

High-Resolution Chandra Observations of the Crab Nebula in Coincidence with the April Gamma-Ray Flares

Allyn F. Tennant¹, M. C. Weisskopf¹, M. Tavani², R. Buehler³, R. Blandford⁴,
P. Caraveo², E. Costa², D. Horns⁵, C. Ferrigno⁶, S. Funk³, R. Mignani⁷, A.
Lobonav⁸, A. de Luca⁹, Y. Uchiyama³

¹NASA MSFC, ²Ist di Astrofisica, INAF, Italy, ³Stanford University,
⁴Stanford university, ⁵Universitat Hamburg, Germany, ⁶Integral Science Data
Center, Switzerland, ⁷MSSL, United Kingdom, ⁸Max-Planck Inst for Radio
Astronomy, Germany, ⁹Luca (Ist di Astrofisica, INAF, Italy).

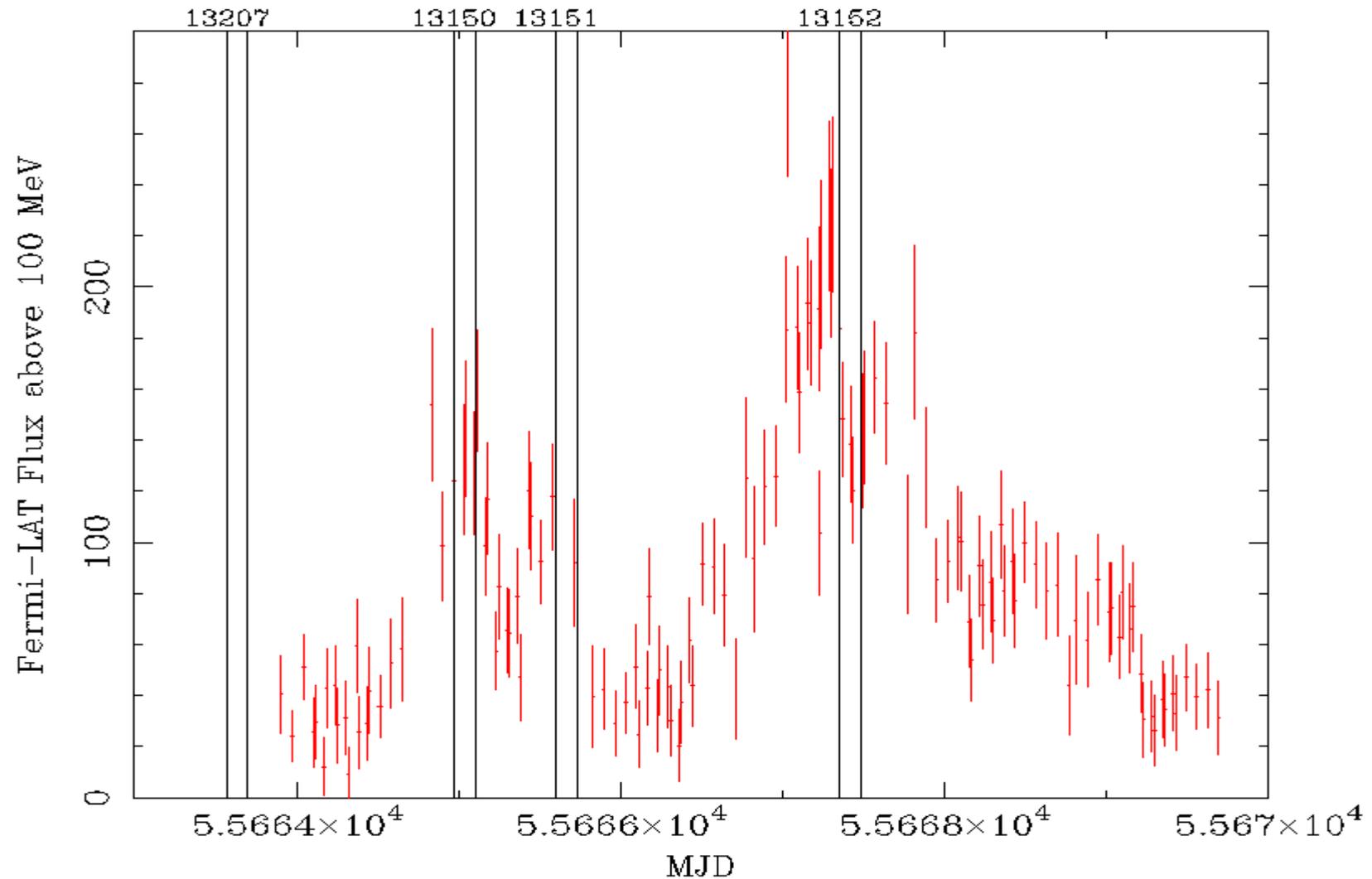
The 2010 Sep flare

- Agile and Fermi both detected a flare from the Crab in Sep 2010
- Chandra executed a ToO
- Lots of minor changes in the nebular over the year
- But nothing obviously associated with the flare

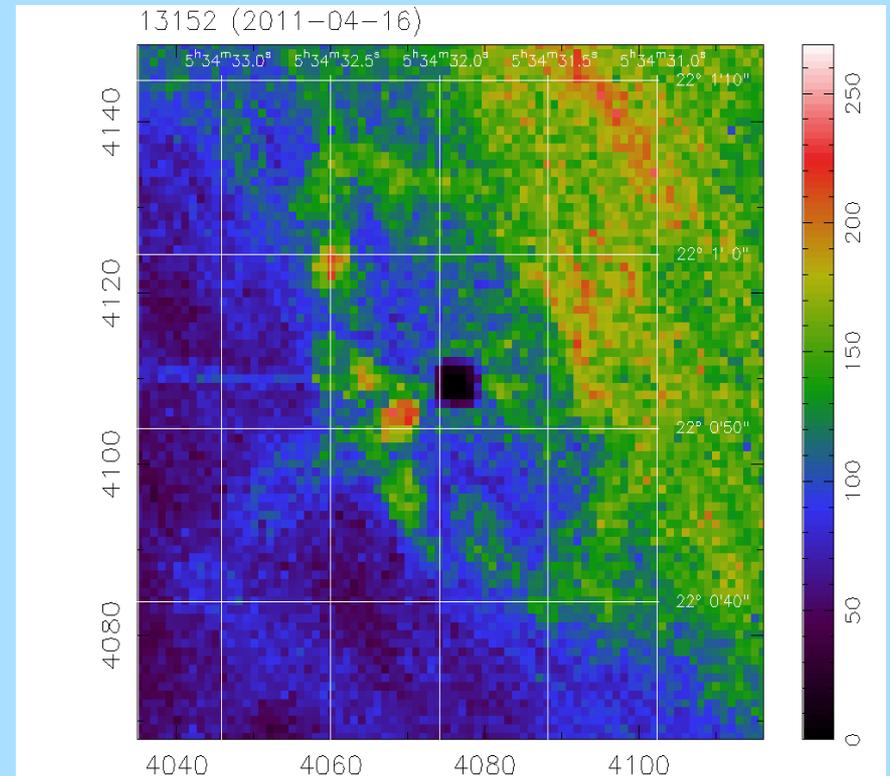
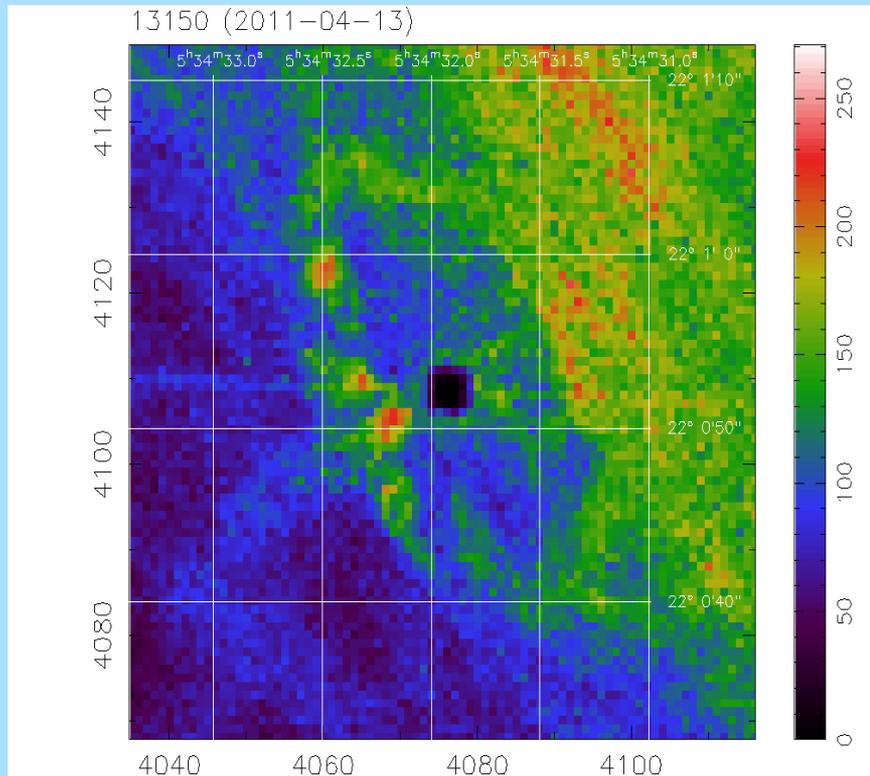
Set up a monitoring program

- Two goals:
 1. Make sure we have a pre-flare observation
 2. Search for original of the recently discovered variations (10% in 2 years) reported by Wilson-Hodge (2011).
- 5 ksec observations once per month
- Future ToO, 10 ksec five observations in one month

Gamma Ray flux high in April



Nothing Obvious



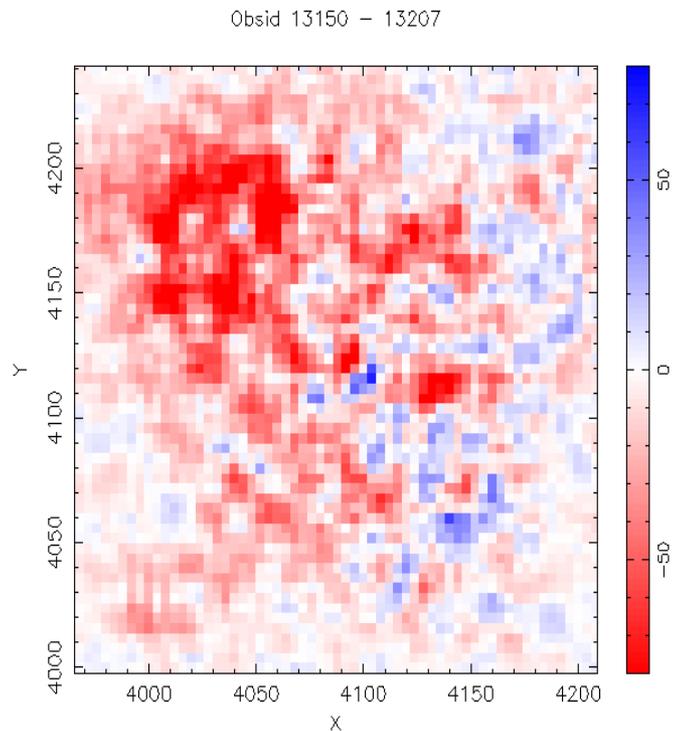
What are we looking for?

- X-ray rise may slightly lead gamma ray increase.
 1. Acceleration typically reach X-ray energies first.
 2. Very few gamma ray photons, i.e., down scattering has minor impact on X-ray rate.
- However, synchrotron losses will cause gamma ray flux to decline first

What are we looking for?

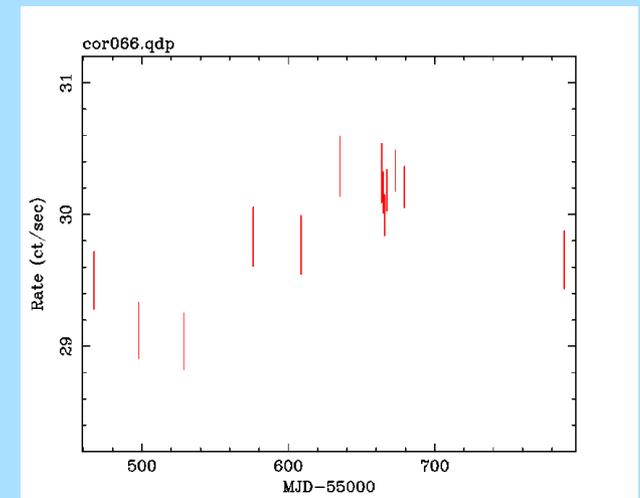
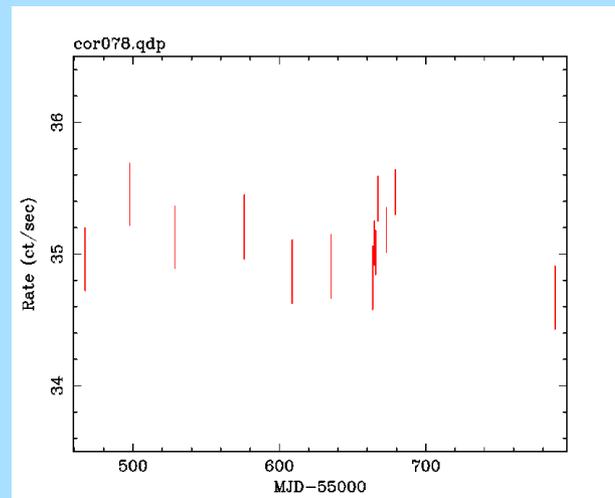
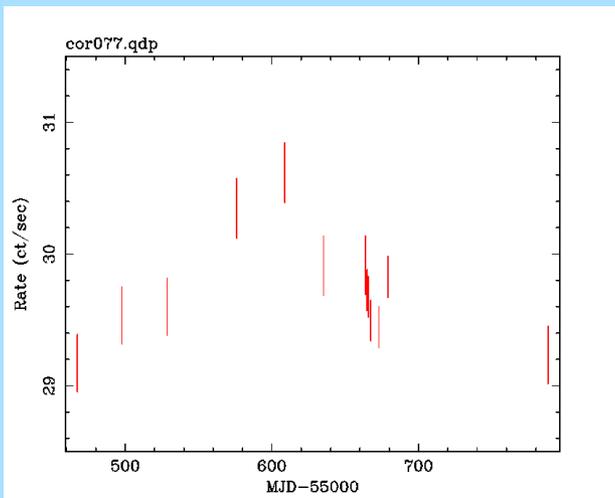
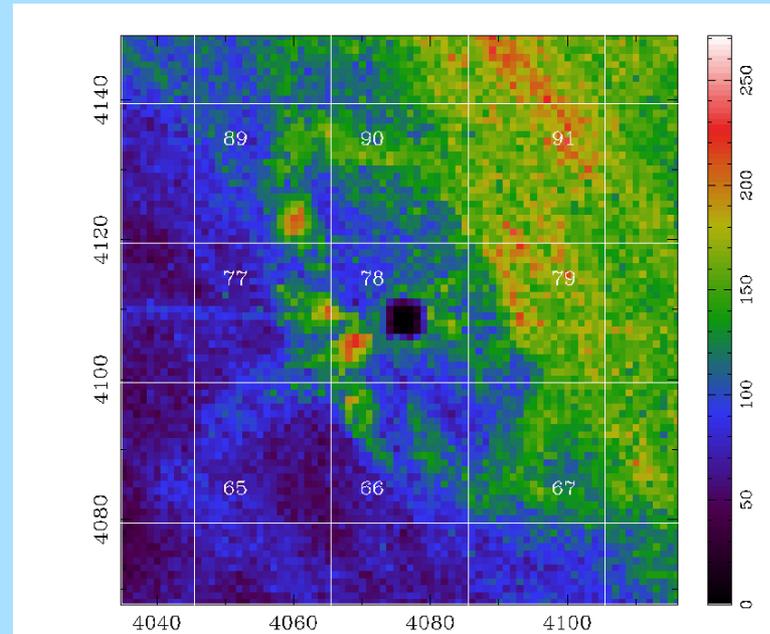
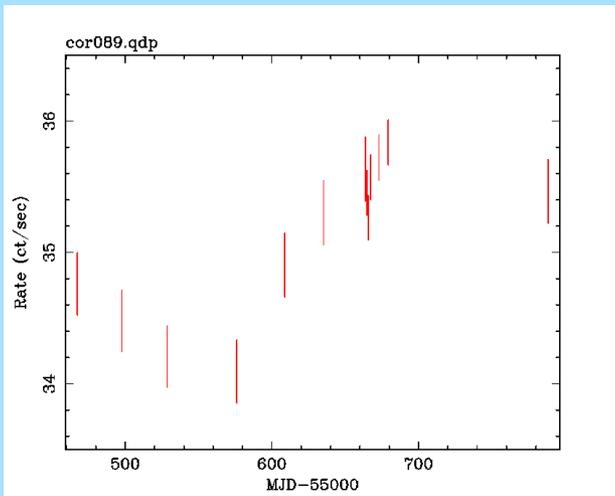
- Size should be single pixel
- Due to pileup, count rate could decline...
- Could see filaments colliding
- To prove that you are sensitive to variability you need to look at something that does not vary and show that it doesn't vary (R. Mushotzky).

Search for variability



- Huge swath of nebular faded in 33 hours?
- No! Image closer to edge of detector and contamination layer thicker.
- Mostly corrected in cal.
- Complicated by pileup

Light curves near pulsar



Summary

- Monitoring observations continue
- Instrumental effects (slowly) being removed
- Still no obvious indication of gamma ray flare location