Mem. S.A.It. Vol. 81, 440

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An apparent GRBs evolution around us or a sampling of thin GRB beaming jets?

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Abstract. The gamma ray burst *apparent average isotropic* power versus their red-shift of all known GRB (Sept. 2009) is reported. It calls for an unrealistic Gamma Ray Burst Evolution around us or it just probe the need of a very thin gamma precession-jet model. These precessing and spinning γ jet are originated by Inverse Compton and-or Synchrotron Radiation at pulsars or micro-quasars sources, by ultra-relativistic electrons. These Jets are most powerful at Supernova birth, blazing, once on axis, to us and flashing GRB detector. The trembling of the thin jet (spinning, precessing, bent by magnetic fields) explains naturally the observed erratic multi-explosive structure of different GRBs, as well as its rare re-brightening. The jets are precessing (by binary companion or inner disk asymmetry) and decaying by power law $\frac{t_o}{t}$ on time scales t_o a few hours. GRB blazing occurs inside the observer cone of view only a seconds duration times; because relativistic synchrotron (or IC) laws the jet angle is thinner in gamma but wider in X band. Its apparent brightening is so well correlated with its hardness (The Amati correlation). This explain the wider and longer X GRB afterglow duration and the (not so much) rare presence of X-ray precursors well before the apparent main GRB explosion. The jet lepton maybe originated by an inner primary hadron core (as well as pions and muons secondary Jets). The EGRET, AGILE and Fermi few hardest and late GeV gamma might be PeV neutron beta decay in flight observed in-axis under a relativistic shrinkage.

Key words. Jets – Gamma-ray bursts – Cosmology

1. Introduction

The well probed Super-novae-GRBs connection since 1998 naturally require a thin beaming whose softer external cone (as for nearest GRB980425) is explaining the huge diversity between spherical SN output and apparent coexisting GRB. Last and nearest GRB-XRF 080109 has been an exceptional lesson on GRB nature. Its lowest output maybe understood as the external tail of GRB jet. It also calls for a huge population of such SN-XRF in far Universe, undetected because below the present Swift,Fermi threshold. After a decade (since 25 April 08) we know by sure that Supernovae may often contain a Jet. Its persistent activity may shine on axis as a GRBs. Such a persistent, thin beamed gamma jet may be powered by either a BH (Black Holes) or Pulsars. Late stages of these jets may loose the SN traces and appear as a short GRB or a long

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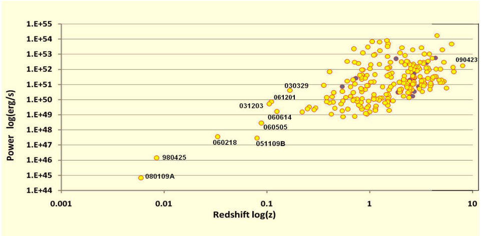

Fig. 1. The GRB X-ray luminosity updated to September 2009. The Luminosity vs red-shift law in a quadratic power, is mostly due (in lower regions) to the quadratic distance cut-off and (in higher regions) to the rarer beaming in axis occurring mostly by largest samples and cosmic volumes. The spread of nearly ten order of magnitude in luminosity (iso) calls for a thin (0.001 – 0.0001 rad and micro-nano-sr solid angle) beams. The new events 2009 are marked by a gray dots. The key events are with their name label.

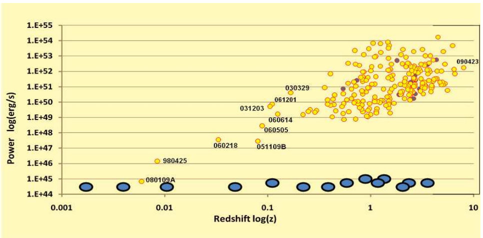

Fig. 2. The GRB gamma and X-ray luminosity updated to September 2009. The Luminosity vs red-shift observed for an imaginary standard candle Supernova isotropic explosions (circled rings below). They differ from the *apparent wide spread populations* of GRBs

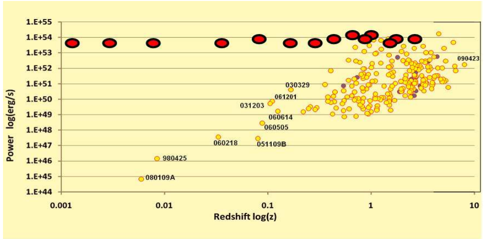

Fig. 3. As above the hypothetical GRB Fireball (isotropic) Luminosity vs red-shift strongly in disagreement to the observed GRB one.

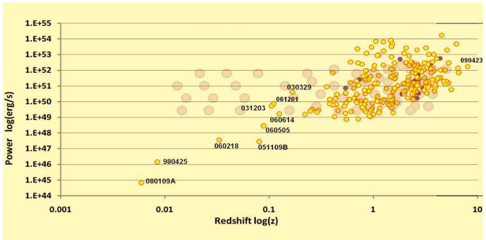

Fig. 4. As above an hypothetical (popular) GRB Jet-Fountain Fireball (Jet 0.001 sr solid cone), one shoot. The events are overlap on the record of data. The luminosity vs red-shift is partially in agreement (an illusion of success) only for redshift above unity, but it is still in strong disagreement with the observed GRB luminosity at nearest ($z << 1$) distances.

orphan GRB (depending on jet angular velocity and view angle). XRF are peripheries viewing of the same GRB inner jets.

2. Actual unresolved GRB puzzles

GRBs understanding (for Fireball one shoot models) is still an open challenge; many questions need to be answered. The total energy output spans more than 8 order of magnitude (see Fargion, 1999), with the most powerful and variable events residing at the cosmic edges (see Yonetoku et al., 2004), see Figure.(1-4). This is apparently contrary to any reasonable Hubble law (see Fargion, 1999). GRBs peak energy follow the so-called Amati correlation (see Amati et al., 2002; Amati, 2006). It has not a great cosmic meaning, but it simply correlate the geometry beaming and the relativistic inner harder spectra. The most far ones are more abundant and more of them are better beamed and more *apparently* hard and bright. This *law* holds also within a single GRB event, between peak and peak activity while the jet, spinning and precessing, is bent in and out the target (our Earth). When the jet is more aligned to the observer the apparent luminosity and hardness increase. There is another (somehow comparable) relation regarding the total energy emitted versus redshift, which is far from being negligible, but it is less compelling because it combine the whole event history. Moreover power is a relativistic invariant.The energy is not.

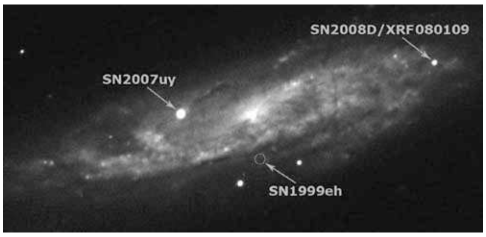

Fig. 5. The rare NGC 2770 twice SN within a week time: the XRF080109-SN2008D has deep meaning even for most sceptic theorist

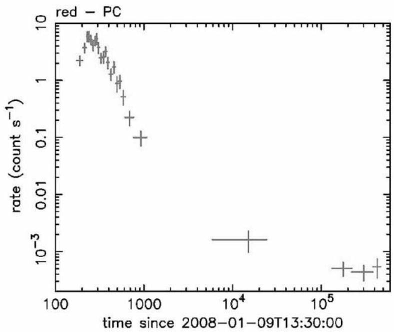

Fig. 6. The above long XRF luminosity imply a new object or just a SN-GRB jet whose precessing is observed much off-axis, nearly at widest angle

Why the average GRB power is not a constant but it is a growing function (almost quadratic) of the red-shift? Only a very few events are located in local universe, at lower redshift (40-150 Mpc: just a part over a million of cosmic space), such GRB980425 at $z = 0.008$ and GRB060218 at $z = 0.03$. Most GRBs are located at largest distances, at $z \geq 1$ (see Fargion, 1999). Calling, apparently, to a rare explosive event. However these nearby events have less power (also GRB030329), slow and smooth evolution time respect to the farthest ones. Even if few statistically they (if isotropic) occur more often than far ones. Moreover they show rough afterglows, bumps, re-brightening, such features being very difficult to explain with one-shot explosive event (Fireball or Fireball-Jet). Such model would predict monotonic decaying light curves, rather they often show sudden re-brightening or bumpy afterglows at different time scales and wavelengths (see Stanek et al., 2006, Fargion, 2003) - see e.g. GRB050502B (see Falcone et al., 2006).

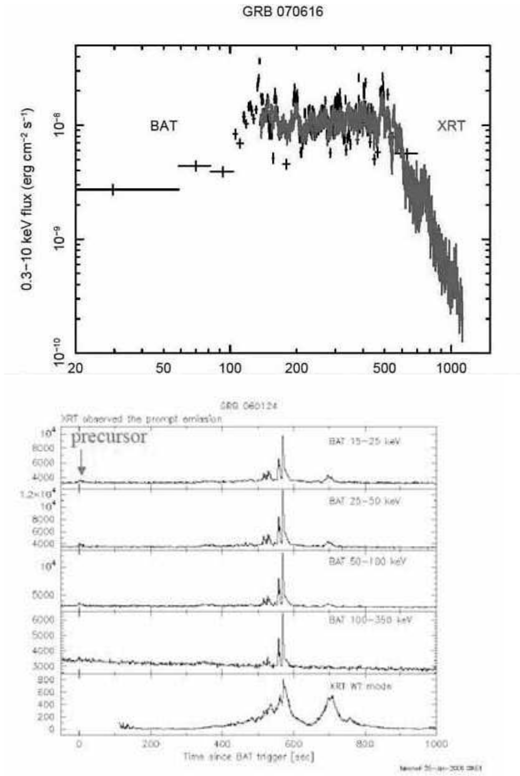

Fig. 7. Left: The last GRB070616 long X-ray life; right: the puzzling ten-minute X-Ray precursor in GRB060124

Another relevant puzzling evidence (for Fireball and Magnetar, (see Ducan 1992)) is the spectra structure similarity in few GRBs and SGRs, hinting for the same origin rather than any beamed fountain explosion and any isotropic magnetar (see Fargion 1999, Woods

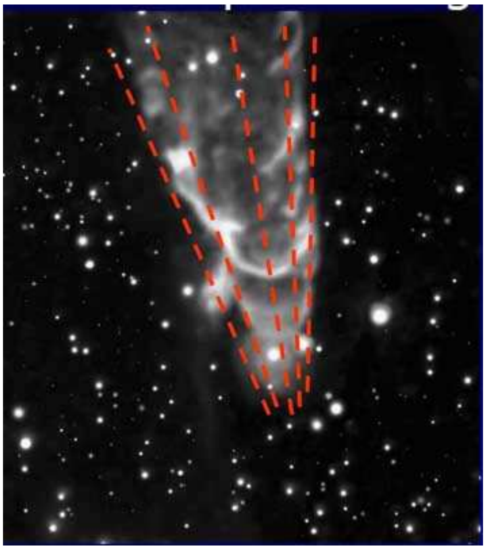

Fig. 8. From the left to the right: A possible *3D* structure view of the precessing jet obtained with a precessing and spinning, gamma jet; In the panel we show an Herbig Haro-like object HH49, whose spiral jets are describing, in our opinion, at a lower energy scale, such precessing Jets as micro-quasars SS-433.

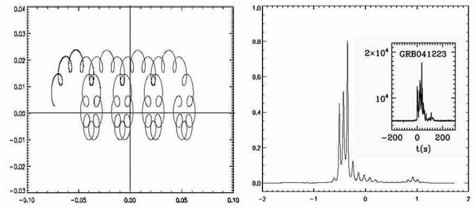

Fig. 9. The possible simple beam track of a precessing jet to observer located at origin. On the left, observer stays in (0.00 ; 0.00); the progenitor electron pair jet (leading by IC, see Fargion & Salis 1998) to a gamma jet) has here a Lorentz factor of a thousand and consequent solid angle at $\sim \mu$ sr. Its consequent blazing light curve corresponding to such a similar outcome observed in GRB041223.

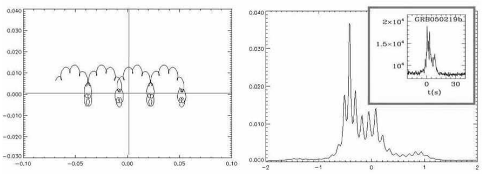

Fig. 10. Same as in Fig. 9: a precessing jet and its consequent light curve versus a similar outcome observed in GRB050219b.

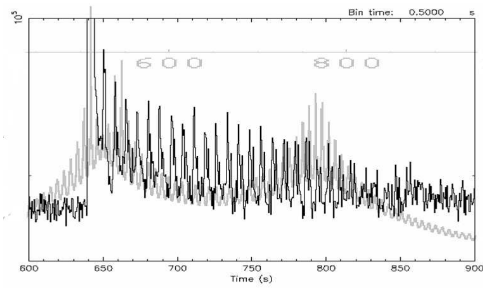

Fig. 11. Similar to Fig. 9: a spiral, spinning precessing jet model by PeV muons, tens or hundred TeV electrons radiating via synchrotron radiations and the consequent light curve (by persistent spinning and precessing jet) versus the similar outcome observed in huge flare SGR1806-20.

1999). Both should share a similar processes (a thin precessing and blazing jet) but different distances and output. Indeed, how can a *popular jetted fireball* (with an opening angle of 5^o-10^o and solid angle as wide as $0.1 - 0.01 sr.$) release an energy-power 10^{50} ergs^{-1}, nearly 6 orders of magnitude more energetic than 10^{44} ergs^{-1}, the corresponding isotropic SN? It is not explained why this enormous energy output imbalance can occur same place at same time. Moreover *Fireball Jet Model* need fine tune of multi-shells around a GRB in order to produce tuned shock explosions and re-brightening with no opacity within minutes, hours, days time-distances from the source(see Fargion, 2003); this is not realistic and justified. Finally some time a tiny, but still extremely powerful, precursor is followed, after ten minute of quite, by a huge more powerful explosion, such as in GRB060124 (at redshift $z = 2.3$): a 10 minutes precursor and subsequent bursts hundreds of times brighter cannot be easily explained by Fireball, but it may be acceptable by a persistent thin (decaying) jet, whose geometry beaming may flashes at different times and intensity. Late (hundreds-thousands) GRB-SN event or BH jets become by metamorphosis SGR stages. Their huge flare are mostly blazing flashes and not explosive revival. Indeed the SGR1806-20 of 2004 Dec. 27th, shows no evidence of the loss of its period P or its derivative $\dot{P}$ after the huge *so called Magnetar* , (see Ducan, 1992), eruption. In this model its hypothetical magnetic energy reservoir (linearly proportional to $P \cdot \dot{P}$) must be largely exhausted. In the later SGR1806 radio afterglows there is a mysterious two-bump radio curve implying additional energy injection many days later SGR huge event. In this connection the GRB021004 light curves (from X to radio) are calling for an early and late energy injection. Also the SGR1806-20 polarization curve has been changing angle radically in short (~ days) timescale. We indebt them to a precessing jet blazing geometry. In similar way the short GRB050724 was able to bump and rebright a day after the main burst(see Campana, 2006); the late energy contribute is comparable to the prompt one. In some sense it has been a repeater event (observed at different angle and time). About hardest GeV components we remind that rarest EGRET GRB940217, at highest energetic events, could held more than 5000s. The GeV delayed tail, as discussed next paragraph, might be indebt to a hadron (as neutron decay in flight) component of the jet. The main one is related to the electromagnetic-lepton Jet. This lepton jet maybe also the secondary of an inner hadronic Jet core.

Once these major questions are addressed and (in our opinion) mostly solved by our precessing gamma jet model, a final question still remains, calling for a radical assumption on the thin precessing gamma jet: how can an ultra-relativistic electron beam (a common parental jet in any kind of Jet models) survive the SN background and dense matter layers and escape in the outer space while remaining collimated? Such questions are ignored in most Fireball fountain models that try to fit the very different GRB afterglow light curves with shock waves on tuned shells and polynomial ad-hoc curves around the GRB event. The solution forces us more and more toward a unified precessing Gamma Jet model feeded by the PeV-TeV lepton showering (about UHE showering beam see analogous ones, see Fargion, 1997, 2000, 2004) into γ discussed below. As we will show, the thin gamma precessing jet is indeed made by a chain of primary processes (PeV prompt hadrons and muon pair bundles decaying into electrons and then radiating via synchrotron radiation), requiring an inner ultra-relativistic jet inside the source.

3. PeV muons and neutrons bundles escaping from the GRB-SN explosion: the GeV delayed flare

The spinning Jet maybe made by UHE (tens PeV) hadrons whose secondaries are muons bundles and later on electron pairs. These pairs feed the gamma thin jet. However also neutrons tails (made by proton photo-pion conversions) at PeVs may escape the SN-GRB. In this case their UHE neutron beta decay in flight nearly ($t \simeq 30$ yrs) later maybe source of TeV electrons, themselves sources of tens GeV photons (by IR-TeV cut-off gamma tail showering). The neutron delay seem incomparable with observed delay (tens of seconds-minutes-hour). But these processes are *apparently too late*. Indeed the decay of neutron occur on-axis and it is observed by relativistic shrinkage. A relativistic reduction factor

$$(1 - \beta \cos \theta) \simeq \frac{\gamma^{-2}}{2} + \frac{\vartheta^2}{2}$$

makes the neutron decay comparable with observed GeV delayed tail. The first factor for the neutron Lorentz boost (a million) is quite negligible, but for the second a thin view angle $\theta \simeq 10^{-3} - 10^{-4}$, (just $10^{-7} - 10^{-9}$ sr), fits the observed delay for the observed GRBs

$$t' \simeq (1 - \beta \cos \theta) t \simeq 100 - 1 s.$$

It should be noticed that both radiative (bremsstrahlung) beta decay and electron synchrotron radiation in galaxy field may offer GeVs photons.

4. Blazing spinning and precessing jets in GRBs

The huge GRBs luminosity (up to 10^{54} erg s^{-1}) may be due to a high collimated on-axis blazing jet, powered by a Supernova output; the gamma jet is made by relativistic synchrotron radiation and the inner the jet the harder and the denser is its output. The harder the photon energy, the thinner is the jet opening angle. The hardest and shortest core Gamma event occur at maximal apparent luminosity once the jet is beamed in inner axis. The jets whole lifetime, while decaying in output, could survive as long as thousands of years, linking huge GRB-SN jet apparent Luminosity to more modest SGR relic Jets (at corresponding X-Ray pulsar output). Therefore long-life SGR (linked to anomalous X-ray AXPs) may be repeating; if they are around our galaxy they might be observed again as the few known ones and the few rare extragalactic XRFs. The orientation of the beam respect to the line of sight plays a key role in differentiating the wide GRB morphology. The relativistic cone is as small as the inverse of the electron progenitor Lorentz factor. To observe the inner beamed GRB events, one needs the widest SN sample and the largest cosmic volumes. Therefore the most far away are usually the brightest. On the contrary, the nearest ones, within tens Mpc distances, are mostly observable on the cone jet *periphery*, a bit off-axis. Their consequent large impact crossing angle leads to longest *anomalous* SN-GRB duration, with lowest fluency and the softest spectra, as in earliest GRB98425 and in particular recent GRB060218 signature. A majority of GRB jet blazing much later (weeks, months after their SN) may hide their progenitor explosive after-glow and therefore they are called *orphan* GRB. Conical shape of few nebulae and the precessing jet of few known micro-quasar, describe in space the model signature as well as famous Cygnus nebulae. Recent outstanding episode of X-ray precursor, ten minutes before the main GRB event, cannot be understood otherwise.

In our model to make GRB-SN in nearly energy equipartition the jet must be very collimated $\frac{\Omega}{\Delta\Omega} \simeq 10^8$-$10^{10}$ (see Fargion et al., 1995-2005) explaining why apparent (but beamed) GRB luminosity $\dot{E}_{GR-jet} \simeq 10^{53}$-$10^{54}$ erg s^{-1} coexist on the same place and similar epochs with lower (isotropic) SN powers $\dot{E}_{SN} \simeq 10^{44}-10^{45} ergs^{-1}$. In order to fit the statistics between GRB-SN rates, the jet must have a decaying activity ($\dot{L} \simeq (\frac{t}{t_o})^{-\alpha}$, $\alpha \simeq 1$): it must survive not just for the observed GRB duration but for a much longer timescale, possibly thousands of time longer $t_o \simeq 10^4$ s. The late stages of the GRBs (within the same decaying power law) would appear as a SGRs: indeed the same law for GRB output at late time (thousand years) is still valid for SGRs. SGRs are not Magnetar fire-ball explosion but blazing jets.

5. The case of extreme SGR1806-20 flare and the GRB-SGR connection

Indeed the puzzle (for one shot popular Magnetar-Fireball model (see Ducan 1992)) arises for the surprising giant flare from SGR 1806-20 that occurred on 2004 December 27th: if it has been radiated isotropically (as assumed by the Magnetar model, most of - if not all - the magnetic energy stored in the neutron star NS, should have been consumed at once. This should have been reflected into sudden angular velocity loss (and-or its derivative) which was *never observed*. On the contrary a thin collimated precessing jet $\dot{E}_{SGR-jet} \simeq 10^{36}$-$10^{38}$ erg s^{-1}, blazing on-axis, may be the source of such an apparently (the inverse of the solid beam angle $\frac{\Omega}{\Delta\Omega} \simeq 10^8$-$10^9$) huge bursts $\dot{E}_{SGR-Flare} \simeq 10^{38} \cdot \frac{\Omega}{\Delta\Omega} \simeq 10^{47}$ erg s^{-1} with a moderate steady jet output power (X-Pulsar, SS433). This explains the absence of any variation in the SGR1806-20 period and its time derivative, contrary to any obvious correlation with the dipole energy loss law.

In our model, the temporal evolution of the angle between the spinning (PSRs), precessing (binary, nutating) jet direction and the rotational axis of the NS, can be expressed as

$$\theta_1(t) = \sqrt{\theta_x^2 + \theta_y^2}$$

where

$$\theta_y(t) = \theta_a \cdot \sin\omega_0 t + \cos(\omega_b t + \phi_b) + \theta_{psr} \cdot$$

$$\cdot \cos(\omega_{psr}t + \phi_{psr}) \cdot |(\sin(\omega_N t + \phi_N))| + \theta_s \cdot$$

$$\cdot \cos(\omega_s t + \phi_s) + \theta_N \cdot \cos(\omega_N t + \phi_N)) + \theta_y(0)$$

and a similar law express the $\theta_x(t)$ evolution. The angular velocities and phase labels are self-explained (See Fargion et. al., 2005, 2006). Lorentz factor γ of the jet's relativistic particles, for the most powerful SGR1806-20 event, and other parameters adopted for the jet model represented in Fig.11 are shown in the following Table 1 (see also Fargion et al., 2005, 2006).

The simplest way to produce the γ emission would be by IC of GeVs electron pairs onto thermal infra-red photons. Also electromagnetic showering of PeV electron pairs by synchrotron emission in galactic fields, ($e^\pm$ from muon decay) may be the progenitor of the γ blazing jet. However, the main difficulty for a jet of GeV electrons is that their propagation through the SN radiation field is highly suppressed. UHE muons ($E_\mu \geq$ PeV) instead are characterized by a longer interaction length either with the circum-stellar matter and the radiation field, thus they have the advantage to avoid the opacity of the star and escape the dense GRB-SN isotropic radiation field (see also Fargion et al., 2005, 2006). We propose that also the emission of SGRs is due to a primary hadronic jet producing ultra relativistic $e^\pm$ (1 - 10 PeV) from hundreds PeV pions, $\pi \to \mu \to e$, (as well as EeV neutron decay in flight): primary protons can be accelerated by the large magnetic field of the NS up to EeV energy. The protons could in principle emit directly soft gamma rays via synchrotron radiation with the galactic magnetic field ($E_\gamma^p \simeq 10(E_p/EeV)^2(B/2.5 \cdot 10^{-6}\,G)$ keV), but the efficiency is poor because of the too small proton cross-section, too long timescale of proton synchrotron interactions. By interacting with the local galactic magnetic field relativistic pair electrons lose energy via synchrotron radiation: $E_\gamma^{sync} \simeq 4.2 \cdot 10^6(\frac{E_e}{5\cdot 10^{15}\,eV})^2(\frac{B}{2.5\cdot 10^{-6}\,G})\,eV$ with a characteristic timescale $t^{sync} \simeq 1.3 \cdot 10^{10}(\frac{E_e}{5\cdot 10^{15}\,eV})^{-1}(\frac{B}{2.5\cdot 10^{-6}\,G})^{-2}\,s$. This mechanism would produce a few hundreds keV radiation as it is observed in the intense γ-ray flare from SGR 1806-20. The inner multi-precessing and spinning jet to the observer may lead to an apparent resonant bumps as well a first huge flash (see Fig.9-10-11).

The Larmor radius is about two orders of magnitude smaller than the synchrotron interaction length and this may imply that the aperture of the showering jet is spread in a fan structure (see Fargion, 1997-2004) by the magnetic field, $\frac{R_L}{c} \simeq 4.1 \cdot 10^8(\frac{E_e}{5\cdot 10^{15}\,eV})(\frac{B}{2.5\cdot 10^{-6}\,G})^{-1}\,s$. Therefore the solid angle is here the inverse of the Lorentz factor ($\sim$ nsr). In particular a thin ($\Delta\Omega \simeq 10^{-9}$-$10^{-10}$ sr) precessing jet from a pulsar may naturally explain the negligible variation of the spin frequency $\nu = 1/P$ after the giant flare ($\Delta\nu < 10^{-5}$ Hz). Indeed it seems quite unlucky that a huge ($E_{Flare} \simeq 5 \cdot 10^{46}$ erg) explosive event, as the needed mini-fireball by a magnetar model(Ducan 1992), is not leaving any trace in the rotational energy of the SGR 1806-20, $E_{rot} = \frac{1}{2} I_{NS}\,\omega^2 \simeq 3.6\cdot 10^{44}(\frac{P}{7.5\,s})^{-2}(\frac{I_{NS}}{10^{45} g\,cm^2})$ erg. The consequent fraction of energy lost after the flare is severely bounded by observations: $\frac{\Delta(E_{Rot})}{E_{Flare}} \leq 10^{-6}$. More absurd in Magnetar-explosive model is the evidence of a brief precursor event (one-second SN output) taking place with no disturbance on SGR1806-20 *two minutes before* the hugest flare of 2004 Dec. 27th. The thin precessing Jet while being extremely collimated (solid angle $\frac{\Omega}{\Delta\Omega} \simeq 10^8$-$10^{10}$ (see Fargion & Salis, 1995; Fargion, 1999; Fargion et. al., 2005, 2006) may blaze at different angles within a wide energy range (inverse of $\frac{\Omega}{\Delta\Omega} \simeq 10^8$-$10^{10}$). The output power may exceed $\simeq 10^8$, explaining the extreme low observed output in GRB980425 -an off-axis event-, the long late off-axis gamma tail by GRB060218 see Fargion-GNC-2006), respect to the on-axis and more distant GRB990123 (as well as GRB050904).

6. Conclusion

The GRBs are not the most powerful explosions, but just the most collimated ones. They are within a mundane Supernova output power. Their birth rate is comparable to the SN ones (a few a second in the observable Universe), but their thin beaming (10^{-8} sr) make them

Table 1. Main values of the thin precessing jet to fit the observed huge SGR burst on 2004, as in Figure 11

$\gamma = 10^9$	$\theta_a = 0.2$	$\omega_a = 1.6 \cdot 10^{-8}$ rad/s
$\theta_b = 1$	θ_{psr}=1.5 $\cdot 10^7/\gamma$	θ_N=5 $\cdot$ $10^7/\gamma$
ω_b=4.9 $\cdot 10^{-4}$ rad/s	ω_{psr}=0.83 rad/s	ω_N=1.38 $\cdot 10^{-2}$ rad/s
$\phi_b = 2\pi - 0.44$	ϕ_{psr}=$\pi + \pi/4$	ϕ_N=3.5 $\pi/2 + \pi/3$
$\phi_s \sim \phi_{psr}$	θ_s=1.5 $\cdot 10^6/\gamma$	ω_s = 25 rad/s

extremely rare ($10^{-8} s^{-1}$) to observe, while pointing to us at their very birth (days-months after the SN birth). This peculiar geometry tuning explain the wide spread of apparent power shown versus SN and GRBs as shown in Fig(1,2,3,4). The persistent precessing (in a slow decay of scale time of hours) and the moving beam span a wider angle with time and it encompass a larger solid angle increasing the rate by 3 order of magnitude, just to agree with the observed GRB rate ($10^{-5} s^{-1}$); after a few hours $\simeq 10^4 s$. the beam may hit the Earth and appear as a GRB near coincident with a SN. After months the optical SN is fade and the event is *orphan*. The power law decay mode of the jet make it alive at a smaller power days, months and year later, observable mainly at nearer and middle distance as a Short GRB or (at its jet periphery) as an XRF or in our galaxy as a SGRs. The link with SN is guaranteed in Long GRB. The presence of a huge population of active jets fits a wide spectrum of GRB morphology (see Giovannelli & Sabau-Graziati, 2003). The nearest (tens-hundred Mpc) are observable mostly off-axis (because of probability arguments) while the most distant ones are seen mostly on axis (because threshold cut at lowest fluxes). Therefore the hardest are often at highest redshift. But the IR cut-off makes this gamma bounded. Now in our Universe thousands of GRBs are shining at SN peak power, but they are mostly pointing else where. Only nearly one a day might be blazing to us and captured at SWIFT, Agile, Fermi threshold level. Thousand of billions are blazing (unobserved) as SGRs in the Universe. Short GRBs as well SGRs are born in SNRs location and might be revealed in nearby spaces. The GRB-SGRs connection with XRay-Pulsars make a possible link to Anomalous X-Ray pulsar jets recently observed in most X-gamma sources as the famous Crab. The possible GRB-SGR link to X-gamma pulsar is a natural possibility to be considered as a grand unification of the model. Our prediction is that a lower threshold Fermi satellite will induce a higher rate of GRBs both at nearer volumes (as GRB060218 and GRB 980425) and at largest red-shifts, where *apparent* hardest, and brightest, event occurs. In a puzzling evolution frame. Therefore the most probable source of GRB hardest neutrinos are the most distant GRBs at highest redshift, whose photons are often hidden by photon-IR-photon opacity. Therefore orphan GRB might be among the best UHE GRB neutrino sources. Making their discover more difficult and uncorrelated to GRB.

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