

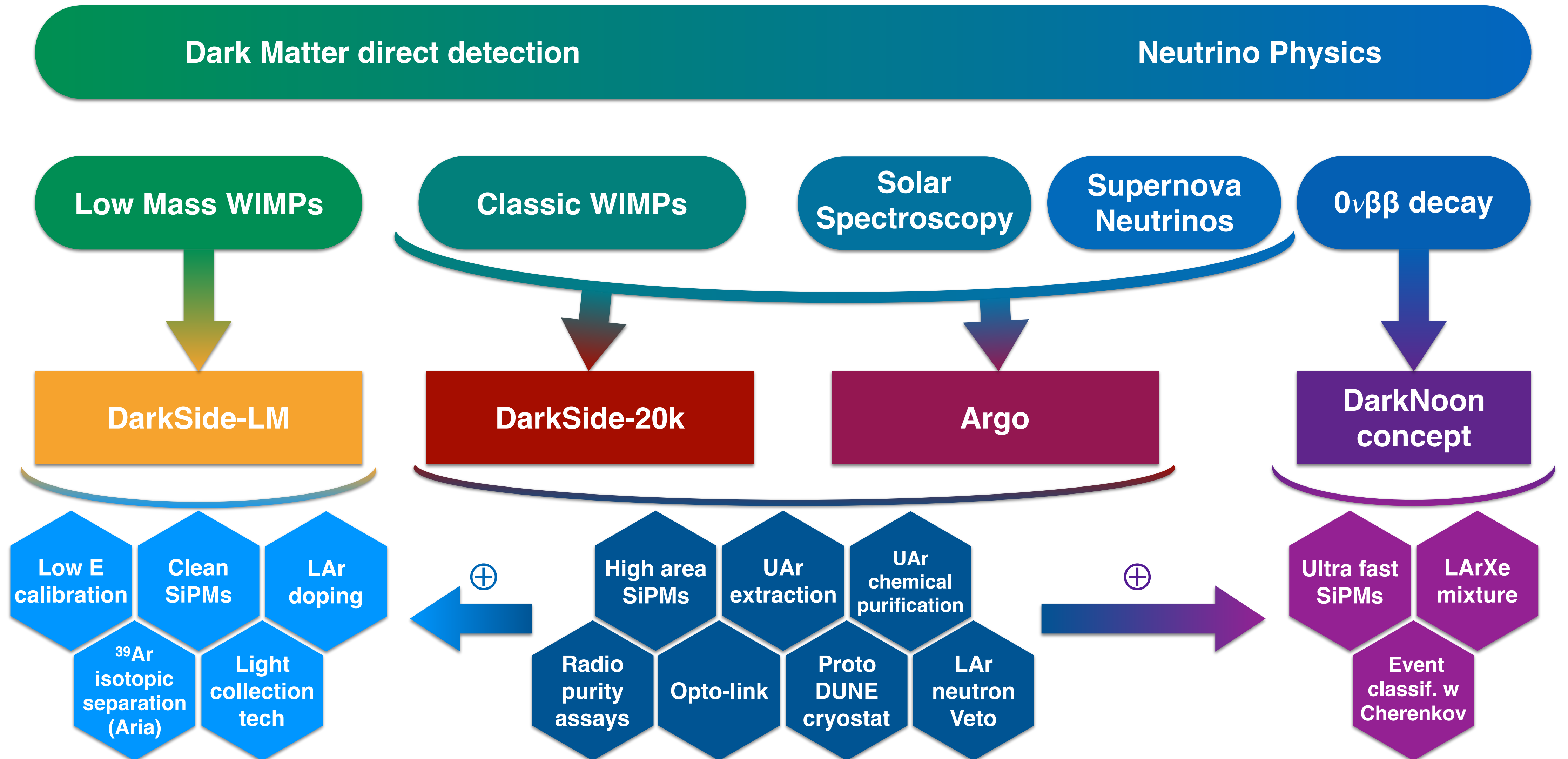
Current and future R&Ds of the GADMC

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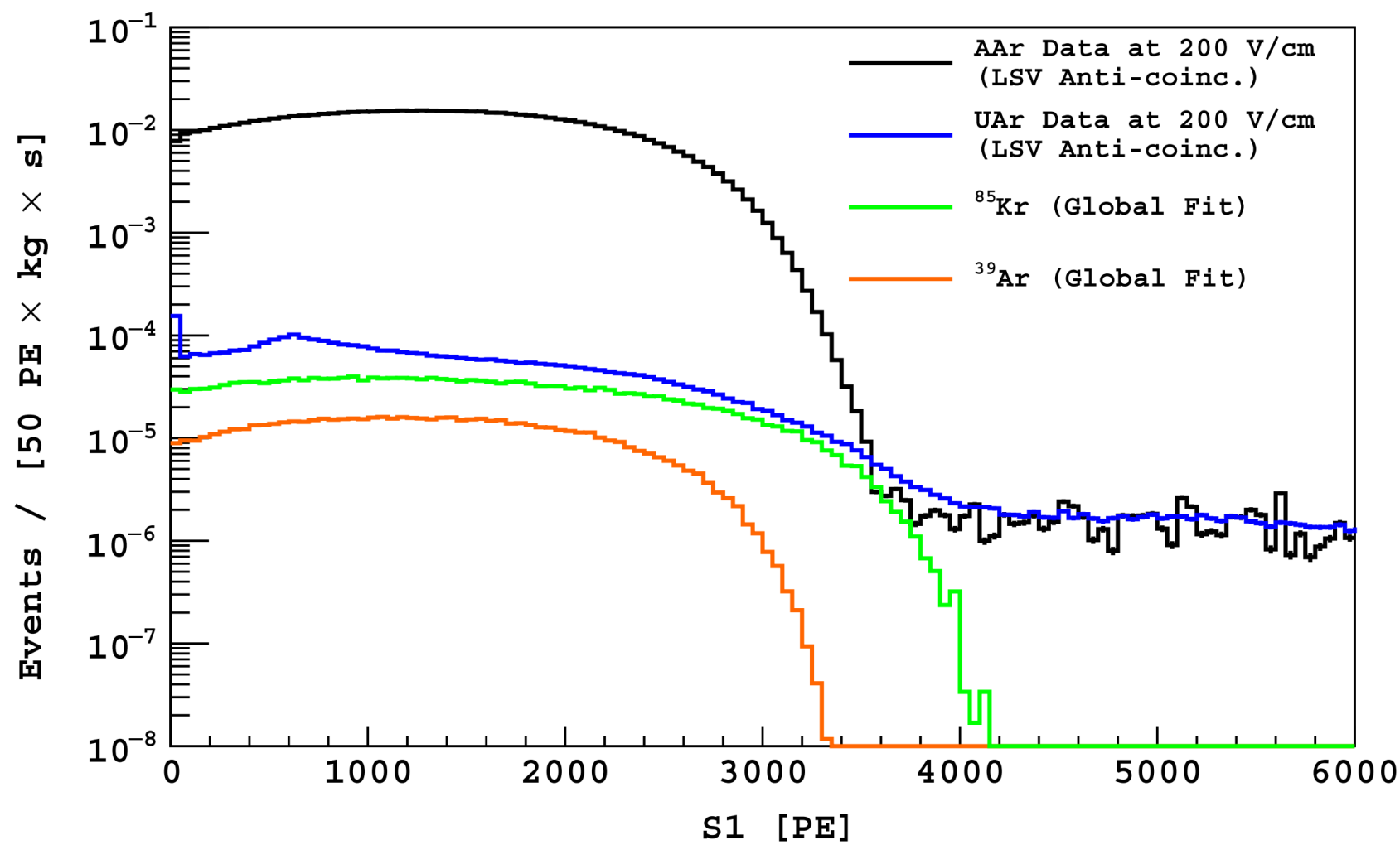
*Noble Elements topical group (IF) - Snowmass2021
Aug 31st 2020*

Overview



Argon extraction and purification

^{39}Ar and UAr



- ^{39}Ar : cosmogenic isotope
- β -decay: $Q = 565 \text{ keV}$ and $\tau_{1/2} \sim 269\text{y}$
- $\sim 1\text{Bq/kg}$ in atmospheric Ar
- Rejection possible with PSD. Pile-up!
- No activation in deep CO_2 wells
- Suppression of ~ 1400 (DS-50)

Urania



- CO_2 well: Cortez (CO)
- Extraction plant: Urania
- Rate: $\sim 330\text{kg/d}$
- Purity: 99.9%
- Total foreseen mass: 60t
- Shipping by sea

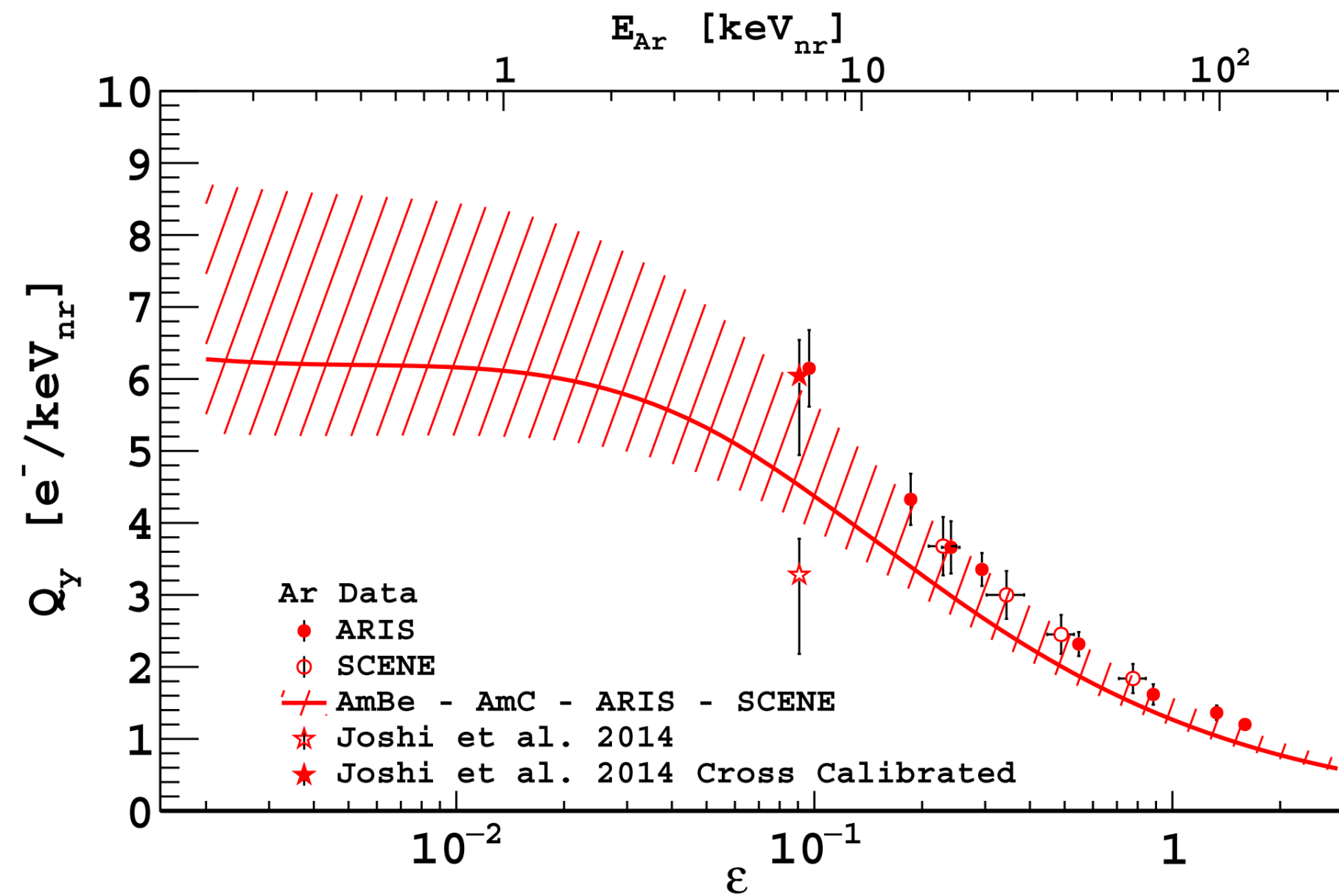
Aria



- Aria: chemical purification through cryogenic distillation
- 350m tall column in a mine shaft in Italy
- Purification rate: $\sim 1\text{t/d}$
- Possibility of isotopic separation ($^{39}\text{Ar}/^{40}\text{Ar}$) by difference in vapour pressure (10kg/d)

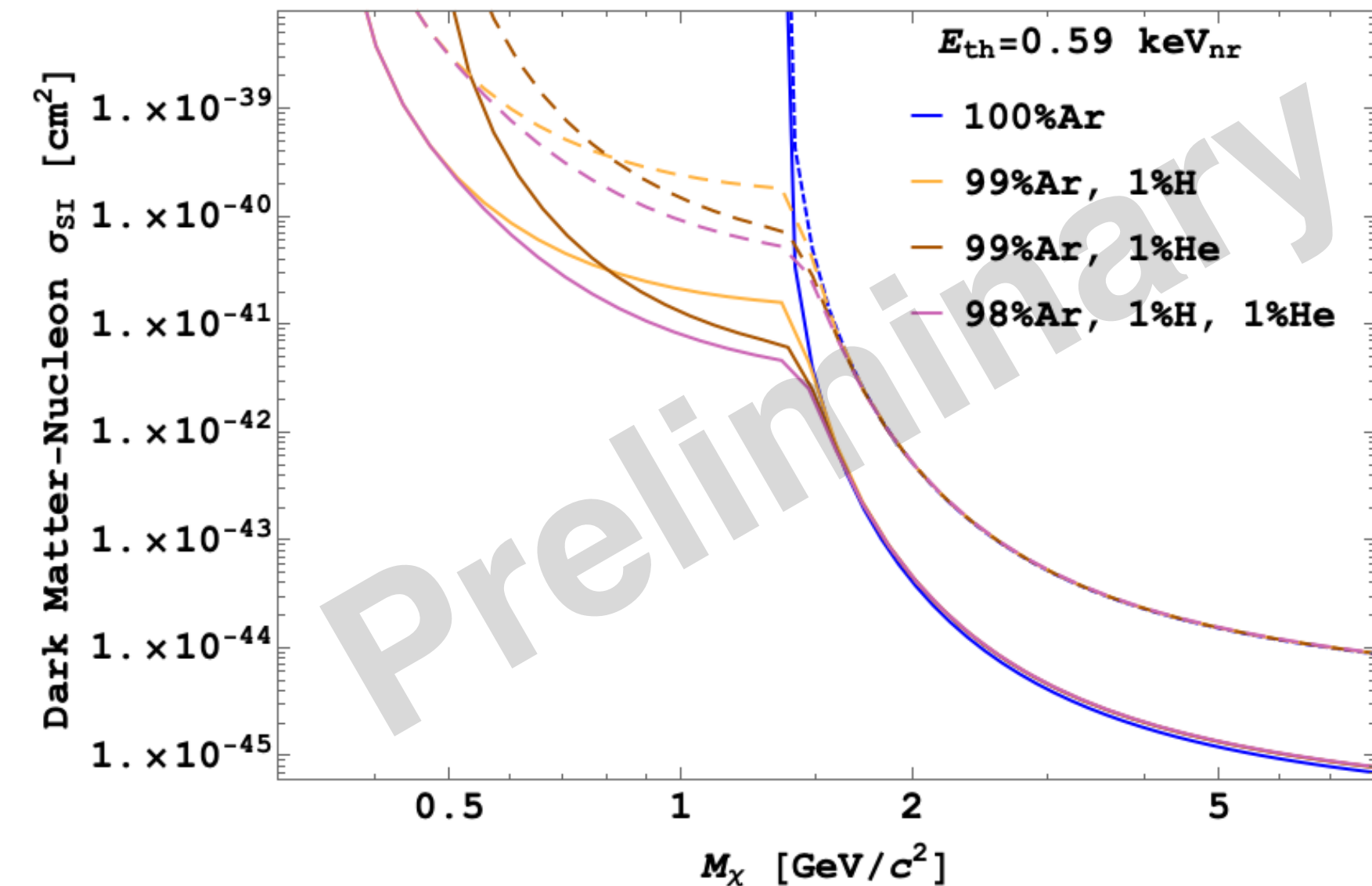
LAr R&D activities

LAr response to low energy NR



- Imperative to carry out LM searches.
- Current lowest calibration data point at 7keV_{nr} .
- Objectives: measure NR ionization yield for energies around and possibly below 1keV_{nr} . Characterize the ionization yield distribution (i.e. fluctuations width)

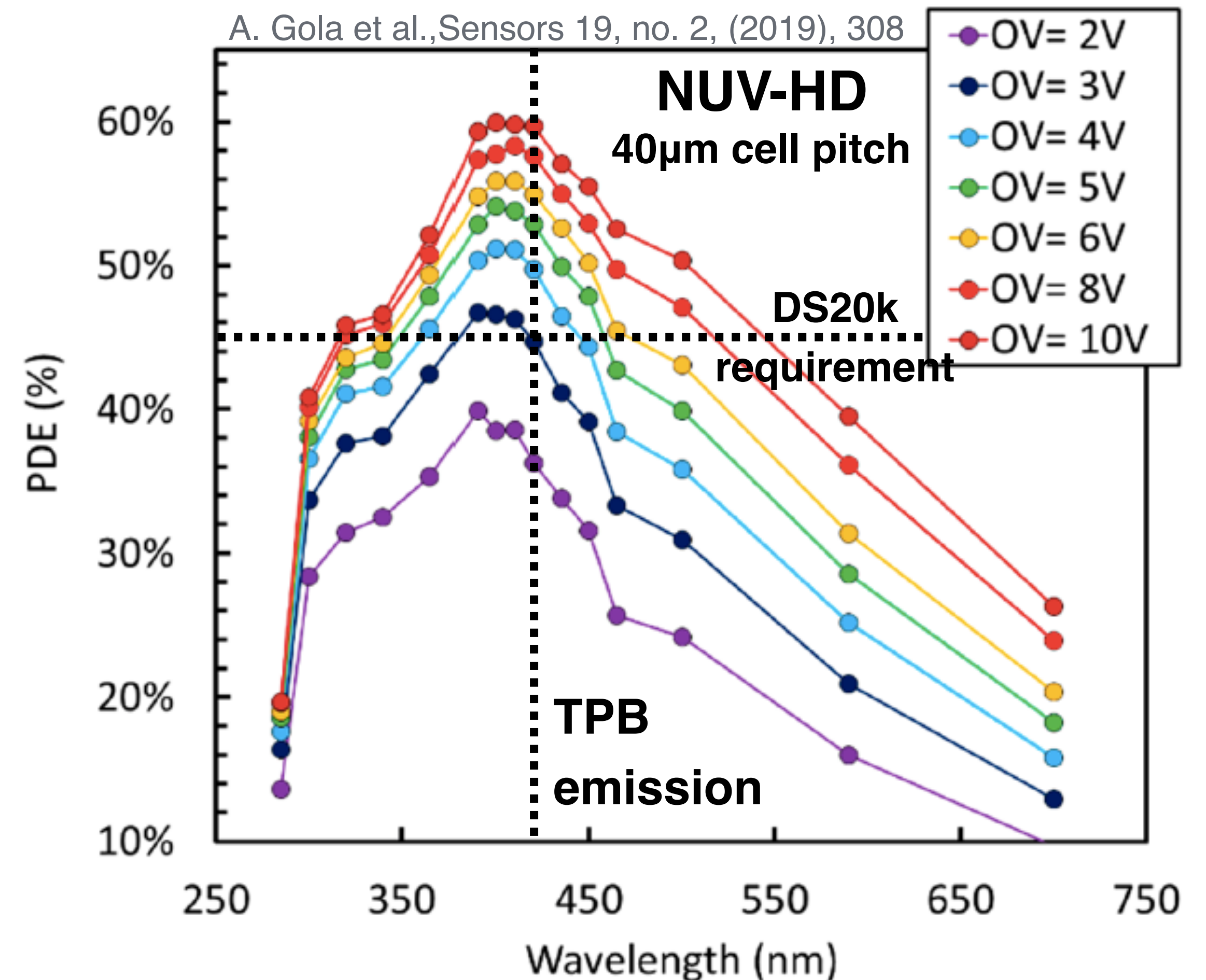
LAr doping



- Potential to aid LM direct detection.
- Two main reasons: lower ionization threshold (Xe, Allene) and better kinematic match to LM dark matter (H_2 , He).
- Solubility, doping techniques, mixture stability under investigation.
- Characterization of scintillation and ionization yields.

SiPM improvements

- Current SiPMs developed for DarkSide-20k meet all the basic requirements (PDE, DCR, TCN, timing).
- PDE at LAr temperature could be further increased with some tweaks to the depletion region.
- DarkSide-LM will have more stringent requirements on gamma radioactivity. R&D of smaller, cleaner photo-detectors. Possible ASIC readout.
- DBD experiments are developing background rejection based on Cherenkov light. Sub-nanosecond time resolution needed.



Miscellanea

- New high voltage cable feed-throughs (see L. Pagani's talk at 15:35)
- Gd-doped PMMA for a liquid argon neutron veto (DarkSide-20k)
- Signal transmission system based on optical fibers (DarkSide-20k)
- Light collection tech to reduce photo-detector area (DarkSide-LM). In particular we are considering parabolic reflectors. Metalenses described by Justo Martín-Albo on July 27th kickoff meeting are very appealing too
- TPC optimization (DarkSide-LM) for optimal detection of S2 signals (E fields, gas pocket configuration, wavelength shifting)
- Deeper study on single electron release mechanisms (DarkSide-LM)

Very rich R&D program, hopefully beneficial to a community broader than GADMC!

