MS-DESI

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with slides from Michael Levi, Arjun Dey, and David Schlegel

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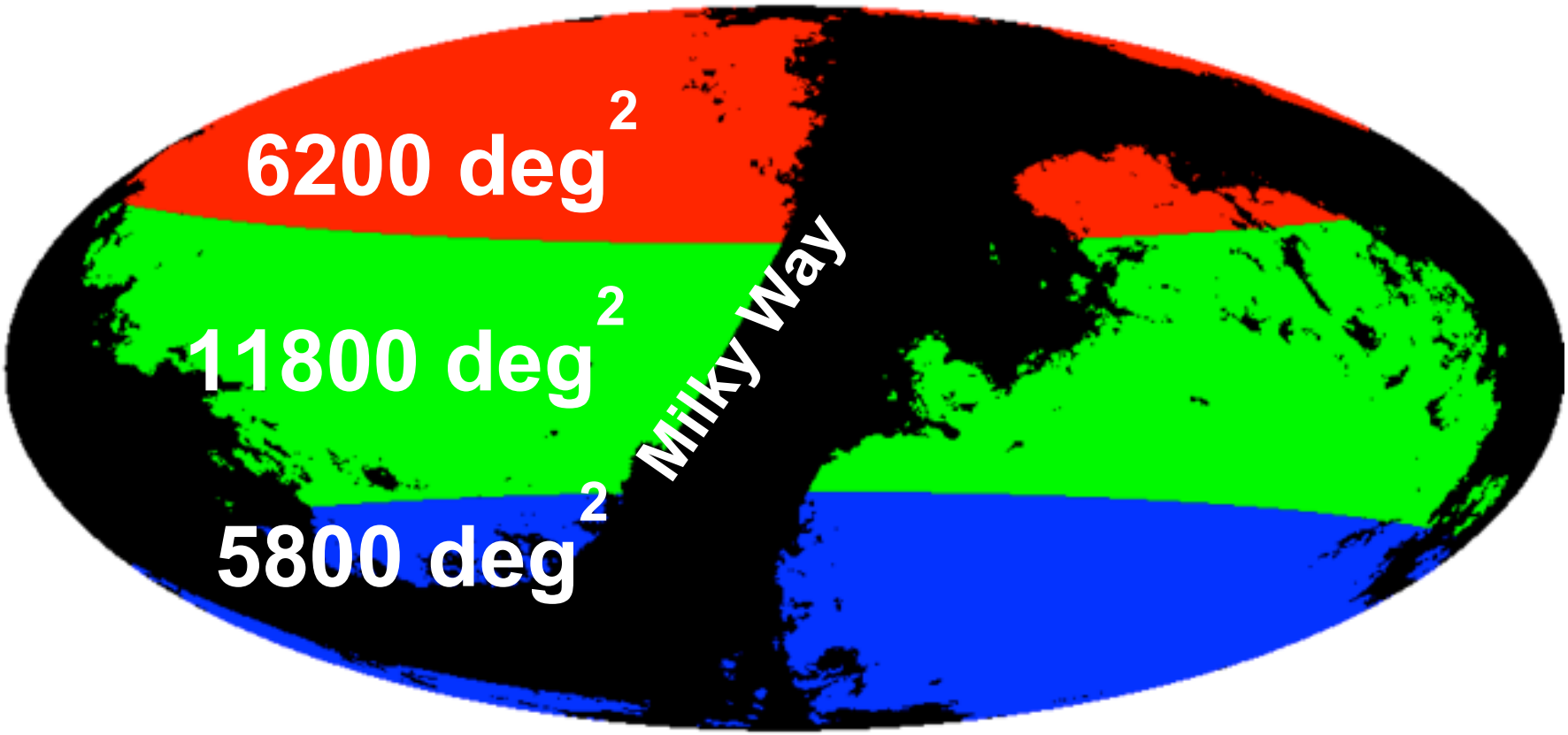
MS-DESI Goals

- MS-DESI is the Medium Scale – Dark Energy Spectroscopic Instrument
- Scale up BOSS to a massively parallel fiber-fed spectrometer at a 4-meter telescope.
- Stage-IV BAO/RSD, build upon BOSS
- Broad range of target classes: LRG's, ELG's, QSO's
- Broad redshift range: $0.5 < z < 1.6$, $2.2 < z < 3.5$
- Sky area: 14,000 – 18,000 square degrees
- Number of redshifts: 20 – 40 million
- Medium resolution spectroscopy, R ~ 3000 – 5000
- Spectroscopy from blue to far-red, ~0.4 - ~1μm
- Automated fiber system, N_{fiber} ~ 4000 – 5000

Credit: M. Levi

Potential LSST-MS-DESI overlap



- Up to ~12,000 square degrees of DES-Mayall overlap, would be similar for LSST
- Potential to move instrument between hemispheres to get maximal BAO survey

MS-DESI targets

Four target categories:

1. Luminous Red Galaxies (LRGs) — **4 million LRGs**

- Selected to z<1
- Efficient BAO tracers due to large bias

2. Emission Line Galaxies (ELGs) — **20-30 million ELGs**

—Selected 0.5<z<1.6 when the Universe was forming stars

—Redshifts from [O II] emission lines

3. QSOs — **2-4 million QSOs**

- Target ***all*** of them

4. Lyman-alpha QSOs (at z > 2.2) — **1 million LyA-QSOs**

- 3-D density map from Ly-alpha forest z>2.2

- **For cross-correlation calibration of photo-z's, desire >100k spectra over >100 square degrees spanning full redshift (NOT necessarily magnitude) range of LSST gold sample - MS-DESI is overkill**

Credit: M. Levi

MS-DESI for deep surveys

- **MS-DESI vs Subaru/PFS:**
  - **5000 fibers vs 2500**
  - **4m aperture vs 8m**
- **Getting the same number of photons on the same number of objects will take ~2x longer survey time with MS-DESI**
- **>2x the observing time may be available**

- **Example scenario: 300,000 LSST deep drilling supernova hosts in 300 square degrees**
- **~60 nights total on MS-DESI to get host redshifts to r~24**
- **>600 nights with VLT/VIMOS, >2000 nights with Keck/ DEIMOS**

BigBOSS Calibration Fields: A unique opportunity

- 4 to 6 deep fields (~30 – 40 deg^2)
  - characterize instrument and survey performance, sampling / completeness / selection functions, etc.
- Targeted in Pilot Survey and also ~ 1 per run:
  - Denser sampling
  - Deeper exposures (~ 4.5 h for some targets)
  - Sampling / targeting TBD
- High legacy value for other science projects
  - Building blocks of Galaxy Evolution Survey?

Credit: A. Dey

Current status

- DOE has charged LBNL to manage MS-DESI
- No "downselect" between BigBOSS and DESpec
- CD-1 / Conceptual Design review late 2013
- Operations start 2018

First MS-DESI Meeting: March 5, 2013

Credit: M. Levi

Current status

- **Site selection (Science Alternatives Analysis) report recently submitted to DOE & NSF, now public.**
- **Evaluated scenarios for 70+% of dark time on Mayall/Blanco/ CFHT for 3-5 years**
- **Relative survey speed:1/1.17/1.44xKPNO**
- **Conclusion of Executive Summary:**

The selection of the site should be guided by where the maximum dark time can be made available to the MS-DESI key project in a timely manner. The time window for operation of MS-DESI is 2018-2022, when it will have the greatest impact on dark energy science. The scientific reach of MS-DESI will increase proportionally to the total survey time allocated. At the Mayall, a total of approximately 5300 hours of dark-time would survey 14K deg^2, 8900 hours of dark-time would survey 18K deg^2. The scientifically best measurement of dark energy, and lowest operating cost, will be made by maximizing access to the provided telescope. We conclude that all three telescopes are capable of meeting scientific "mission need" assuming the needed access to the telescope during the darkest night hours for an approximately five year period.