# Astrophysics Enabled By The Return to the Moon

David Spergel

Princeton

# Community Process

- STScI Workshop on Lunar-Enabled Astrophysics
- White Papers

# Advantages of the Moon as an Observatory

- Gravity (good and bad)
- Shielding
  - Thermal shield (infrared)
  - Radiation shield (radio)
- Lunar infrastructure
  - Astronaut servicing
  - Ares V and launch vehicle
  - Lunar-orbiting spacecraft

# Important Science Questions?

- Are we alone?
- Understanding the 96% of the universe that isn't made of atoms:  Dark matter? Dark Energy?
- Probing fundamental physics
- Understanding the origin and evolution of planets, stars, the Galaxy and the universe: Where did we come from?

# Intriguing Lunar Astronomy

- Lunar ranging: tests of fundamental gravity (suitcase science)
- Radio observatories ($\upsilon < 10$ MHz)
  - Probing the history of reionization
  - New window into the universe
  - Hewitt: terrestrial experiments
  - Burns: first generation experiments
- Piggy-backed instrumentation for astrophysics

# Less Intriguing Options

- Large Optical/IR telescopes on the moon
  - No significant gain over orbit
  - New technical difficulties (dust, etc.)
  - Site limits operations
  - Cost to land mass on the moon versus cost to orbit
  - *Transit Telescopes seem like a poor match to our scientific needs*
  - Significant sky coverage essential for astronomy. Deep narrow pencil beam only probes a very small volume of the universe (not statistically significant)

# Lunar Infrastructure

- Heavy Launch Vehicles with large aperture
  - Big telescopes
  - Powerful but expensive (10 m class telescope in space would be very useful for a wide range of astronomical uses)
  - Does not have direct impact on lunar planning
  - In-orbit servicing?