

detectors astrophysics <2026

Fermilab is currently involved in the development of the following detectors:

Dark Matter:

- Now Lab is focused in G-2 dark matter program)
 - LZ (begin operations 2019) — noble liquids
 - superCDMS (begin operations 2020) — sub kelvin
 - ADMX (running now, goes beyond 2020) — sub kelvin
- Other 2020+ ideas recently discussed
 - extension of ADMX (2 **LDRDs** going on now) — sub kelvin
 - pico-500 (very small FNAL role?)
 - SENSEI (**LDRD** now, could grow in the coming year) — Si detectors
 - NEXUS as a detector calibration/testing facility for DM ideas (NuMI) — sub kelvin

Dark Energy:

- Dark Energy Spectroscopic Instrument (begin operations ~2019) — Si detectors

CMB:

- SPT-3G (now with some upgrades planned) — sub kelvin

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Dark Matter:

“Cosmic Visions Workshop” is just now starting to discuss R&D for long term future . Depends on what the results of G2 are:

- several tons bubble chamber (investigate different targets)
- several kg single electron threshold experiments (Si detectors of sub-Kelvin)
- directional detection ideas (gas detectors, graphene detectors) - FNAL not yet involved but there is interest (Si detectors)
- quantum detectors sub kelvin

Dark Energy:

Cosmic Visions community workshop considering the next possibilities for cosmic surveys. The options include were FNAL has expressed some interest:

- high density - low resolution spectroscopy (MKIDS (**LDRD**) sub kelvin, prisms)
- high resolution - low density spectroscopy (billion object apparatus , “superDESI”, Si detectors + possible involvement in high density fiber positioning)
- 21cm survey

CMB:

- CMB-S4 — sub kelvin (big role in coming from experience in SPT-3G)

- what are the areas of synergy between these ideas, where the development of common facilities and expertise would benefit more than one effort.
- Sub-kelvin expertise is becoming more important for astrophysics in the near and long term future. We have talked several times about the possibility of a more efficient facility for this (maybe inside IERC). We now have several fridges, but not a real Sub-Kelvin Detector Facility.
- large integration lab space versus smaller testing lab space. We have nice integration labs (a place to put together something like DECam or SPT-3g), but could get better labs for testing smaller ideas (a place to check a first small prototype for an idea). Role of NEXUS as a facility for low background sub-kelvin detector testing, and calibration.
- Keep a healthy diversity to be ready for future (small R&D). We have done a lot of this in the past and enables several experiments (PICO, DarkSide, DAMIC).