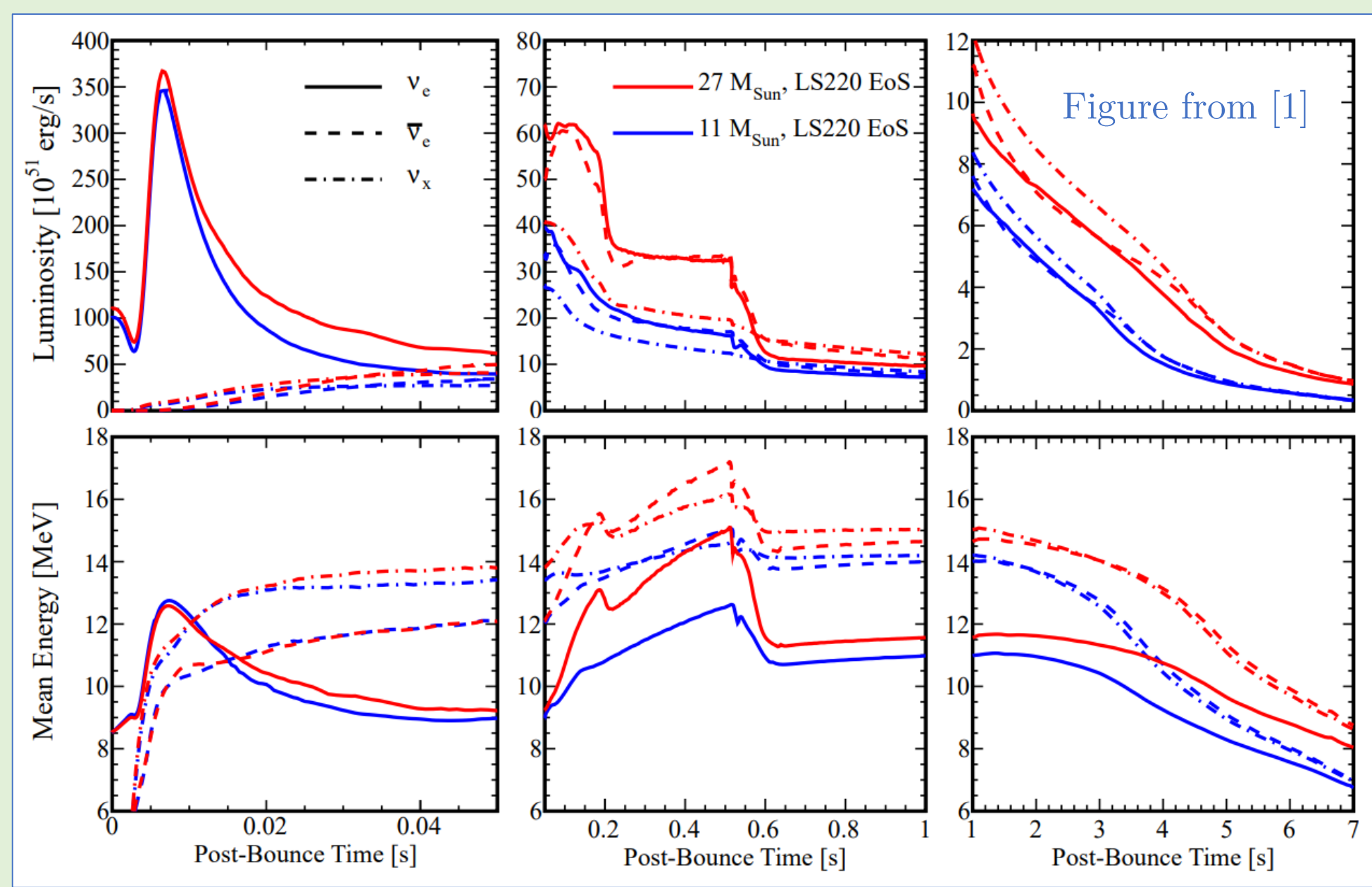


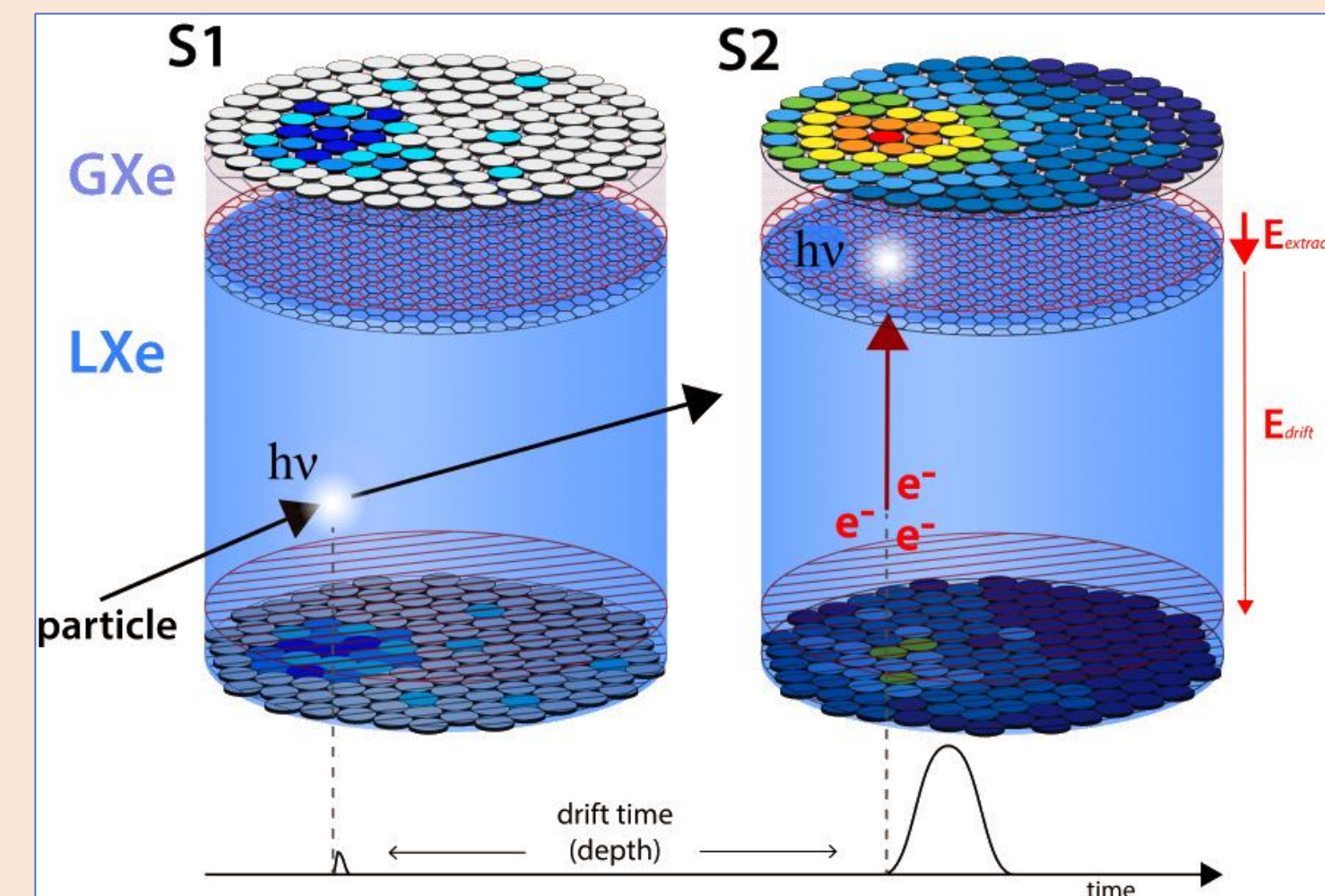
Supernovae, Neutrinos and CEvNS

- Supernovae (SN) are the catastrophic events marking the death of a massive star that exhausted its nuclear fuel.
- In core-collapse SNe, Around 99% of the gravitational binding energy of the remnant is converted to neutrinos with energies of $O(10)\text{MeV}$ over just a few seconds. [2]
- SN neutrinos can be detected in various ways. Amongst them, coherent elastic neutrino-nucleus scattering (CEvNS) is of particular interest, given its flavour-blind behaviour.

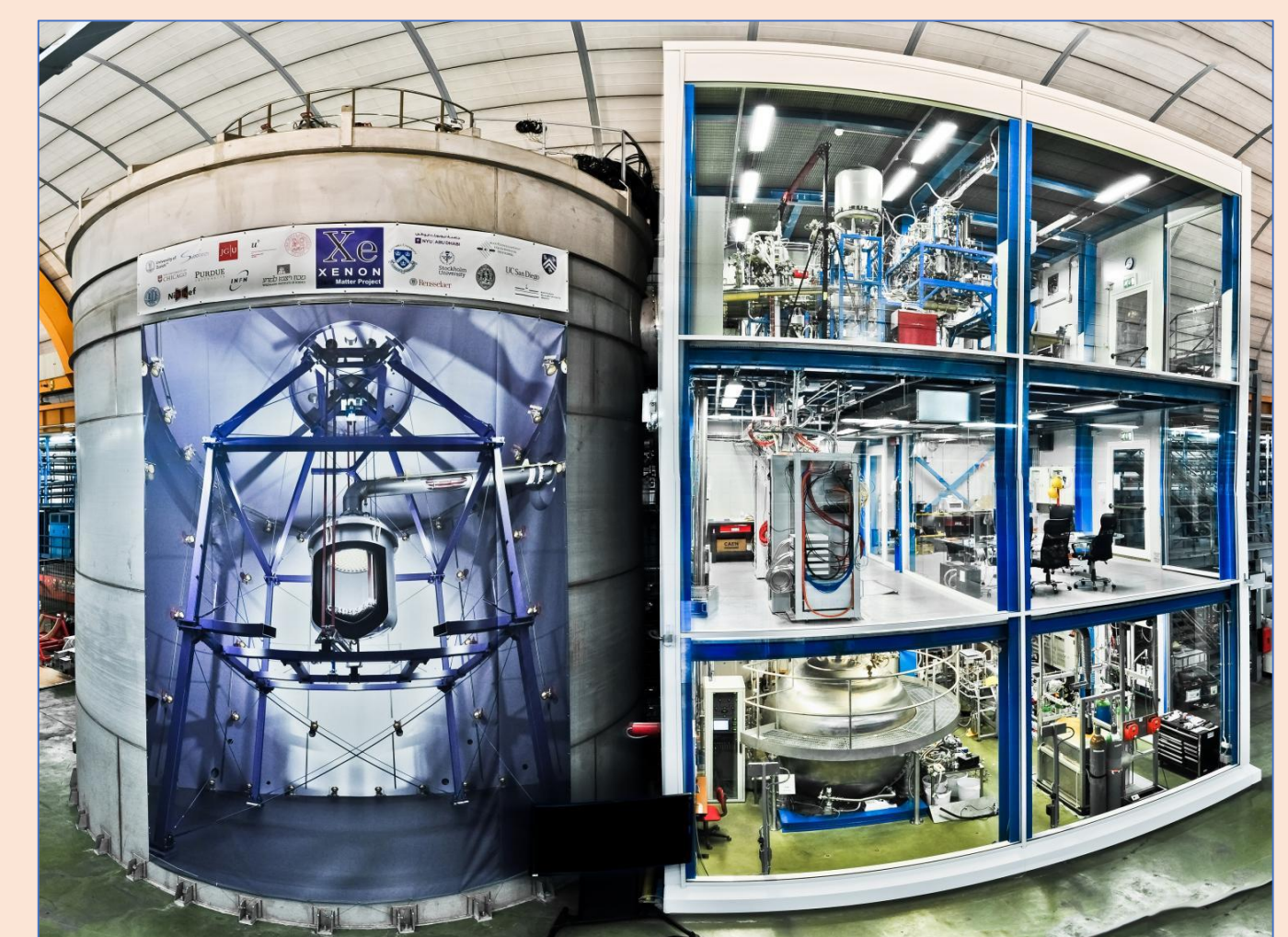


The XENON1T Detector

- Located underground inside the Laboratori Nazionali del Gran Sasso (LNGS) - 3600 m.w.e.
- Excels in the search for WIMP scattering and other rare events [3,4,5].

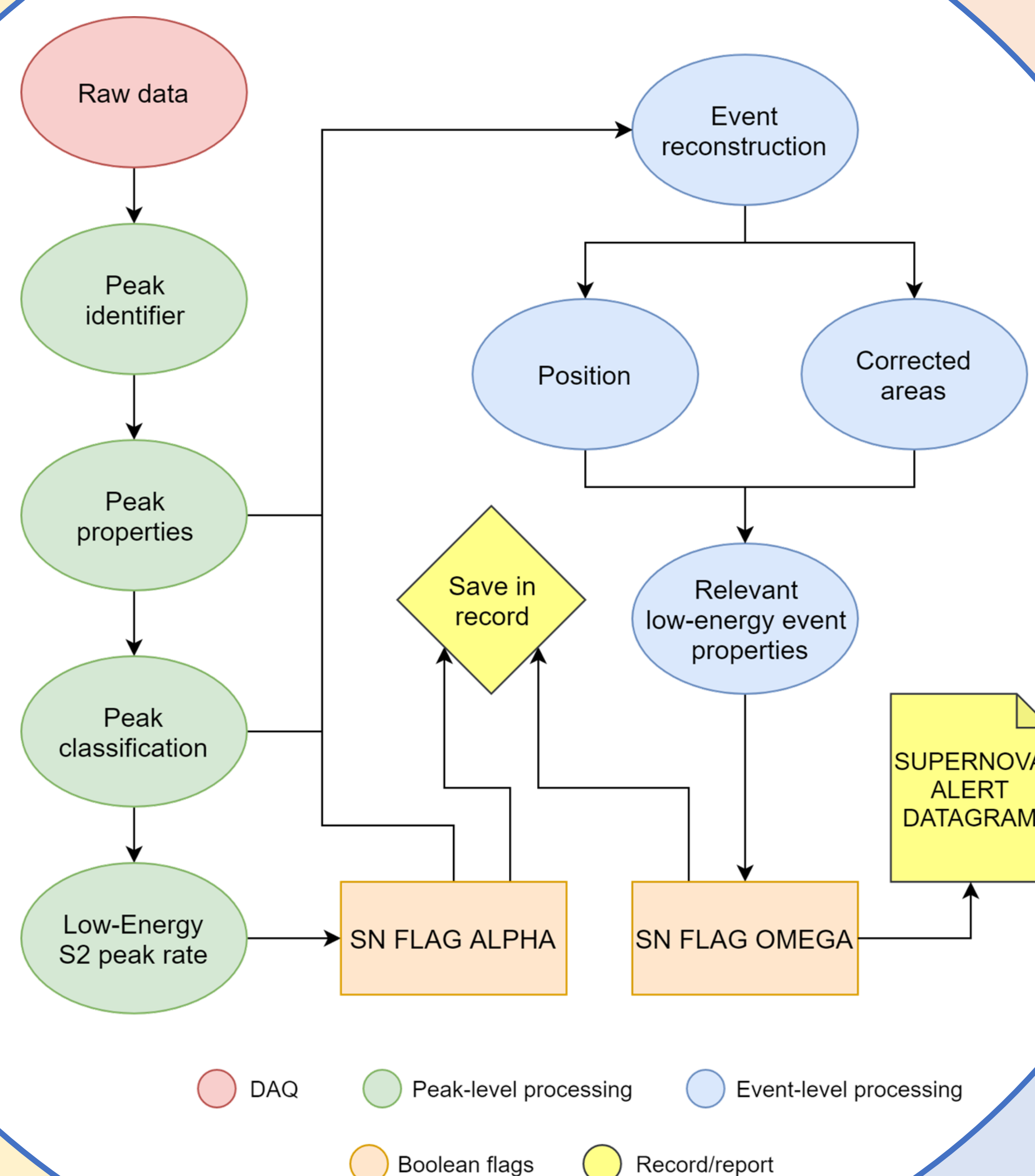


- Cylindrical dual-phase time projection chamber (TPC) with 2t of LXe, instrumented with PMT arrays on the top and bottom.
- 3D position reconstruction and background discrimination with light (S1) and charge (S2) detection.
- The upgrade, XENONnT, with 6t of LXe as active target, will start to be commissioned in 2019.



SNe Observation in LXe DM Experiments

- SN neutrinos deposit up to $O(1)$ keV of energy in xenon targets through CEvNS.
- Low energy events demand low energy threshold. For double-phase TPCs, lower thresholds may be reached by giving up the requirement of a generated S1 signal (known as an S2-Only framework).
- In the timeframe ($<10\text{s}$) of a SN event at 10 kpc the experiment expects $O(10)$ signal events (SN@10kpc) in the TPC, over a low background rate.
- Based on a S2-only analysis with 0.7 keV energy threshold, XENONnT will provide enough sensitivity to detect a $27 M_{\odot}$ SN burst past the edge of the Milky Way with more than 5σ significance [1].
- The result may be improved using the signals from the 700 t water Cherenkov detector used as muon veto for the TPC.



SN Alert Software

- The ability to receive alarms from the SuperNova Early Warning System (SNEWS) and promptly save all data from a given time period was implemented in XENON1T [7] in the fall of 2017.

- XENON1T synchronized its DAQ system with a GPS-based absolute timing module [8], which is crucial to accurately record the time of external events, such as SNe, and coordinate with other experiments.

- XENONnT will feature a triggerless DAQ system [7], followed by an online processing framework using the XENON-developed open-source data processor, "strax" [6].
- In parallel of acting upon alarms sent by SNEWS, the viability of actively contributing to the network with XENONnT is under investigation.

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