Cosmic Ray Telescope for the Effects of Radiation (CRaTER)

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LRO CRaTER TIM
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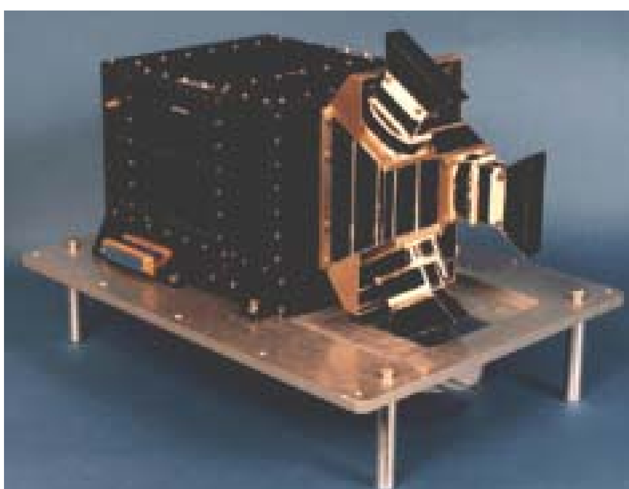
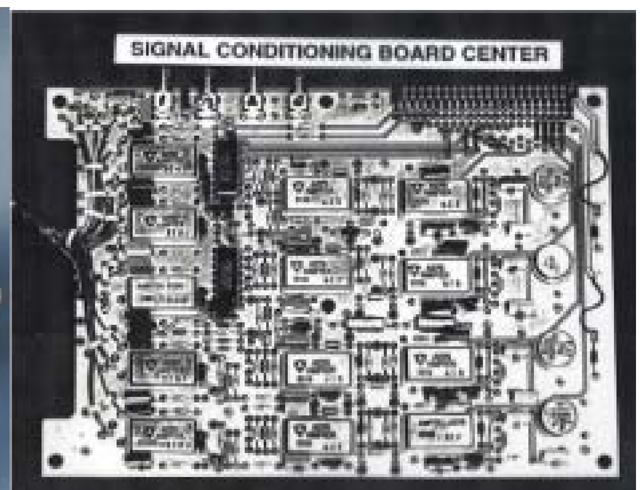
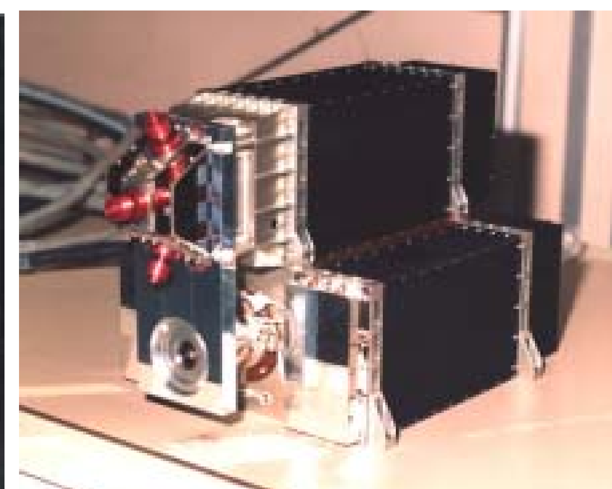
Background

- PhD, Earth and Space Science, UCLA, 1989
- Senior Member of the Technical Staff, The Aerospace Corporation, 1989-1994 (“casual status” now)
- Professor of Astronomy, Boston University, 1994-present

- Lead instrument scientist of Imaging Proton Spectrometer on NASA/POLAR s/c (led design, development, testing, and calibration)
- Co-investigator on CEPPAD and CAMMICE energetic particle instruments on POLAR
- Co-investigator on energetic particle instrument suite on SMART consortium for NASA/MMS Mission (in Phase A downselect)



NASA POLAR IPS instrument and analog board

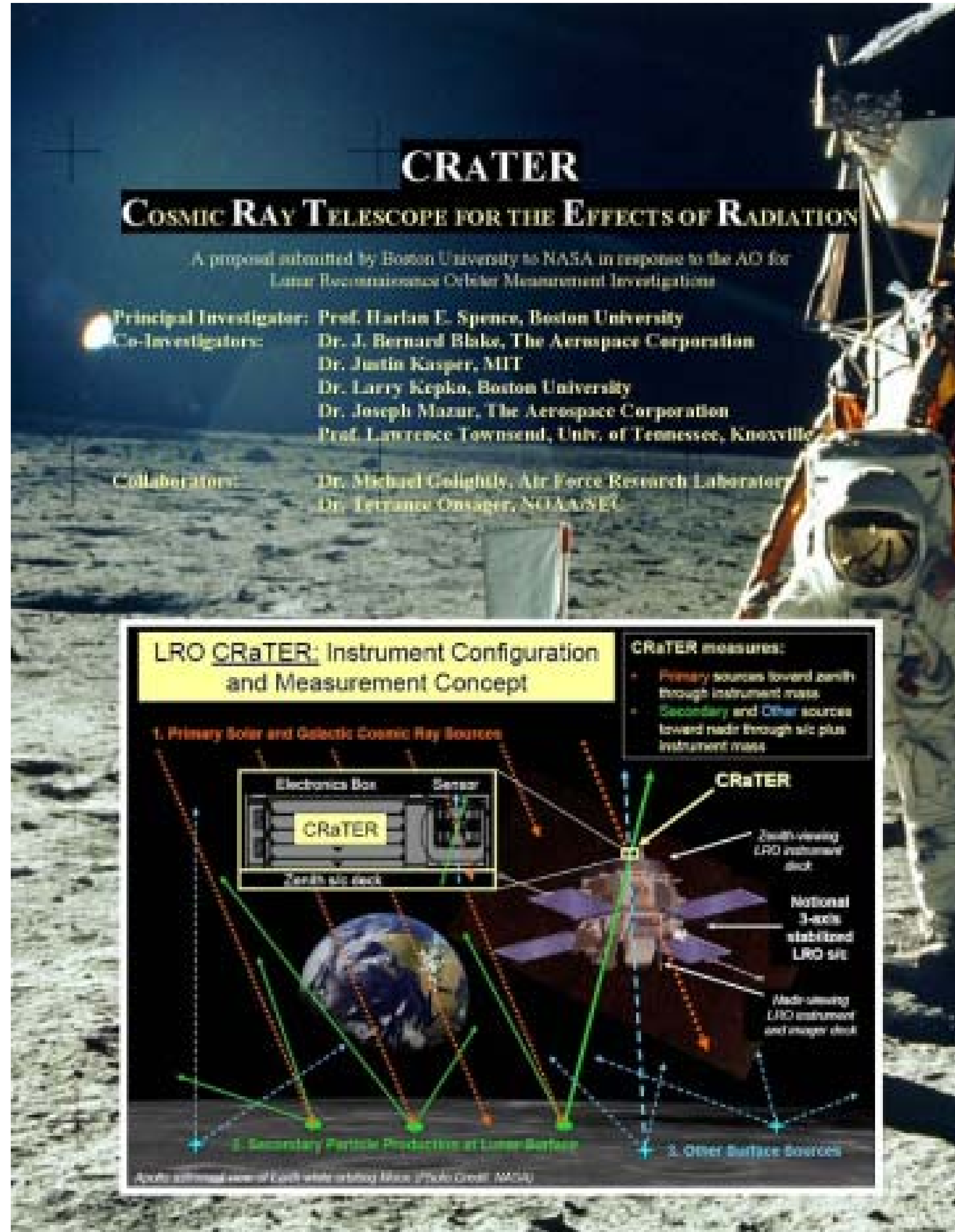
POLAR CEPPAD

Science/Measurement Overview

CRaTER Objective:

"To characterize the global lunar radiation environment and its biological impacts."

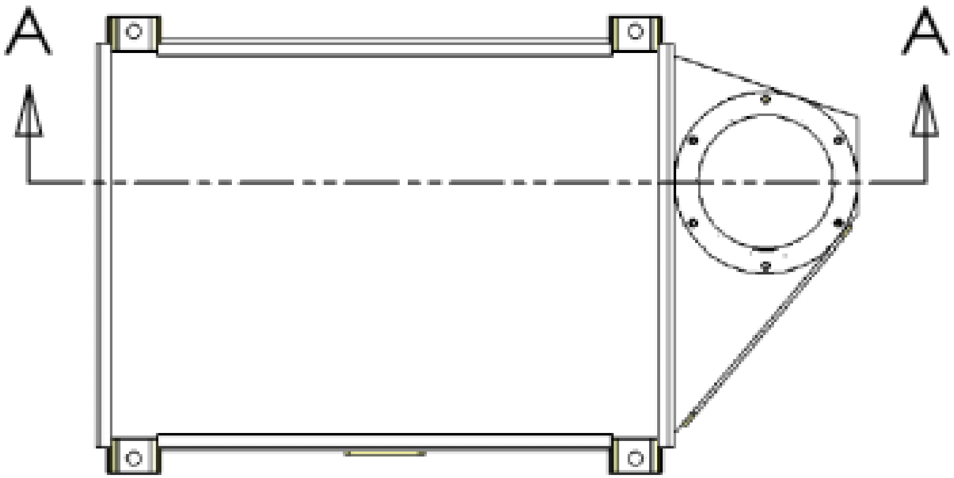
"…to address the prime LRO objective and to answer key questions required for enabling the next phase of human exploration in our solar system. "

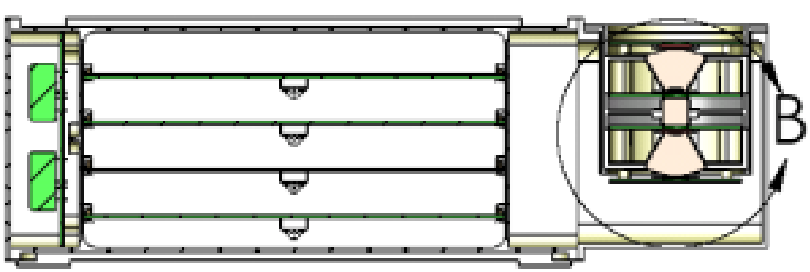


Relationship of CRaTER Measurement Goals to LRO Mission Objectives

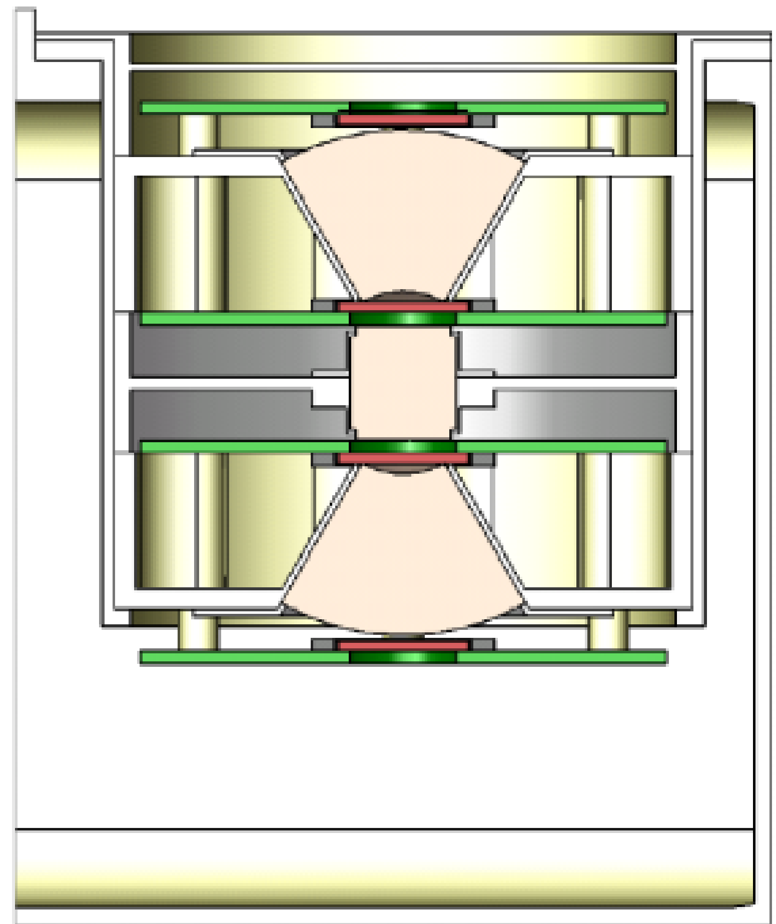
Highest-priority LRO Objective	*Characterization of the global lunar radiation environment and its biological impacts and potential mitigation, as well as investigation of shielding capabilities and validation of other deep space radiation mitigation strategies involving materials.*
CRaTER Objective	*To characterize the global lunar radiation environment and its biological impacts.*
CRaTER Measurement Goals	*1. Measure and characterize that aspect of the deep space radiation environment, LET spectra of galactic and solar cosmic rays (particularly above 10 MeV) and their secondaries, most critically important to the engineering and modeling communities to assure safe, long-term, human presence in space* *2. Develop a novel instrument, steeped in flight heritage, that is simple, compact, and comparatively low-cost, but with a sufficiently large geometric factor needed to measure LET spectra and its time variation, globally, in the lunar orbit.* *3. Investigate the effects of shielding by measuring LET spectra behind different amounts and types of areal density, including tissue-equivalent plastic.* *4. Test models of radiation effects and shielding by verifying/validating model predictions of LET spectra with LRO/CRaTER measurements, using high-quality GCR and SCR spectra available contemporaneously on ongoing/planned NASA (ACE, STEREO, SAMPEX) and other agency spacecraft (NOAA-GOES).*

CRaTER Conceptual Design as Proposed





SECTION A-A



DETAIL B
SCALE 1 : 1

Science Trades

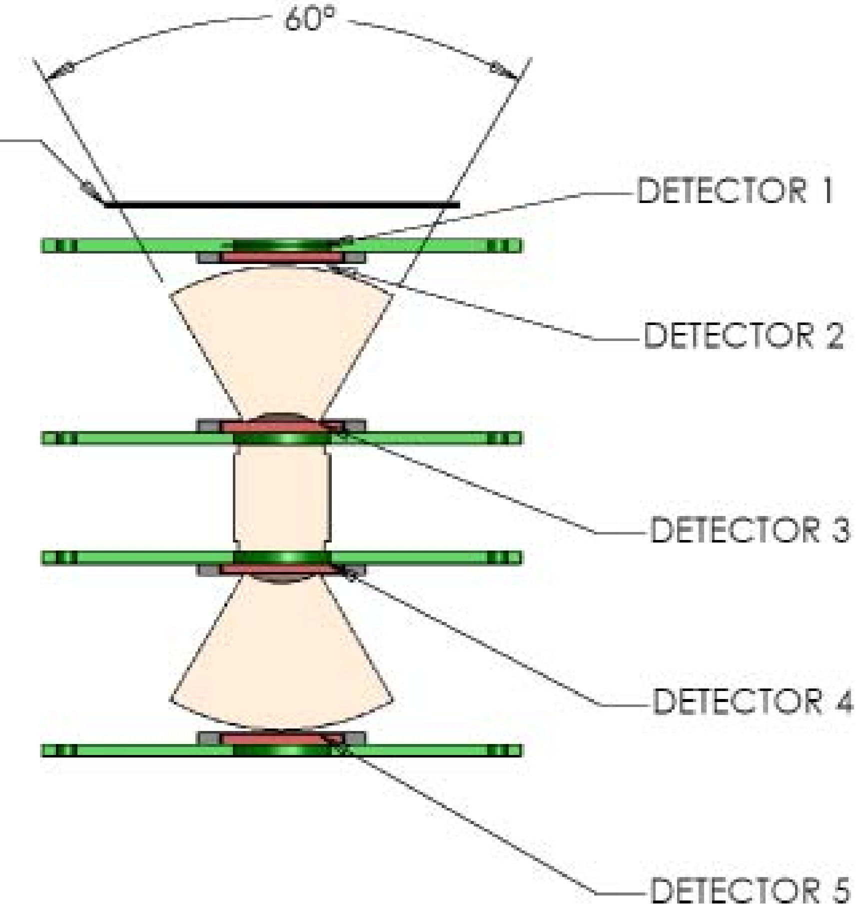
- As proposed design has evolved in response to selection debrief and as a result of detailed knowledge of s/c configuration and instrument accommodation

- Science trade studies ongoing that are refining telescope configuration – basic design is unchanged, but internal configuration has been modified in response to simulation studies

- One science driver that affects engineering is interplay between angular opening/length of scope/detector area – Justin Kasper will show more about this later

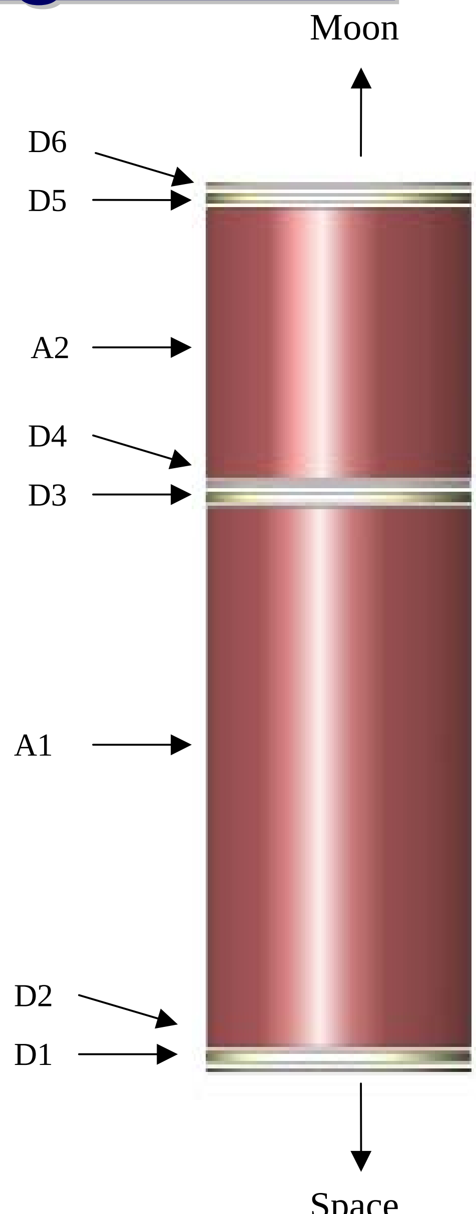
- Trade studies are still underway…

CRaTER Telescope Configuration

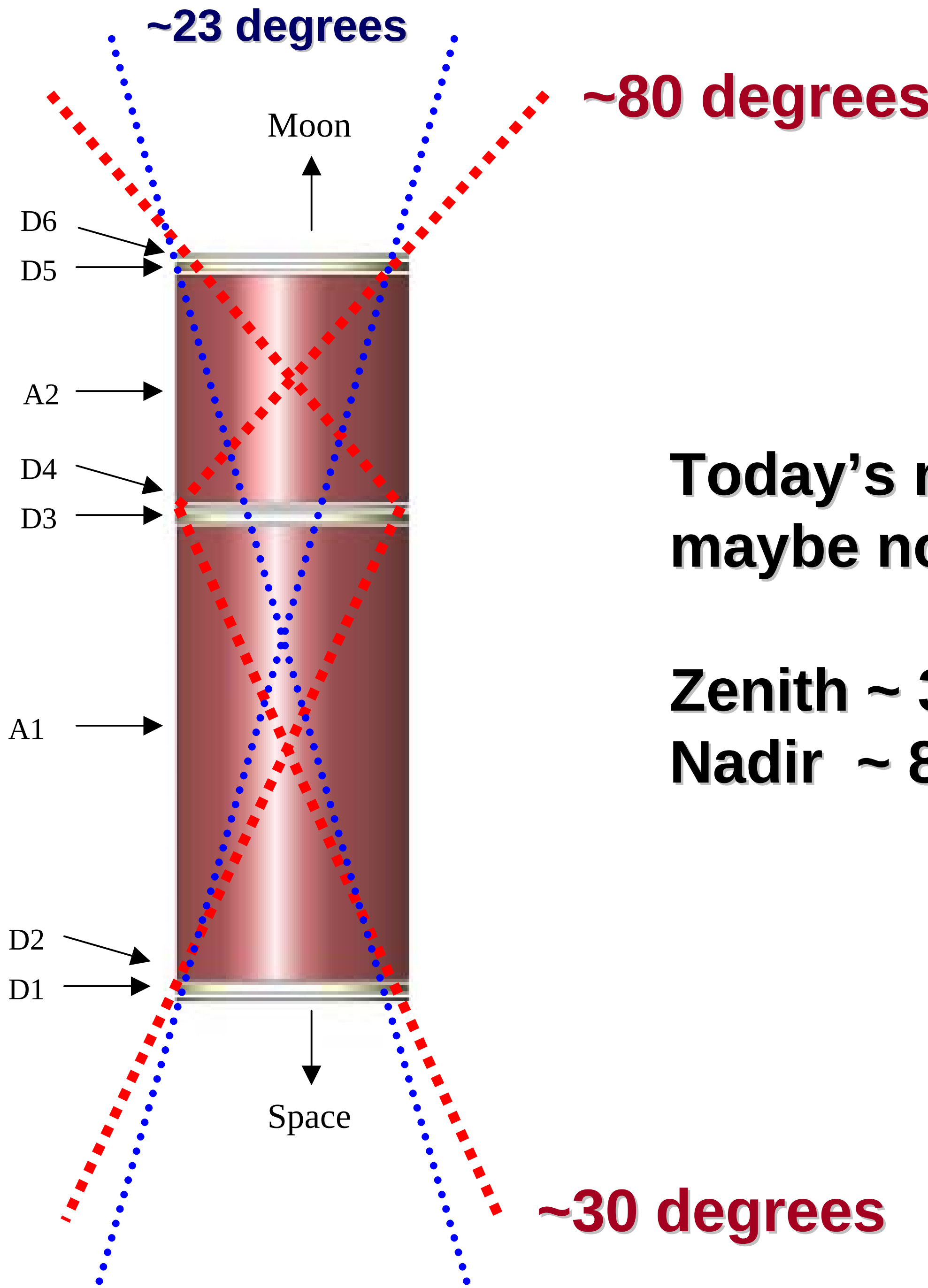


Five-element detector stack with 3 volumes of TEP sandwiched between

Cylindrical telescope rather than conical



Six-element detector stack with 2 volumes of TEP sandwiched between



Today's numbers (but maybe not tomorrow's…)

Zenith ~ 30° full angle
Nadir ~ 80° full angle