Multi-TeV measurement with CREST experiment

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Cosmic Ray Electrons

- Primary + Secondary
  - Substantially primary
    (positron fraction \( \sim 10\% \))
  - \( \sim 1\% \) of proton intensity at 1GeV, rapidly decreased than proton
    - Energy loss of high energy electron is proportional to \( E^2 \)
    - TeV electron horizon: \( \sim 1 \) kpc (\( 10^5 \) yr propagation)
    - Possible local source: Vela, Cygnus loop, Monogen, SNRs

Compiled data up to Jan. 2010 from CR database (A.W.Strong et al, 2009 ICRC)
Multi-TeV region largely unexplored, where the potential is greatest for detecting nearby cosmic accelerators…
**Cosmic Ray Electron Synchrotron Telescope**

- High energy electron (>TeV) measurement via synchrotron radiation
  - Detect x-ray synchrotron photons generated in the magnetic field of the Earth as primary electron passes through
    - Advantage
      - Increase of the effective area of instrument
      - Rejection of proton signal

- Designed for long duration balloon flight
CREST Collaboration

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Signal and Background

Signal
- Synchrotron radiation generated from electron
  - Line of photons arriving nearly simultaneously
  - Mean photon energy related to primary electron energy

Background
- Cosmic and shower-produced x-rays and large charged particle flux
  - Random single x-ray coincidences
    - Interactions in the detector and frame
  - Bremsstrahlung photons from low energy electrons

→ Requires good timing resolution
Detector Design

Crystal Array
- 1024 BaF$_2$ crystals w/ 2” PMT readout, embedded in foam matrix
- Photon energies from ~30 keV to 30 MeV
- Designed to have 1 nsec timing resolution

Veto paddles
- > 99% hermetic
- Thin plastic scintillator with waveshifting fiber readout into 2” PMTs

Expected Performance
- Sensitivity on synchrotron coming from electron up to ~ 50 TeV or so
Antarctica Flight

- Antarctica flight in 2011/12 season
  - Launch on Christmas day on 2011
  - Flight time: ~ 10 days
  - Recovery done on Feb. 2012
Current Status

Analysis

• Flight calibration
  • Timing calibration: by using LED pulser run & adjacent hits in crystal (calibration trigger)
  • Energy calibration: by using Radium impurities in crystal and 511 keV line
• Comparison between flight data and simulation

Investigation on hardware improvements

• Lighter detector
• Better Compton scattering shield