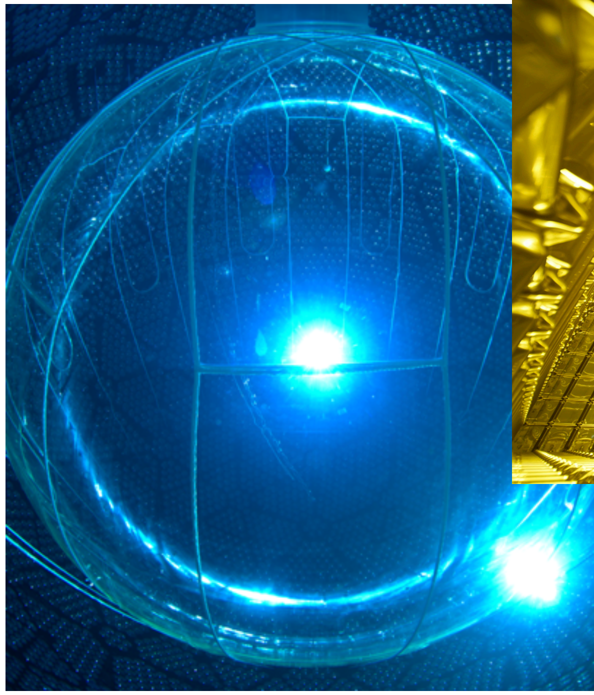
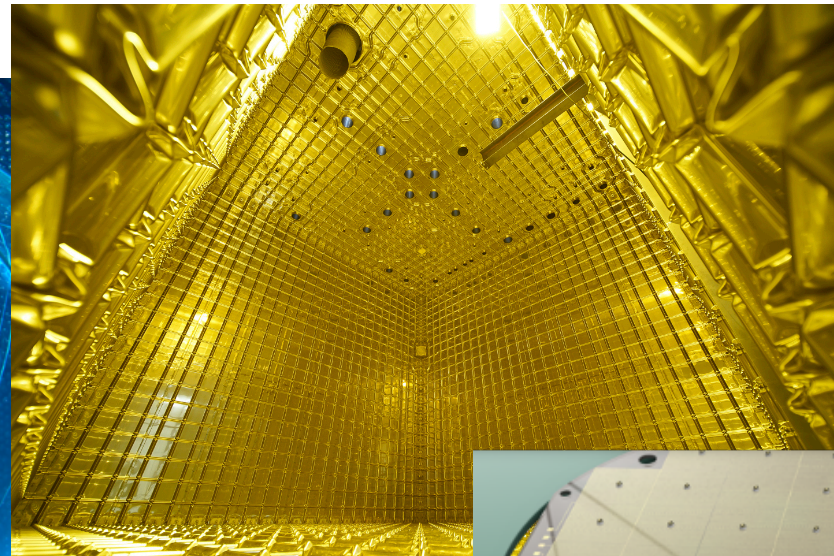
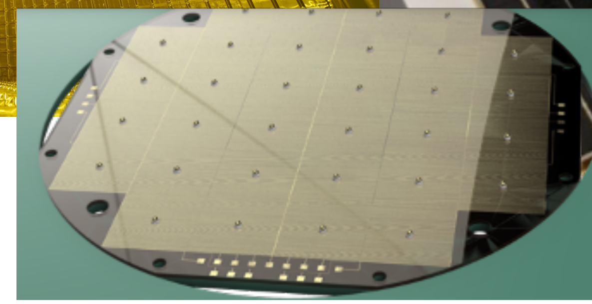
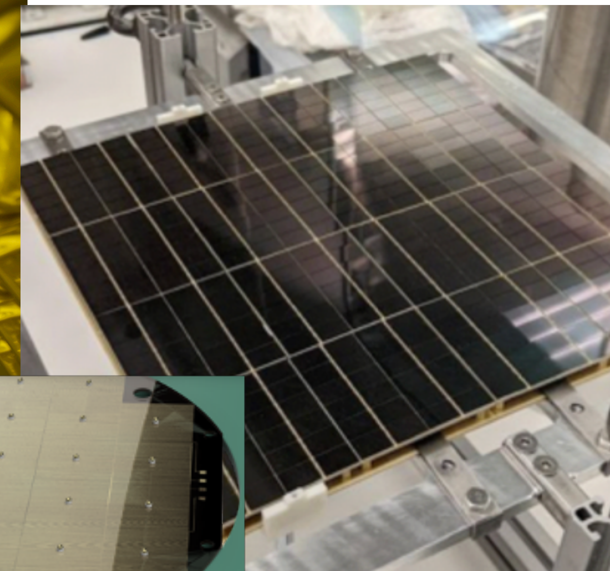
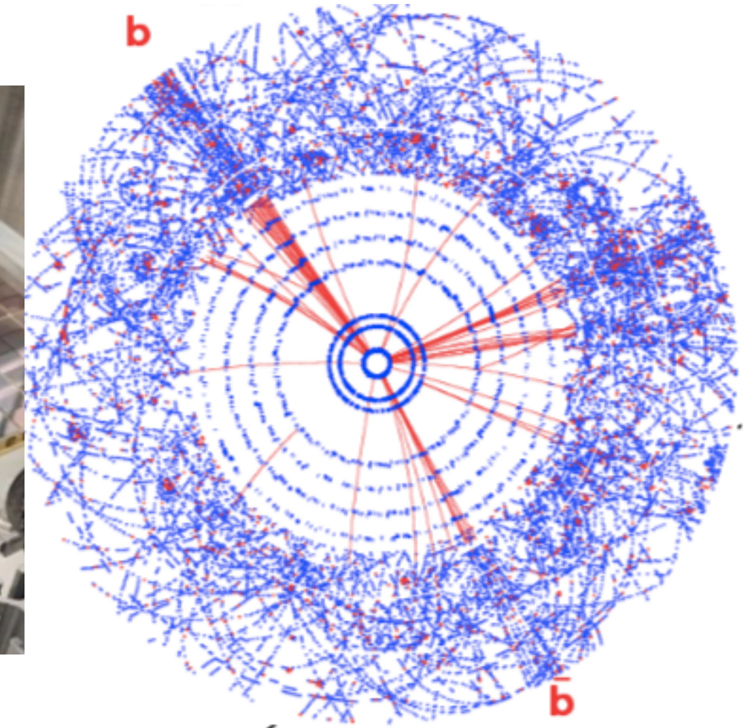






DRD2: Liquid Detectors & DRD6: Calorimetry

Jocelyn Monroe
Roxanne Guenette
(ECFA DRD2 Conveners)

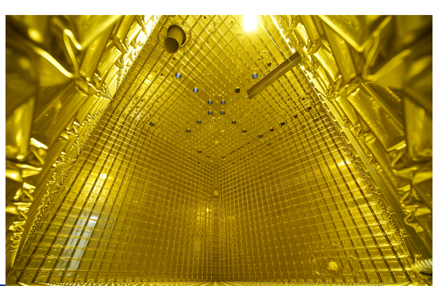
Roman Poeschl
Roberto Ferrari
Gabriella Gaudio
(ECFA DRD6 Conveners)

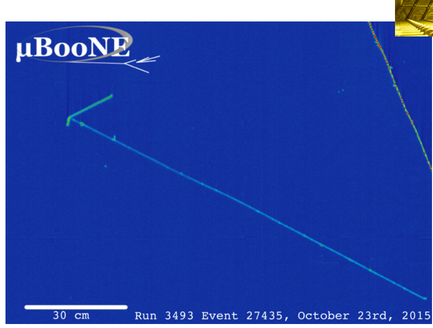
ICFA Seminar
Hamburg, DE
28 November 2023

Liquid Detectors: Science Areas

Neutrinos

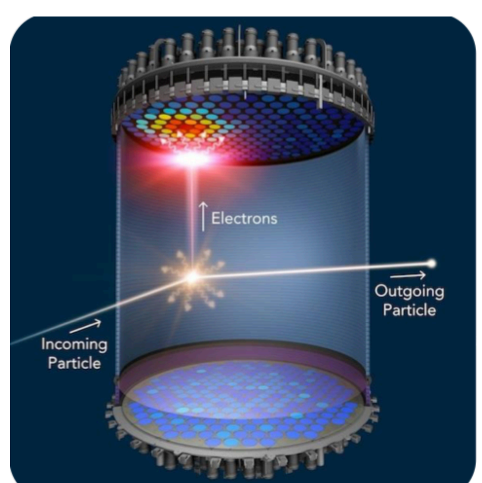
- Oscillation precision measurements (δ_{CP}, mass ordering, θ_{23} octant, sterile νs)
- Neutrino interactions (from CEvNS to DIS)
- Astro neutrinos





Dark Matter

- Direct detection (WIMPs, …)



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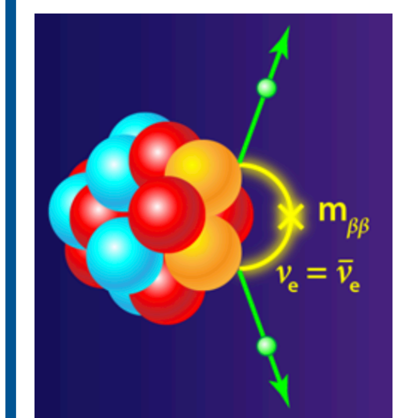
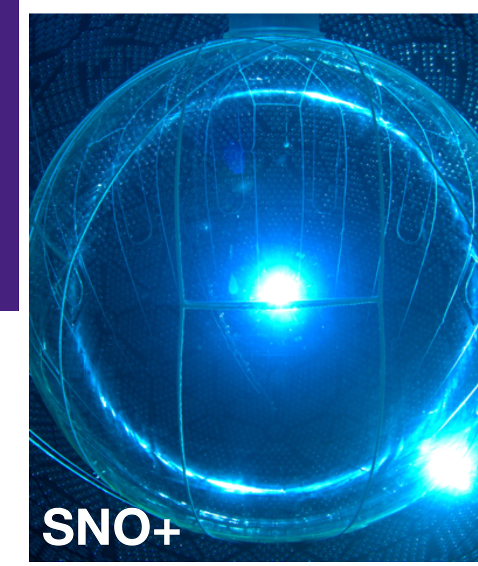
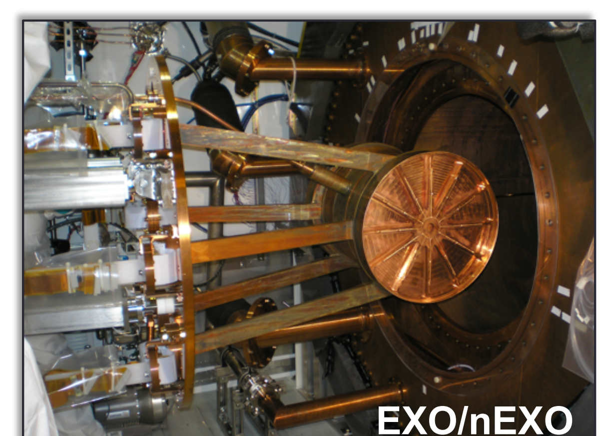
- Search for Majorana neutrinos







Liquid Detectors: Science Requirements

Neutrinos

- **Push Energy thresholds down** to ~1MeV to enhance oscillation physics, supernovae νs study, to enable solar νs …
- **Unambiguous readout**
- **Scalability**

Dark Matter

- **Push Energy thresholds down** to 1 meV/10 eV/1 keV to enable low mass DM/1 GeV DM/ WIMPs.
- **Reduce background rates**
- **Scalability**

$0\nu\beta\beta$

- **Improve Energy Resolution** to sub-% FWHM
- **Reduce background rates**
- **Scalability**

Liquid Detectors: Current Ecosystem

Neutrinos

- Current generation:
  - ✓ MicroBooNE & SBN
  - ✓ LArIAT
  - ✓ protoDUNEs
  - ✓ CAPTAIN
  - ✓ COHERENT
  - ✓ Borexino
  - ✓ SK
  - ✓ Antares
  - ✓ KM3Net
- Future generation:
  - ✓ DUNE modules 1 & 2
  - ✓ DUNE near detectors
  - ✓ DUNE modules 3 & 4
  - ✓ HK
  - ✓ Future neutrino telescopes

Dark Matter

- Current generation:
  - ✓ LUX / LZ
  - ✓ XENON 10/100/1T/nT
  - ✓ Dark Side 50/20k
  - ✓ DEAP-3600
  - ✓ Panda-X
- Future generation:
  - ✓ XLZD
  - ✓ GADMC/Argo
  - ✓ HeRALD
  - ✓ SBC

$0\nu\beta\beta$

- Current generation:
  - ✓ EXO-200
  - ✓ KamLand-Zen
  - ✓ SNO+
- Future generation:
  - ✓ nEXO
  - ✓ KL-Z+
  - ✓ Upgrades to SNO+

R&D Roadmap for Liquid Detectors (DRD2)

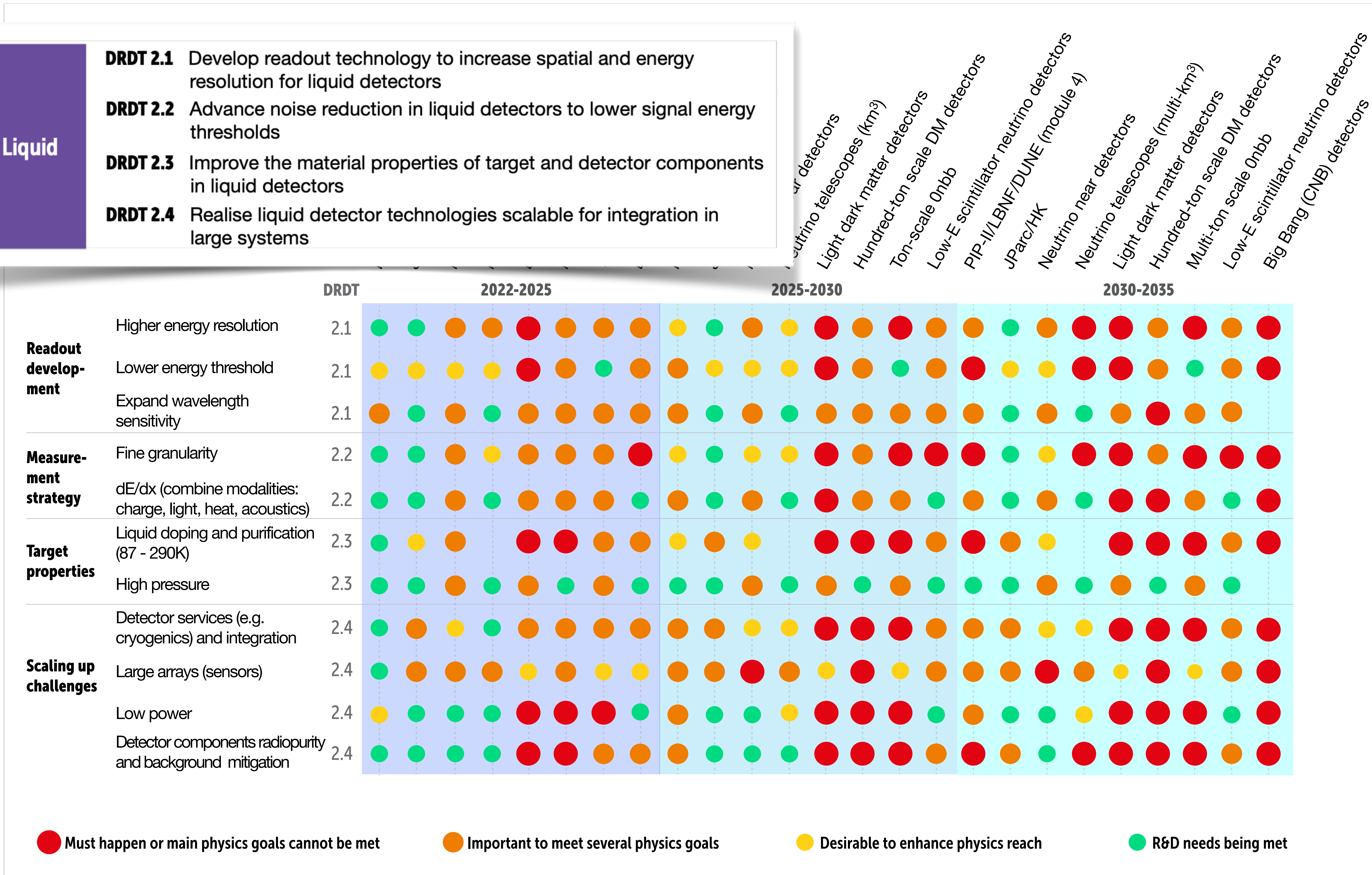
Liquid

DRDT 2.1 Develop readout technology to increase spatial and energy resolution for liquid detectors

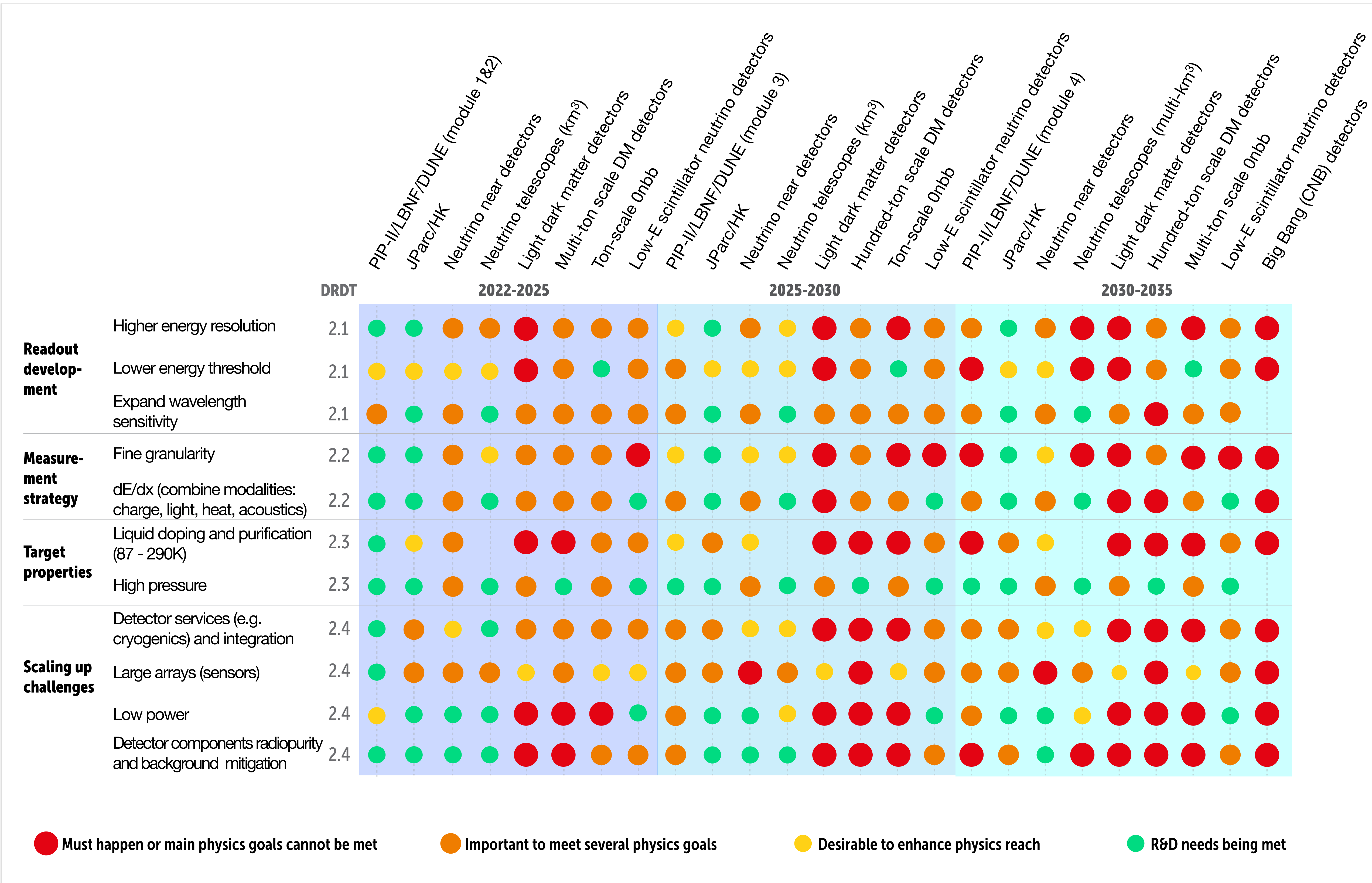
DRDT 2.2 Advance noise reduction in liquid detectors to lower signal energy thresholds

DRDT 2.3 Improve the material properties of target and detector components in liquid detectors

DRDT 2.4 Realise liquid detector technologies scalable for integration in large systems



R&D Roadmap for Liquid Detectors (DRD2)



Liquid Detectors WP1 - Charge Readout

Charge Readout Conveners

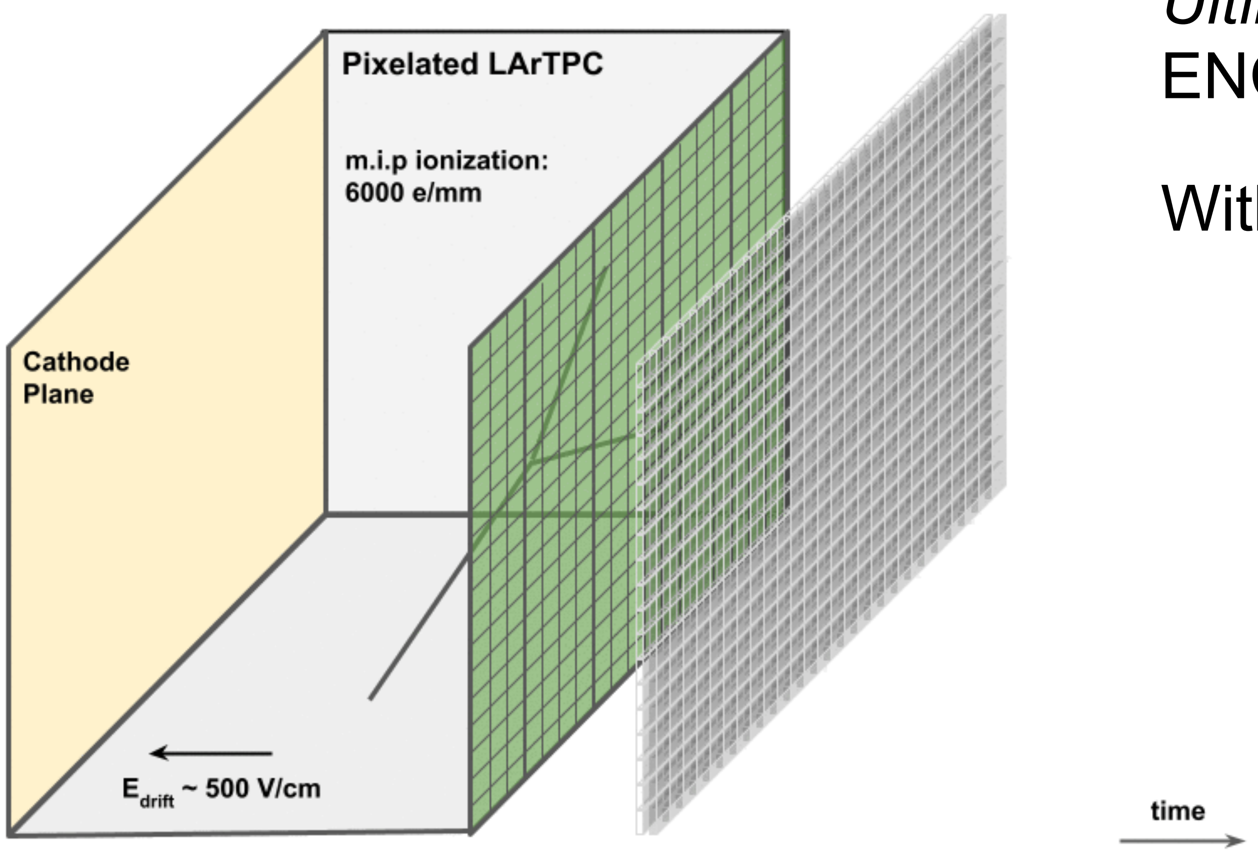
Pixels & charge+light Group leaders

Charge-to-light, electroluminescence & amplification Group leaders

Ion detection Group leaders

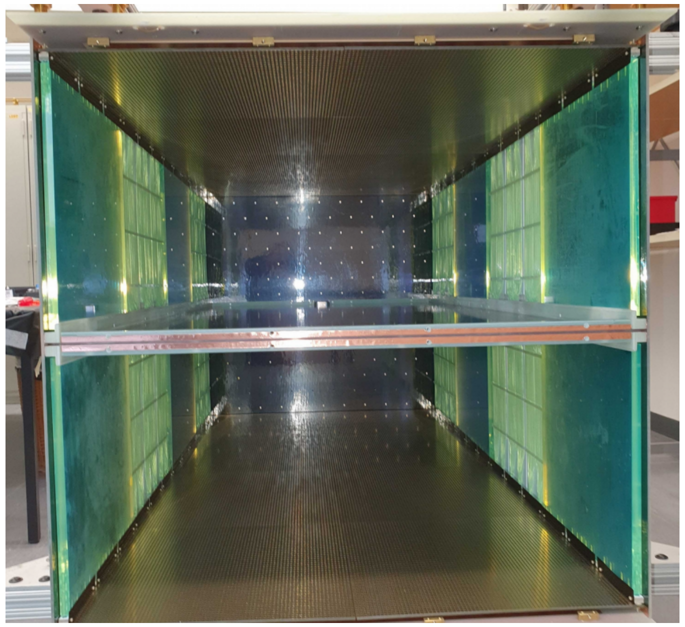
DRD1

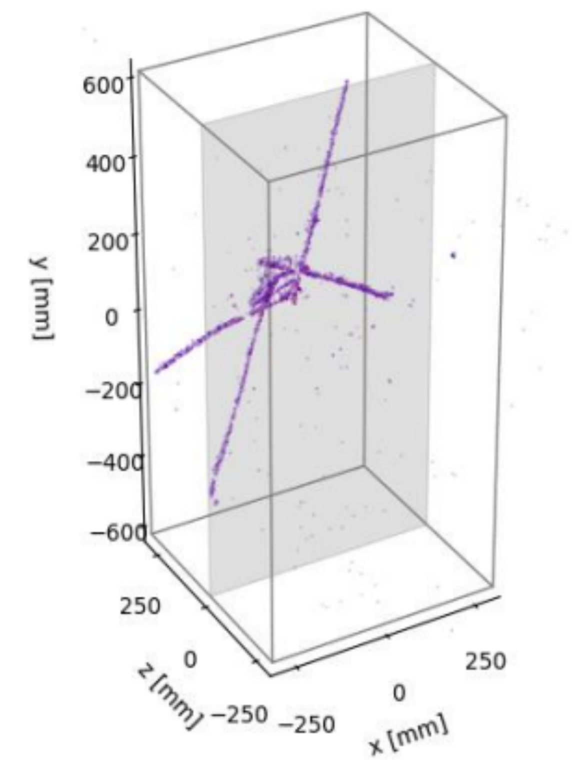
- Noble Element TPCs with fine-grained readout enable access to detailed neutrino interaction information, from MeV - GeV scales
- Capturing this data without compromise and maintaining the intrinsic 3-D quality is an aspirational goal of all readouts!
- Conventional charge readout uses sets of wire planes at different orientations to reconstruct the 3D image
  - Challenge in reconstruction of some topologies, lower energy = harder!
- Pixel based readout is a natural solution
-



Ultimate goals: reach 10^7 channels, fC charge, 100 ENC, lower-energy photon detection threshold

With charge…. **LArPix:** O(100k) channel**, QPix**





J. Asaadi, 2nd Liquid Detectors Community Meeting

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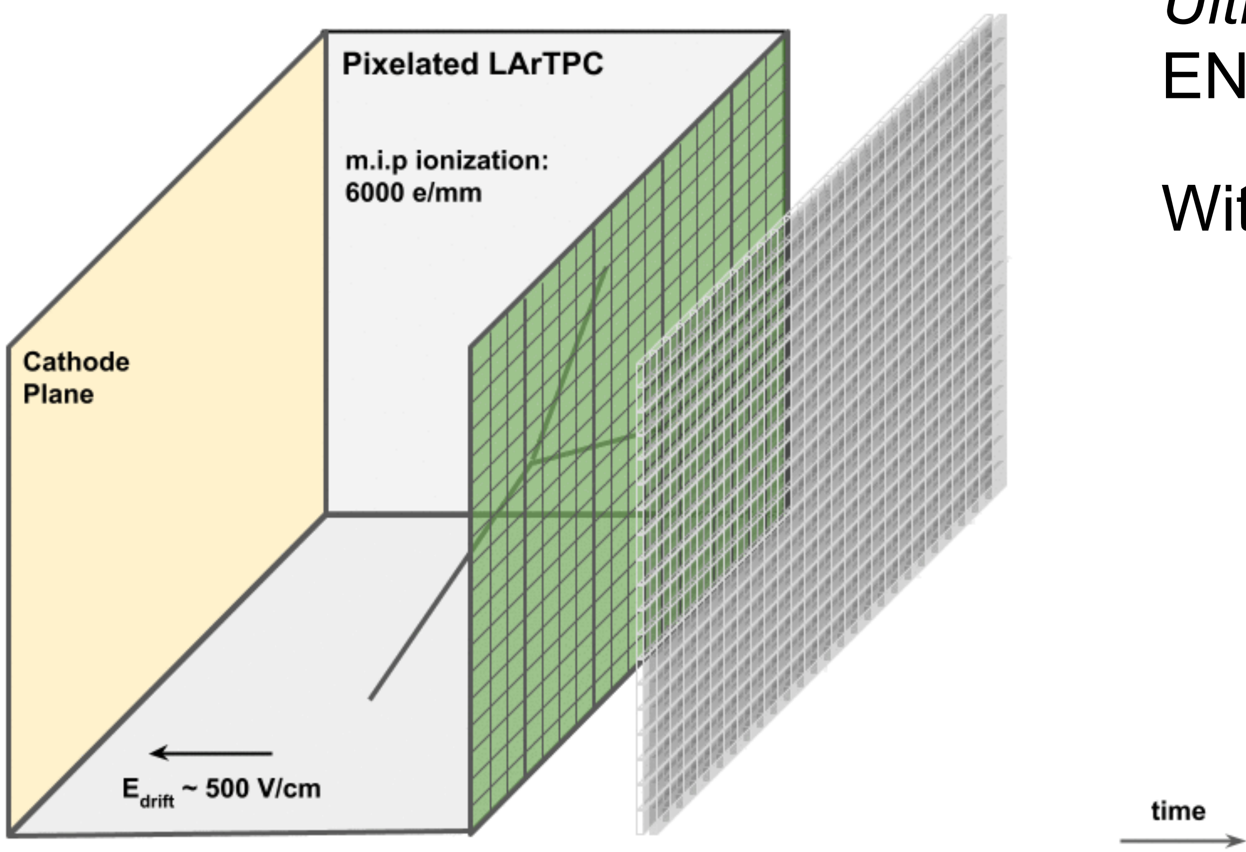
DRD1

-



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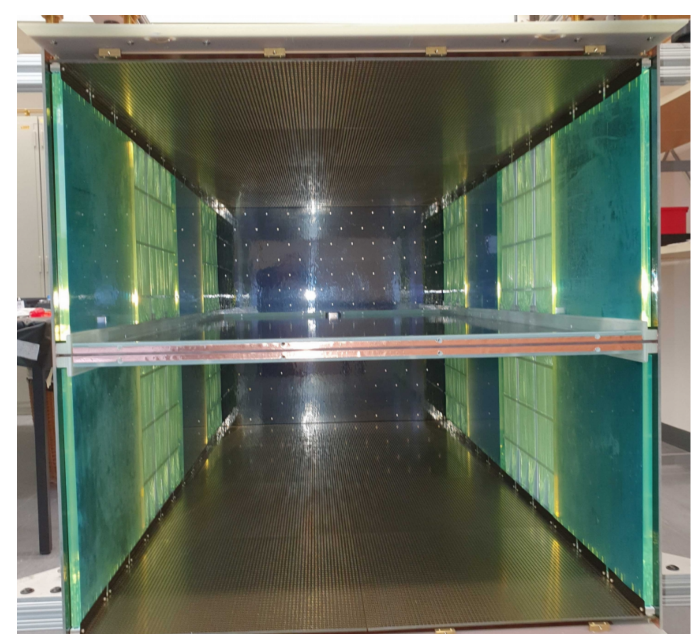

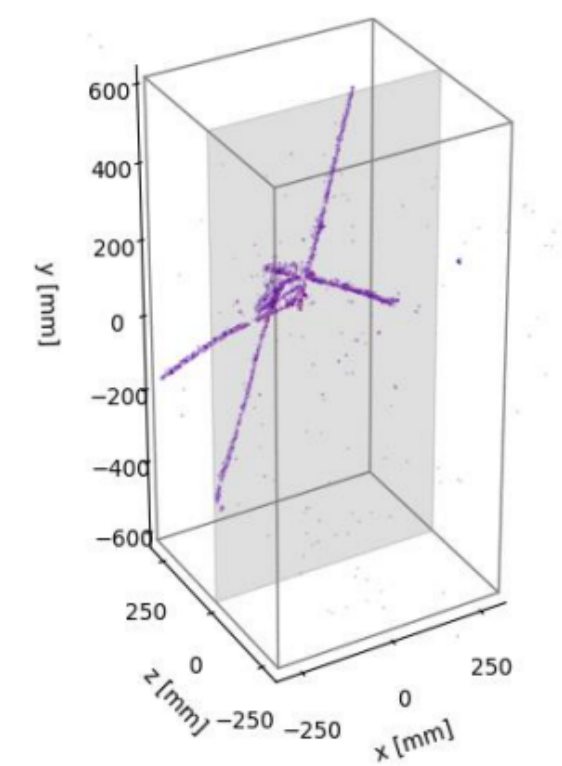

J. Asaadi, 2nd Liquid Detectors Community Meeting

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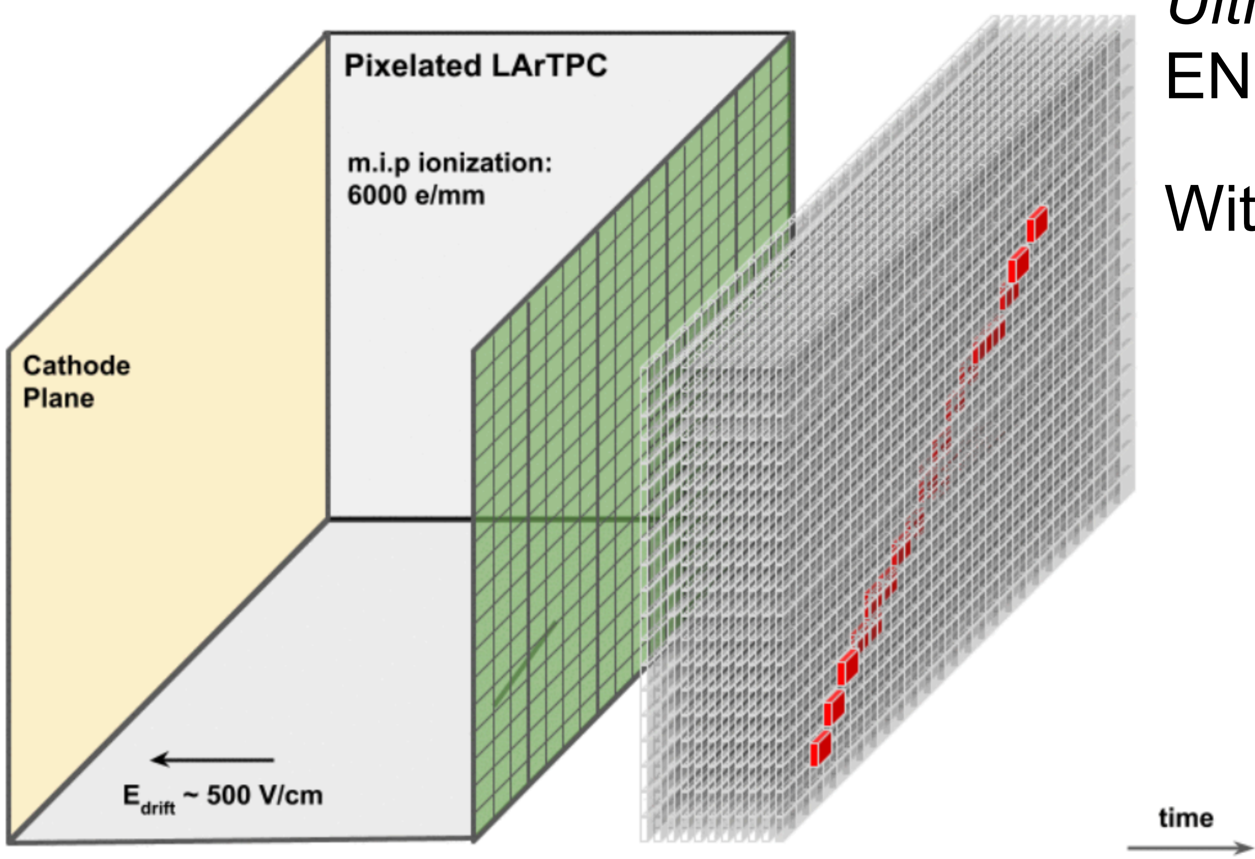

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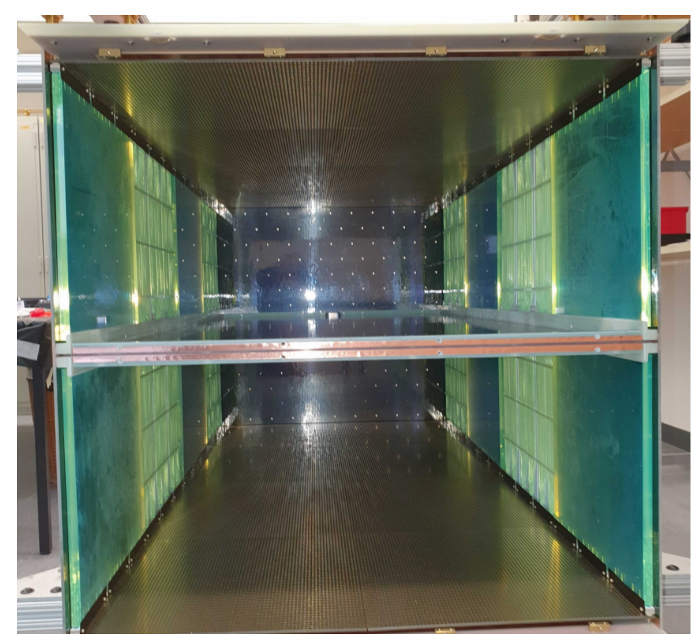

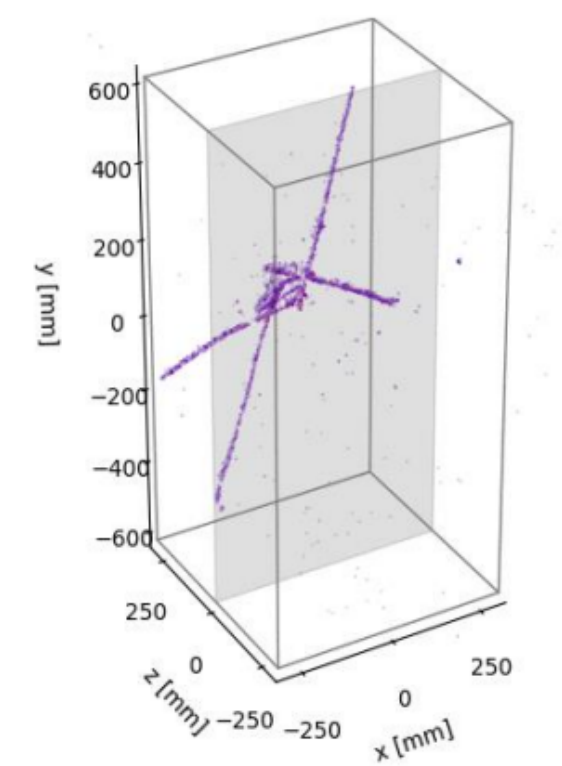

J. Asaadi, 2nd Liquid Detectors Community Meeting

Liquid Detectors WP1 - Charge Readout

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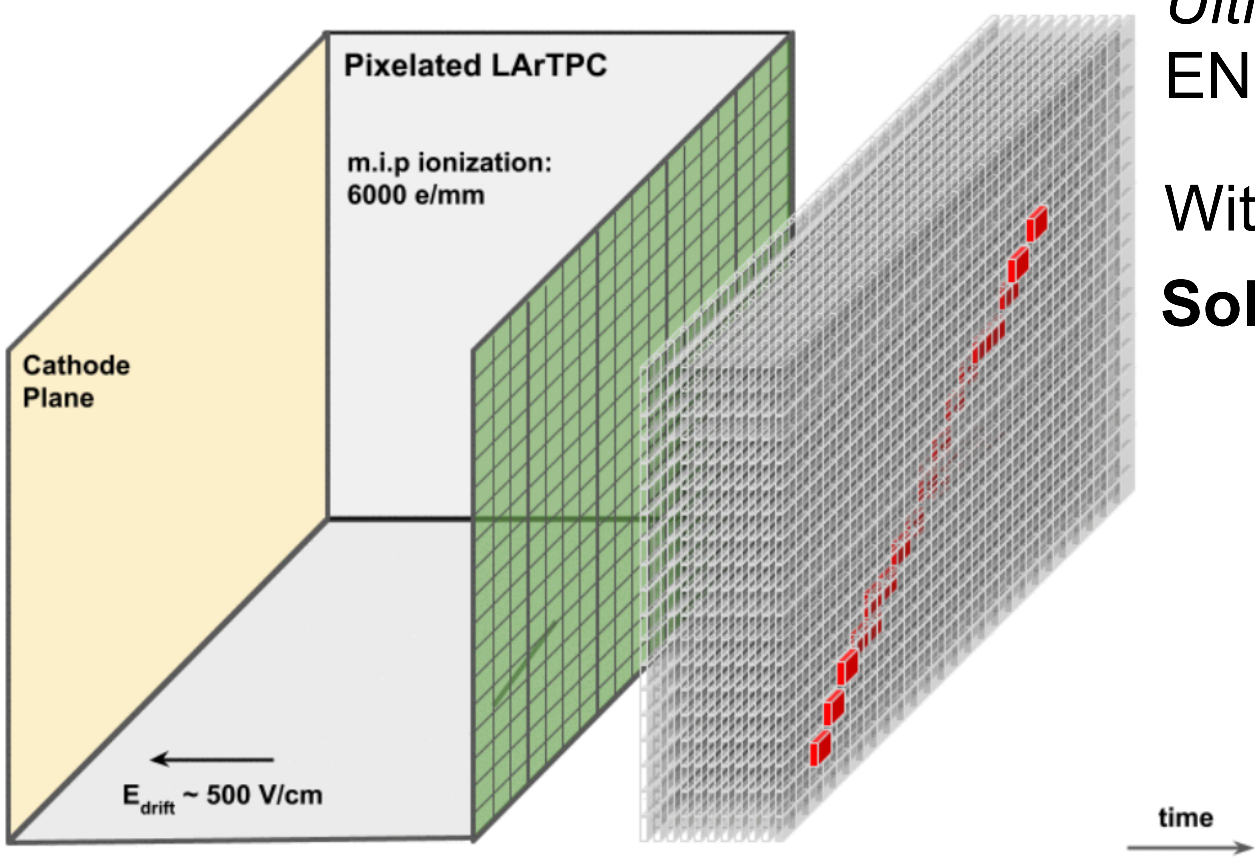

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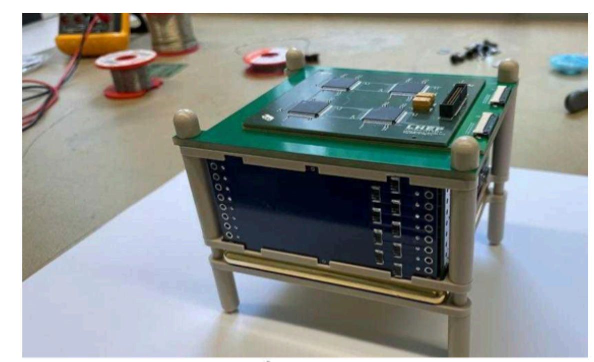
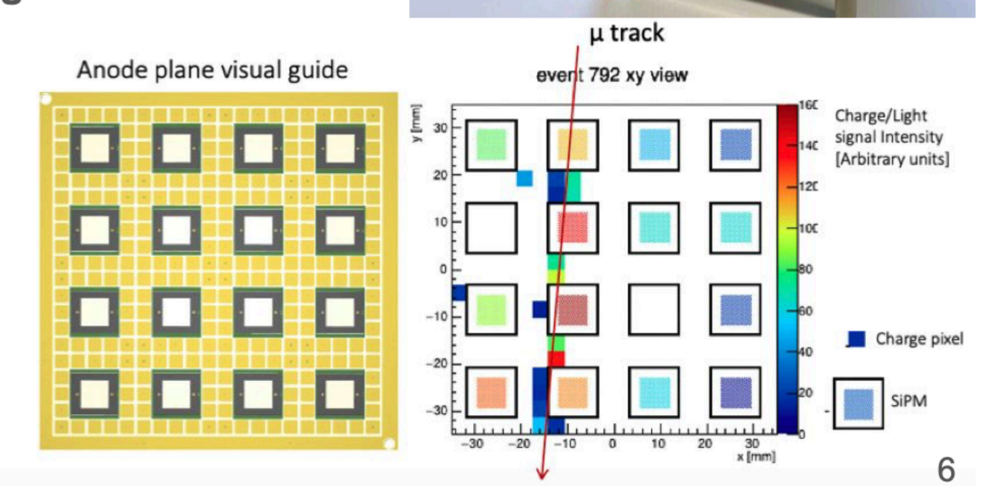
With charge and light….

SoLAR, LiLAR



First track with
integrated Q+L readout



E. Grammelini, 2nd Liquid Detectors Community Meeting

Liquid Detectors WP1 - Charge Readout

Charge Readout Conveners

Pixels & charge+light Group leaders

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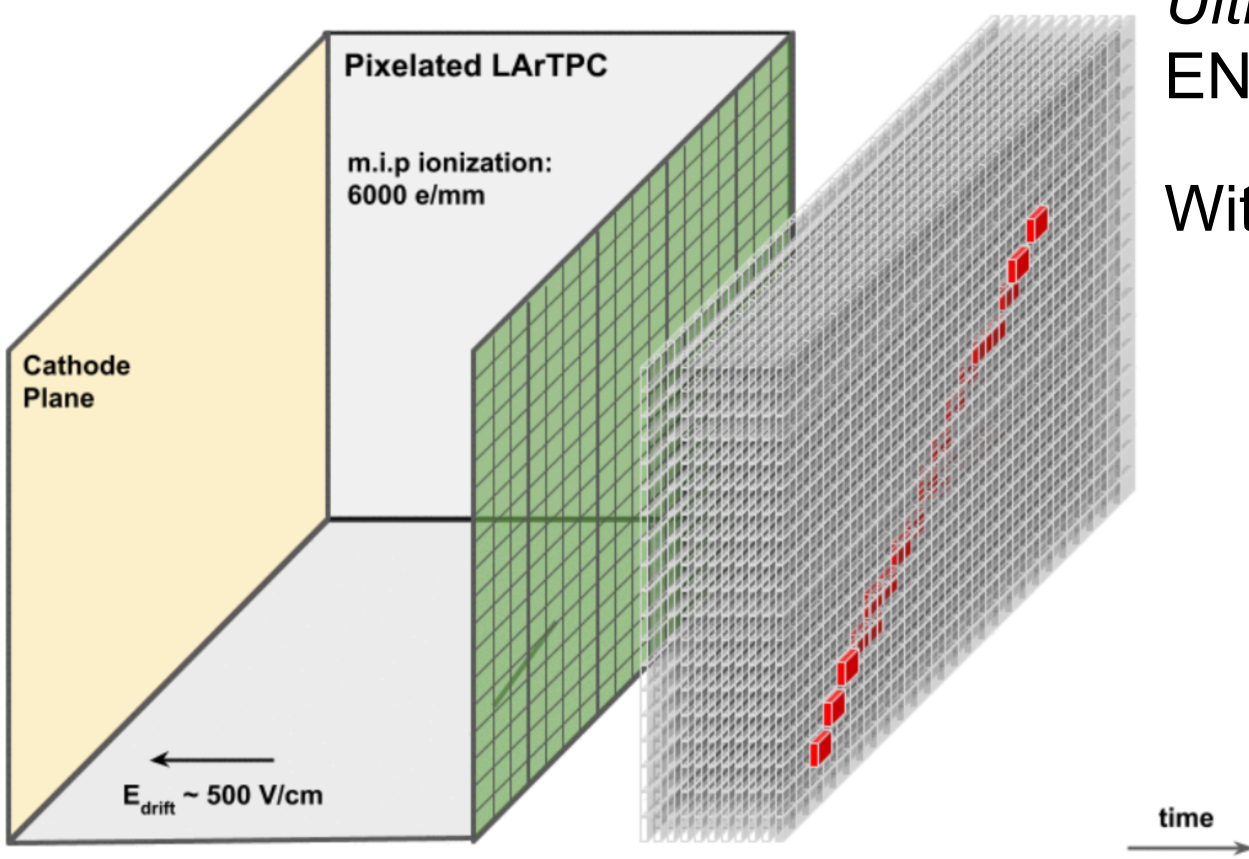

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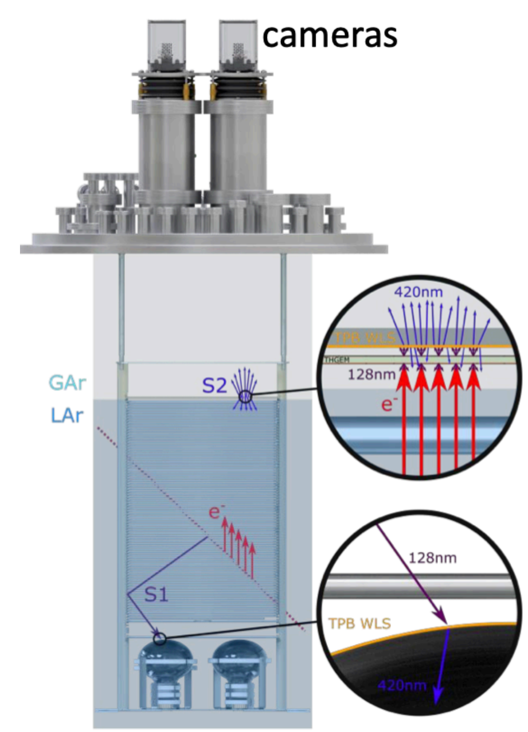
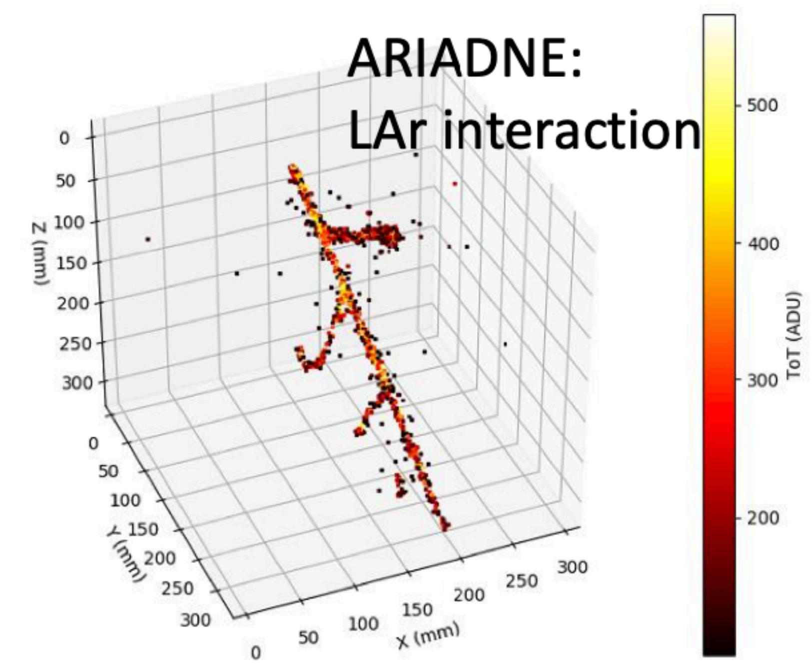
With charge-to-light…. **ARIADNE**





K. Mavrokoridis, 2nd Liquid Detectors Community Meeting

Liquid Detectors WP2 - Light Readout

Light Readout Conveners

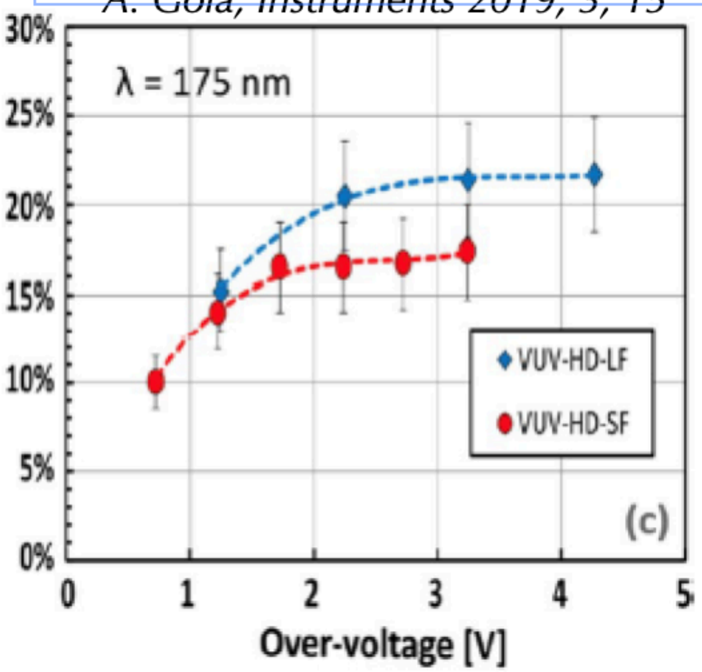
Increased sensor quantum efficiency
Group leaders

Higher efficiency WLS and collection
Group leaders

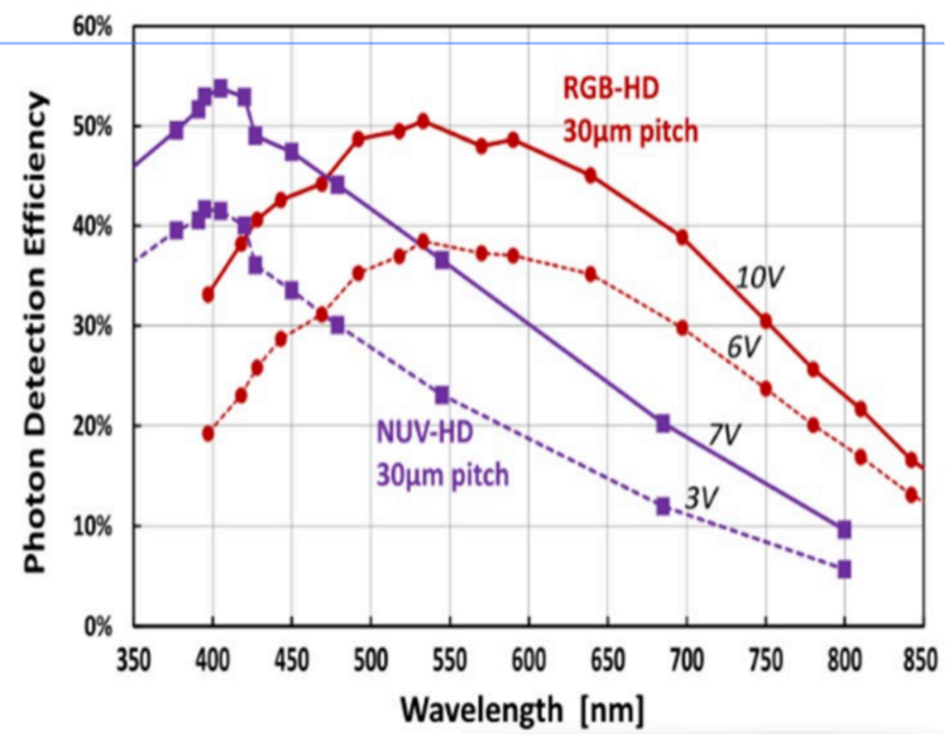
Improved sensors for LS & WC
Group leaders

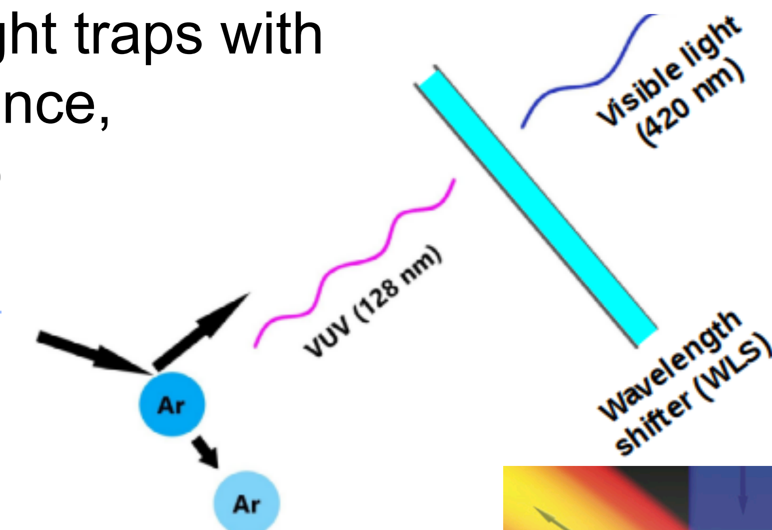
DRD4

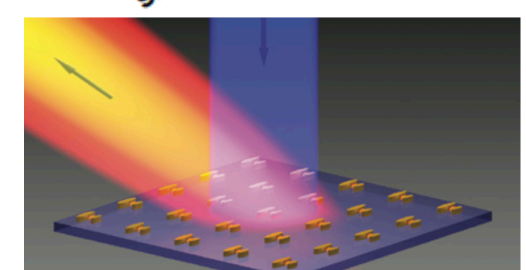
- O(0.1-10) kT experiments are, and are planned, to use liquid noble targets which scintillate in the VUV wavelength range (Ar, He, Xe)
    - Aim: photon readouts reaching O(100 m^2), *cryogenic temperature*
- Conventional strategy: either accept photon detection efficiency << in visible range, or, wavelength shift using thin films with ~isotropic emission
    - Key challenges: decrease reflectivity, increase collection efficiency, increase quantum efficiency
- Exploration of new materials, i.e. better wavelength shifters, light traps with dichroic filters, coatings optimised for range of angles of incidence, metalenses, and new processes (i.e. BSI-SPAD + passivation)

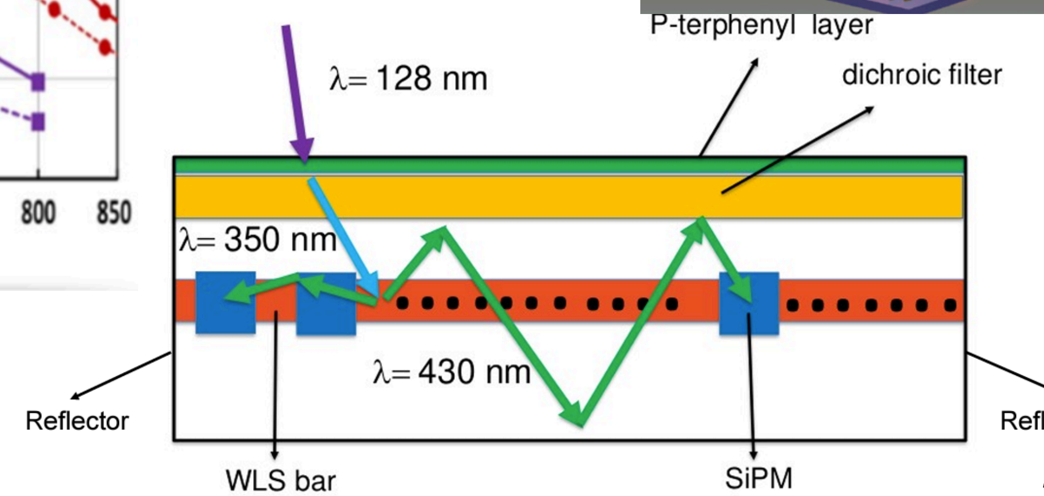


A. Gola, Instruments 2019, 3, 15









C. Cuesta, 2nd Liquid Detectors Community Meeting

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Light Readout
Conveners

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Group leaders

Higher efficiency WLS and collection
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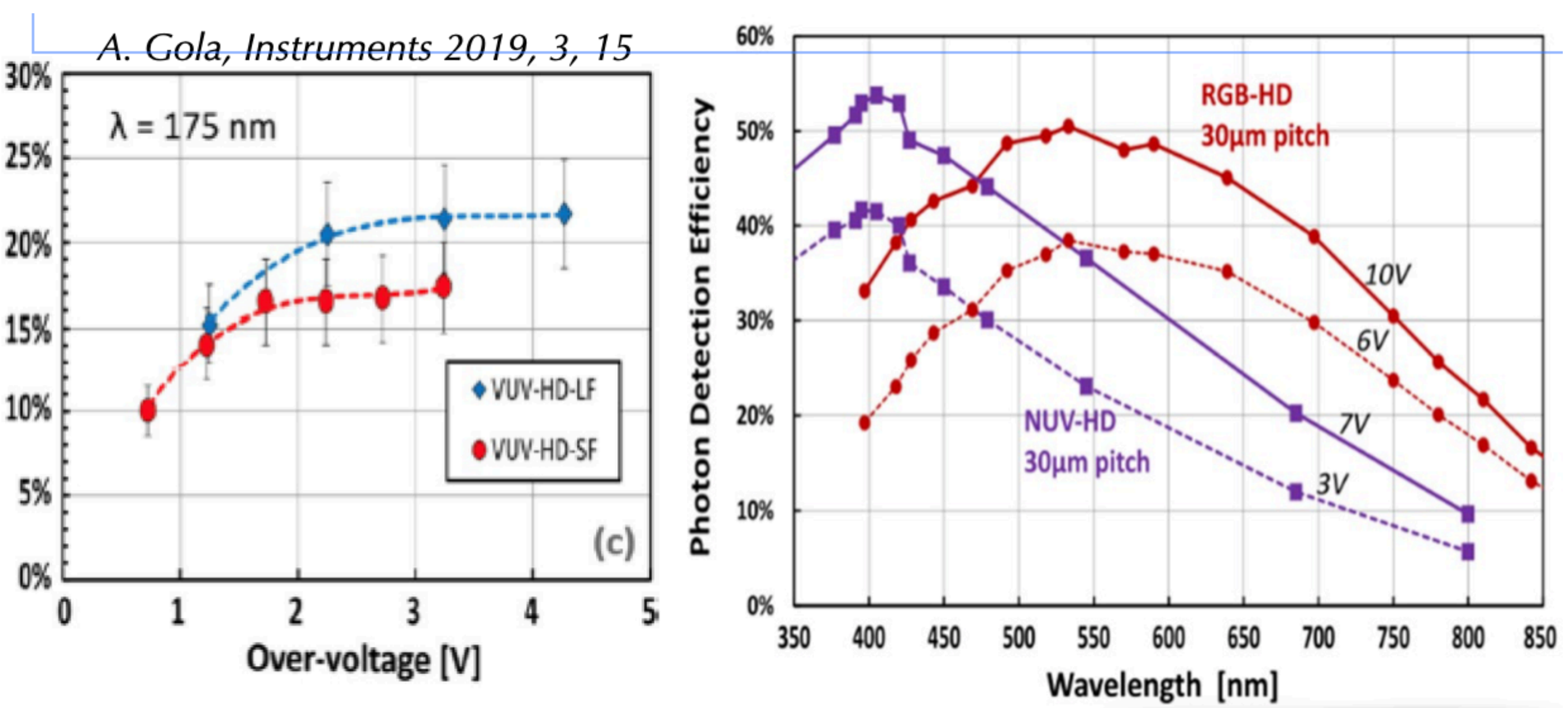
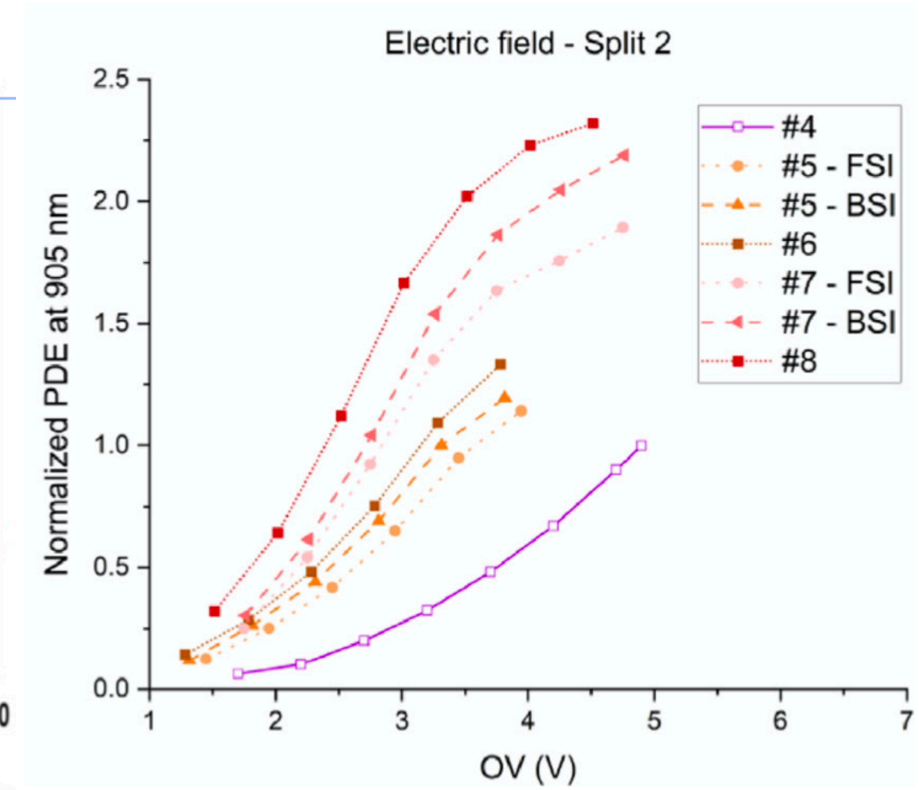
DRD4





Parellada-Monreal et al., NIM A 1049(2023) 168042

J. Monroe, 2nd Liquid Detectors Community Meeting

Liquid Detectors WP3 - Target Properties

Target Properties
Conveners

Target properties and isotope loading of LS & WC
Group leaders

Target properties and isotope loading of noble elements
Group leaders

- Aim is to increase photon yield and detection efficiency by doping, *improve* understanding of microphysics, add additional physics/medical capability to large liquid detectors, in two paths….

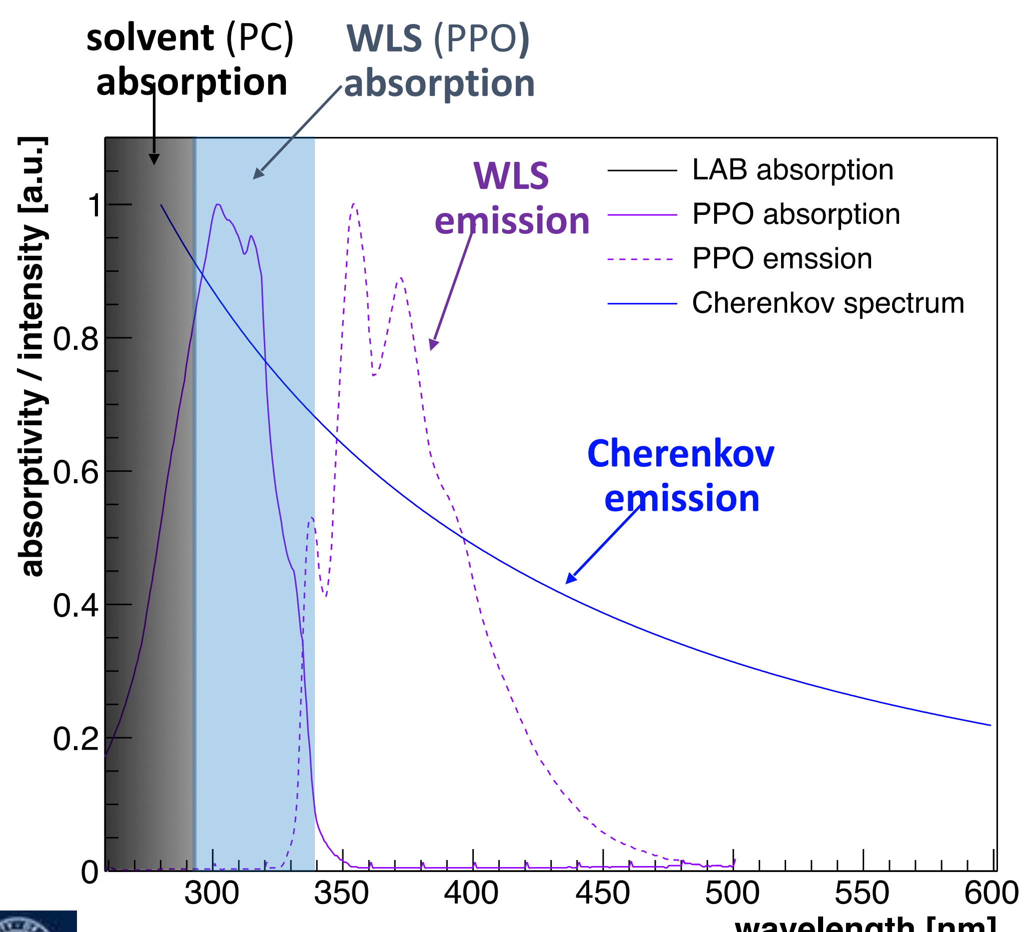
Cryogenic noble gases (CNG):

- Liquid Argon
- Liquid Xenon
- Liquid Helium (future?)

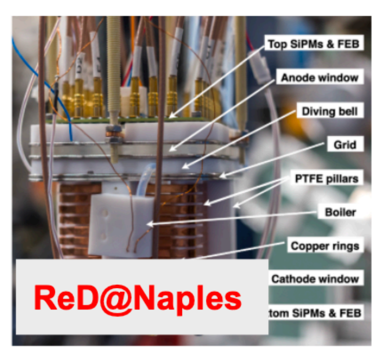
➡ Doping of liquid Argon with Xenon or more complex mixtures

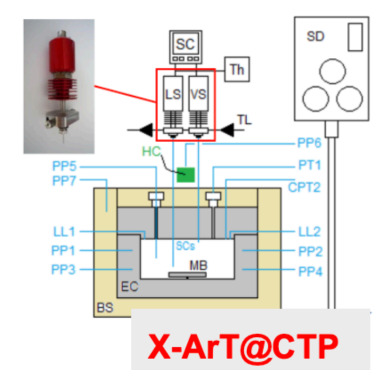
Liquid scintillators (LS) (organic/water):

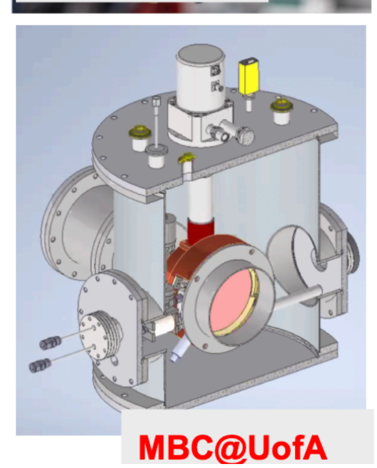
- Solvents: LAB, DIN, PC, Xylene, …
- Diluted Solvents
- Slow Scintillators and Blended Solvents
- Wavelength Shifters
- Water Based Scintillators + Surfactants
- Loading of scintillators with Gd, Te, Xe, Cd, B, Li, In …

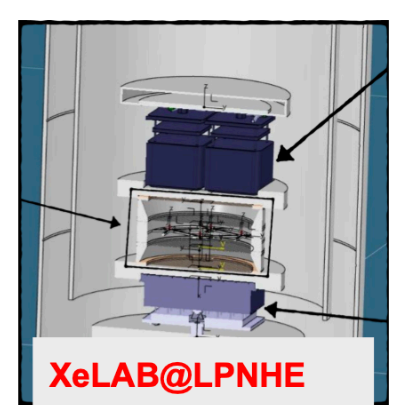


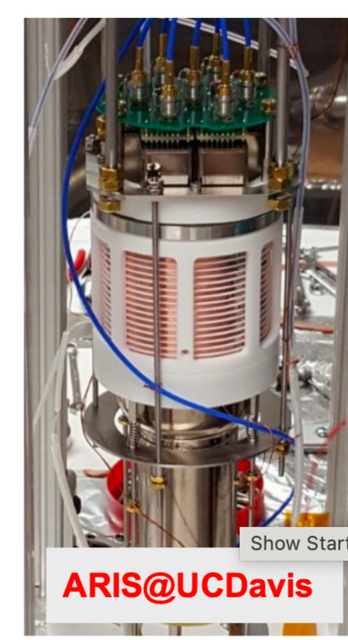
Intense and worldwide efforts on characterisation…

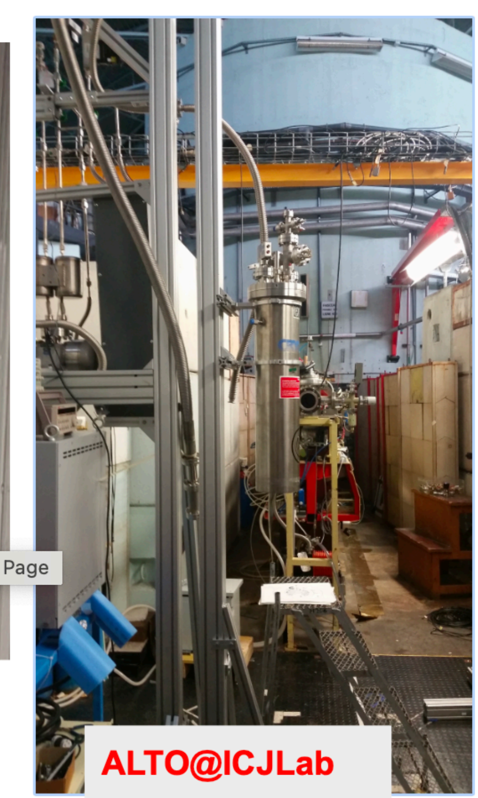












Liquid Detectors WP4 - Scaling-up

- Background reduction requirements get commensurately harder
  - Key challenges: radiopurity of *all* detector materials, including target liquids!
  - Ultimate goal reaching *1 event/kg/**millenium***
- Developments in production/purification thus far owned by experiments
  - UAr production led by GADMC development of major infrastructures (URANIA, ARIA), use cases for DarkSide-20k / LEGEND-1000 / COHERENT / ARGO
  - Xe purification in each of current experiments + developments towards XLZD/DARWIN
  - LSc challenges in scale-up synthesis of laboratory-prepared fluorescence materials
  - Gd-doping now widespread in use, R&D needs on increasing concentration, purity, optics
- Large scale assembly and test facilities needed, including underground

Scaling-up Challenges
Conveners

Radiopurity & background mitigation
Group leaders

Detector and target procurement/production & purification
Group leaders

Large-area readouts
Group leaders

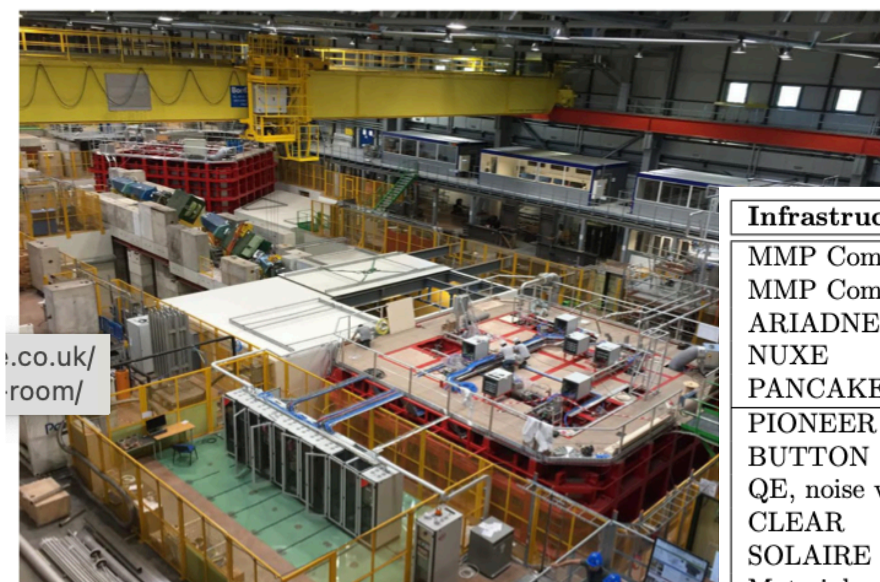
Material properties
Group leaders

Vision: develop DRD2 Collaboration coordinated requests to 'access-giving' infrastructures

CERN Neutrino Platform
- Large cold box
- Large scale cryogenics
- Charged particle beam

Gran Sasso ++
- Underground facility
- Cryogenic infrastructure

Local labs for specific tests
- Readout
- Assembly



.co.uk/
room/

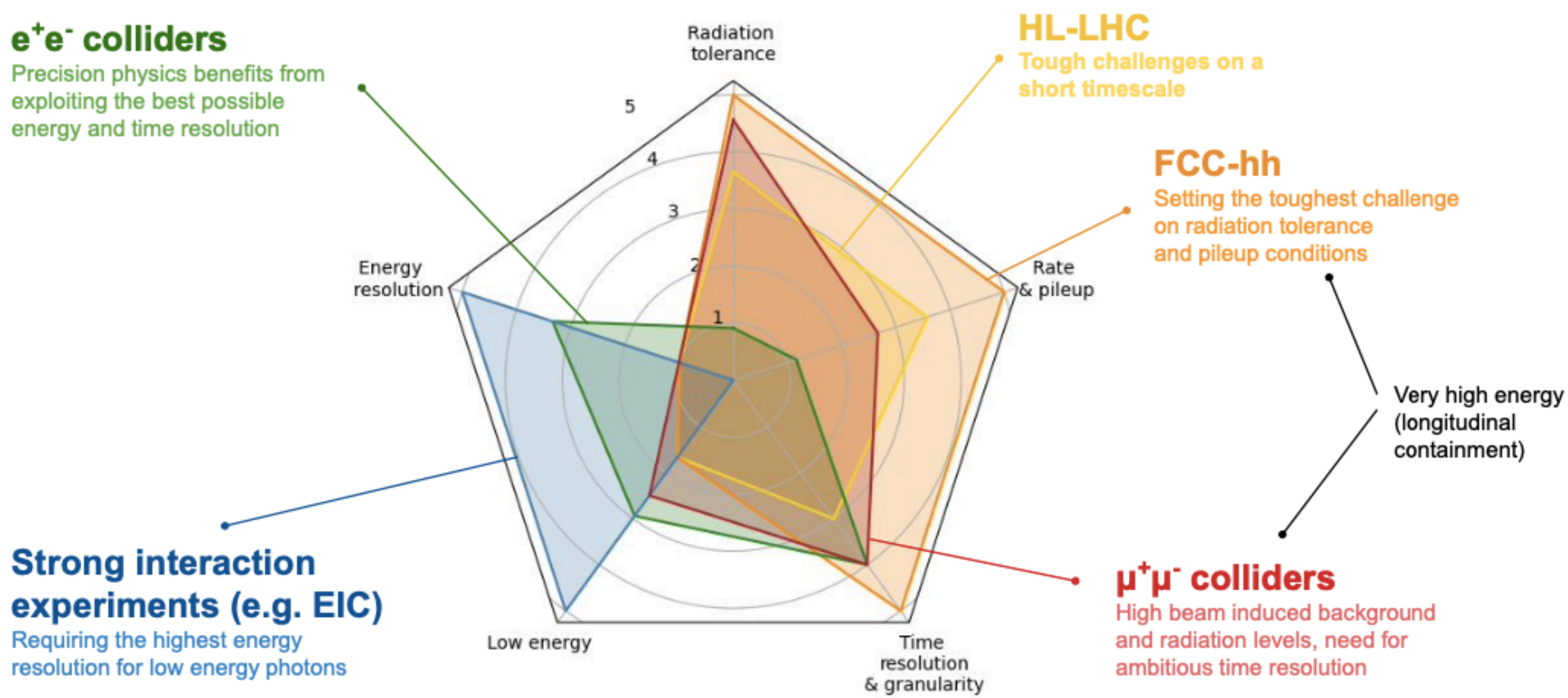
Infrastructure	Location	Work Package
MMP Common Test Platform	SNS	1.1
MMP Common Test Platform	CERN (potentially Neutrino Platform)	1.1
ARIADNE	Liverpool	1.2
NUXE	UCSD	1.2
PANCAKE	Freiburg	1.2
PIONEER	TRIUMF	2.1
BUTTON	Boulby	2.1
QE, noise vs. (λ, T)	CIEMAT, Liverpool, Napoli	2.1
CLEAR	TRIUMF	2.1
SOLAIRE	Boulby	2.1
Materials characterisation	Nikhef	2.2
WLS/light collection	[illegible]	2
1TBNL, 30TBNL	[illegible]	1
1TBNL, 30TBNL	BNL	3.1
Xenoscope	Zurich	3.2
WbLS Testbeds	various	4.2
100 tonne-scale WbLS facility	TBD	4.2
URANIA	Colorado	4.2
ARIA	Sardinia	4.2
Neutrino Platform	CERN	4.3
WCTE	CERN	4.3

https://stjohns.footfallpractice.co.uk/
sp_footfall_rooms/consulting-room/

W. Bonivento, J. Dobson, G. Fiorillo, 2nd Liquid Detectors Community Meeting

Thanks to R. Poeschl

Calorimetry: Science Areas



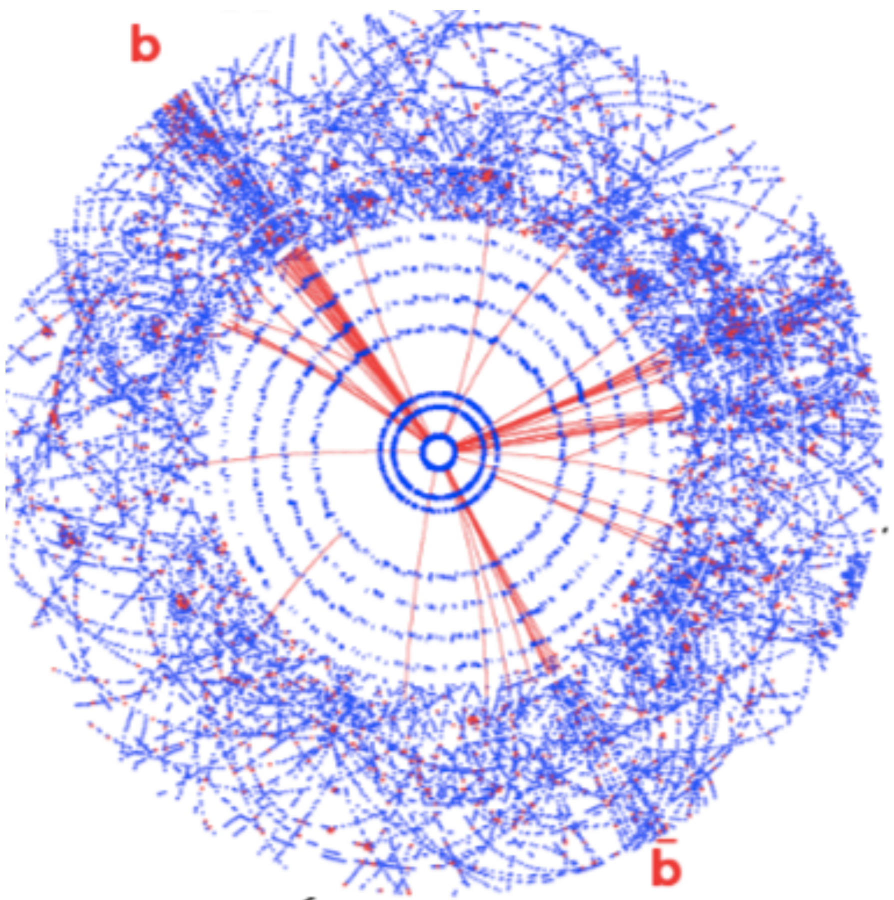
Inspired from https://indico.cern.ch/event/994685/

M. T. Lucchini, 1st Calo Community Meeting

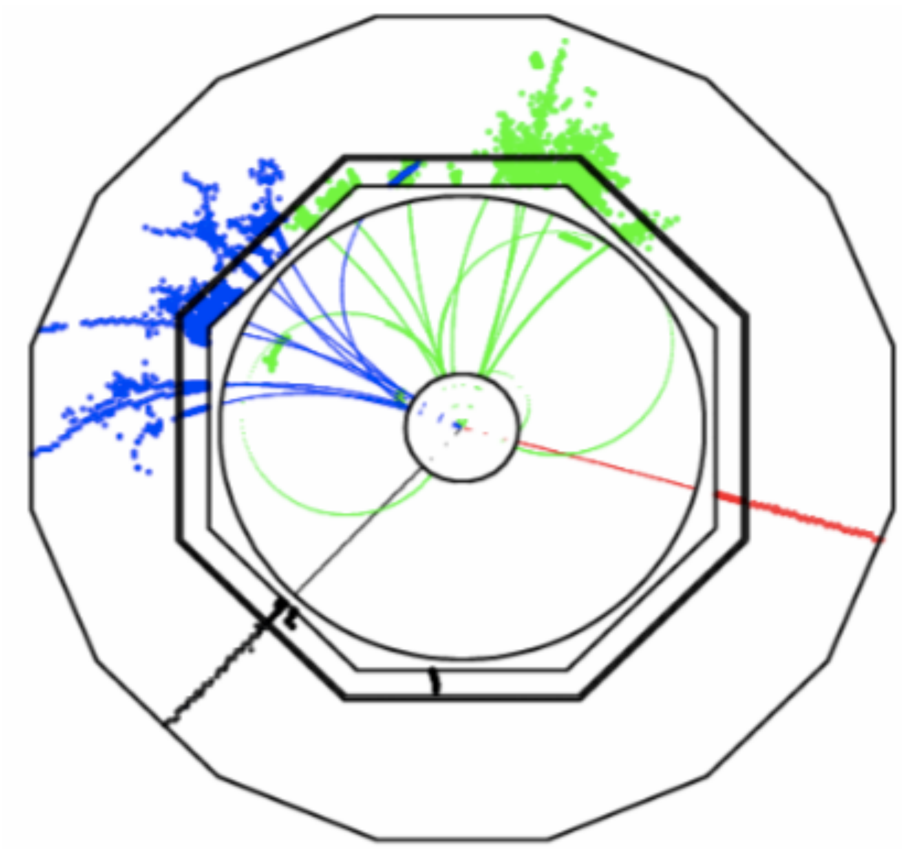
Thanks to R. Poeschl

Calorimetry: Requirements Illustration

Hadron-hadron collisions e.g. LHC



e$^+$e$^-$-collisions



- Busy events
- Require hardware and software triggers
- High radiation levels

- Clean events
- No trigger **(??)**
- Full event reconstruction

Large fraction of community submitted input is targeted at a future e+e- collider

Slide from Y. Sirois

Calorimetry Current Ecosystem

- Proposals comes from pre-existing collaborations or working framework
- Consolidated modus-operandi and experience
- Need to pick up all the best and put into the DRD6 collaboration

G. Gaudio, 2nd Calo Community Meeting

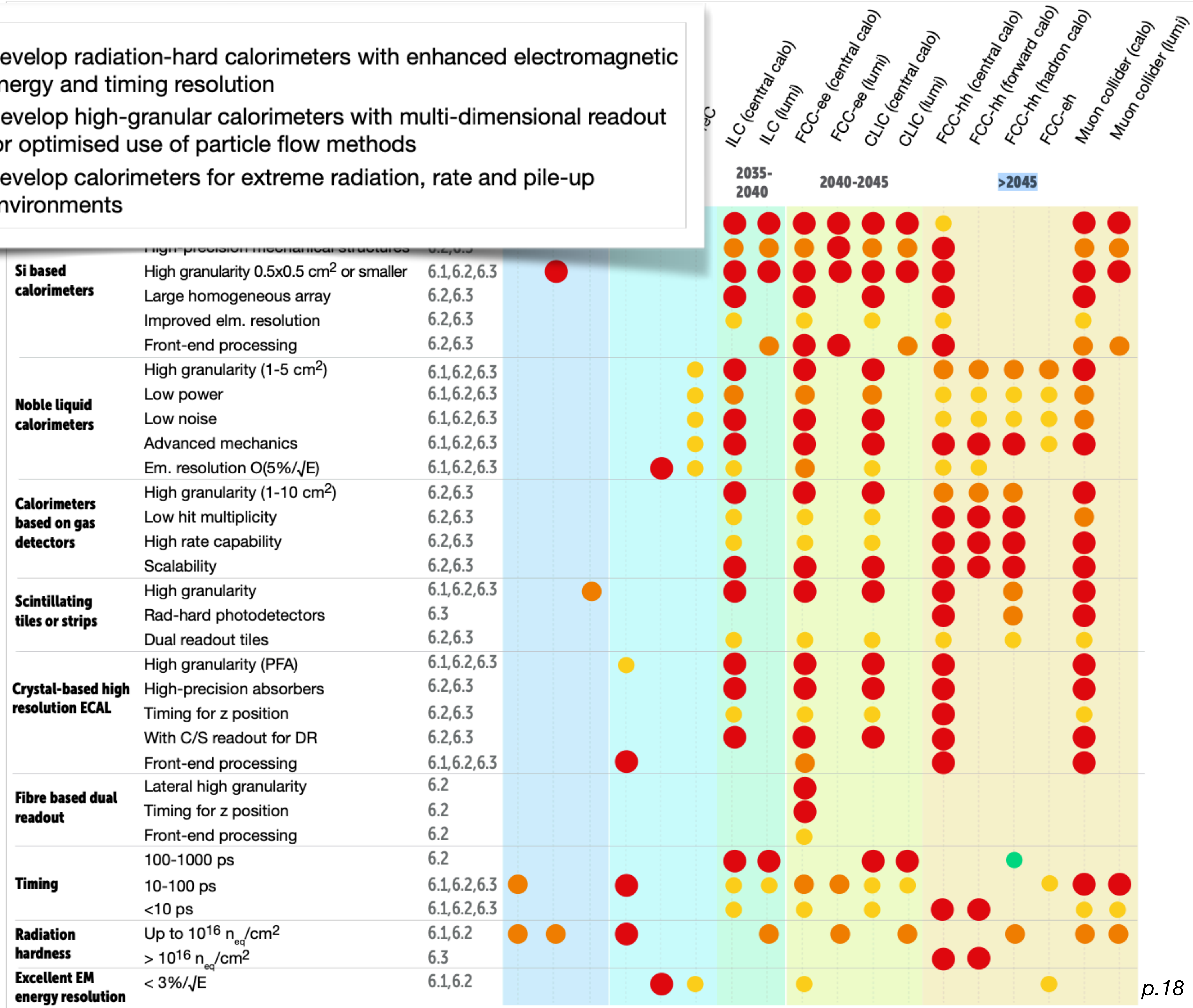
R&D Roadmap for Calorimetry (DRD6)

Calorimetry

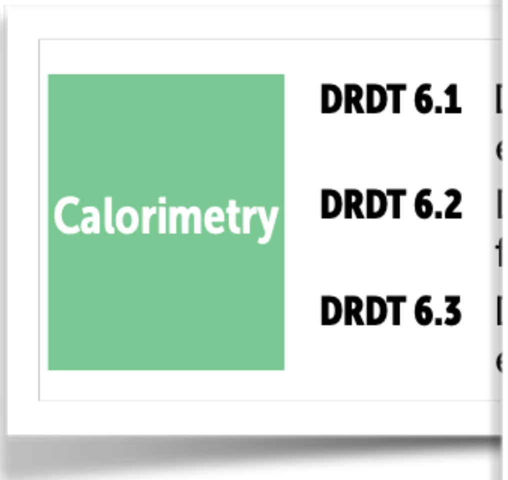
DRDT 6.1 Develop radiation-hard calorimeters with enhanced electromagnetic energy and timing resolution

DRDT 6.2 Develop high-granular calorimeters with multi-dimensional readout for optimised use of particle flow methods

DRDT 6.3 Develop calorimeters for extreme radiation, rate and pile-up environments

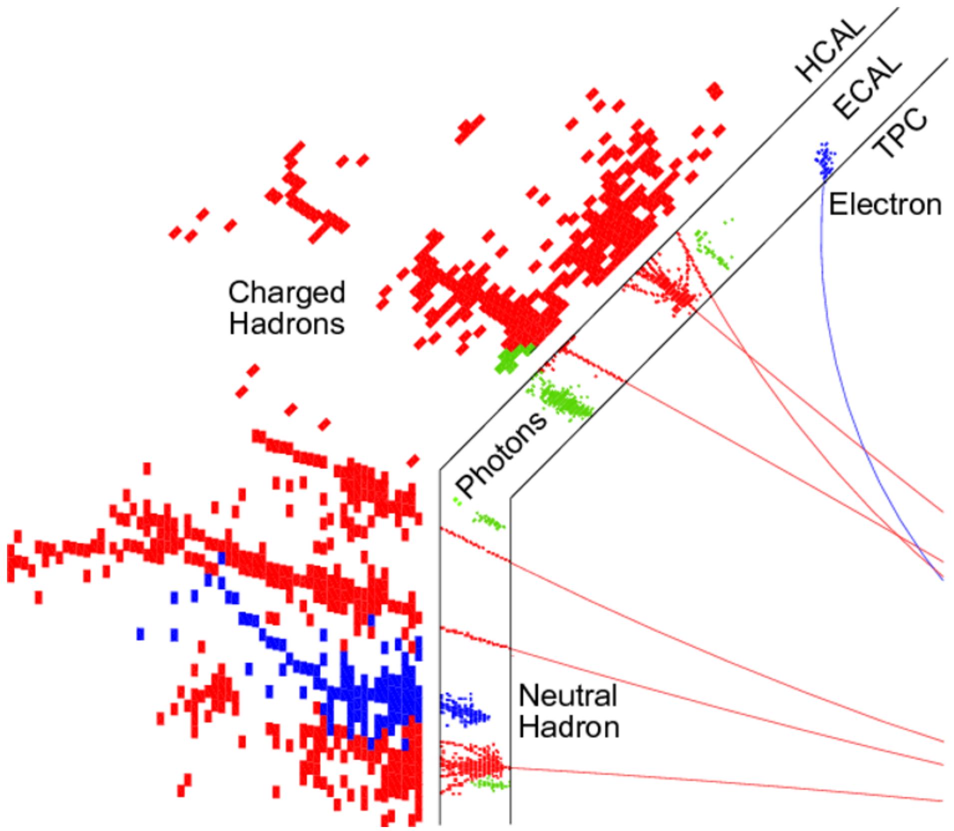


R&D Roadmap for Calorimetry (DRD6)

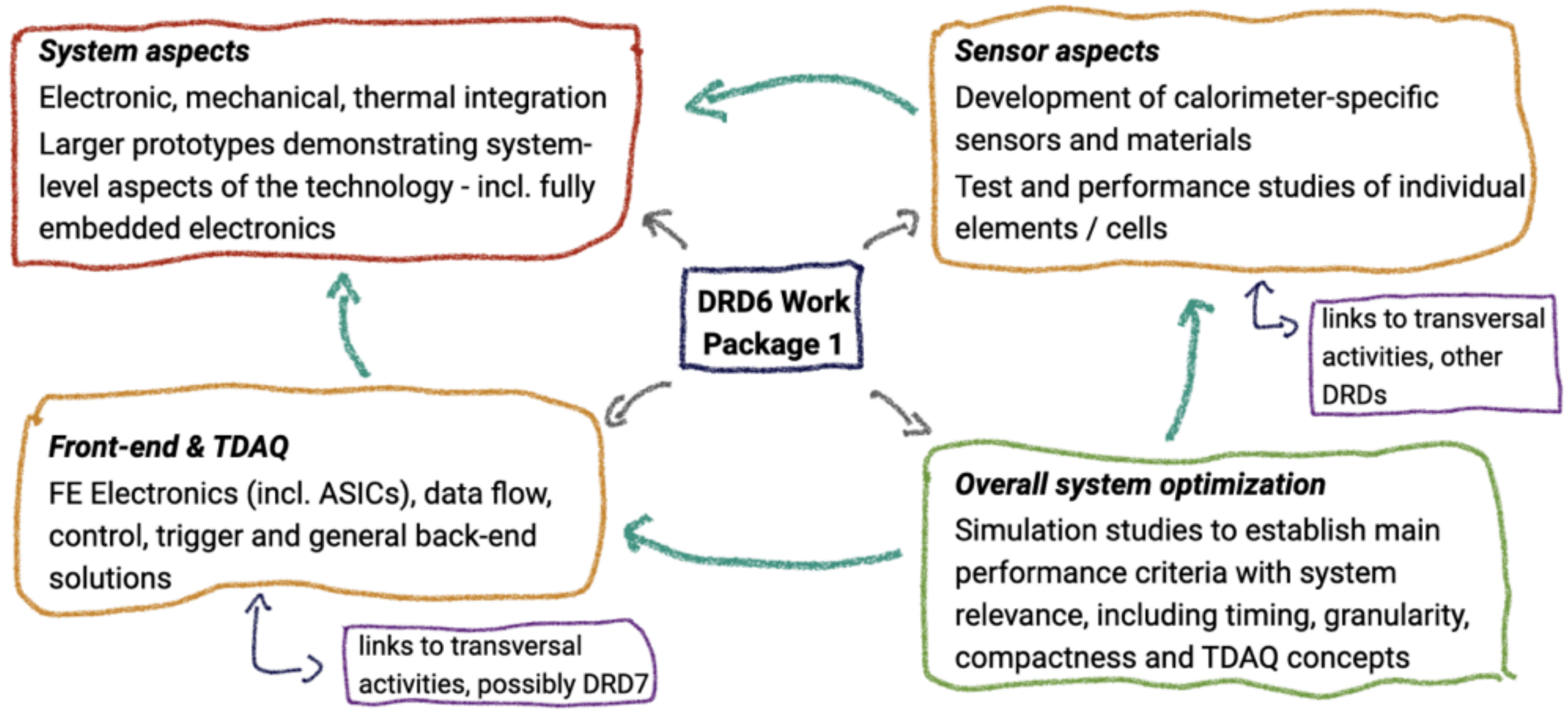


Thanks to R. Poeschl

Calorimetry WP1 - Imaging Calorimeters



Imaging calorimeters live on the high separation power for Particle Flow



- Challenges:
  - High pixelisation, 4pi hermetic -> little room for services
    - Detector integration plays a crucial role
- New strategic R&D issues
  - Detector module integration
  - Timing
  - High rate e+e- collider (such as FCCee)

Thanks to R. Poeschl

Calorimetry WP2 - Liquid Noble Gas Calorimeters

- Develop the calo design
  - Study design solutions for endcaps
  - Study general performance in simulation, in combination with some HCAL concept
  - Optimize granularity
- Build a first prototype and measure performance in testbeam
  - Need to design and optimize electrodes, absorbers
  - Readout electronics
  - Can then be refined to test further developments / new ideas

4 Work Areas

1. General design and expected performance
2. Readout electrodes
3. Readout electronics
4. Mechanical studies and prototype

N. Morange, 2nd Calo Community Meeting

Thanks to R. Poeschl

Calorimetry WP3 - Optical Calorimeters

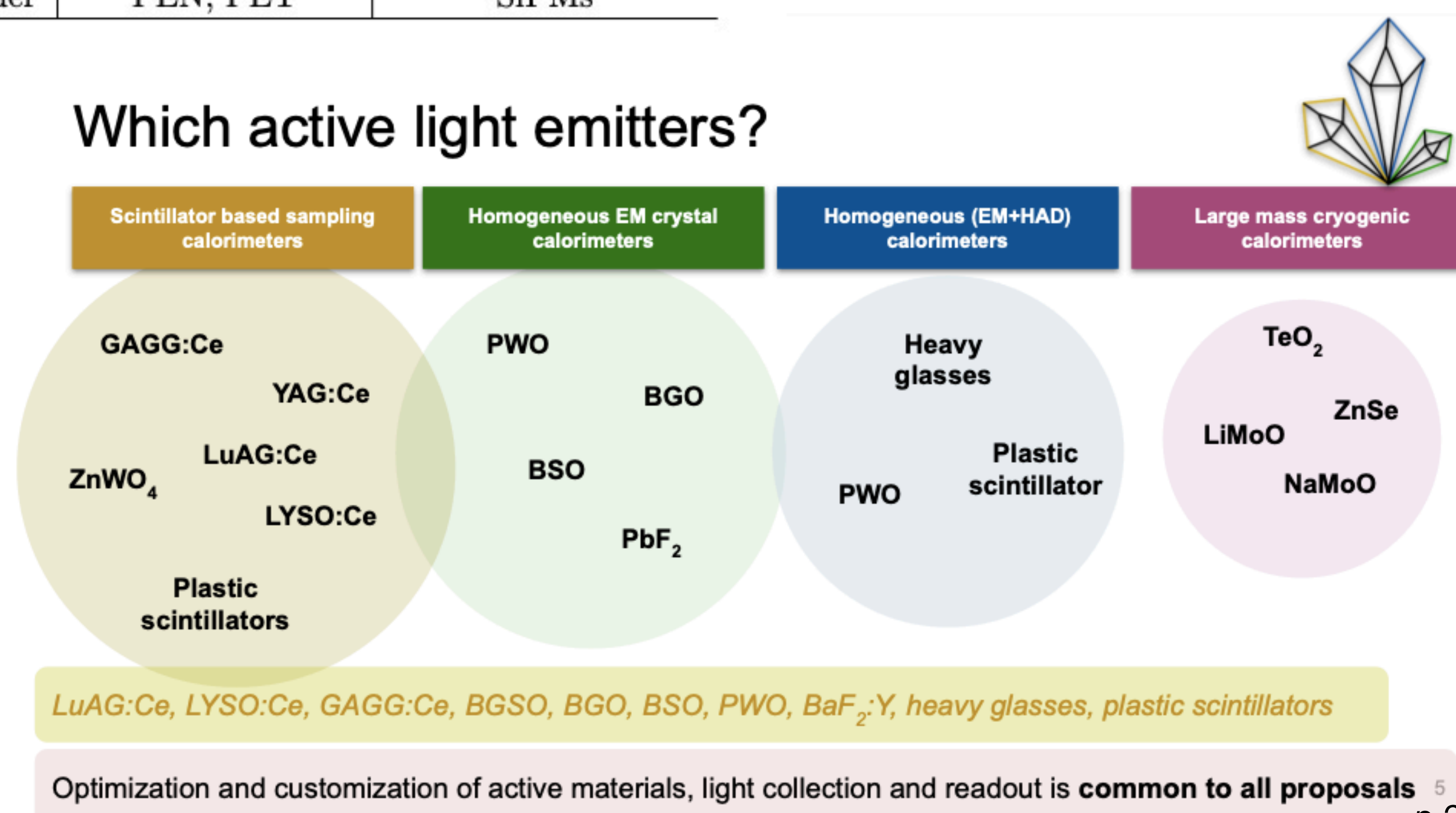
- More than e.g. Imaging calo, optical calorimeters put emphasis on the electromagnetic energy resolution
  - (Liquid Noble) interpolates a bit between these two cases
- EM resolutions down to 1-2%/√E are envisaged
  - Advantageous for Higgs Factory, indispensable for Heavy Flavour

Table 2: Overview of R&D activities on optical calorimeter concepts.

Name	Calorimeter type	Application	Scintillator/WLS	Photodetector
HGCCAL	EM / Homogeneous	e^+e^- collider	BGO, LYSO	SiPMs
MAXICC	EM / Homogeneous	e^+e^- collider	PWO, BGO, BSO	SiPMs
CRILIN	EM / Quasi-Homog.	$\mu^+\mu^-$ collider	PbF_2, PWO-UF	SiPMs
GRAINITA	EM / Quasi-Homog.	e^+e^- collider	$ZnWO_4$, BGO	SiPMs
SPACAL	EM / Sampling	e^+e^-/hh collider	GAGG, organic	MCD-PMTs, SiPMs
RADICAL	EM / Sampling	hh collider	LYSO, LuAG	SiPMs
DRCAL	EM+HAD / Sampling	e^+e^- collider	PMMA, plastic	SiPMs, MCP
TILECAL	HAD / Sampling	e^+e^-/hh collider	PEN, PET	SiPMs

P. Roloff, M. Lucchini
2nd Calo Community Meeting

- Main challenges
  - Find the good optical material
  - Find the adequate photosensor
  - Move from table top to system
    - First project to fully make this step is SpaCal (LHCb)



Thanks to R. Poeschl

Calorimetry WP4 - Electronics & DAQ

Name	Track	Active media	readout
LAr	2	LAr	cold/warm elx"HGCROC/CALICElike ASICs"
ScintCal	3	several	SiPM
Cryogenic DBD	3	several	TES/KID/NTL
HGCC	3	Crystal	SiPM
MaxInfo	3	Crystals	SIPM
Crilin	3	PbF2	UV-SiPM
DSC	3	PBbGlass+PbW04	SiPM
ADRIANO3	3	Heavy Glass, Plastic Scint, RPC	SIPM
FiberDR	3	Scint+Cher Fibres	PMT/SiPM,timing via CAENFERS, AARDVARC-v3,DRS
SpaCal	3	scint fibres	PMT/SiPMSPIDER ASIC for timing
Radical	3	Lyso:CE, WLS	SiPM
Grainita	3	BGO, ZnWO4	SiPM
TileHCal	3	organic scnt. tiles	SiPM
GlassScintTile	1	SciGlass	SiPM
Scint-Strip	1	Scint.Strips	SiPM
T-SDHCAL	1	GRPC	pad boards
MPGD-Calo	1	muRWELL,MMegas	pad boards(FATIC ASIC/MOSAIC)
Si-W ECAL	1	Silicon sensors	direct withdedicated ASICS (SKIROCN)
Si/GaAS-W ECAL	1	Silicon/GaAS	direct withdedicated ASICS (FLAME, FLAXE)
DECAL	1	CMOS/MAPS	Sensor=ASIC
AHCAL	1	Scint. Tiles	SiPM
MODE	4	-	-
Common RO ASIC	4	-	common R/O ASIC Si/SiPM/Lar

Survey of Readout Landscape: different calorimeter types but similar challenges

Trends:

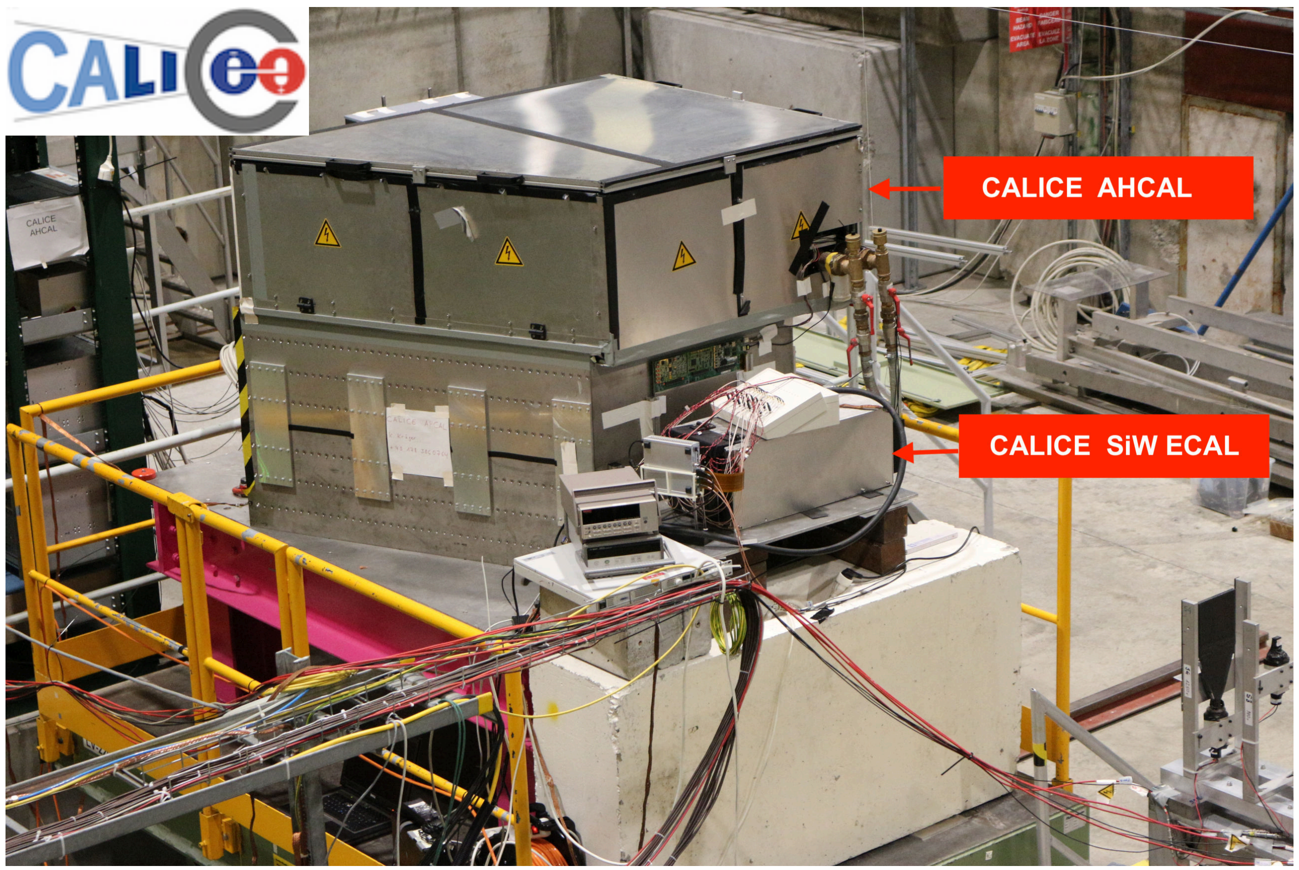
- On-detector embedded elx.
  - Challenges: #channels, Low power digital noise, data reduction
- Off-detector electronics:

Fibre/crystal readout

  - Challenges:
  - Low power, data reduction
- Digital calorimetry:
  - Challenges:
  - (extreme) #channels, low power, data reduction

- The main goal of WP4 will be to avoid parallel developments
  - Take CALICE as example
- ASICs needed for prototypes > 2025/26 should be produced in a common MPW run that serve many projects within DRD Calo
  - ASICs for prototype that should take data in ~2027 have to be available latest around one year earlier
  - => Common ASICs production will be one overarching goal of the DRD Calo
- Evoke possibility to hook onto production for other large projects (EiC?)
  - Agree on sharing among DRD Calo institutes and maybe with MPW runs in other DRD
- Requires close communication with DRD 3 and DRD 7

Calorimetry Shared Infrastructure - Dedicated Beamline?



Common setup at CERN June 2022

- Calorimeters are typically large objects
  - A beam test is similar to a small experiment
- Difficult for facility managers to schedule calorimeter beam tests
  - No concurring running with other devices possible
- Takes lots of expertise to carry out a successful beam test campaign
  - Implies use of infrastructure
- A dedicated beam line maybe with dedicated slots during a year may help curing these issues
  - Would need sustained expertise on the beamline
- R&D programme has to cope with facility schedules
  - e.g. CERN-SPS essentially closed 2026-2028

Thanks to R. Poeschl

Conclusions and Outlook

- DRD6 on **Calorimetry** will pursue strategic R&D for calorimeters for future colliders
  - Partially new efforts, partially capitalising on existing activities
- DRD2 on **Liquid Detectors** will pursue strategic R&D for future dark matter, neutrino and neutrino-less double beta decay experiments

- Programmes of these DRDs compiled based on wide consultation with community in series of workshops, meetings, proposal writing process
- world-wide efforts with mix of European and non-European projects, close coordination with CPAD underway
- Structure of collaborations initiated, in work packages with working groups
  - Transversal activities across existing efforts/experiments to encourage greater coordination worldwide
  - Strong links to other DRDs and cross-collaboration
- Proposals under review by DRD Committee (Dec. 4), CERN Research Board (Dec. 6)

Goal is to have the DRDs Liquid Detectors and Calo in place on January 1st 2024

Discussion to (concretely) set up the DRD are making progress in the proposal teams
Next steps: formation of proto-Collaboration Board soon,
Scheduling of first collaboration meetings imminent…

DRD2 Liquid Detectors: Proposal Team

- Coordinators: Roxanne Guenette, Jocelyn Monroe
- Proposal Work Package Writing Leads:

WP 1: Charge Readout	WP 2: Light Readout	WP 3: Target Properties	WP4: Scaling-up challenges
1.1: Pixels & Charge+ Light Readouts **J.Asaadi (US), E. Gramellini (UK)**	**2.1: Increased sensor QE** **J. Monroe (UK), F. Retiere (CA), P. Agnes (IT)**	**3.1: Target properties & isotope loading of Water / LSc** **S. Schoppman (DE), H. Steiger (DE), M. Wurm (DE)**	**4.1: Radiopurity & bkg mitigation** **J. Dobson (UK) R. Santorelli (ES)**
1.2: Amplification & Charge-to-Light Readouts **A. Diesting (DE), K. Mavrokoridis (UK)**	**2.2: Higher efficiency WLS/ collection** **M. Kuzniak (PO) J. Martin-Albo (ES) C. Cuesta (ES)**	**3.2: Target properties of Liquid Nobles** **D. Franco (APC), M.C. Piro (CA), A. Szelc (UK), A. Zani (IT)**	**4.2: Detector & target procurement/production** **W. Bonivento (IT) M. Yeh(US)**
1.3: Ion detection **Fully within DRD1**	**2.3: Improved sensors for LSc/ Water** **M. Bongrand (FR) T. Lachenmaier(DE) Fully within DRD4**		**4.3: Large-area (light) readouts** **I. Gil-Botella (ES) J. Crespo (ES) G. Fiorillo (IT)**

Community: 99 institutes in 15 countries, interest from all over the world (35%)

- US biggest single participation (27%) and close coordination with ongoing CPAD process - aim is one global collaboration

Thanks to R. Poeschl

DRD6 Calorimetry: Proposal Team

Coordinators: Roberto Ferrari, Gabriella Gaudio (INFN-Pavia), Roman Poeschl
Representative from Coordination Team: Felix Sefkow

Track 1: Sandwich calorimeters with fully embedded Electronics – Main and forward calorimeters

Track conveners: Adrian Irles (IFIC, adrian.irles@ific.uv.es), Frank Simon (KIT, frank.simon@kit.edu), Jim Brau (University of Oregon, jimbrau@uoregon.edu), Wataru Ootani (University of Tokyo, wataru@icepp.s.u-tokyo.ac.jp), Imad Laktineh (I2PI, imad.laktineh@in2p3.fr)

Track 2: Liquified Noble Gas Calorimeters

Track Conveners: Martin Aleksa (CERN, martin.aleksa@cern.ch), Nicolas Morange (IJCLab, nicolas.morange@ijclab.in2p3.fr), Marc-Andre Pleier (mpleier@bnl.gov)

Track 3: Optical calorimeters: Scintillating based sampling and homogenous calorimeters

Track Conveners: Etiennette Auffray (CERN, etiennette.auffray@cern.ch),
Gabriella Gaudio (INFN-Pavia, gabriella.gaudio@pv.infn.it),
Macro Lucchini (University and INFN Milano-Bicocca, marco.toliman.lucchini@cern.ch),
Philipp Roloff (CERN, philipp.roloff@cern.ch), Sarah Eno (University of Maryland, eno@umd.edu),
Hwidong Yoo (Yonsei University, hdyoo@cern.ch)

Track 4: Transversal activities.

Christophe de la Taille (OMEGA, taille@in2p3.fr), Alberto Gola (FBK, gola@fbk.it)

Remark: Tracks in early proposal phase became Work Packages + Electronics

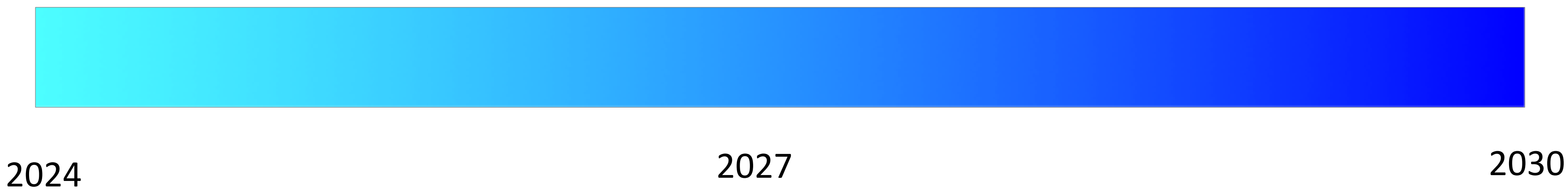
Community: 133 institutes, mainly European, interest from all over the world (37%)

- US biggest single participation -> close contact to emerging effort in US + very visible participation in Asia

Backup Slides

Thanks to R. Poeschl

DRD Calo Ramp up of activities – Rough View



- Input-proposals reveal little (extra) need at the beginning (2024-2026)
  - Start with prototypes that are either existing or currently under construction
  - (Mainly) benefitting from existing funding at national level of international level (i.e. AIDAinnova, EUROLABS in Europe or CalVision, RADICAL in the US [plus maybe others])
  - Specification studies, concept proof – Would require fresh funding

- Relatively high density of beam tests with new (large scale) prototypes after 2026
  - Several large scale prototypes demonstrate ambition of R&D programme

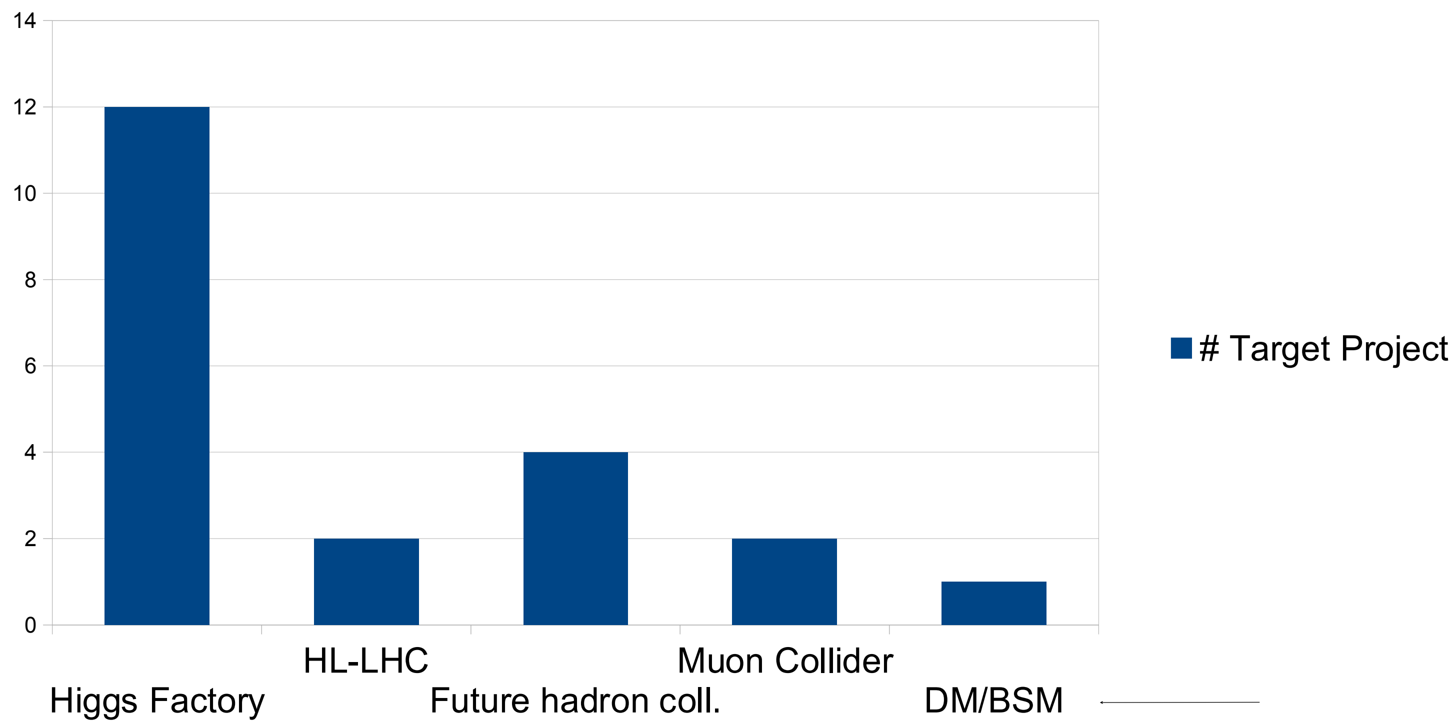
- Execution of program requires <u>availability and support</u> of beam test facilities
  - See also later

Thanks to R. Poeschl

ECFA

DRD Calo - Input proposals and target projects

European Strategy Update



Particle energy O(1 GeV)

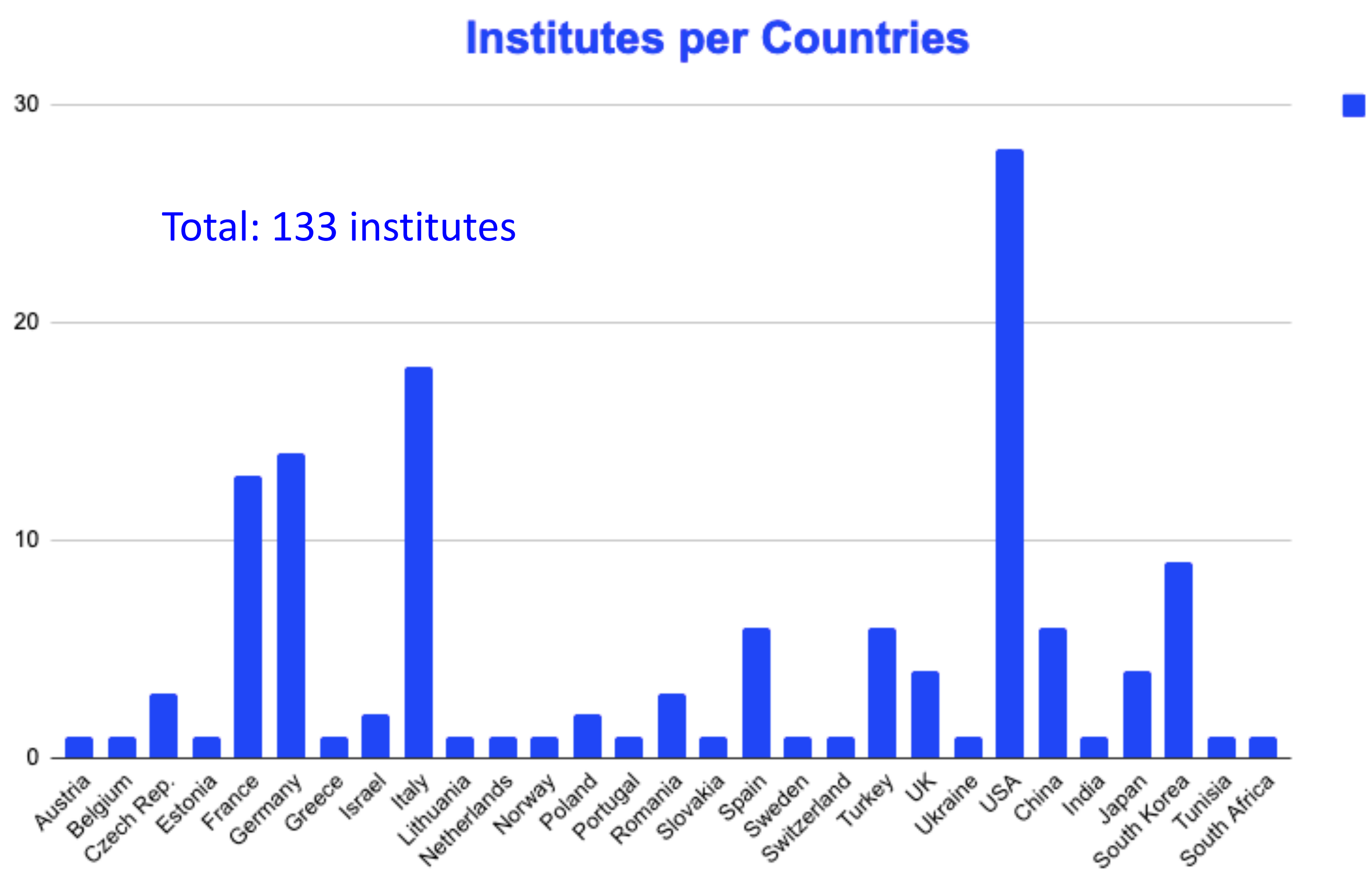
- Higgs factories dominate
  - HF includes heavy flavor that target superb elm. energy resolutions
- (Already now) orientation towards future hadron collider and muon collider

Thanks to R. Poeschl

ECFA

DRD Calo – Overall Interest

European Strategy Update



- Mainly European Groups but interest from all over the world (37%)
  - US biggest single participation -> close contact to emerging effort in US
  - Very visible Asian participation

DRD2: Liquid Detectors Ramp of Activities

ECFA R&D Roadmap: https://indico.cern.ch/e/ECFADetectorRDRoadmap

Apr.'21: TF2 Symposium https://indico.cern.ch/event/999815/
197+5 registered to list (used for subsequent mail distribution)

…Roadmap drafting…

Sept.-Dec.'22: Community input questionnaire, to
(i) develop the work packages of the Liquid Detectors RD Collaboration Proposal, and
(ii) invite participation in proposal-drafting team

- announced on all previous email lists, advertised at LIDINE (Sept.'22) and DUNE Module of Opportunity workshops (Nov.'22) and via ECFA: https://indico.cern.ch/event/957057/page/21912-questionnaires
- 49 responses, of whom14 willing to serve on proposal-drafting team

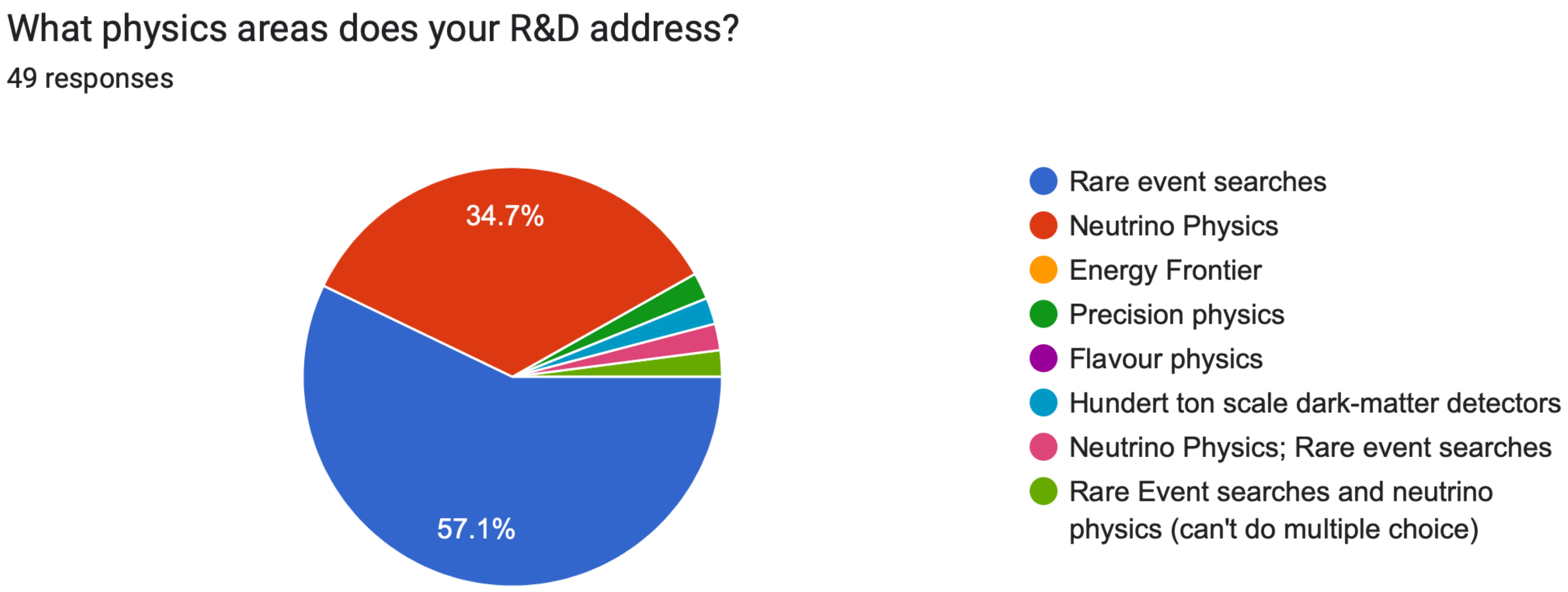
Dec.'22: mini-workshop of proposal-drafting team to develop collaboration proto-structure based on community inputs

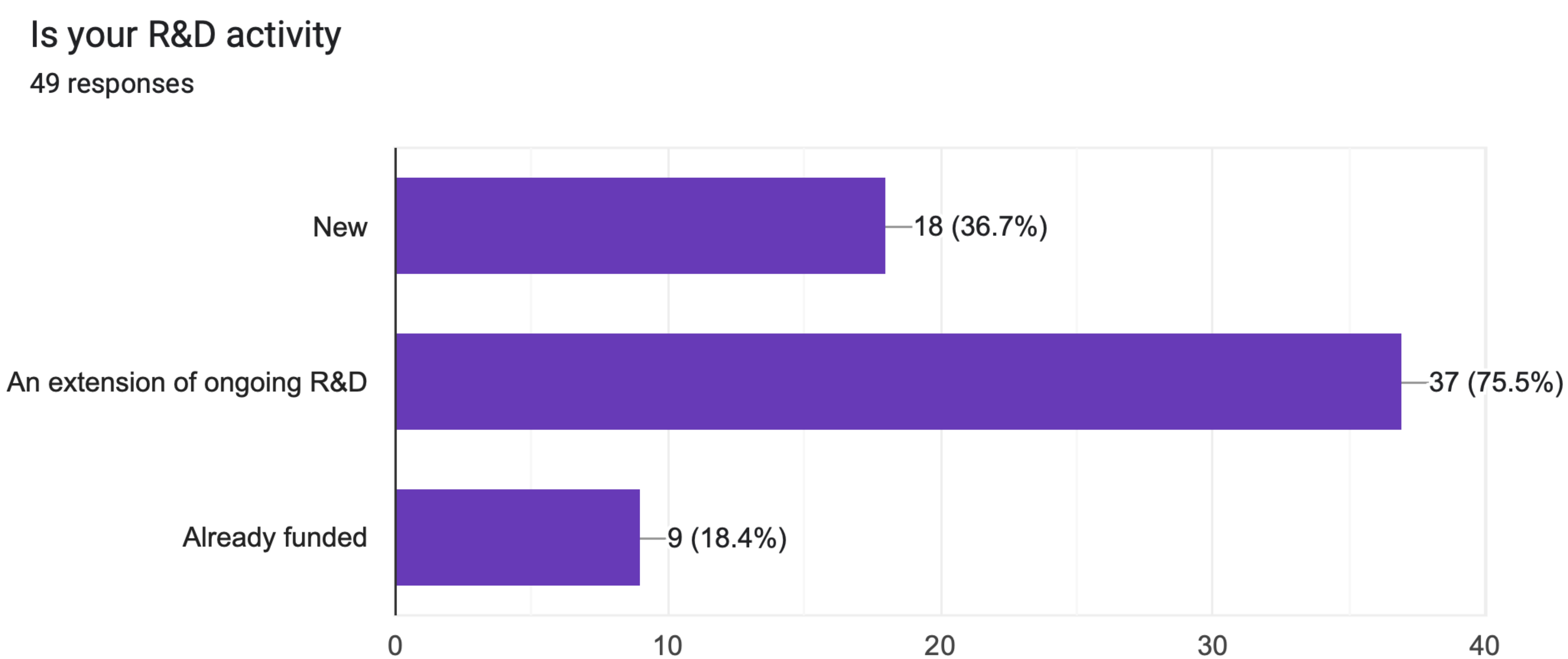
Jan.'23: meeting of proposal-drafting team to define proposal structure, following ECFA Steering Group guidance

Feb-Mar.'23: …proposal drafting…

Apr.'23: 2nd community workshop

Community Survey Outcomes: DRD2 Physics

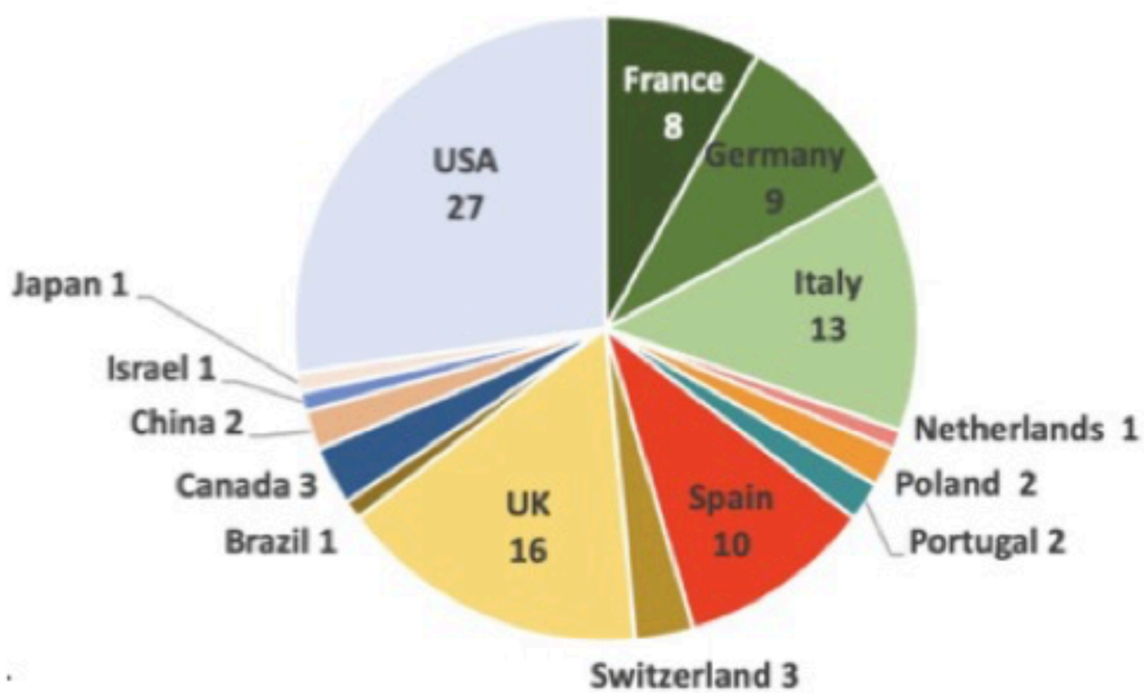




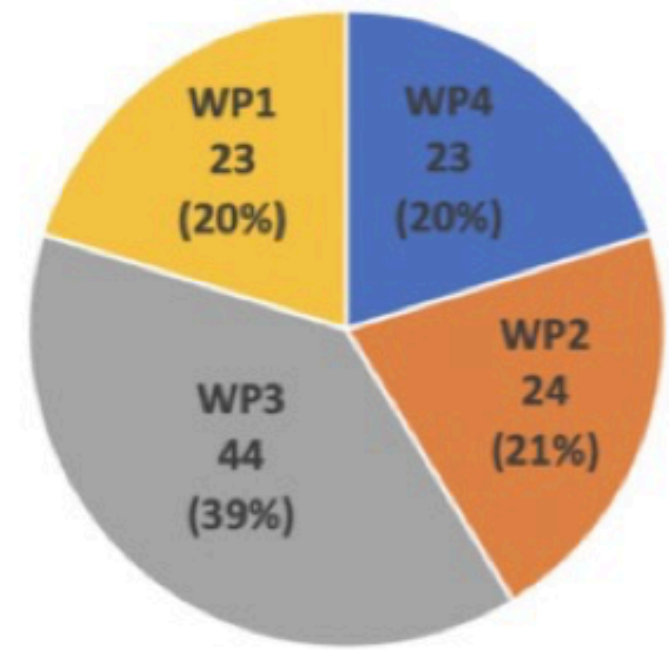
takeaway:
2/3 unfunded

DRD2 Participation by Country, WP

99 institutes in 15 countries



technology interests



initial resource estimates*

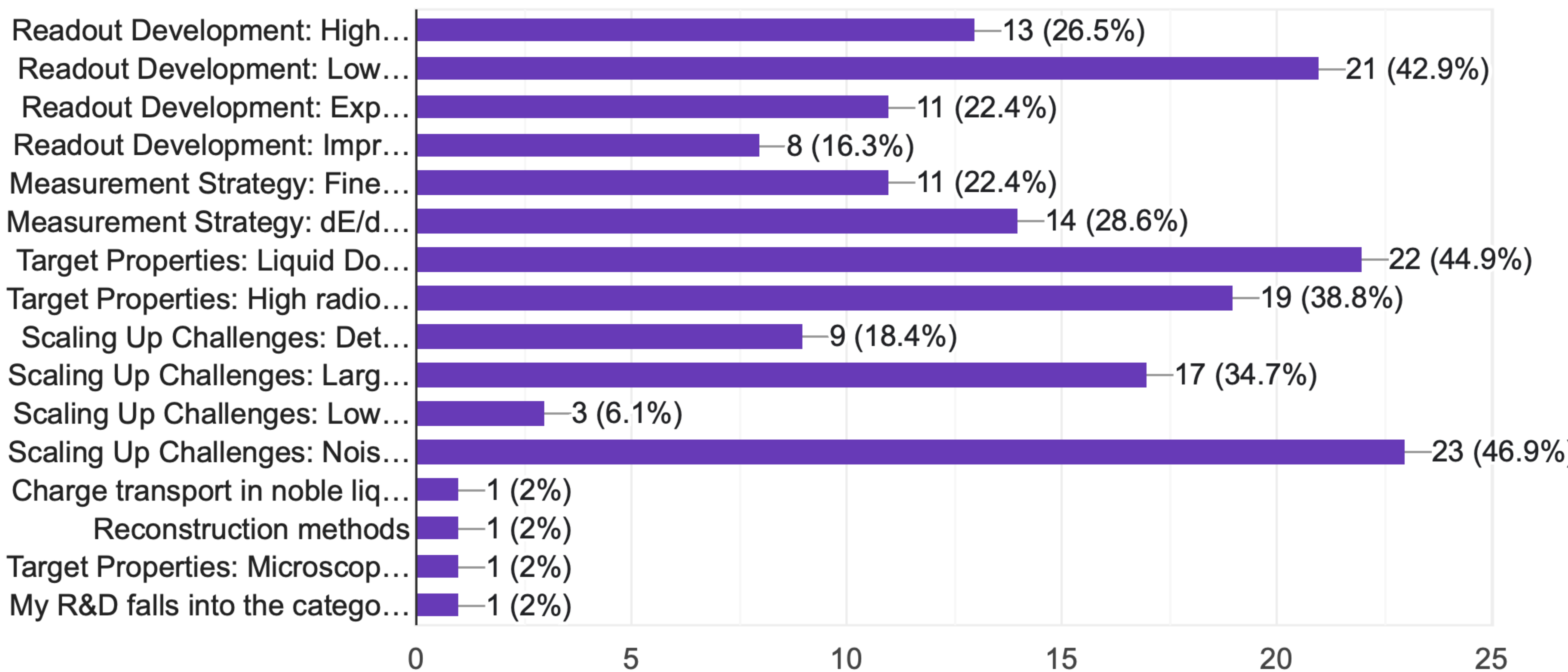
- 2.6(7.8) MCHF/y available(additional)
- 148(305) FTE available(additional)

** T. Bergauer Plenary ECFA, 17 Nov.*

Community Survey Outcomes: DRD2 DRDTs

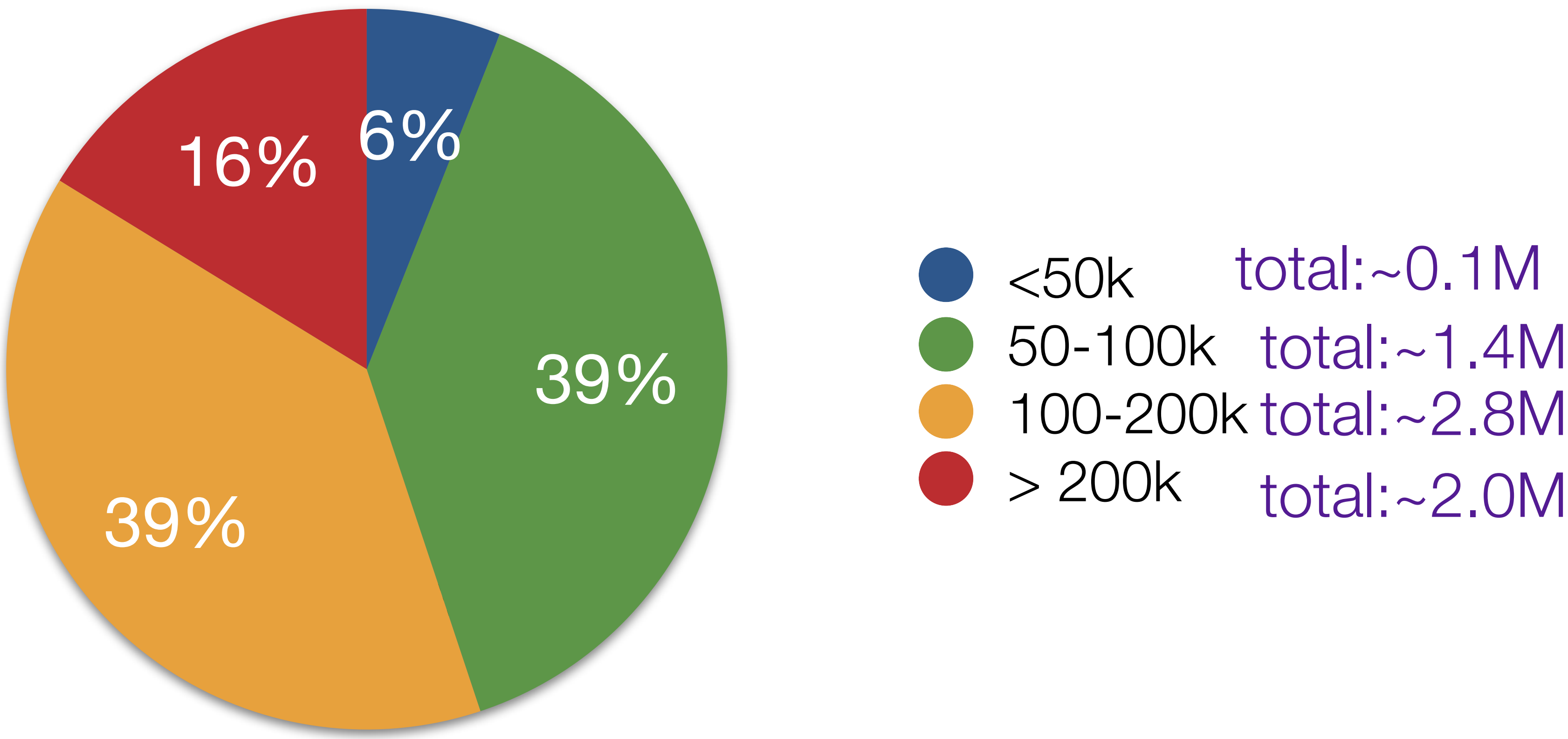
Under which Detector R&D Theme(s) would your R&D activities fall? Please refer to the Roadmap document for more details on the definition of DRTDs (link).

49 responses

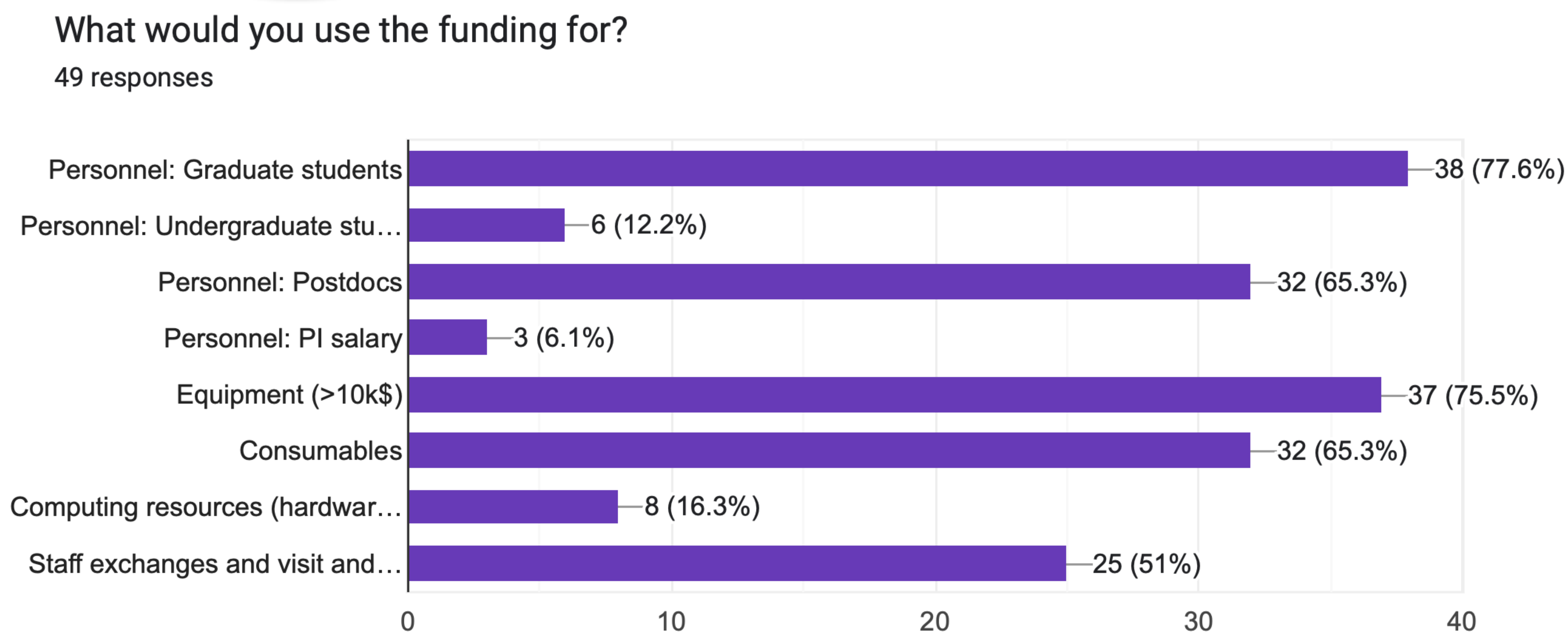


takeaway: main interest in readout development for lower energies (top 3 areas: lower noise, higher light yield, higher QE)

Community Survey Outcomes: DRD2 Budgets

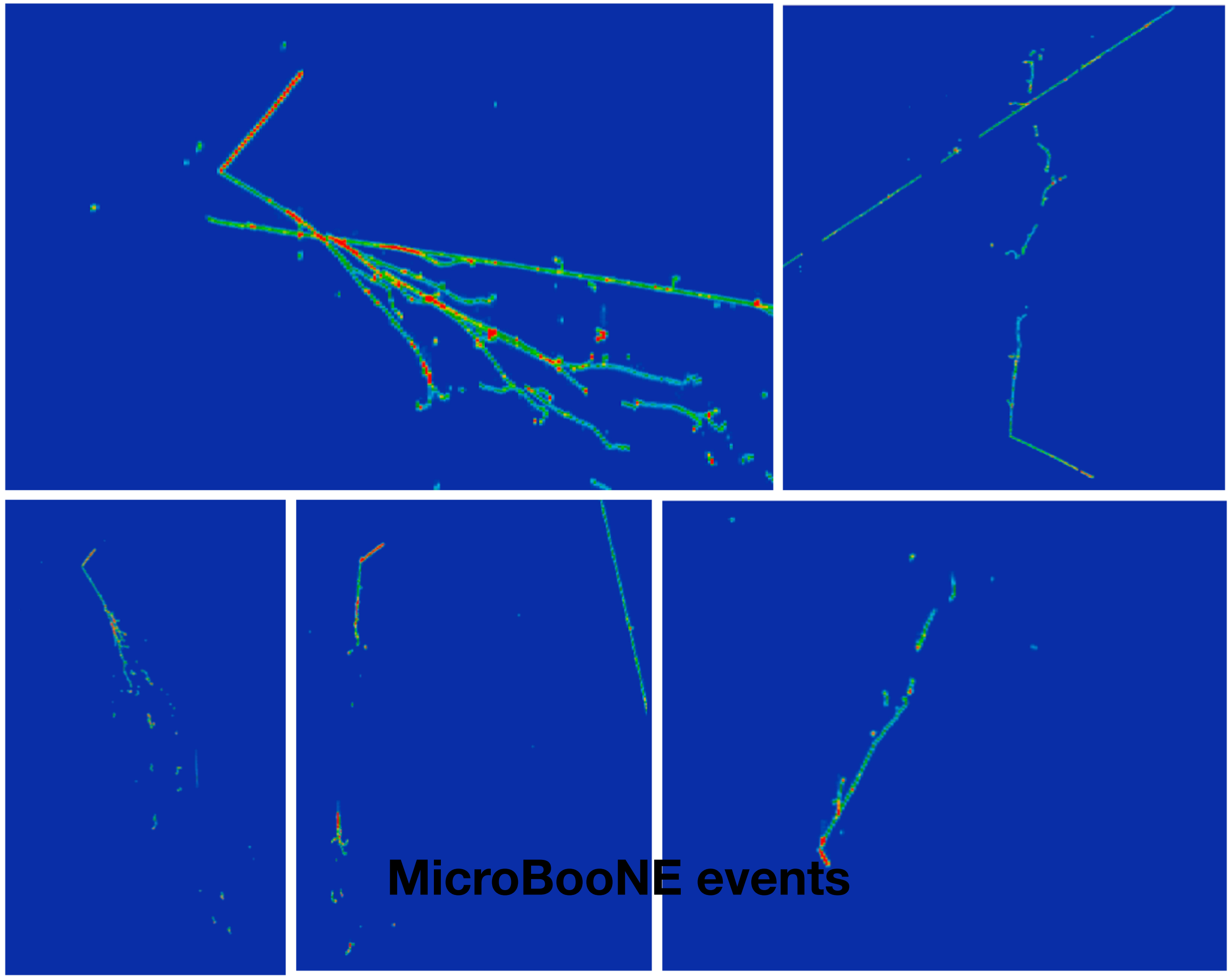


Current total:~5M



DRD2 DAQ & data analysis needs

- Large data volumes (especially for higher occupancy detectors)
- Long (O(msec) readout times (need ZLE etc.)
- Complex topology event reconstructions → GPU needs



DRD2 Overlaps with DRD7 Letter of Intent

- Based on DRD2 proto-projects list link circulated June 7: from DRD7 link circulated June 7 https://docs.google.com/document/d/1pq3-7MYnBarrsHlMNLykD3v-QCPRbS-T/edit

- WG7.1: Data density and power efficiency
—> low radioactivity + scalability challenge
Project 7.1a: DRD2 collaborators are users of Si photonics links and integration task (WP2.3) prototyping Si photonics comms
Project 7.1.b material and power reduction is a goal (possibly not in the terms laid out by current 7.1.b)
Project 7.1.c Wireless Power and data transmission

- WG7.3: 4D and 5D techniques
—> scalability challenge
Project 7.3.a TDC & ADC ultralow power
Project 7.3.b-2 Timing distribution techniques

- WG7.4: Extreme environments
—> Liquid noble detectors
Project 7.4.a Cryogenics, we bring measurement capability from 0.1 mK up. Cross-collaboration.

- WG7.5: Backend systems and COTS
—> scalability challenge (as users not necessarily developers)
Projects 7.5.a TDAQ tools and algorithms
Projects 7.5.b No backend full 100GbE Solutions from FE to DAQ

- WG7.6: Complex imaging ASICs and Technologies
—> prototyping in view of detectors at scale, our emphasis on cryogenic performance and low-radioactivity
Project 7.6.a & 7.6.b TSV developments for BSI sensors, Common access to imaging technologies, IP blocks and 3D&advanced integration