



XLZD: @BOULBY?

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A RARE EVENT OBSERVATORY BASED ON THE NOBLE LIQUID XENON

Science White Paper

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Topical Review

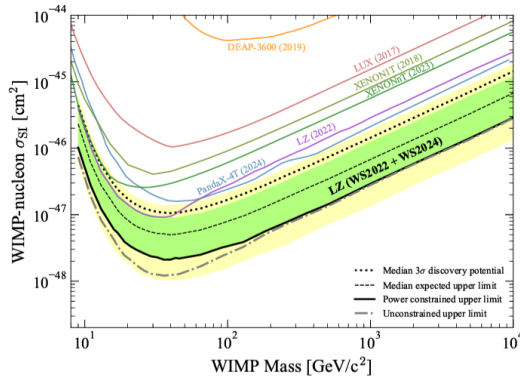
A next-generation liquid xenon observatory for dark matter and neutrino physics

[2410.17137](#)

[2410.19016](#)

LZ approved to 2028, and new world's best result!

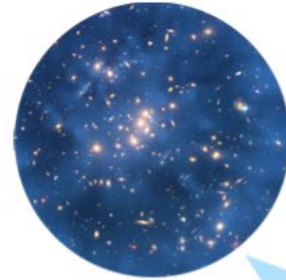
[2410.17036](#)



Henrique Araujo

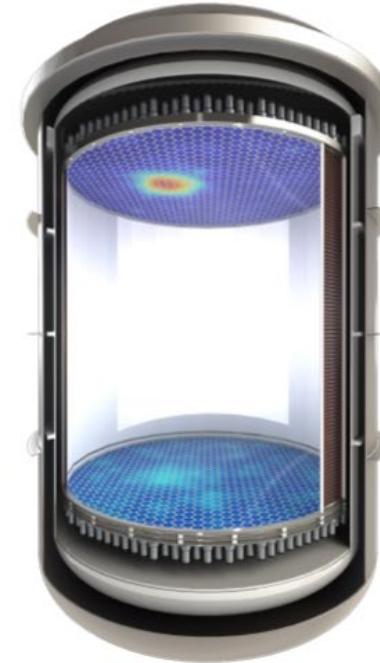
Dark Matter

WIMPs
Sub-GeV
Inelastic
Axion-like particles
Planck mass
Dark photons



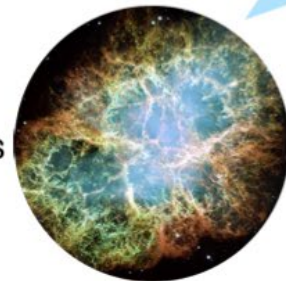
Neutrino nature

Neutrinoless double beta decay
Neutrino magnetic moment
Double electron capture



Supernovae

Early alert
Supernova neutrinos
Multi-messenger astrophysics



Sun

pp neutrinos
Solar metallicity
 ^7Be , ^8B , hep



XLZD: XENON – LUX-ZEPLIN – DARWIN

The definitive LXe experiment for dark matter and neutrino physics for the next decade

- XLZD Collaboration: ~500 people in 72 institutions, 17 countries
- Operating the two largest LXe experiments at the 10-tonne scale
- Five underground labs interested in hosting, three shortlisted



Boulby
North Yorkshire, UK
1,300 m



Kamioka
Japan
1,000 m



SNOLAB
Ontario, Canada
2,070 m



LNGS
Gran Sasso, Italy
1,400 m



SURF
South Dakota, US
1,500 m



XLZD meeting at RAL, 2024

THE XLZD@BOULBY PROGRAMME

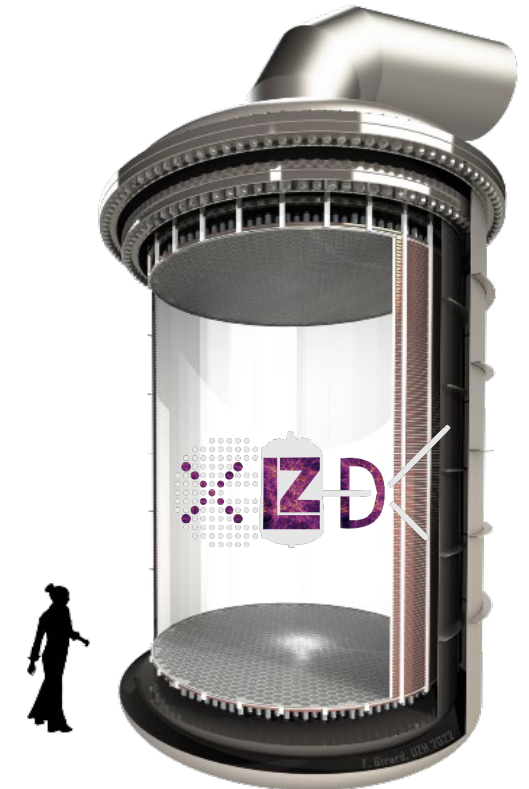
We are proposing to host XLZD in a major new underground laboratory at the Boulby mine

Nominal infrastructure plan entails a faster **Stage 1 facility at 1,100 m (clean manufacture)** and a larger **Stage 2 facility at 1,300 m (installation)** – STFC is highly committed to this plan

We can enable:

- **A competitive schedule** (start of operations c2033)
- **A larger experiment** (up to 80 tonnes of active mass)
- Installed in a **purpose-designed laboratory**

Excellent strategic alignment with STFC, UKRI and UK Government



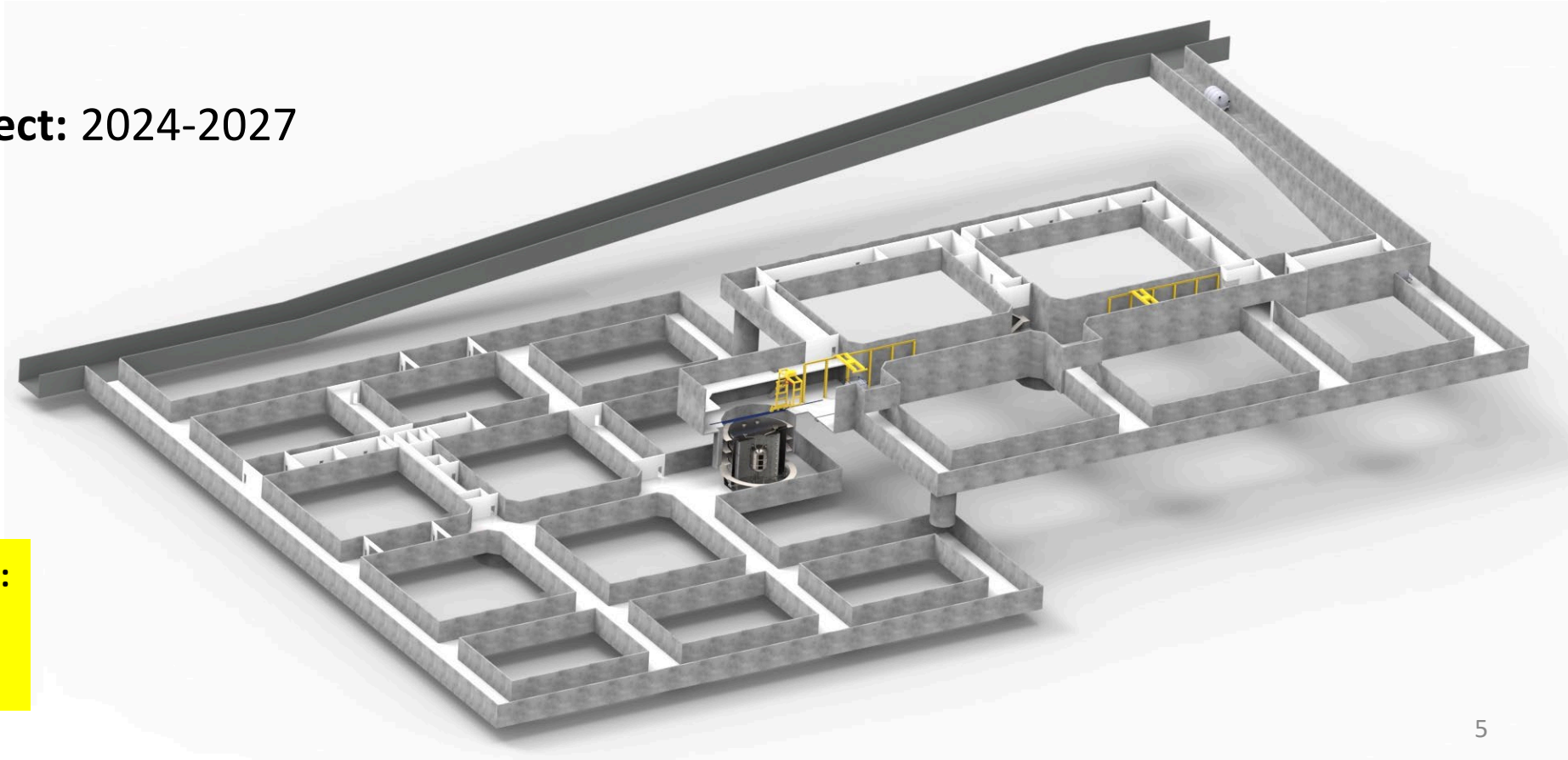
PROPOSED INVESTMENT

1. A major new underground facility – Boulby Development Project, led by STFC, ongoing
 2. One-third of XLZD project cost – UKRI Preliminary Activity (£8.7M) sets us off on this road
- Combined package of ~£500M being discussed with STFC, UKRI and UK Government



XLZD-UK

- **Pre-Construction project:** 2024-2027
- **Construction project:**
6 years from 2027/28,
operations c2033



**THIS IS A CRITICAL TIME FOR US:
TO BRING XLZD TO BOULBY,
AND HMG/UKRI TO INVEST!**

XLZD@BOULBY DEVELOPMENT

XLZD@BOULBY

(WIDER TEAM OF PROPONENTS)

58 SENIOR RESEARCHERS IN 21 INSTITUTES



XLZD-UK “Pre-Construction” project just funded by the UKRI Infrastructure Fund



XLZD-UK PRE-CONSTRUCTION PROJECT

A TEAM OF 80+ PHYSICISTS & ENGINEERS IN 14 UK INSTITUTES



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A strong PPD is essential if we are going to pull this off:

RAL is probably the closest we will get to a “lead lab”

- PPD is the gateway to RAL and wider STFC “firepower”
- Interface to engineering from RAL Technology
- Project Management Office
- Technical contributions: Cryostat (Pawel), Xenon (Jens, HA), Radioassay (Maurits), Computing (Chris),..

But a larger team will be required.



THANK YOU!