CF6: Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities

- Cosmic Frontier topic 6 (CF6) conveners:
  Brenna Flaugher (FNAL)
  David Schlegel (LBNL)
  Chihway Chang (UChicago)
- Slack channel: #cf06-dark_energy_comp
- Communication on slack + mailing list
- Wiki page: https://snowmass21.org/cosmic/start

CF6: Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities

Process for this sub-group

- Reviewed Astro2020 submissions (from July 2019)
- Defined splits between CF3/4/5/6/7
- Solicited LOIs — Aug 31, 2021
- Review LOIs with the goal of coordinating Snowmass white papers
- Short presentations+discussions, alternating weeks CF4 & CF6 (July—Nov 2020)
- “Fermilab” community planning meeting (Oct 5-9, 2020)
- Drafted white paper plans + identified “facilitators”
- Hit “pause”, re-start in Sep 2021

CF6: Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities

This group consist two fairly separate themes, addressed at the community planning workshop sessions #142-144 —

- **Complementary Probes:** Joint analysis is key to making progress in understanding Dark Energy and Cosmic Acceleration. Dedicated resources and collaborations for joint analysis is critical. (#142/143)
- **New facilities:** An overview/summary of all new facilities proposed in this snowmass process that focus on Dark Energy/Cosmic Acceleration. (#144, but also #69/70/71)

CF6: Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities

Goals going into the Community Planning Workshop Nov 2020 —

- **#142/143: Connect LOI authors of similar interest**, form smaller groups that could be in close contact going forward (whitepaper writing and/or responsible for subsections in the TG report). Plans for future telecons/ workshop (maybe with CF4/5/7).
- **#144: Have an overall picture of the landscape of proposed new facilities** (in science goals, wavelength, scale of project etc.). Discuss possible grouping of projects (corresponding to subsections in the TG report). Plans for future telecons/workshop (maybe with CF4/5/7).

CF6 “Solicited” White Paper Topics

- **Joint-analysis of Static Probes** [overleaf] [notes] [#wp-cf06-static-probes]
  Importance of joint analysis in static (large-scale structure) probes.
  Facilitators: Andrew Hearin, Eric Baxter, Chihway Chang

- **Joint-analysis of Transient Probes** [overleaf] [notes] [#wp-cf06-transient-probes]
  Importance of joint analysis in transient (time-domain) probes.
  Facilitators: Maria Elidaiana, Alex Kim, Antonella Palmese

- **Collaboration Structure for Joint Analysis** [overleaf] [notes] [#wp-cf06-collaboration]
  Importance of substantial change in funding and collaboration model for joint analysis.
  Facilitators: Jason Rhodes, Brenna Flaugher

- **New Facilities:** Currently we do not plan to have an overall white paper for new facilities, but rather to summarize facility white papers across CF in the report
  - CF3 has solicited a paper on new facilities [#wp-cf03-dark_matter_facilities]
  - CF7 has a GW facility paper

CF4 “Solicited” White Paper Topics

- **Science from Large N_{linear} sky surveys** [email Martin White for overleaf access]
  Facilitators: Martin White, Simone Ferraro, Anže Slosar
  Partial overlap with: CF6 joint-analysis of static

- **Science from large nP sky surveys**
  Facilitators: Kyle Dawson, Katrin Heitman, Andrew Hearin

- **High precision in Astrophysics** (ultra-stable and precise spectroscopy, precise astrometry)
  Facilitators: Anthony Gonzalez, Sukanya Chakrabarti, Michael Pierce

- **Enabling current flagship experiments to reach their full potential**
  Facilitators: Jeff Newman, Peter Nugent, Alex Kim, Michael Dickinson
  Partial overlap with: CF6 joint-analysis transient, CF6 joint-analysis static

LOIs covered by each proposed CF4 white paper

- **CF6: Joint-analysis of Static Probes**

Higher-order statistics with galaxy and CMB surveys
Theory and Computing Across LSST, DESI, and CMB-S4
Improving Cosmological Constraints by Cross-correlating Galaxy and CMB surveys
Dark Energy Discovery with Multi-Survey Cross-Correlations
CMB-S4: Mapping matter in the Cosmos
CMB-HD: High-resolution, ultra-low-noise matter mapping
Cosmology from Multi-Wavelength Observations of Clusters of Galaxies
Unified inference of the cosmological parameters from noise-dominated galaxy clustering and shear
Joint pixel-level processing of WFIRST, Euclid, LSST, and SPHEREx
Understanding the accelerated expansion of the Universe with Rubin Observatory's Legacy Survey of Space and Time
Narrow band imaging as a cosmological survey complement
Multi-Wavelength Simulations
CosmoSIS for the Next Decade
Cosmological Synergies Enabled by Joint Analysis of Multi-probe data from…
Complementarity of ground- and space-based observations of the cosmic microwave background
Cycle and symbiosis: AI and Cosmology intersect to produce new knowledge and tools
Synergies between Millimeter-Wave Line Intensity Mapping with Radio, Optical and Microwave Observations

LOIs covered by each proposed CF4 white paper

- **CF6:Dark Energy Science with Multimessenger Probes and the Vera Rubin Observatory's Legacy Survey of Space and Time**

  Probing the expansion history of the Universe with Gravitational Waves
  Multi-messenger Probes of Cosmology and Fundamental Physics using Gravitational Waves
  Probing Dark Energy with Gravitational Wave Standard Sirens in the HEP Experimental Cosmic Frontier
  Cycle and symbiosis: AI and Cosmology intersect to produce new knowledge and tools

LOIs covered by each proposed CF4 white paper

- **CF6: Collaboration Structure for Joint Analysis (many of the above might also be relevant, LOI authors feel free to add/reach out)**
  - The US Extremely Large Telescope Program
  - → Cosmological Synergies Enabled by Joint Analysis of Multi-probe data from…
  - → Complementarity of ground- and space-based observations of the cosmic microwave background
  - Joint pixel-level processing of WFIRST, Euclid, LSST, and SPHEREx
  - → Theory and Computing Across LSST, DESI, and CMB-S4
  - → Cycle and symbiosis: AI and Cosmology intersect to produce new knowledge and tools

LOIs covered by each proposed CF4 white paper

- **CF6: New Facility LOIs (not going into a single white paper but scattered around white papers hosted under different CF3/4/5/7)**

  MegaMapper: a Massively-Multiplexed Spectroscopic Instrument for Cosmology
  The Maunakea Spectroscopic Explorer
  Enhancing probes of the dark sector with Keck-FOBOS optical spectroscopy
  The US Extremely Large Telescope Program
  La Silla Schmidt Southern Survey
  Illuminating the Dark Universe with ATLAS Probe
  Packed Ultra-wideband Mapping Array (PUMA): Next generation facility for Sky Survey in Radio
  Millimeter-Wave Line Intensity Mapping Facilities
  An Intelligent Platform for Theoretical Understandings of Type Ia Supernovae
  CMB-HD: An Ultra-Deep, High-Resolution Millimeter-Wave Survey Over Half the Sky
  [+ GW and CR new facilities]

CF6: Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities

- Activities to re-start in September 2021
- We did not *decide* the White Paper "leads", we just identified "facilitators" that could take on the task to contact other LOI authors to get the discussion going → explained in Oct 29th e-mail

> We made an effort on the call to identify initial volunteers for each white paper to contact relevant LOI authors and start the discussion (see some names on slide 39), but do feel free to contact us or the names on that slide if you also like to help coordinate/contribute. If you like to help coordinate, please do so in the next week.

- Suggesting the recognition of cross-collaboration (multi-wavelength) analyses at the "project" level
- What cannot be done with current models? i.e. simulations, tools
- Ideas for what the model actually looks like, i.e. DESC+CMB, DESI+CMB
- Articulate the need for "additional funding", or can existing projects not just talk to each other?
- Transient followup