THEORY OF THE PROMPT EMISSION

Davide Lazzati (NC State)

THE MODELS GUEST STARS

Synchrotron and Outflow composition friends

Photospheres

Dissipation mechanism

Inverse Compton Observations

=> Non-Thermal



GUEST STARS

Outflow composition

Dissipation mechanism

Observations
> Non-Therma

e.g., Kaneko et al. 2006

THE MODELS

Synchrotron and friends

Asano, Dai, Daigne, DL, Ghisellini, Granot, Liang, Medvedev, Meszaros, Mochkovitch, Petrosian, Piran, Rees, Sari, Zhang **Photospheres**

Inverse Compton



=> Non-Thermal

THE MODELS

Synchrotron and friends

Photospheres

Beloborodov, Daigne, DL, Giannios, Goodman, Meszaros, Mochkovitch, Pe'er, Rees, Thompson **Inverse Compton**



> Non-Thermal

THE MODELS

 Synchrotron and friends

Photospheres

Inverse Compton



=> Non-Thermal

Observational constraints

Integrated

Resolved

Ensemble

Ensemble Constraints



Liang et al. 2010 Ghirlanda et al. 2012

"Amati" correlation

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Amati et al. 2002 (and updates)

Flash simulations

16 M_0 , $θ_0$ =10°, Γ_0 =5, η=400, L=5x10⁵⁰ erg/s

Run for 500 s, out to 2.5x10¹³ cm=625 stellar radii

DL, Morsony, & Begelman See also Nagakura et al., Mizuta et al.



The jet's photosphere: staring into the abyss



The jet's photosphere: light curves



The jet's photosphere: "Amati" correlation



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The jet's photosphere: Lorentz factor



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The jet's photosphere: efficiency



The jet's photosphere: spectrum



The jet's photosphere: extreme frequencies



Take home bites

- SSM is all but discarded
- Photosphere is NOT a Planck Law!!!
- Photospheric emission with progenitor-induced sub-photospheric dissipation can reproduce Amati and Γ-E_{iso} correlations (parameter-free)
- Need to give-up the idea of an "emission radius". Same plasma producing radiation at different radii
- **Still need a convincing model for the low-v.**
- What about short GRBs?

Summary – the model that will make (almost) everyone happy

An accreting magnetar that collapses to a black hole. A B-B jet with $\sigma=1$ is enhanced by neutrino luminosity dissipates near the photosphere (with both IS, np collisions and **B** reconnection. Additinal IS follow and the rest of the **B** is dissipated in relativistically turbulent ES. Some low energy photons arise from the cocoon and via IC produce GeV. Additional GeV from B-ES.





Flash simulations



Two important effects: -The jet is collimated by the interaction with the star -Tangential collimation shocks dissipate and thermalize

cm (10¹¹)



I WANT TO BELIEVE

