

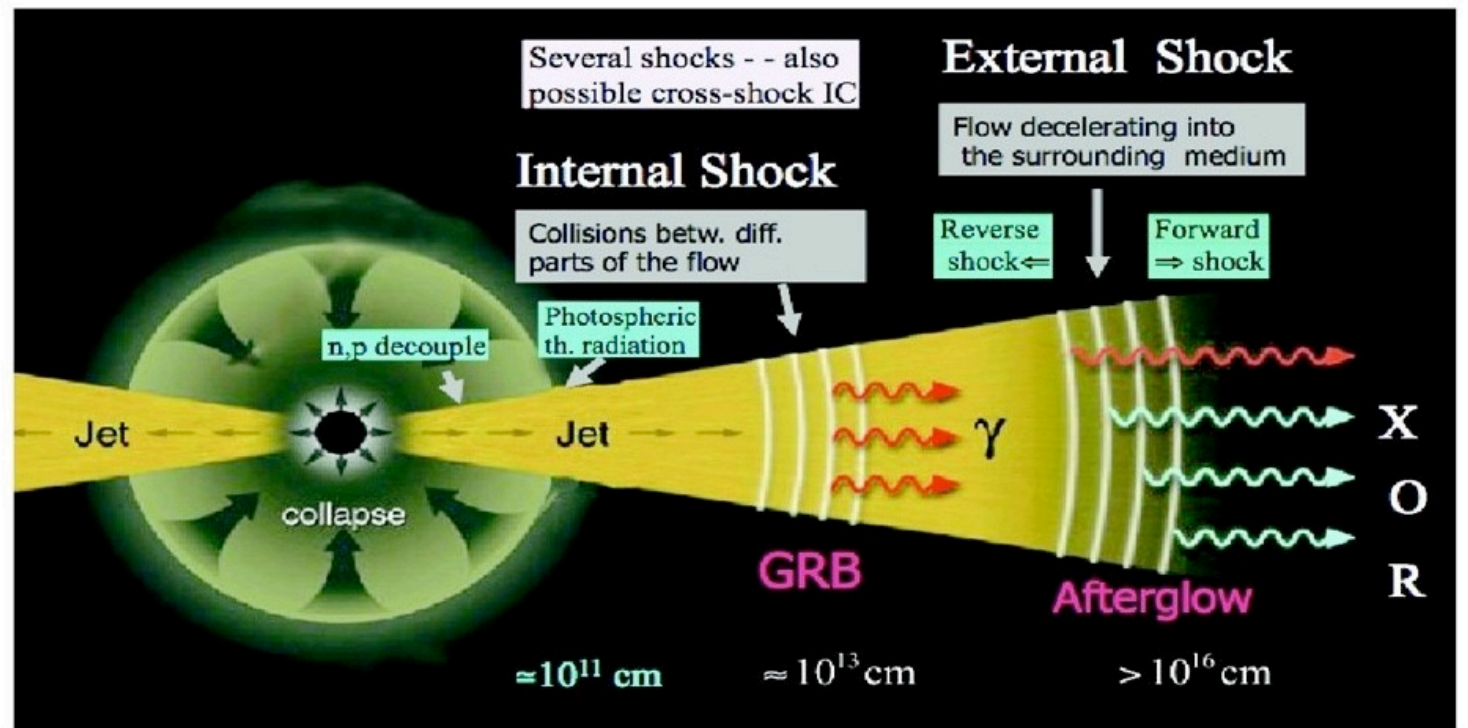
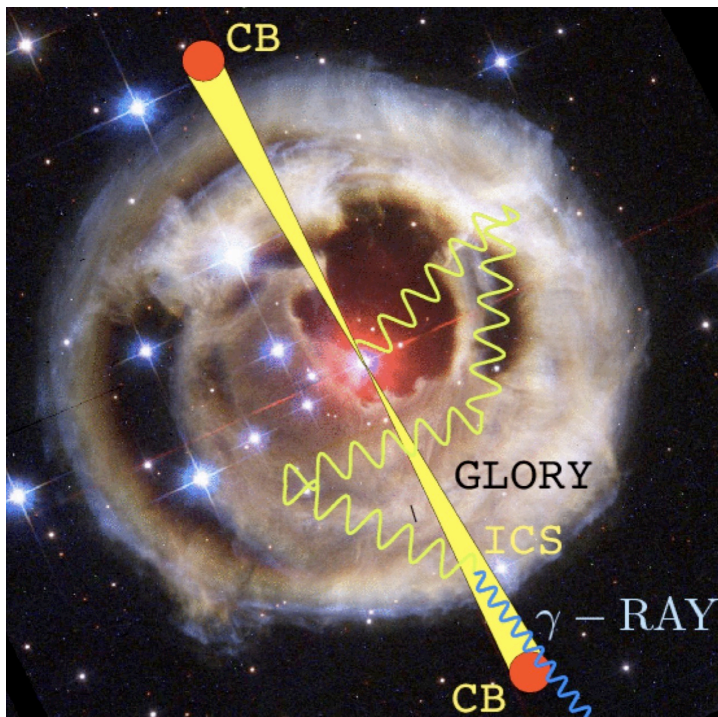
Main Contributions of DD & DDD To High Energy Astrophysics:

(DD=Dar & De R'ujula DDD=Dado, Dar & De R'ujula)

Unified Theory of the Origin and Production Mechanism of: Gamma Ray Bursts (GRBs), High Energy Cosmic Rays (CRs) and the "Missing" High Energy GRB Neutrinos (NUs)

DD: Cannon Ball (CB) Model of GRBs

Failed Fireball / Fire cone Models (e.g., Meszaros & Rees), etc, etc,



DD(2000): the CB Model yield:

$$E_p(\text{GRB}) \sim A (E_{\text{iso}})^k$$

$$k \sim (1/3 + 1/4)/2 \sim 0.417$$

Amati et al. (2002): Observations yield:

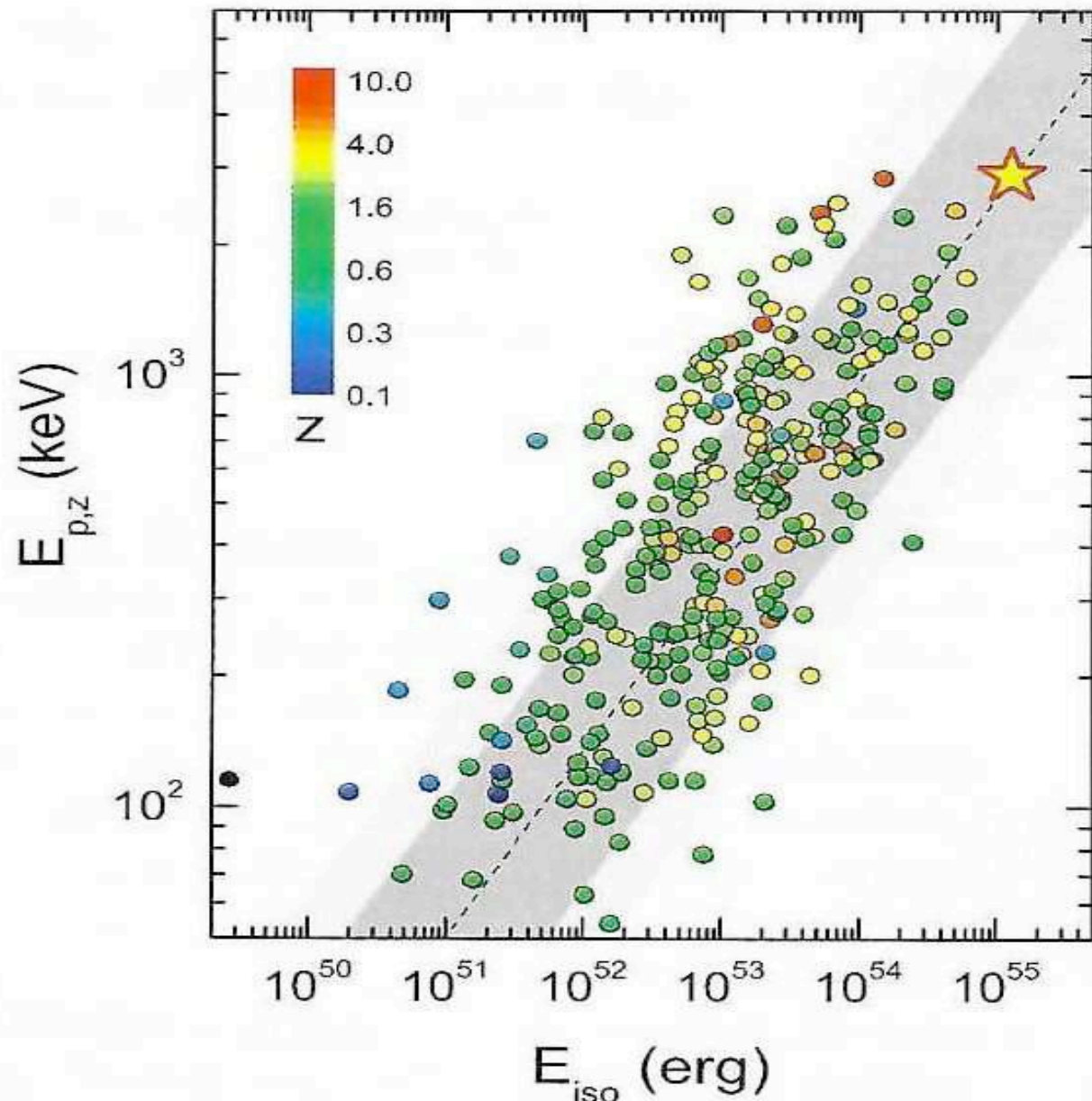
$$E_p(\text{GRB}) \sim A (E_{\text{iso}})^k$$

$$k = (0.52 \pm 0.06)$$

Konus-Wind collaboration (2023):

315 long GRBs with known redshift, including the “brightest of all time” GRB 221009 (★), yield $k=0.42$,

ICS of its SN glory & max $E_p \Rightarrow$ max Lorentz factor of CBs $\sim 10^3$

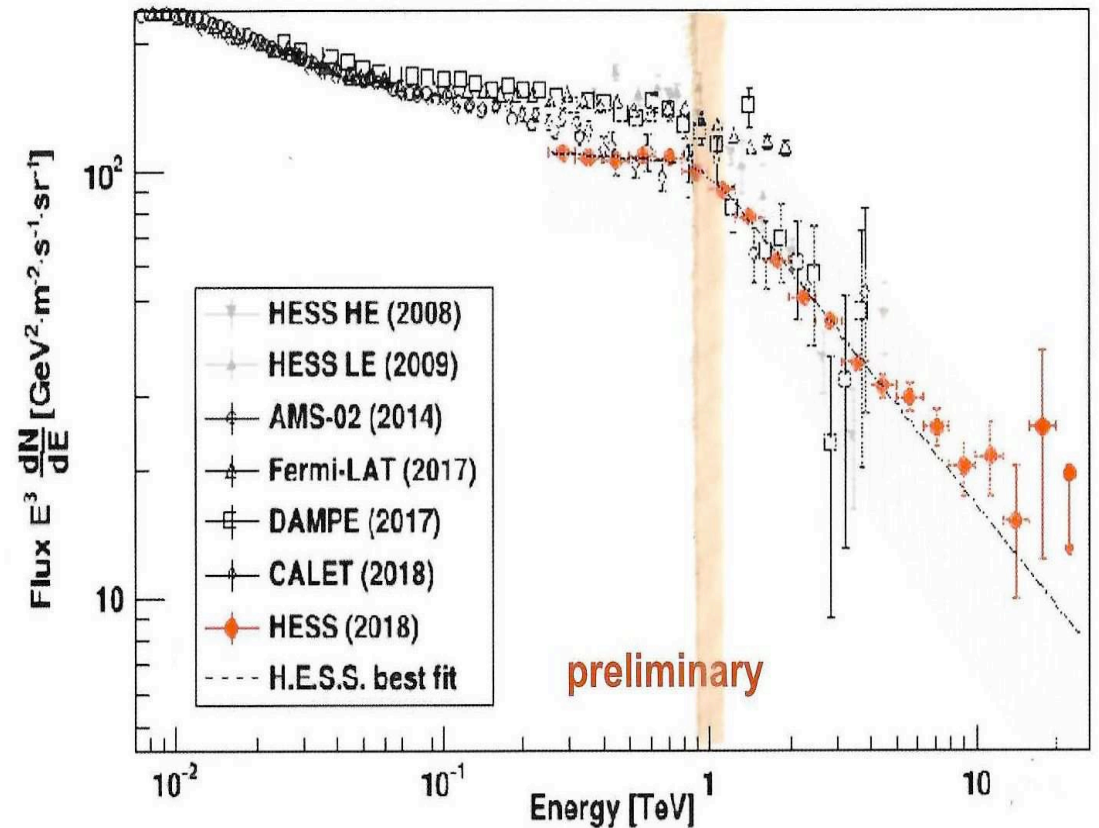
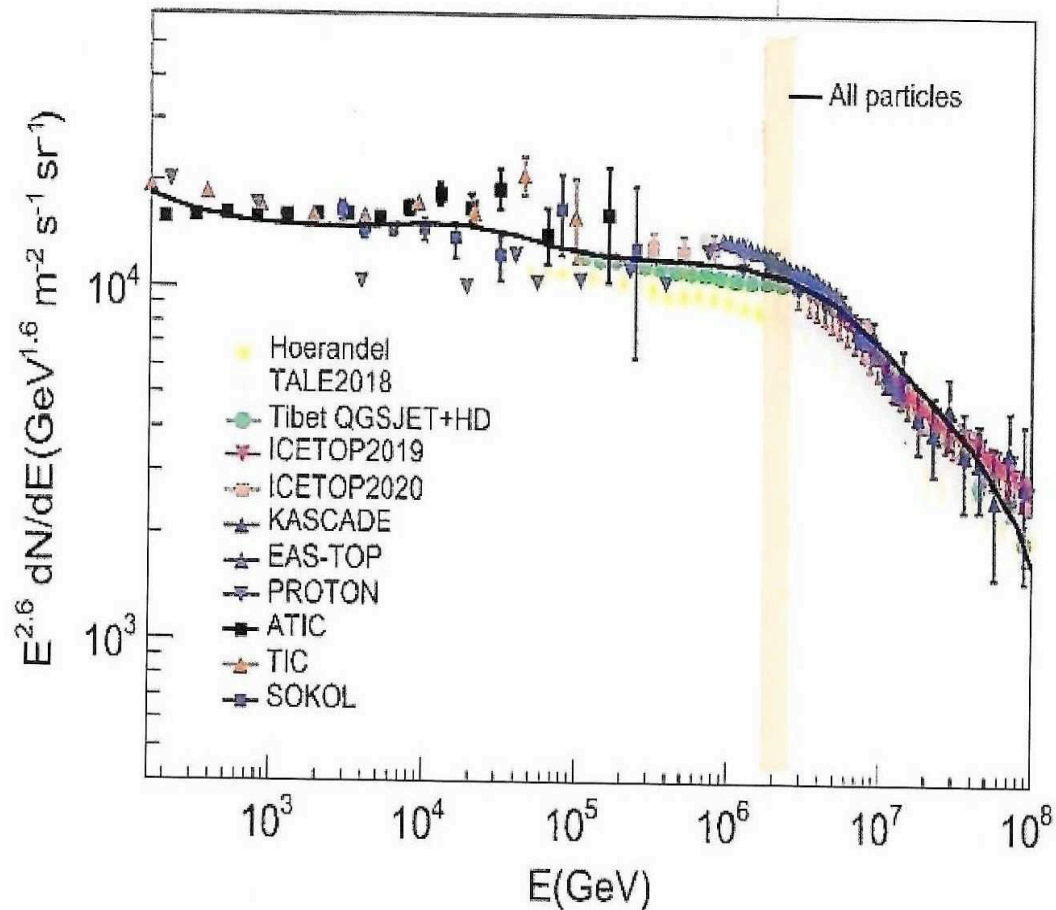


DD 2006: GRBs Are The Main Source Of High Energy Cosmic Rays

Konus Wind 2022: $\max((1+z)E_p) \text{ of GRBs} = (1+z) E_p \text{ of GRB221009} = 3.5 \text{ MeV}$

→ $E \text{ knee}(p) \sim 2 \text{ PeV}$,

→ $E \text{ knee}(e) \sim \text{TeV}$



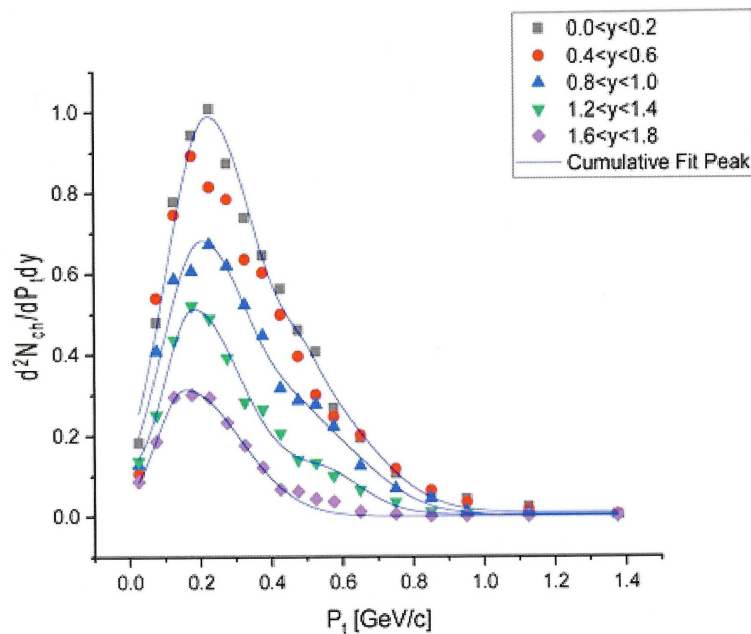
Where Are The HIGH ENERGY GRB NEUTRINOS ?

SNeIc Launch Narrow Jets of CBs which produce a narrow beam of HE CRs.
CR Collisions with ISM Nuclei Produce Very Narrow Beam of HE Neutrinos.

$pp \rightarrow$ mesons \rightarrow neutrinos with $\langle p_T \rangle \sim 0.2$ GeV independent of $E(p)$!

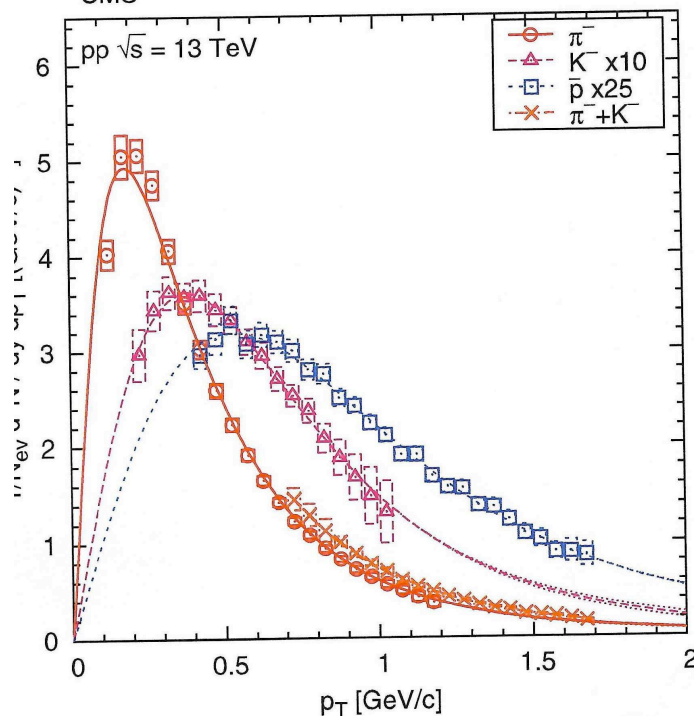
ISR

pp sqrt (s) = 6.3 GeV



CMS

pp \sqrt{s} = 13 TeV



CMS

pp \sqrt{s} = 13 TeV

