High-Energy Emission from SGR 1806-20

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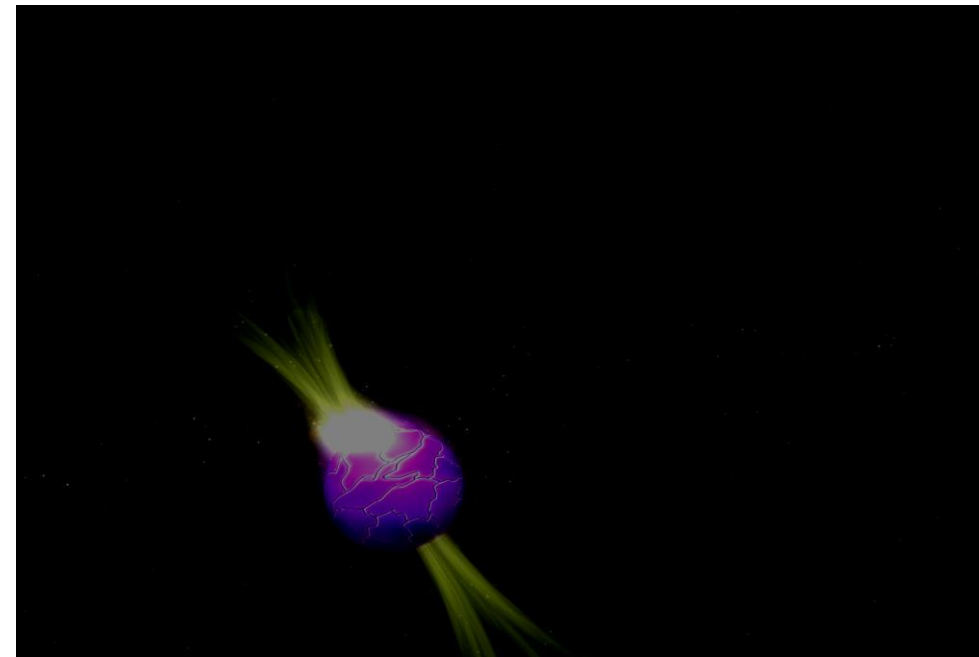
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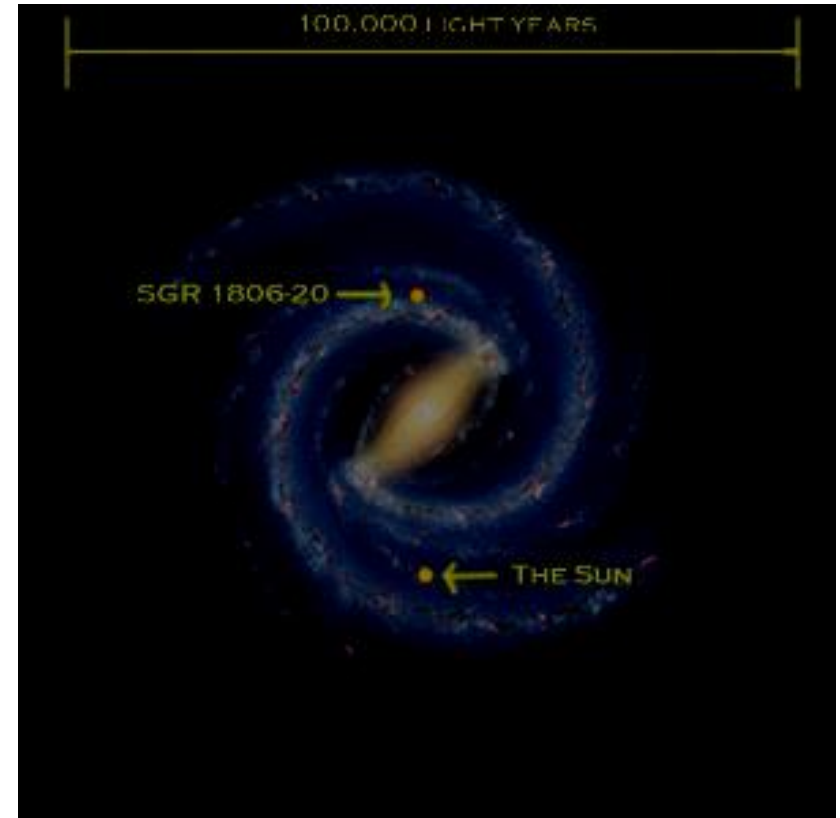
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http://blogs.discovermagazine.com/badastronomy/2009/12/27/
anniversary-of-a-cosmic-blast/#.V_OBS7UvBCU

Basic Info

- Discovered in 1979

- RA: 18.13h, Dec: $-20.40°$

- Most magnetized object discovered(B ~ 10^{15} G)

- Has undergone > 70 flares

- Hyperflare detected on Dec. 27/2004

- Both thermal and non-thermal emission detected

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Measured Spectra

- Nakagawa+ 2009 (*Suzaku*)
- Malkov+ 2005 (*INTEGRAL, XMM-Newton*)
- Boggs+ 2007 (*RHESSI*)
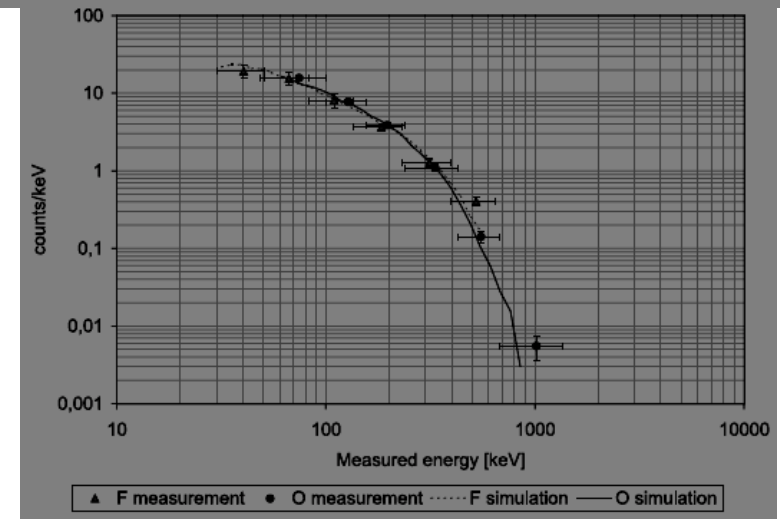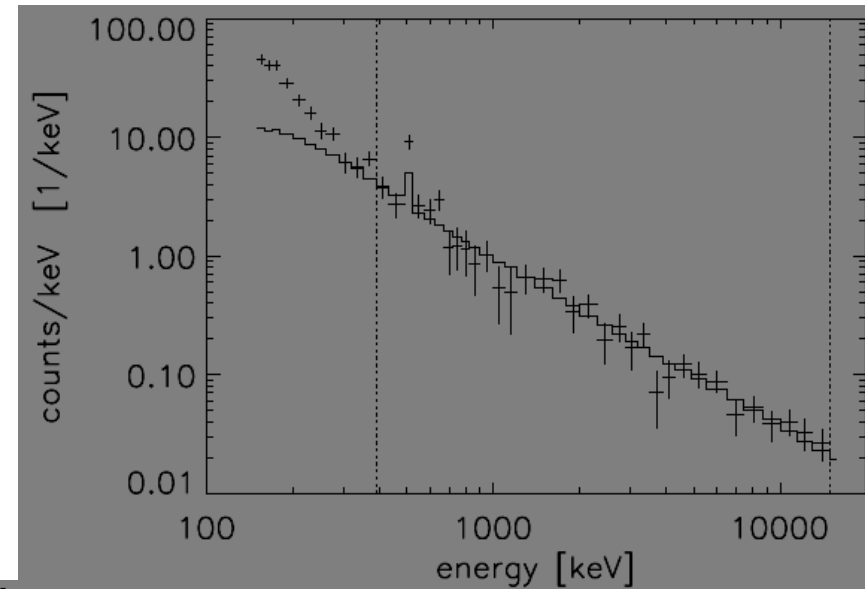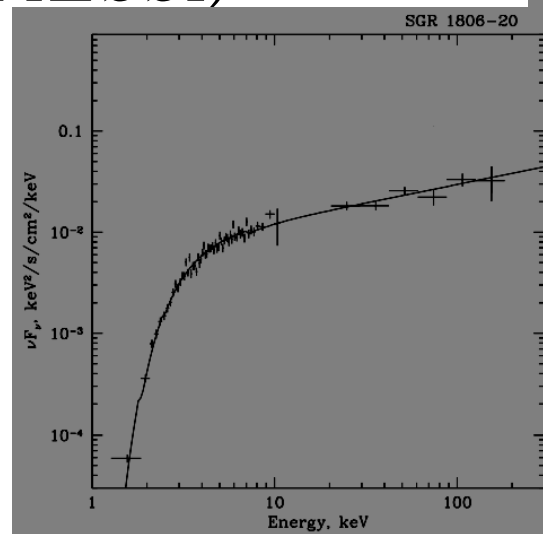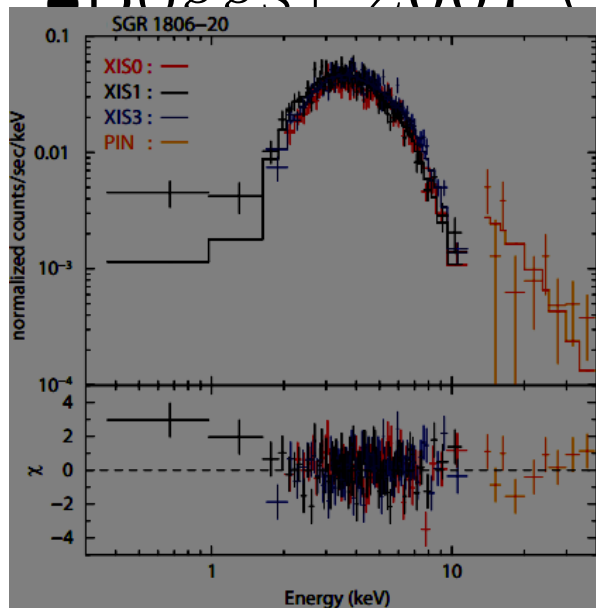
Project Idea

- Figure out what's causing non-thermal emission, electron acceleration

- Compare to fireball model (Thompson and Duncan)

- Long term goal: Determine role of magnetars in the excess production of positrons in cosmic rays

Heyl, J., Gill R., and Hernquist L.. "Cosmic rays from pulsars and magnetars." MNRAS 406.1 (2010): L25-L29.
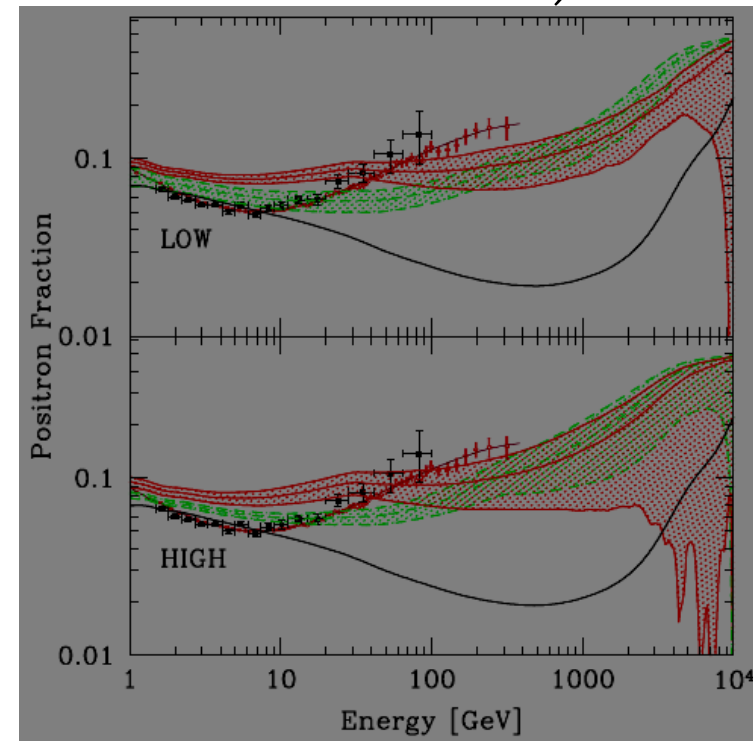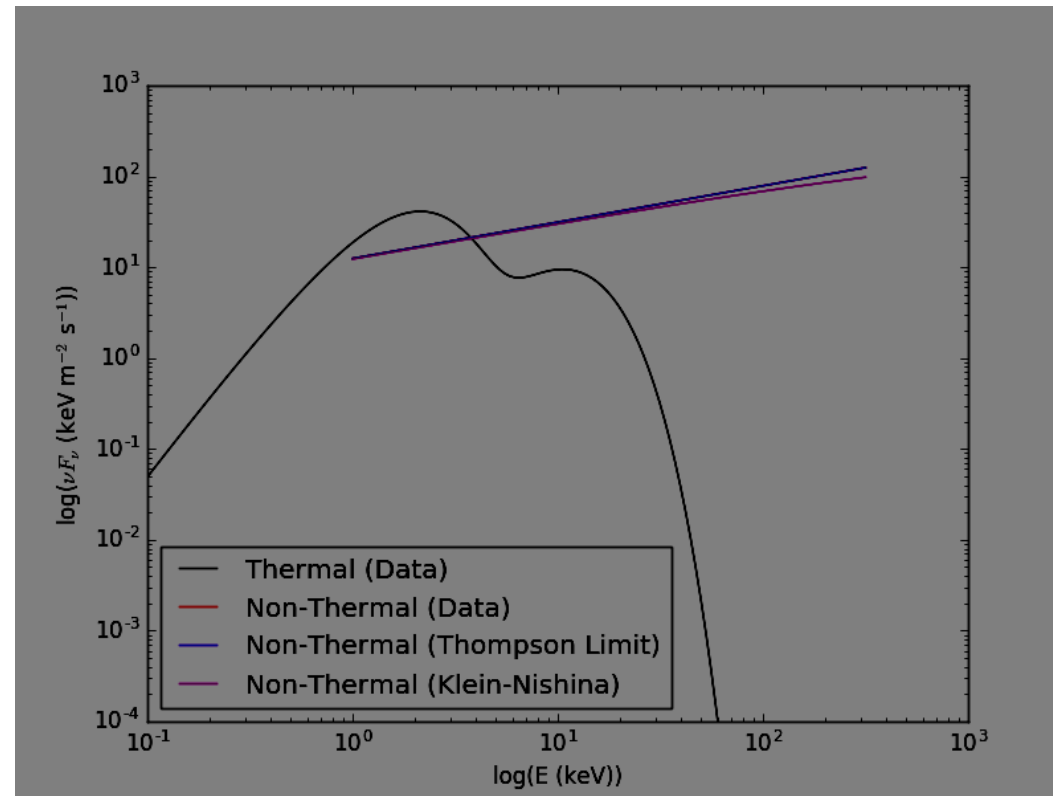
Quiescent ICS

● Calculate the electron distribution using ICS and the thermal/non-thermal data

● $N(E) = N_e \gamma^{-\Gamma}$
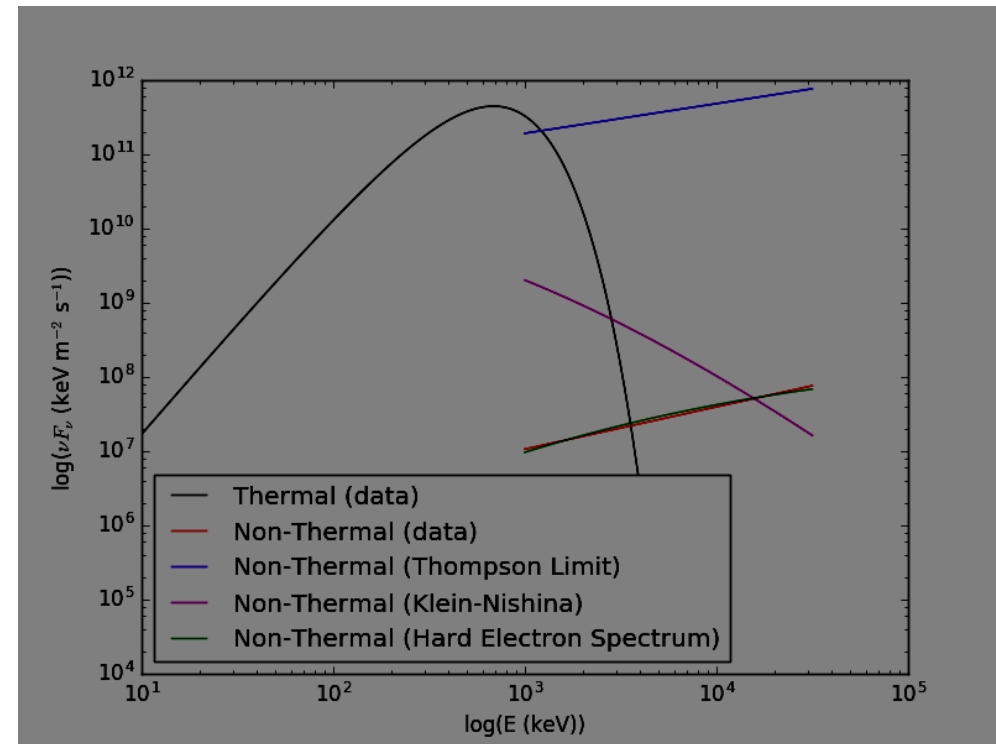$N_e = 8.56 \times 10^{27} \text{ m}^{-2}$
$\Gamma = 3.2$

● Adding KN makes factor of two difference at 200 keV

Flare ICS

- Use electrons from quiescence at first, non-thermal emission is soft

- e^- spectrum needs index 1.05 to fit – unphysical

- Cooling time in these situations is ~ 1 ms

- Conclusion: It isn't ICS

If not ICS, then:

- RICS
  - No. Cooling time is still too low (R/c).

- Synchotron
  - Maybe. Electron spectrum would have same index as Thompson ICS ($\sim$ 3), energetics need to be checked.
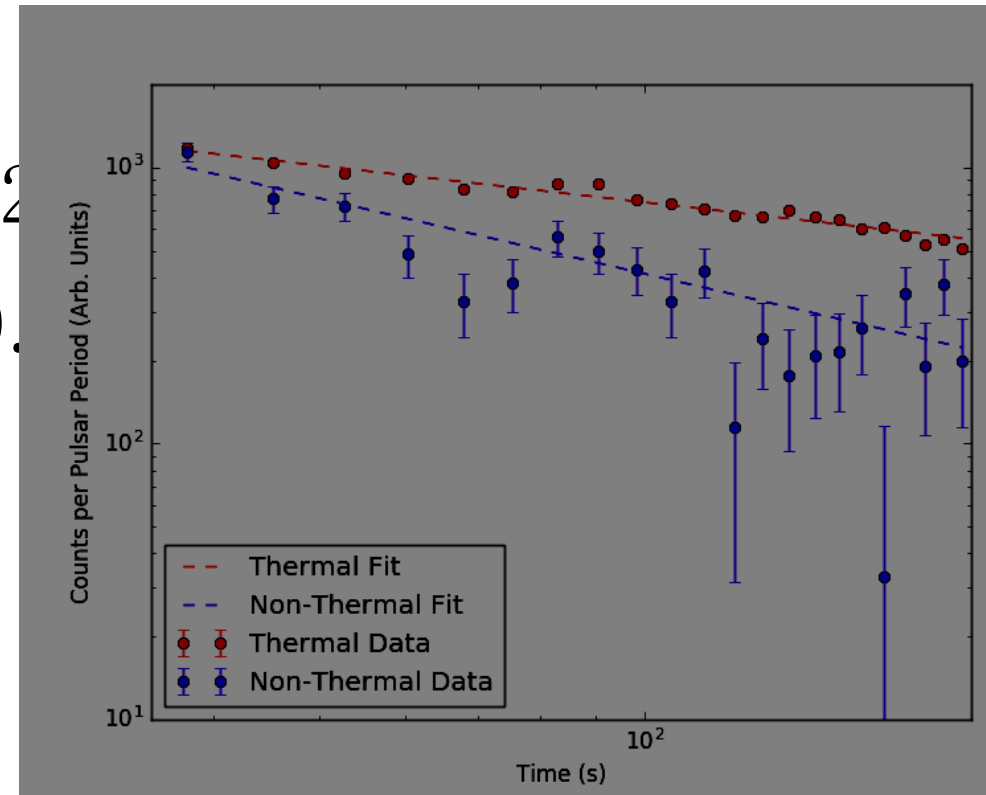
Timescale

- Power Law Index:
  - Thermal: -0.442 ± 0.002
  - Non-thermal: $-0.91 \pm 0.$
- Factor of two implies shock − seed photons and electrons decay at same rate (were accelerated together)

To do list:

- Test synchrotron
  - Spectral properties looks good, but is there enough energy?

- Put constraints on location
  - Cooling time should be able to constrain the electron location

- Examine Polarization (another paper)
  - In progress, but slow

Summary

- Non−thermal radiation from 2004 hyperflare
    - Not caused by ICS (not enough energy, too soft)
    - Likely synchrotron
- Thermal photons and electrons accelerated by a shock
- Still lots to be done on the hyperflare