

DRD2: Liquid Detectors

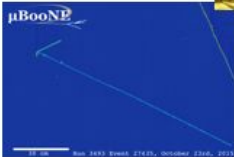
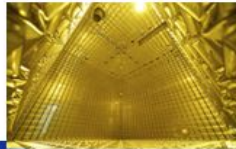
Giuliana Fiorillo
Roxanne Guenette

Dark Matter Technologies Network
29 November 2024

Our scientific communities

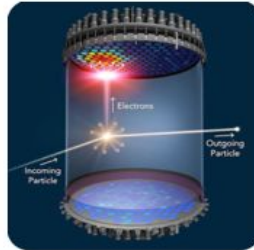
Neutrinos

- Oscillation precision measurements (δ_{CP} , mass ordering, θ_{23} octant, sterile ν_s)
- Neutrino interactions (from CEvNS to DIS)
- Astro neutrinos



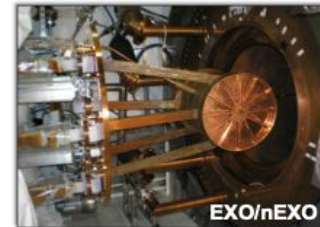
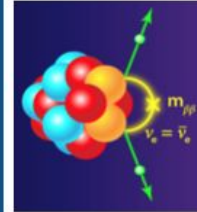
Dark Matter

- Direct detection (WIMPs, ...)



$0\nu\beta\beta$

- Search for Majorana neutrinos

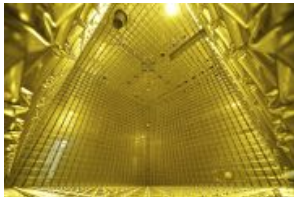
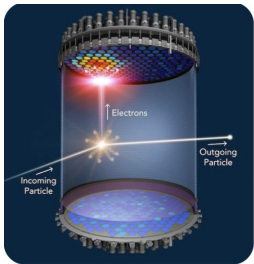


Our technology communities

Noble Elements

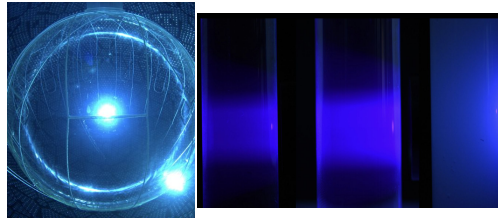
- Argon & Xenon
- Ionisation charge & transport
- VUV Scintillation, light propagation & detection

Relates to DM



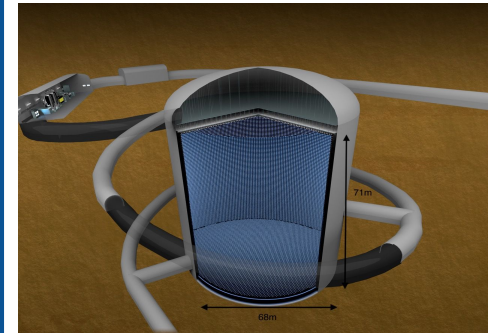
Liquid Scintillators

- Visible Scintillation, light propagation
- Scintillator properties
- Isotope loading

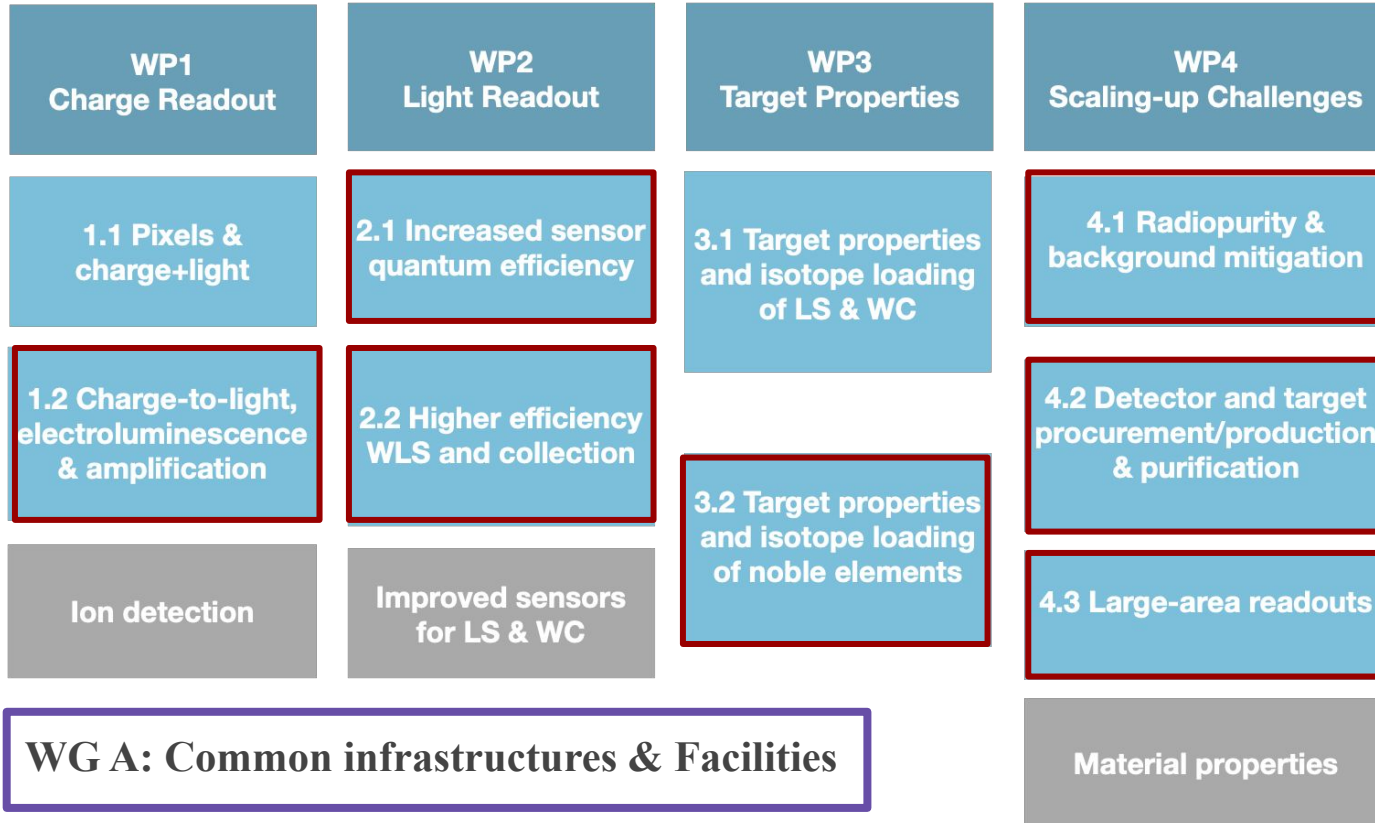


Water Cherenkov

- Cherenkov light, light propagation
- Doping for n-capture



Our scientific strategy: Work Packages



All relate to DM

WP1 Charge Readout: Progress

WP1.2 Charge-to-light, EL & Amplification

(A. Deisting & K. Mavrokoridis)

- Consolidated the scientific programme to 3 Deliverables: camera and SiPM-based particle tracking, novel devices for charge amplification in single- and dual-phase, large-scale demonstrators

	Title	Description	Institutions
D1.4	Prototype for imaging light readout	Prototypes for light imaging of charge amplification with cameras and SiPMs	2
D1.5	Report on novel charge amplification devices	Report on novel devices for charge amplification in single- and dual-phase detectors	12
D1.6	Report on large-scale tests for amplification devices	Report on large-scale tests in single- and dual-phase LAr and LXe detectors	4

Relate to DM

WP2 Light Readout: Progress

WP2.1 Increase sensor quantum efficiency

(P. Agnes & M. Garcia Peris)

- Consolidated the scientific programme to 3 Deliverables: effort targeted at efficiency in the VUV and at cryogenic temperatures, complementarity with WP1 of DRD4

Title	Description	Institutions
D2.1 Sensor development for VUV sensitivity	Development and characterization of organic photosensors, coatings and passivation methods and of SPAD geometry for VUV detection	7
D2.2 Prototype SPAD arrays	Prototypes and characterization of new SPAD arrays for 3D-integrated FSI and BSI, analog BSI and monolithic arrays	8
D2.3 Report on VUV-optimized sensor	Report on the performance of new VUV-optimised sensors in term of PDE, noise and application to rare-event searches	8

Relate to DM

WP2 Light Readout: Progress

WP2.2 Higher efficiency WLS and collection

(M. Kuzniak & J. Martin-Albo)

- Consolidated the scientific programme to 2 Deliverables: WLS and light collection optimization

	Title	Description	Institutions
D2.4	Report on optimised WLS	Report on optimised WLS (VUV to visible) and evaporation systems	3
D2.5	Design report on light collection	Design report on VUV light collection in noble elements and light readout for liquid scintillators	10

Relate to DM

WP3 Target Properties: Progress

WP3.2 Target properties and isotope loading of noble elements

(D. Franco & D. Rudik)

- Consolidated the scientific programme to 2 Deliverables: noble liquids microphysics + properties of mixtures

	Title	Description	Institutions
D3.3	Measurement of noble liquid response for low-energy recoils	Characterization of NL response to low-energy recoils and design of low-energy calibration systems	10
D3.4	Measurement of noble liquids mixtures properties	Characterization and measurement of properties of NL mixtures	13

Relate to DM

WP4 Scale-up Challenges: Progress

WP4.1 Radiopurity and background mitigation

(R. Santorelli & P. Scovell)

- Consolidated the scientific programme to 3 Deliverables: radioassay techniques, low-bckgd materials, bckgd evaluation

Title	Description	Institutions
D4.1 Report on improved radioassay techniques	Demonstration of radioassay techniques at required sensitivity for next generation of rare-event search experiments	8
D4.2 Report on low-background materials	Report on the development of novel materials, material selection, and clean treatment/manufacturing processes	8
D4.3 New tools for background evaluation	Development of new tools for background simulations and measurements of cross-section materials	6

Relate to DM

WP4 Scale-up Challenges: Progress

WP4.2 Detector and target procurement/production & purification

(M. Caravati & M. Yeh)

- Consolidated the scientific programme to 2 Deliverables: production & purification facilities, radiopurity assessment and verification

Title	Description	Institutions
D4.4 Mass production facilities	Purification and production plants for liquid targets	8
D4.5 Demonstration of UAr purification technology	Demonstration of improved purification technologies on testbeds	5

Relate to DM

WP4 Scale-up Challenges: Progress

WP4.3 Large-area readouts

(J. Crespo & D. Dwyer)

- Consolidated the scientific programme to 2 Deliverables: mid-scale and large-scale facilities for integration tests

	Title	Description	Institutions
D4.6	Medium-scale integrated testing facilities	Development of mid-scale facilities for large-area readout assembly and characterization at cryogenic temperature	6
D4.7	Report on large-area readout	Report on large-scale light and charge readout systems	5

Relate to DM

Thank You

Backup

Progress in DRD2 since approval

- First Collaboration Meeting (02/2024) ([indico link](#))
- CB Chair election: Walter Bonivento
- Co-spokespersons election: Giuliana Fiorillo, Roxanne Guenette
- All WP/Tasks leaders appointed and approved
- Creation of first WG and appointment of 1 convener
- Series of Topical Workshop to engage the community ([indico meetings](#))

Number of Institutions per Task group

