PPAP Online Community Meeting

Impact Assessment

Low-Background / Underground Physics

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Underground Physics

[Includes dark matter searches (PAAP) and neutrinoless double beta decay and other neutrino physics (PPAP), as well as national underground facility (Boulby)]

Direct dark matter searches make up around one-third of the UK's Astroparticle Physics programme; the number of DM academics has at least doubled in the last decade. The success of the broader field rests in part on a technology pioneered in the UK, with LUX-ZEPLIN (LZ) the flagship experiment of the 2020s.

XLZD@Boulby has been recognised as a unique opportunity by STFC, UKRI and DSIT to host world-leading fundamental science in the UK, in clear alignment with the "Growth" agenda and the "Place" agenda. Significantly, this is one of very few STFC projects fully aligned with these Government priorities, via technical skills development, investment in high value manufacturing and opportunities for STEM outreach, in a region that has been neglected previously by UKRI and STFC.

Impact Chain

Decision / change

NOTE: No change has been announced for XLZD@Boulby: UKRI IF Preliminary Activity in place until Dec 2027; hereafter we assume the counterfactual for the purpose of today's discussion; will not focus on LZ here.

Immediate impact

Following the DOE announcement in December, XLZD would probably collapse without major UK participation. Boulby could be lost as a facility to support PPAN science, and possibly lost altogether for other science.

Capability impact

Significant capability in project and infrastructure delivery would be dispersed. A significant team of over 80 UK physicists and engineers could disband -- a fraction retained if XLZD is hosted overseas, mostly on the physics side

Strategic impact

UK could miss out on discoveries made using the very technology we pioneered, across DM, 0NBB decay, etc.
Loss of strategic capability for underground science if the Boulby investment is discontinued.
Loss of a unique opportunity for STFC and UKRI to deliver regional impact benefitting the whole PPAN community.

Reputational impact

UK has strength and leadership in DM searches through LZ and XLZD (and others), and has made a strong case internationally for its ambition to host XLZD. A full withdrawal could unravel the international dark matter programme.

Recovery cost

It could be terminal: the scientific opportunity could be lost; it would be very difficult to restart a national/international underground facility operated in a commercial mine once this is lost.

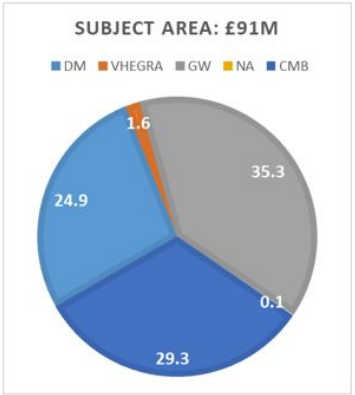
High-level narrative

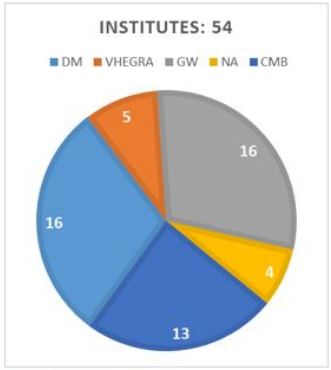
The UK has made a very strong case to host the next-generation XLZD Rare Event Observatory in strong alignment with government priorities of “place” and “growth”. A substantial team in a growing UK community is preparing this opportunity and persuading the international community that “yes we can”. Major delays to, or reversal of, these plans would bring reputational damage to the UK community (and to STFC and UKRI) and damage the field of direct dark matter searches internationally. The loss of our national capability for multidisciplinary underground science at Boulby could be compromised too. Last, but not least: STFC would miss out on a major opportunity to derive socioeconomic impact from its PPAN programme and to counter the emerging narrative that fundamental science does not lead to growth!

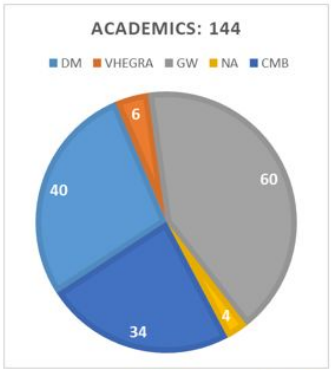
UK PA FROM R-ECFA VISIT IN 2024

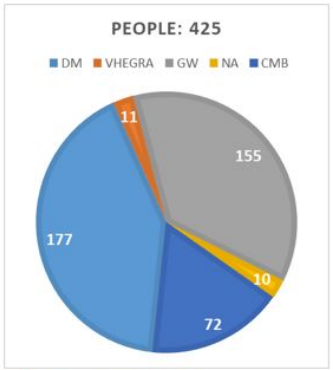
UK ASTROPARTICLE IN NUMBERS

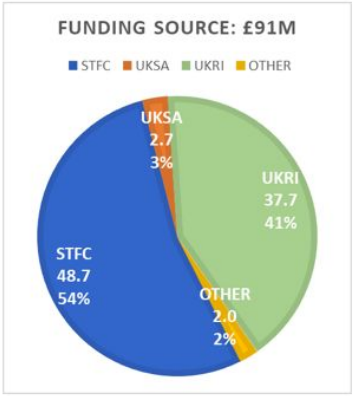
- 144 academics in 53 institutes (unique per area), over 400 people
  - Larger communities: Dark Matter, Gravitational Waves, CMB Cosmology
- Significant growth in key areas in the last decade
  - Gravitational Waves ~3x, Dark Matter ~2x
- Total funding over ~5 years: £91M, with just over half from STFC
  - Major funding from UKRI Infrastructure Fund











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Boulby Facility and Hosted Science

Boulby Underground Lab as an impact case study

Boulby is the UK's deep underground science facility, an internationally-important national scientific asset providing experimental space in an ultra-low background environment - important for a wide range of UK and international pure and applied low background particle physics projects (Dark Matter and neutrino studies, nuclear security and more). It provides world-leading material screening capability (with the BUGS facility) to support UK and international low background projects. It also provides rare and important access and national capability for wider UKRI science themes (Earth and environmental sciences, quantum sensors and computing, biology / astrobiology and planetary exploration studies). Boulby is also an important asset for, and a very active provider of, STEM outreach, education and skills development - locally and nationally.

Impact Chain

Decision / change

Boulby currently receives on-going core facility funding from STFC (through PPD). Future facility funding is expected to be tensioned against STFC facilities costs (bucket 4), but science projects undertaken at Boulby will be funded / prioritised through PPAN channels.

Potential impact

a) Impact of loss of Boulby facility (inc BUGs).

- Loss of national capability important for core STFC and wider UKRI science themes
- Damage to international reputation and leadership re: facilities and science hosted
- Further imbalance of place-based UKRI activity. Reputational damage with local stakeholders
- Loss of capability for regional and national STEM outreach and skill development.

b) Impact of loss of Boulby hosted science (e.g DarkSPHERE).

- Damage to international reputation and leadership re: facilities and science hosted
- Discontinuity of strategic path growth for UK ultra-low background and rare-event fields
- Damage to international confidence in, and national readiness for, longer term growth in UK ultralow background science hosted on UK soil.
- Ineffective exploitation of an important strategic scientific asset.