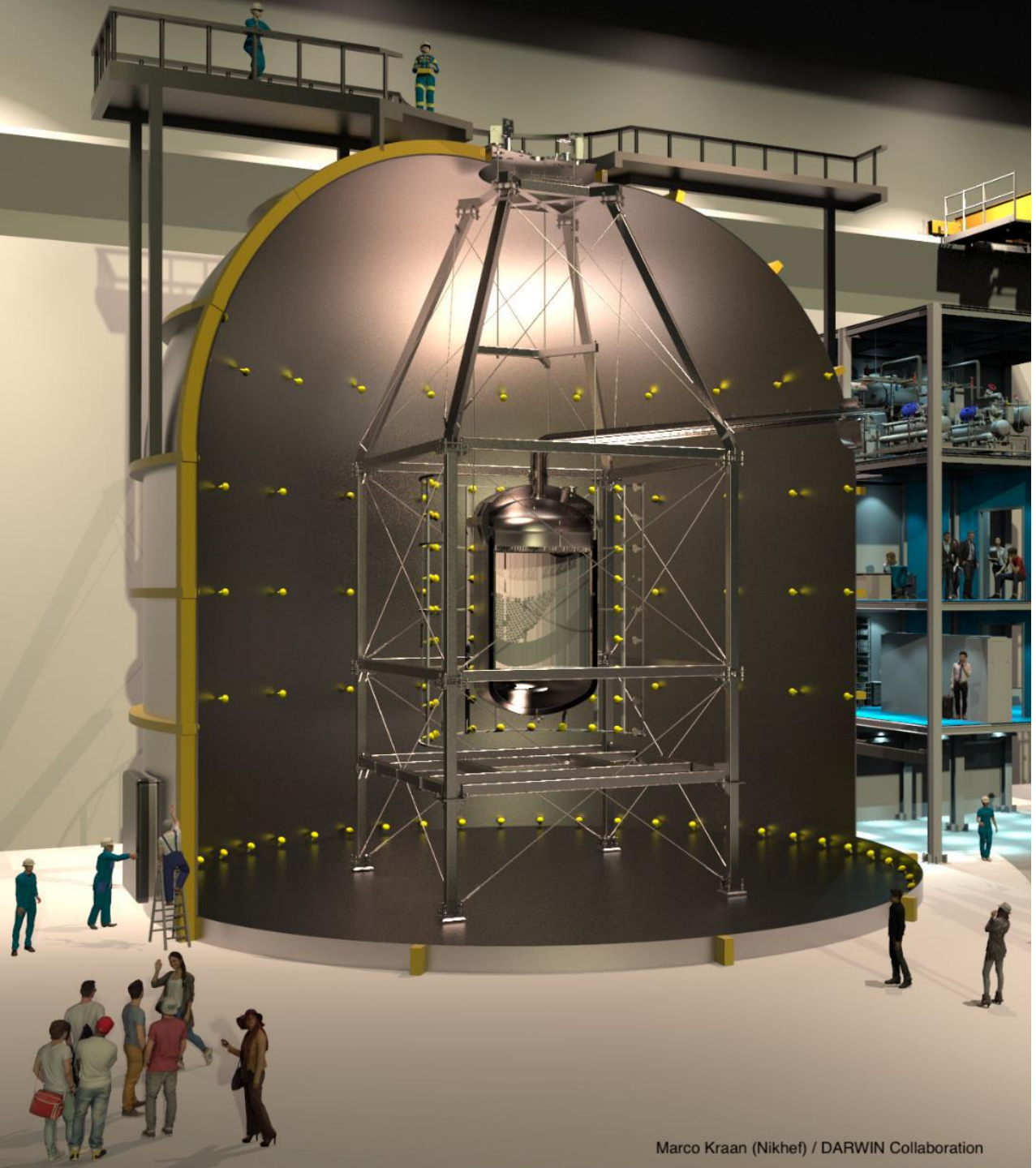


Patras | 12th August 2022

DARWIN

Adam Brown
University of Freiburg
on behalf of DARWIN

adam.brown@physik.uni-freiburg.de

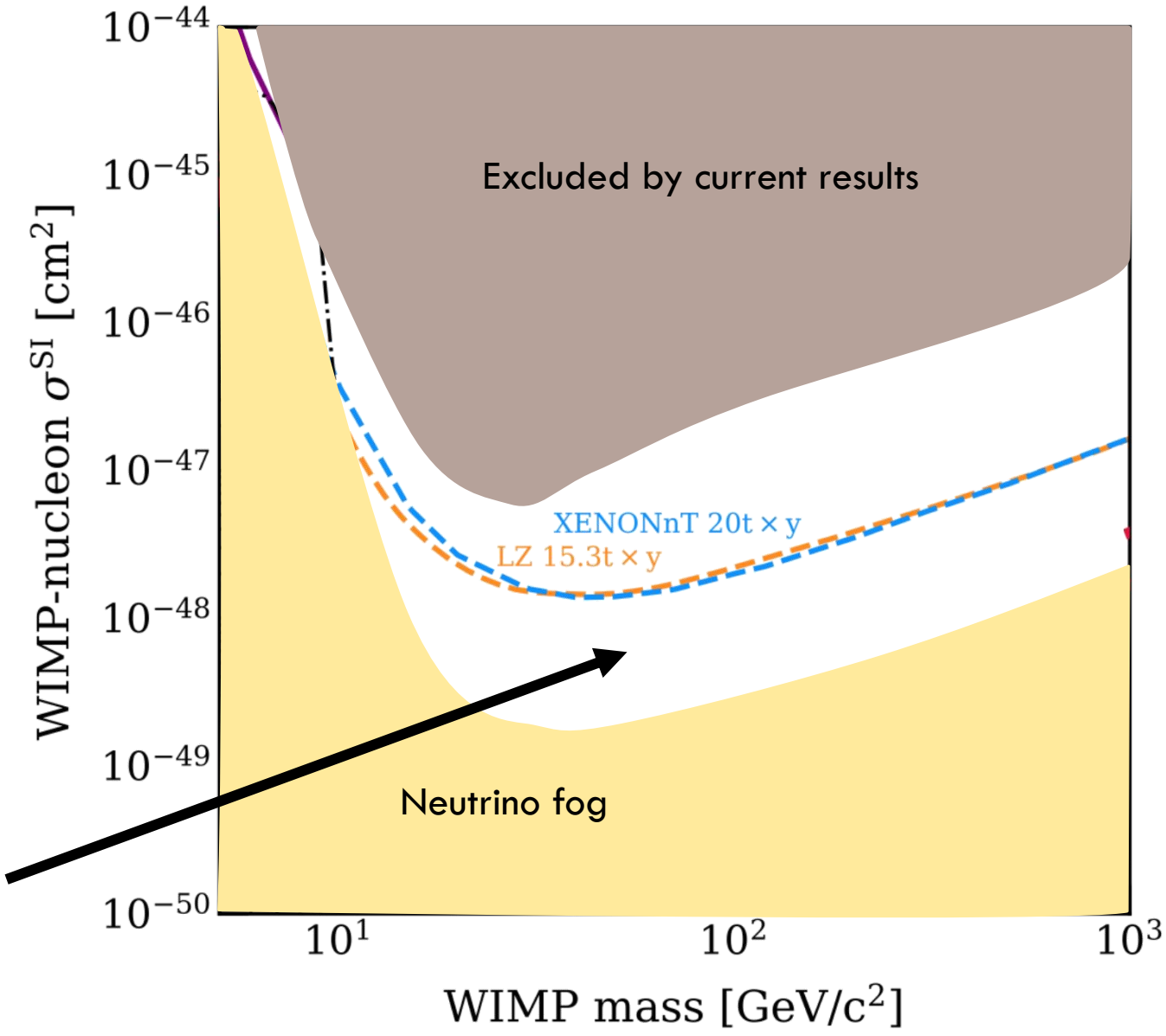
European Research Council

UNI FREIBURG

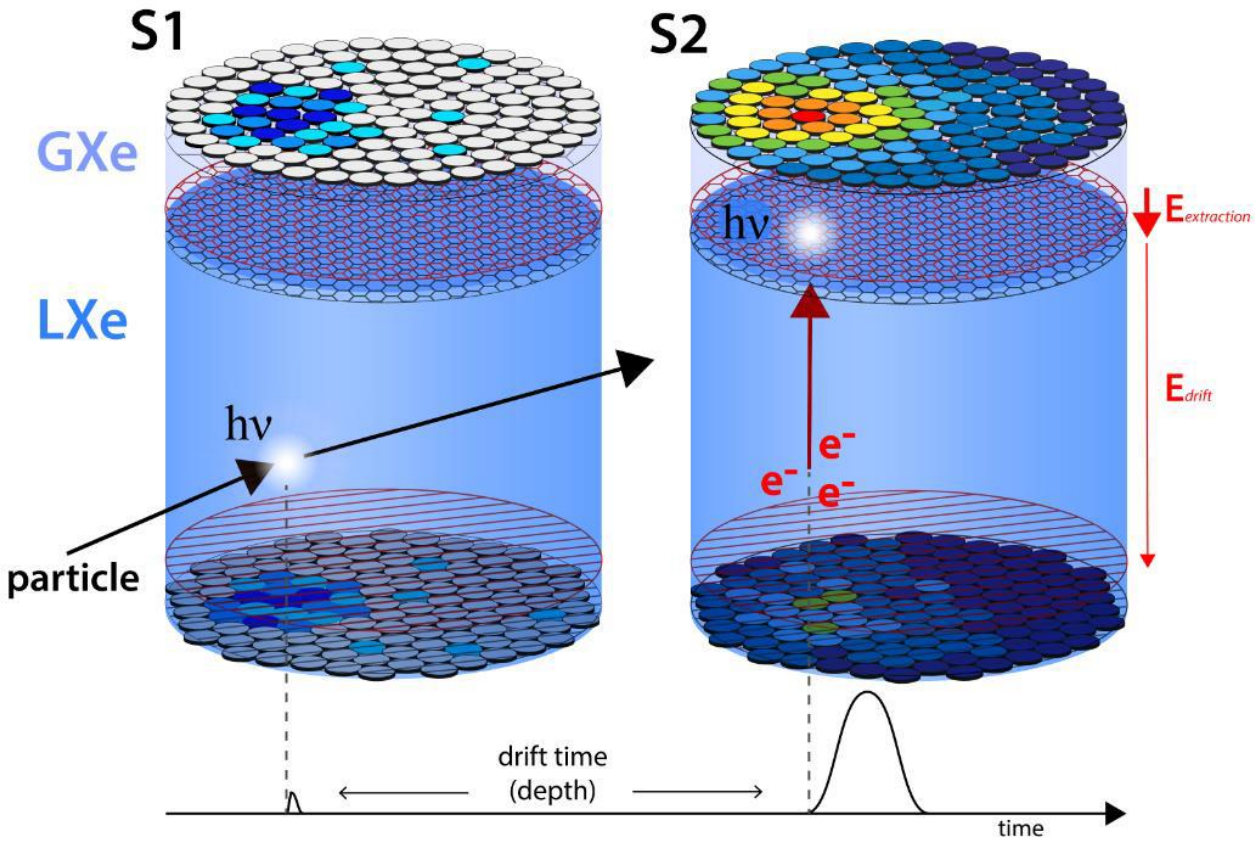
Current xenon experiments (XENONnT, LZ) expect ~ order of magnitude stronger limits than existing

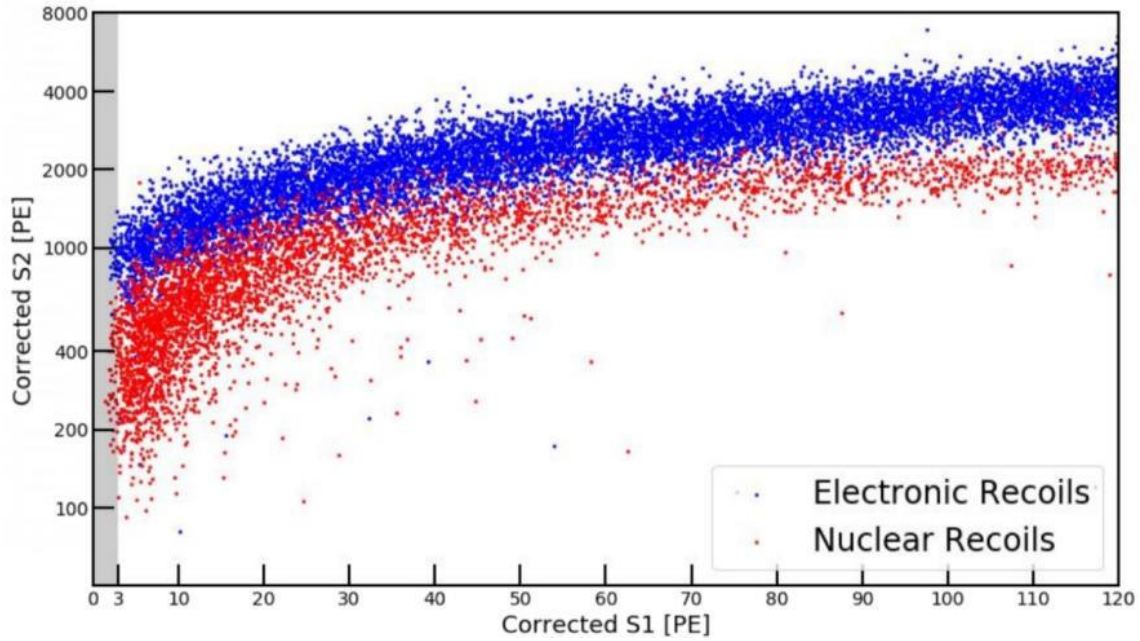
Significant gap until neutrino fog where sensitivity becomes difficult

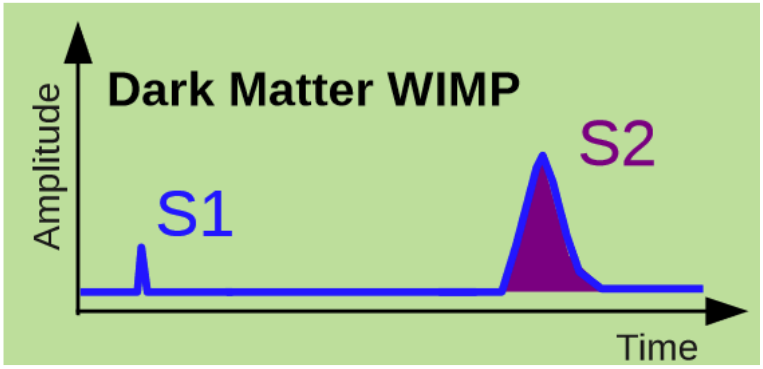
DARWIN will probe this region

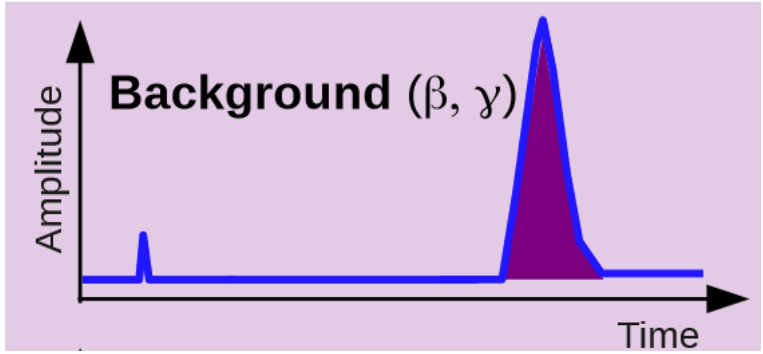


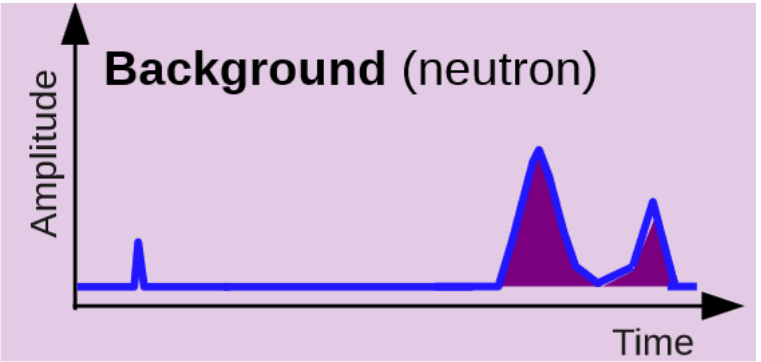
DUAL-PHASE LIQUID XENON TPC



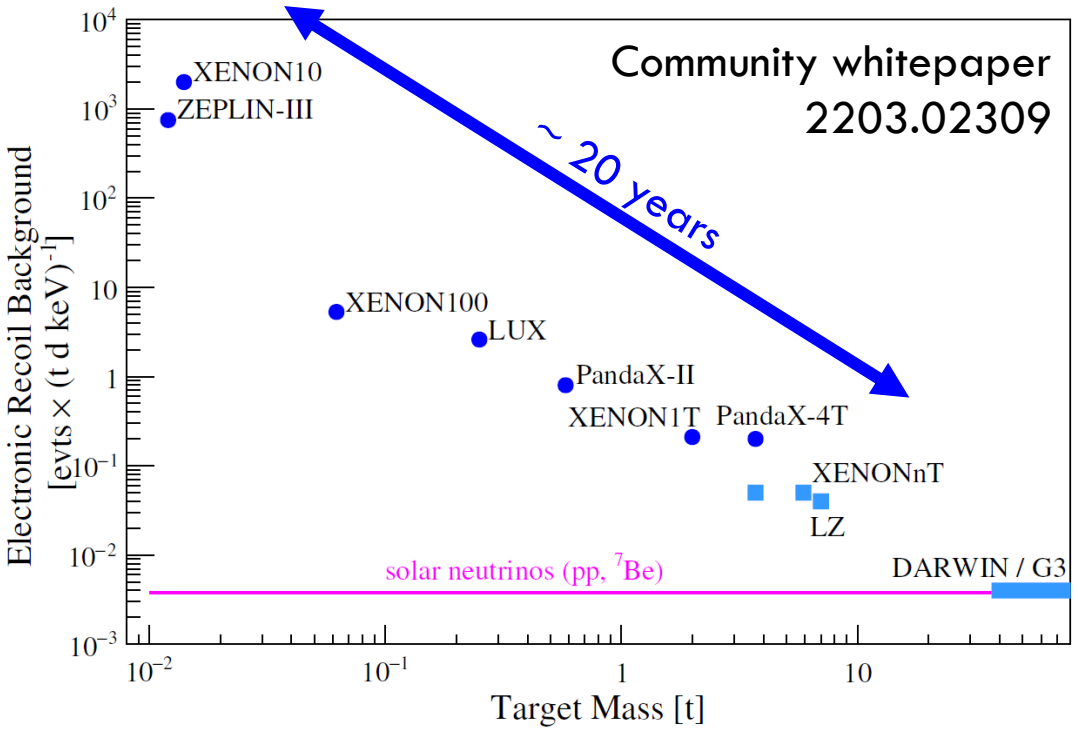




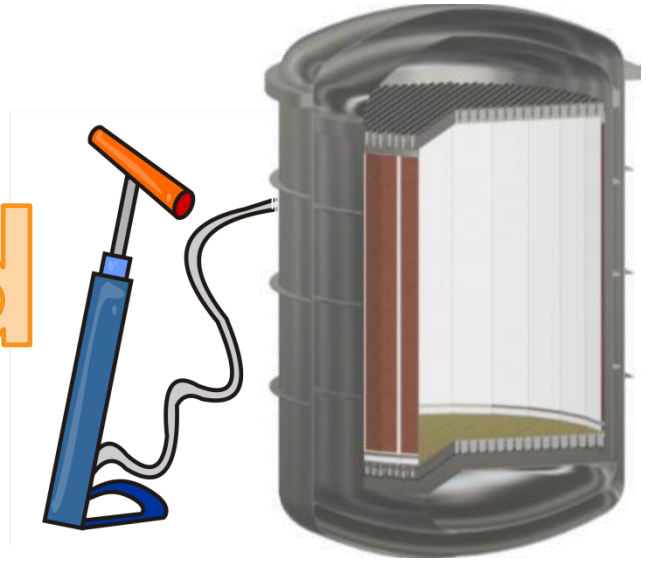




To probe lower cross-sections detectors need to



Expand



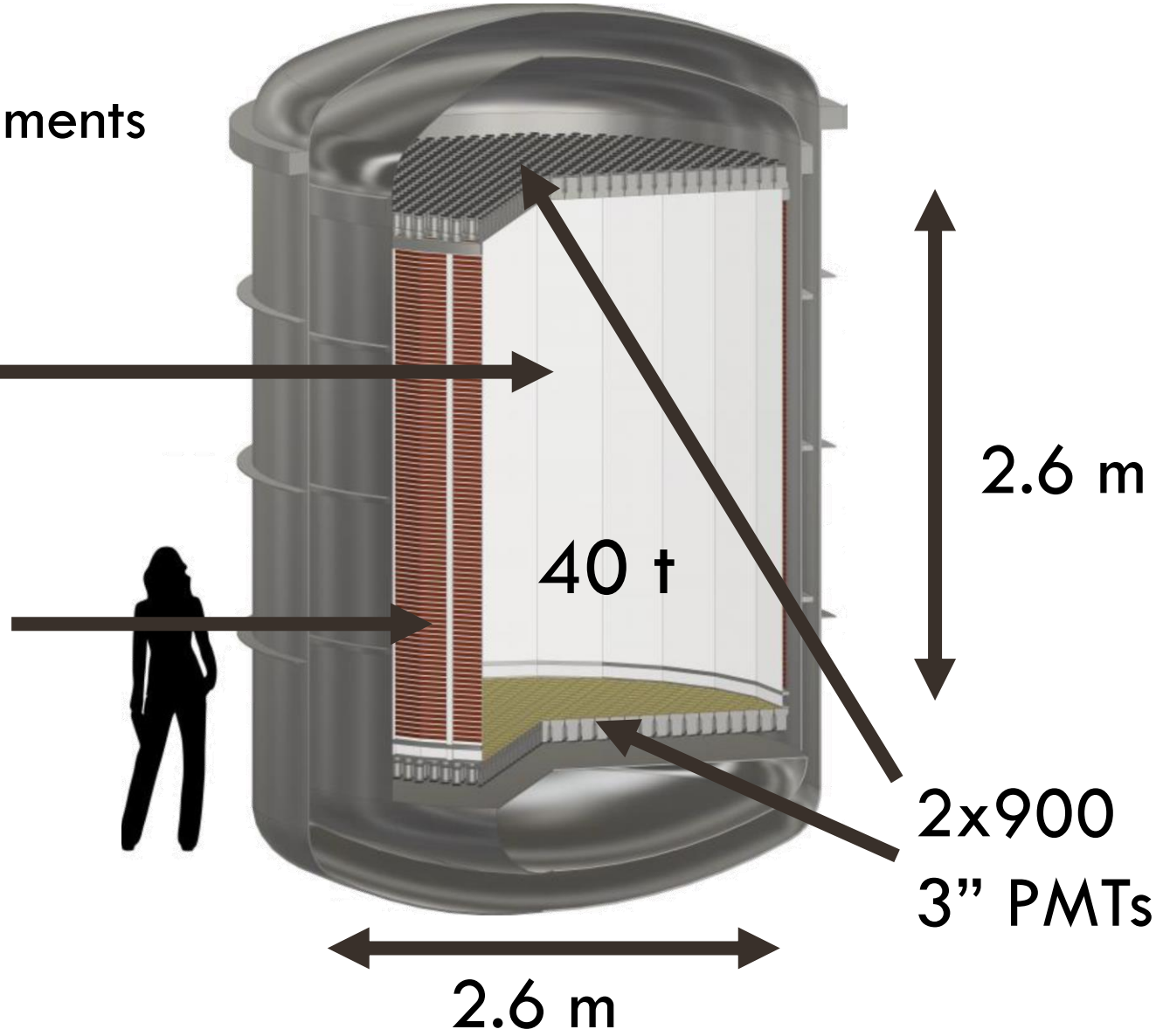
&

Clean

Evolution of
previous experiments

PTFE panels

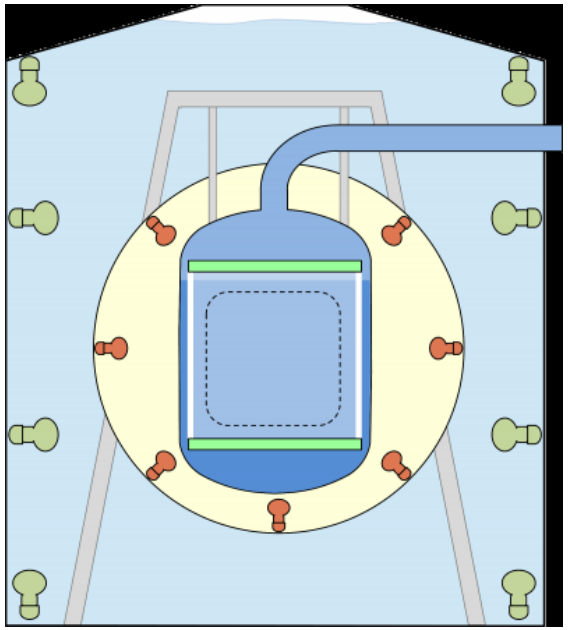
Copper field
shaping rings



50 t total Xe

Kr and Rn
distillation

μ & n vetos



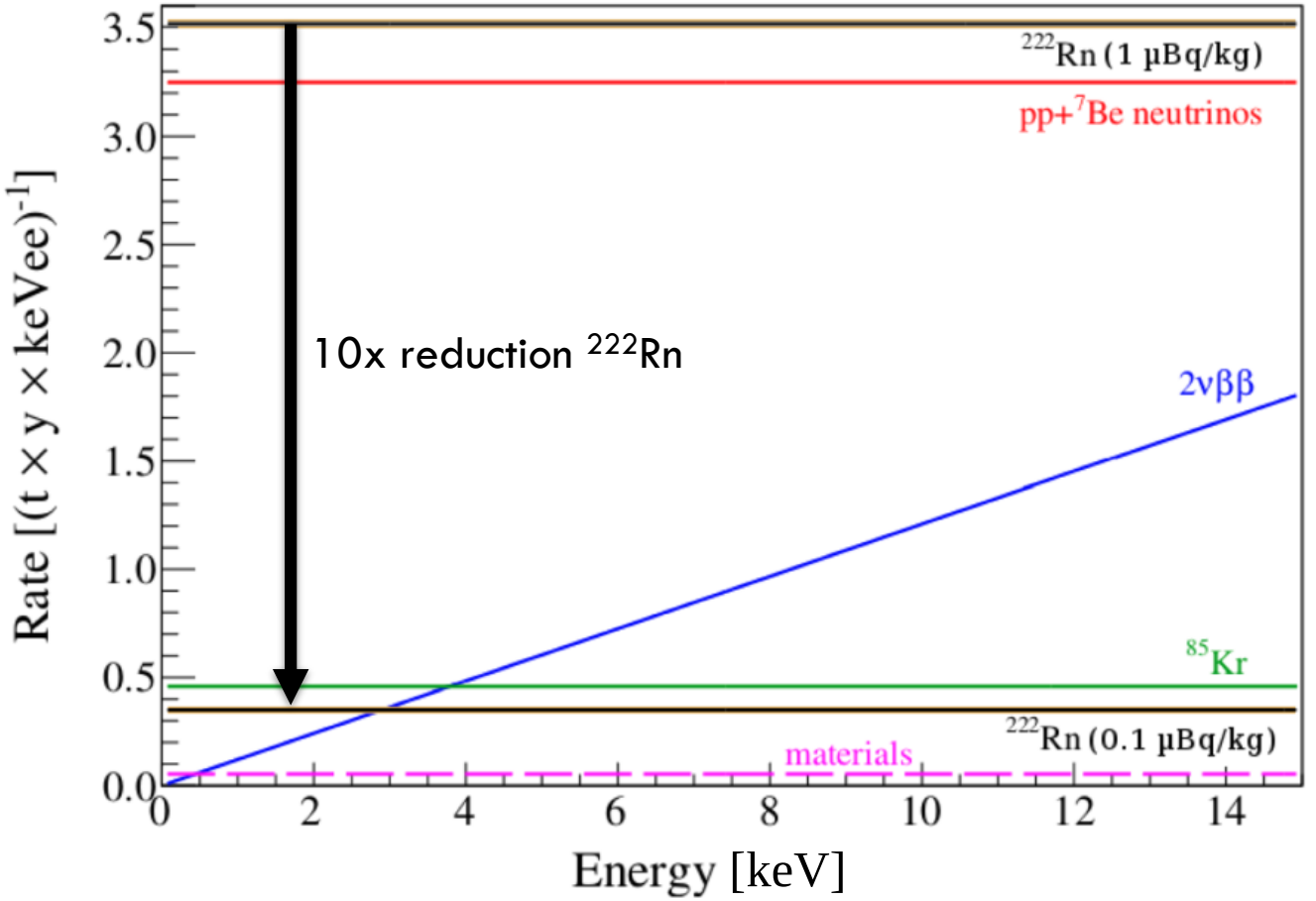
→ DARWIN, JCAP 1611, 17 (2016)

Aim: BG dominated by neutrinos

Material BG helped by size (fiducialisation) and selection

^{85}Kr: on- or offline distillation

^{222}Rn: online distillation, other techniques

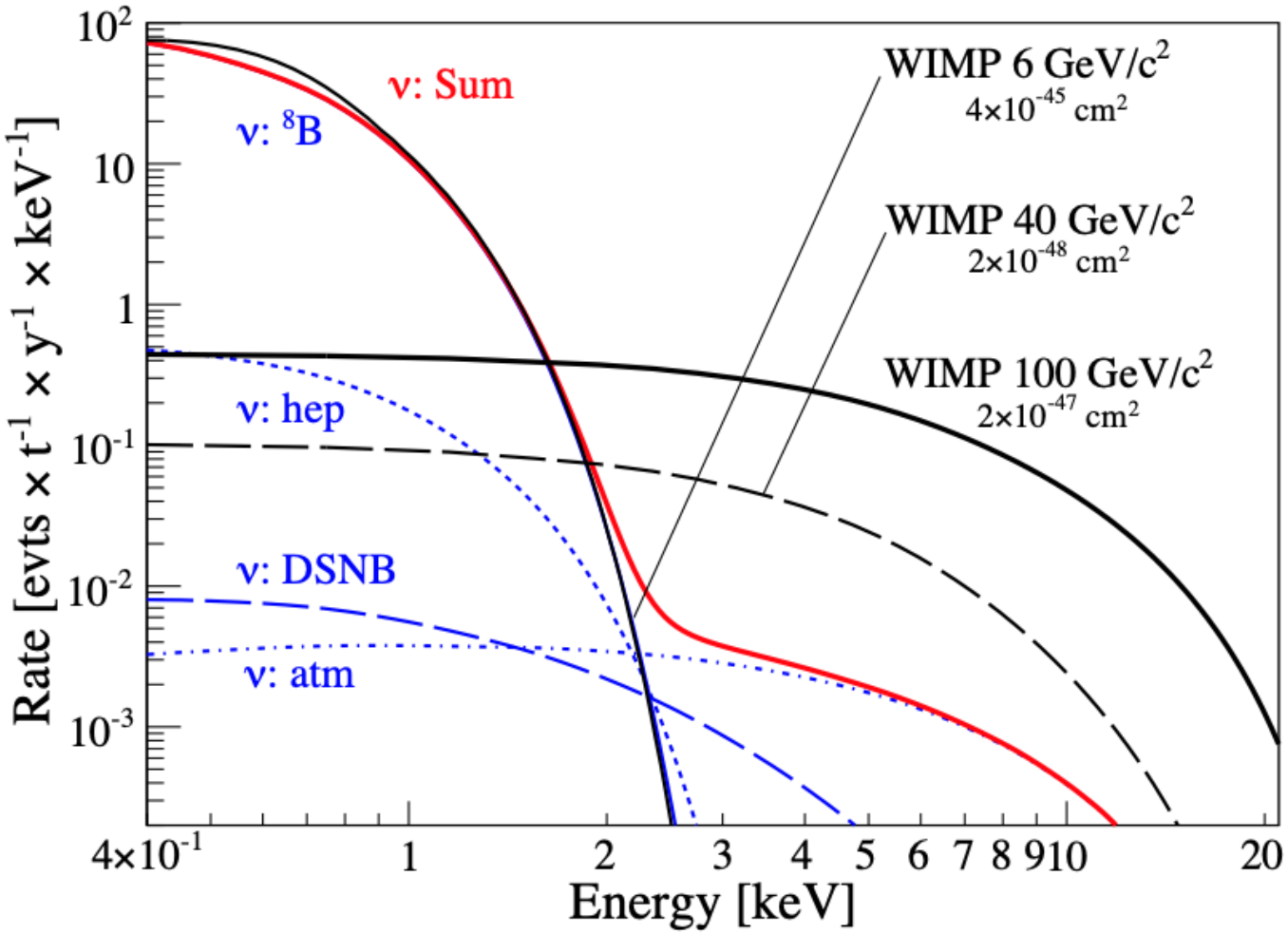


Aim: BG dominated by neutrinos

Coherent n-nucleus scattering dominates NR background

Very similar to WIMP signal (almost) irreducible background fog

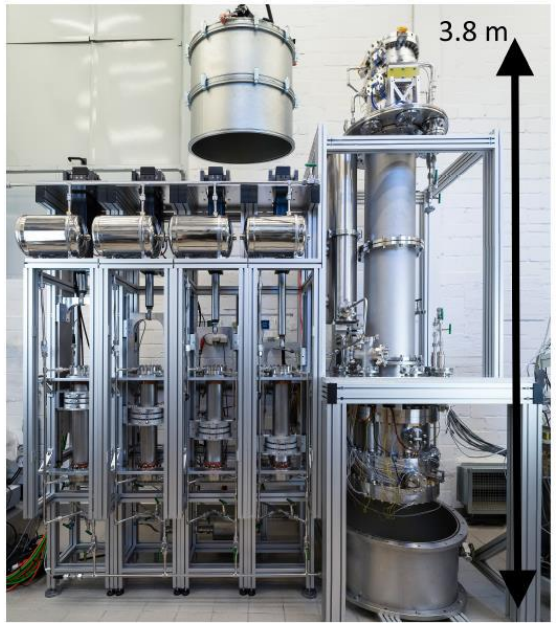
Requires clean materials



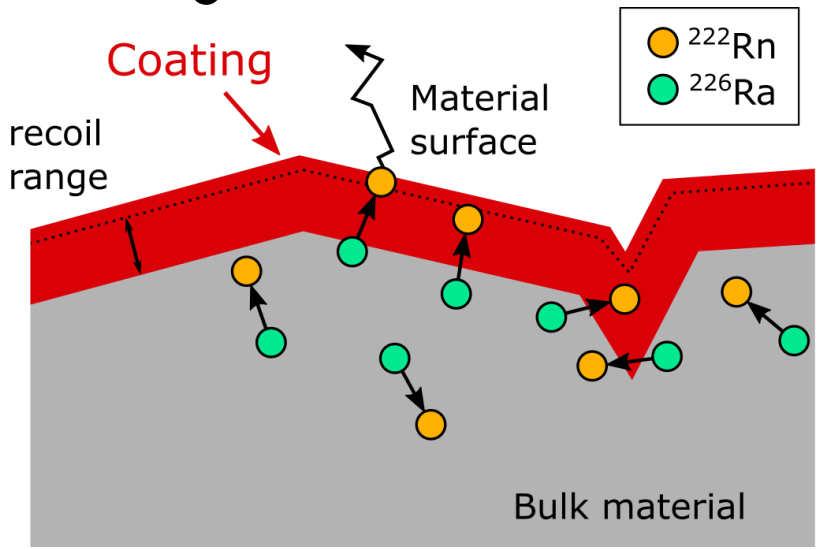
Online distillation

Proven in XENON1T

XENONnT < 1 μBq/kg



Coating materials



Barrier to
Trap radon after radium decays

Material screening and selection

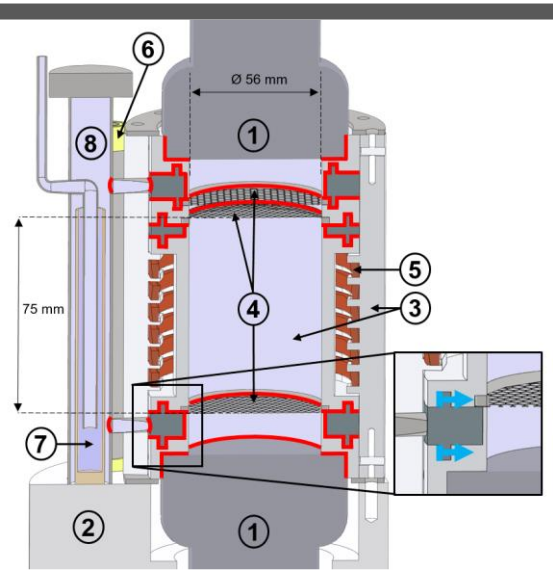
Low-emanation materials

New detectors to increase screening capacity

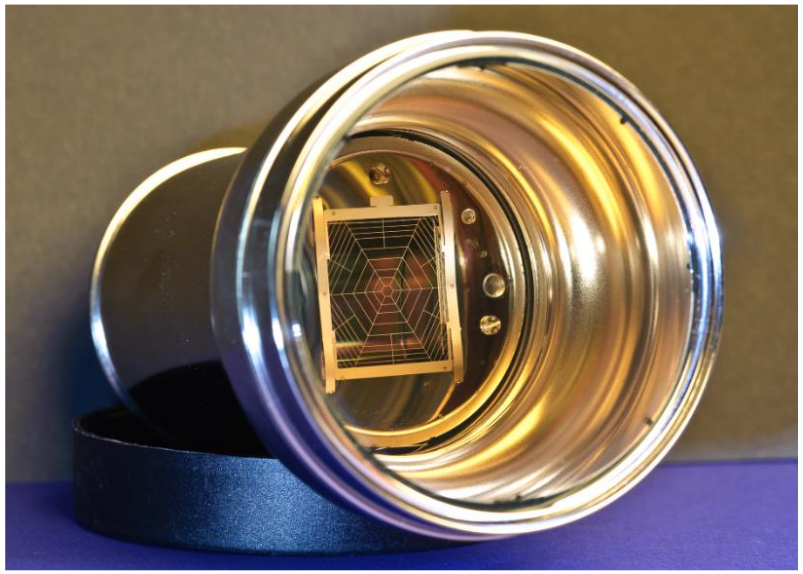
Hermetic TPCs

Separate “clean” TPC

From “dirty” outer skin region



Baseline option:

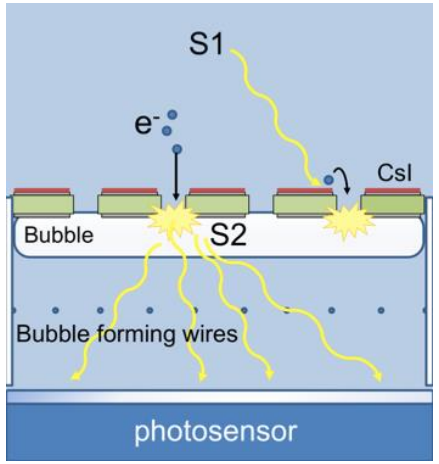


R11410 (LZ, XENONnT)
not clean enough
(5 events in 200 t yr)

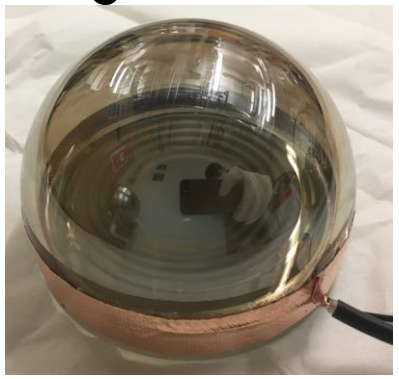
New PMTs
(e.g. R13111)

Possible alternatives

Liquid hole multiplier



Hybrid sensors
e.g. Abalone



SiPMs

Baudis *et al.*
JINST **16** P08052 (2021)

Full-height demonstrator

Electron drift, purity, HV

2.6 m

Large scale
→ Technical challenges

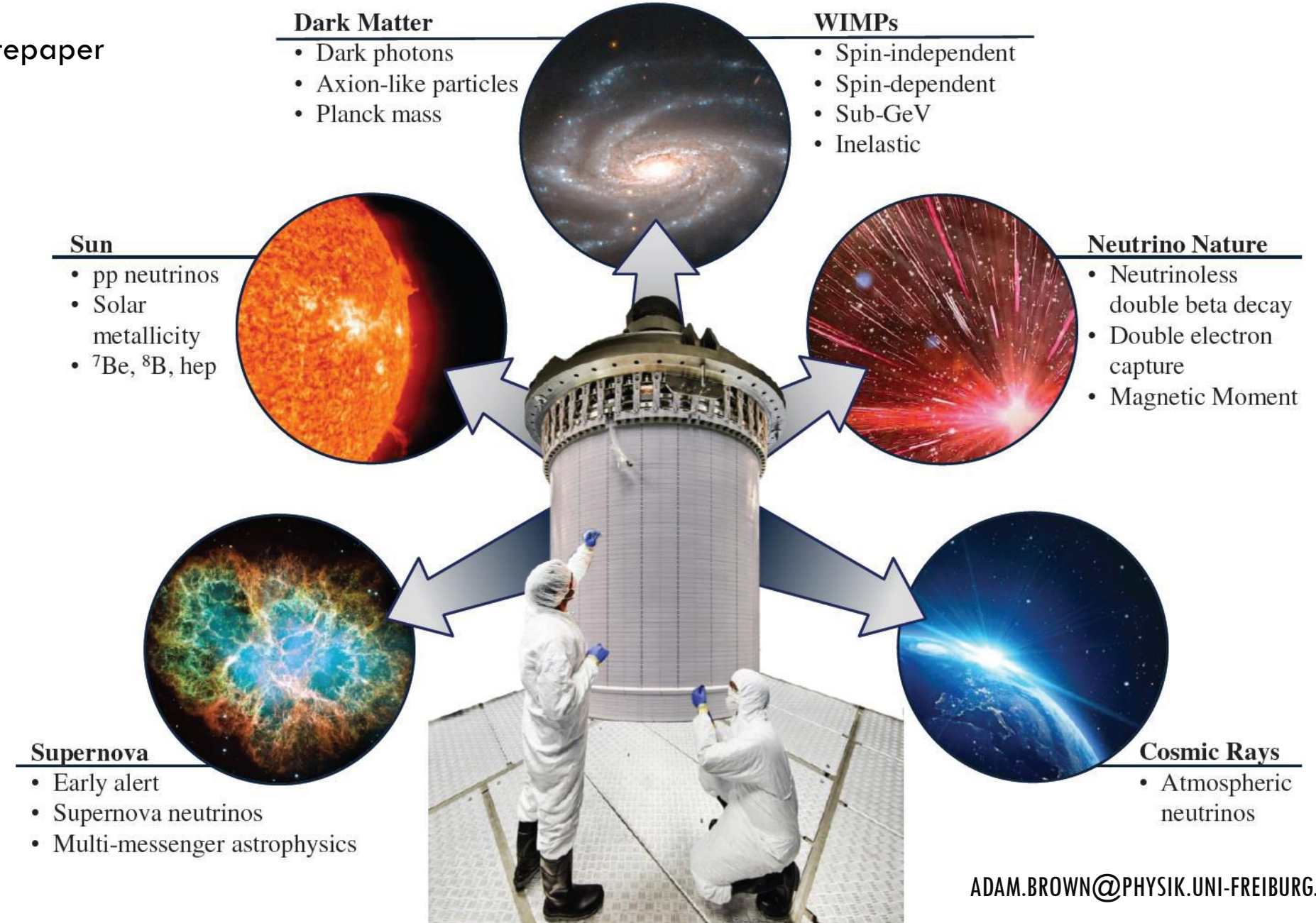
High voltage
Large electrodes
…

2.6 m

Full-diameter demonstrator

Component tests
e.g. electrodes

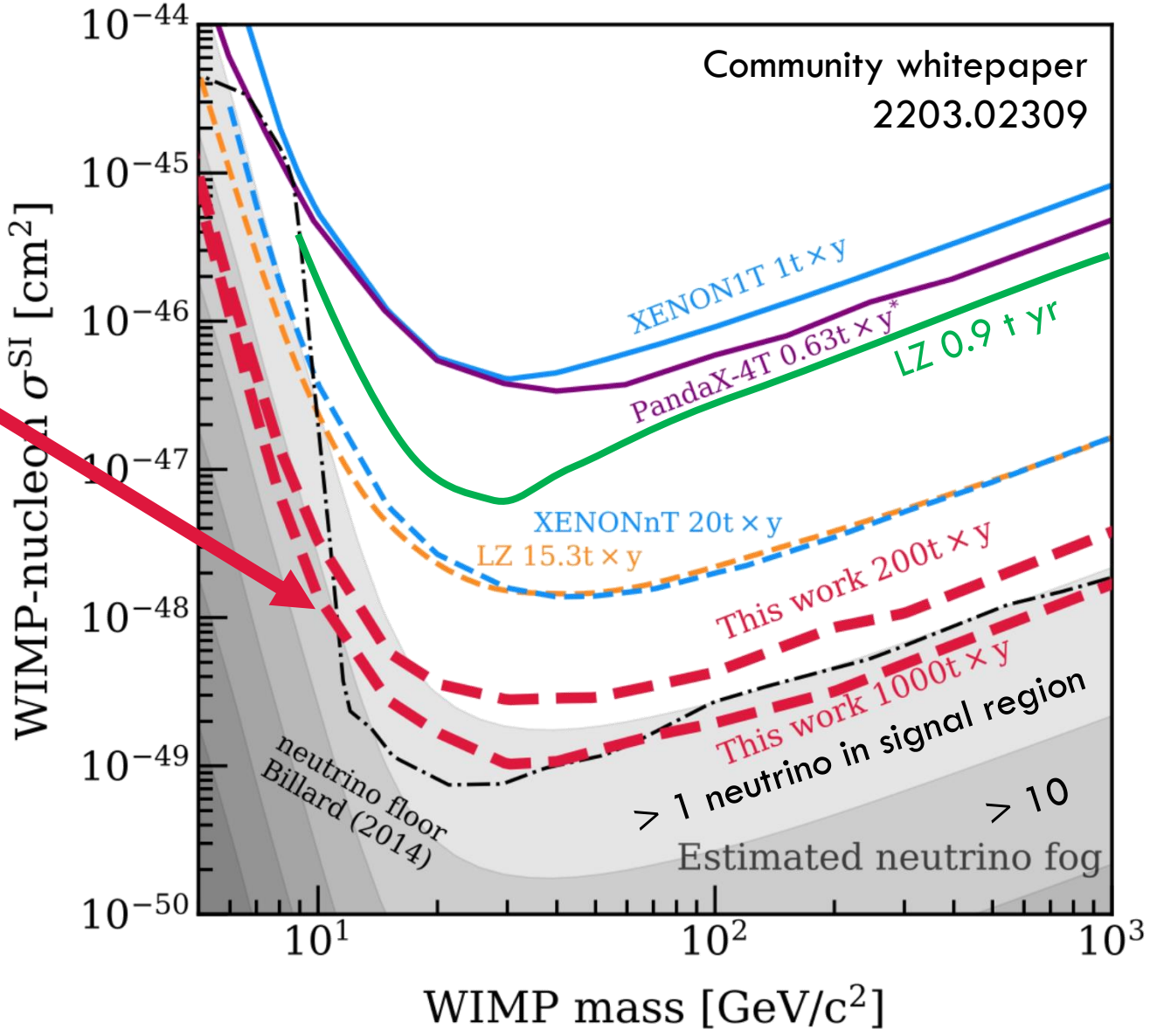
Community whitepaper
2203.02309



Will probe WIMP cross-sections into the neutrino fog

Projected limits dashed

Current limits solid



→ DARWIN, JCAP 1611, 17 (2016)

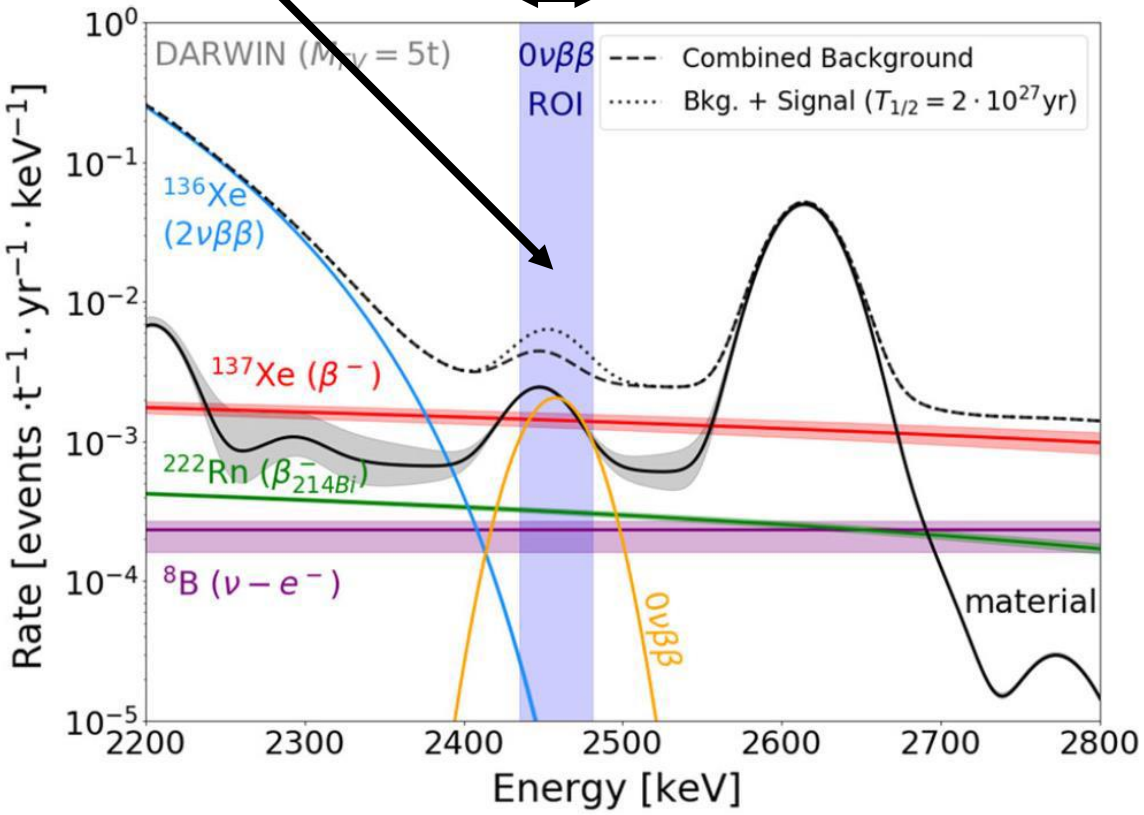
0νββ of ^{136}Xe

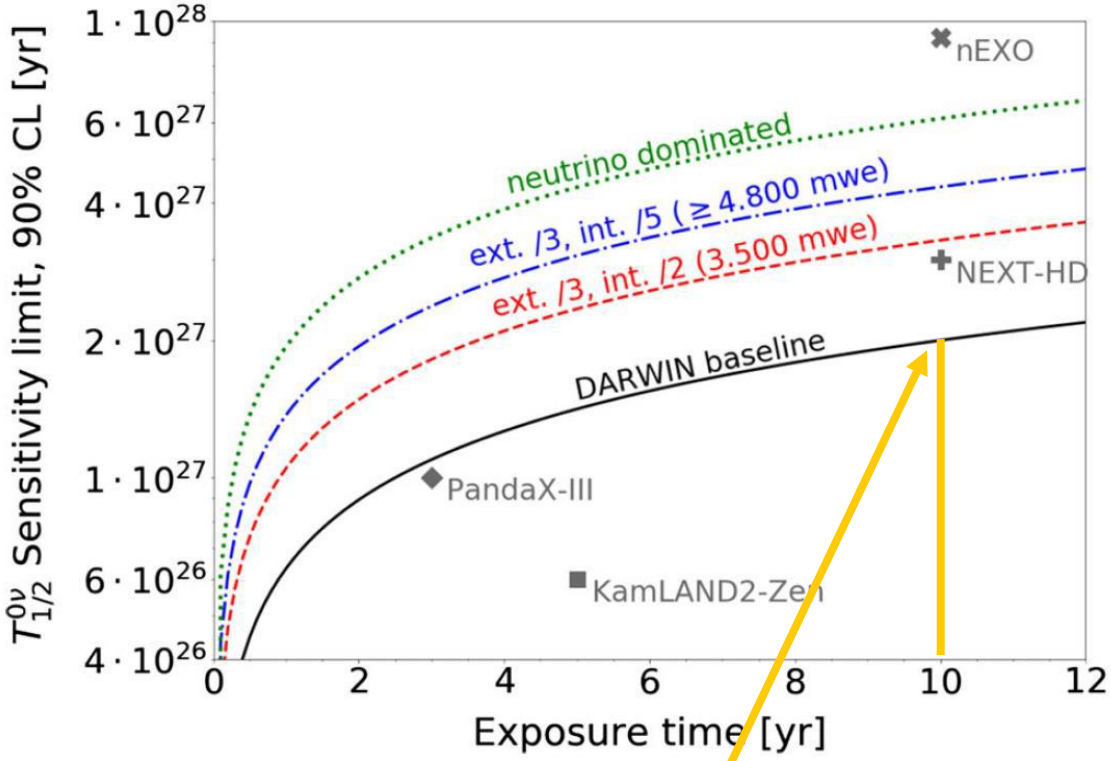
Abundance 8.9% ⇒ 3.5 t in DARWIN

Resolution 0.8% achieved by XENON1T

0.2 BG events/t yr in ROI

FWHM





2.4×10^{27} yr sensitivity with 50 t × 10 yr exposure

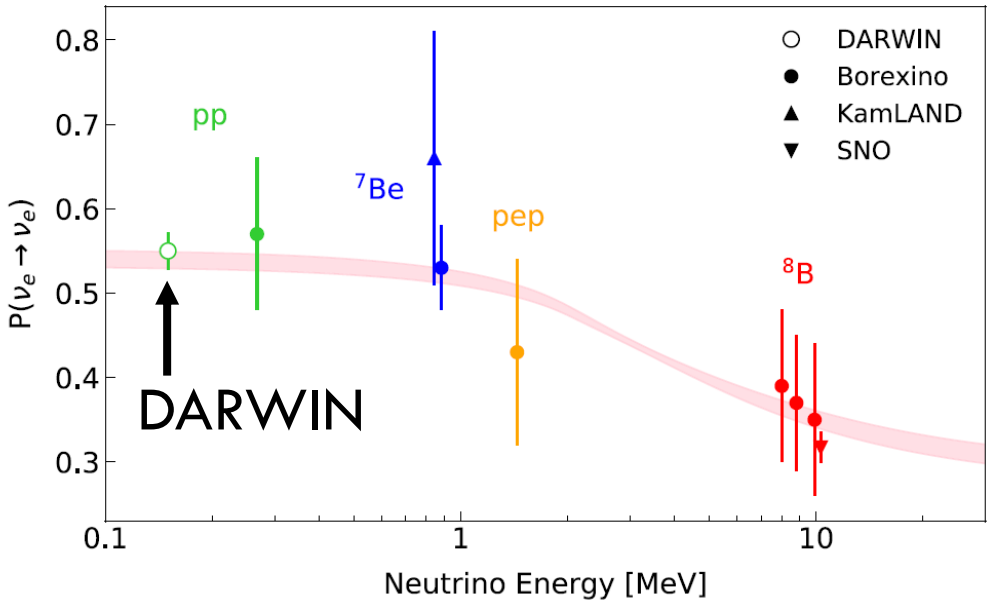
→ DARWIN, EPJ C 80, 808 (2020)

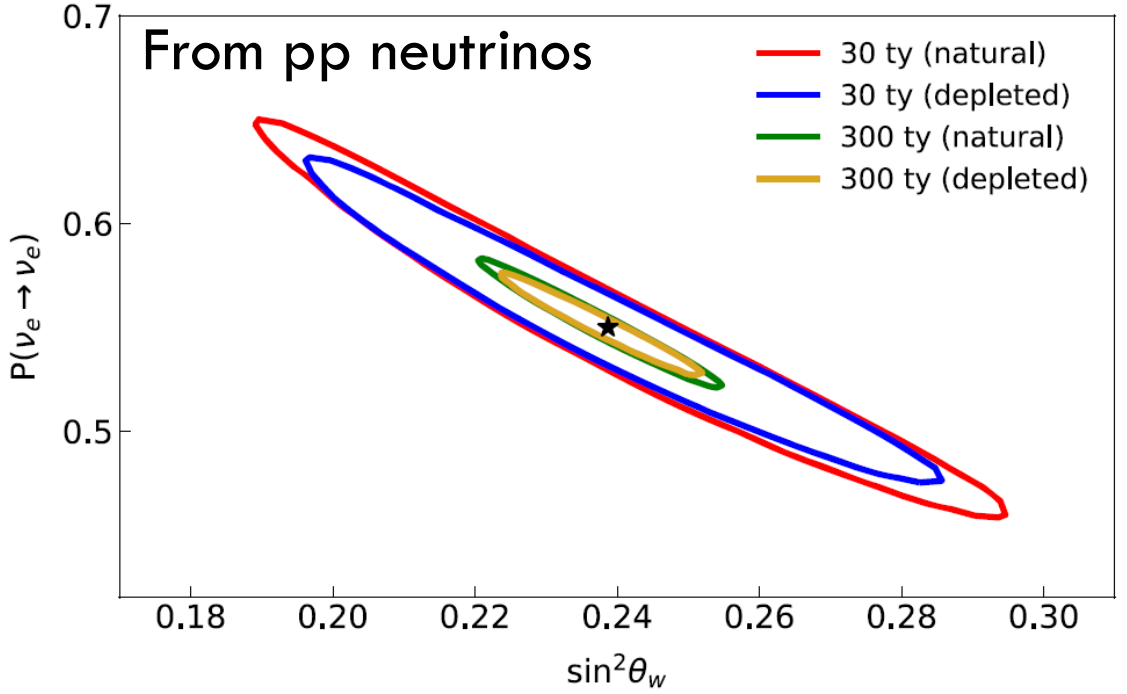
Elastic scattering:

$\nu + e^- \longrightarrow \nu + e^-$

Event rate:

~365 pp neutrinos / t yr



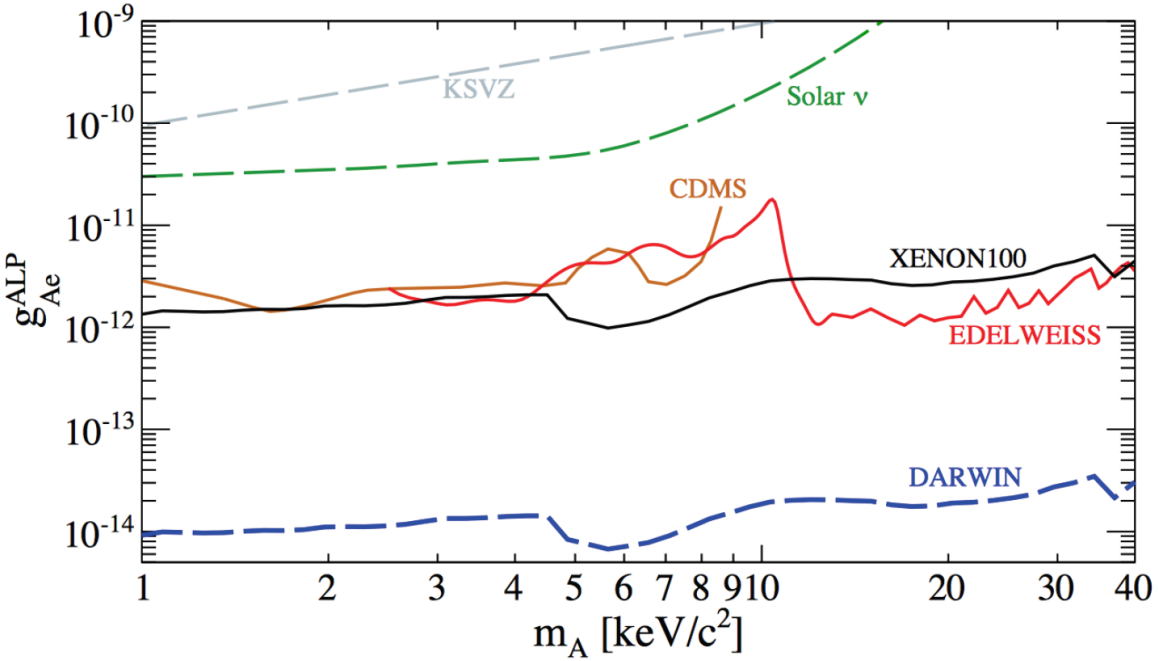


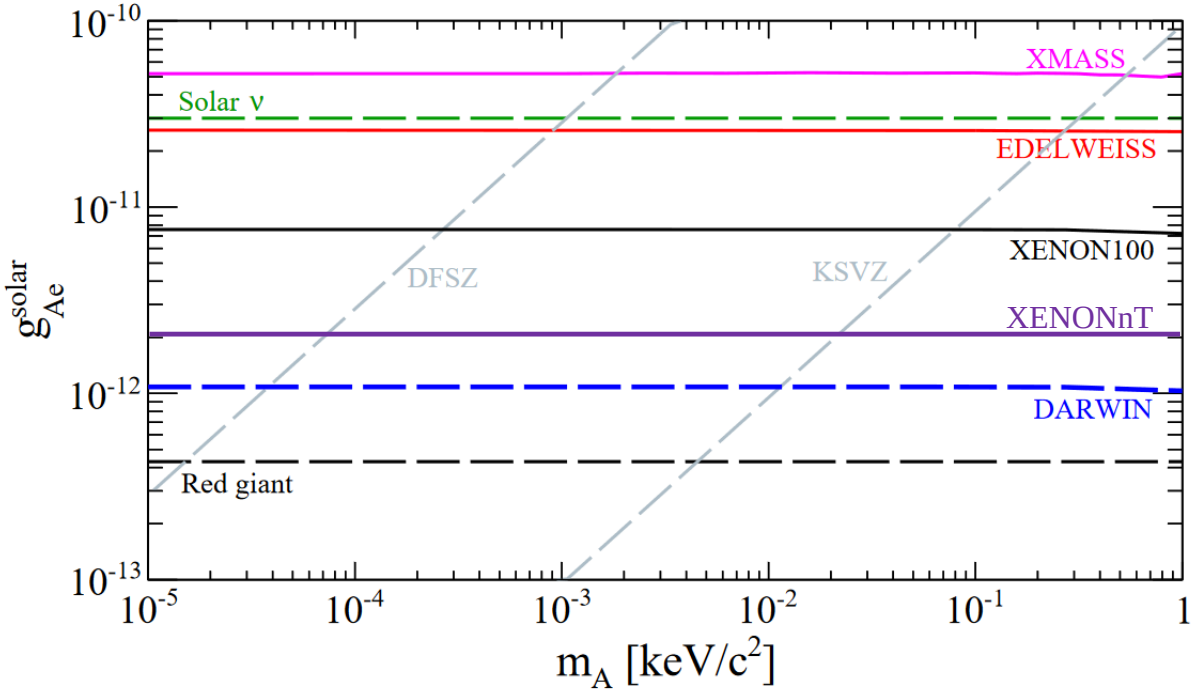
Measure:

- weak mixing angle
- $P(\nu_e \longrightarrow \nu_e)$
- Flux at 0.15% precision after 300 t yr

→ DARWIN, EPJ C 80, 1133 (2020)

Sensitive to axions, axion-like particles via axio-electric (considered here) and Primakoff effect





→ DARWIN, JCAP 1611, 17 (2016)

XENON

DARWIN

Shared expertise between 3 collaborations

Meeting in Karlsruhe June 2022

XLZD.org

SUMMARY

DARWIN will continue legacy of liquid xenon dark matter experiments

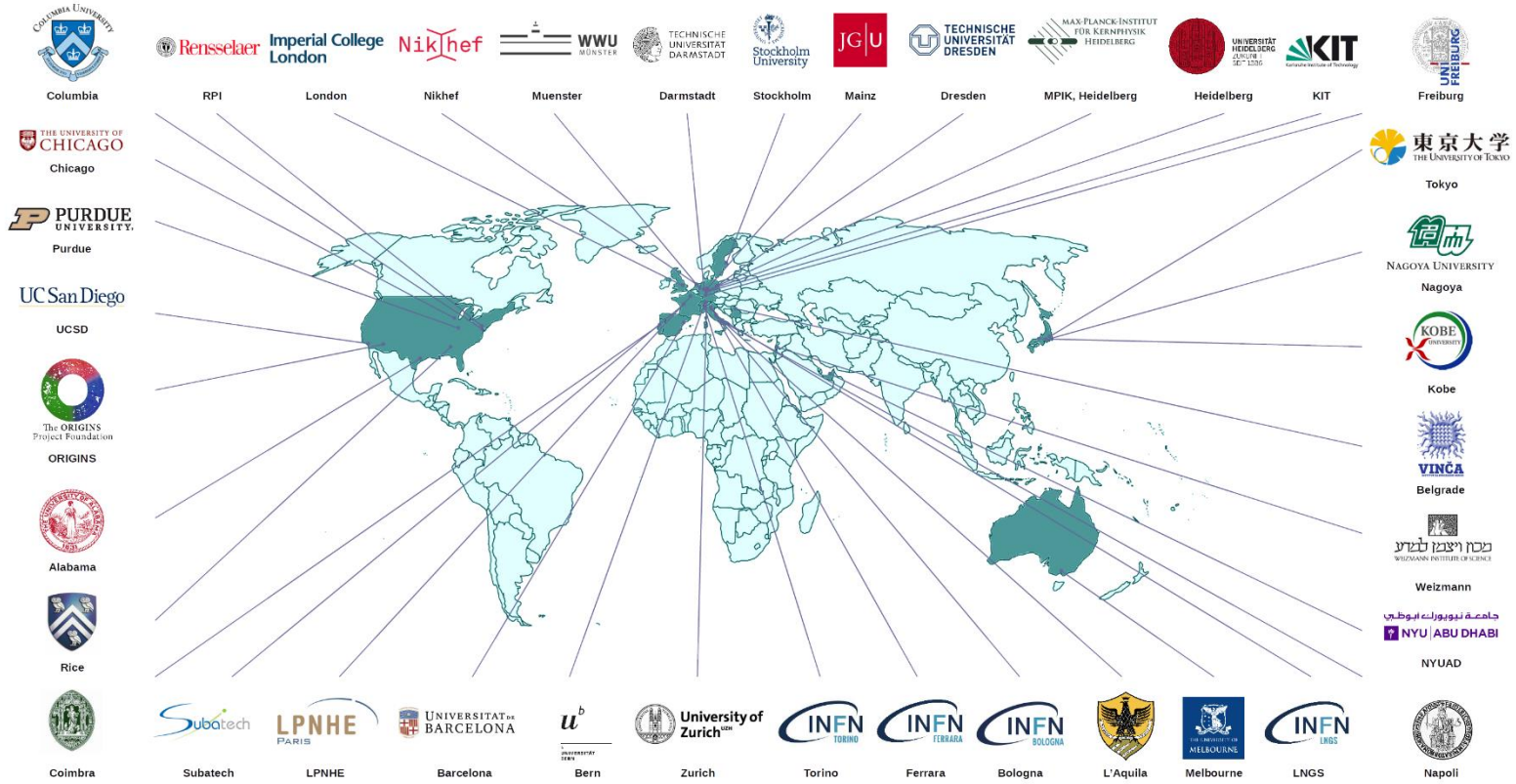
Search for WIMPs into the neutrino fog

Broad range of other physics channels

Varied R&D ongoing

First data taking 2027/2028

>170 members
33 institutions
11 countries



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