Neutrino predictions from choked GRBs and comparison with the observed cosmic diffuse neutrino flux

A. Zegarelli, M. Fasano, S. Celli, D. Guetta, A. Capone, I. Di Palma

angela.zegarelli@roma1.infn.it



Abstract

The strong constraints from the Fermi-LAT data to the isotropic gamma-ray background suggest that the neutrinos observed by IceCube might come from sources that are hidden to gamma-ray observations. A possibility discussed in recent years is that neutrinos may come from jets of collapsing massive stars which fail to break out of the stellar envelope, and for this reason they are known as choked jets, or choked Gamma-Ray Bursts (GRBs). We here show the recent results of our simulations concerning the neutrino flux and spectrum expected from these sources, focusing on Type II Supernovae. To this extent, we performed detailed Monte Carlo computations of py interactions accounting for all the neutrino production channels and scattering angles. We provide predictions of expected event rates for ANTARES, IceCube, and the next generation neutrino telescope KM3NeT. We also compute the contribution of the choked GRB population to the diffuse astrophysical neutrino flux, providing constraints to the local rate of this source population as to reproduce the observed neutrino flux.

See here our

Type II Supernova explosion



Choked GRBs

<u>*Hypothesis*</u>: Type II Supernovae accompanied by a Gamma-Ray Burst (GRB)-like outflow that does not escape the progenitor star in the collapsar scenario \rightarrow GRB transfers most of its own energy to the stellar layers where it is moving \rightarrow There is not enough left for the GRB to break through [1] \rightarrow failed jets



- No gamma-ray emission
- **Potential emitters of neutrinos**



IceCube \rightarrow all-flavor cosmic neutrino flux may be as large as 10^{-7} GeV cm⁻² s⁻¹ sr⁻¹ around 30 TeV [2].

Fermi \rightarrow isotropic diffuse gamma-ray emission from neutrino sources is much weaker than one would expect based on the IceCube neutrino observation [3].



[1] P. Meszaros and E. Waxman, Phys. Rev. Lett. 87 (2001) 171102 [2] M. G. Aartsen et al. (IceCube Collaboration), Astrophys. J. 809 (2015) 98 [3] M. Ackermann et al. (Fermi LAT Collaboration), Astrophys.J. 799 (2015), 86

Expected number of events induced by v_{μ} from an individual choked GRB

If $\mathbf{E}_{\mathbf{p},\mathbf{iet}}$ is decreased, the local rate of choked GRBs has

to increase in order to reproduce the IceCube data.