Introduction to Cosmic Visions

Katrin Heitmann

Future Cosmic Surveys

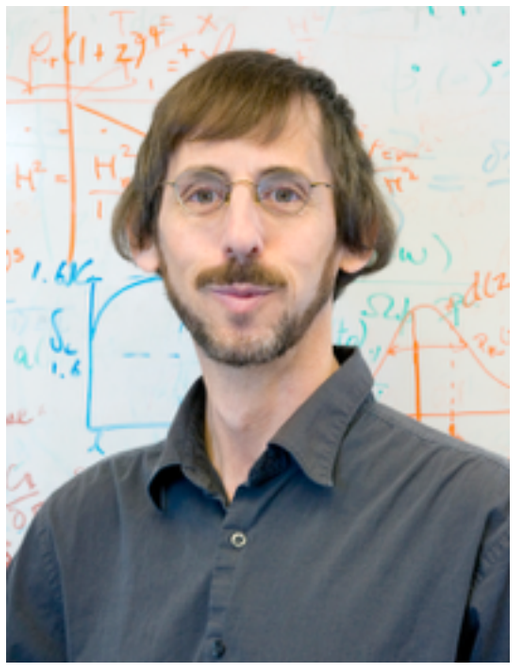
Chicago, September 21, 2016

Thanks to Klaus Honscheid for his slides!

Cosmic Visions: Dark Energy

DOE Cosmic Frontier

Kathy Turner



Eric Linder

- **Cosmic Visions Program**
  - DOE HEP Cosmic Frontier program managers (Kathy Turner and Eric Linder) assembled three panels to look into future directions for CMB, dark energy (cosmic surveys), and dark matter
- **Charge to Cosmic Visions Dark Energy Group**
  - Projects beyond LSST and DESI to further our understanding of “dark energy” (includes modified gravity, neutrinos etc)
  - What can be done to enhance the science outcome from DESI and LSST even further?
    - This can include additional observations, instrumentation, but also theory and simulation programs
  - Deliver three white papers (science, technology, programmatics) and gather input from the community
- **Cosmic Visions Dark Energy Group:**
  - Scott Dodelson (Chair), Katrin Heitmann, Chris Hirata, Klaus Honscheid, Aaron Roodman, Uros Seljak, Anze Slosar, Mark Trodden

Process

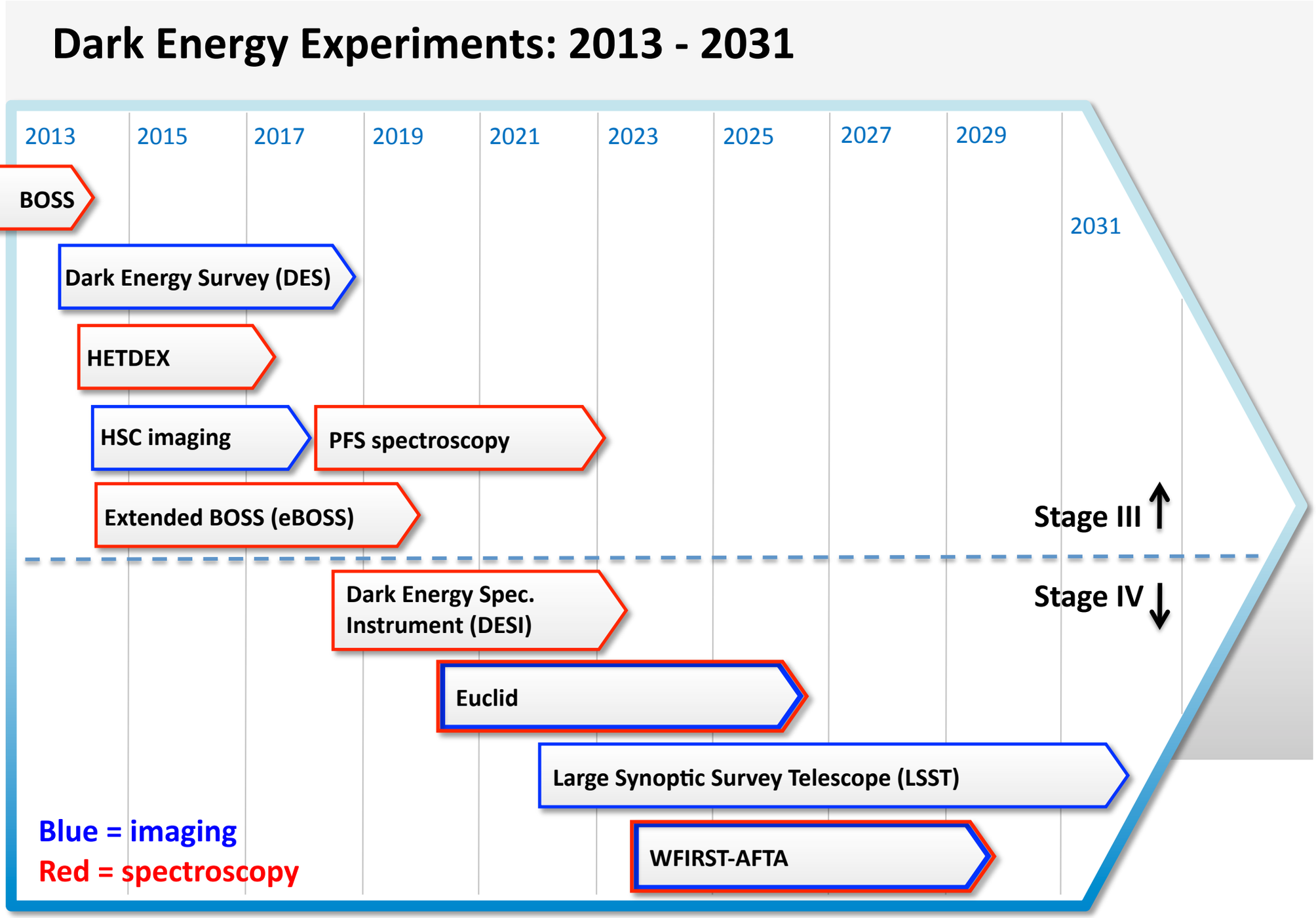
- **Weekly telecons between August 2015 and January 2016**
- **Members of Group of Eight attended DESI and LSST DESC Collaboration Meetings and held focused discussions**
- **Organized three workshops to gather input from the community**
  - East Coast: Brookhaven, October 1, 2015. Agenda and slides available at https://indico.bnl.gov/categoryDisplay.py?categId=124
  - Midwest: Fermilab, November 10, 2015. Agenda and slides available at https://indico.fnal.gov/conferenceOtherViews.py?view=standard\&confId=10639
  - West Coast: SLAC, November 13, 2015. Agenda and slides available at https://indico.fnal.gov/conferenceDisplay.py?confId=10842

- **Face-to-face meeting at Fermilab in January 2016**

Outcome so far

- **Delivered three White Papers, incorporating a lot of input gathered from the community**
- **Two White Papers (Science, Technology) submitted to the arXiv: 1604.07626 and 1604.07821**
- **Follow-up Workshops:**
  - Low-resolution spectroscopy workshop at Fermilab (February 2016)
  - SSSI (Southern Spectroscopic Survey Instrument) at Argonne (September 2016). Agenda and slides available at https://indico.hep.anl.gov/indico/conferenceOtherViews.py?view=standard&confId=1035
  - Cosmic Surveys 2016 Chicago, **here, today**
- **Charge for current workshop**
  - Generate 5 slides for next HEPAP meeting
  - Discussion about our core science goals (also tomorrow, led by Uros)
  - Possibly a science book(s) (discussion tomorrow, led by Scott)

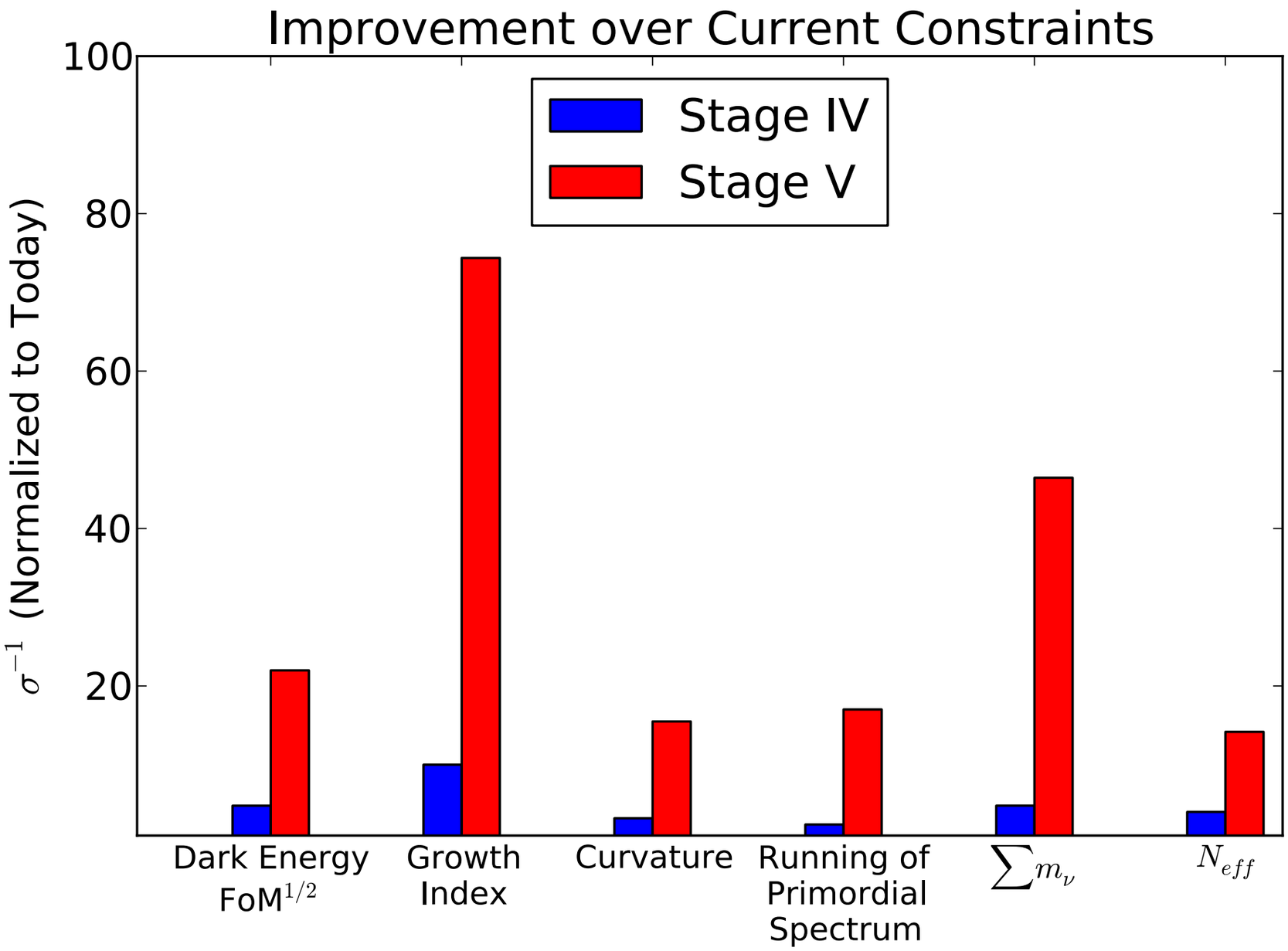
Our Current Roadmap for Cosmic Surveys



A new project cannot be incremental!

Cosmic Visions: Dark Energy Science

arXiv: 1604.07626



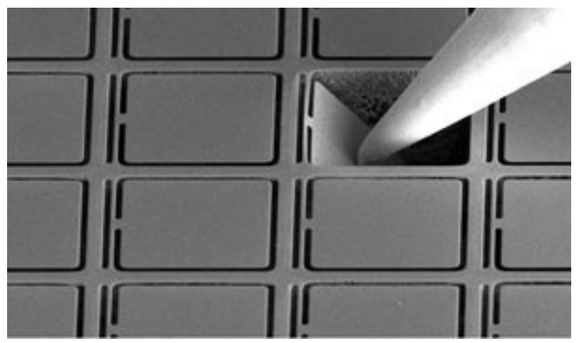
(B) Even after DESI and LSST, there will be a lot of information left in the sky

(B*) But don't forget, we haven't built any Stage IV experiment yet

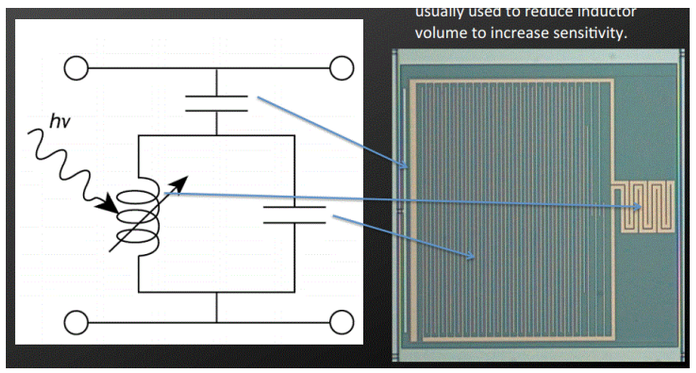
Cosmic Visions: Dark Energy Technology

Instrumentation R&D and new technologies will be key for many (all) future cosmic surveys

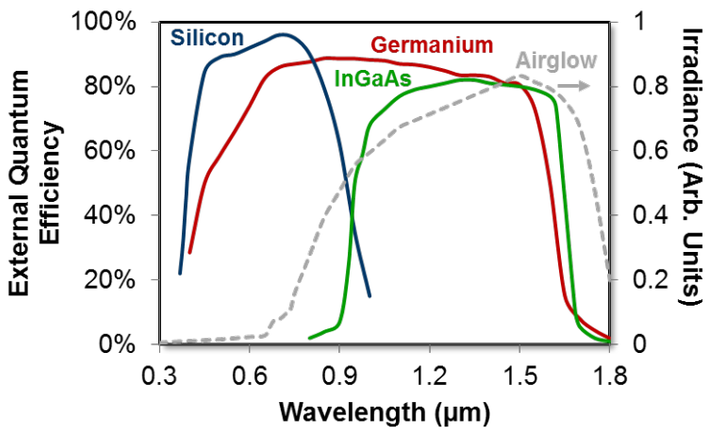
Micro Shutter Arrays developed for JWST



MKIDS Detector Arrays



Ge CCDs (MIT LL, LBNL)



C. Leitz

CV Whitepaper on arXiv 1604.07821

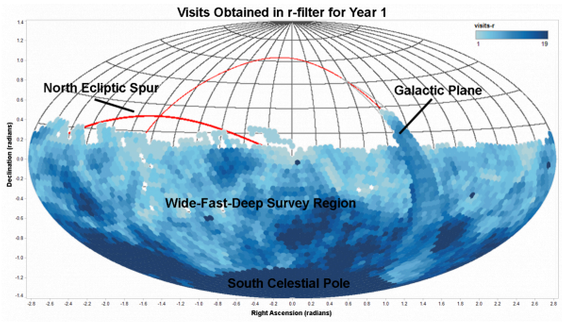
Cosmic Visions Dark Energy: Technology

Scott Dodelson, Katrin Heitmann, Chris Hirata, Klaus Honscheid, Aaron Roodman, Uroš Seljak, Anže Slosar, Mark Trodden

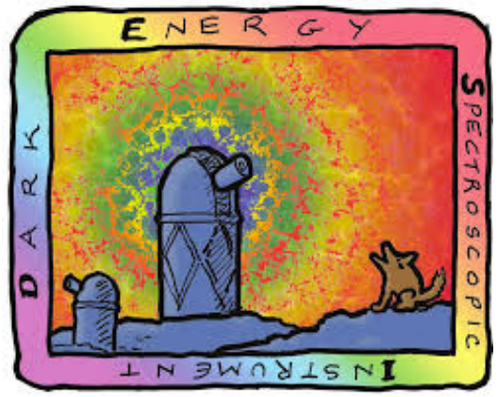
Executive Summary

A strong instrumentation and detector R&D program has enabled the current generation of cosmic frontier surveys. A small investment in R&D will continue to pay dividends and enable new probes to investigate the accelerated expansion of the universe. Instrumentation and detector R&D provide critical training opportunities for future generations of experimentalists, skills that are important across the entire DOE HEP program.

Cosmic Visions: Dark Energy Ideas



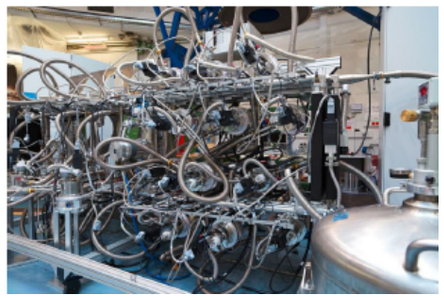
SSSI

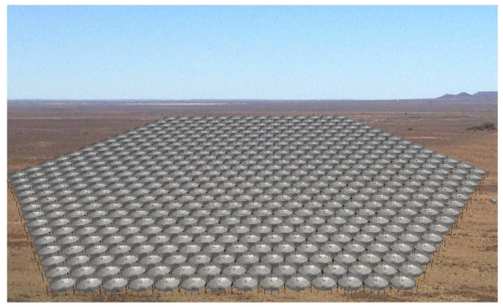


DESI-2

Low Resolution Spectroscopy

Billion Object Apparatus



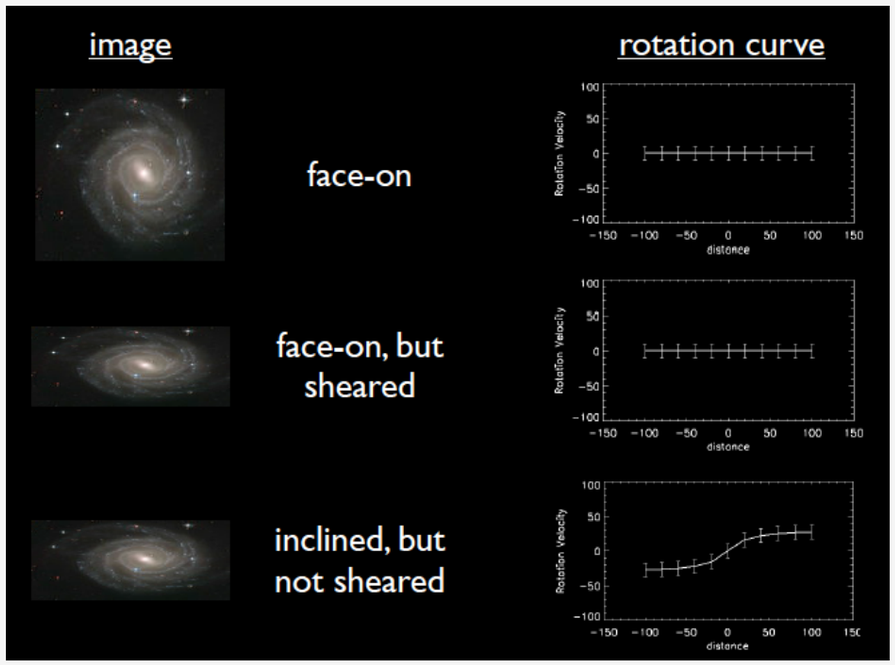


21 cm

All these ideas will be discussed at this workshop

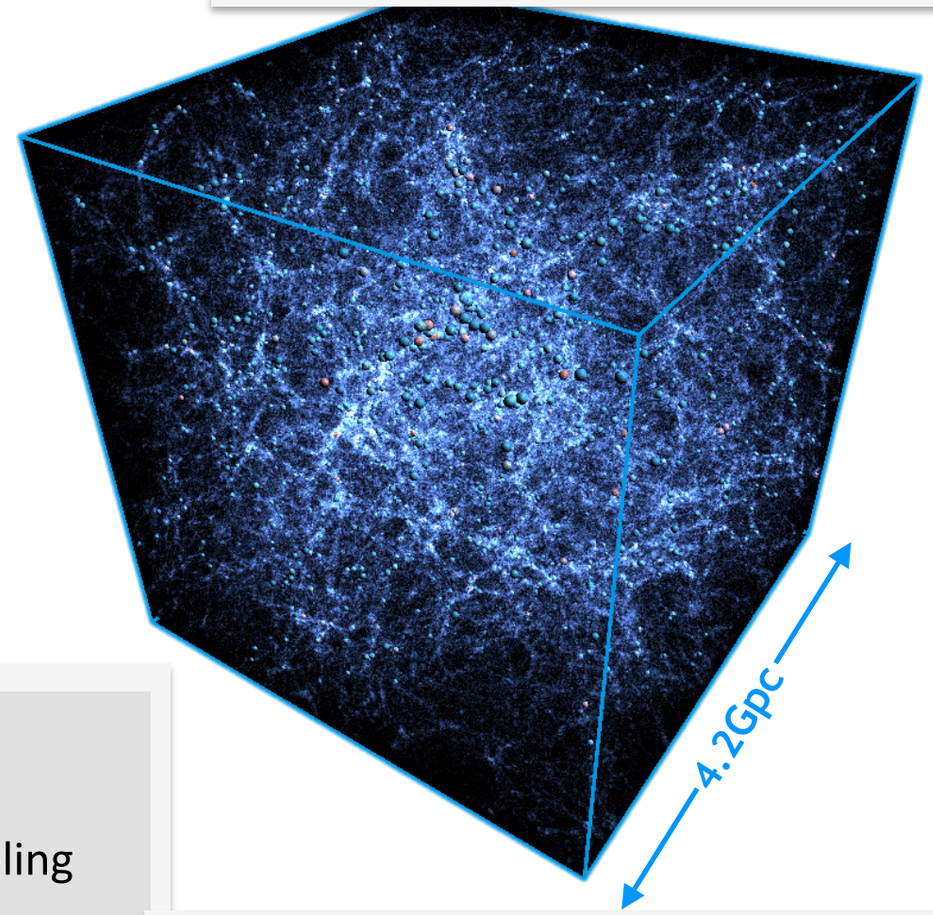
Cosmic Visions: Many Additional Ideas

Kinematic WL (E. Huff): Get shape priors by measuring rotation curves



Novel Probes (Study Modified Gravity)

Compare the behavior of gravity in screened and unscreened regions (e.g. infall velocities of nearby galaxies)



Theory, Synthetic Sky Maps & Simulations

Reliable predictions of observables on small Scales; viable fundamental physics models, modeling efforts to match the expected statistical power of LSST and DESI; End-to-end simulations and synthetic catalogs for validation of pipelines and systematics

Pixel Level Comparison

Combine data samples at the pixel level across projects, funding agencies and continents.

FUTURE COSMIC SURVEYS

2016 • CHICAGO

SEPTEMBER 22, 2016 - THURSDAY

9:00 AM Introduction to Cosmic Visions
9:15 AM Introduction to NSF-Kavli
9:30 AM What science are we after?
10:20 AM DESI-2 Science
11:00 AM DESI-2 Programmatics
11:15 AM Beyond DESI
11:40 AM SSSI Science
1:30 PM SSSI Science, Discussion
1:50 PM SSSI Programmatics
2:15 PM Low-Res Science Reach
2:45 PM Technological Challenges
3:45 PM 21-cm at z>6
4:15 PM 21-cm at z<6
4:45 PM 21-cm technical challenges
5:15 PM Galaxy Survey with Radio Observations
5:35 PM Galaxy Survey with Optical Spectroscopy
5:55 PM BOA science reach

SEPTEMBER 23, 2016 - FRIDAY

9:00 AM Core Science Goals
9:30 AM Structure of Science Book(s)
10:30 AM Breakout Sessions
21 cm: Room 106
DESI-2: Room 105
SSSI: Room 103
low-res spec.: Room 213
BOA: Room 206
2:00 PM DESI-2
2:30 PM SSSI
3:00 PM 21 cm
3:30 PM Low Resolution Spectroscopy
4:00 PM Billion Object Apparatus