Cosmic Visions Workshop: Dark Energy

Second workshop on shaping dark energy research over the next decade and beyond

Lawrence Berkeley National Laboratory, November 14, 2017

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Aim of the Workshop

- **Overall goal of Cosmic Visions Dark Energy Meetings:**
  - Plan and shape future directions in dark energy research, experiments, or facilities following the end of construction phase of DESI and LSST
  - Identify and develop small-scale ideas to occur concurrently with DESI and LSST that would enhance dark energy science
  - Develop the science case and approach for the next “big idea” for 2030+
- **Specific goals of this workshop**
  - Prepare a White Paper to be presented to DOE in December 2017/January 2018 outlining our small (<$10M) ideas -- the more focused we can be, the better!
  - Start preparations for ideas for the Decadal Survey -- these would be community ideas that could go beyond dark energy but dark energy would play an important role
  - Prepare for the next P5 report and inspire new projects for DOE HEP long-term future planning

DOE-HEP Cosmic Frontier Project Planning

- **HEP is currently following the 2014 HEPAP P5 Strategic Plan**
- **Starting preparations for the next P5 strategic planning process, timed to be after the large projects, HL-LHC upgrade and LBNF/DUNE have CD2 (Critical Decision 2) approval**
- **P5 study would be carried out in early 2020's (completed by ~2022) and will develop US particle physics strategy for next 10 years**
- **P5 Inputs:**
    - Snowmass process for HEP community science input starts ~2019
    - Particle physics European strategy update early 2019, report May 2020
    - Astro Decadal Survey, start ~Decemeber 2018 and complete December 2020

Recap of Chicago Meeting

- **First Cosmic Visions Dark Energy Meeting was held in September 2016 in Chicago**
  - http://kicp-workshops.uchicago.edu/FutureSurveys/
- **Five major topics:**
  - 21cm
  - Southern Spectroscopic Survey Instrument (SSSI), medium size effort in 2025+
  - DESI-2
  - BOA: Billion Object Apparatus, large spectroscopic survey in 2030+
  - Low resolution spectroscopy
- **All topics still covered in this second meeting but re-arranged:**
  - 21 cm
  - Southern Spectroscopic Roadmap (includes SSSi, DESI-2, BOA)
  - Small-scale ideas (includes low resolution spectroscopy)

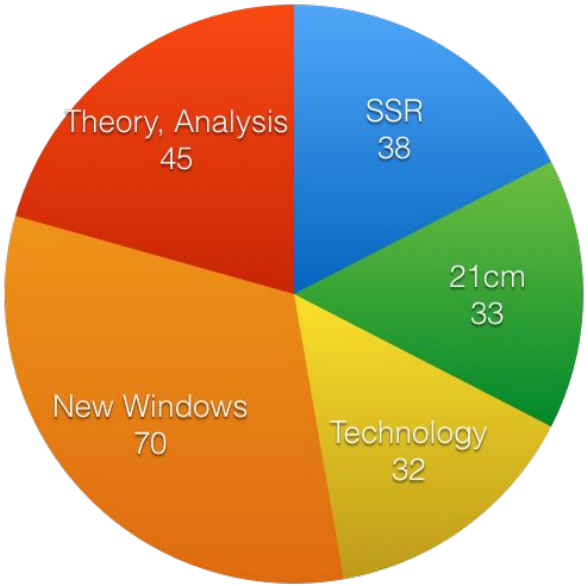
Small-scale Ideas

- **New Technology Developments for the Future**
  - Research on technologies for the next big project is essential!
  - New technology developments (e.g., innovative fiber positioners, new sensors) might open up new opportunities that would have been deemed impossible before
- **New Observational Windows to Enhance LSST and DESI**
  - Are there additional observations we can carry out that will enhance the science return of Stage IV missions?
  - What would it take to make this happen (build a small new instrument, do follow-up observations,...)
- **Theory, Analysis, and Computing**
  - Develop new ideas to push beyond LCDM
  - Cross-correlations: Data in different wavebands will be available, great opportunities if we have the resources (people!) to analyse them
  - Simulations play an ever more important role in cosmology ...

The Roadmap Concept

- **21cm**
  - Many opportunities to further P5 science: Dark energy, neutrinos, early Universe physics …
  - Small-scale opportunities that can be realized now: Build (or join) a small instrument that will enhance LSST/DESI science
  - Technology developments that pave the road to an ambitious experiment to follow LSST/DESI
  - Develop plan for large instrument/survey in 2025+
- **Southern Spectroscopic Roadmap**
  - Opportunities while LSST is on the sky: Spectroscopic follow-up
  - DESI-2 opportunities
  - Technology developments that pave the road to an ambitious experiment to follow LSST/DESI
  - Develop plan for large instrument/survey in 2030+

Participants' Interests



White Paper Thoughts

- **“Dream” outcome:**
  - A document (or two) that describes a plan leading to a major mission in 2030+ that DOE can integrate into their long-term planning and can be part of the Decadal Survey
  - The document(s) should also include a few shorter-term, small-scale ideas that we can present to DOE in the near future to enhance LSST and/or DESI or outline new technologies that are important for the major mission
- **Alternative: Many white papers that we put together into one document**
  - Disadvantage: DOE HEP might not know what to push forward
- **White paper content:**
  - How will this effort enhance our current knowledge of dark energy?
  - How does the idea complement other efforts?
  - Cost estimate and timeline
  - Possible technical and logistical obstacles?

White Paper Logistics 1

- **Join our Slack Workspace: CVDE**
  - As a participant, you should have gotten an invitation
  - Feel free to invite your colleagues
- **Five Google Docs for Notes:**
  - SSR: https://docs.google.com/document/d/1S3QzhgI2NKtqoUKS0QJJnWTh0bw_TxIj6yW2m1Zy-0Y/edit#heading=h.dv6l71slbjmk
  - 21cm: https://docs.google.com/document/d/1LpxceEqIMaw0_VG0QYTNiDmHPgYwn6nGO1uAIOlHbvI/edit#heading=h.wfmv9qykf953
  - Windows: https://docs.google.com/document/d/1ImrtQ8HGZpTpxZwMCJ5y1YqS3ZCf5aonHw9dsUa0zzc/edit#heading=h.ugnxmmoy5sj2
  - Technology: https://docs.google.com/document/d/1UIouMgDaCzTFyYBguC1gUm6-lbJrrCW9Zpsgts67fXg/edit#heading=h.bplo9c2docxa
  - Theory: https://docs.google.com/document/d/1YVoQlYSAUz9G_kt07ZtwaPV0rvPQwtJx71Vedgk7XB0/edit#heading=h.nnjkdpt1b4u0

White Paper Logistics 2

- **Writing the White Paper**
  - Overleaf doc: https://www.overleaf.com/11381523nfhczkfhwwxc
- **Work in iterations with weekly telecons with leaders of individual efforts**
  - Set up table of content
  - Set up subsections for individual contributions
  - 2 or 3 iterations on contents, team writes introduction
  - Polish and write executive summary
- **During the meeting:**
  - Identify one or two POCs for each subsection that will work on the writing tasks
  - POCs will also be responsible to seek input from interested people who were not able to attend meeting
- **This is a serious effort (quote from Anze)! Our chance to make an impact within DOE**