4]

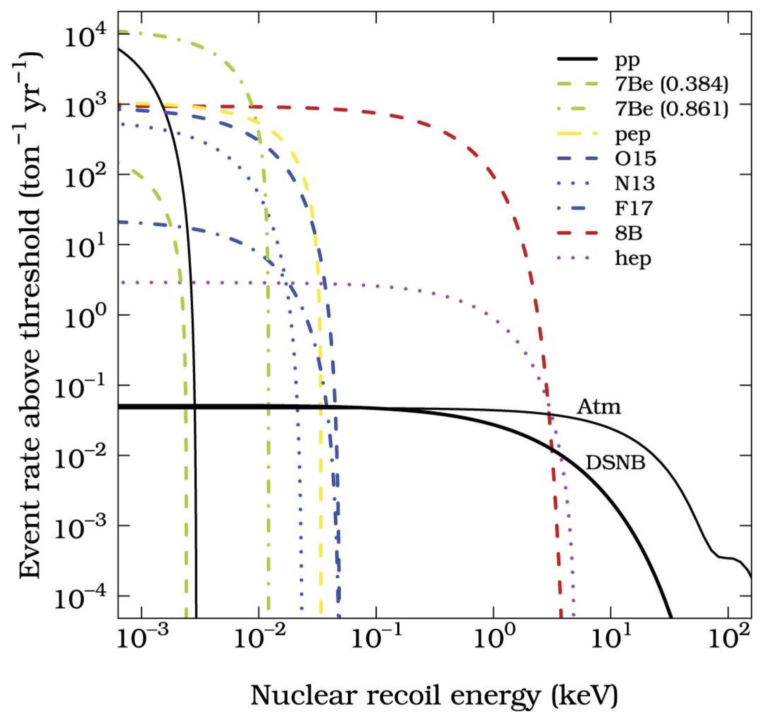
- ^{136}Xe abundance of 8.9 % in ^{nat}Xe
- *Q*-value of $Q_{\beta\beta}$ = 2457.8 keV
- Expected energy resolution at $Q_{\beta\beta}$ of about 0.8 %
- Main backgrounds in ROI from detector materials, ^{222}Rn, (cosmogenically activated) ^{137}Xe, and ^{8}B solar neutrinos
- $T^{0\nu}_{1/2}$ > 3.0 x 10^{27} yr (90 % CL) for a 50 tonne-year exposure (^{nat}Xe)

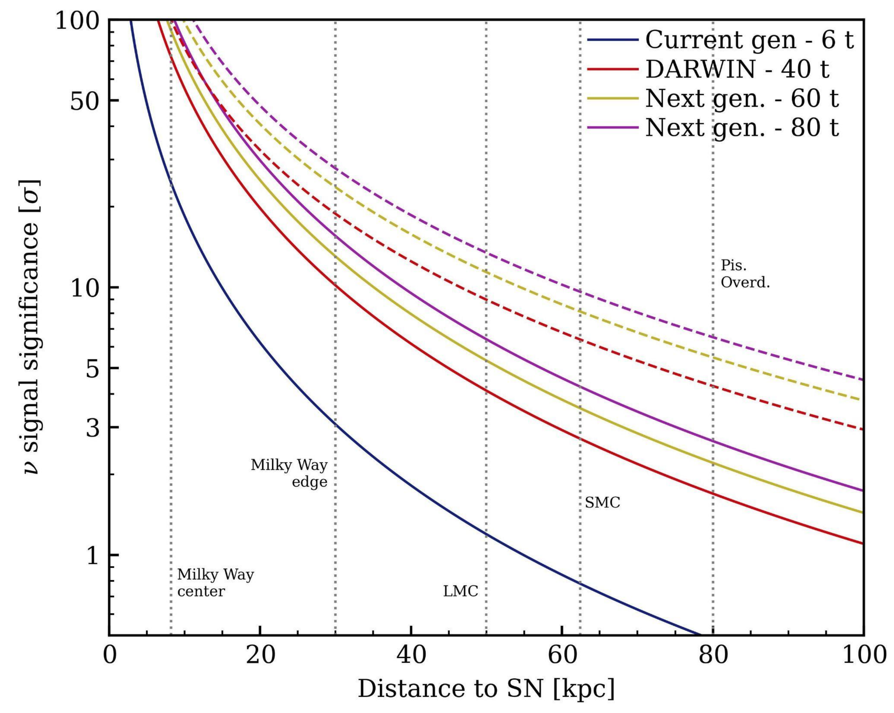




Coherent elastic neutrino-nucleus scattering [5, 6]

- Flavor independent detection
- Measurement of the ^{8}B solar neutrino flux and spectral shape
- Potential first measurement of atmospheric neutrinos in a liquid xenon time projection chamber
- High-significance detection of supernova burst up to ~100 kpc





[1] J. Aalbers et al. (DARWIN collaboration), JCAP 11, 017 (2016)
[2] J. Aalbers et al. (DARWIN collaboration), Eur. Phys. J. C 80, 1133 (2020)
[3] F. Agostini et al. (DARWIN collaboration), Eur. Phys. J. C 80, 808 (2020)
[4] F. Agostini et al. (DARWIN collaboration), Eur. Phys. J. C 83, 996 (2023)
[5] J. Aalbers et al. (DARWIN collaboration), J. Phys. G 50, 013001 (2023)
[6] R. Lang et al., Phys. Rev. D 94 (10), 103009 (2016)

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