



Cosmic Frontier Strategic Plan

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Cosmic Frontier Working Group

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FNAL Cosmic Planning Process

- Engaged in 3-phase strategic planning process for the Cosmic Frontier (CF) program:
 - **Phase 1:** identified core capabilities that the laboratory provides to the OHEP CF program;
 - **Phase 2:** identified major activities the lab should pursue over the next ~7 years, that exploit these capabilities, constitute critical contributions, align with OHEP/P5 priorities, deliver on our commitments, and maximize scientific impact;
 - **Phase 3:** beginning to implement *focused* plan by directing effort from activities not deemed essential in the first two phases, to build our future program.
- Cosmic Steering Group met weekly from July 2018 and got input from FNAL cosmic community in Nov.



Dark Energy	FNAL critical roles	FNAL core capabilities
DES	Project management, detector test & integration, ops management, calibration, collaboration leadership, computing, data management & database	Detector testing, assembly & integration at SiDet; survey design & ops; data mgmt; project mgmt
DESI	Detectors, corrector, online database, fiber to target translation	Detector packaging, testing, assembly at SiDet; survey design & operations, active optics software, commissioning
LSST	Dark Energy Science framework, survey operations & strategy, data management	Survey operations, computing infrastructure, computing operations
Dark Matter	FNAL critical roles	FNAL core capabilities
SuperCDMS	cryogenics, electronics, operations, calibration, data analysis, project management	Precision assembly, testing; underground facility (NEXUS); cryo engineering; project management
LZ	TPC engineering, process control	Cryo and process control engineering
ADMX	RF cavity development, operations management, Quantum sensors	RF engineering; test & assembly at SiDet; Quantum sensors; magnets; ops management
Skipper CCD R&D	dark matter search (SENSEI), R&D for applications to dark matter/neutrino expt's & large scale surveys	Detector R&D expertise; SiDet facility
CMB	FNAL critical roles	FNAL core capabilities
SPT 3G	Cryostat, detector packaging and FP design, testing, integration, camera installation, operations lead	Detector test, assembly, integration at SiDet; operations management; detector electronics; project management
CMB S4	R&D, design, electronics, integration, management	

Plan Elements

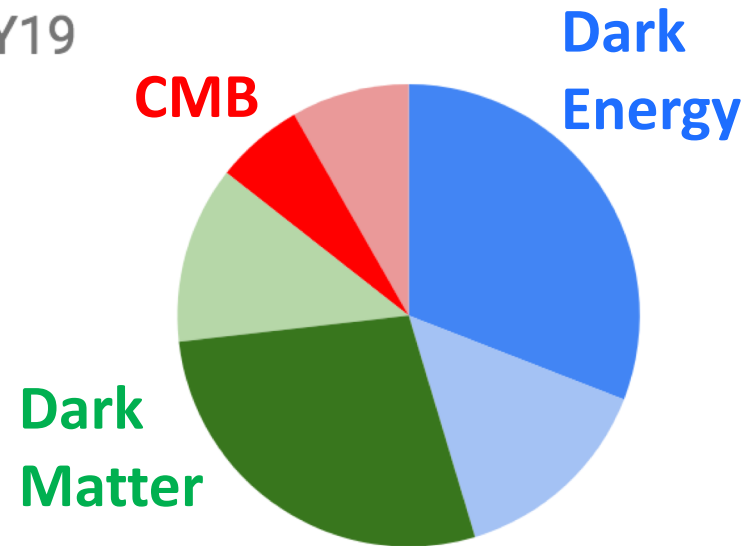
- **Cosmic Microwave Background** (inflation, neutrinos) 
 - **SPT 3G lead operations** → **CMB Stage 4** leading/major roles
- **Dark Matter Detection** 
 - **Axions**: lead lab ADMX, develop Quantum sensors (via QIS) for next-generation experiment
 - **Sub-GeV DM**:
 - SuperCDMS construction, operations, HVeV R&D
 - Skipper-CCD R&D and deployment/scale-up
 - Discontinue LZ effort this year, when deliverables completed
- **Cosmic Surveys** (cosmic acceleration, dark matter) 
 - **DES** → **LSST operations** (small but critical role in DESI ops)
 - **R&D toward Stage V DE spectroscopic survey** (LDRD)
- **Astro Theory program** w/ growing focus on cosmic neutrinos
- **Cosmic Physics Center** to provide connectivity and serve users

Cosmic activities flow from P5 drivers and from our core capabilities and synergize with other lab activities (Quantum, Neutrino, Energy...)

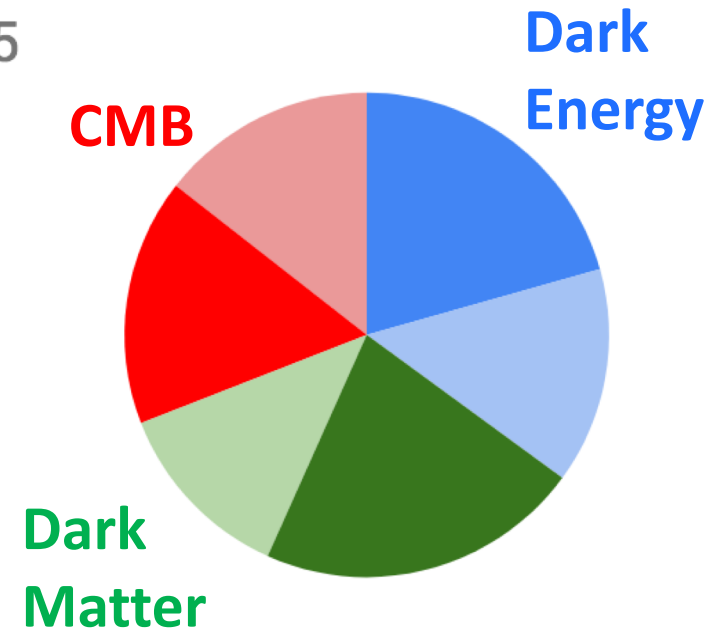
Cosmic Program Balance

- Moving towards a more balanced program centered around the pillars of:
 - CMB
 - Dark Matter
 - Dark Energy
- Seeking major roles in future CMB and axion experiments.
- Cosmic surveys transition from DES to LSST (with an eye on a large next-generation experiment).

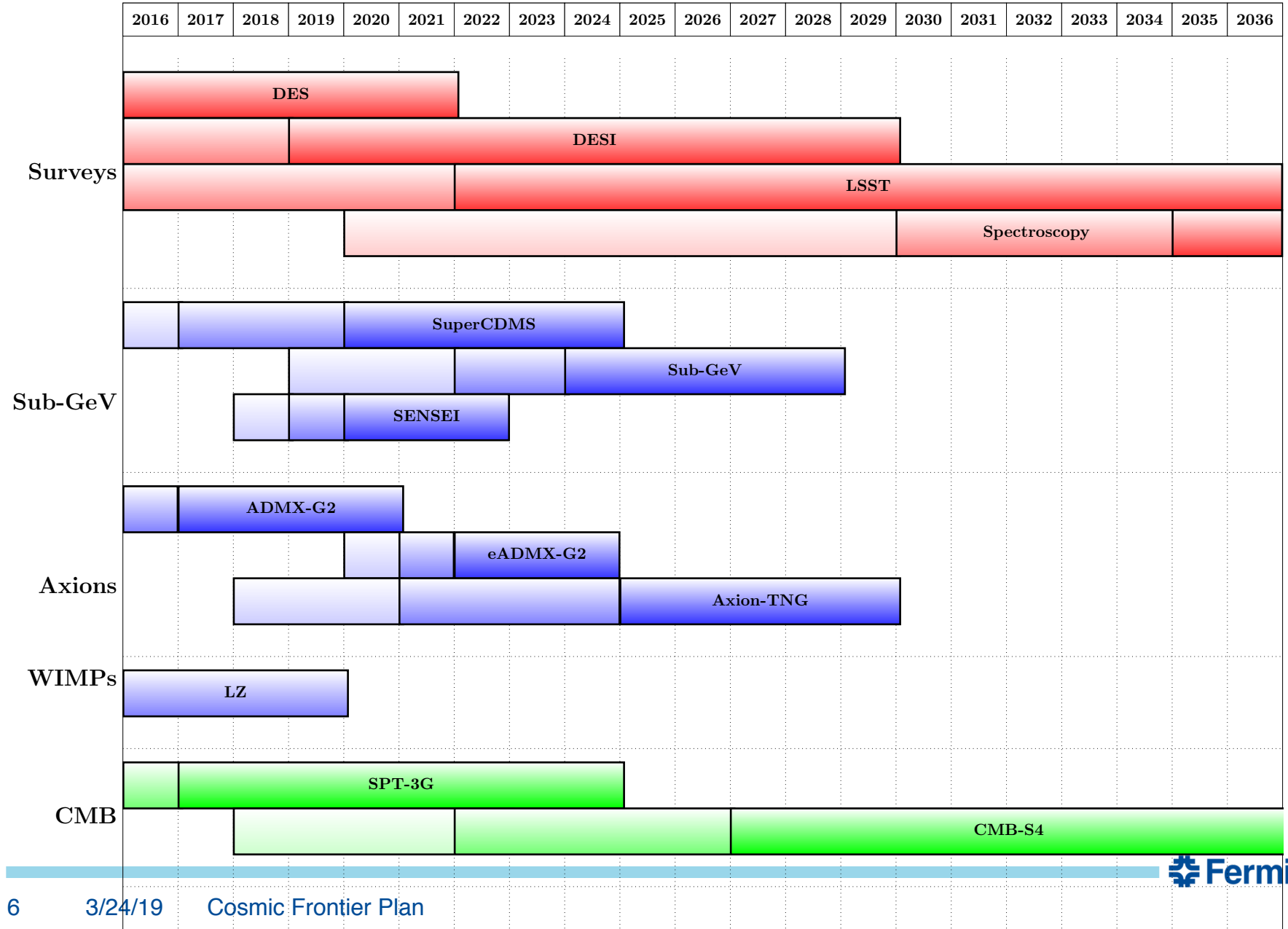
FY19



FY25



Cosmic Experiments Timeline



Cosmic Frontier Working Group Path Forward

- First Cosmic Working Group planning meeting Friday 3/29 from 1PM-3PM in Curia II
 - Presenting the SAC charge
 - Presenting the steering group plan
 - Discuss how to address the SAC charge
- Primary emphasis will be on connecting the recent cosmic plan to the SAC charge for the post-2026 era.
- How does the near-term cosmic plan prepare Fermilab for leadership on the next generation of experiments?
- What technology do we need to be developing now for experiments in the post-2026 era.