IACHEC
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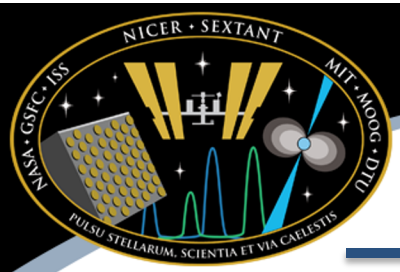
NICER
Neutron star Interior Composition ExploreR

Non-Thermal SNR Working Group

Craig Markwardt (NASA/GSFC) &
Lorenzo Natalucci

NASA GSFC MIT KAVLI INSTITUTE DTU BROAD REACH MOOG

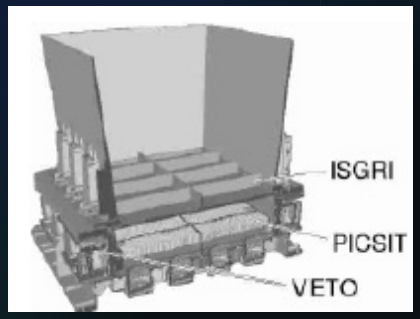


Summary

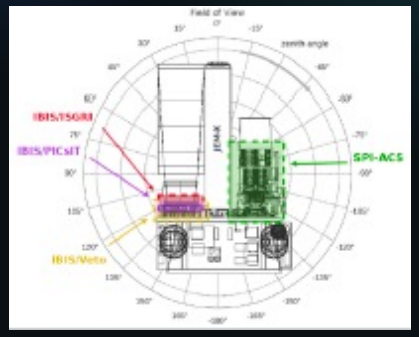
- INTEGRAL PICsIT analysis of Crab (Rodi)
- Crab Reference Model proposal (Markwardt)
- Crab Cross-Calibration Paper (Natalucci)
- Actions

IBIS-PICsIT Instrument Review

- IBIS-PICsIT (Pixelated Caesium Iodide Telescope)
  - High-energy imaging plane of IBIS
  - Energy range ~175 keV – 14 MeV imaging
  - Spectral-imaging: ~1800 – 3600 sec



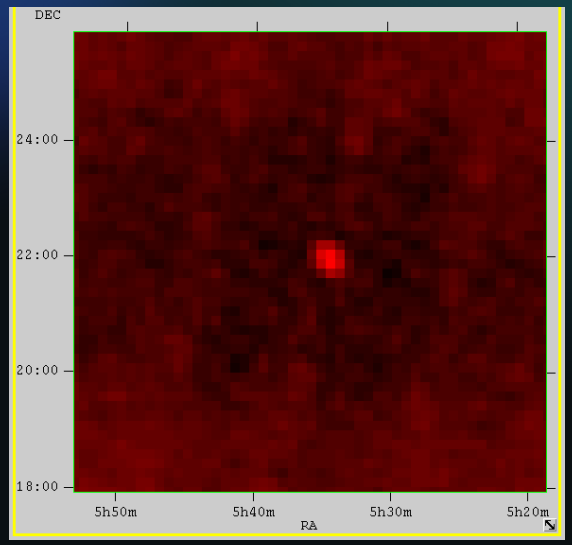
Bird et al.(2003)



Savchenko et al.(2017)

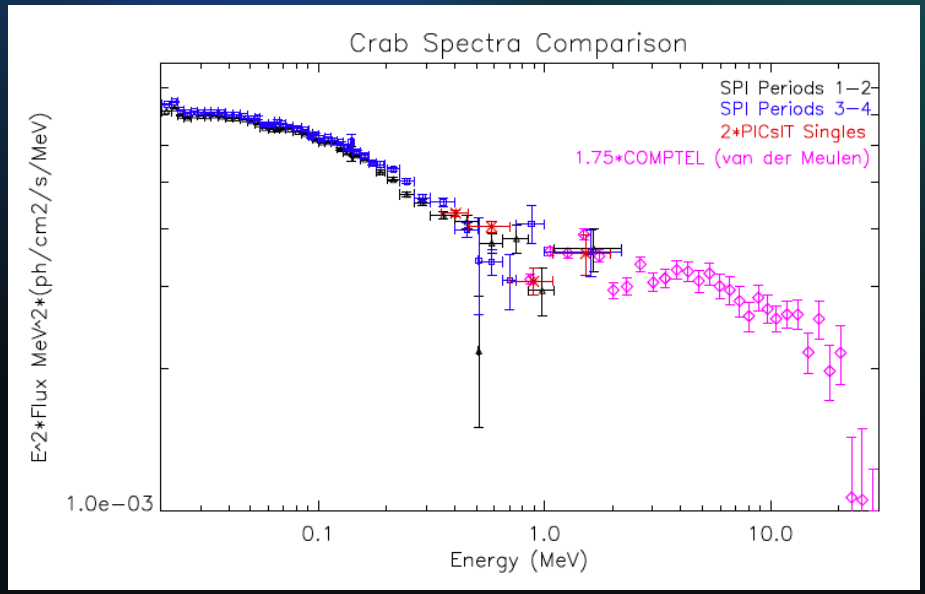
Crab Analysis

- Selected Crab observations < 6 deg of pointing dir.
- Ran standard OSA analysis until imaging step
- Stacked the images (varmosaic) for lc/spectra
- Fit count-rate and significance images with 2D Gaussian (MPFIT2DPEAK) for source count rates and errors



Crab Spectrum

- SPI spectrum (Jourdain & Roque 2020) vs PICsIT single events vs COMPTEL (van der Meulen 1998)
- Spectrum:
  - COMPTEL has harder spectrum
    - Fit:
      - **Γ** ~ 1.95, E_{cut} ~27 MeV (locally)
      - Knodlseder (2022): **Γ** ~ 2.0, E_{cut} ~39 MeV



Crab Reference Model - Motivations

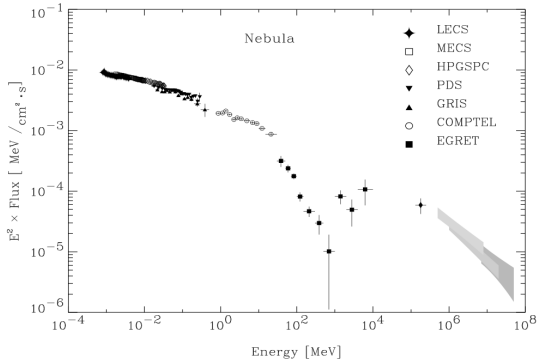
- Most observers use an absorbed power law for Crab nebula+pulsar observations

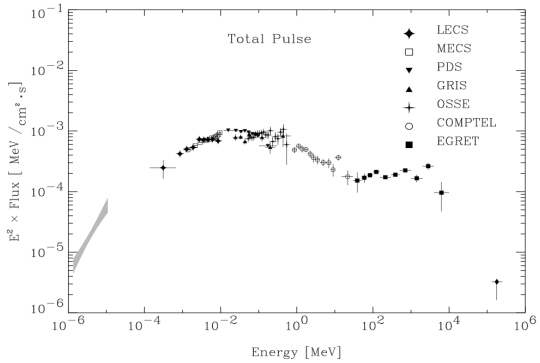
  tbabs * pow (and sometimes tbabs*logpar)

  - Pro
    - It's simple
    - It does work well >2 keV
  - Con
    - Doesn't work as well at lower energies
    - Not really physically motivated, inconsistent use in literature
    - We know that the pulsar and nebula have distinct spectra (Kuiper 2000)
    - Nebula has spatial variations (Mori et al 2001)
- Would be nice to have a Crab reference model that covers larger range of energies and can distinguish contributions from nebula and pulsar
  - Goal: support X-ray observations in the 0.1-100 keV band
  - Recognize that for energy band < 2 keV absorption model matters
  - Recognize that dust scattering can be important
  - Timing studies can separate pulsar from nebula

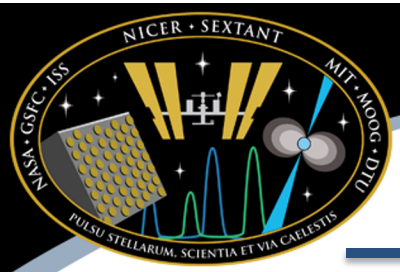
Craig's Proposed Model

- XSPEC model
  model TBvarabs*xscat*(curv*powerlaw + crab_pulsar)
  Absorption Dust Nebula Pulsar
- Absorption (Kaastra et al 2009)
- Dust ("xscat" model Smith)
- Curvature correction (Kaastra)
- Crab pulsar
  - Kuiper 2000 & Kaastra 2009





Kuiper 2000

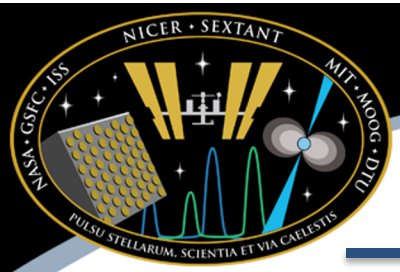


Reference Model Plans

- Craig will post NICER model
- Model can be improved, made a bit more general and usable
- Maybe worth a quick paper

Crab Cross-Calibration Paper

- Multi-mission cross-calibration paper using Nebula + Pulsar
  - ~10 instruments
- Lorenzo Natalucci coordinating author
- Status
  - Multiple mission data collected through 2017
  - Overleaf draft started
  - Open question of soliciting data through 2020?



Working Group Actions

- Crab Cross-Calibration Paper (in work)
- G21.5 – delayed at moment
- Crab Reference Model (proposed)