

The future of dark matter search with XENONnT

Adam Brown for the XENON collaboration

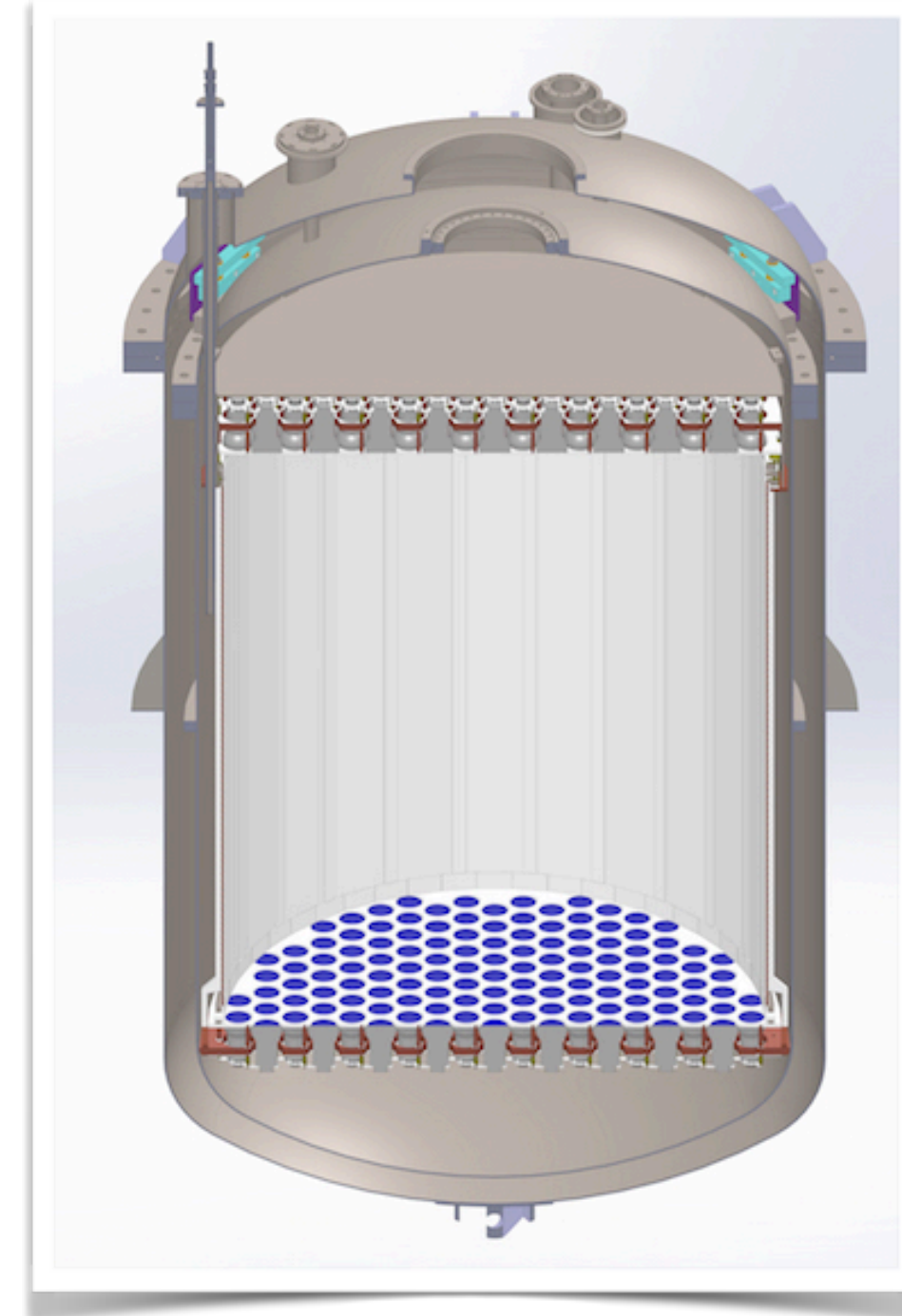
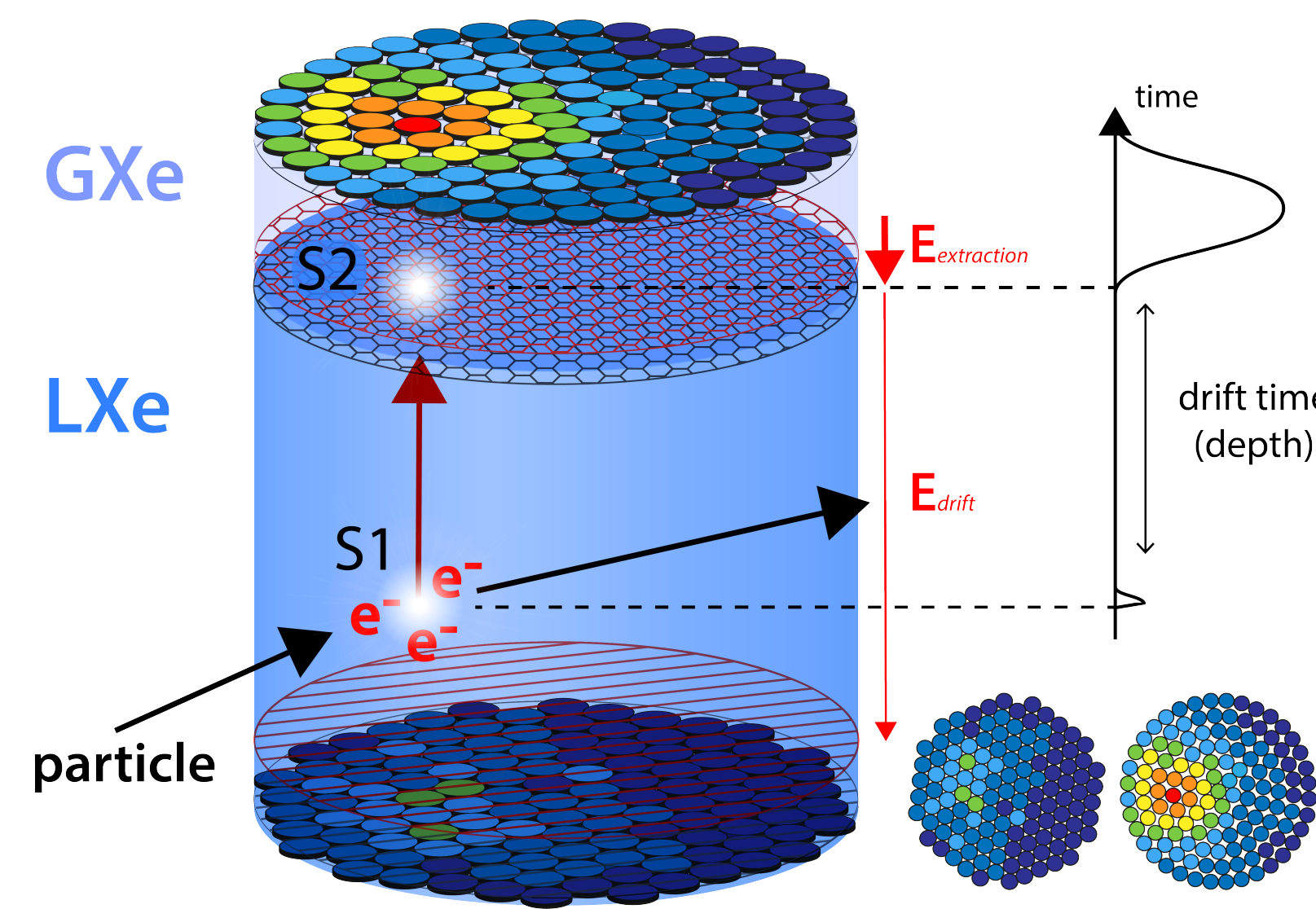


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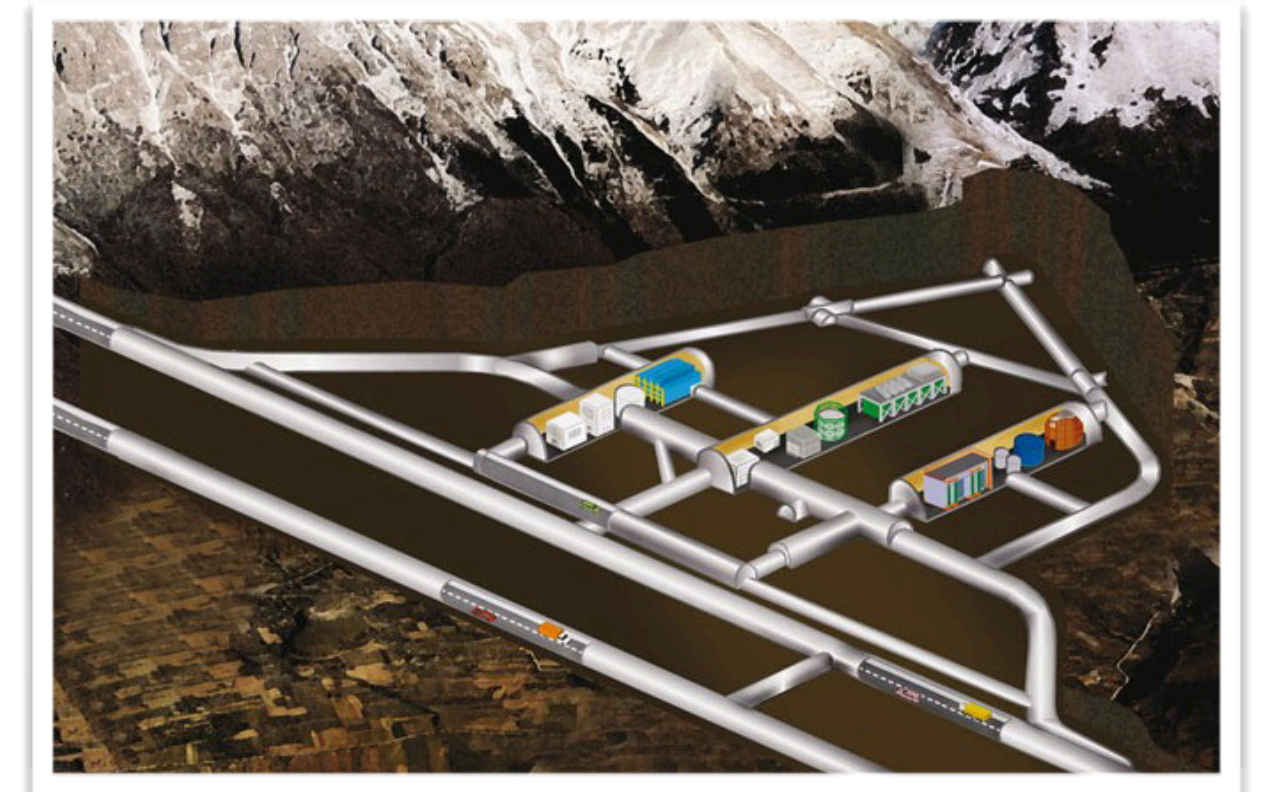


Liquid xenon TPCs

- ▶ Interaction \Rightarrow light (S1) & ionisation
- ▶ e^- drift up to gas; e^- -Xe collisions in gas \Rightarrow light (S2)
- ▶ S2 hit pattern + drift time \Rightarrow 3D position
- ▶ S2/S1 ratio \Rightarrow type of interaction: electronic recoil (ER) / nuclear recoil (NR)

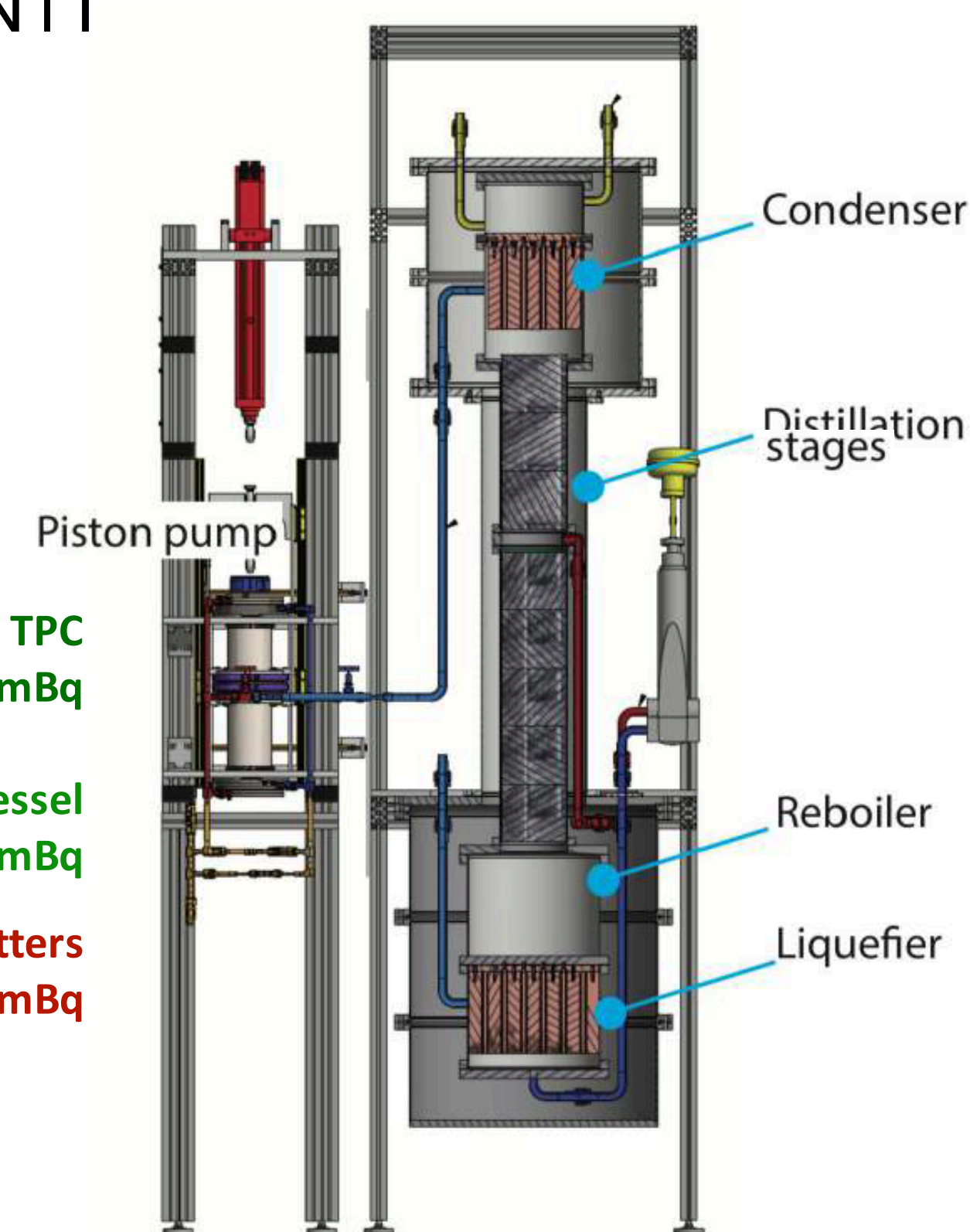
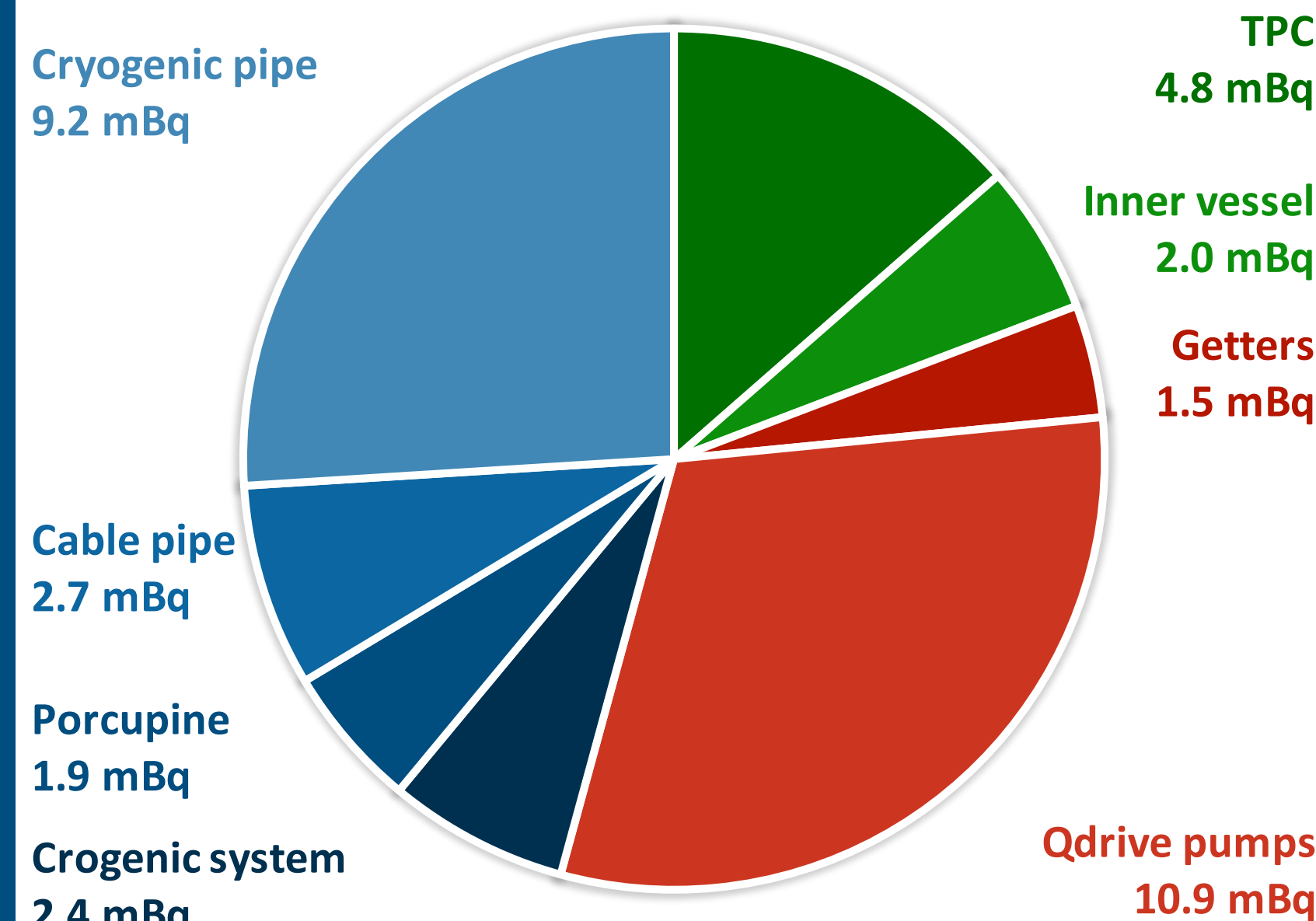


- ▶ XENONnT is an evolution of XENON1T, which set very strong limits on DM-nucleus interactions [1] and observed 0vDEC [2]
- ▶ Located in LNGS underground lab shielded against cosmic rays: rock shielding equivalent to 3600 m of water
- ▶ TPC contains 5.9 t xenon, three times more than XENON1T
- ▶ S1 and S2 readout with two arrays of 3" PMTs: in total 494
- ▶ All tested in liquid and gaseous xenon to check for stable operation and leak-tightness



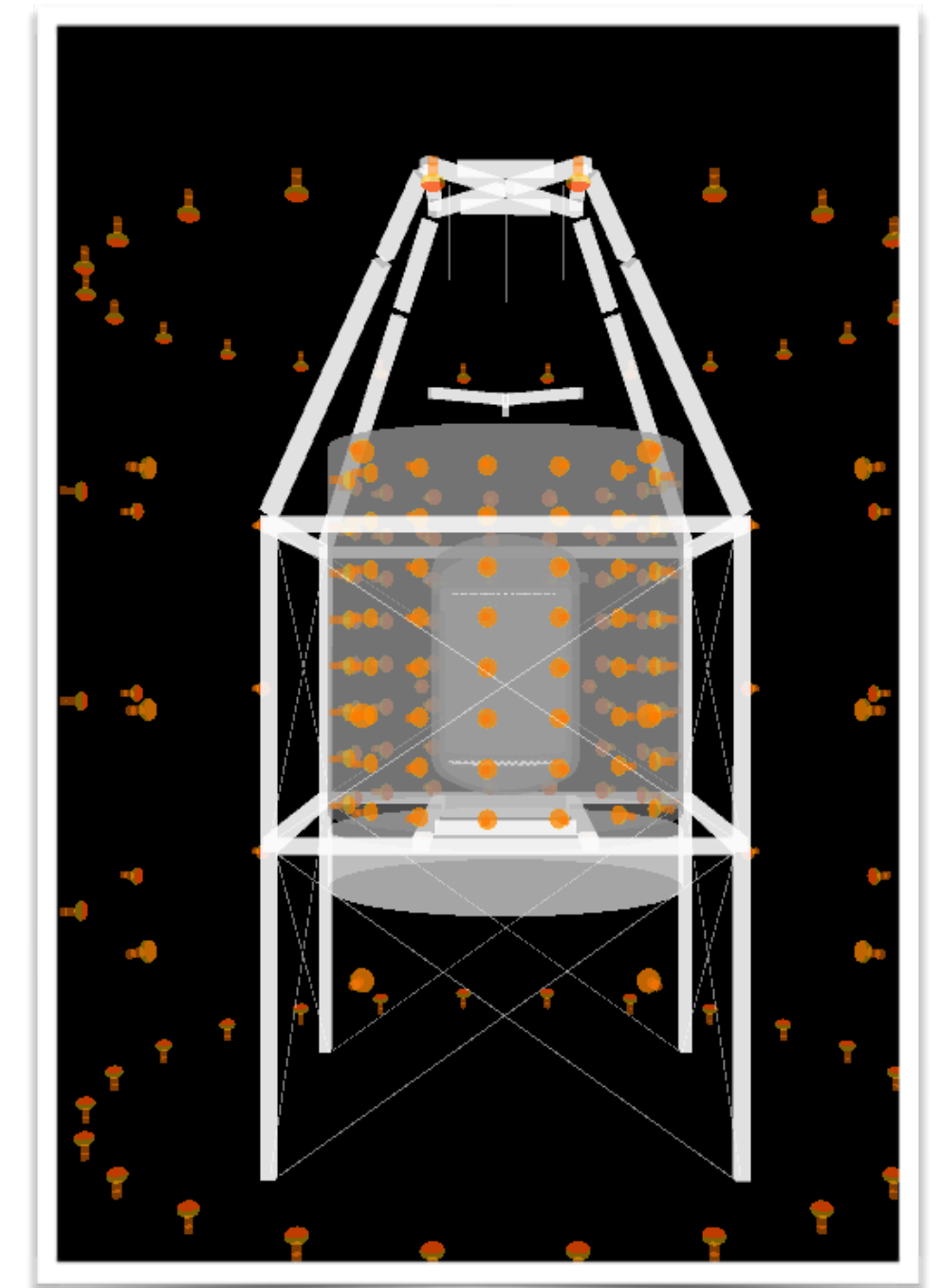
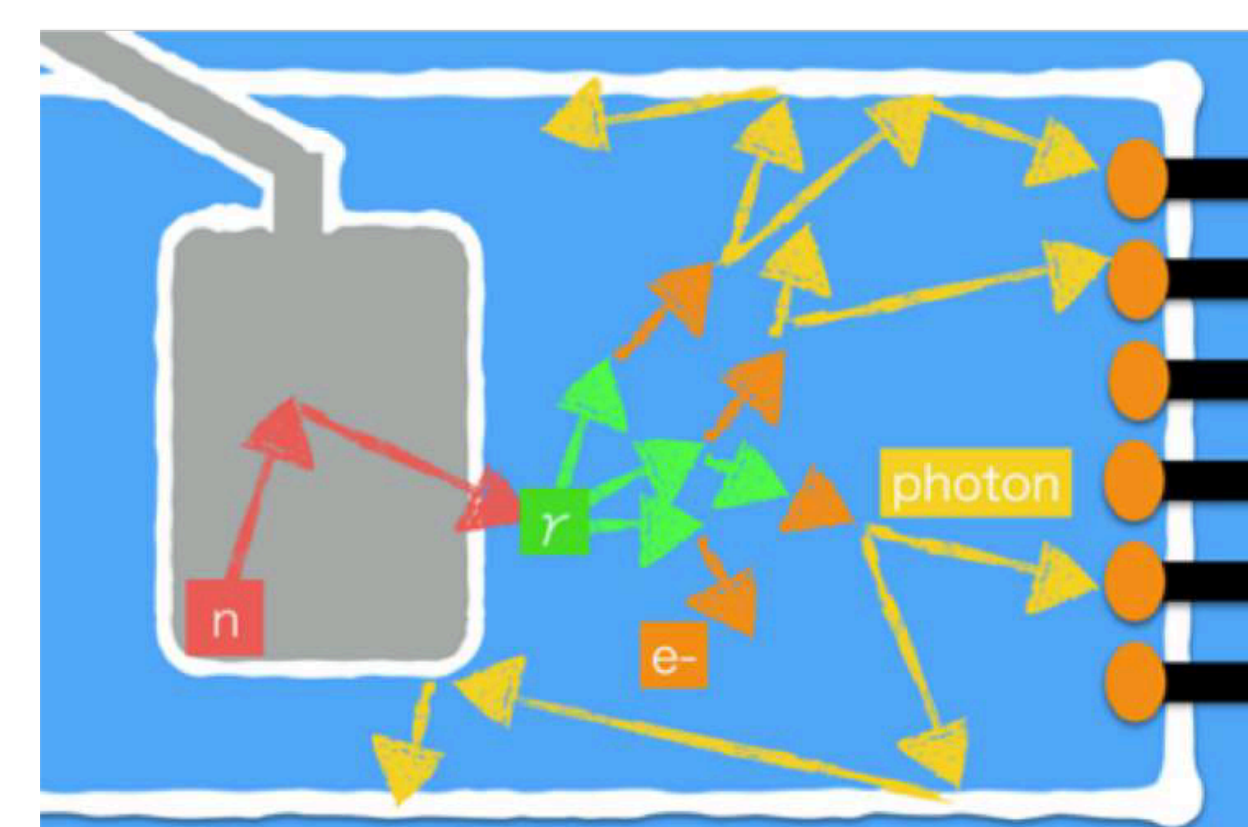
Radon reduction compared to XENON1T

- ▶ Rn creates majority of background in predecessor experiment XENON1T
- ▶ New magnetically coupled piston pump to reduce radon input from **purification system**
- ▶ Radon distillation column helps with radon from **TPC, cryostat and cryogenics**



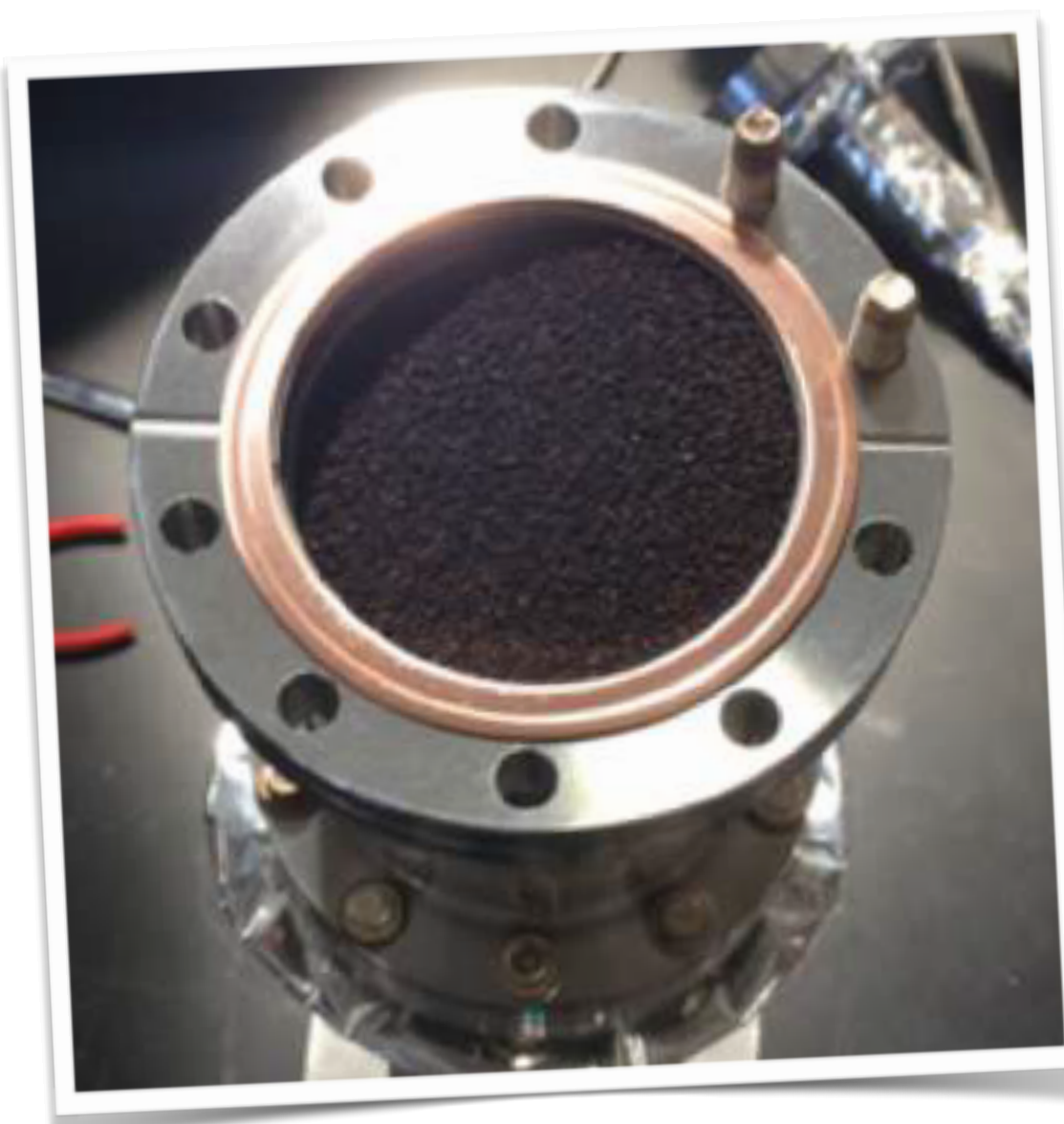
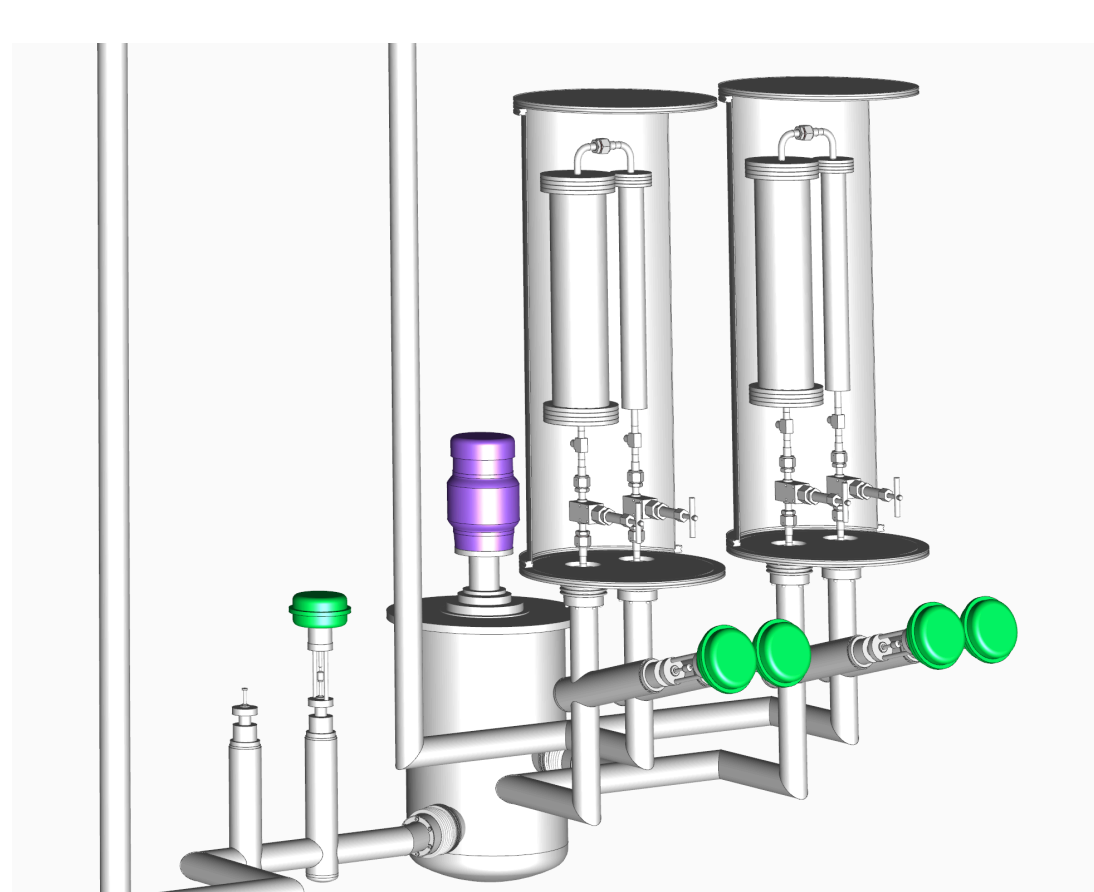
Neutron veto

- ▶ Neutrons are dangerous NR background
- ▶ New n-veto subsystem for XENONnT
- ▶ Inner region of existing muon veto
- ▶ Optically separate region, with 120 additional PMTs
- ▶ 0.5% $Gd_2(SO_4)_3$ in the water tank
- ▶ >80% efficiency tagging neutrons which have scattered once in the TPC



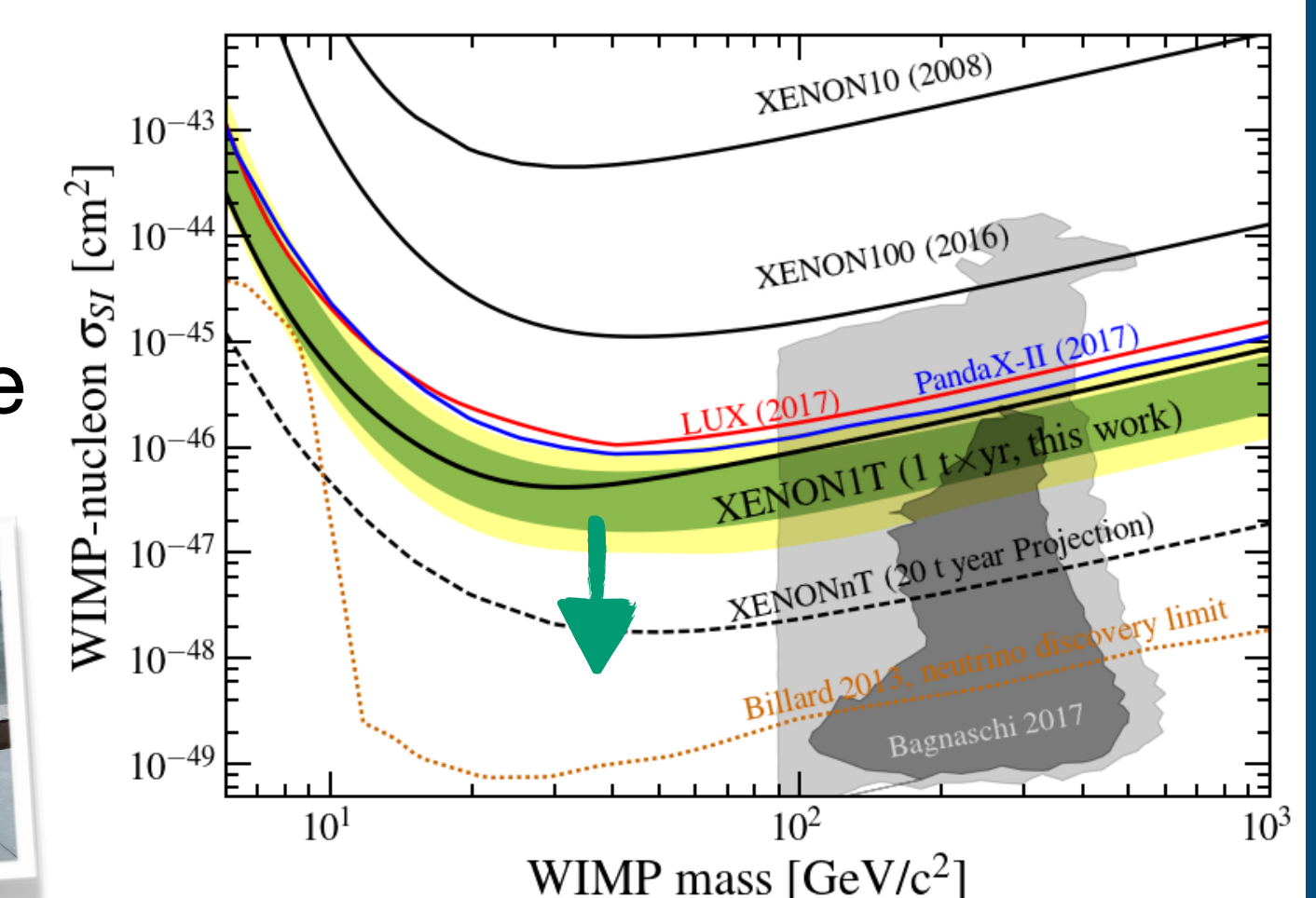
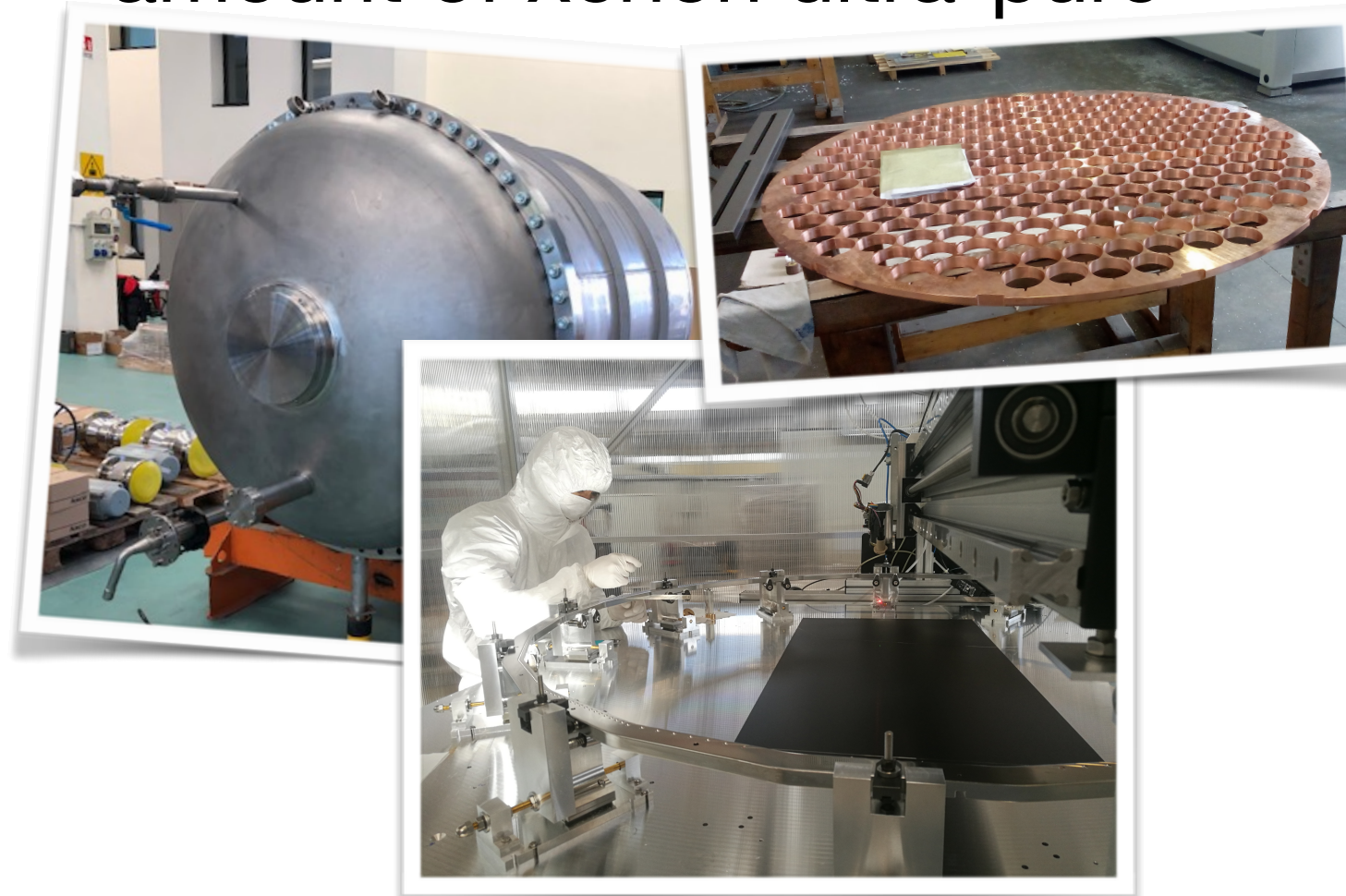
Liquid xenon purification

- ▶ Purification removes electronegative contamination so electrons reach the gas
- ▶ With gas purification ~ 1.8 t/day possible
- ▶ Liquid purification means 21 t/day
- ▶ Two custom cryogenic oxygen filters



Summary

- ▶ XENONnT is coming with unprecedented sensitivity to WIMP dark matter
- ▶ New technologies keep the large amount of xenon ultra-pure



- ▶ Construction is ongoing
- ▶ First data will be taken in 2020

References

1. Aprile *et al.*, PRL 121 111302 (2018)
2. Aprile *et al.*, Nature 568, 532 (2019)

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