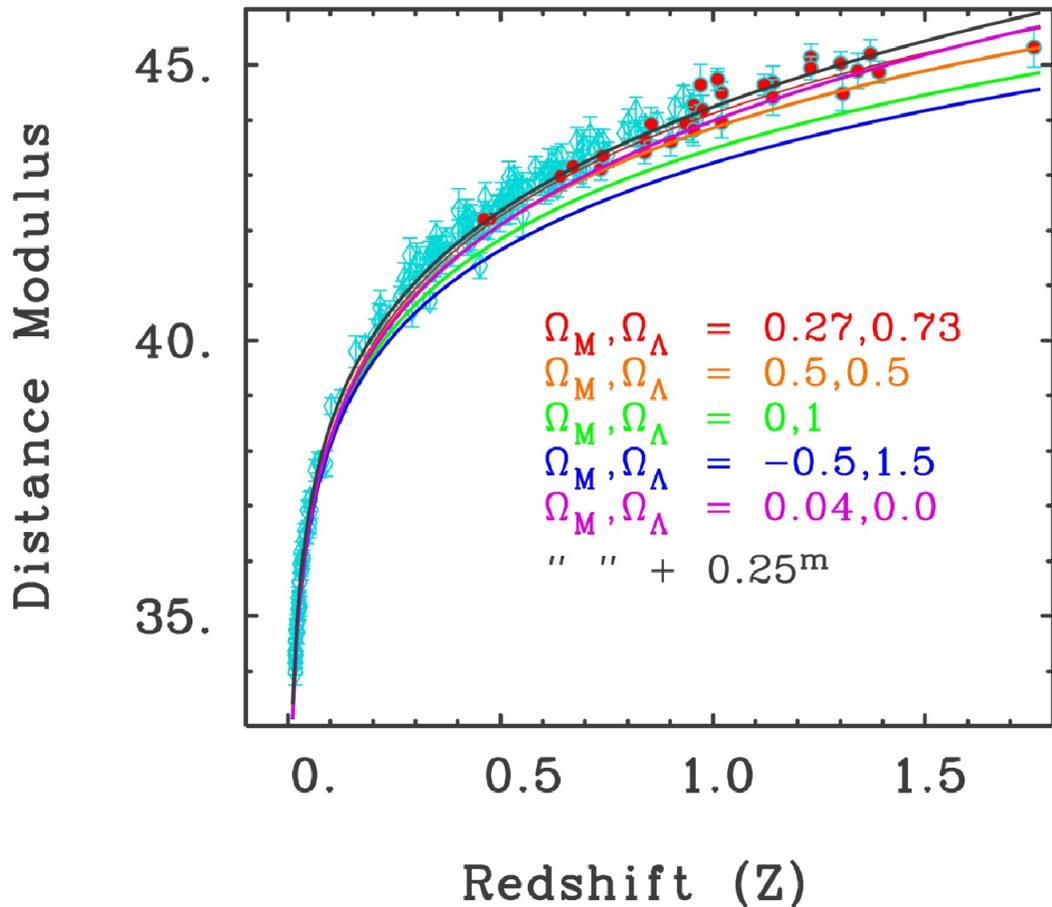


# Pulsar-driven Jets and the Non-existence of Dark Energy and Matter

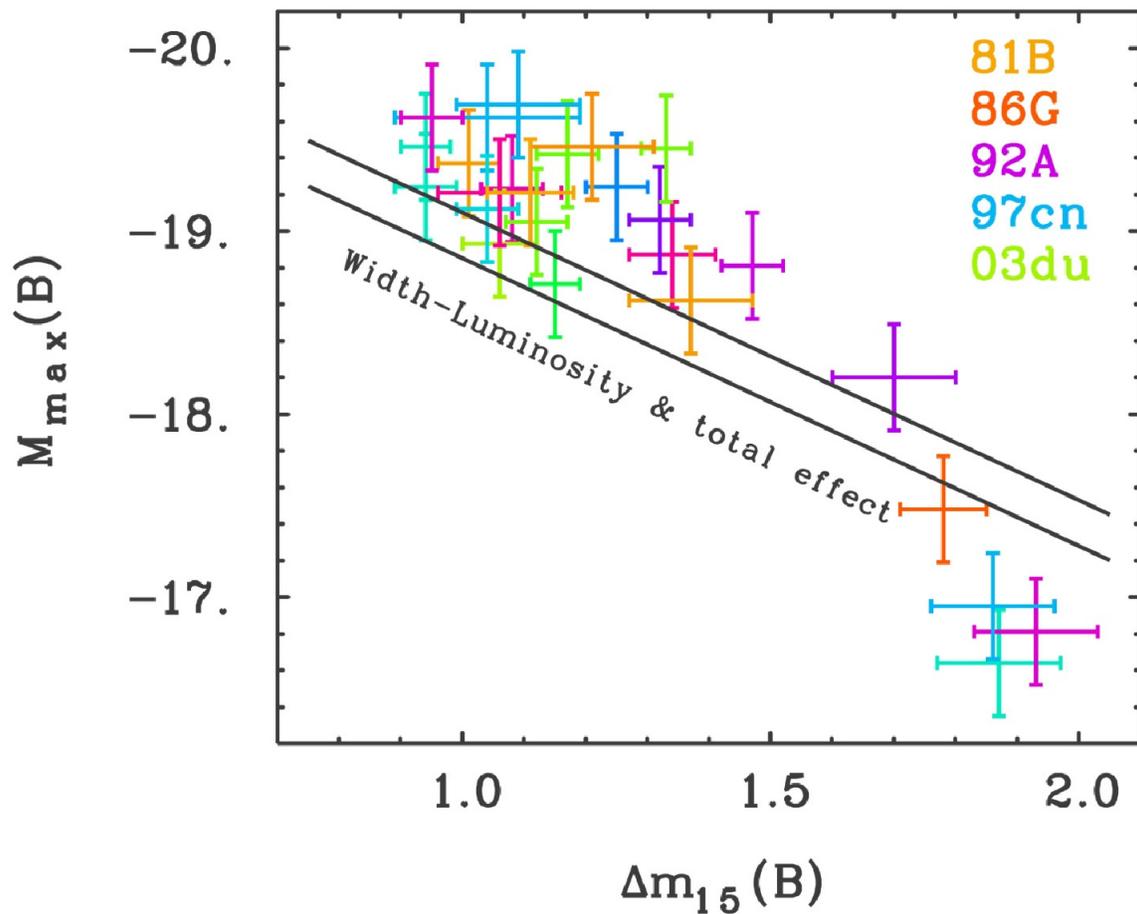
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The bipolarity of Supernova 1987A and other SNe can be understood in terms of its very early light curve as observed from the CTIO 0.4-m telescope, as well as the IUE FES, and the slightly later speckle observations of the “Mystery Spot” by two groups. These observations and the resulting kinematic solution support pulsar emission from polarization currents induced beyond the pulsar light cylinder by the periodically modulated (at many times the speed of light) electromagnetic field (supraluminally induced polarization currents – SLIP). With plasma available at many times the light cylinder radius, as would be the case for a spinning neutron star formed at the center of its progenitor, pulsed emission is directed close to the rotation axis, eviscerating this progenitor remnant, and continuing for months to years, until very little circumpulsar material remains. There is no reason to suggest that this evisceration mechanism is not universally applicable to all SNe with gaseous remnants remaining, forcing SNe into a geometry consisting of two polar jets and an equatorial torus, of which the former almost never encapsulate  $^{56}\text{Ni}$   $e^+/e^-$   $\gamma$ -rays well, and the latter, in the case of SNe Ia, only for those with the largest mass in excess of that lost to core-collapse. A large fraction of SNe Ia will therefore lie considerably below the width-luminosity relation, complicating their usefulness as standard candles in cosmological interpretation, and possibly accounting for their apparent anomalous dimming with distance. Pulsar-driven jets from the SNe of the first stars also allow star clusters to form without the need for dark matter. SLIP also accounts for GRBs, the Sco X-1 and SS 433 jets, LMXBs, and predicts that GRB afterglows are 100% pulsed at  $\sim 500 \text{ Hz}/(1+z)$ .



The cosmological constant and mass contributions derived from distant SNe Ia are extraordinarily sensitive to the calibration of the luminosities of local SN Ia. There is also very little difference between  $\Omega_\Lambda, \Omega_M = 0.73, 0.27$  and  $0.0, 0.04$ , and a small 0.25 magnitude decrease in the local luminosity more than erases the difference between the two cosmologies.

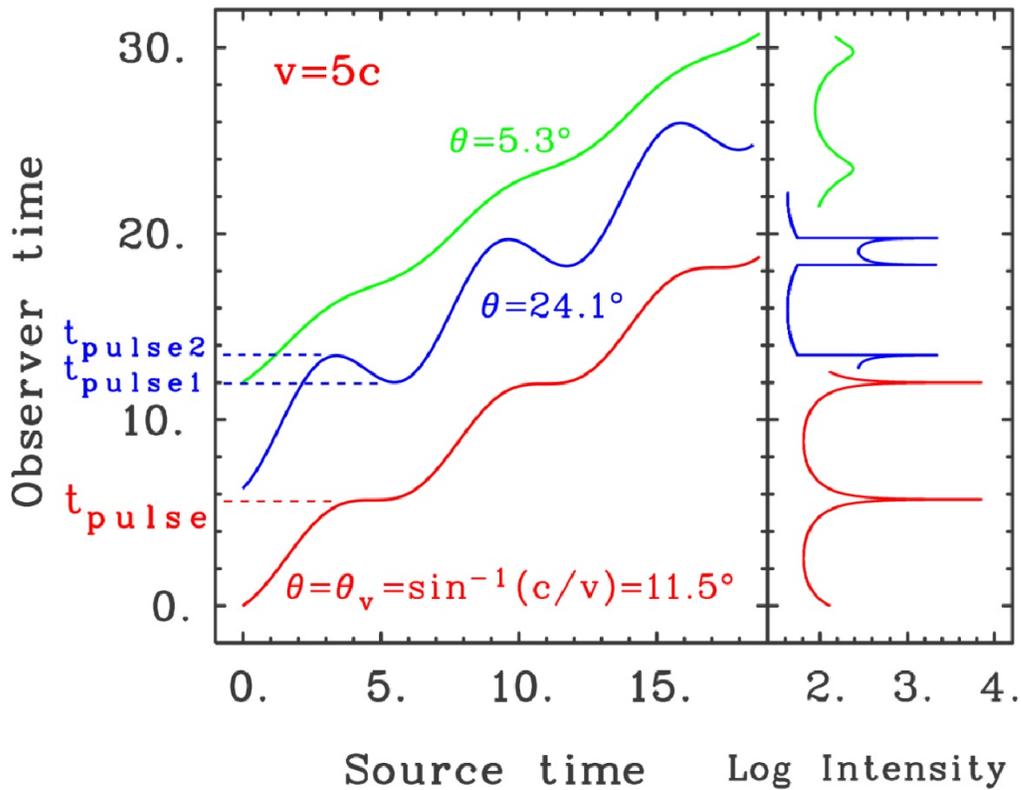


The only hope for standardizing the local sample of SNe Ia was that they would all adhere to the width-luminosity relation. But then Benetti et al. found in 2005 that this was not the case. By 2007, SNe Ia were found “all over the map,” even in the lower middle part of the above figure (where none are shown). That was the end of only direct evidence that the expansion of the Universe is accelerating. A few choice quotes from the 2007 SN conference about this: “... a little bit of ‘the emperor has no clothes,’” “We keep saying the same thing, but the evidence for it doesn’t get better, and that’s a bad sign.” “There’s a lot of holes in the story.”

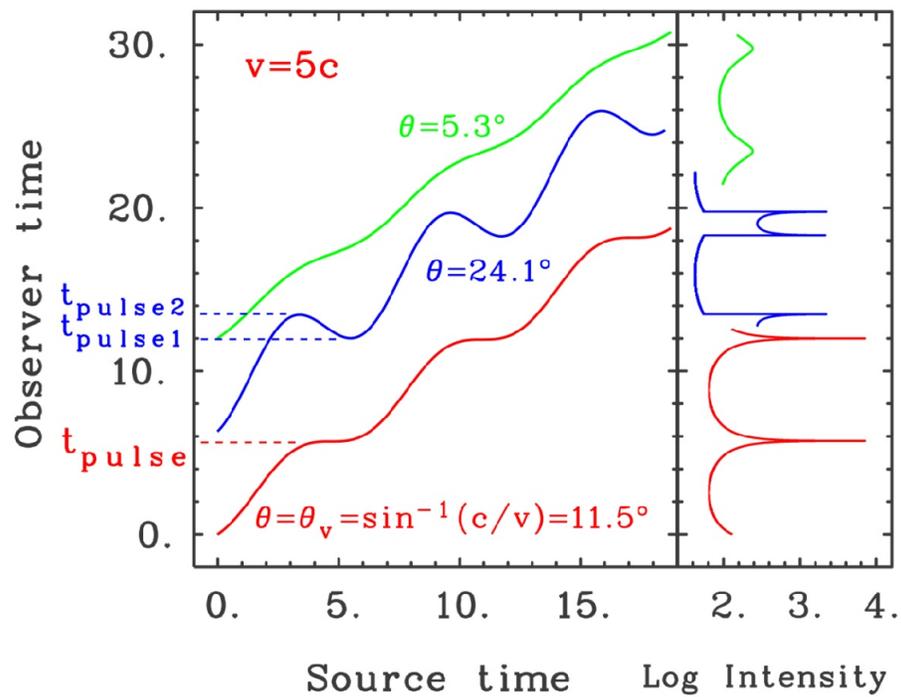
Why did this fail?

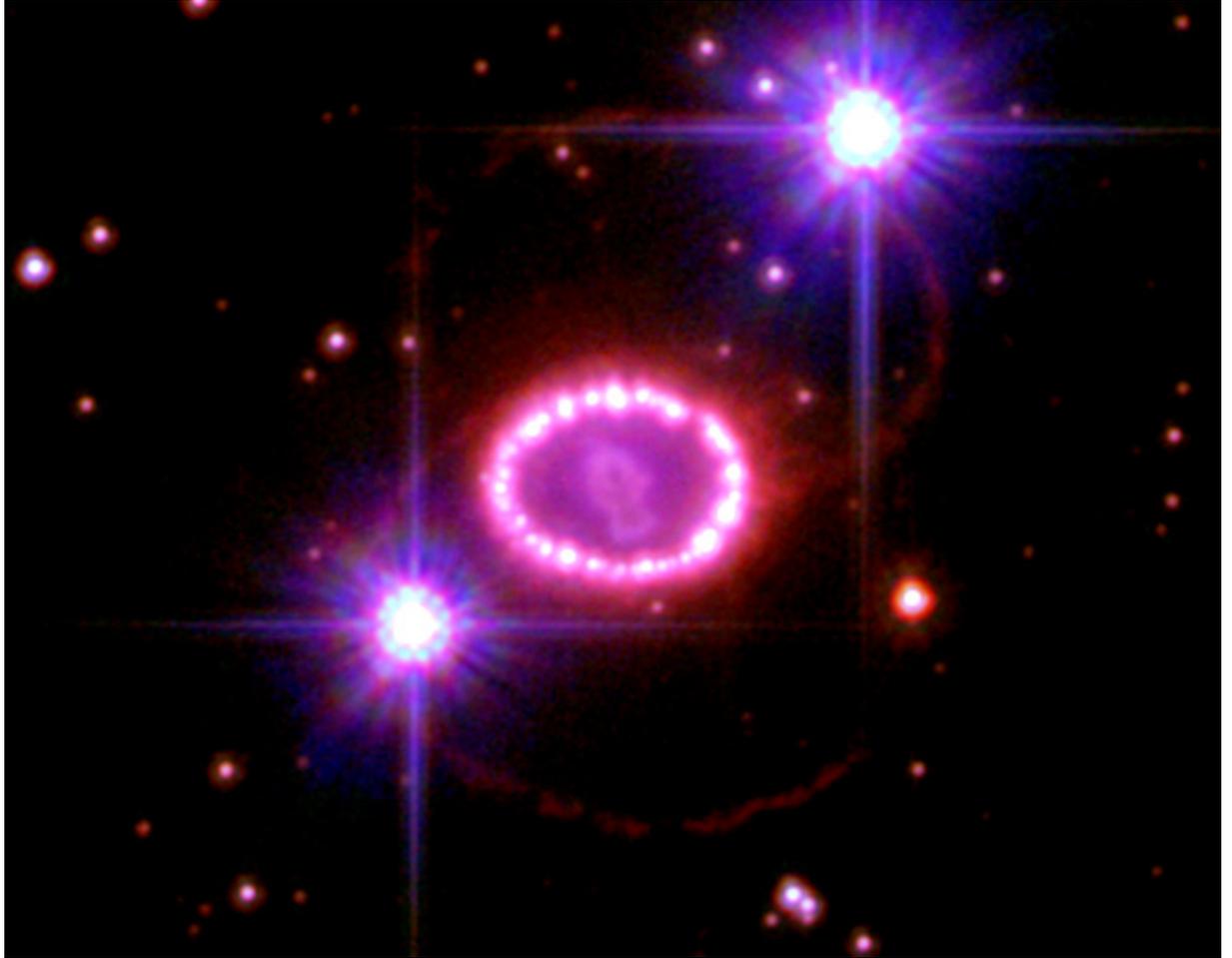
Because of the very nature of SNe!

Start with SN 1987A:



For the lower curve, a time source of finite dimension (1) contributes to a single time (dimension 0) for an observer. Thus the intensity of the pulsations, in the direction represented by this curve (the “**cusp**” -- polar angle  $\theta_v$ ) only as  **$1/\text{distance}$** , and this goes on *forever* for the cusp – the further away the observer, the more source contributes to the signal. For observers at larger polar angles, as for the middle curve, two still narrow peaks are observed in the pulse profile, and the intensity drops with the usual  **$1/\text{distance}^2$**  law. At smaller polar angles (top curve), the pulse profile consists of only a broad, weak, single peak.





SN 1987A as of December 2006, as viewed with the HST (NASA, P. Challis, & R. Kirshner, Harvard-Smithsonian Center for Astrophysics). North is up, east is to the left. The axis of the bipolarity corresponds to the “Mystery Spot” bearing of  $194^\circ$  (the far-side [southern] minor axis of the equatorial ring has a bearing of  $179^\circ$ ). The pulsar within **this** remnant (and **all** other remnants as well) **caused** this bipolarity (see further below).

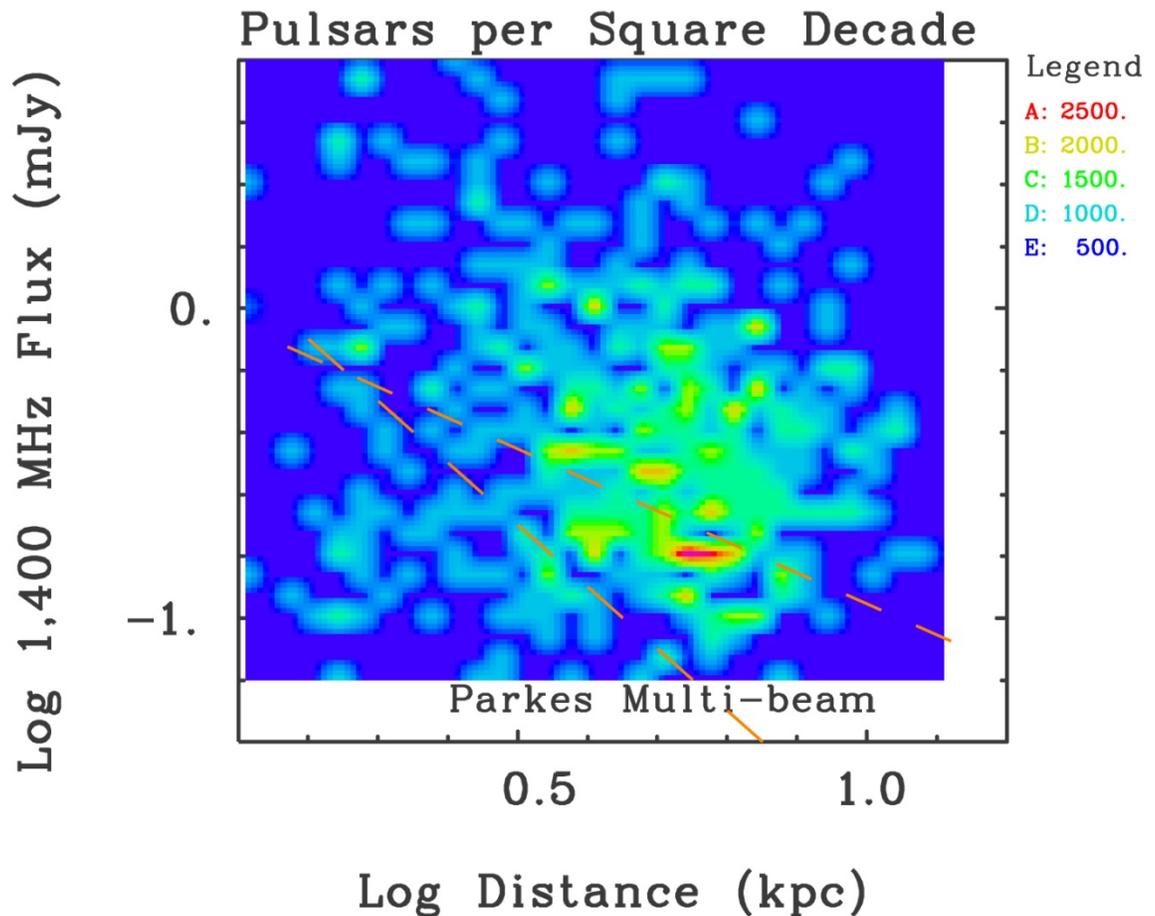
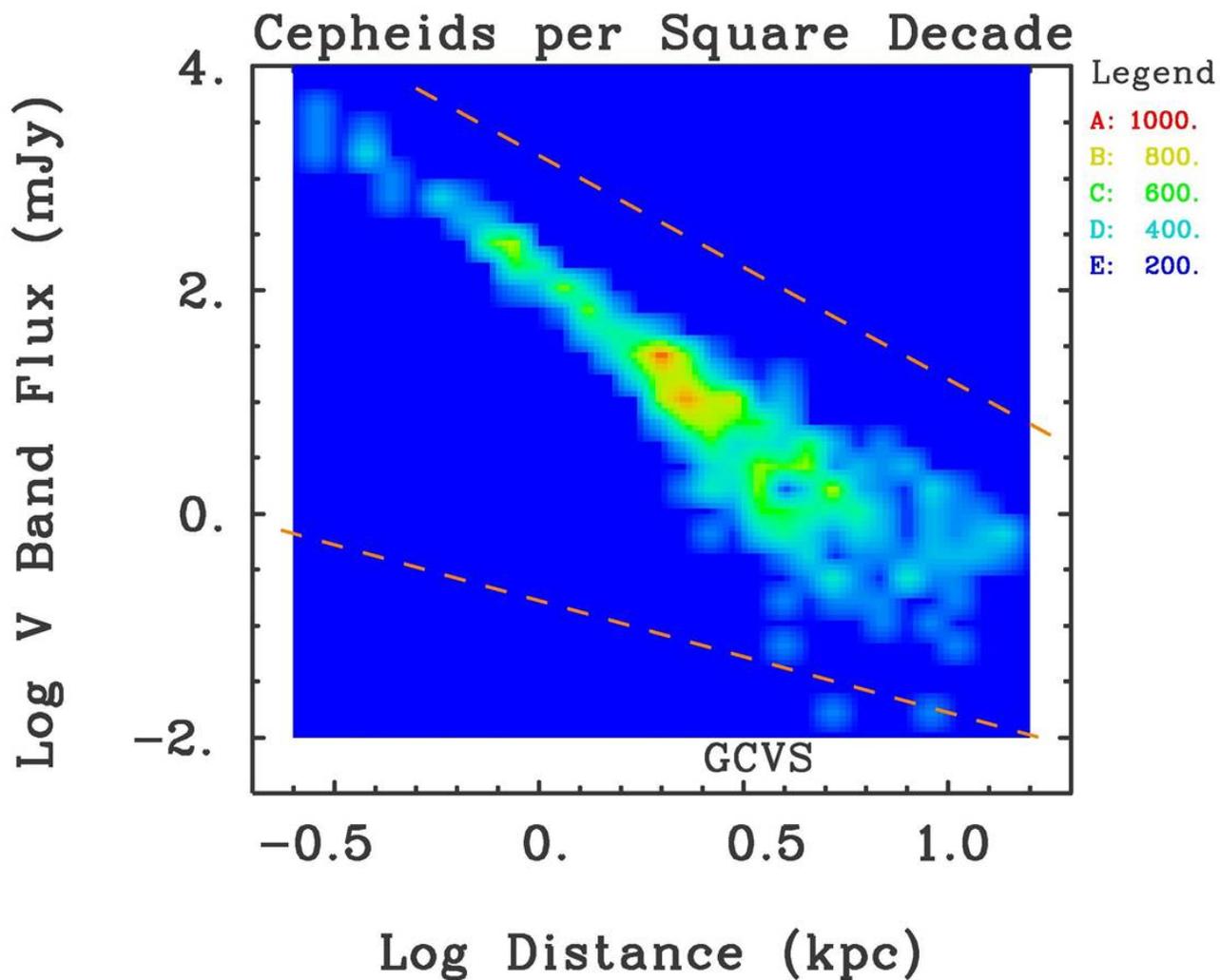
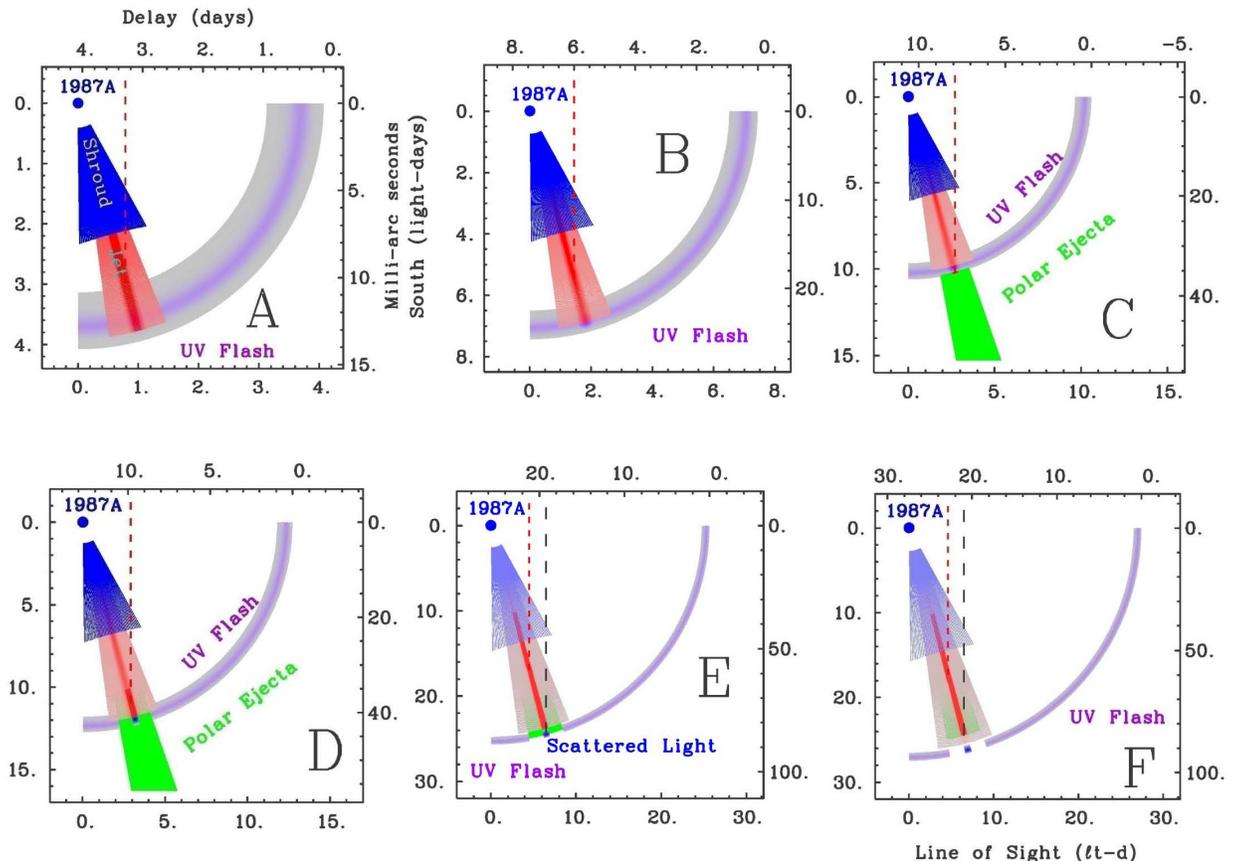


Fig. 2. Pulsars dim only as  $1/\text{distance}$  in certain directions. This remarkable fact was *predicted* in H. Ardavan's Superluminally Induced Polarization Current Model (SLIP -- H. Ardavan, 1998, Phys. Rev. E., 58, 6659), but the effect has been known for decades ("Curved electromagnetic missiles"). This has been demonstrated in the field, and is also confirmed by the Parkes Multibeam Survey pulsars shown in this figure. There is no way that the steeper **dashed line** (with slope of -2) can bisect the nearby pulsar population and still bisect the distant pulsar population, even accounting for those pulsars which are undetected due to instrumental sensitivity (but lines of slope -1 and -1.5 can). In effect, there are too many faint, nearby pulsars for the overall distance law to be inverse square.



By contrast the **Cepheids** follow a **distance law** at least as steep as -2 (distances thanks to **Eduardo Amores**).



The progression of the **beam** and **jet** from SN 1987A for times corresponding to Fig. 11. At ‘A’ the **beam** and **jet** expand freely. By ‘B’ the jet expands and cools, or loses the ability to do so, resulting in a diminishing luminosity. At ‘C’ the **beam** impacts the **polar ejecta** (PE) and reprocesses, producing an impulse of light. By ‘D’ the jet has penetrated into the PE, producing another uptick of light following the decay of the 1<sup>st</sup> uptick at day 7.8. By ‘E’ the **beam** has broken through the PE and scattered light produces yet another uptick of light around day 19.3 or so. In another day, the **jet** has cleared the PE, resulting in a decrement of the light near day 20.8. The 1 day lag out of in 20 means that the fastest **jet** particles are moving at 95% of the speed of light.

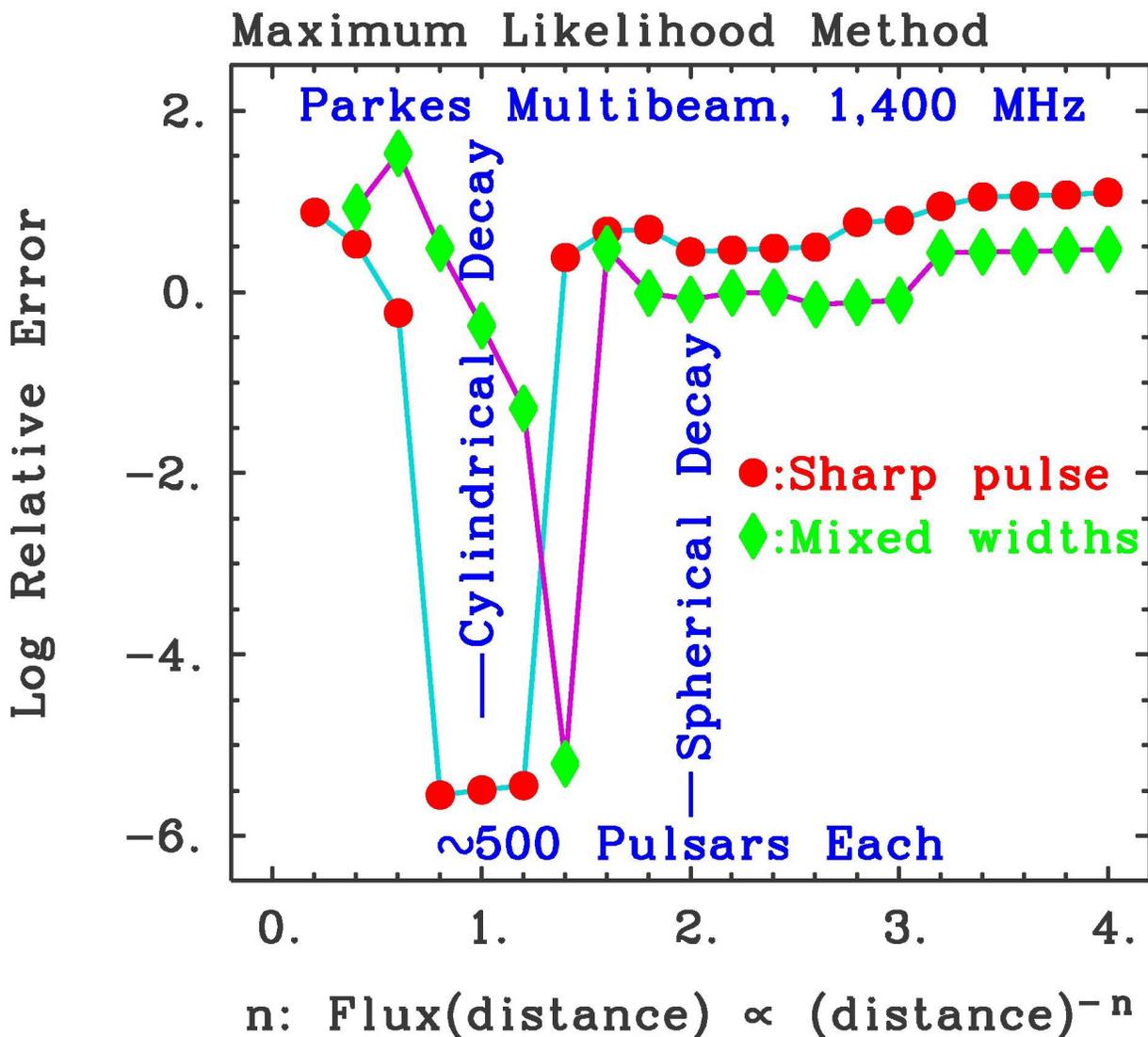
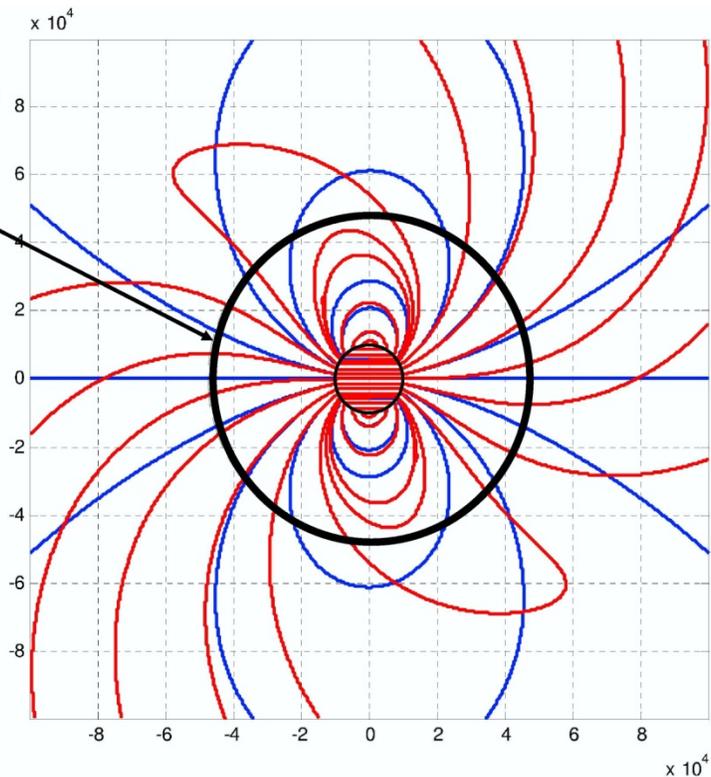


Fig. 3. The method of Efstathiou et al. (1988) as applied by Singleton et al. [arXiv:0912.0350] shows that those pulsars in the Parkes Multibeam Survey with sharp pulses (full width half maxima  $< 3\%$  of their periods) dim only as  $1/\text{distance}$ , while those with wider pulses are displaced toward  $\text{distance}^{-2}$  as predicted by SLIP.

Polarization currents outside the light cylinder are induced by the electric field produced by the rotating magnetic field. These currents are updated faster than the speed of light.



(Blue – non-rotating. Red – rotating clockwise.)

Fig. 4. A rotating, magnetized body produces a periodic disturbance, even beyond its light cylinder, which, if there is plasma available, induces polarization currents that are updated at a rate faster than the speed of light. **There are no open field lines.**

With a source orbiting at  $5 \times LC$  radius, the emission in its history, from 10 hr 20 m to 1 o'clock, all contribute to a spot tangent to the LC near 2 o'clock.

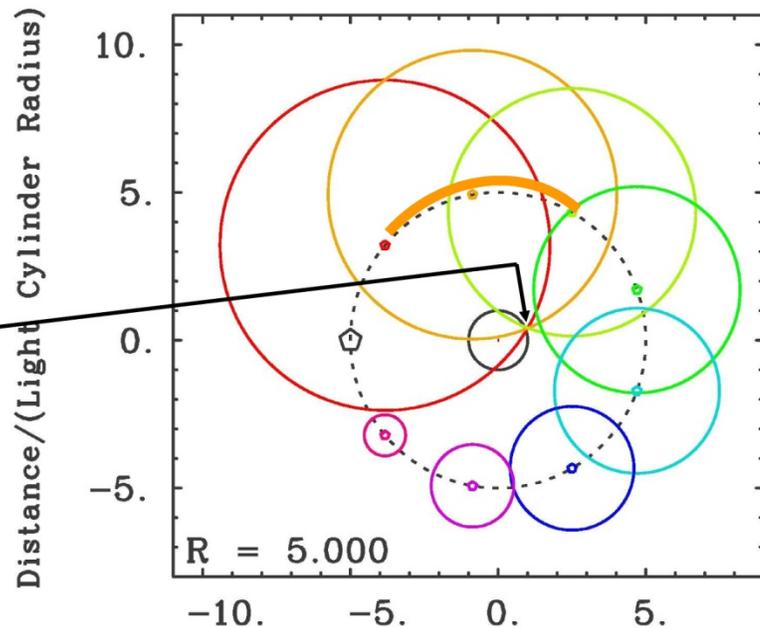


Fig. 4. A polarization current source, rotating clockwise, at 5 times the light cylinder radius. Contributions to the cusp run from  $140^\circ$  to nearly  $20^\circ$ , almost a third of an entire revolution. This is the well-known “cusp” of the SLIP model, whose intensity diminishes only as  $1/\text{distance}$  due to temporal focusing. It is the circular analog of a shock wave. The range of sources contributing to the cusp (a single *point* of observer time) runs from  $140^\circ$  to  $20^\circ$ , a *third* of an entire revolution.

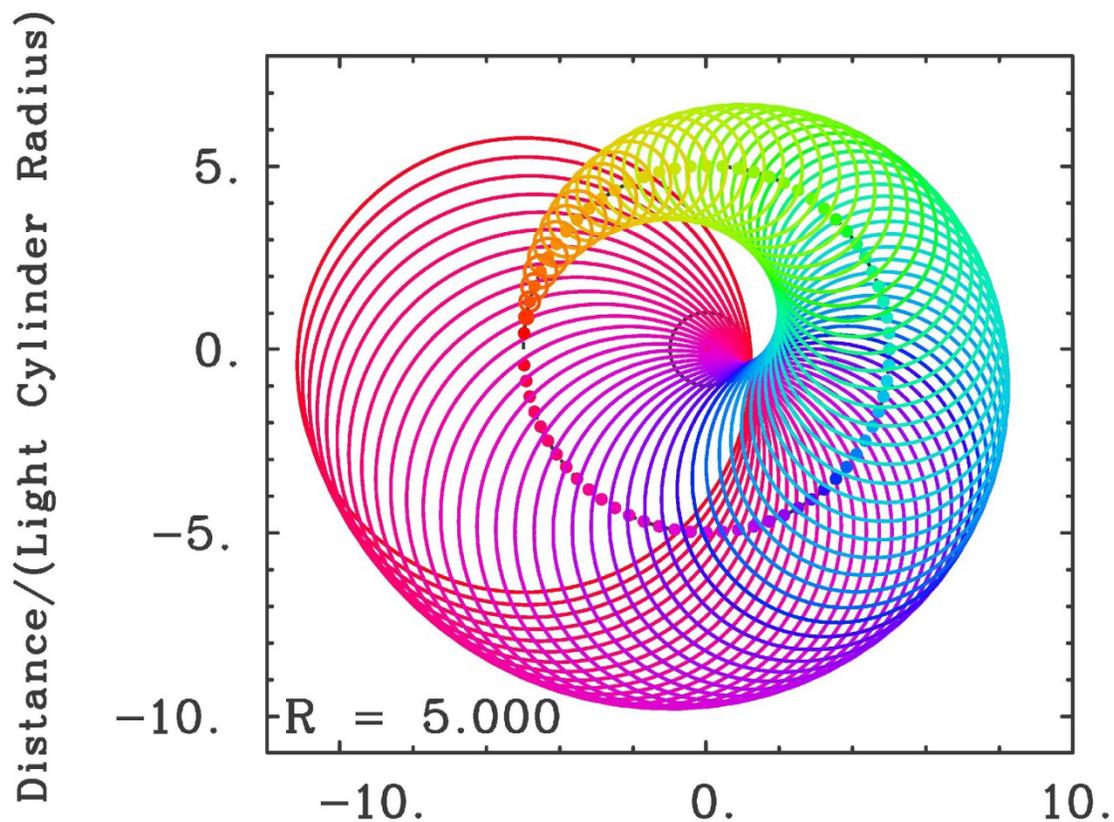


Fig. 5. A polarization current source, now rotating counterclockwise at 5 times the light cylinder radius, starting just  $>180^\circ$ , and ending at just  $<180^\circ$ , produces a pattern of emission (Huygens wavelets as colored circles) which is initially focused on its light cylinder (inner circle) just  $<360^\circ$ , and then progresses out of the plane with time (see next). The range of sources (dots), contributing to the cusp, runs from red through magenta to blue ( $180^\circ$  to  $320^\circ$ ), again a *third* of an entire revolution.

Huygens' wavelets for a polarization current source rotating counterclockwise at 5 times the light cylinder radius ( $v=5c$ ), starting at 9:10 o'clock (bottom frame, left largest red circle), and ending at 7 o'clock (top frame, magenta dot), produces a pattern of emission which is initially focused (a "cusp") on its light cylinder (inner black circle) at 11:30 o'clock (middle frame), and then progresses to 12:30 o'clock (and eventually out of the plane with time with an angle of  $\sin^{-1}(v/c)$ ). The range of sources (dots), contributing to the cusp, runs from red into green and eventually into blue (9:10 o'clock to 3 o'clock). **This is a rotation-powered pulsar.** If  $v=100c$  (plasma at 100 light cylinder radii), **this is a supernova.** If you get in front of this, you, and a lot of starguts, will end up going very, very fast.

If a pulsar is born within a star, there will be plasma at many light cylinder radii, thus one would expect the pulsed beam to be close to the rotation axis, *right down the gunsight*. This may be the GRB mechanism, and what blows out the poles of SNe.

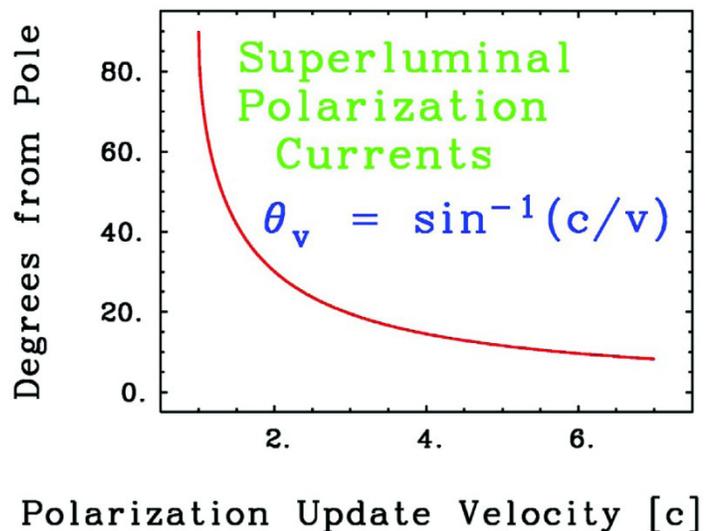


Fig. 6. The reason why SNe are bipolar is because of what the pulsar within them does in the 1<sup>st</sup> few months. Pulsars are a significant, and unignorable part of the SN process, and SN calculations are orders of magnitude more difficult than ever imagined.

The pulsations propagate out on the cone of half angle,  $\theta_v$ , somewhat like a bedspring. This half angle may have caused the 30° misalignment between 87A's bipolarity and normal to its equatorial ring.

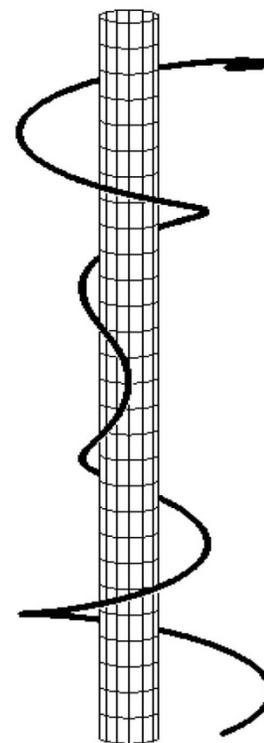


Fig. 6.5

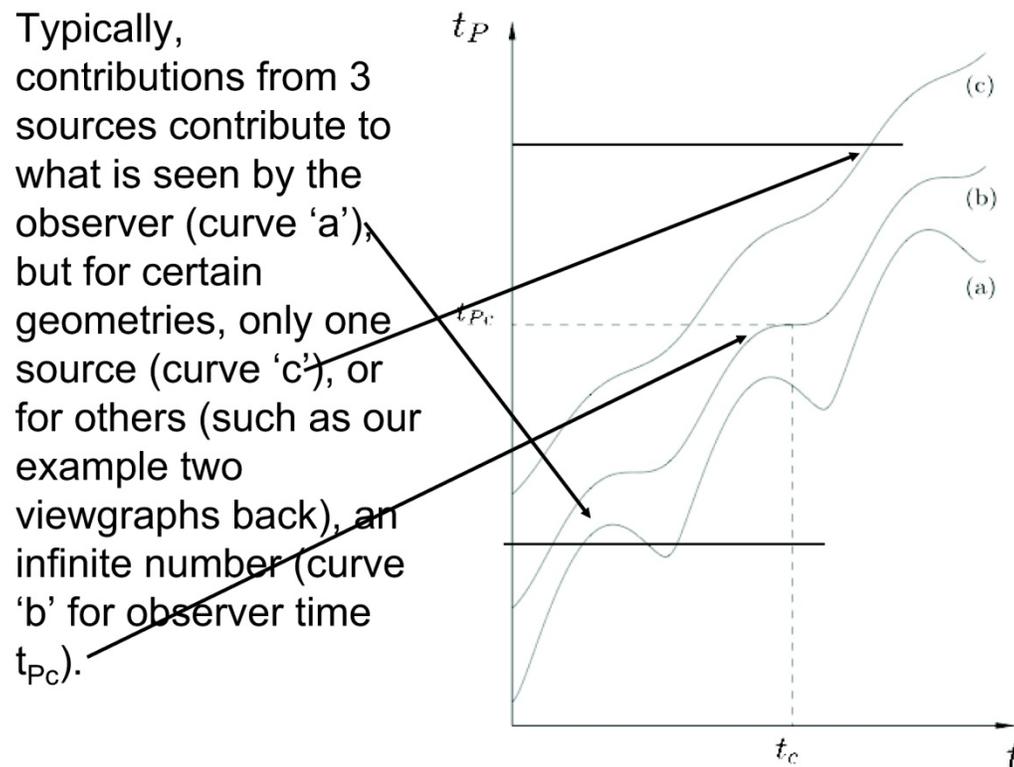


Fig. 7. For curve (b), a time source of finite dimension, (1) contributes to a single time (dimension 0) for an observer. Thus the  $1/\text{distance}$  law goes on *forever* for the cusp -- the further away the observer, the more source contributes to the signal.

In the SLIP model, the pulse profile comes from the same 3 sources. These produce the typical, cusped, doubly-peaked profile, and predict that **all** singly-pulsed profiles are **actually doubles**.

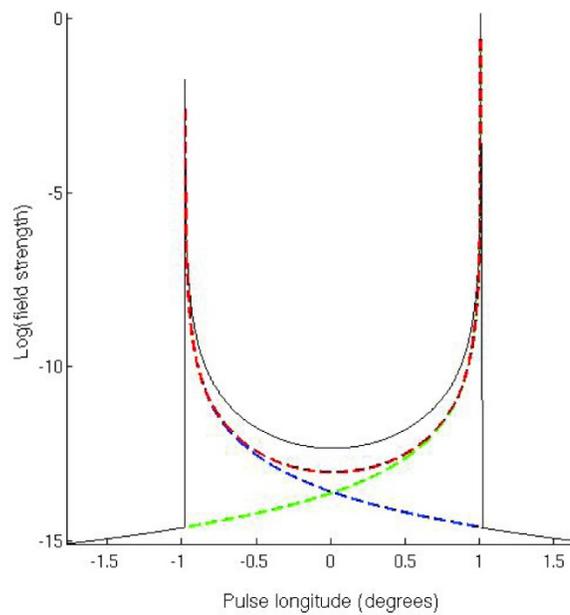


Fig. 8

The pulse profile of PSR J0537-6910 (16.1 ms) tends to progressively split, if allowed, over successive iterations which generate a new master fitting pulse each time, consistent with the prediction of the SLIP model. Proving this is meaningful will be the hard part.

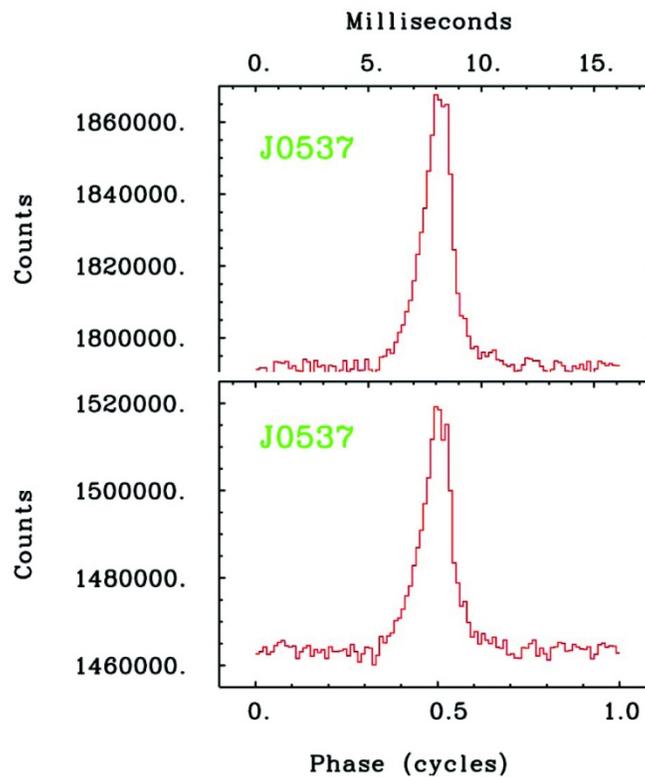


Fig. 9

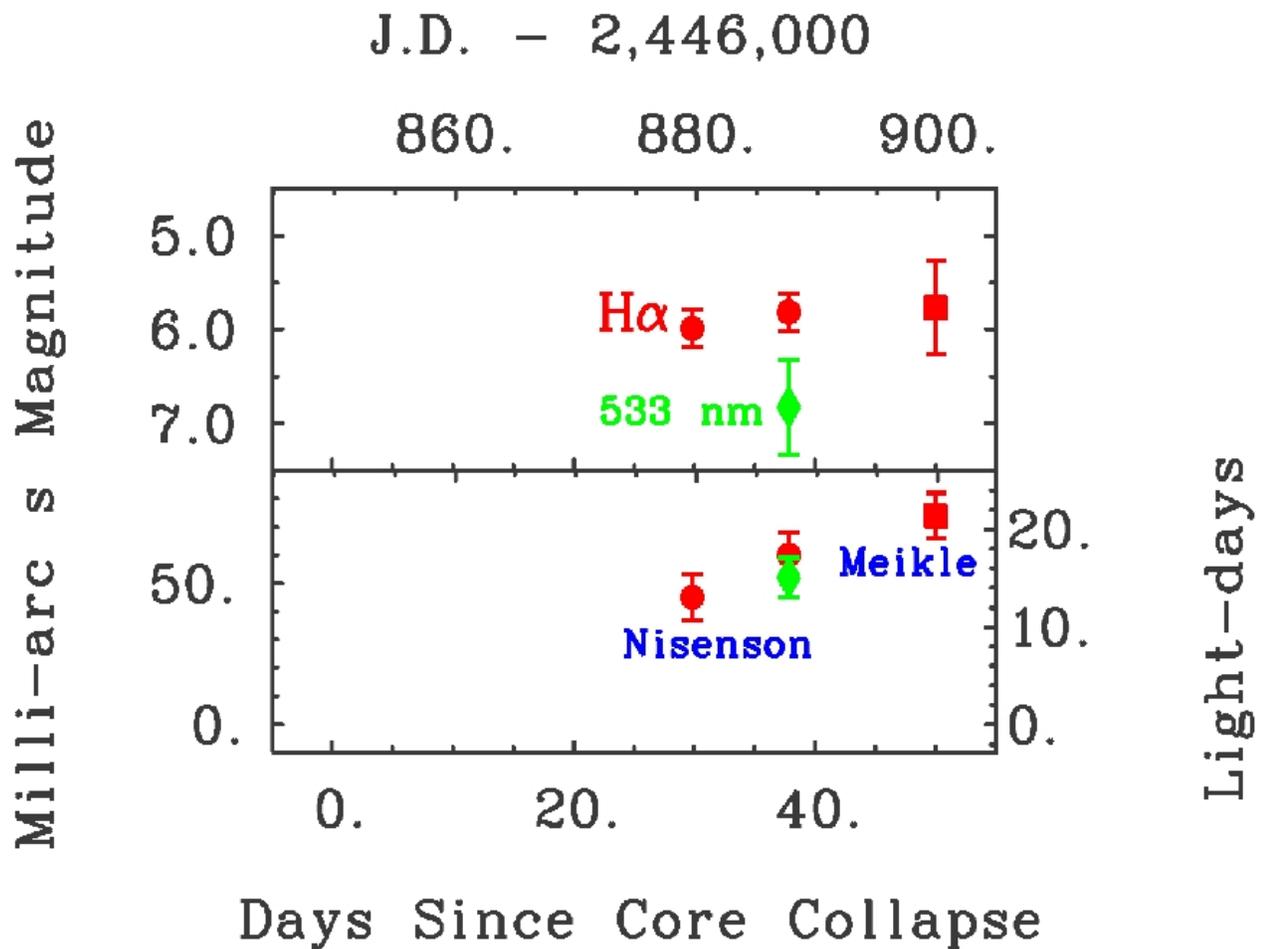
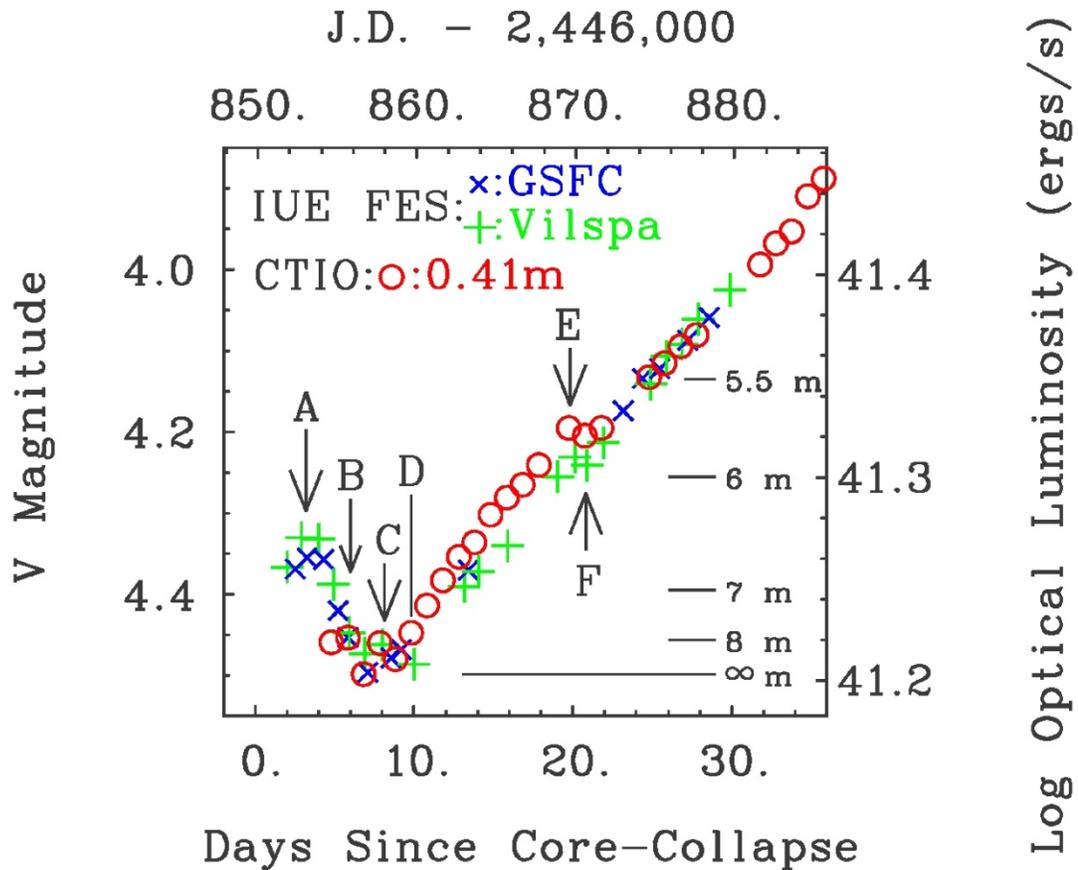


Fig. 10. Measurements of displacement (lower) and observed magnitude (upper) of the “Mystery Spot” (MS) from SN 1987A, at H $\alpha$  and 533 nm, vs time, from Nisenson et al. 1987, ApJ, 320, L15, and Meikle et al. 1987, Nature, 329, 608.



After Hamuy & Suntzeff 1990, *AJ*, 99, 1146, and Wamsteker et al. 1987, *A&A*, 177 L21, the very early luminosity history of SN 1987A as observed with the CTIO 0.41-m and the Fine Error Sensor of IUE. Data taken at Goddard Space Flight Center by Sonneborn & Kirshner, and the Villafranca Station in Madrid, are marked as blue X's, and green + 's, respectively. Various stages of beam/jet breakout and interaction with polar ejecta are labeled. The flux level near day 20 corresponds to 5.8 magnitudes above the day 7 minimum, the *same* (see Fig. 10) as that of the MS in H $\alpha$  measured near days 30, 38, and 50.

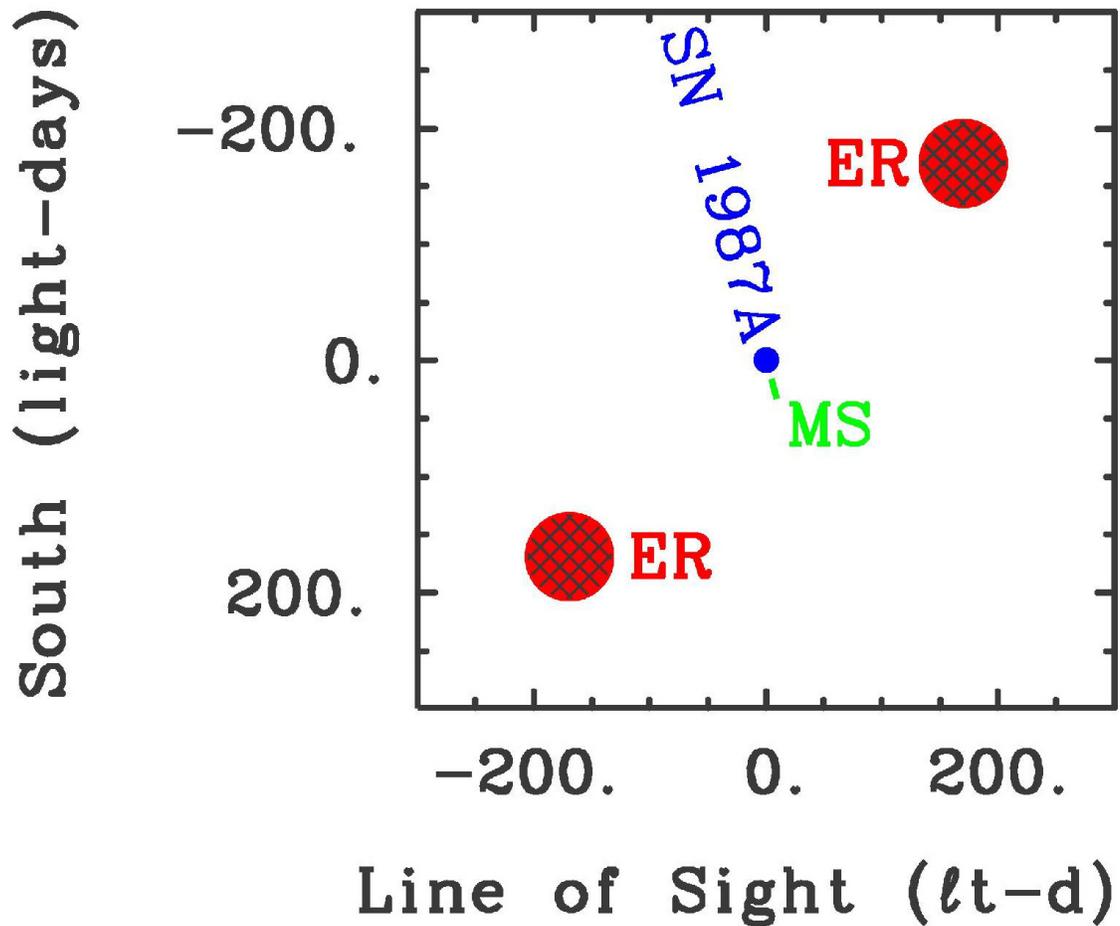


Fig. 12. The approximate path of the “Mystery Spot” (MS) relative to SN 1987A and the equatorial ring (ER -- shown in cross-section).

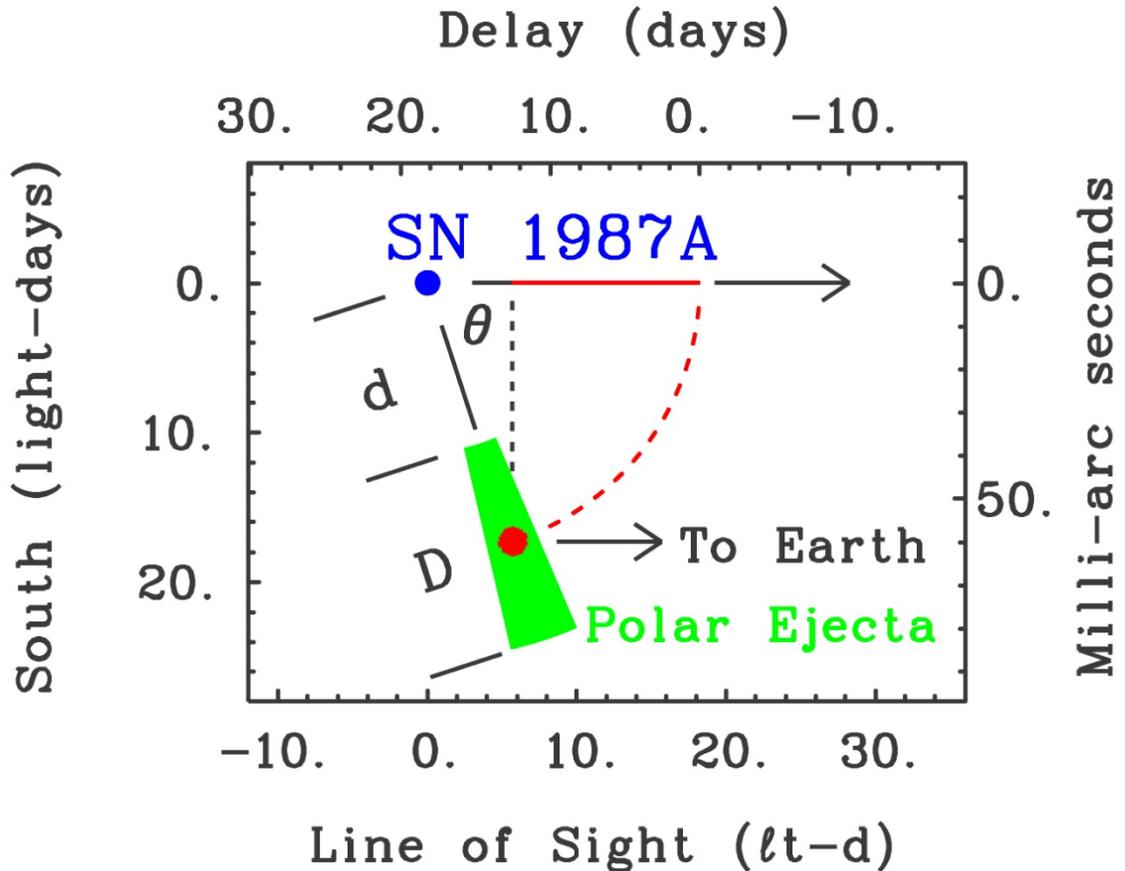


Fig. 13. The geometry of the “**Mystery Spot**,” (**MS** – red dot) associated beam/jet, and direct line of sight from **SN 1987A**. It takes an extra 8 days for light from **87A** to hit the **polar ejecta** (**PE** – an extra 13 days to the **PE** midpoint), and proceed on to the Earth. The distance from **87A** to the **MS**, at day 30, is  $\sim 20$  light-days. An offset by the  $0.5^\circ$  half collimation angle of a GRB over this distance would delay the flux by about 100 s, the characteristic delay for long duration, soft spectrum GRBs ( $\ell$ GRBs).

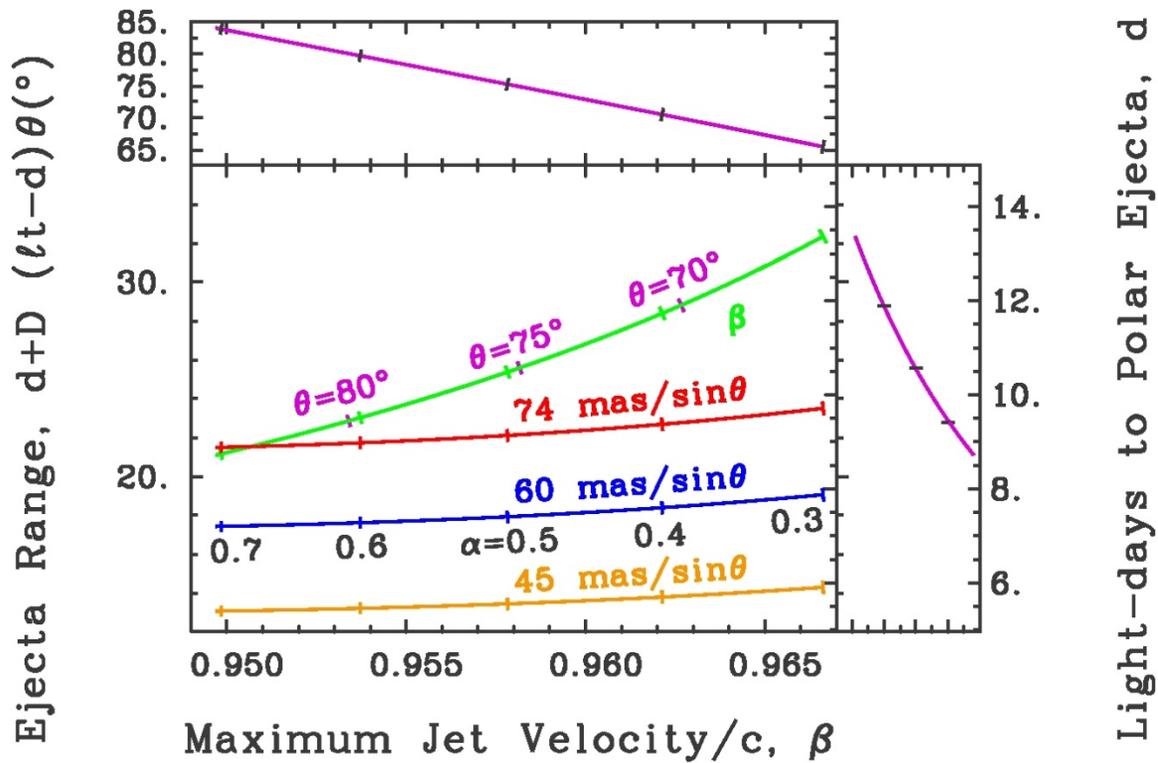
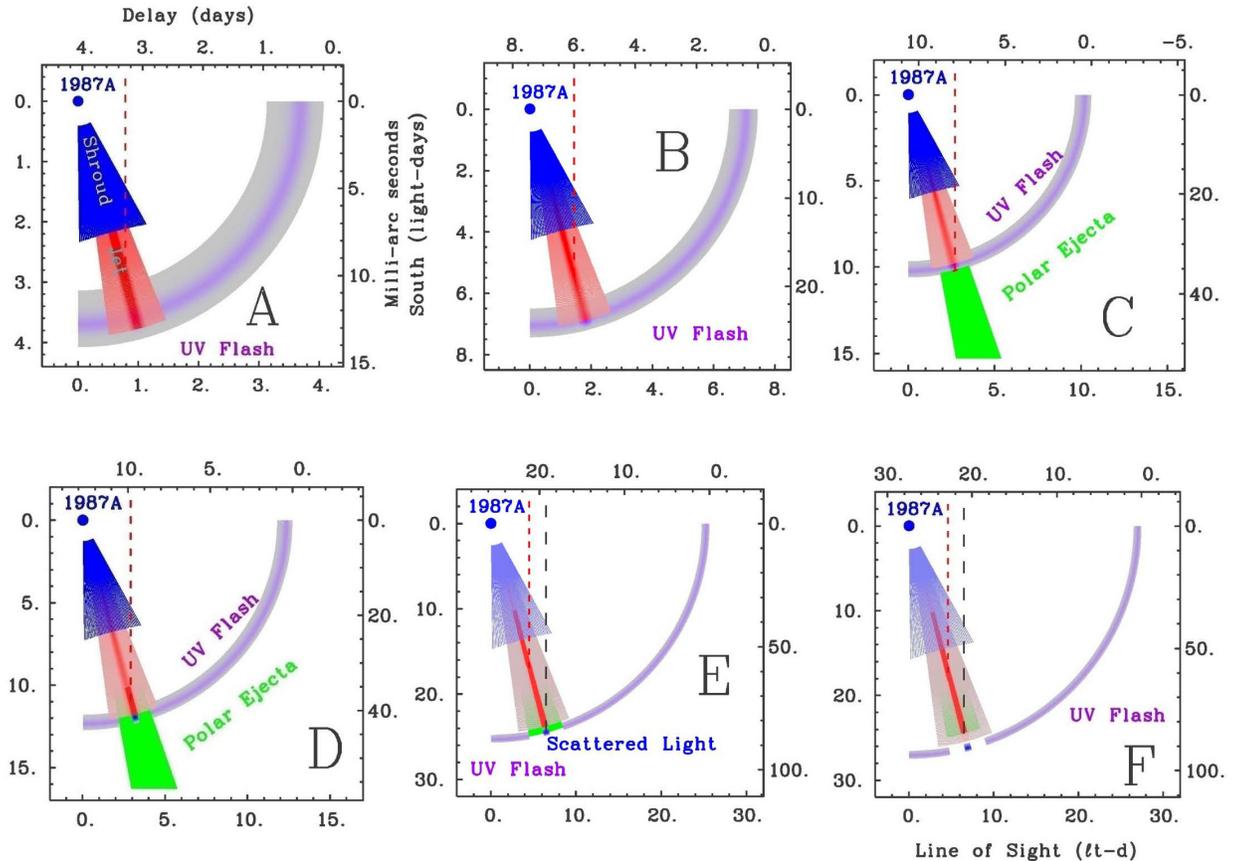


Fig. 14. We solve for the geometry of the beam/jet (green curve) from SN 1987A (as diagrammed in Fig. 13) using the constraints shown in Figs. 10 and 11. Here  $\alpha$  is the fraction of the way through the polar ejecta that the Mystery Spot had penetrated at day 37.8, when its projected offset from SN 1987A was 0.060 arc s. The solution for  $\alpha=0.5$  gives:

$$\begin{aligned} \theta &= 75.193^\circ, \\ d &= 10.47738 \text{ lt-d}, \\ D &= 14.888 \text{ lt-d}, \\ \beta_{\text{max}} &= 0.9578. \end{aligned}$$



The progression of the **beam** and **jet** from SN 1987A for times corresponding to Fig. 11. At 'A' the **beam** and **jet** expand freely. By 'B' the jet expands and cools, or loses the ability to do so, resulting in a diminishing luminosity. At 'C' the **beam** impacts the **polar ejecta** (PE) and reprocesses, producing an impulse of light. By 'D' the jet has penetrated into the PE, producing another uptick of light following the decay of the 1<sup>st</sup> uptick at day 7.8. By 'E' the **beam** has broken through the PE and scattered light produces yet another uptick of light around day 19.3 or so. In another day, the **jet** has cleared the PE, resulting in a decrement of the light near day 20.8. The 1 day lag out of in 20 means that the fastest **jet** particles are moving at 95% of the speed of light.

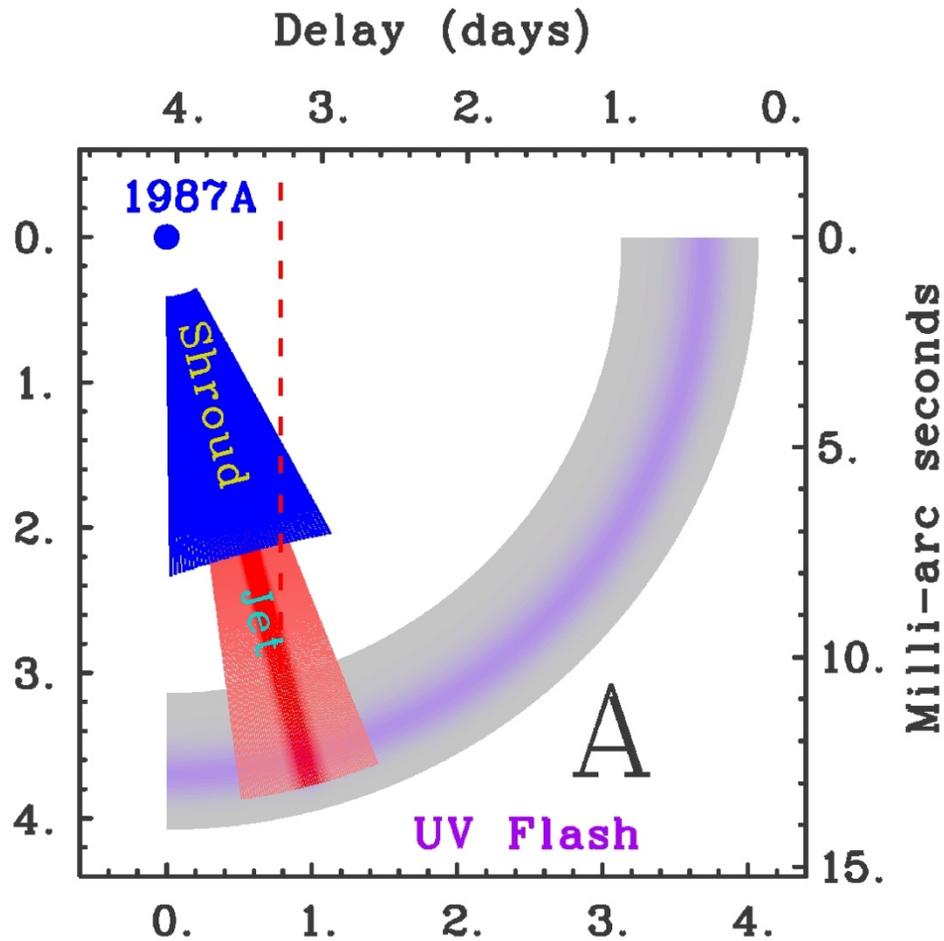


Fig. 15. The geometry of the 87A glowing **beam/jet** (BJ), initially opaque **shroud**, and **UV Flash** (which may have an enhanced **beam** of its own in the **jet** direction (here  $75^\circ$ , down and to the right)). The center of the emerging **jet** produces the rising luminosity shown in Fig. 11 at day 3.3 (read on the upper, delay scale). The maximum velocity of the **jet** is  $0.95 c$ . That of the **shroud**, was arbitrarily set to  $0.55 c$ . Because of the short time response of the luminosity shown in Fig. 11, the full angular width of the **jet** has been set to  $\sim 1^\circ$ .

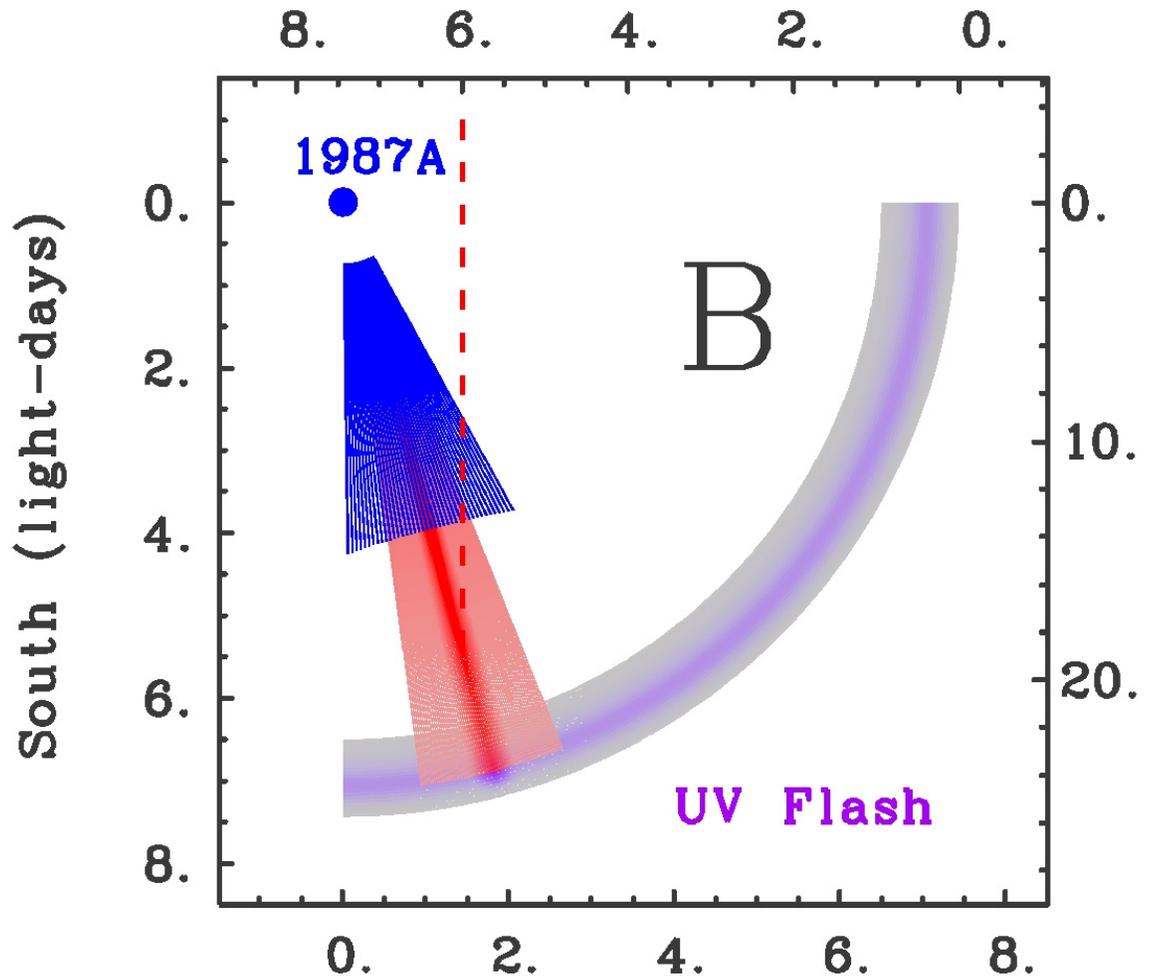


Fig. 16. The configuration in which the light from the center of the exposed part of the now fading **jet** lies on the dropping luminosity curve at day 6 (point 'B' in Fig. 11).

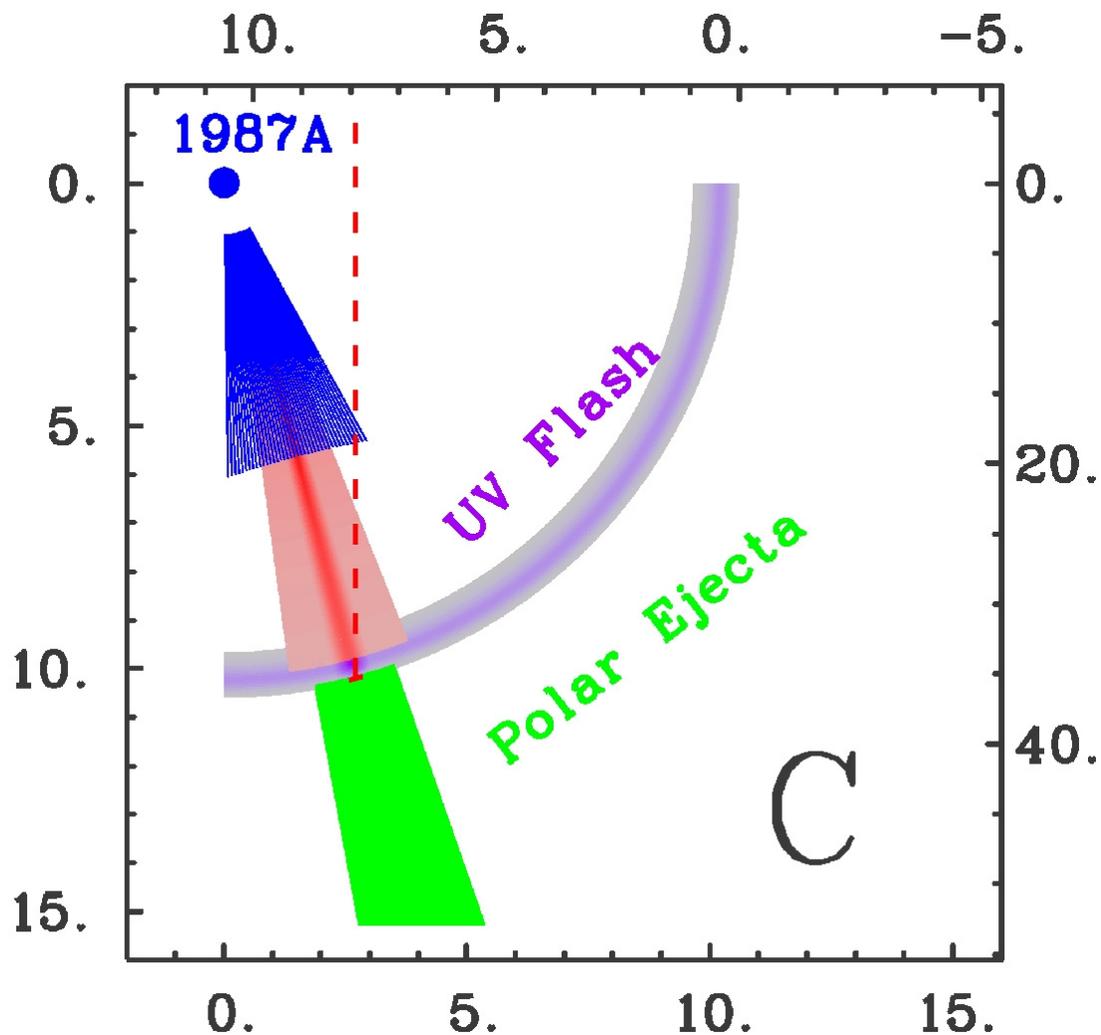


Fig. 17. The intense beam from the pulsar scatters and reprocesses off the **polar ejecta (PE)**, producing the jump in luminosity at day 7.8 (top scale for the **tiny red disk** in the **PE** and 'C' in Fig. 11 –  $\sim 2 \times 10^{39}$  ergs/s for a day). A polar ejecta density of  $10^7 \text{ cm}^{-3}$  would predict that the **UV Flash** part of the beam does not penetrate it deeply, and this is confirmed by the dropoff of luminosity near day 9 in Fig. 11. The **tiny red disk** corresponds to the highly collimated ( $\sim 1^\circ$ ) intense pulsed beam, and can not be much larger all because of the fast rise/drop in luminosity before/after day 8 in Fig. 11, and thus its collimation factor is  $> 10^4$ .

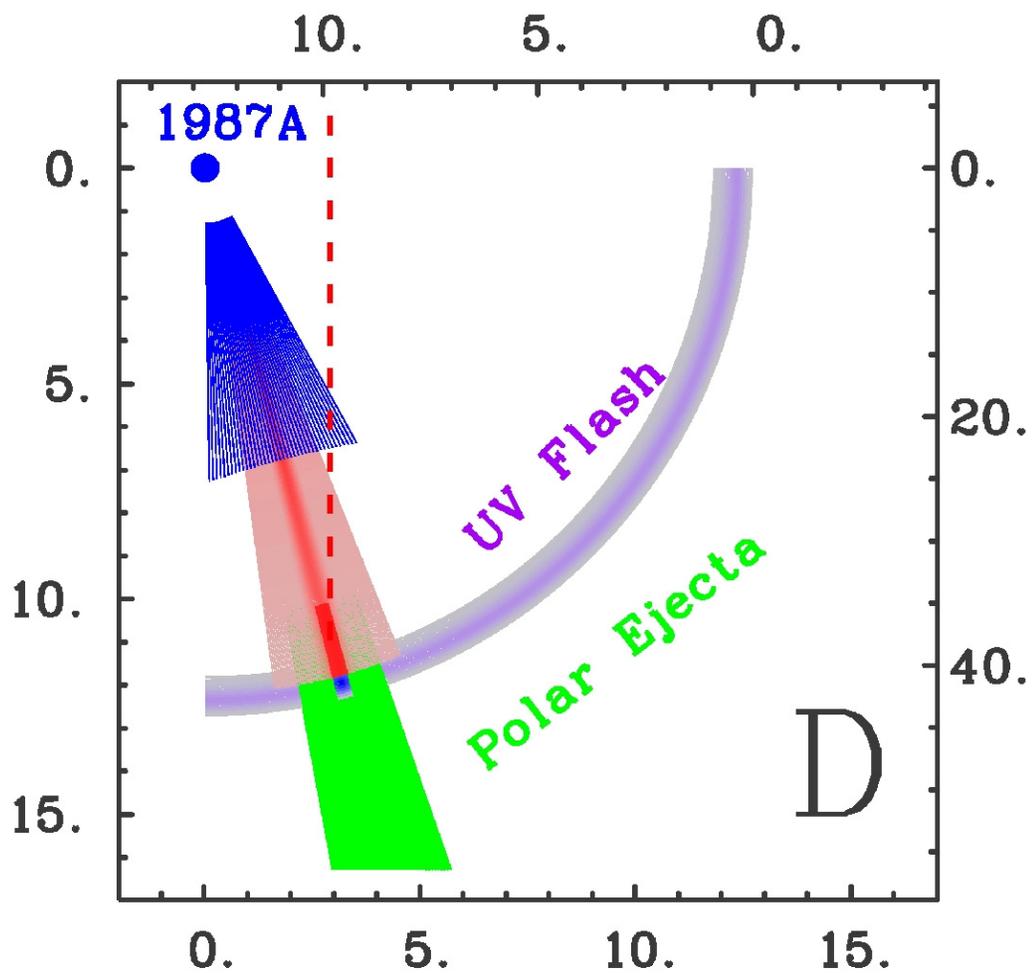


Fig. 18. The intense center ( $\sim 1^\circ$ ) of the **jet** begins to produce light (**red**) as it penetrates into the **polar ejecta** (**green**), producing the jump in luminosity at day 9.8 (again, top scale for the **intense red column** in this figure [18]), visible in Fig. 11 for the same time. The penetration may continue because the cross sections for this process are orders of magnitude smaller than for the **UV Flash**. The collimation factor for the **jet** is also  $>10^4$ .

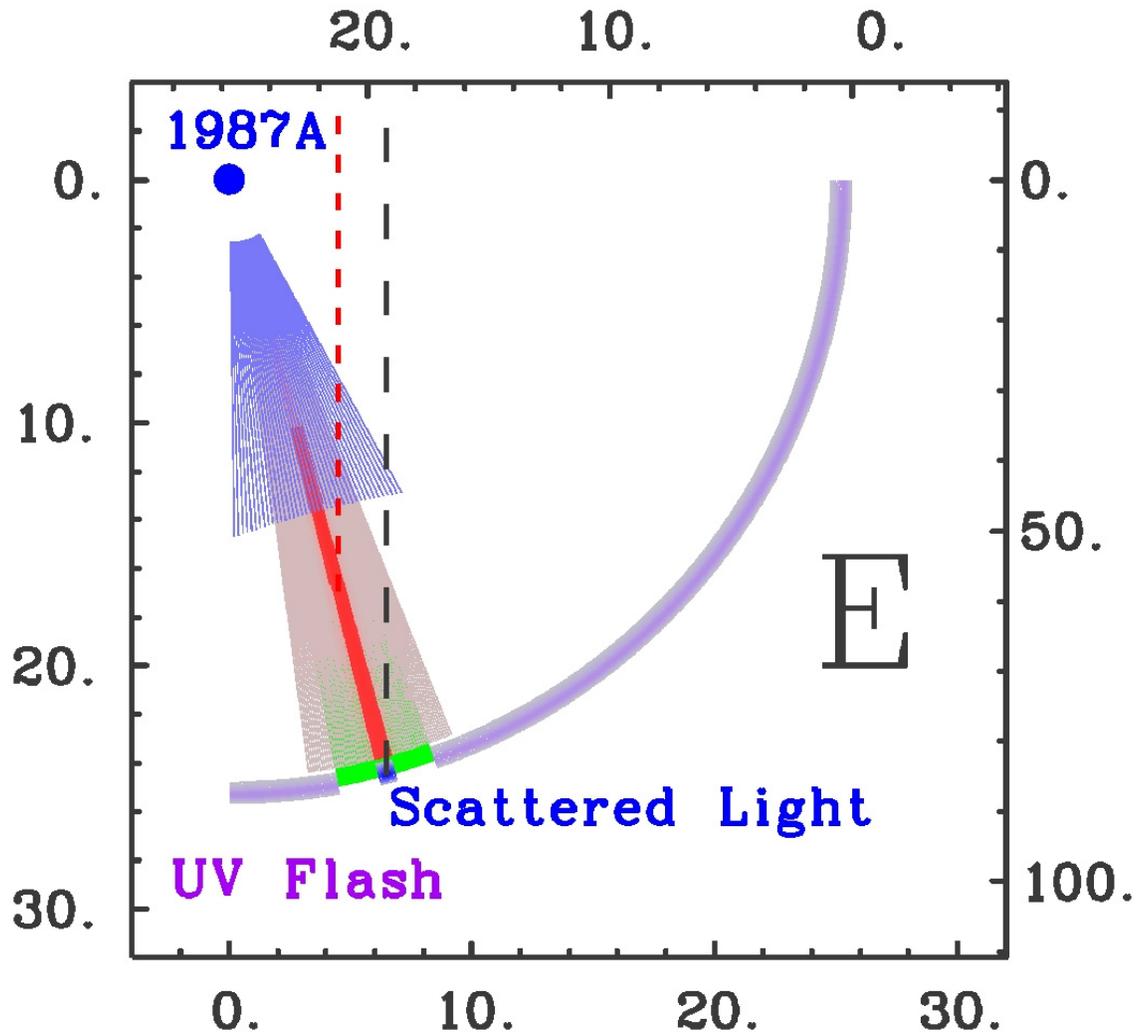


Fig. 19. After filtering through the polar ejecta, the enhanced pulsed beam breaks free, but still scatters off of some remaining clumps, producing excess light, in the **B**, **R**, and **I** bands observed near day 19.2 (black dashed line to upper delay scale), visible in the next figure.

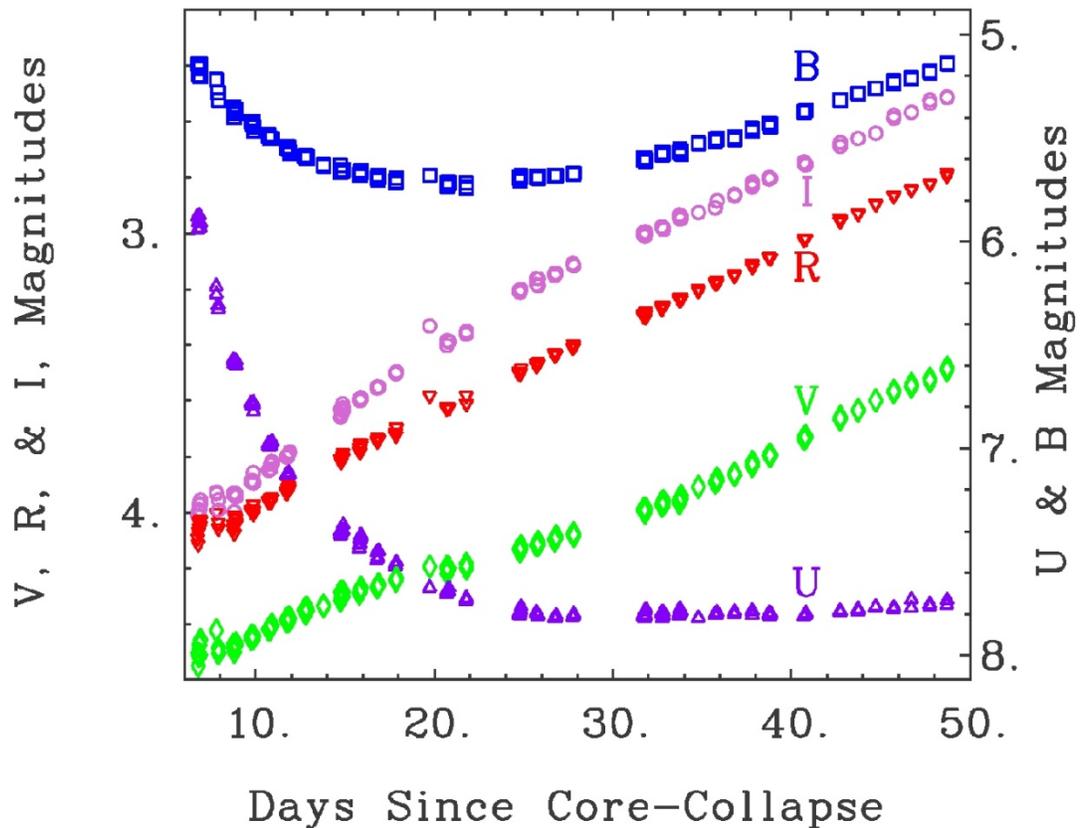


Fig. 20. The photometric data from the CTIO 0.4-m telescope plotted against time for days 6-50. Excess light in the **B**, **R**, and **I** bands was observed at day 19.8, but was also observed in the same bands in spectra taken by Menzies et al. (1987) on day 19.50, and Danziger et al. (1987) on day 19.76 (and this might have been the case for the previous day for which there is no available data). **V** band light is only slightly enhanced, and **U** band light is slightly suppressed. The **R** band light is associated with an enhancement of the  $H\alpha$  line, and the **B** and **I** band light matches the colors speculated for the 2.14 ms signal from SN 1987A seen by Middleditch et al. (2000). The excess light visible in Fig. 11 for day 19.8 can be used for a lower limit estimate for the isotropic luminosity of  $10^{40}$  ergs/s for the 2.14 ms pulsations.



Scaling up 5<sup>th</sup> magnitude by just 1/distance from 8 Glt-y to 25 lt-d gives -22.7 m, 1/100<sup>th</sup> of solar radiation. Scaling 10<sup>40</sup> ergs/s by 1/distance to 25 lt-d would be a solar constant of 600. At 41 lt-yr, by 1/distance, this would be reduced to one solar constant. Scaling this back to 8 Glt-y by 1/distance gives magnitude -6. On two occasions Howard Bond has seen two 2<sup>nd</sup> magnitude transients, which reddened as they faded, likely optical GRB AGs.



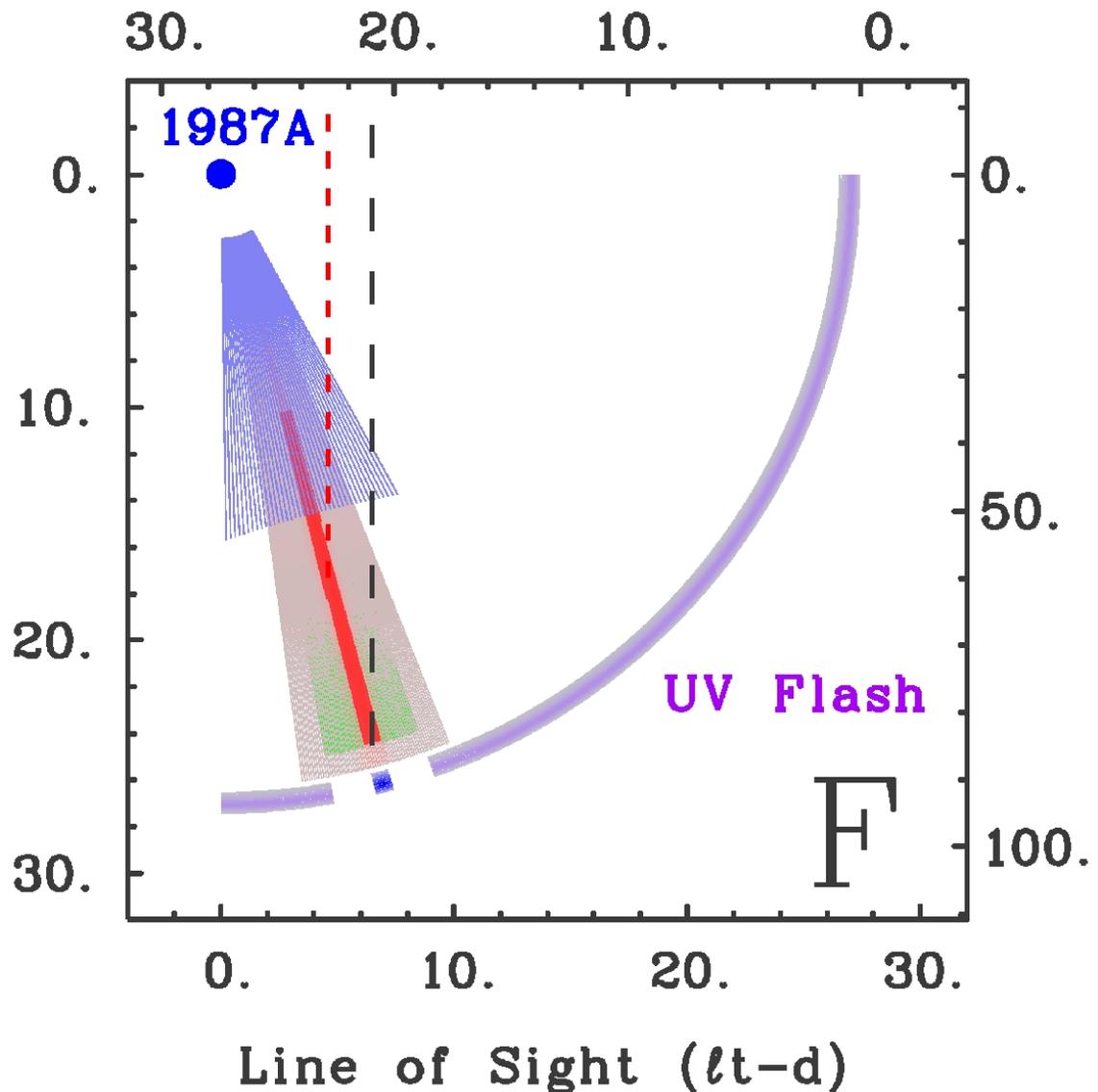
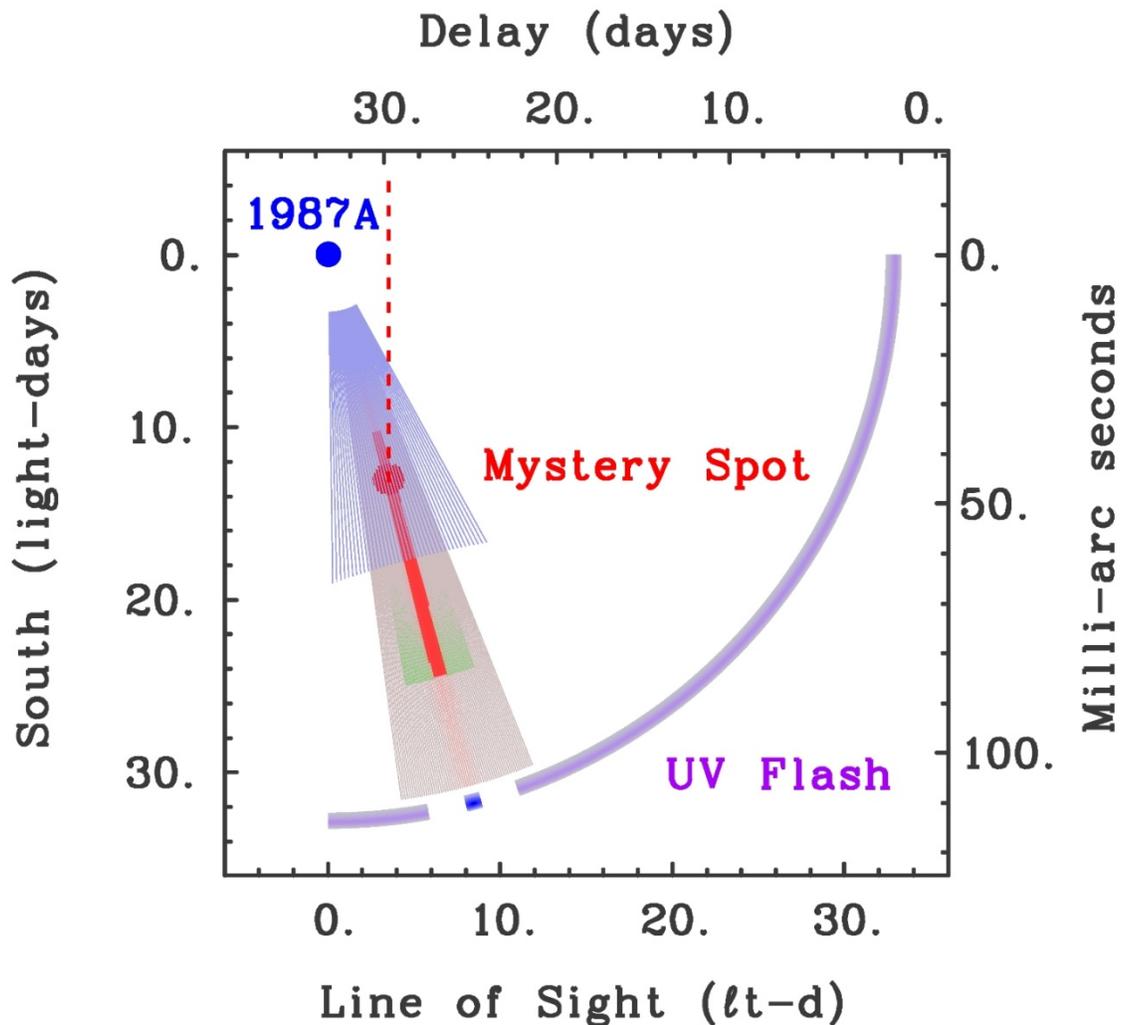
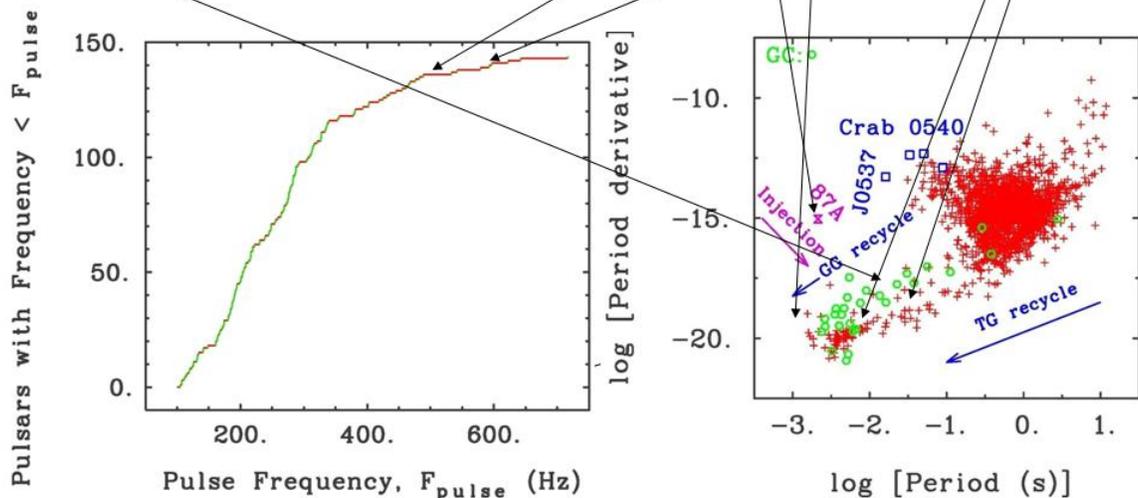


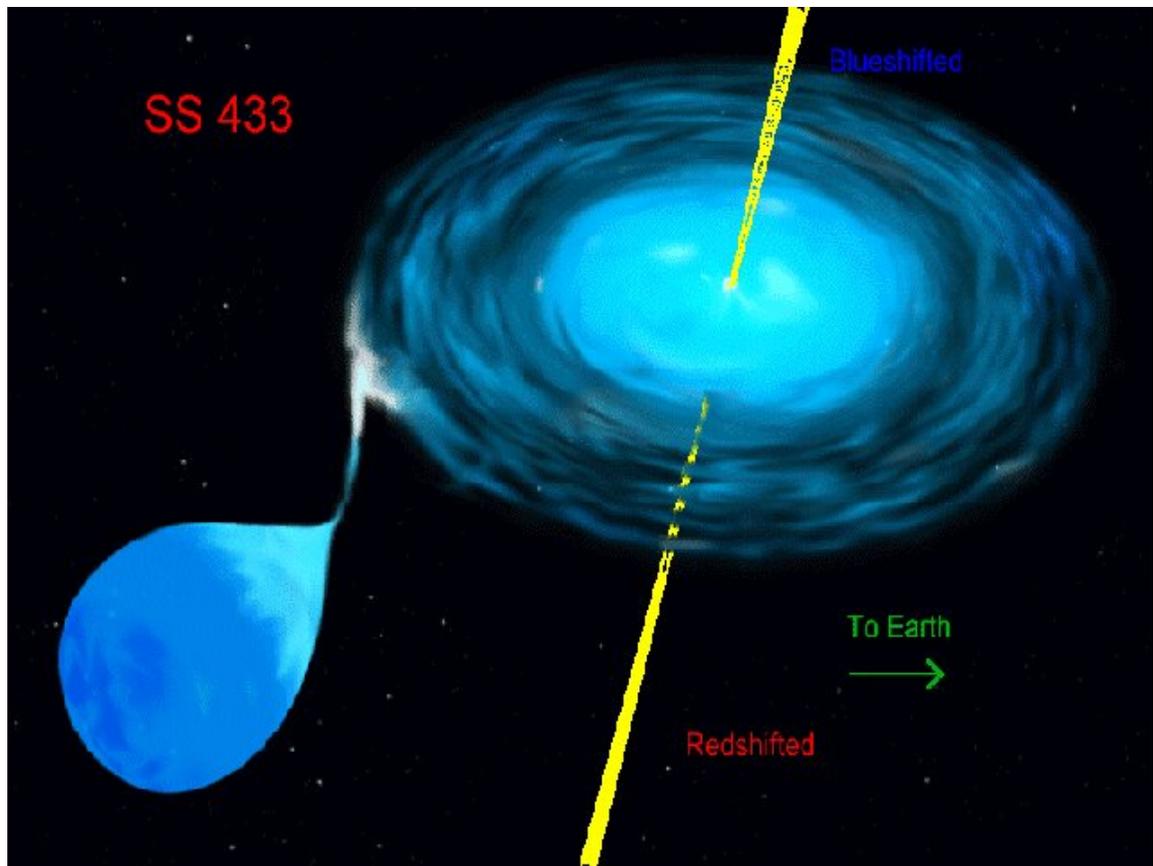
Fig. 21. Particles in the **jet** begin to clear the **polar ejecta** (mostly hidden **green cone section**), producing the decrement in luminosity visible in Fig. 11 near day 20.8 (top scale for the black dashed line in *this* figure [21]). A luminosity decrement, possibly indicating particles clearing the **polar ejecta**, appears in Fig. 11 just after this time (black, dashed line to top scale). Each of the polar **jets** contains as much as  $2 \times 10^{-5} M_{\odot}$ , and this can result in a spindown of  $10^{-5}$  Hz/s for a pulsar spinning at 500 Hz.



Particles continue to inject energy into the **Mystery Spot (MS)** around day 30, where its offset from **SN 1987A** was 0.045 arc s. Rather than a luminous strip, the Mystery Spot has become a more spherical plume. Penetration into a very deep ( $\sim 13$ -14 light-days) **polar ejecta** is consistent with the **MS** offset measures plotted in Fig. 10. There is no hard limit on its width at this late stage. The Mystery Spot was also observed on days 38 and 50. The mean velocity of the MS from day 30 to 38 was 0.5 c, from day 38 to day 50 was 0.35 c.

If the **2.14 ms** signal from **SN 1987A** is real, most pulsars are **born spinning** with **periods near 2 ms**, and these may **slow drastically** during the first few months following the SN. The statistics of pulsars spinning faster than 100 Hz bear this out: there's a gap of nearly 45 Hz at 500 Hz. A few pulsars are recycled to spin rates  $> 500$  Hz. Most just spin down. The main spinup/down paths differ.





(From [www.dstrange.freemove.co.uk/ss433.htm](http://www.dstrange.freemove.co.uk/ss433.htm))

Fig 23.5. SS 433's jets are likely also driven by a weakly magnetized millisecond pulsar, but unlike in SN 1987A, immersed in a hydrogen-dominated plasma, which limits the redshift to  $0.26c$ , when Lyman recombination to the ground state changes to  $L_{\alpha}$ . The rarity of this object is due to a weakly-magnetized, millisecond pulsar being in a binary system with an early-type O or B star (ordinarily the companion to such a star would also have a high mass, ultimately producing a strongly-magnetized neutron star). The low mass X-ray binary, Scorpius X-1, also produces jets which, as with SN 1987A, also transport energy at velocities up to  $0.95c$ , because its neutron star's accretia may also be high in metals, again as with SN 1987A, because its companion may be an M-dwarf (estimated by size restrictions).

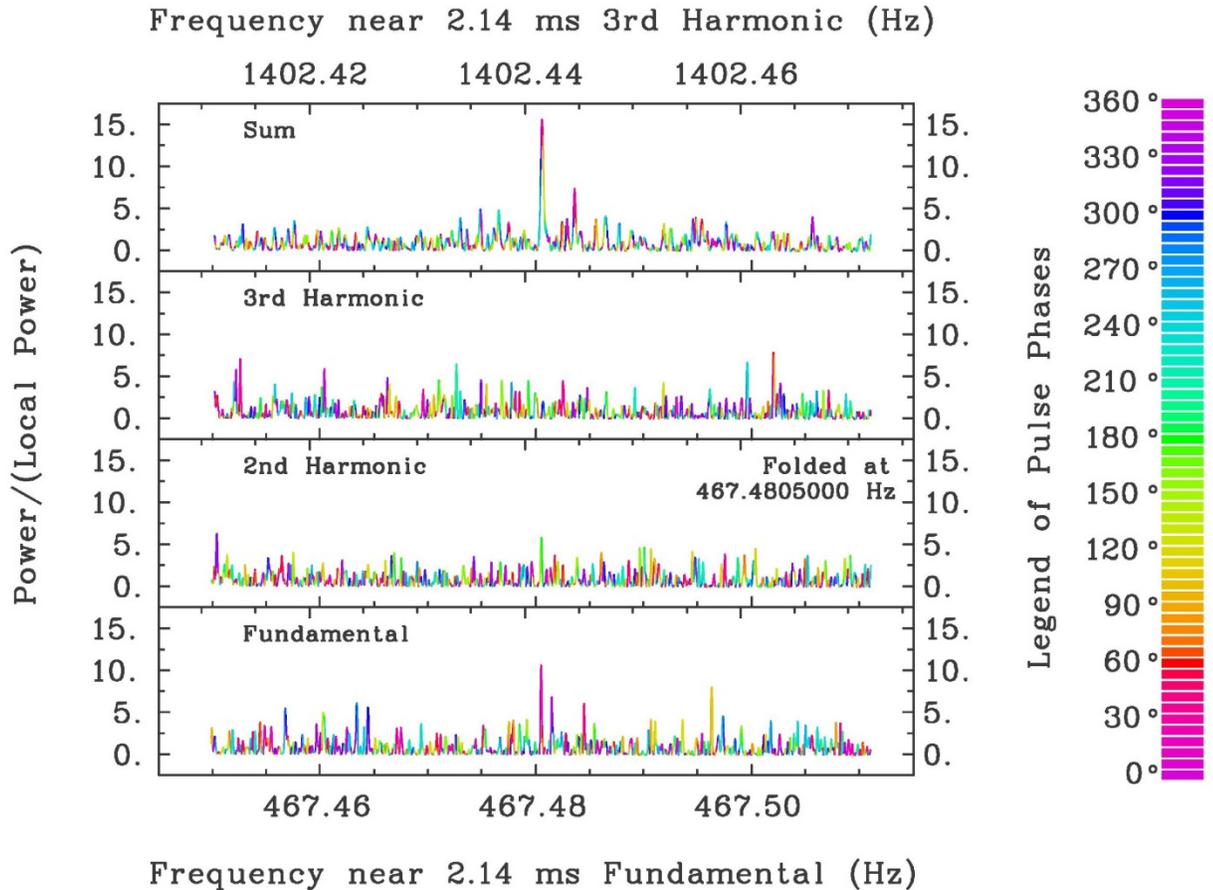
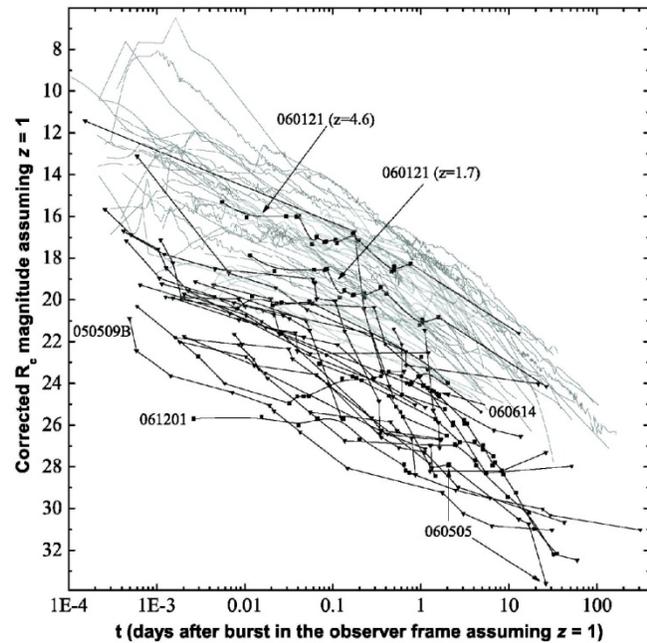


Fig. 23. The 2.14 ms signal (top = fundamental + 2<sup>nd</sup> harmonic), from observations with the Mt. Canopus 1-m Tasmania, was consistent with the LCO 2.5-m Wratten 87 magnitude of 21. After 1993, August 23, the probability that the 2.14 ms signal was not real was  $10^{-10}$ . The fact that the pulsar is not visible now, in spite of any amount of wishful thinking on the part of many, only means that it ran out of plasma, and has entered the Cas A phase. That is the *boundary condition* for these objects, as 99% of SNe, near enough to tell, show no evidence of a non-thermal source at late times (1986J is the exception). The real questions to be answered were: Did a pulsar ever appear, and if so, when and why, and what did it do to the progenitor star? The SLIP model has answered these questions satisfactorily.

From Kann & Klose,  
Proc. 2007 Santa Fe  
GRB Conference.

They write: "... , and  
once again, nearby  
afterglows were less  
luminous than more  
distant ones." Does  
this sound familiar?

Afterglows are  
pulsars! The free  
lunch! Are GRBs  
themselves pulsed?  
Maybe not.



Pulsars, ALL!

Fig. 24. The premier prediction of the SLIP model  
is that gamma-ray burst afterglows will be  
essentially 100% pulsed.

## The Demise of the Single Degenerate Paradigm

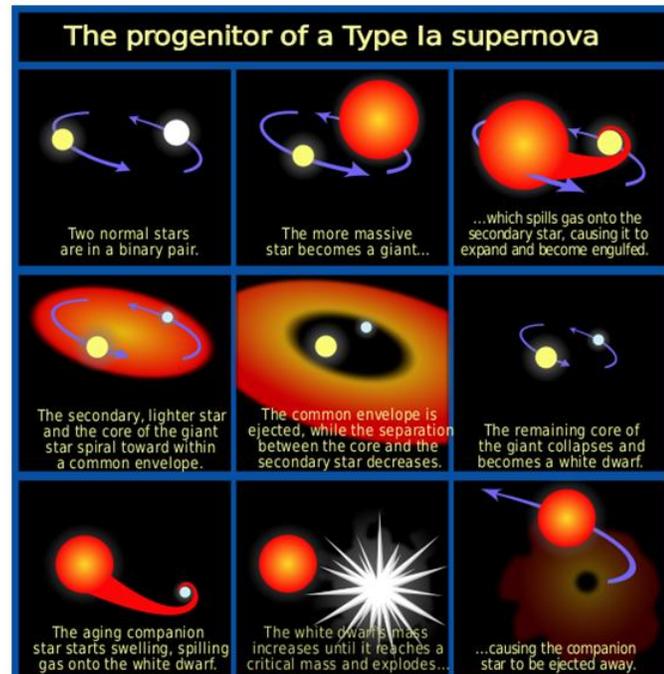
At ~5:30 p.m., on 21 Feb. 2007, at the **SN 1987A 20 Years After, and Gamma-ray Burst Conference** in **Aspen**, the question

was posed: **Is there any way of avoiding double-degenerate for these objects [Type Ia SNe]?**

**There was no answer.**

**Kirshner, Wheeler, & Filippenko were all there.**

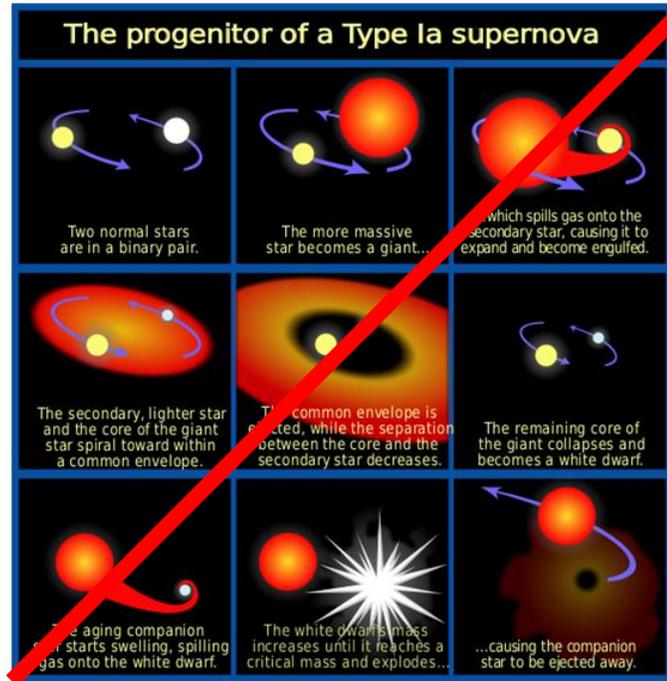
**They also haven't said anything since then.** This means that the thermo-nuclear mass left over from the merger can go to **ZERO!** **No standard candle** there until there's enough to encapsulate the  $^{56}\text{Ni}$   $e^+e^- \gamma$ -rays.



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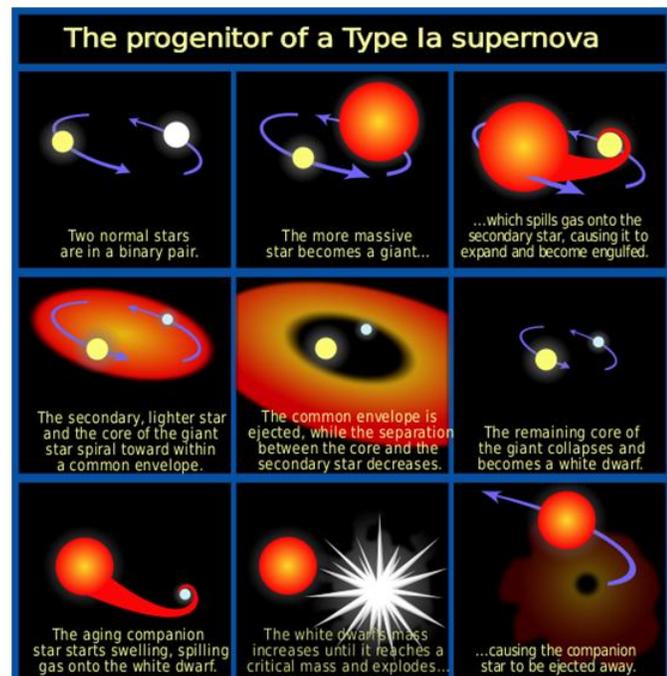
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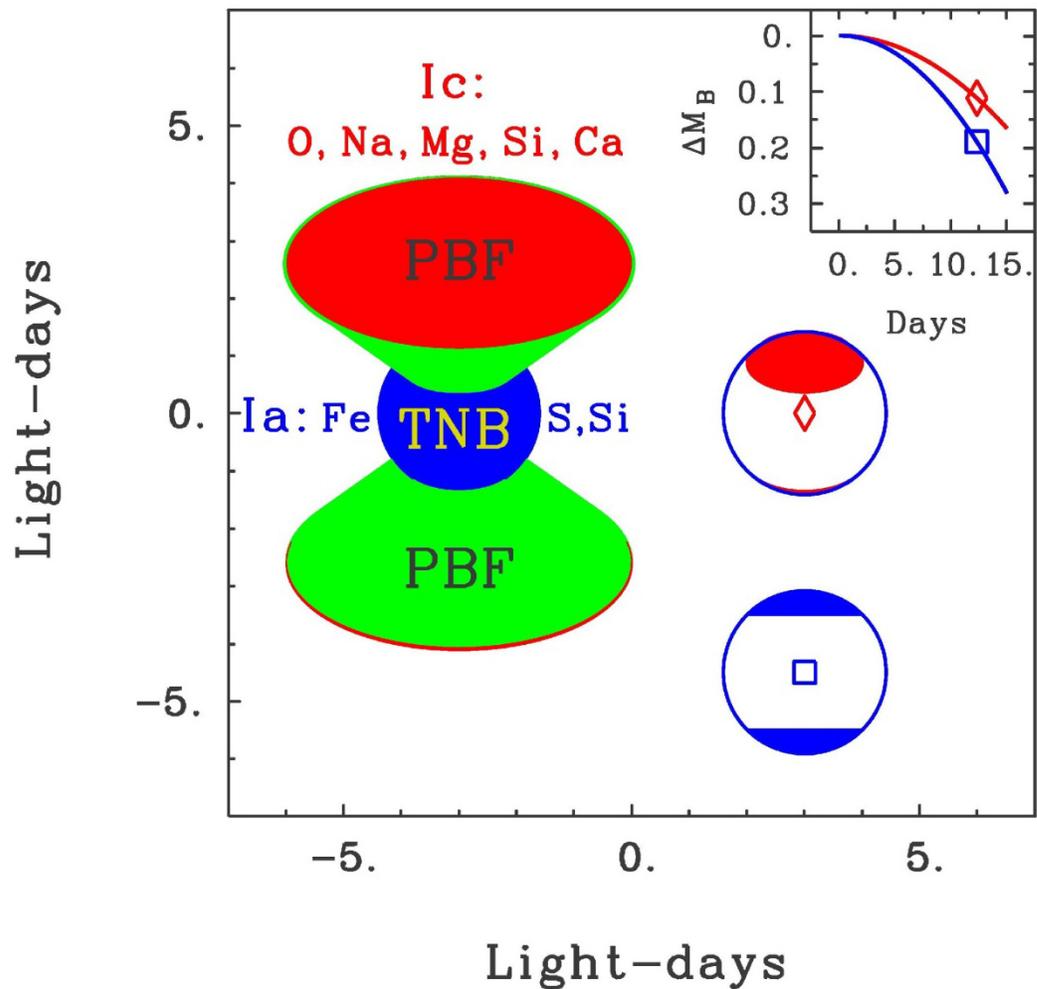


Fig. 25. In supernovae, the pulsar blows out the poles (**PBF** -- left hand figure), and it doesn't stop doing that until there is no material remaining around it. This is **catastrophic** to cosmology by Type Ia SNe, because the pulsar forces the **thermonuclear ball** (**TNB**) to remain *toroidal* for *all* of the lifetime of the SN, allowing much of the positron annihilation gamma-ray flux to escape from a much higher mass **TNB** than previously thought. In addition, the width-luminosity magnitude drop is smaller than

expected (still smaller than the red curve plotted in the upper right frame) because of the exposure of the rear, forward-looking face of the toroid, as the **PBF** thins in the weeks past maximum light of the SN.

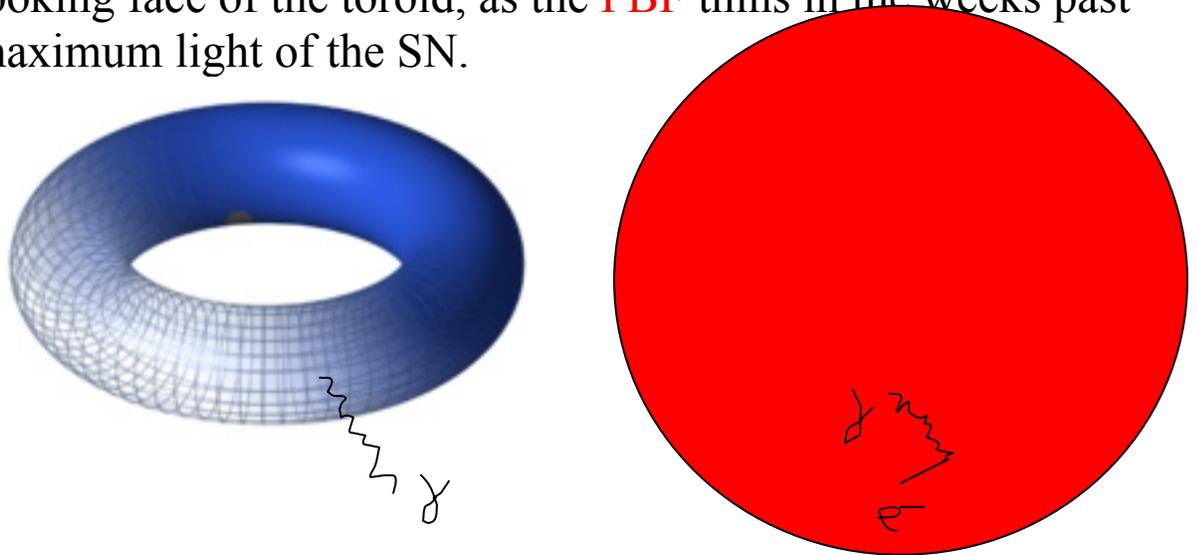
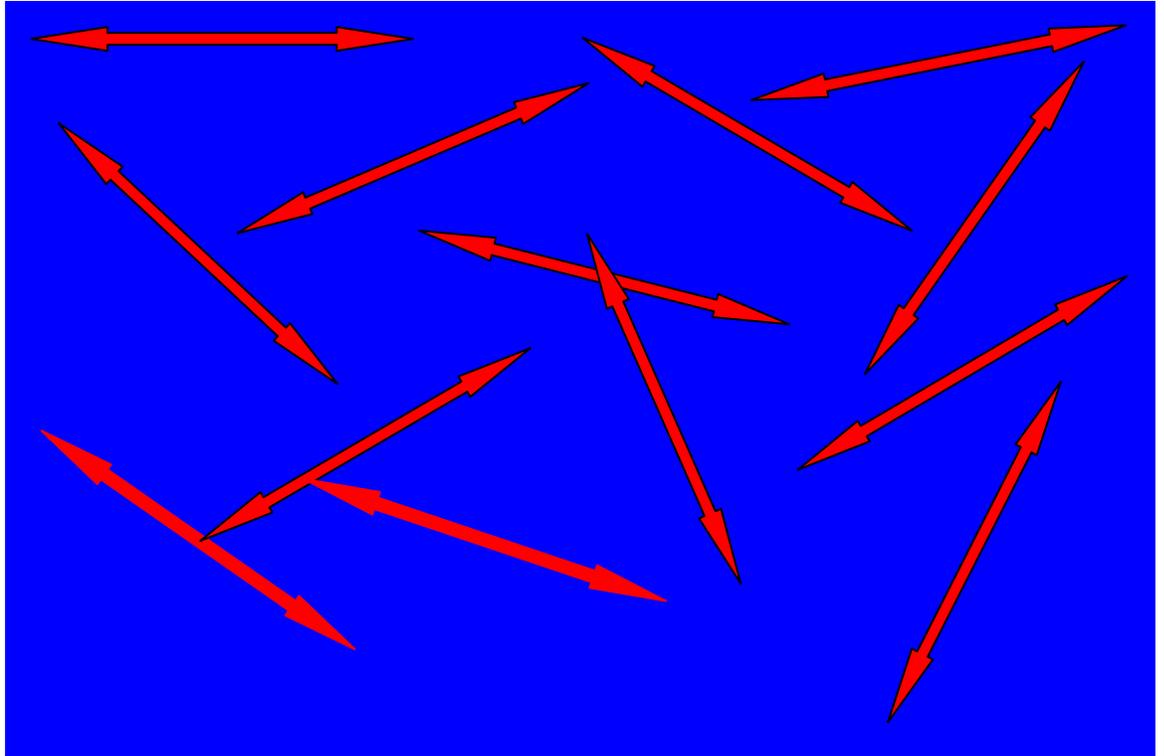


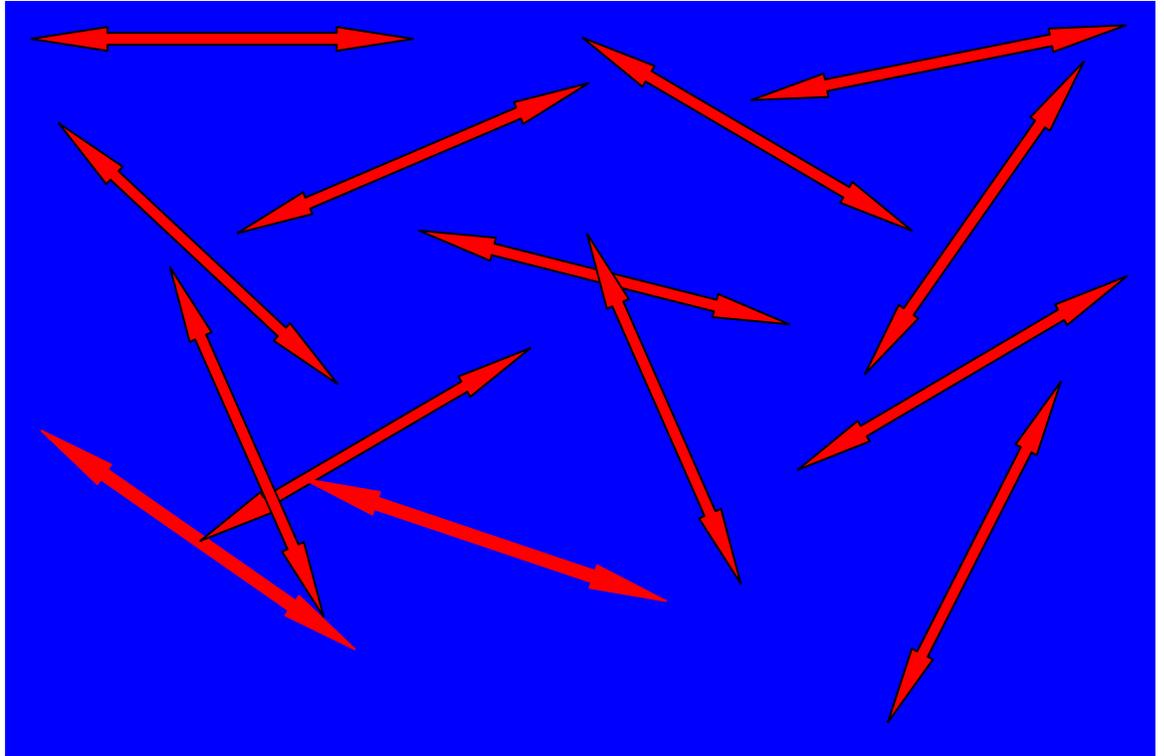
Fig. 26. SN Ia cosmology has failed because the equatorial **toroid** allows  $\gamma$ -rays to escape more readily than a **spheroid** of the same volume. Also, the material in excess of that lost to core-collapse can go to 0. Thus a population of Ia's exists that is not bolometric, and contaminates distant, but not local, samples.



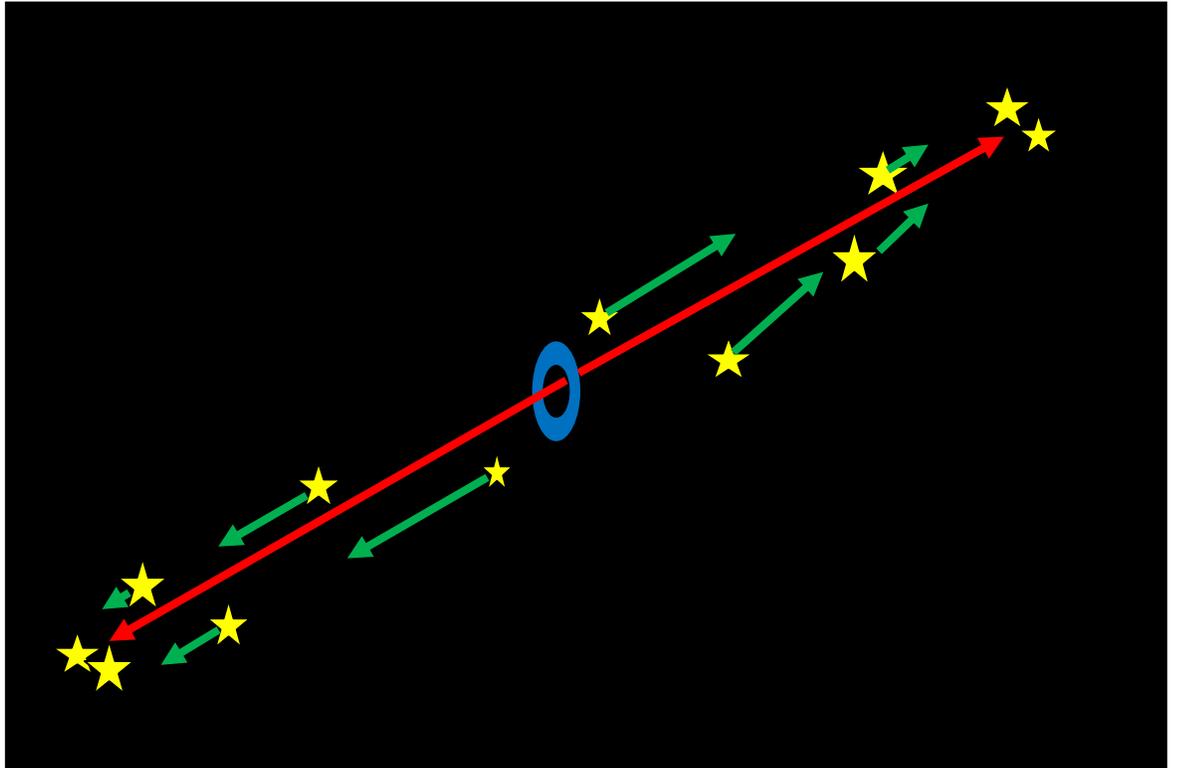




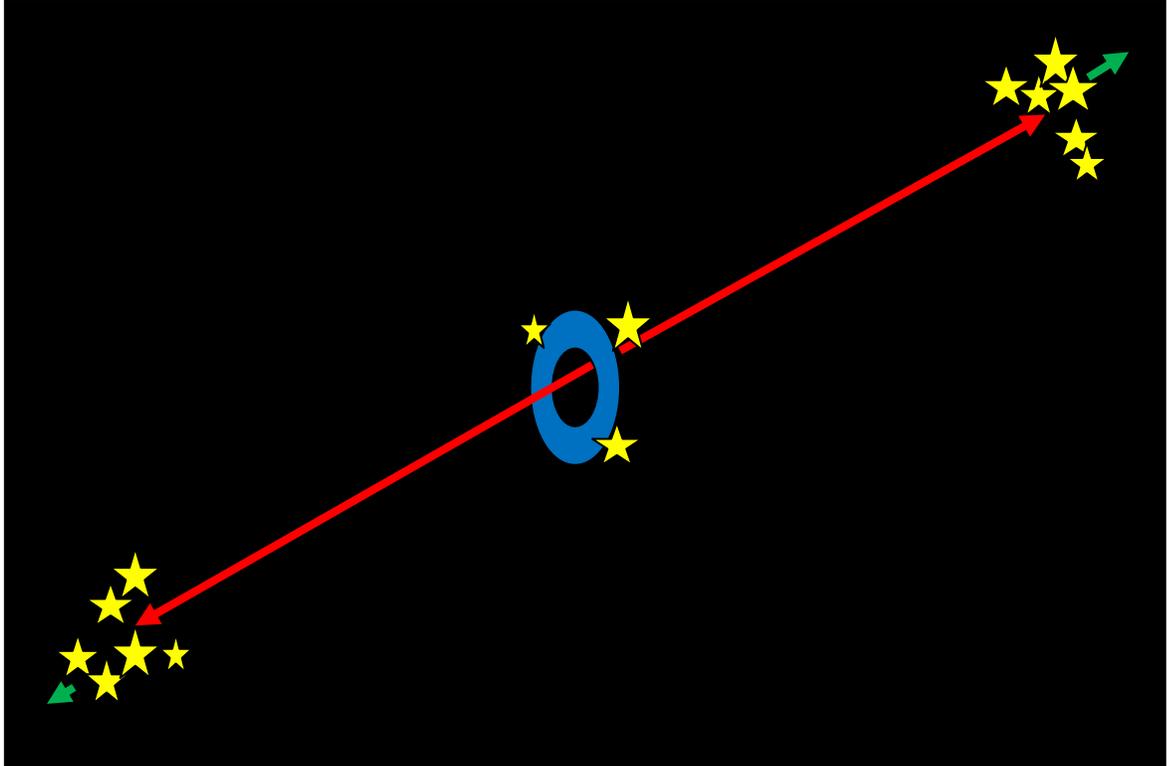
Do the **jets** from the **pulsars** produced by the 1<sup>st</sup> **SNe** allow the formation of **galaxies** within **500 million years**? **Maybe!** They do **trash** a lot of **entropy** between **stars**. They inhibit star formation locally, but space is vast, and the pulsar-driven plumes (aka “Mystery Spot”), in addition to inducing star formation in lines along their paths, may plough up enough material to form stars at their endpoints.



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The streams/clusters which form at the end of the jets retain a small fraction of the initial jet velocity ( $\sim 0.2 c$ ), which may explain the results from GALEX, where near pairs of distant galaxies have velocities which do not reflect their mutual gravitational attraction.

## Conclusions

The model of pulsar emission by superluminally induced polarization currents (SLIP) provides a means by which spinning neutron stars can drive a highly collimated beam and relativistic jet which can account for SN 1987A's beam, jet, and "Mystery Spot," the bipolarity of all other SNe, the jets of Sco X-1 and SS 433, the LMXBs, the multi-GeV  $e^+$  excess, and possibly star formation in the early Universe. It predicts that gamma-ray burst afterglows will be pulsars, and that the pulsars within SNe will literally eviscerate the gaseous remnant into two polar jets and enforce a toroidal geometry on the remainder of the equatorial ejecta. This geometry and mechanism apply to all SNe observed so far, which makes it extraordinarily difficult to calculate, or to establish a representative local sample of any type of SNe, including Ia's. Because the local sample of Ia's was selected on the basis of obeying the width-luminosity relation, in which the  $e^+e^- \gamma$ -rays were well encapsulated, this sample undoubtedly lies at the high end of the range in mass, and hence is too luminous to be representative of a distant sample which could not be so carefully selected. The most likely interpretation of SNe Ia data is that there is no anomalous dimming of the distant sample, and therefore *no direct evidence at all for the existence of dark energy*. And if dark energy goes, then there's no longer any sleazy numerical coincidence to argue for dark matter, so that goes as well. There is likely **NO DARK STUFF** affecting the Universe for the last 8 billion years, when gravity didn't matter and  $\Omega_{\text{Total}} \sim 0.04$ , even though  $\Omega_{\text{Total}} = 1.0$  at the era of recombination, when gravity did matter – this is a deeper problem than many have been willing to admit.

The path to the intimate and productive study of the SN and GRB processes is now clear: with high time resolution of GRB afterglows, we let the Universe reveal the behavior of the pulsars responsible (including even core collapse events of the first stars), through the selection effect of the inverted distance law ( $\text{flux} \sim 1/\text{distance}$ ) operating across billions of light years. This research was supported in part by Los Alamos National Laboratory Directed Research grant DR20080083.

