A marginally fast-cooling proton-synchrotron model for prompt GRB emission

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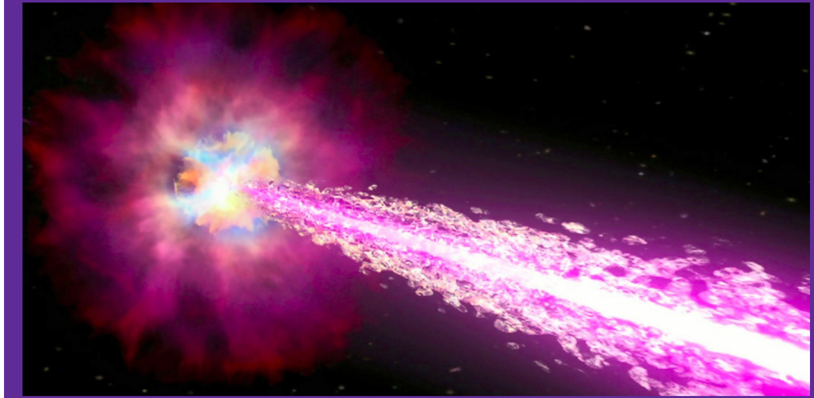

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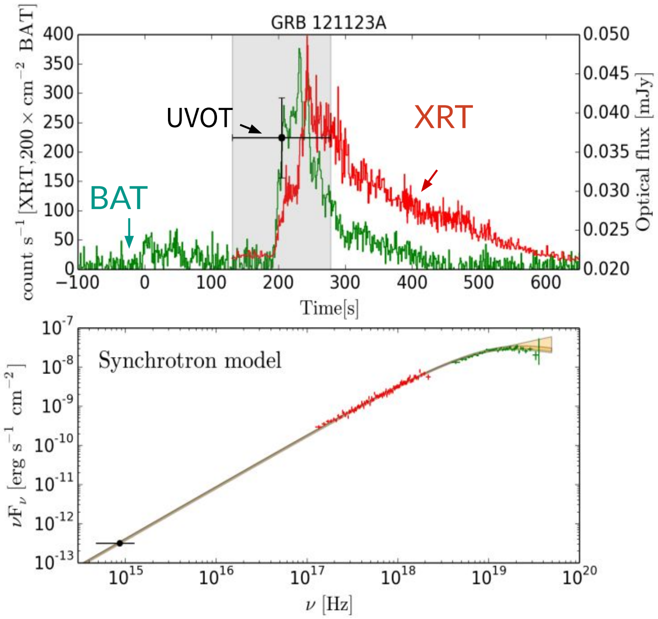
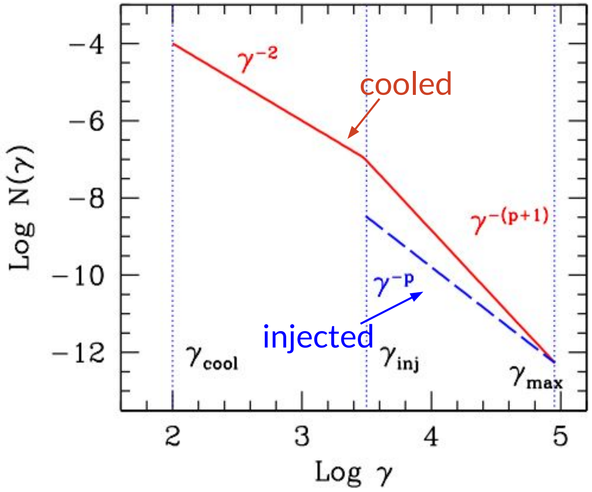
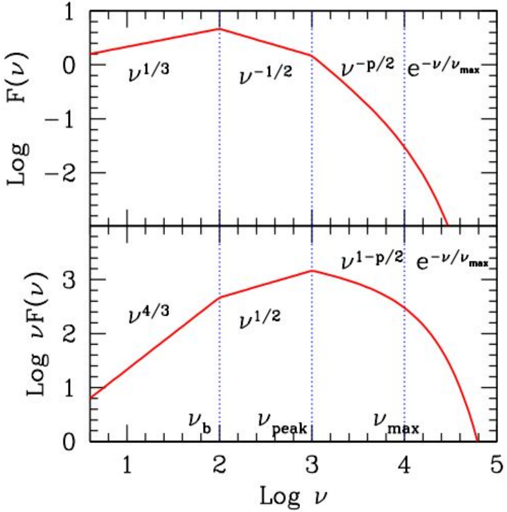
The marginally fast cooling synchrotron model



Oganesyan et al 2017,2019





Ghisellini et al 2020: Synchrotron radiation from marginally fast cooling electrons is able to reproduce the GRB if $R>10^{16}$ cm and $B<1$G ⟶ Avoid a strong self Compton emission (and thus a severe cooling).

$$t_{var} = \frac{R(1+z)}{2c\Gamma^2} \sim 17\, \frac{R_{16}(1+z)}{\Gamma_2^2}\ \mathrm{s}$$

What about hadrons?

Our goals!

- ➔ Check the proton synchrotron marginally cooling model
- ➔ Investigate how the GRB spectra are affected by the photo hadronic processes and γγ absorption
- ➔ Construct neutrino spectra

$$E_{\mathrm{pk,obs}} = \frac{m_e}{m_p}\frac{3qhB\gamma_m^2}{4\pi m_e c}\frac{\Gamma}{1+z}$$

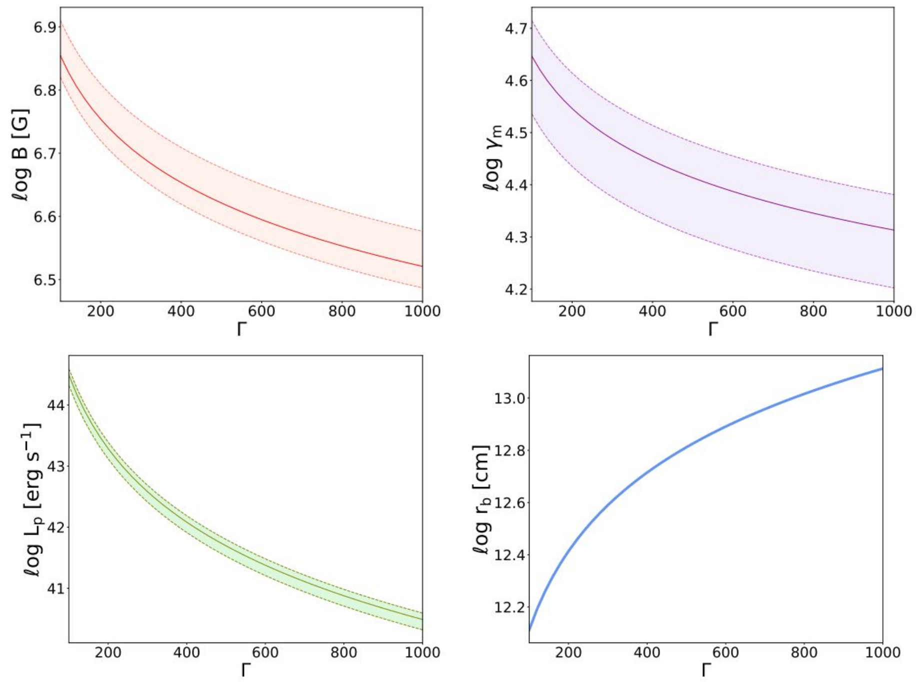
$$E_{\mathrm{c,obs}} = \left(\frac{m_p}{m_e}\right)^5 \frac{27\pi q h m_e c(1+z)}{\sigma_T^2 B^3 t_{\gamma,\mathrm{obs}}^2 \Gamma(1+Y)^2}$$

$$t_{\gamma,\mathrm{obs}} = \frac{R_\gamma(1+z)}{c\Gamma^2},$$

$$E_{\mathrm{pk,obs}} = \left(\frac{\gamma_m}{\gamma_c}\right)^2 E_{\mathrm{c,obs}}.$$

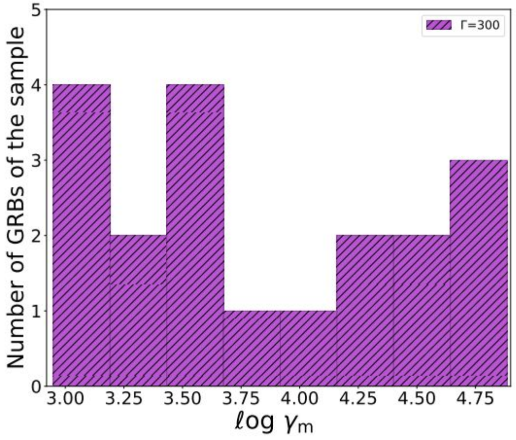
$$F_\gamma = F_c \nu_c \left(\frac{3}{4} + 2\left(\sqrt{\frac{\nu_m}{\nu_c}} - 1\right) + \frac{2}{p-2}\sqrt{\frac{\nu_m}{\nu_c}}\right).$$

GRB 061121

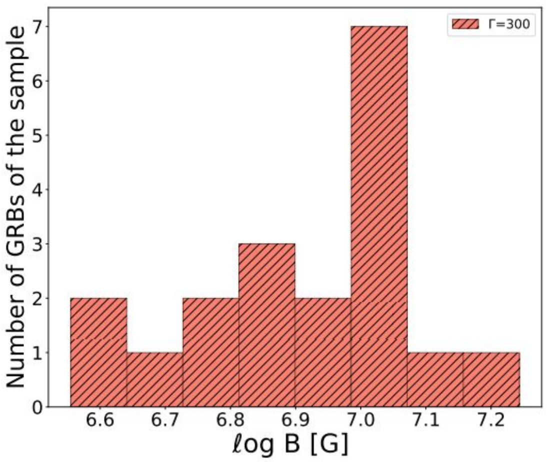


Parameters in case of the proton synchrotron scenario

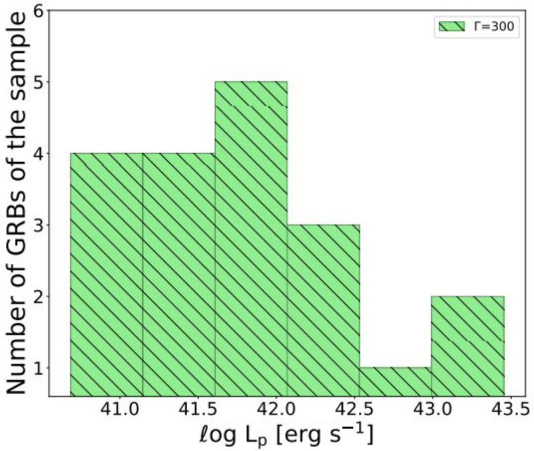
Minimum proton Lorentz factor



Comoving magnetic field



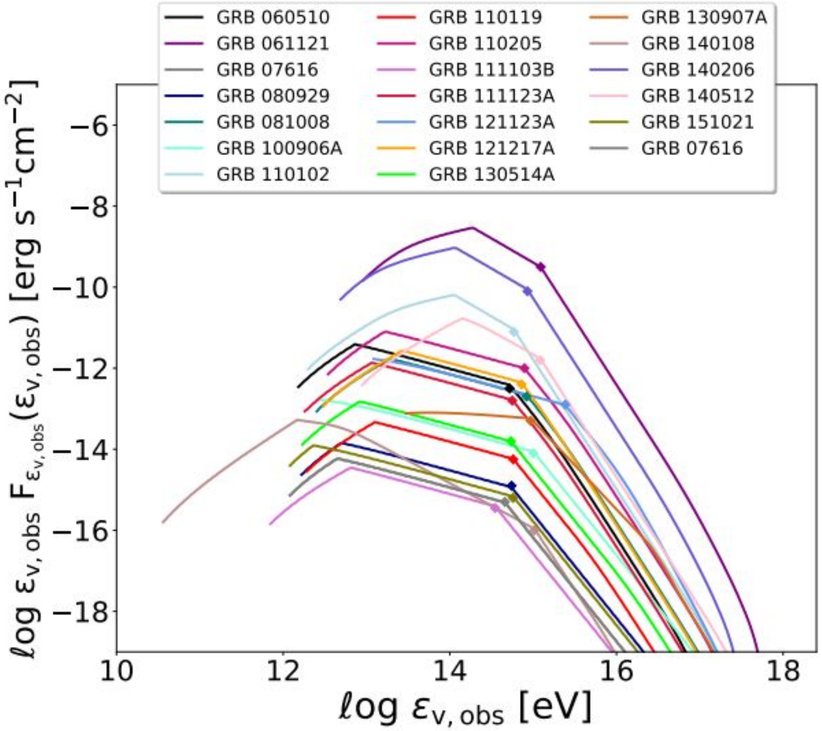
Injected proton luminosity



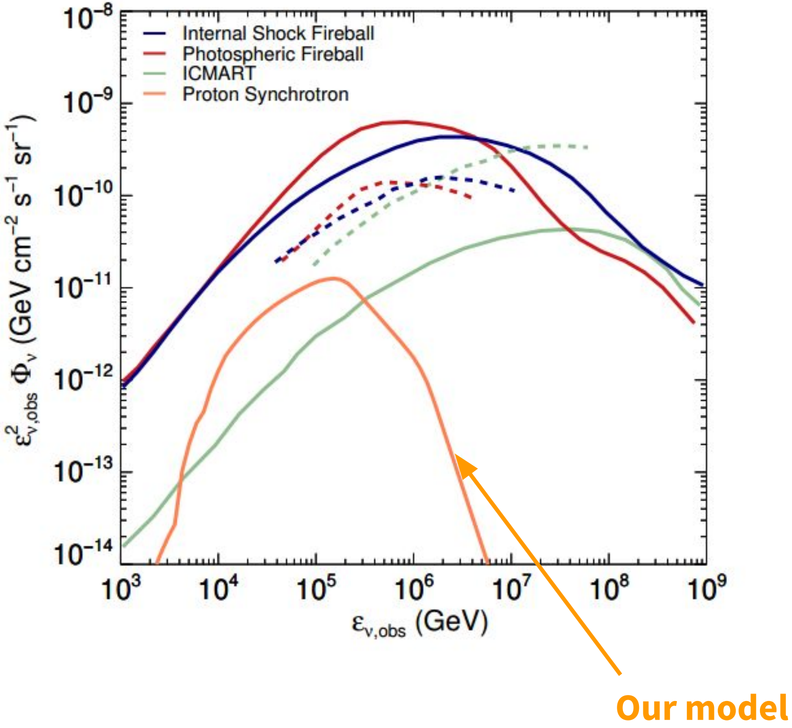
Florou et al 2021 MNRAS https://doi.org/10.1093/mnras/stab1285

Analytical neutrino spectra calculation

All flavour neutrino flux



All flavour quasi diffuse neutrino flux



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Numerical investigation: the role of pγ and γγ processes

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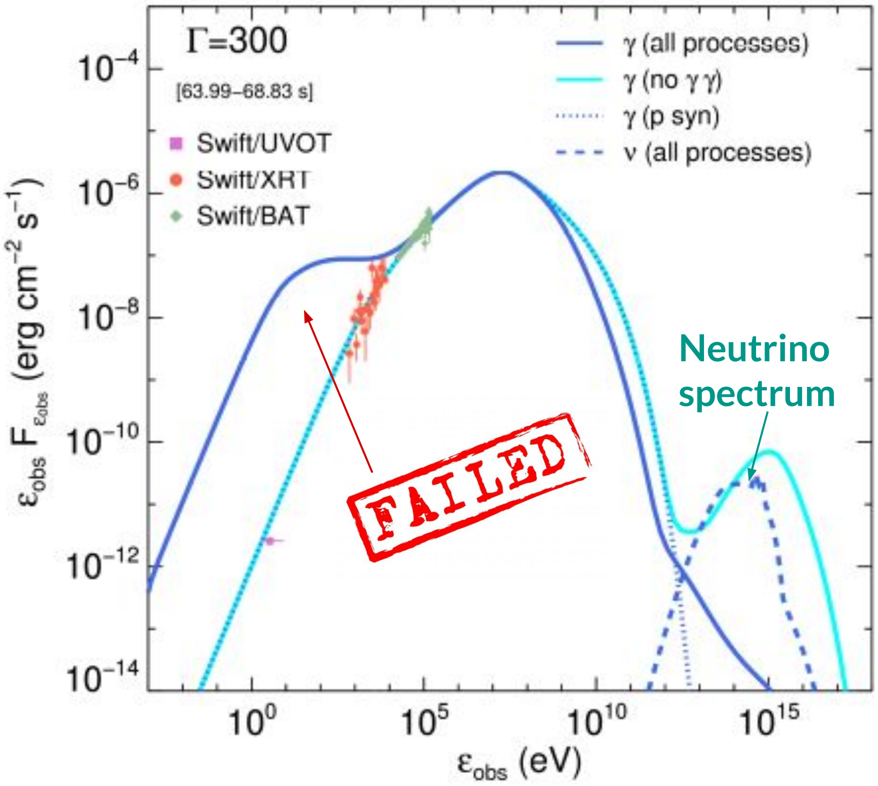

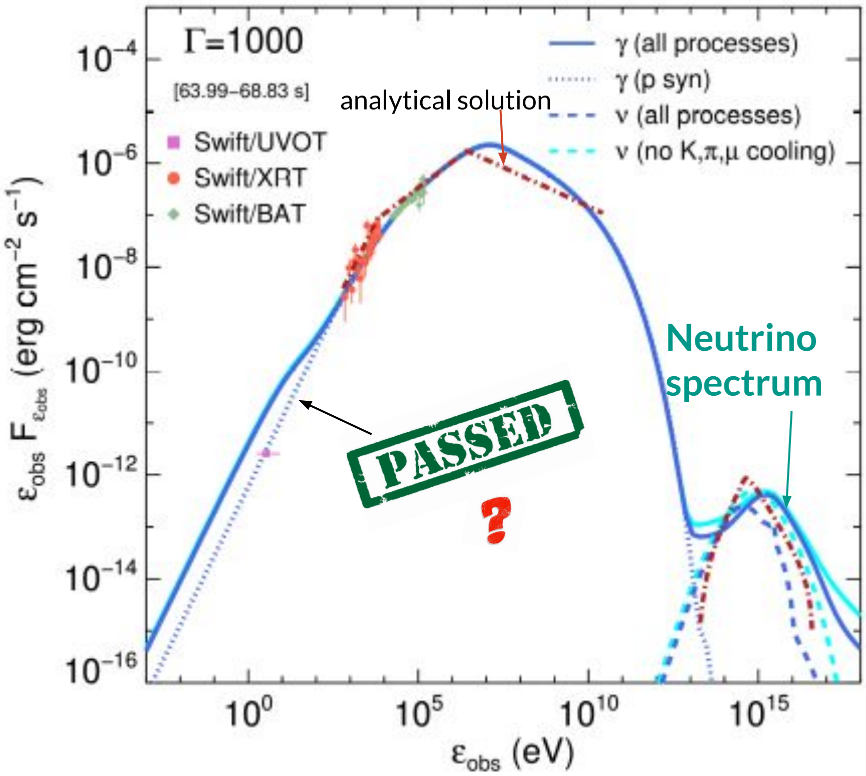

Code Atheva (Dimitrakoudis et al 2012)

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Conclusions

Did we “kill” the model?

- Observations and numerical solutions only in agreement for $\Gamma>1000$
- Extremely high Poynting Luminosity (~10^56 erg/sec)

➢ Diffuse neutrino flux not following the standard models.

Future work: Re-address the electro-synchrotron marginally fast cooling scenario

Thank you for your attention!!

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