Multi-TeV measurement with CREST experiment

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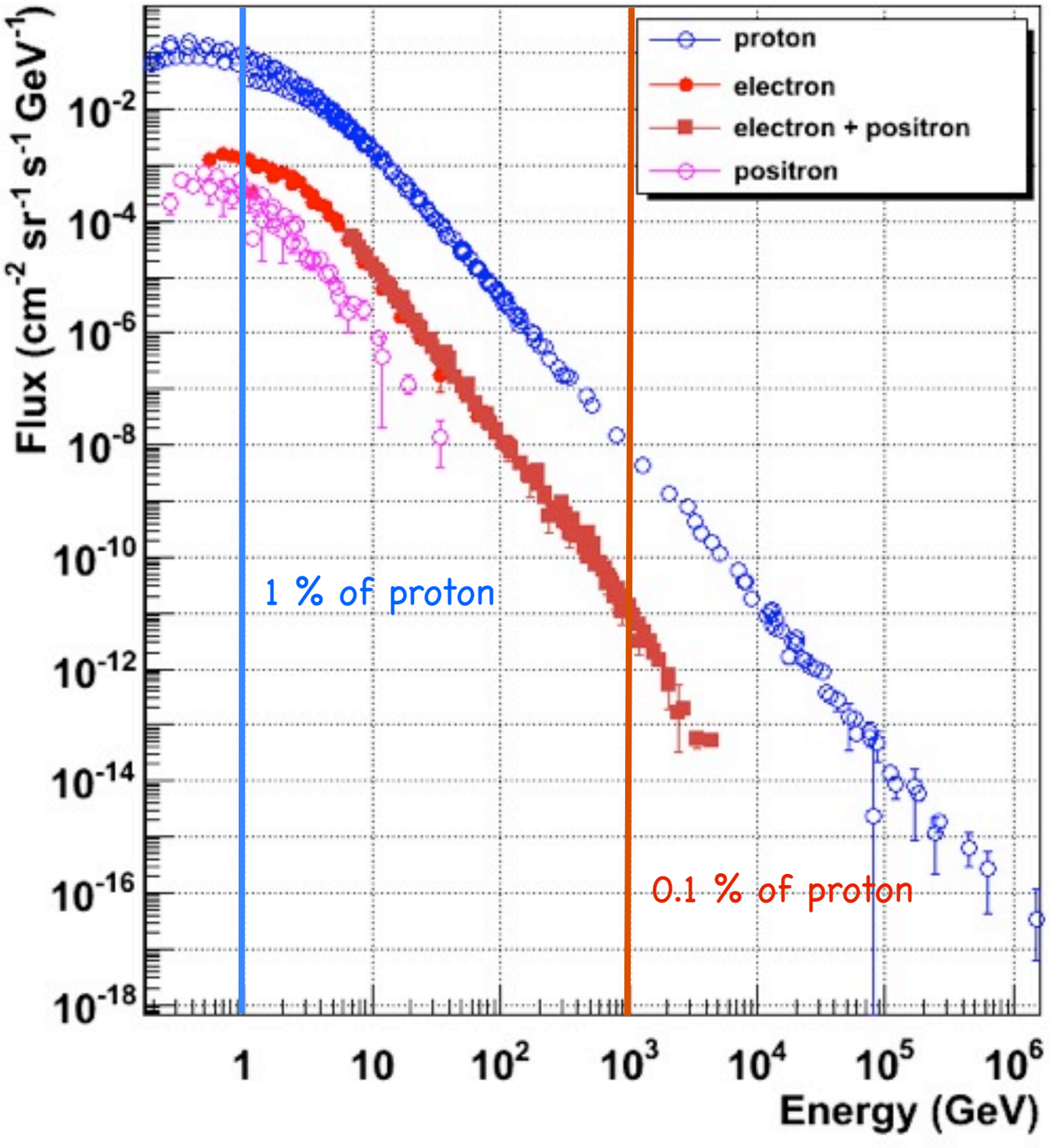
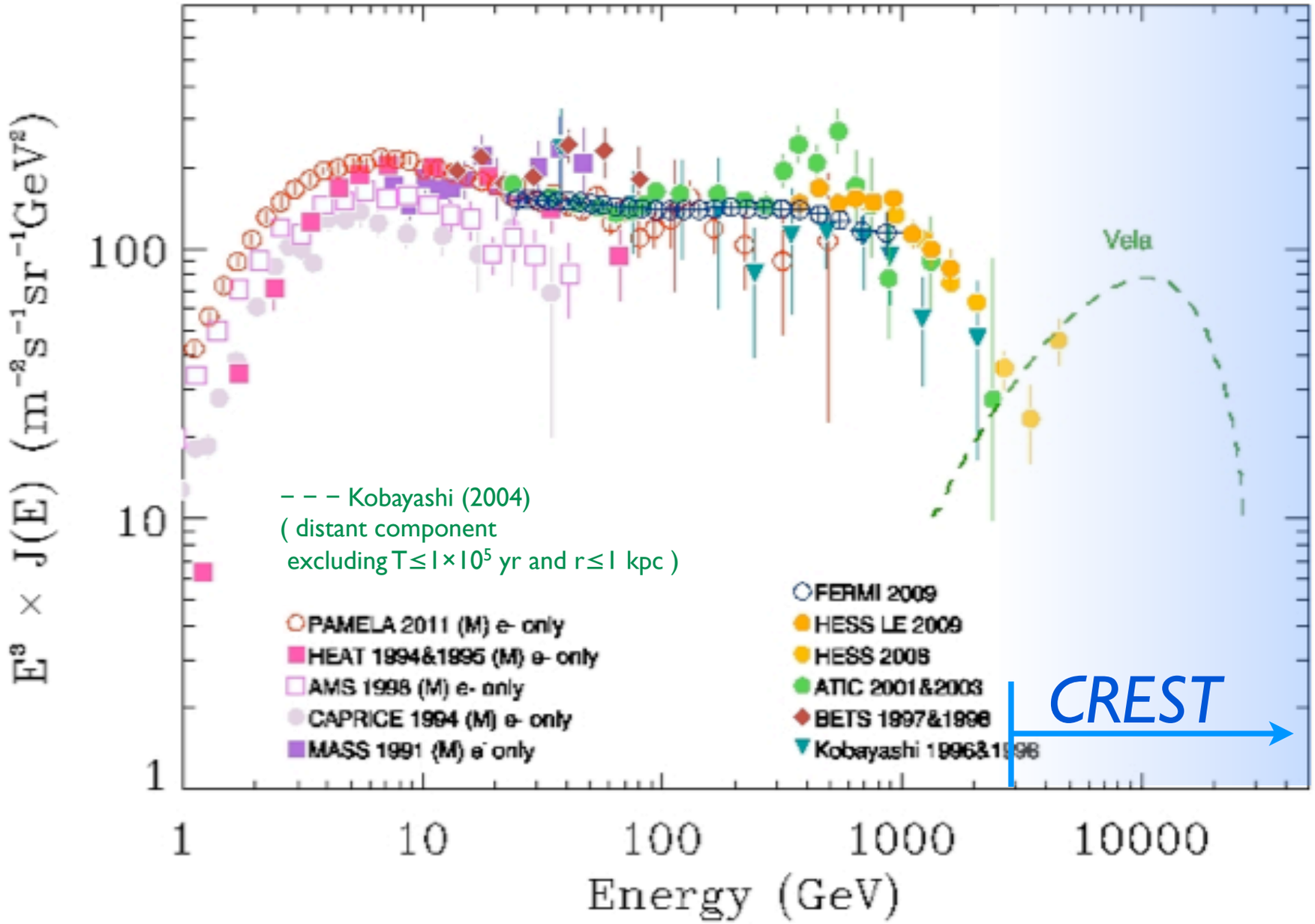
Cosmic Ray Electrons



Compiled data up to Jan. 2010 from CR database (A.W.Strong et al, 2009 ICRC)

- Primary + Secondary
  - Substantially primary (positron fraction ~ 10 %)
- ~ 1% of proton intensity at 1GeV, rapidly decreased than proton
  - Energy loss of high energy electron is proportional to E2
  - TeV electron horizon : ~ 1 kpc (10^5 yr propagation)
  - Possible local source : Vela, Cygnus loop, Monogen, SNRs

TeV measurement @ Earth

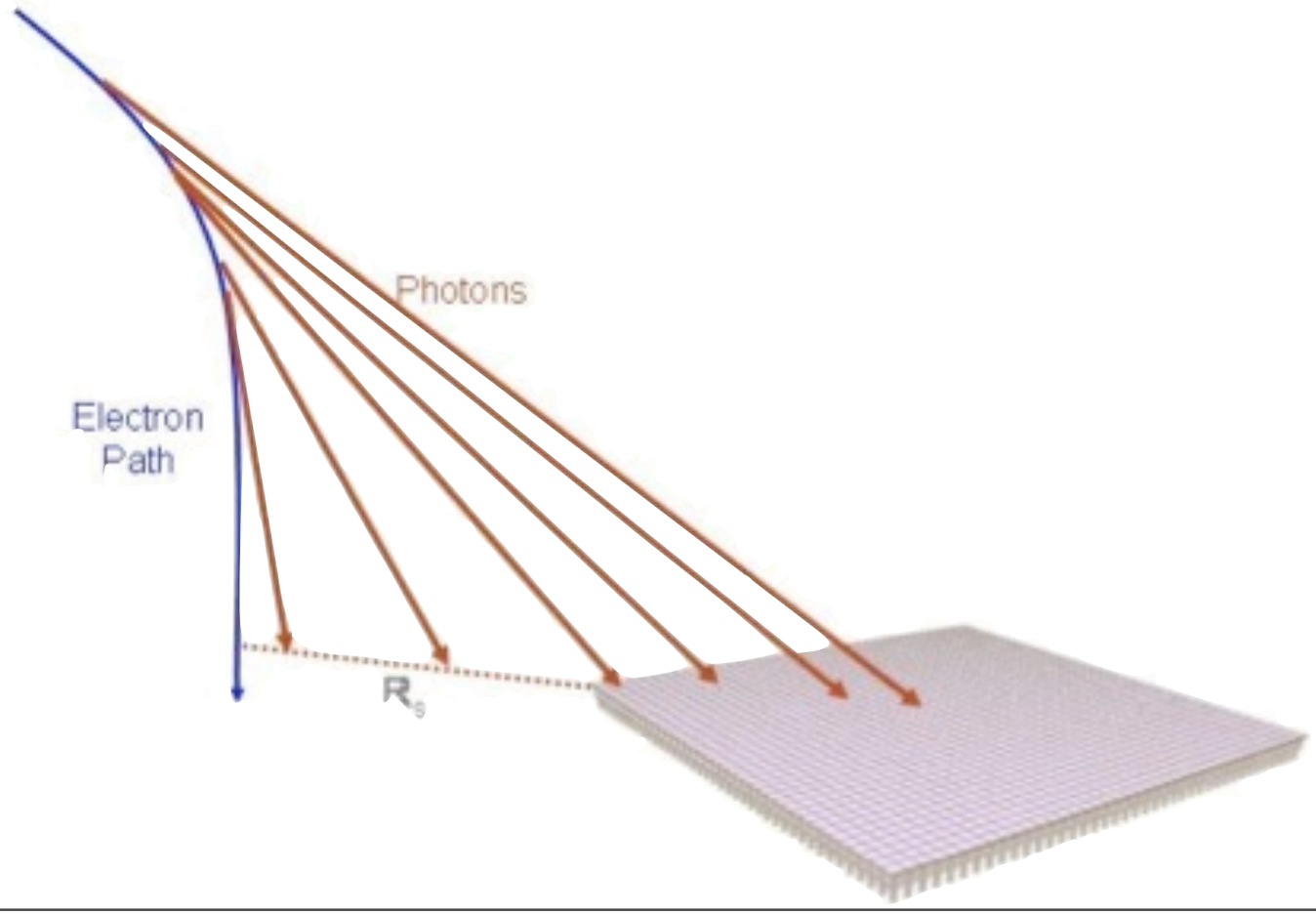


Multi-TeV region largely unexplored,
where the potential is greatest for detecting nearby cosmic accelerators…

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

University of Chicago : S. Wakely, N. H. Park, D. Müller

Indiana University : C.R. Bower, J. Musser

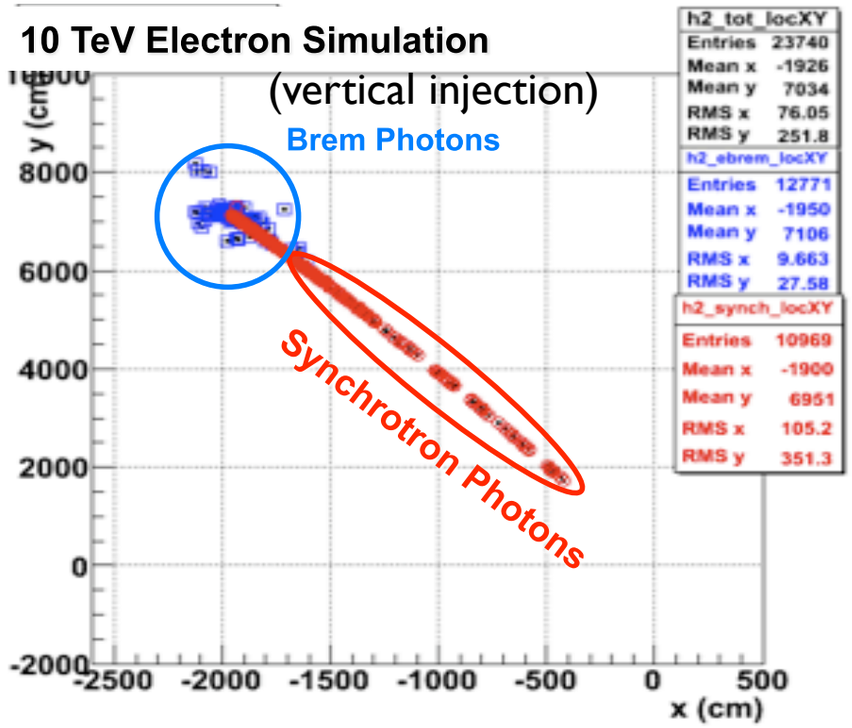
Northern Kenturcky University : S. Nutter

Penn State University : T. Anderson, S. Coutu, M. Geske

University of Michigan : M. Schubnell, G, Tarlé, A. Yagi, J. Gennaro

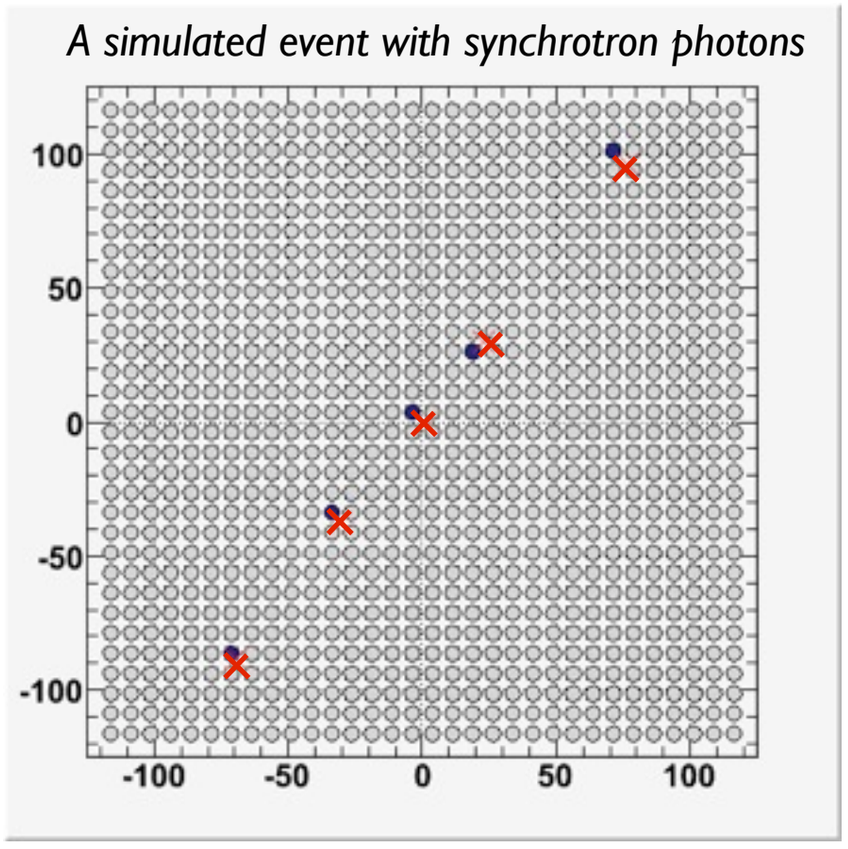
Signal and Background

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



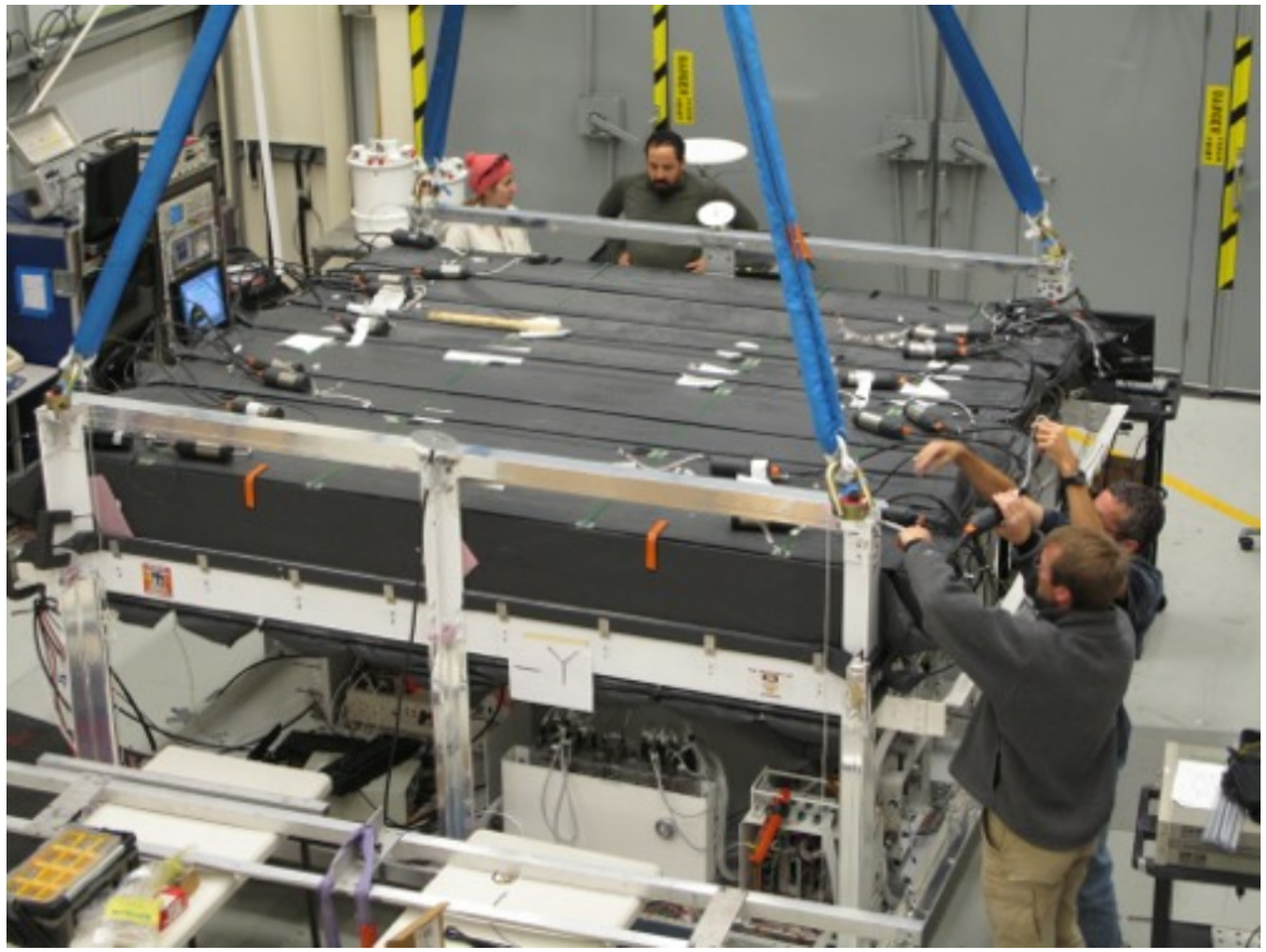
- Background
  - Cosmic and shower-produced x-rays and large charged particle flux
    - Random single x-ray coincidences
      - Interactions in the detector and frame
  - Bremsstrahlung photons from low energy electrons

→ *Requires good timing resolution*



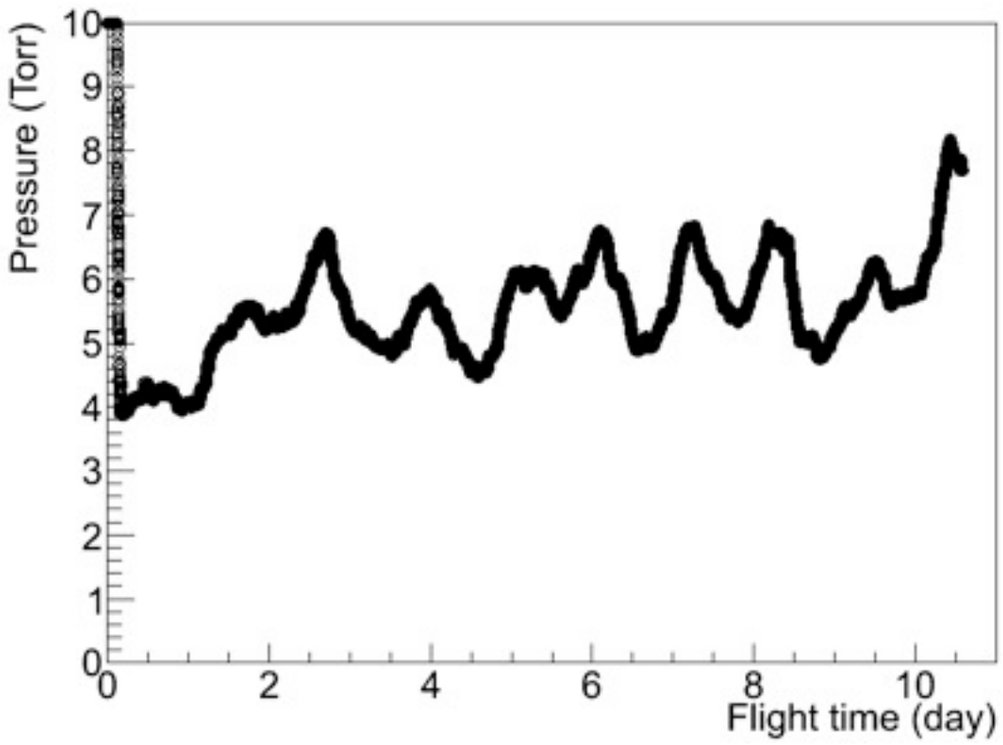
Detector Design

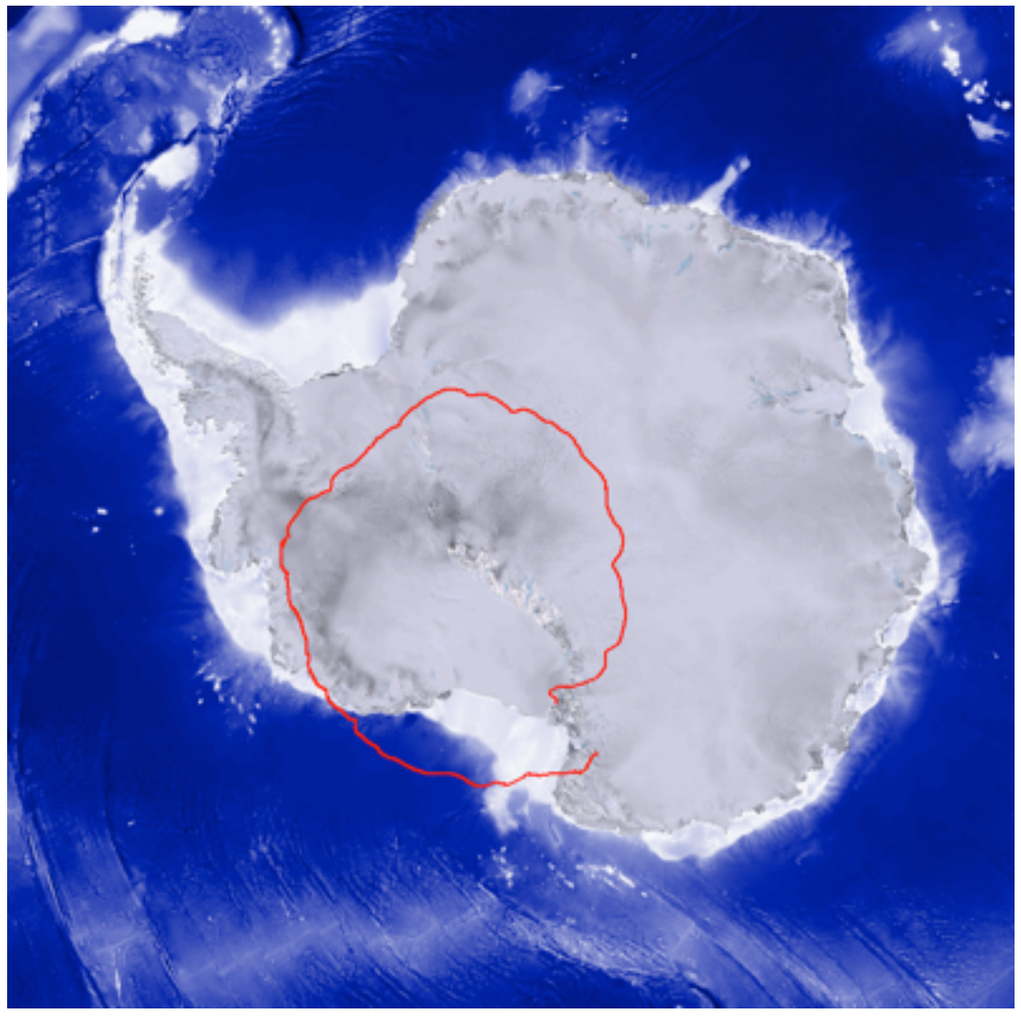
- Crystal Array
  - 1024 BaF_2 crystals w/ 2” PMT readout, embedded in foam matrix
  - Photon energies from ~30 keV to 30 MeV
  - Designed to have 1 nsec timing resolution
- Veto paddles
  - > 99% hermetic
  - Thin plastic scintillator with waveshifting fiber readout into 2” PMTs
- Expected Performance
  - Sensitivity on synchrotron coming from electron up to ~ 50 TeV or so



Antarctica Flight

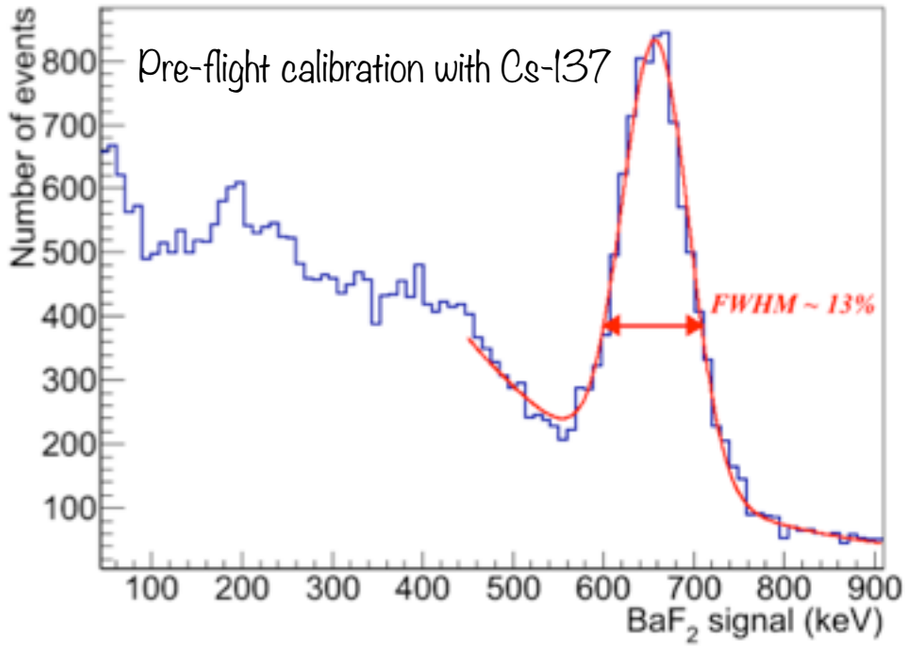
- Antarctica flight in 2011/12 season
  - Launch on Christmas day on 2011
  - Flight time : ~ 10 days
  - Recovery done on Feb. 2012



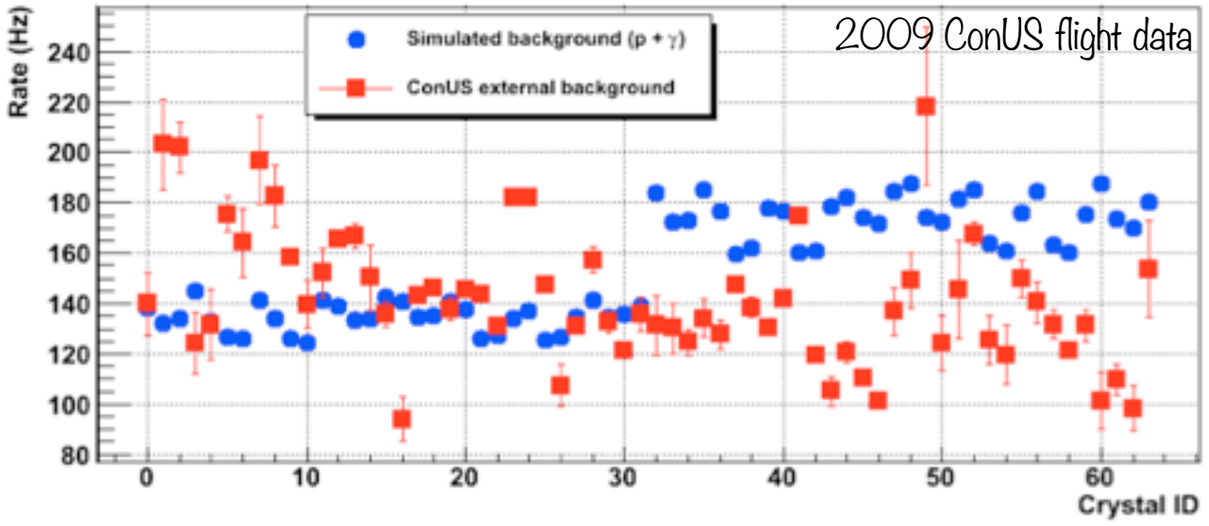


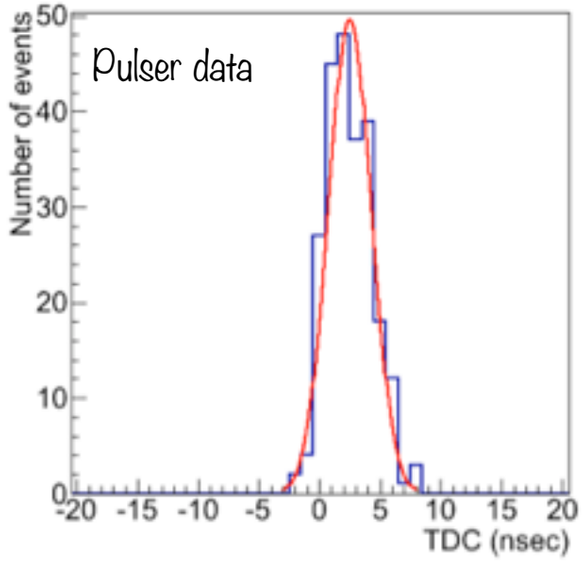
Current Status

- 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