JDEM
Joint Dark Energy Mission

JDEM

Neil Gehrels
NASA/GSFC

JDEM Project Scientist

AAAC
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JDEM Motivation

JDEM is a space mission to determine the nature of the **dark energy** that is driving the current accelerated expansion of the universe

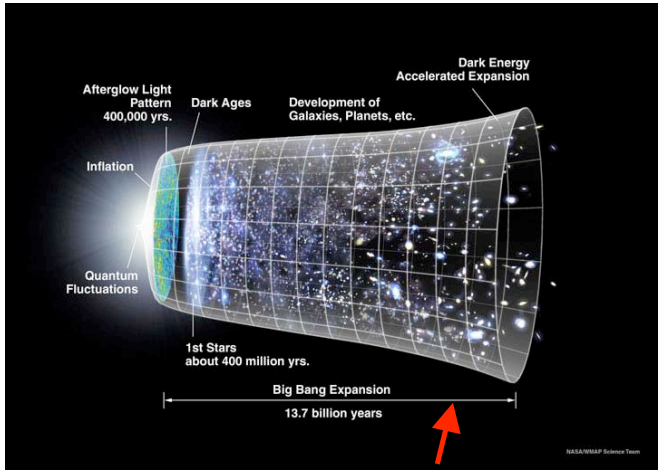
Space observations provide the best opportunity for a major step forward in understanding

L2 orbit

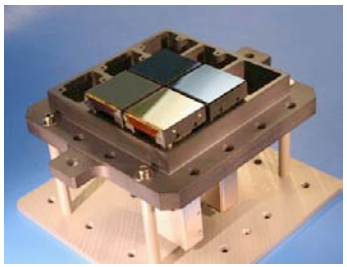
3-5 year mission

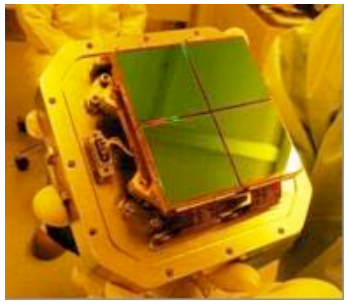
The time is ripe for JDEM:

- Dark energy study needs large area, sensitive surveys in the NIR and visible
- Space-qualified large format HgCdTe and CCD detectors are US developed technology and flight ready



current acceleration





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JDEM Science

- JDEM is an optical-IR survey mission with Dark Energy as its major goal. Ancillary science comes as a by-product of DE surveys.

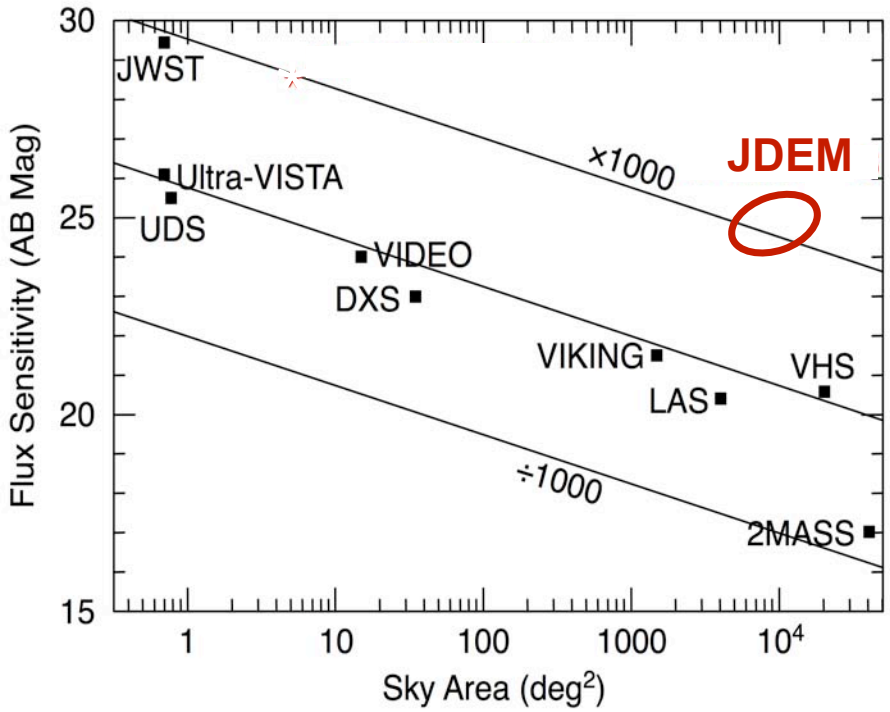
- JDEM must perform as a precision cosmology experiment with tight error control. DE measurements are systematics limited.

- There are 3 DE major techniques. Each is best done in the stable, clear environment of space. JDEM will employ one or more of them to give 10x advance in DE.
  - weak lensing: large-scale imaging and photo-z survey
  - baryon acoustic oscillations: large-scale spectroscopy and imaging survey
  - supernovae: monitoring 10 deg^2 field

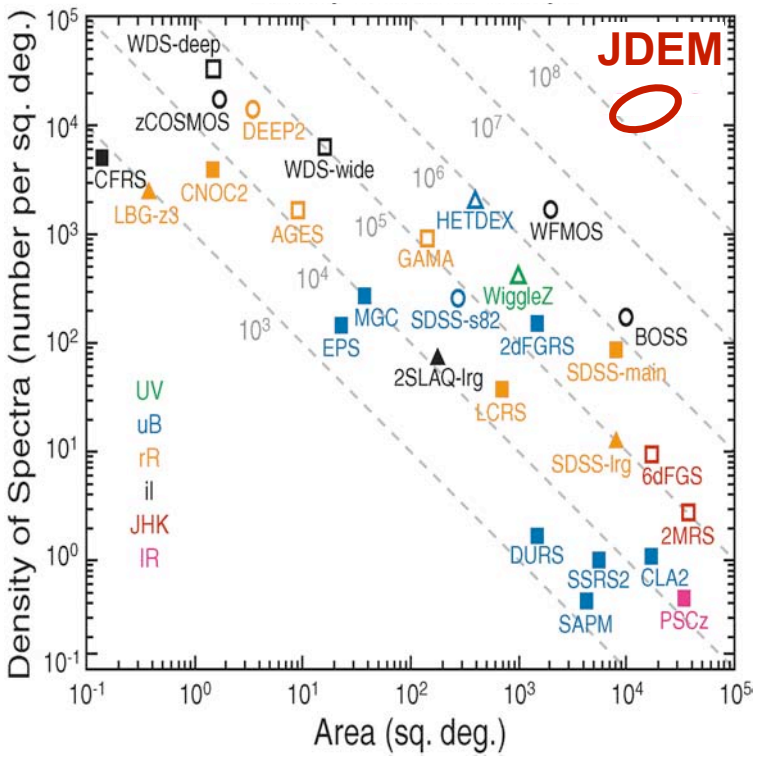
- JDEM provides a comprehensive sky survey data set (100's TB) to the world community for ancillary science

JDEM NIR Surveys

NIR Imaging Surveys



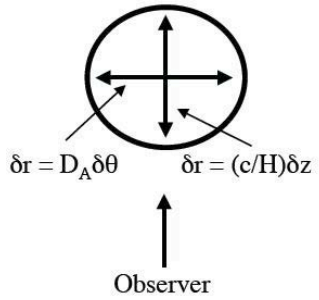
Redshift Surveys

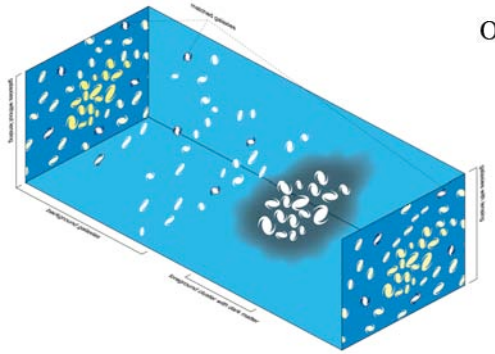


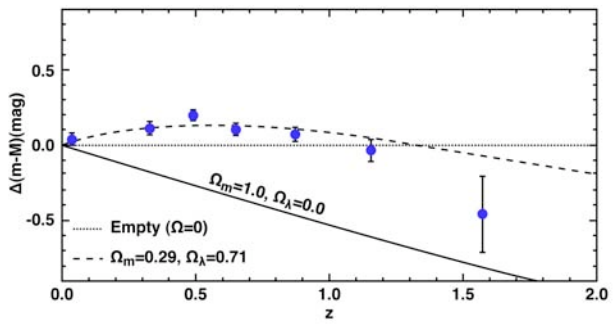
JDEM provides factor of 100-1000
step forward in imaging & redshift surveys

JDEM Techniques

- Three most promising techniques each provide different physical observables and unique information related to DE:
  - Baryon Acoustic Oscillation (BAO)
    $D_A(z)$, $H(z)$ direct measure
  - Weak Lensing (WL)
    $D_A(z)$, growth of structure
  - Type Ia Supernovae (SNe)
    $D_L(z)$







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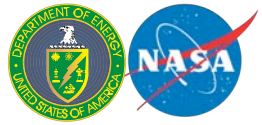
Why Space?



- The following observations that are critical to dark energy progress are impossible or infeasible to make from the ground:
  - Wide-field spectroscopy of the bright H-alpha line to z>1 for BAO
  - Supernova observations to z>1. Precision NIR light curves of all supernovae.
  - Wide-field survey to >25th mag in NIR for WL photo-z's
  - Galaxy shape measurements with small & stable PSF

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JDEM Mission Formulation

- JDEM is a joint NASA-DOE mission
- MOU in place between NASA and DOE
- JDEM Project Offices have been established at GSFC and LBNL
- Implementation Agreement will follow
- Oversight group at agency level chaired by J. Morse and D. Kovar

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JDEM Configurations

- Two mission architectures were presented to Astro2010 in June
  - JDEM-IDECS
    - ESA participation
    - HgCdTe and CCD imagers, plus HgCdTe spectrometers.
    - WL shape measurement with CCDs in visible.
  - JDEM-Omega
    - HgCdTe imager and spectrometers. No CCD imager.
    - WL shape measurement with HgCdTe in space-unique NIR, at some risk. Visible photo-z data from ground.
- Project offices will be studying Probe-class architectures with cost goal of $650M + launch services

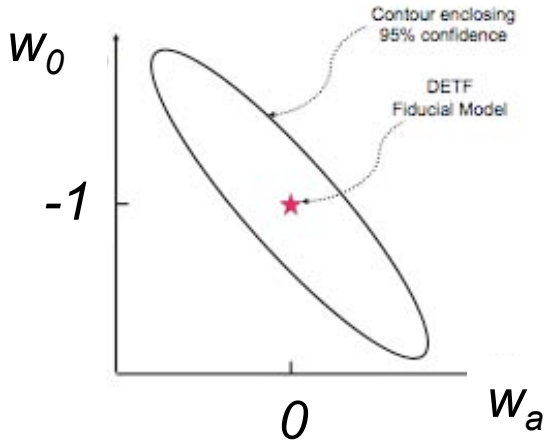
Dark Energy Figures of Merit

- Key dark energy FoMs defined by Dark Energy Task Force (DETF) and Figure of Merit Science Working Group (FoMSWG) committees
  - **DETF FoM** measures dark energy equation of state
  - **Gamma FoM** measures growth of structure

- JDEM goal defined by DETF is factor of 10 improvement in the DETF FoM compared to current (Stage II) experiments

- FoMSWG and JDEM SCG expanded this to factor of 10 improvement compared to pre-JDEM (Stage III) experiments

- JDEM Probe goal is original DETF definition



DETF FoM is inverse of the area of error ellipse in w_0 - w_a plane

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Community Involvement in Mission

- The science community has had and will continue to have many opportunities to provide input into the definition of the mission.
- A Science Coordination Group (SCG) was established for 6 months to aid in establishing initial requirements and evaluating JDEM Project Office developed Reference Missions.
- An Interim Science Working Group solicitation is currently out
  - To provide assistance to Project Office during concept development
  - Members to be selected by NASA and DOE
  - Members of Astro2010 main committee and EOS panel excluded due to conflict of interest concerns
  - Chair selected from proposers by NASA and DOE
  - NASA Project Scientist (Gehrels) and DOE Project Manager (Levi) to be ex-officio
- A Science Working Group will be competitively selected following mission formulation based on Astro2010 report & contingent upon its recommendation
  - The SWG will work with the Project Office to optimize the science requirements and observing strategies.

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Project Status

- JDEM Probe Study requested by NASA and DOE. The requirement is $650M mission life cycle cost excluding launch vehicle.
  - Initial efforts will be focused on defining a wide range of possible payload concepts. Varying levels of emphasis in BAO, SNe and WL techniques in each of the concepts. FoM will be determined for various ops concepts.
  - Range of spacecraft concepts to be considered to accommodate each of the Probe study payload concepts.
  - One of the concepts may be selected or modified for more detailed development in 2010 (depending on Astro2010 recommendation).
- Completed evaluation of industry proposals for Omega telescope concept development. Award imminent.
  - Determine feasible design concepts, perform integrated modeling and parametric cost trades, and develop cost and schedule estimates.

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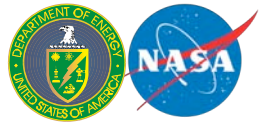
Project Status cont.



- Omega reference configuration will be updated in the winter to incorporate results of telescope study and probe activity.
- Study in process to assess suitability of HgCdTe detectors for WL imaging. Examining impact of Interpixel Capacitance, Reciprocity and Persistence on shape measurements. Preliminary results look encouraging.
- NASA and DOE HQ's in process of establishing a JDEM Interim Science Working group to assist Project during Pre-Phase A.

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Summary

- The time is right for JDEM
- New technology large-format detectors are now space qualified, enabling wide-field space surveys
- Space observations provide the needed clean systematics control. JDEM promises the best path forward for dark energy understanding in the coming decade.
- Direction for JDEM to come from Astro2010

Dark energy is the mystery of our time. Solving it will lead to a new era of understanding how the universe works and what our cosmic fate is