JDEM
Joint Dark Energy Mission

JDEM Update

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JDEM
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JDEM BASELINE

- JDEM is envisioned as a medium-class space observatory
- Objective: Determine nature of dark energy
- Method: Measure expansion history and growth of structure in Universe to unprecedented accuracy
- Orbit: L2
- Launch date: Mid-decade
- Ops concept: 5 year prime dark energy mission, with potential for extended mission with observations determined by peer review
- Website http://jdem.gsfc.nasa.gov

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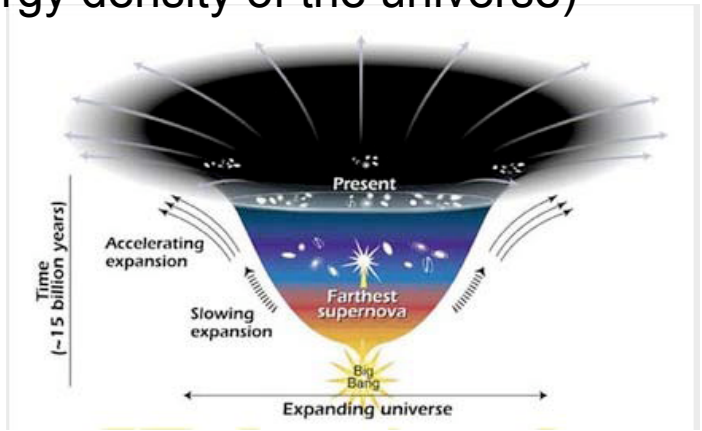
JDEM Science

- Potential for order of magnitude improvement in figure-of-merit for joint errors on equation of state parameters w & w_a (plotted against each other) compared to current experiments
- Measurements of growth factor exponent to distinguish Einstein's theory of general relativity from alternate theories
- JDEM designed for greatest leverage to determine what dark energy is.
- Profound implications on understanding the universe:
  - Universe density (DE is 73% of the mass-energy density of the universe)
  - Existence of cosmological constant
  - Signal of new gravitational physics
  - Relation to dark matter, inflation, neutrino mass
  - Connections to superstring theories and extra dimensions



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Measurement Techniques

- High-sensitivity large-scale visible and NIR galaxy surveys
- Weak lensing (WL) dark energy probe
  - precision shape measurement of galaxy shapes
  - photo-z redshifts
  - 1-2 x 10^9 galaxies mapped
- Baryon acoustic oscillations (BAO) dark energy probe
  - spectroscopic redshift survey
  - emission line galaxies positioned in 3D
  - few x 10^8 galaxies mapped with spectroscopic redshifts
- Supernova (SN) dark energy probe
  - Type Ia supernovae detected into NIR
  - color and lightcurve parameters for standard candles

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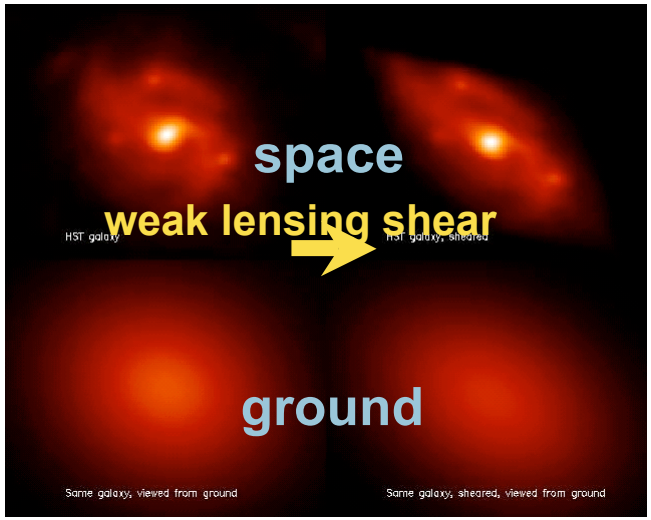
Advantage of Space

- Precision measurements of dark energy probes are necessarily systematics limited

- Space provides
  - broadband NIR coverage
  - no blur from atmospheric scintillations
  - accessibility of low background sky regions
  - stable systematics control at L2
    (e.g. psf over large fov)
  - all sky available day and night
  - precise repetition of measurements

- JDEM focuses on space-unique capabilities that are complementary with ground



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Technologies & Readiness

- Enabling technologies
  - Large format CCDs and HgCdTe detectors
  - Wide-field broad-band diffraction-limited telescopes
  - Ground processing with high-speed processors with large data storage
- Diffraction-limited sensitive wide-field sky coverage in NIR available for first time
- All JDEM technologies are high Technology Readiness Level (TRL) and ready-to-go
  - -- Heritage from HST, JWST, other missions
- JDEM can be built today

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JDEM History

- 1998-99: Discovery via SN Ia that expansion of space is accelerating
- 2003: Quarks to Cosmos (Turner) study highlights importance of understanding DE and endorses a space-based mission
- 2005-6: Multi-agency IWG and DETF panels recommended joint NASA/DOE JDEM mission
- 2007: NRC BEPAC committee commissioned by NASA and DOE recommends JDEM as first Beyond Einstein mission to fly
- 2008: JDEM formulated as a strategic agency-led mission
- summer-fall 2008: Figure of Merit Science Working Group
- fall 2008: Science Coordination Group

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Theoretical Studies

- Dark Energy Task Force - 2005

- Figure of Merit Science Working Group - Summer 2008

  Chair: Rocky Kolb

  Fisher Matrix Approach

  Principal Component Analysis

  FoMSWG report published (http://jdem.gsfc.nasa.gov)

  Emphasis on combination of methods

Science Coordination Group

- Formed by NASA and DOE in September 2008 for community input on JDEM
- Charge:
  - develop level 1 & 2 requirements
  - review reference mission developed by the JDEM project office and comment on capabilities
  - define reference observing program
- 17 members chosen from community
- 5 meetings and several telecons held
- Final report to be completed by mid-March

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SCG Findings

- SCG deliberations start with findings of Dark Energy Task Force (DETF - 2006) and Figure-of-Merit Science Working Group (FoM SWG - 2008)
- BAO and WL are most powerful techniques from FoM viewpoint. SNe provide direct "simple" measure of luminosity distance
- FoMSWG and SCG support enabling all 3 techniques (plus growth of structure) with JDEM
- Primary strength of space measurement is NIR coverage, observations over full sky at any time and tight systematics control

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Ancillary Science

- Large area BAO and WL surveys will be a legacy of JDEM
- Hundreds of millions of galaxies will be mapped in 3D
- Large NIR sky survey will be a boon for ancillary science
  - large-scale structure
  - galaxy clusters
  - high redshift AGN
  - galaxy evolution/structure/formation
  - stellar populations
  - star formation history
  - solar system objects

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Program Status

- Project Office formed at NASA GSFC supported by DOE project at LBNL
- Discussions in progress with ESA about possible participation
- Near-term schedule:
  - Mission Concept Review to start Phase A (conceptual design) in ~ March 2009
  - Announcement of Opportunity (AO) to select science investigations
  - AO release in Spring 2009
  - Science Working Group made up of science investigation leads
  - Phase B (preliminary design) starts in early 2010