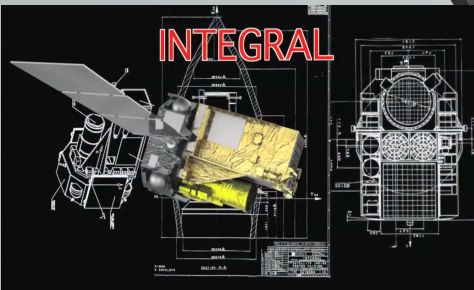


GRB (Near) Real-Time Analysis with IBIS/PICsIT on board *INTEGRAL*

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On behalf of the *INTEGRAL* Gravitational Team:

A. Bazzano, E. Bozzo, S. Brandt, J. Chenevez, T. J.-L. Courvoisier, R. Diehl, A. Domingo, C. Ferrigno, L. Hanlon, E. Kuulkers, E. Jourdain, A. von Kienlin, P. Laurent, A. Lutovinov, A. Martin-Carrillo, S. Mereghetti, L. Natalucci, J. Rodi, J.-P. Roques, V. Savchenko, R. Sunyaev, and P. Ubertini



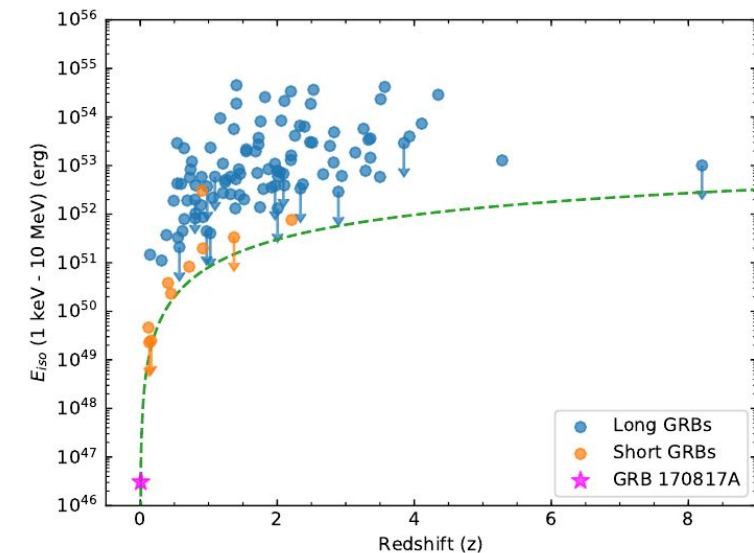
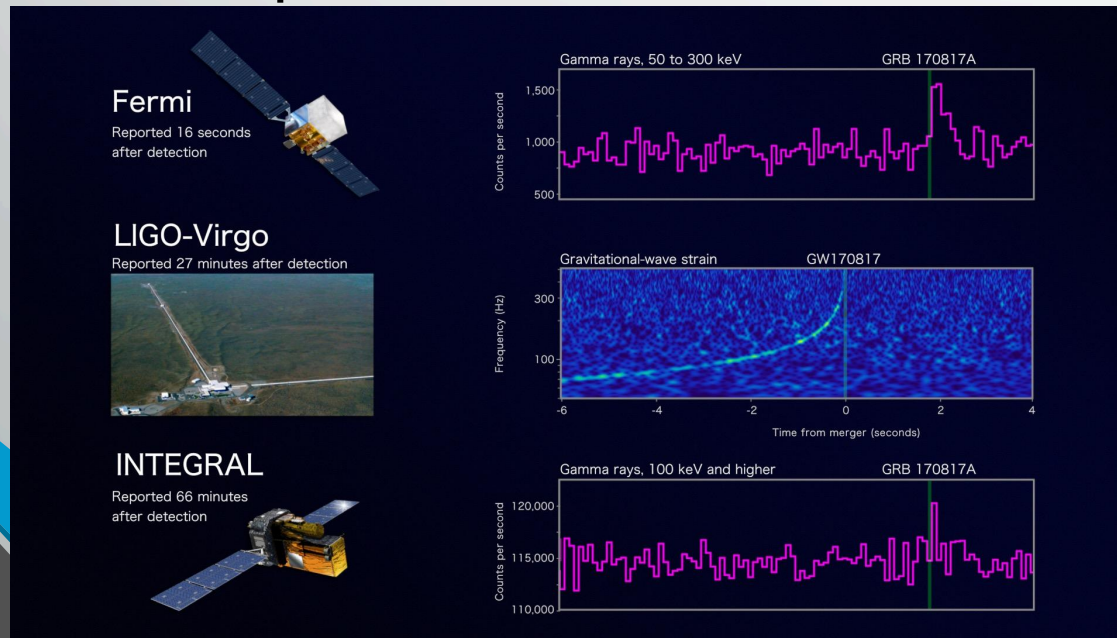
12th INTEGRAL Conference, 11-15
February Geneva

Outline

- Motivation of GRB search
- Description of PICsIT Capabilities
- Search process and NRT results
- GRB Spectral capabilities with PICsIT
- Conclusions and Future Work

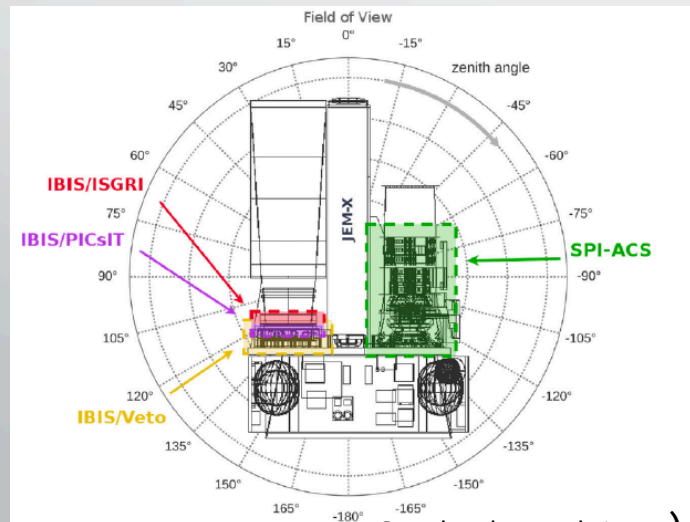
Motivation of GRB Search

- Since GW170817/GRB170817A, a greater emphasis on detecting prompt GRB emission and follow-up for GW events
 - Prompt emission can help in event localization for multi-wavelength follow-up
 - So quickly analyzing data and alerting the community is important
 - Gamma-ray emission interesting for understand emission processes (GW-GR $\Delta t \sim 1.7s$ and low E_{iso})
- *INTEGRAL*'s long orbit (~ 2.7 days) allow for continuous searches and uninterrupted follow-up

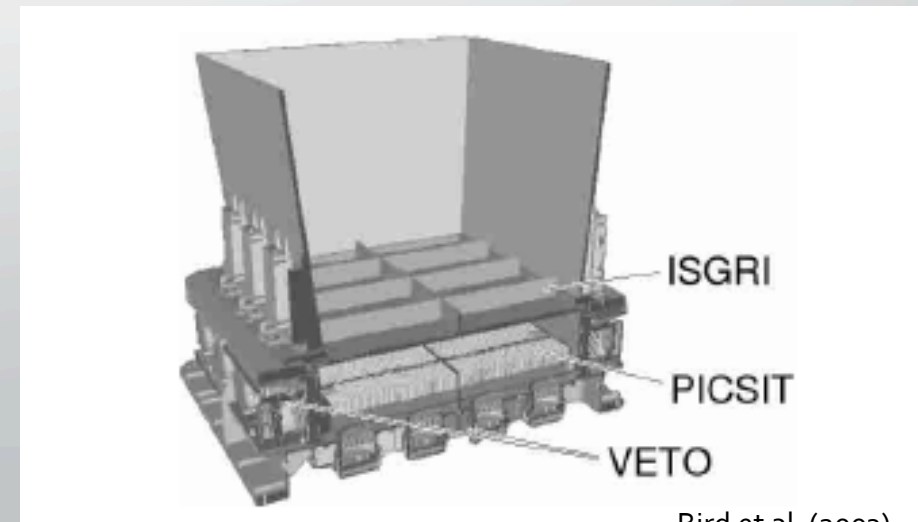


IBIS/PICsIT Characteristics

- PICsIT (PIxelated Caesium Iodide Telescope) is high-energy imaging plane of IBIS
- Detector area of 2900 cm² and FoV of ~ 900 sq deg
 - Standard data: 175 keV – 10 MeV detector images in 64 energy channels with 0.5 – 2 hours time resolution
 - “Spectral-timing” data: ~200 keV – 2.6 MeV in 8 channels with 7.8-ms; no imaging
 - Can detect impulsive events outside imaging



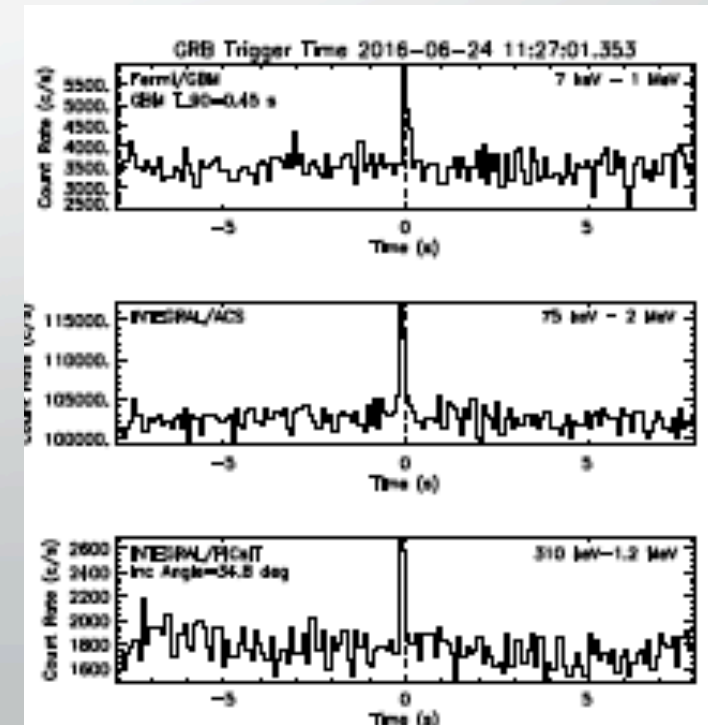
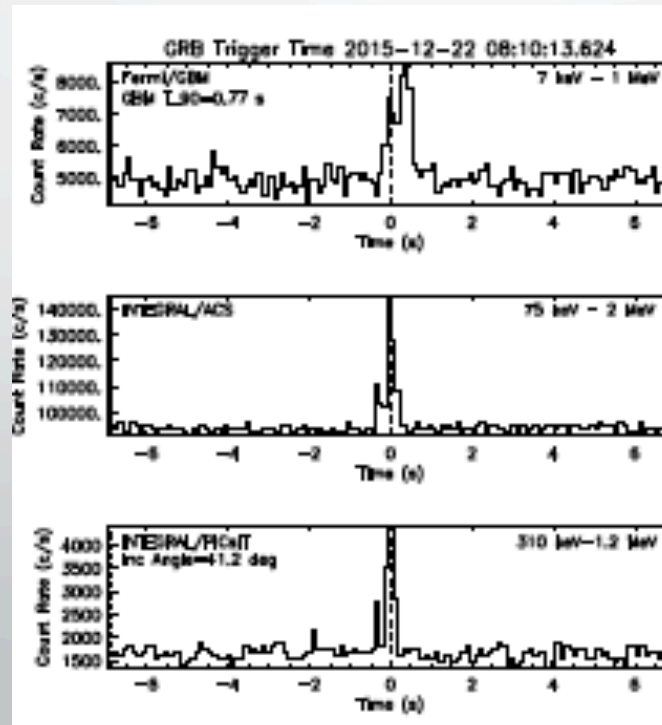
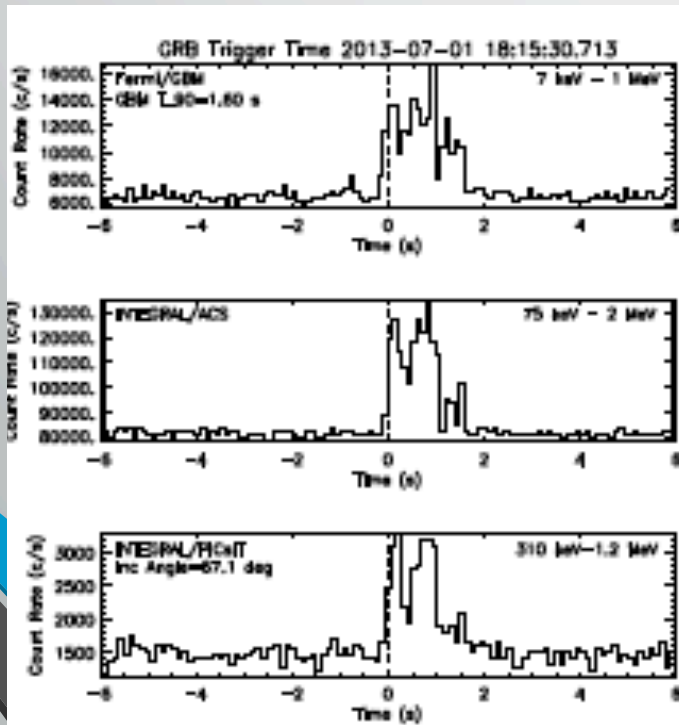
Savchenko et al. (2017)



Bird et al. (2003)

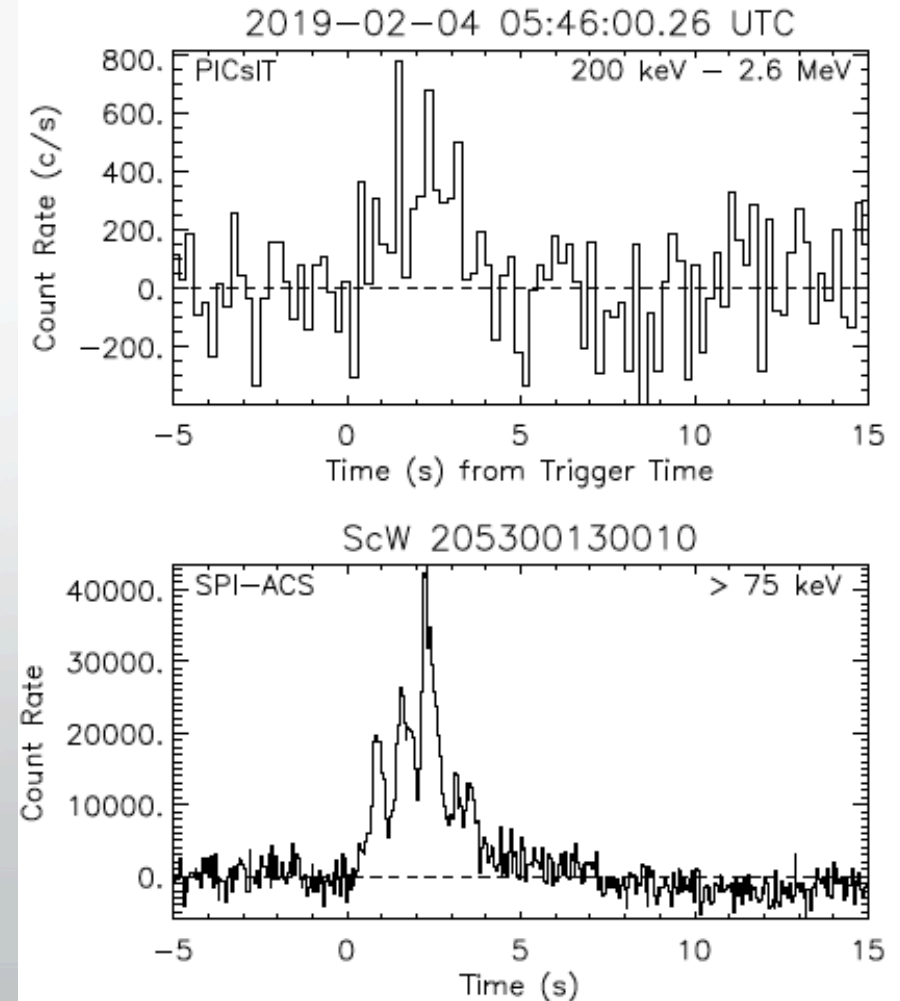
GRB Search with PICsIT

- Initial testing searching scw's with GBM sGRBs
 - Integration times 64 ms to 4.096 s (GBM integration times)
 - Find about 35% with PICsIT
- Also searched past scw's without reported GBM GRBs



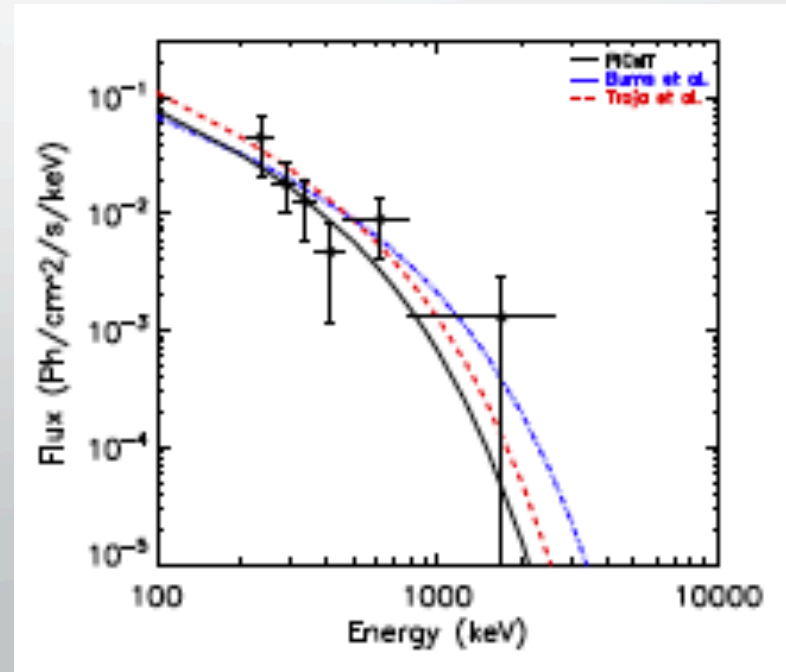
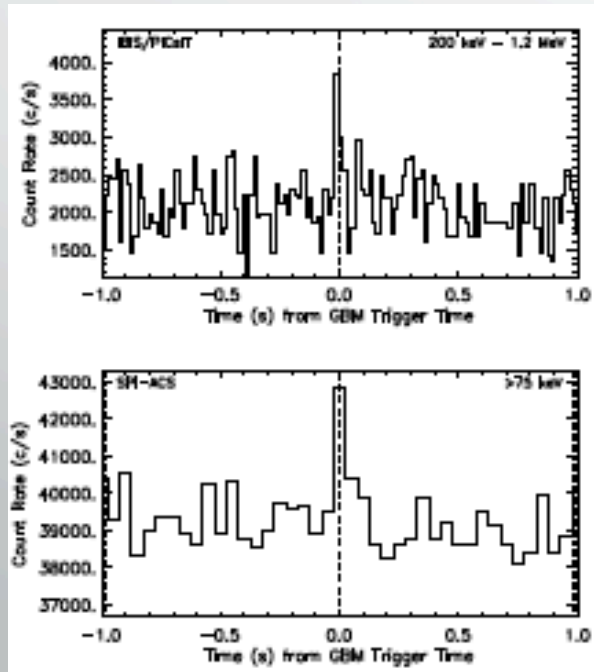
Near Real-Time Search

- Starting from rev 2051 (29-01-2019) begun looking at data in NRT (~few hours after)
- Currently running every hour to look for new data
- Missed a couple of GRBs due to no data; between rev's
- Detected GRB 190204A



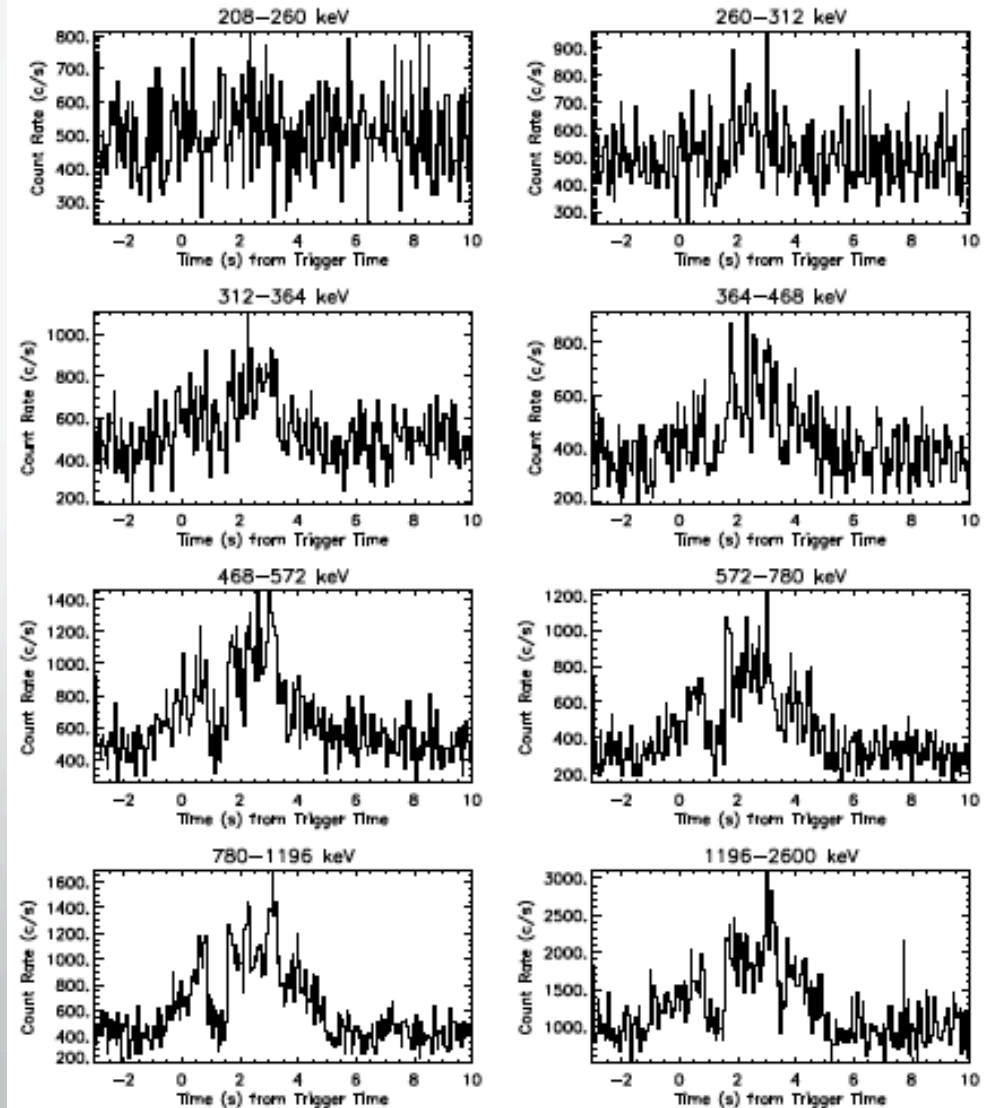
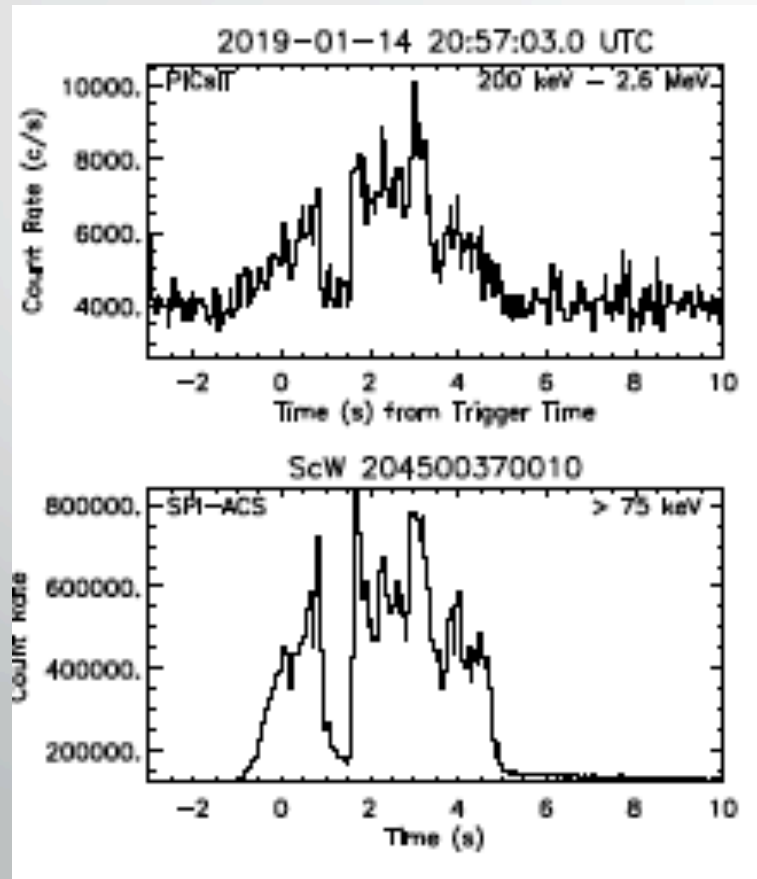
PICsIT GRB Spectral Capabilities

- With 8 energy channels, can make spectra
- Started with possible-kilonova GRB 150101B
- Low count-rate and ~ 26 deg off-axis
- Can compare to *Fermi*/GBM and *Swift*/BAT
- But would be nice to look at a higher count-rate GRB



PICsIT GRB Spectral Capabilities

- A better opportunity for a PICsIT spectrum is GRB 190114C
- GRB signal in 7 channels above 300 keV



Conclusions and Future Work

- PICsIT near real-time search for GRBs up and running
- Detected our first GRB (190204A)
- Next step is to implement analysis in real-time for start of LIGO-Virgo O3 for early April
- Also incorporate search with IBAS at ISDC and be able to send out alerts, especially for EM counterparts to GW triggers
- Develop analysis tools to make GRB spectra with PICsIT

Sub-Threshold SGRBs with *INTEGRAL*

- GBM reports ~ 80 un-triggered SGRBs/yr
 - ~40 SGRBs triggered/yr
 - ~120 total SGRBs/yr
- With high *INTEGRAL* live-time can:
 - Strengthen GBM detections
 - Look for events missed by GBM
 - Possibly push to lower significance events using 3 instruments

