X RAY PRECURSORS IN GRBs and SGRs: OUTER X TAILS AROUND A PRECESSING γ JET

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Abstract

Weak isolated X-ray precursor events before the main Gamma Ray Burst, GRB, and also rare Soft Gamma Repeaters, SGR, events are in disagreement with any Fireball, or Magnetar, scenarios. These models are originated by an unique explosive event leading, by internal-external shock waves, to softer secondary trains following a main gamma signals. Indeed the earliest GRB980519, GRB981226 events as well as the latest and most distant identified one as GRB000131 are showing rare but well identified and distinct X Ray precursor, occurring tens of seconds or even a minute before the main GRB eruption. These weak X precursors bursts correspond to non-negligible energy powers, up to million Supernova ones. They are rare, about $(3-6)\%$ of all GRBs, but not unique. Similar huge explosive precursor are in total disagreement with a successive main Fireball GRB outburst. Comparable brief X-ray precursor flashes are found also in rarest and most detailed SGRs events as those observed on 27 and 29 August 1999 from SGR 1900+14. They are inconsistent with a Magnetar Fireball explosion. We interpret them as earlier marginal blazing of outlying X conical Jet tails surrounding a narrower gamma precessing,spinning beamed Jet in blazing mode toward the Earth; later re-crossing and better hitting of the target -the satellite detectors- is source of the main GRB (and SGR) observed structured event. The X Ray precursor existence is an additional remarkable evidence of the Precessing relativistic Jet Nature of both GRBs and SGRs.

1 Introduction: GRBs and SGRs: Spinning, Precessing and Blazing γ Jet

Gamma Ray Burst and Soft Gamma Repeaters reached an apparent stage of maturity: tens of GRBs found, finally, an X, optical and (or) radio transient (the after-glow) identification as well as some associated host galaxies at cosmic red-shifts (Bloom et all 2000). New categories of GRBs and SGRs events have been labeled, but even within these wider updated data no conclusive theory or even partial understanding seem to solve the old-standing GRB/SGRs puzzle: the Nature of The GRB-SGR signals.

On the contrary the wider and wider collection of data are leading to a schizophrenic attitude in the most popular isotropic models, the Largest Cosmic Explosions (Fireball, Hypernova, Supra-Nova) with more and more phenomenological descriptions (power laws everywhere) and less and less unifying views. This "give up" attitude seem to reflect the surprising never ending morphologies of GRBs.
We argued on the contrary that GRBs and SGRs find a comprehensive theory within a thin spinning and multi precessing γ Jet, sprayed by a Neutron Star, NS, or Black Hole, BH, (Fargion 1994-1999, Fargion, Salis 1995-1998). For instance the extreme energy released in last GRBs ($\gg 10^{54}$ erg), comparable to few solar masses or more, leads to a deep conflict with any isotropic GRB energy (masses and corresponding Schwarchild scale times above milliseconds) and the sharp observed GRBs fine time structures (below a fraction of millisecond). Moreover the energy power spread (from 10^{53} $ergs^{-1}$) for most far GRBs versus 10^{46} $ergs^{-1}$ for nearest GRB980425, led most Fireball defenders to neglect, hide or even reject in a very arbitrary way the nearest and best identified GRB connection to a Supernova, SN, explosion as SN1998bw. Finally the same rarity of GRB-SN detections and the established GRB980425-SN link favors the thin Jet Nature of GRBs.

Even originally $(1970-80)$ unified GRB/SGR models since last fifteen years are commonly separated by their repeater and spectra differences; however very recently they openly shared the same spectra, time and flux structures. This favours once again their common Nature. However they are up present times usually described by catastrophic spherical explosions, but, as we shall show in this paper, they should not be. Their different distances, cosmic versus galactic ones, imply different power source Jet, but their morphological similarity strongly suggest an unique process: the blazing of a spinning and multi-precessing gamma Jet, from either Neutron Star or Black Hole. The γ Jet is born by high GeVs electron pairs Jet which are regenerating, via Inverse Compton Scattering, an inner collimated beamed γ (MeVs) precessing Jet. The thin jet (an opening angle inverse of the electron Lorentz factor, a milli-radiant or below), while spinning, is driven by a companion and/or an asymmetric accreting disk in a Quasi Periodic Oscillation (QPO) and in a Keplerian multi-precessing blazing mode: its $\gamma - X$ ray lighthouse trembling and flashing is the source of the complex and wide structure of observed Gamma Bursts.
These γ Jets share a peak power of a Supernova ($10^{44} ergs^{-1}$) at their birth (during SN and Neutron Star formations), decaying by power law $\sim t^{-1} - \sim t^{-(1.5)}$ to less power-full Jets that converge to present persistent SGRs stages. Indeed these ones are

blazing events from late relic X pulsar observable only at nearer distances. The γ Jet emit in general at $\sim 10^{35}$ ergs^{-1} powers; both of GRB and SGR show an apparent luminosity amplified by the inverse square of the thin from 10^{-3} to 10^{-4} radiant angle Jet beaming: the corresponding solid angle Ω spreads between 10^{-7} and 10^{-9}.
Optical-Radio After-Glows are not the fading fireball explosion tails often observed in puzzling variable non monotonic decay, but the averaged external Jet tails moving and precessing and geometrically fading away. The rare optical re-brightening (the so called SN bump) observed in few afterglow has been erroneously associated to an underlying isotropic SN flash: it is more probably the late re-crossing of the precessing Jet periphery toward the observer direction.

One of the most recent and convincing evidence against any explosive GRB model, confirming present γ precessing Jet theory, is hidden in the in the recent GRB 000131 data which show an un-explicable, for Fireball model, X precursor signal 7 sec long, just 62 seconds prior to the huge main gamma trigger. How could any GRB source coexist such a powefull precursor?

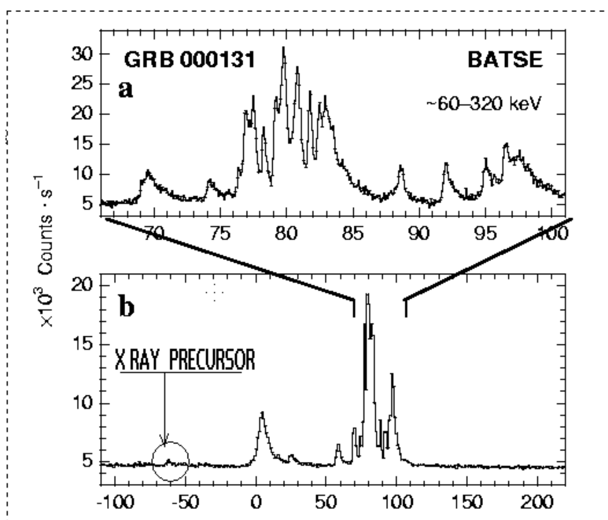

Figure 1: *Location and Intensity of early X Precursor in GRB000131*

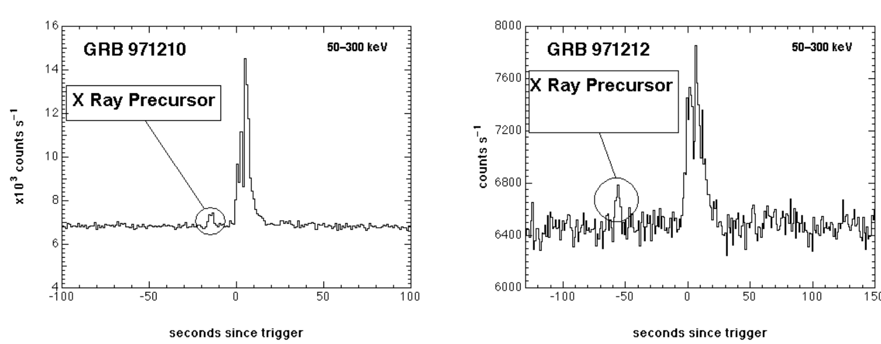

Figure 2: *Fig 2a and 2b: Time evolution and X precursors in GRB* 971210 *and GRB* 971212

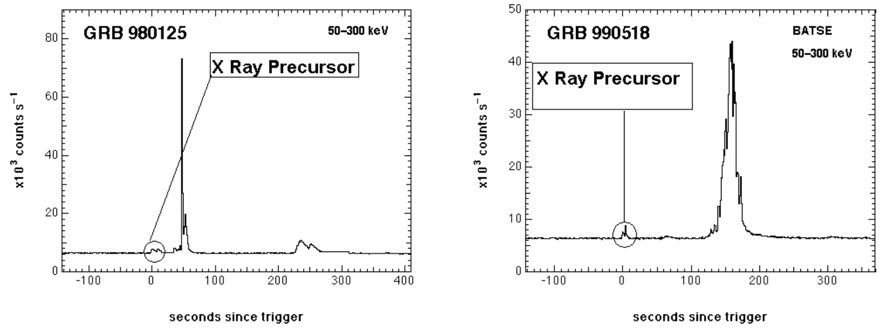

Figure 3: *Fig 3a and 3b: Time evolution and X precursor in GRB* 980125 *and GRB* 990518

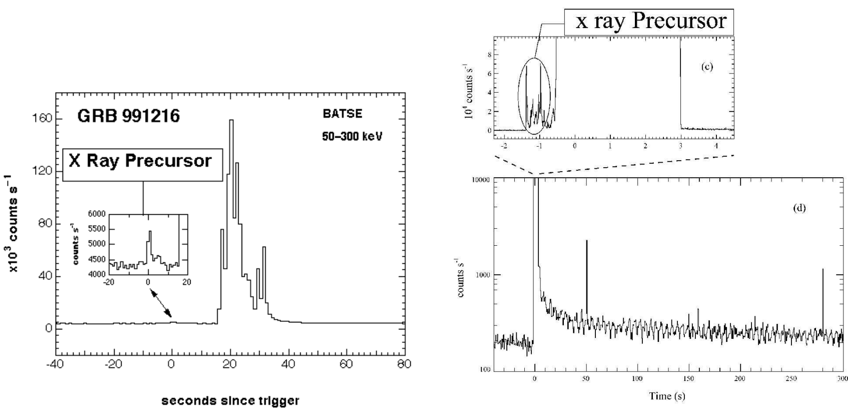

Figure 4: *Fig* 4*a and* 4*b: Time evolution and X precursor in GRB* 991216 *and in SGR* $1900 + 14$ *on 29 August* 1998

2 Are GRBs an Unique γ Jet Explosion?

As we noted above GRBs are not showing any standard candle behaviours within any Fireball isotropic model. Some moderate wide Fireball-Jet (a not conclusive compromise, like so called collapsar combining SN and open fountain-like Jet explosion) models with a large beaming (ten degree opening) can accommodate all cosmic GRBs excluding the "problematic" nearest GRB980425 event keeping it out of the frame.
Nevertheless SGRs, which share, some time, the same GRB signature, are themselves still within a popular isotropic mini-Fireball scenario powered by Magnetar explosive events. This model imply a magnetic energy in the neutron star at least 4 order of magnitude above the kinetic rotational energy, calling for an anomalous and unexplained energy e-qui-partition bias.
Beaming may solve the puzzle within a common X-ray Pulsar power.

Indeed the SGR1900+14 event BATSE trigger 7171 left an almost identical event comparable to a just following GRB (trigger 7172) on the same day, same detector, with same spectra and comparable flux. This Hard-Soft connection has been re-discovered and confirmed more recently by BATSE group: (Fargion 1998-1999;Woods et all 1999) with an additional hard event of SGR 1900+14 recorded in GRB990110 event.
2)an additional GRB-SGR connection occur between GRB980706 event with an almost identical (in time, channel spectra, morphology and intensities) observed in GRB980618 originated by SGR 1627-41. Nature would be very perverse in mimic two signals, (even

if at different distances and different powers), by two extreme different source engines.

To decide for a model intuitively let us just consider with no prejudice the last reported (and most distant $z = 4.5$) event: GRB000131 and its X ray precursor:
This event while being red-shifted and slowed down by a factor 5.5 exhibit on the contrary a short scale time fine structure not explicable by any fireball model, but well compatible with a thin, fast spinning precessing γ jet.
The extreme γ energy budget, calling for a comparable ν one, exceeds few solar masses in its main emission even for ideal full energy conversion.
Moreover one must notice the presence of a weak X-ray precursor pulse lasting 7 sec, 62 sec before the huge main structured γ burst trigger. Its arrival direction (within 12 degree error) with main GRB is consistent only with the main pulse (a probability to occur by chance below3.610^{-3}).
The time clustering proximity (one minute over a day GRB rate average) has the probability to occur by chance below once over a thousand. The over all probability to observe this precursor by change is below 3.4 over a million making inseparable its association with the main GRB000131 event. This weak burst signal correspond to a power above a million Supernova and have left no trace or Optical/X transient just a minute before the real (peak power $>$ *billion* Supernova) energetic event. Similar X precursors occured in a non negligible minor sample of GRBs (see for example Fig 2-4a) and also few SGRs event (Fig 4b).

How could any isotropic GRB explosive progenitor survive such a disruptive isotropic precursor trigger? Twice a miracle? Only a persistent precessing Gamma Jet crossing nearby the observer direction twice could do it.

3 The GRB-SN Connection and the Thin Precessing γ Jet

The need for GRBs beaming is wide: the GRB luminosities are over Eddington, the event peaked structure is chaotic, the spectra is non-thermal, the energy budget may exceed two solar masses annihilation (Fargion 1994, Fargion, Salis 1995-98, Fargion 1998-1999). The spinning and precessing periodicity is hidden into the short GRB observational window; indeed the periodicity did finally arise in Soft Gamma Repeaters as soon as more data have been available. As it was demonstrated recently, many light curves and spectra of the GRB might be explained by the blazing of multi-precessing gamma jets (Fargion 1994-1995-1999). A wider GRBs data sheet, as for SGRs data would show the spinning periodicity of GRBs and possibly the quasi periodic oscillations (QPO) of the parental binary system.

Behind the energy problem stand (to isotropic fireball models) the puzzling low probability to observe any close GRB as GRB980425 at a negligible cosmic distance (38 Mpc) along with a couple of dozen of far and very far events seen by BeppoSax in last two years.

Statistical arguments (Fargion 1998, 1999) favor a unified GRBs model based on blazing, spinning and precessing thin jet. We assume that GRB jet arise in most SNe outbursts. The far GRBs are observables at their peak intensities (coincident to SN) while blazing in axis to us within the thin jet very rarely; consequently the hit of the target occurs only within a wide sample of sources found in a huge cosmic volume. In this frame work the GRB rate do not differ much from the SN rate. Assuming a SN-GRB event every 30 years in a galaxy and assuming a thin angular cone ($\Omega <(1/4)10^{-8}$) the probability to be within the cone jet in a ($4*10^{10}$)cosmic sample of galaxies (at limited Hubble R$\geq$ 28 magnitude) within our main present observable Universe volume ($z\sim$ 1-$z\sim$ 4) during one day of observation at a nominal 10 sec GRB duration is quite small: ($P<10^{-2}$). This value should be suppressed by nearly an order of magnitude because of the detector acceptance. However a precessing gamma jet whose decaying scale time is a thousand time longer than the GRB itself (decaying by a power law $\sim t^{-1}$) whose scale time is nearly ten or twenty thousand of seconds, may fit naturally the observed GRB rate.

Also, if these jets have complicated spinning and multi-precession spirals, they could explain many (or all) features of the light-curves of GRB. Consider especially the observed periodic tails in SGR signals and rarest (3%-6%) mini-X-GRB precursors: their periodicity has been discovered only when long data sample of events have been collected, contrary to GRBs where the decaying power and the distance make difficult recording their signal tails.

4 The Spiral Jets and the Rings in SN1987A

The precessing Jet signature is hidden in different forms. The possibility that precessing Gamma jets are source by their interactions onto a red giant relic shell of the Twin Ring around SN1987A has been proposed since 1994 (Fargion & Salis 1995b, 1995c). It has been also been suggested (Fargion & Salis 1995) that the variable presence of a paraboloid thin arc along one of the twin ring of SN1987A, the mysterious "Napoleon Hat" observed on 1989-1990, was the evidence for a thin long projected jet interacting tens parsec away from the SN1987A toward us. The jet pressure could also accumulate gas and form dense filamentary gas. Such gas filament fragment as well as gravitationally clusterize may lead to contemporaneous stellar arc formations.(Y.Efremov&D.Fargion, 2000).

5 GRBs and their Neutrino ν and γ Energy Budget in Fireball

It is surprising (at least to the author) that after a decade of fireball inflation papers, at present crisis (GRB990123, GRB990510, GRB991226, GRB000131 over energetic event) there is no definitive rejection of this popular isotropic model. On the contrary there is wide spread resistance and inertia to give up with some excuse to this famous misleading fireball model.

Gamma Ray Bursts as recent $GRB990123 and GRB990510$ emit, for isotropic explosions, γ energies as large as two solar masses annihilation. These energies are under-

estimated because of the neglected role of comparable ejected MeV (Comptel signal) neutrinos ν bursts and assume an unrealistic ideal energy conversion efficiency. Indeed, as often neglected, it is important to remind that the huge energy bath (for a fireball model) on GRB990123 imply also a corresponding neutrino burst. As in hot universe, if entropy conservation holds, the ν energy density factor to be added to the photon γ budget is at least ($\simeq (21/8) \times (4/11)^{4/3}$). If entropy conservation do not hold the energy needed is at least a factor [21/8] larger than the gamma one. The consequent total energy-mass needed for the two cases are respectively 3.5 and 7.2 solar masses. Additional factors must be introduced for realistic energy conversion efficiency leading to energies as large as tens of solar masses. No fireball by NS may coexist with it. Jet could.
These extreme power cannot be explained with any standard spherically symmetric Black Hole Fireball model. A too heavy Black Hole (hundred or thousands solar masses) or, worse, Star would be unable to coexist with the shortest millisecond time structure of Gamma Ray Burst. Cosmological and nearby Gravitational Red-shifts may only make the Fireball Model more inconsistent. Smaller size BH or NS do not offer enough mass reserve. Beaming of the gamma radiation may overcome the energy puzzle along with the short scale-time. However any mild "explosive beam" event as some models (Wang & Wheeler 1998) ($\Omega > 10^{-2}$) would not solve the jet containment at the corresponding disruptive energies. Moreover such a small beaming would not solve the huge GRBs flux energy windows ($10^{47} \div 10^{54}$ erg/sec), keeping GRB980425 and GRB990123 within the same GRB framework.

Only extreme beaming ($\Omega \sim 10^{-8}$), by a slow decaying, but long-lived precessing jet, may coexist with characteristic Supernova energies, apparent GRBs output and the puzzling GRB980425 statistics as well as the GRB connection with older, nearer and weaker SGRs relics. Therefore SGRs are very useful nearby astrophysical Laboratory where to study and test the far GRB process. SGRs are not associated with huge OT afterglow or explosive SN event. Indeed they are persistent Jet eventually feed by an accreting companion or disk. The optical transient OT of GRB is in part due to the coeval SN-like explosive birth of the jet related to its maximal intensity; the OT is absent in older relic Gamma jets, the SGRs because their time-scales are too short (few seconds or below) to being revealed. Their explosive memory is left around in their relic nebula or plerion injected by the Gamma Jet which is running away. The late GRB OT, days after the burst, are related mainly to the Jet tail precession; it is usually enhanced only by a partial beaming ($\Omega \simeq 10^{-2}$). The extreme peak OT during GRB990123 (at a million time a Supernova luminosity) is just the extreme beamed ($\Omega \leq 10^{-5}$) Inverse Compton optical tail, responsible of the same extreme gamma (MeV) extreme beamed ($\Omega \leq 10^{-8}$) signal.

6 The Peculiar Nearest, Weakest, Slowest GRB980425 in SN1998bw

Finally Fireballs are unable to explain the following key questions (Fargion 1998-1999) related to the association GRB980425 and SN1998bw (Galama et all1998):

1. Why nearest "local" GRB980425 in ESO 184-G82 galaxy at redshift $z_2 = 0.0083$ (nearly 38 Mpc.) and the most far away "cosmic" ones as GRB971214 (Kulkarni et al.1998) (or GRB00131 (Andersen et al. 2000)) at redshift $z_2 = 3.42$ (and $z_2 = 4.5$) exhibit a huge average and peak intrinsic luminosity ratio?

$$\frac{< L_{1\gamma} >}{< L_{2\gamma} >} \cong \frac{< l_{1\gamma} > z_1^2}{< l_{2\gamma} > z_2^2} \cong 2 \cdot 10^5 \;\; ; \frac{L_{1\gamma}}{L_{2\gamma}}\bigg|_{peak} \simeq 10^7. \tag{1}$$

   Fluence ratios E_1/E_2 are also extreme ($\geq 4 \cdot 10^5$).

2. Why GRB980425 nearest event spectrum is softer than cosmic GRB971214 while Hubble expansion would naturally imply the opposite by a redshift factor $(1 + z_1) \sim 4.43$?

3. Why, GRB980425 time structure is slower and smoother than cosmic one, as above contrary to Hubble law?

4. Why we observed so many (even just the rare April one over 14 Beppo Sax optical transient event) nearby GRBs? Their probability to occur, with respect to a cosmic redshift $z_1 \sim 3.42$ must be suppressed by a severe volume factor

$$\frac{P_1}{P_2} \cong \frac{z_1^3}{z_2^3} \simeq 7 \cdot 10^7 \quad . \tag{2}$$

The above questions remain unanswered by fireball candle model. Indeed hard defenders of fireball models either ignore the problem or, worse, they negate the same reality of the April GRB event. A family of new GRB fireballs are ad hoc and fine-tuned solutions. We believed since 1993 (Fargion 1994) that spectral and time evolution of GRB are made up blazing beam gamma jet GJ. The GJ is born by ICS of ultrarelativistic (1 GeV-tens GeV) electrons (pairs) on source IR, or diffused companion IR, BBR photons (Fargion, Salis 1998). The beamed electron jet pairs will produce a coaxial gamma jet. The simplest solution to solve the GRBs energetic crisis (as GRB990123 whose isotropic budget requires an energy above two solar masses) finds solution in a geometrical enhancement by the jet thin beam.

7 Hard Gamma Jet by Inverse Compton Scattering of GeV Electron Pairs

A jet angle related by a relativistic kinematics would imply $\theta \sim \frac{1}{\gamma_e}$, where γ_e is found to reach $\gamma_e \simeq 10^3 \div 10^4$ (Fargion 1994, 1998). At first approximation the gamma constrains is given by Inverse Compton relation: $< \epsilon_\gamma > \simeq \gamma_e^2 \, kT$ for $kT \simeq 10^{-3} - 10^{-1} \, eV$ and $E_e \sim GeVs$ leading to characteristic X-γ GRB spectra.
The origin of $GeVs$ electron pairs are very probably decayed secondary related to primary inner muon pairs jets, able to cross dense stellar target.
However an impulsive unique GRB jet burst (Wang & Wheeler 1998) increases the apparent luminosity by $\frac{4\pi}{\theta^2} \sim 10^7 \div 10^9$ but face a severe probability puzzle due to

the rarity to observe even a most frequent SN burst jet pointing in line toward us. Vice-versa one must assume a high rate of GRB events ($\geq 10^5$ a day larger even than expected SN one a day). As we noted most authors today are in a compromise: they believe acceptable only mild beaming ($\Omega >\sim 10^{-3}$), taking GRB980425 out of the GRB "basket".

On the contrary we considered GRBs and SGRs as multi-precessing and spinning Gamma Jets and the GRB980425 an off-axis classical jet. In particular we considered (Fargion 1998) an unique scenario where primordial GRB jets decaying in hundred and thousand years become the observable nearby SGRs. Sometimes accretion binary systems may increase the SGRs activity. The ICS for monochromatic electrons on BBR leads to a coaxial gamma jet spectrum(Fargion & Salis 1995, 1996, 1998): $\frac{dN_1}{dt_1\, d\epsilon_1\, d\Omega_1}$ is

$$\epsilon_1 \ln\left[\frac{1-\exp\left(\frac{-\epsilon_1(1-\beta\cos\theta_1)}{k_B\,T\,(1-\beta)}\right)}{1-\exp\left(\frac{-\epsilon_1(1-\beta\cos\theta_1)}{k_B\,T\,(1+\beta)}\right)}\right]\left[1+\left(\frac{\cos\theta_1-\beta}{1-\beta\cos\theta_1}\right)^2\right] \tag{3}$$

scaled by a proportional factor A_1 related to the electron jet intensity. The adimensional photon number rate (Fargion & Salis 1996) as a function of the observational angle θ_1 responsible for peak luminosity (eq. 1) becomes

$$\frac{\left(\frac{dN_1}{dt_1\, d\theta_1}\right)_{\theta_1(t)}}{\left(\frac{dN_1}{dt_1\, d\theta_1}\right)_{\theta_1=0}} \simeq \frac{1+\gamma^4\,\theta_1^4(t)}{[1+\gamma^2\,\theta_1^2(t)]^4}\,\theta_1 \approx \frac{1}{(\theta_1)^3} \quad . \tag{4}$$

The total fluence at minimal impact angle θ_{1m} responsible for the average luminosity (eq. 1) is

$$\frac{dN_1}{dt_1}(\theta_{1m}) \simeq \int_{\theta_{1m}}^{\infty} \frac{1+\gamma^4\,\theta_1^4}{[1+\gamma^2\,\theta_1^2]^4}\,\theta_1\, d\theta_1 \simeq \frac{1}{(\,\theta_{1m})^2} \quad . \tag{5}$$

These spectra fit GRBs observed ones (Fargion & Salis 1995). Assuming a beam jet intensity I_1 comparable with maximal SN luminosity, $I_1 \simeq 10^{45}\; erg\, s^{-1}$, and replacing this value in adimensional A_1 in equation 3 we find a maximal apparent GRB power for beaming angles $10^{-3} \div 3\times10^{-5}$, $P \simeq 4\pi I_1 \theta^{-2} \simeq 10^{52} \div 10^{55} erg\, s^{-1}$ within observed ones. We also assume a power law jet time decay as follows

$$I_{jet} = I_1\left(\frac{t}{t_0}\right)^{-\alpha} \simeq 10^{45}\left(\frac{t}{3\cdot10^4 s}\right)^{-1}\; erg\, s^{-1} \tag{6}$$

where ($\alpha \simeq 1$) able to reach, at 1000 years time scales, the present known galactic microjet (as SS433) intensities powers: $I_{jet} \simeq 10^{39}\; erg\, s^{-1}$. We used the model to evaluate if April precessing jet might hit us once again. It should be noted that a steady angular velocity would imply an intensity variability ($I \sim \theta^{-2} \sim t^{-2}$) corresponding to some of the earliest afterglow decay law.

8 The GRB980425-SN 1998bw Conenction and the Probable GRB980712 Repeater

Therefore the key answers to the above puzzles (1-4) are: the GRB980425 has been observed off-axis by a cone angle wider than $\frac{1}{\gamma}$ thin jet by a factor $a_2 \sim 500$ (Fargion1998),

$\theta \sim \frac{500}{10^4} \approx \frac{5\cdot 57^0}{100} \approx 2.85^0 \left(\frac{\gamma}{10^4}\right)^{-1}$, and therefore one observed only the "softer" cone jet tail whose spectrum is softer and whose time structure is slower (larger impact parameter angle). A simple statistics favored a repeater hit. Indeed GRB980430 trigger 6715 was within 4σ and particularly in GRB980712 trigger 6917 was within 1.6σ angle away from the April event direction. An additional event 15 hours later, trigger 6918, repeated making the combined probability to occur quite rare ($\leq 10^{-3}$). Because the July event has been sharper in times ($\sim 4\,s$) than the April one ($\sim 20\,s$), the July impact angle had a smaller factor $a_3 \simeq 100$. This value is well compatible with the expected peak-average luminosity flux evolution in eq.(6, 4):

$\frac{L_{04\,\gamma}}{L_{07\,\gamma}} \simeq \frac{I_2\,\theta_2^{-3}}{I_3\,\theta_3^{-3}} \simeq \left(\frac{t_3}{t_2}\right)^{-\alpha} \left(\frac{a_2}{a_3}\right)^3 \leq 3.5$ where $t_3 \sim 78\; day$ while $t_2 \sim 2 \cdot 10^5\; s$.
The predicted fluence is also comparable with the observed ones $\frac{N_{04}}{N_{07}} \simeq \frac{<L_{04\,\gamma}>}{<L_{07\,\gamma}>} \frac{\Delta\tau_{04}}{\Delta\tau_{07}} \simeq \left(\frac{t_3}{t_2}\right)^{-\alpha} \left(\frac{a_2}{a_3}\right)^2 \frac{\Delta\tau_{04}}{\Delta\tau_{07}} \geq 3$.

9 The SGRs Hard Spectra and their GRB Link by Precessing Jet

Last SGR1900+14 (May-August 1998) events and SGR1627-41 (June-October 1998) events did exhibit at peak intensities hard spectra comparable with classical GRBs. We imagine their nature as the late stages of jets fueled by a disk or a companion (WD, NS) star. Their binary angular velocity ω_b reflects the beam evolution $\theta_1(t) = \sqrt{\theta_{1m}^2 + (\omega_b t)^2}$ or more generally a multi-precessing angle $\theta_1(t)$ (Fargion & Salis 1996):

$$\theta_1(t) = \sqrt{\theta_x^2 + \theta_y^2} \tag{7}$$

$$\theta_x(t) = \theta_b sin(\omega_b t + \varphi_b) + \theta_{psr} sin(\omega_{psr} t) + \theta_N sin(\omega_N t + \varphi_N) \tag{8}$$

$$\theta_y(t) = \theta_{1m} + \theta_b cos(\omega_b t + \varphi_b) + \theta_{psr} cos(\omega_{psr} t) + \theta_N cos(\omega_N t + \varphi_N) \tag{9}$$

where θ_{1m} is the minimal angle impact parameter of the jet toward the observer, θ_b, θ_{psr}, θ_N are, in the order, the maximal opening precessing angles due to the binary, spinning pulsar, nutation mode of the jet axis.

The angular velocities combined in the multi-precession keep memory of the pulsar jet spin (ω_{psr}), the precession by the binary ω_b and an additional nutation due to inertial momentum anisotropies or beam-accretion disk torques (ω_N). On average, from eq.(5) the γ flux and the X optical afterglow decays, in first approximation, as t^{-2}; the complicated spinning and precessing jet blazing is responsible for the wide morphology of GRBs and SGRs as well as their internal periodicity.(See figure 5). Similar descriptions with more parameters and with a rapid time evolution of the jet has been also proposed by (Portegies Zwart et all 1999).

We predicted (Fargion et all 1995-1999) that such relic jet source to be found in the South-East region of SN1987A where should be hidden a fast running pulsar accelerated by an off-axis bent beaming. Jets may propel and inflate plerions as the observed ones near SRG1647-21 and SRG1806-20. Optical nebula NGC6543 ("Cat Eye") and its thin jets fingers (as Eta Carina ones), the double cones sections in Egg Nebula CRL2688 are the most detailed and spectacular lateral view of such jets "alive". Their blazing in-axis would appear in our galaxy as SGRs or, at maximal power at their SN birth at cosmic edges, as GRBs.

10 The Morphology of Precessing Jet Relics

The Gamma Jet progenitor of the GRB is leaving a trace in the space: usually a nebulae where the nearby ISM may record the jet sweeping as a three dimensional screen. The outcomes maybe either a twin ring as recent SN1987A has shown, or helix traces as the Cat Eye Nebula or more structured shapes as plerions and hourglass nebulae. How can we explain within an unique jet model such a wide diversity?

We imagine the jet as born by a binary system (or by an asymmetric disk accreting interaction) where the compact companion (Bh or NS) is the source of the ultra relativistic electron pair jet (at tens GeV. Inverse Compton Scattering on IR thermal photons will produce a collinear gamma jet at MeV). The rarest case where the jet is spinning and nearly isolated would produce a jet train whose trace are star chains as the Herbig Haro ones (Fargion, Salis 1995). When the jet is modified by the magnetic field torque of the binary companion field the result may be a more rich cone shape. If the ecliptic lay on the same plane orthogonal to the jet in an ideal circular orbit than the bending will produce an ideal twin precessing cones which is reflected in an ideal twin rings (Fargion, Salis 1995). If the companion is in eccentric orbit the resultant conical jet will be more deflected at perihelion while remain nearly undeflected at a aphelion. The consequent off-axis cones will play the role of a mild "rowing" acceleration able to move the system and speed it far from its original birth (explosive) place. Possible traces are the asymmetric external twin rings painted onto the spherical relic shell by SN1987a. Fast relics NS may be speeded by this processes (Fargion, Salis 1995a, 1995b, 1995c). Because of momentum conservation this asymmetric rowing is the source of a motion of the jet relic in the South-East direction. In extreme eccentric system the internal region of the ring are more powered by the nearby encounter leading to the apparent gas arcs. If the system is orbiting in a plane different from the one orthogonal to the jet the outcoming precessing jet may spread into a mobile twin cone whose filling may appear as a full cone or a twin hourglass by a common plerion shape. At late times there is also possible apparent spherical shapes sprayed and structured by a chaotic helix. External ISM distribution may also play a role enhancing some sides or regions of the arcs. The integral jet in long times may mimic even spherical envelopes but internal detailed inspection might reveal the thin jet origin (as in recent Eta Carina string jets). Variable nebulae behaviours recently observed are confirming our present scenario.

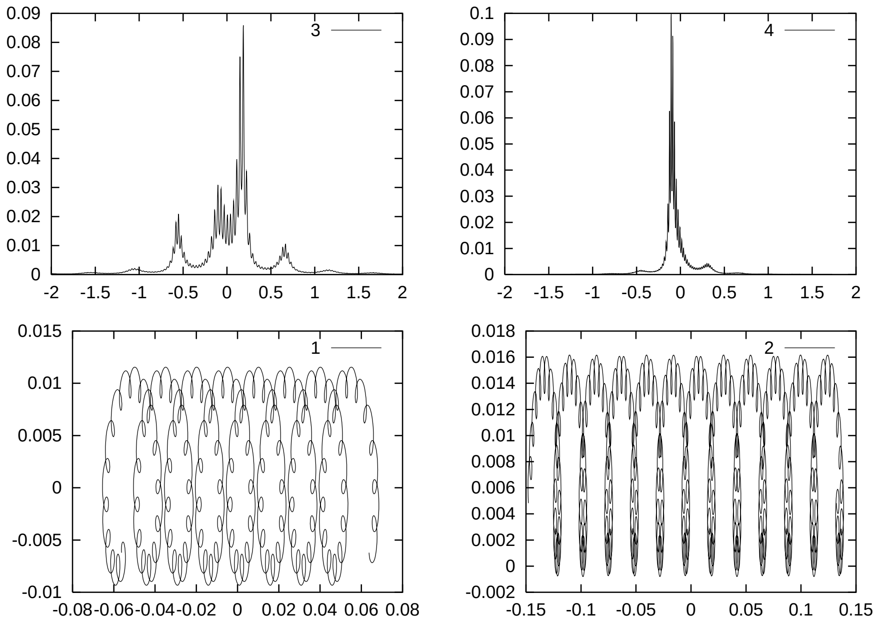

Figure 5: *Down : Label 1 and 2, two different bi-dimensional angle Spinning, Precessing Gamma Jet ring patterns toward the detector at the origin* $(0, 0)$*. Up: Label 3-4, the consequent X,* γ *intensity time evolution signals derived by ICS formula and characteristic beaming as in the text.*

11 Conclusions

GRBs and SGRs are persistent blazing flashes from light-house thin γ Jet spinning in multi-precessing (binary, precession, nutation) mode. These Jets are originated by NSs or BH in binary system or disk powered by infall matter: the Jet is not a single explosive event even in GRB they are powered at maximal output during SN event.The Jet power is comparable at its peak the γ Jet has a chain of progenitor identities: it is born in most SN and or BH birth and it is very probably originated by very collimated primary muon pairs at GeVs-TeVs energies. These muons could cross the dense target matter around the SN explosions. These muon progenitors might be themselves secondary relics of pion decays or even by more transparent beamed ultra-high energy neutrino Jet originated (by hadronic and pion showering) near the NS or BH. The relativistic muons decay in flight in electron pairs is itself source of GeVs relativistic pairs whose Inverse Compton Scattering with nearby thermal photon is the final source of the observed hard X - γ Jet. The relativistic morphology of the Jet and its multi-precession is the source of the puzzling complex X-γ spectra signature of GRBs and SGRs. Its inner internal Jet contain, following the relativistic Inverse Compton Scattering, hardest and rarest beamed GeVs-MeVs photons (as the rarest EGRET GRB940217 one) but its external Jet cones are dressed by softer and softer photons. This onion like multi Jets is not totally axis symmetric: it doesn't appear on front as a concentric ring serial; while turning and spraying around it is deformed (often) into an elliptical off-axis concentric rings preceded by the internal Harder center leading to a common Hard to Soft GRBs (and SGRs) train signal. In our present model and simulation this internal effect has been here neglected without any major consequence. The complex variability of GRBs and SGRs are simulated successfully by the equations and the consequent geometrical beamed Jet blazing leading to the observed $X-\gamma$ signatures. As shown in fig 5 the slightly different precessing configurations could easely mimic the wide morphology of GRBs as well as the surprising rare X-ray precursor shown in Fig.1-4 above.

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