



LZ UK PROGRAMME STATUS

Henrique Araújo
(on behalf of LZ UK)

DMUK Meeting, 9 JUN 2014, Durham



Imperial College
London



UNIVERSITY OF
LIVERPOOL



UNIVERSITY OF
OXFORD



Science & Technology
Facilities Council



The
University
Of
Sheffield.



LZ DETECTOR(S)

LUX
water tank

Gd-loaded
liquid scintillator
veto detector

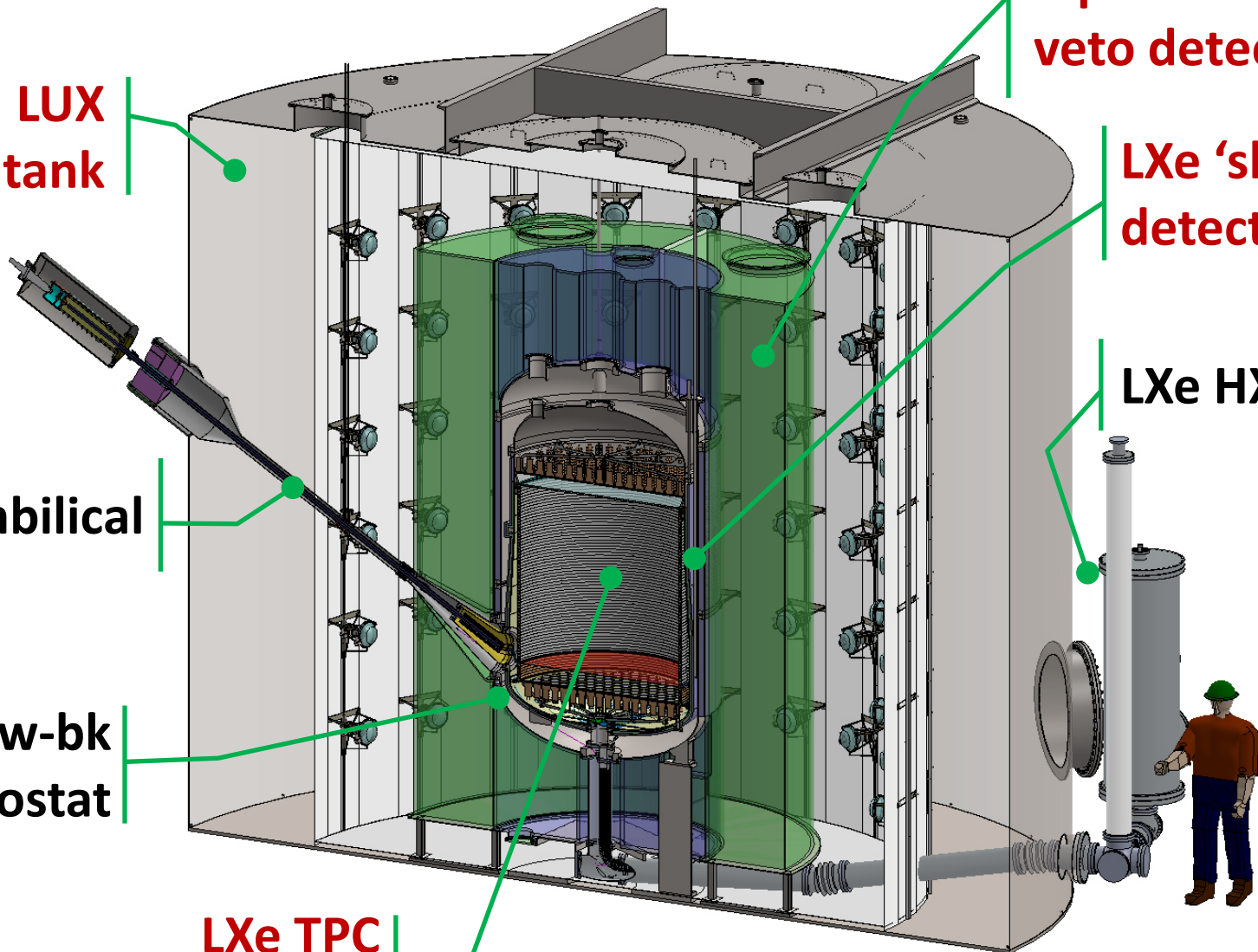
LXe 'skin'
detector

HV umbilical

LXe HX

low-bk
cryostat

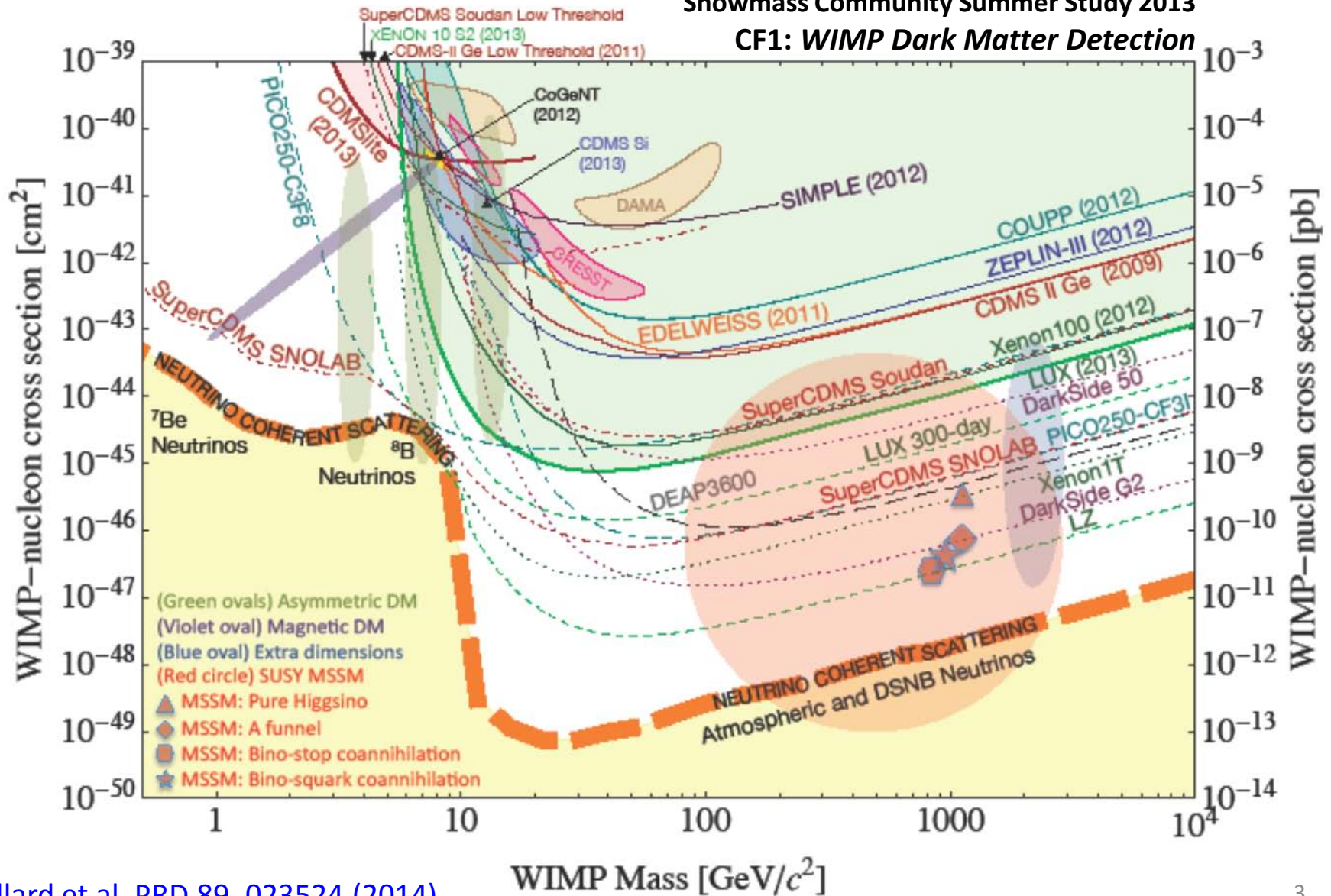
LXe TPC
(7t active)



LZ SENSITIVITY

Snowmass Community Summer Study 2013

CF1: WIMP Dark Matter Detection



LZ TIMELINE

- R&D/design phase – 2013-15
 - DOE, NSF, SDSTA, FCT & STFC funding
 - R&D, conceptual design, reduction of scientific, technical and cost risks
- Project down-selection – imminent
 - (UK down-selection confirmed in STFC Programmatic Review)
 - SOI to STFC accepted, proposal submission by end July 2014
 - Strong P5/HEPAP endorsement for G2 dark matter
 - DOE/NSF experiment down-selection expected end of June
- Construction phase – 2015-18
 - UK: 3-year construction phase from April 2015 (UK FY 15/16)
 - CD-1 Oct 2014 (end of Conceptual Design) – DOE OPC, NSF, SDSTA funds
 - CD-2 Mar 2015 (end of Preliminary Design) – UK construction funds
 - CD-3 Oct 2015 (end of Final Design) – US MIE funds
 - CD-4 2017/18 (LZ ready for science)
- Exploitation phase – 2018-22

STFC Programmatic Review

2.16 Dark Matter Experiments [PPAN]

34. [...] A significant UK community with some international leadership is present in this area, and a coordinated UK strategy has been defined by the Science Board sub-group on dark matter. **This is welcome and should be supported at a level sufficient to allow the UK to be a leading partner in one major international dark matter experiment, and the community has recently agreed that this should be Lux-Zeplin, a second generation experiment using noble liquid detector technologies to be based in the Sanford Underground Research Laboratory.** Direct detection of dark matter would be a scientific breakthrough of enormous proportions, with huge implications for our understanding of physics and the universe.

3.2 Approximate Current Cash [Possible Financial Scenarios]

55. [...] In Particle Astrophysics, the programme of ground-based gravitational wave detection should be continued, though at a reduced rate. **It would not be possible to retain a leading UK involvement in both CTA and direct dark matter searches. Both these areas are high priority and the UK has recently invested in them, and future planning would depend upon the length of time over which a flat cash budget was imposed.**

4. Summary and General Comments

- 62. Decisions on involvement in a muon physics programme, Lux-Zeplin (Dark Matter), CTA, all have to be taken either immediately or very soon.**

6. 1 Flat Cash Scenario [Recommended Overall Programme]

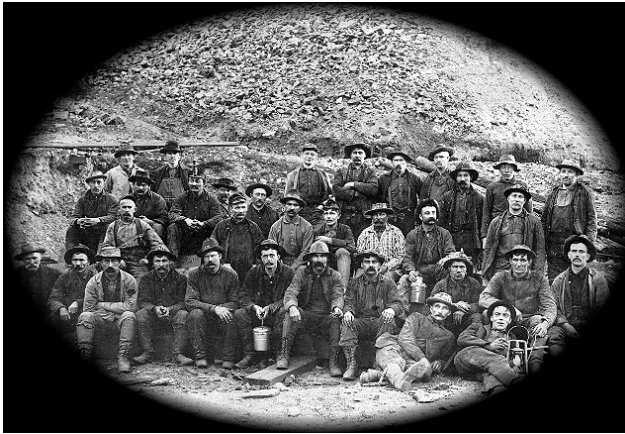
87. This additional funding [~£2M pa savings from self-sustaining Campus Centres] would be used to bolster diversity and leadership in the programme: **for example it could be used to guarantee leadership in areas that Science Board has consistently tried to fund such as dark matter,** the CTA experiment or neutrinoless double-beta decay.

HEPAP/P5 Review (US)



Dark Matter (Direct)

- The experimental challenge of discovery and characterization of dark matter interactions with ordinary matter requires a multi-generational suite of progressively more sensitive and ambitious direct detection experiments.
- This is a highly competitive, rapidly evolving field with excellent potential for discovery. The second-generation direct detection experiments are ready to be designed and built, and should include the search for axions, and the search for low-mass (<10 GeV) and high-mass WIMPs.
 - Several experiments are needed using multiple target materials to search the available spin-independent and spin-dependent parameter space.
 - This suite of experiments should have substantial cross-section reach, as well as the ability to confirm or refute the current anomalous results.
 - Investment at a level substantially larger than that called for in the 2012 joint agency announcement of opportunity will be required for a program of this breadth.
- **Recommendation 19: Proceed immediately with a broad second-generation (G2) dark matter direct detection program with capabilities described in the text. Invest in this program at a level significantly above that called for in the 2012 joint agency announcement of opportunity.**



LZ COLLABORATION

US (17) + UK (8) + PT (1) + RU (1)

- ✧ University of Alabama
- ✧ Brown University
- ✧ University of California, Berkeley
- ✧ University of California, Davis
- ✧ University of California, Santa Barbara
- ✧ Case Western Reserve University
- ✧ Daresbury Laboratory
- ✧ Edinburgh University
- ✧ Imperial College London
- ✧ University of Liverpool
- ✧ Lawrence Berkeley National Laboratory
- ✧ Lawrence Livermore National Laboratory
- ✧ LIP-Coimbra, Portugal
- ✧ MEPHI-Moscow, Russia
- ✧ University of Maryland
- ✧ University of Oxford
- ✧ Rutherford Appleton Laboratory
- ✧ University of Rochester
- ✧ Sheffield University
- ✧ SLAC National Accelerator Laboratory
- ✧ SD School of Mines & Technology
- ✧ University of South Dakota
- ✧ Texas A&M University
- ✧ University College London
- ✧ Washington University
- ✧ University of Wisconsin
- ✧ Yale University

LZ UK

Imperial College
London

- **Imperial College London**

- H. Araújo (A, PI), T. Sumner (A), A. Currie (PDRA), A. Tomas (PDRA), A. Bailey (PG)



- **Rutherford Appleton Laboratory**

- P. Majewski (S), M. van der Grinten (S), E. Holtom (E), J. Nikkel (S), S. Balashov (S), A. Khazov (S), M. Tucker (S)



- **Edinburgh University**

- A. Murphy (A), J. Dobson (PDRA), P. Beltrame (F), T. Davison (PG)



- **University College London**

- C. Ghag (A), L. Reichhart (PDRA), S. Shaw (PG)



- **Daresbury Laboratory**

- J. Simpson (A)



- **Oxford University**

- H. Kraus (A), P. Scovell (PDRA), J. Lin (PG), K. Boast (PG), F. Liao (PG)



- **Sheffield University**

- V. Kudryavtsev (A), E. Korolkova (PDRA)



- **University of Liverpool**

- S. Burdin (A), J. Rose (A)

LZ UK – R&D/DESIGN PHASE

STFC-funded: 1 Jan 2013 – 31 Mar 2015

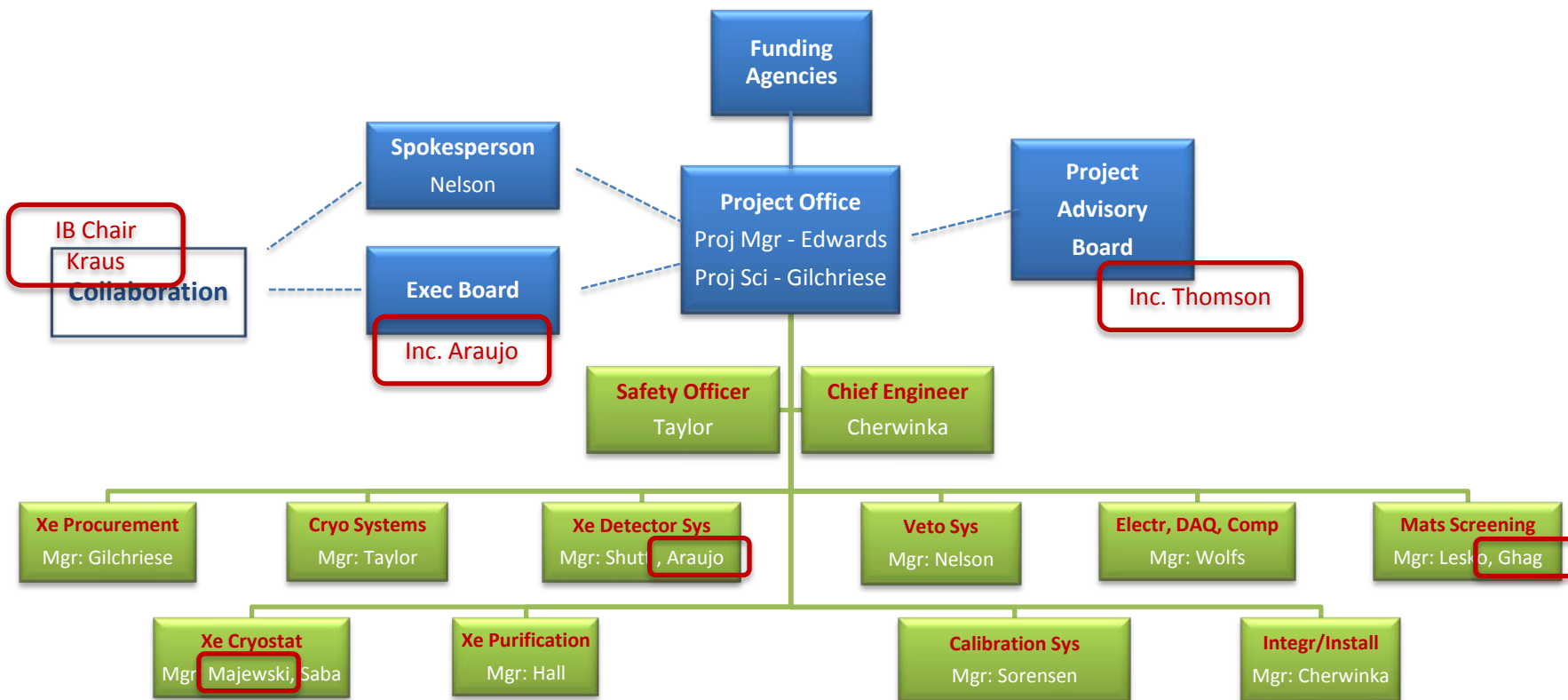
- WP100: Internal LXe TPC Monitoring (lead: Kraus/Oxford)
- WP200: Background Modelling (lead: Murphy/Edinburgh)
- WP300: High Voltage Delivery in LZ (lead: Araujo/Imperial)
- WP400: LZ Cryostat Development (lead: Majewski/RAL)
- WP500: Development of screening capabilities (lead: Ghag/UCL)
- WP600: Slow Control development (lead: Murphy/Edinburgh)
- WP700: Development of UK Data Centre (lead: Sumner/Imperial)

Project-level ongoing activities

- Design, design and more design
- Screening; System Test & other prototyping
- Resource Loaded Schedule
- Conceptual Design Report (& Review)



LZ PROJECT ORG



LZ UK – CONSTRUCTION PHASE

- **WP1: Management** (Araujo/Imperial)
- **WP2: Low-Background Cryostat** (Majewski/RAL) – co-L2
 - Material selection (RAL/UCL)
 - Cryostat construction (RAL)
- **WP3: Xenon Detector Systems** (Araujo/Imperial) – co-L2
 - TPC PMTs (1/3) + all VD bases (Imperial)
 - TPC Internal Monitoring Sensors (Oxford)
- **WP4: Materials Screening** (lead: Ghag/UCL) – co-L2
 - HPGe at Boulby, ICP-MS at UCL, Radon Emanation at UCL/MSSL
- **WP5: UK Data Centre** (lead: Sumner/Imperial)
- **WP6: Simulations & Calibrations** (lead: Kudryavtsev/Sheffield)
 - Simulations (Sheffield)
 - Veto Calibration (Liverpool)
- **WP7: Slow Control** (lead: Murphy/Edinburgh)