Search for low-energy neutrino from the GRB on the BUST

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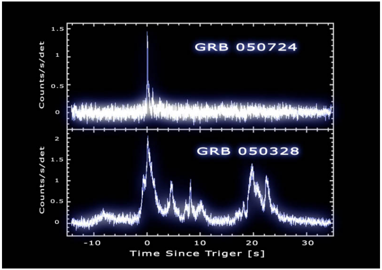
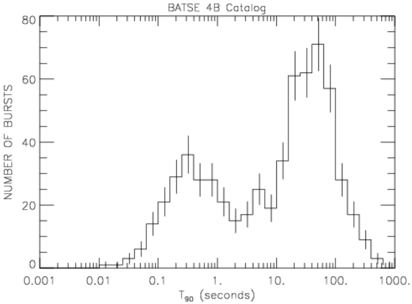
Outlook

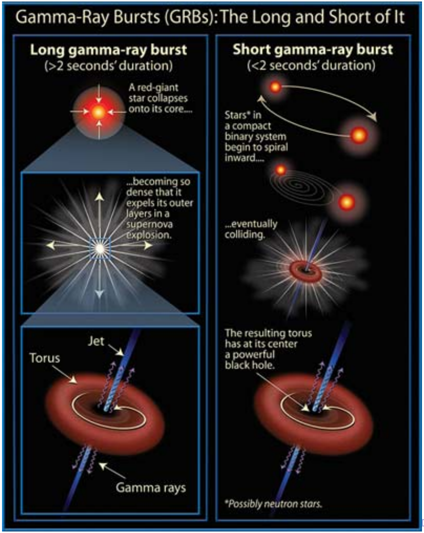
Gamma-Ray Bursts

- First reported by Klebesadel, Strong & Olson (1973);
- Equivalent isotropic energy $\simeq 10^{51}$-10^{54} erg (Bloom et al. 2001);
- Observations to date of temporal duration and spectral hardness ratios confirm a bimodal distribution for GRB





Popular Models for GRB Origins



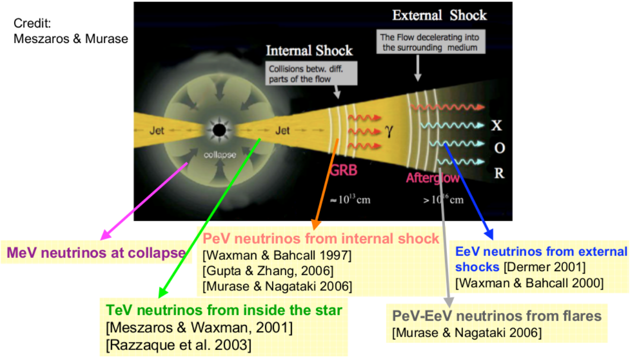
Questions

- The means by which gamma-ray bursts convert energy into radiation poorly understood.
- There is no accepted model for how this conversion occurs.
- Not completely interpreted the physical process for generating an emission of gamma rays which matches the durations, light spectra, and other characteristics of observed GRBs.
- ...

Neutrino from GRB

GRBs as sources of high-energy neutrinos

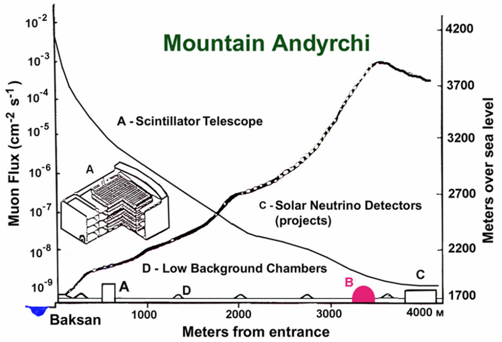
Fireball model for long GRBs:

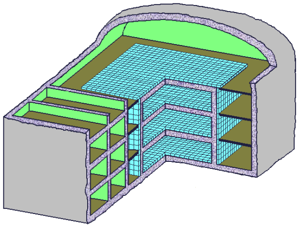


Credit: M.Kowalski "Neutrinos, GRBs and IceCube", 2007

Baksan Underground Scintillation Telescope
location

- North Caucasus, mt. Andyrchy (N43.3°, E42.7°)
- Effective depth 850 m.w.e.

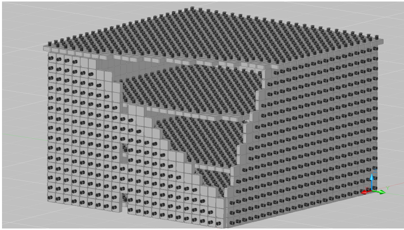




Baksan Underground Scintillation Telescope

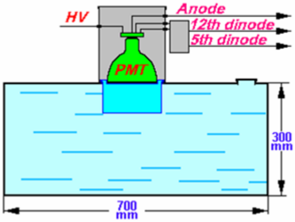
overview

- total number of detectors 3186;
- dimensions 17x17x11 m^3;
- 8 planes (5 external, 3 inner);
- angular resolution $\simeq 2^\circ$;
- total mass of target 0.33 kt.



Baksan Underground Scintillation Telescope

standard scintillation detector

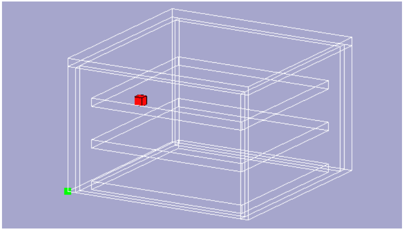


- aluminium tank 0.7x0.7x0.3 m^3;
- PMT: FEU-49B;
- on white spirit based scintillator (C_nH_{2n+2}, n $\simeq$ 9);
- operating threshold of pulse channel $\simeq$ 8 MeV;
- time resolution 5 ns.

Method

Mean reactions:

- $^{12}C(\nu, e)^{12}N$
- $^{12}C(\tilde{\nu}, e^{+})^{12}B$
- ...



Background:

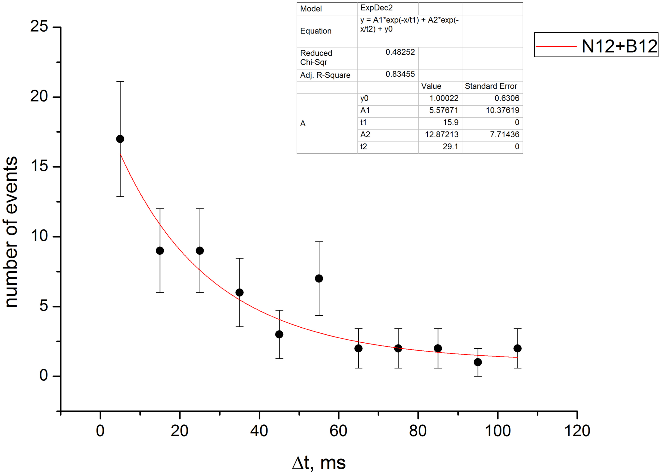
- $^{12}C(n, p)^{12}B$
- $^{13}C(n, p)^{13}B$
- $^{12}C(\mu^{-}, \nu_{\mu})^{12}B$
- ...

Data selection conditions

- "double events" - two single events from the same detector of BUST with clean prehistory and with time interval between them Δt $\leq$ 150 ms (5 lifetimes of ^{12}N);
- energy of secondary event less then max. decay energy of ^{12}N;

Background research

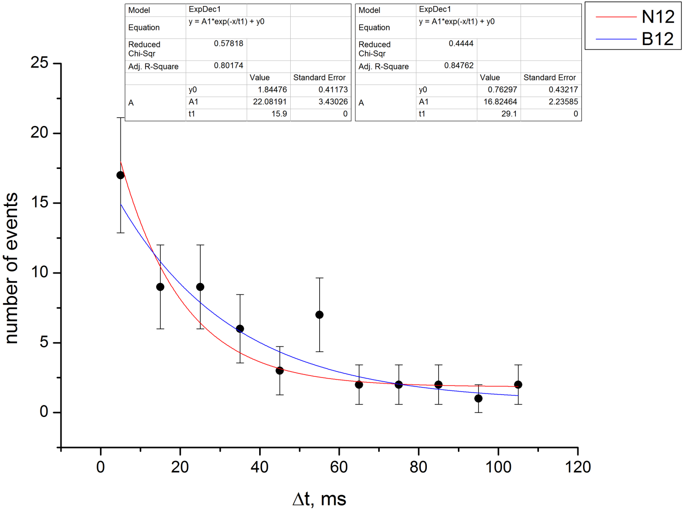
Distribution of events by time interval in comparison with decay curve



Model	ExpDec2		
Equation	y = A1*exp(-x/t1) + A2*exp(-x/t2) + y0		
Reduced Chi-Sqr	0.48252		
Adj. R-Square	0.83455		
		Value	Standard Error
A	y0	1.00022	0.6306
	A1	5.57671	10.37619
	t1	15.9	0
	A2	12.87213	7.71436
	t2	29.1	0

Background research

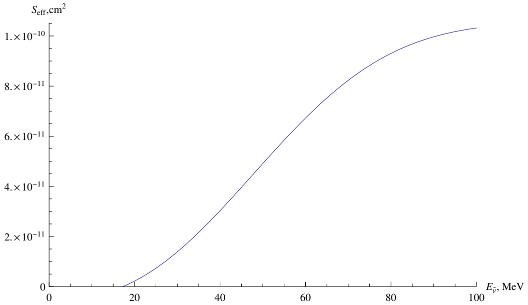
Distribution of events by time interval in comparison with decay curves



Effective area

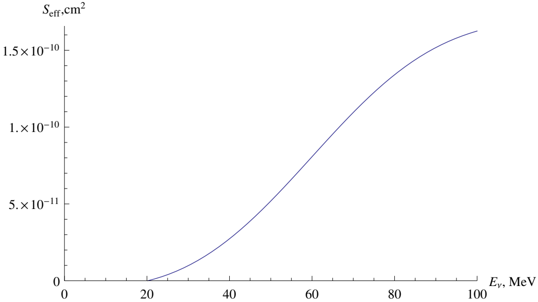
for ν flux

$$S_{eff}(E) = \sigma(E) \cdot W \cdot n \cdot (1 - e^{-\frac{t}{\tau}})$$



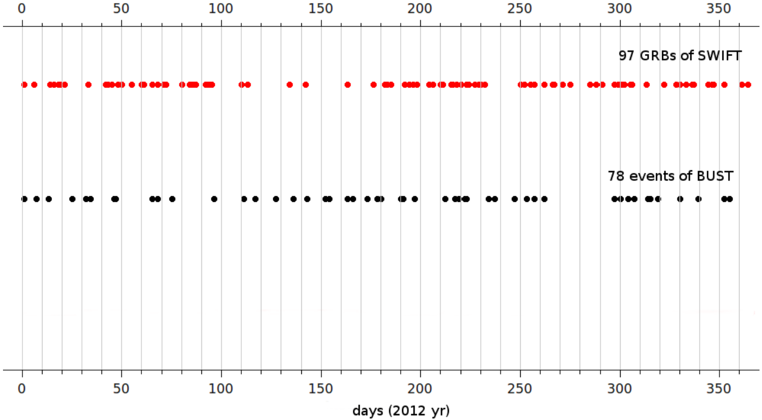
$$\nu +^{12} C \rightarrow e^{+} +^{12} N$$

Effective area
for $\widetilde{\nu}$ flux



$$\widetilde{\nu} + ^{12}C \rightarrow e^{-} + ^{12}B$$

Neutrino candidate event selection



BUST data and GRBs on the time scale

Summary

Our preliminary results show:

- for BUST database during 2012 year no signal coincidence with Gamma-Ray Burst was detected;
- presented data only for one years (2012 yr.);
- in future we will continue treatment of our data for full time of BUST measurements (from 1980 - ...)

Thank you very much!