ANITA: Antarctic Impulsive Transient Antenna

Science Objectives: *Detection of ultra-high energy cosmic neutrinos*

ANITA addresses NASA Structure and Evolution of the Universe (SEU) themes:

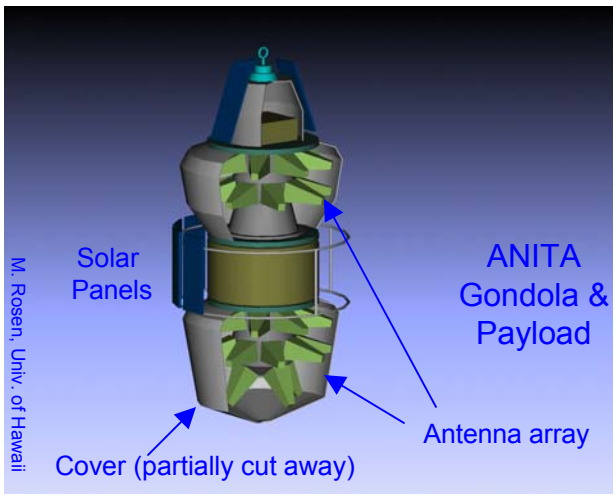
- Examines the *ultimate limits of energy in the universe* by measurements of completely new kinds of energetic particles: **neutrinos**, which are the only known ultra-high-energy particles that are able to reach earth unabsorbed from cosmological distances
- Probes the *nature and origin of the highest energy cosmic rays*, via the most sensitive observation to date of their characteristic neutrino by-products.

A cutaway view of Antarctic ice sheet: ANITA observations penetrate deep into the ice itself. Balloon flight path is shown.

Mission Overview: *A long-duration balloon mission over Antarctica*

- First flight in 2004-2005, two additional flights in 05-06, 06-07
- Each Flight: 9-12 days; Baseline Mission plan: 30 days total flight time
- Radio-frequency monitoring of Antarctic ice sheet from ~40 km altitude
- Flights are circumpolar due to continuous wind circulation around south pole
- Neutrino cascades within ice sheet produce strong Electro-magnetic pulse (EMP) which propagates through ice
- Antarctic ice is transparent to radio waves up to ~1-1.5 GHz
- Ice sheet becomes a neutrino "converter:" neutrinos enter and radio waves come out.
- Effective telescope area: ~1M km^2 !

Science Payload: *36 Dual-Polarized Antennas covering 0.3-1.5 GHz*



- Array of low-gain log-periodic antennas views ice sheet out to ~680 km
- Utilize Askaryan effect in neutrino cascades: radio pulse mechanism tested at accelerators
- ~10^o azimuth resolution via antenna beam gradiometry within antenna clusters
- ~3^o elevation resolution by interferometry between top & bottom antenna clusters
- Pulse polarimetry to get additional information on neutrino direction

ANITA

Balloon Gondola / Launch vehicle

- Balloon gondola plus science payload mass = 1730 kg (3800 lbs)
- Power requirements = 950 W, solar photovoltaic panels
- Gondola is anti-rotation stabilized, sun-pointing
- Long-duration balloon launch from McMurdo Station, Antarctica
- No deployments or articulations necessary during flight

Science Team: *Combining Neutrino astronomy, High Energy Cosmic rays, & Ballooning expertise*

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Collaborators:

D. Besson, J. Ralston (*Univ. of Kansas*), G. Frichter (*Florida State Univ.*), A. Odian (*Stanford Linear Accelerator Center*)

Typical Antarctic long-duration balloon launch

Mission Management

Principal Investigator: P. Gorham, joint position as senior staff member at JPL, and Prof. of Particle Astrophysics, University of Hawaii at Manoa

Project Management & Instrument Development: Jet Propulsion Laboratory

Gondola development: UC Irvine

Antarctic Balloon Operations: National Scientific Balloon Facility (NSBF)

Polar Programs: National Science Foundation

Schedule & Cost

Initial Flight	Dec. 2004 / Jan. 2005
2nd Flight	Dec. 2005 / Jan. 2006
3rd Flight	Dec. 2006 / Jan. 2007
Initial Data release	April 2005

Phase A/B	$1.8 M
Phase C/D	$13.2M
Phase E	$7.7M
Total (FY2002 $)	**$22.7M**