BNL Cosmology /Astrophysics

Morgan May
S and T review
May 20, 2010
This Talk

• Overview of Brookhaven Astrophysics Initiative

Talks this afternoon:

• Erin Sheldon  **DES, BOSS**
• Anze Slosar **BOSS**
• Veljko Radeka **LSST sensor development**
Evolution of the Astrophysics Initiative at Brookhaven

- 2002 Nobel Prize in Physics to Ray Davis for his pioneering contributions to astrophysics (the missing solar neutrinos)
  - Work done over decades as Brookhaven employee, enabled by Instrumentation Division
- 2002 Physics Dept begins planning new Astrophysics Initiative working closely with Instrumentation Division
Evolution of Astrophysics Initiative

- 2003 Brookhaven lead role in LSST sensor development presented to DOE July visit to Germantown
- 2004 FWP plan for LSST + near term cosmology projects
- 2007 plan to hire 2 young astrophysicists encouraged by DOE HEP review committee
- 2008, 2009 2 young astrophysicists + post-doc hired, DES, BOSS, Astro group in Physics
Now all the elements for strong program are in place at Brookhaven

- Talented young astrophysicists
- Key roles in surveys
- Technical strength of the Laboratory

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Fundamental Physics
What is Dark Energy?

Tools:
- Lensing
- Galaxy distribution
- Lyman-alpha

Also:
- Neutrino mass
Superb Data Stream

2008-2014
BOSS

2011-2016
DARK ENERGY SURVEY

2016
LSST

Morgan May
Essential work to make surveys happen is basis of our participation in science

- BOSS target selection, software
- DES lensing pipeline
- LSST sensors, lensing pipeline

→ Important roles in the science analyses

- Potential interest in BigBOSS
Astrophysics/Cosmology Participants

• Astro Group in Physics Department: Morgan May, Erin Sheldon, Anze Slosar, Zhaoming Ma

• Closely coupled to Instrumentation Division: Paul O'Connor, Veljko Radeka, Peter Takacs, Ivan Kotov; Jim Frank (Physics) works closely with Instrumentation on sensor characterization

• Tom Throwe (Physics): Computing and software issues
Erin Sheldon

- Joined BNL 2008 as Assistant Physicist (Formerly post-doc at U. Chicago then NYU). 11 papers since arrival.
- Recognized authority on gravitational lensing
- Leads the lensing analysis of DES data in collaboration with U Penn (M. Jarvis, B. Jain)
Erin Sheldon

- DES is natural extension of his Sloan Digital Sky Survey (SDSS) analysis of galaxy cluster lensing
- Shear measurement in SDSS of one part in $10^4$, the most sensitive detection ever achieved
- Important participant in the Weak Lensing working group of LSST
- Leads target selection for BOSS Quasars and galaxies (LRGs)- crucial role in carrying out the survey.
Anze Slosar

- Assistant Physicist Brookhaven from October 2009 (formerly an Inaugural Fellow, Berkeley Center for Cosmological Physics where he worked with Martin White on BOSS)
- Educated Cambridge, first Class in all years. Best Natural Scientist in his College
Anze Slosar

- An author of 46 papers on astrophysics and cosmology.
- Working on two aspects of BOSS: the baryon acoustic peak in Lyman $\alpha$, and neutrino mass constraints.
- Leads Lyman alpha cosmology working group in BOSS
Zhaoming Ma

• Post-doc Brookhaven since September 2009 (formerly with Gary Bernstein at UPenn). Helped prepare DES proposal.

• DES
  – Point spread function
  – Effect of photometric redshift errors
  – Galaxy Cluster finding algorithms in weak lensing data
  – Testing DES weak lensing pipeline
Astro Group

• Morgan May
  – Planning and organizing Astro initiative since 2002
  – LSST: techniques of analysis, constraints; Weak Lensing collaboration, LSST Science Book

• See Astro Group web site http://www.cosmo.bnl.gov/ for publications of group members - over 100 in total
BNL Strength in Si detectors, Electronics, Metrology

- BNL leading LSST sensor development and tower integration; collaboration with Harvard (Stubbs group), UPenn, IN2P3 France
- Natural role in cosmology projects, present and future
BNL Strength in Large Scale Computing

- RHIC/ATLAS Computing Facility: infrastructure, economy of scale

- Proposal for computing resources at Brookhaven for DES Weak Lensing working group submitted to DES Sheldon, Jarvis, Bernstein

- Slosar co-PI on Mid-Range Computational Cosmology Initiative (simulations)
BNL has essential roles major surveys that will constrain the nature of dark energy

• BOSS
  – MoU signed. Brookhaven is Associate Member of Sloan III for the purpose of working on the BOSS
  – Sheldon leads Target Selection, proposed for architect status, member Weak Lensing Working Group
  – Slosar leads Lyman-alpha Cosmology Working Group

• DES
  – Sheldon co-leads lensing analysis, is Associate Member of DES. Ma lensing pipeline work will lead to Associate Membership

• LSST
  – BNL is Institutional Member -Sam Aronson member Board of Directors. O’Connor, Radeka lead Sensor Development; primary responsibility for towers (each tower comparable to focal plane of a large telescope)
  – Sheldon, Ma, May members Weak Lensing Collaboration, Slosar member Large Scale Structure Collaboration