The unexpected faintness of distant Type Ia Supernovae (SNe) has been used to argue for an accelerated expansion of the universe, with the understanding that these are thermonuclear disruptions of accreting white dwarfs. However, the high velocity and polarized features observed in SNe Ia, and their inverse relation to luminosity, particularly for polarization, are consistent with an extreme version of the axisymmetry now seen in SN 1987A, which could be the result of double-degenerate merger-induced core-collapse. This could be the correct paradigm for many Type I and II SNe, where Ia’s are both thermonuclear and core-collapse objects, which leave weakly magnetized, rapidly spinning (∼2 ms) pulsars. In this paradigm, a Ia/c is produced from the merger of two degenerate cores of common envelope Wolf-Rayet stars, or of two CO white dwarfs. Thus the same explosive mechanism that underlay 10–15 M⊙ in SN 1987A, underlies only 0–1.5 M⊙ in SNe Ia/c. Its now visible polar blowout features produce the observed high velocity and polarized spectral features in Ia’s, and its equatorial bulge is much brighter in Ia’s, due to the greater fraction of ⁵⁶Ni contained within it. Such merger SNe become classified as Ia’s when viewed from the merger equator, and Ic’s when viewed from the poles (given sufficient matter in excess of the 1.4 M⊙ lost to core-collapse), where a hypernova signature and a gamma-ray burst (GRB) will be observed for lines of sight close to the merger axis. This complication may mean that cosmology determined strictly from Ia’s alone is flawed, because the local sample may be selectively biased. Finally, all GRBs start as the short-duration, hard-spectrum variety (sGRBs), after which some are modified to the long duration/soft spectrum variety (ℓGRBs) by interaction with the merger common envelope and/or previous polar ejection. Thus the initial photon spectrum of nearly all GRBs is known.

Subject headings: cosmology:observations—gamma-rays:bursts—pulsars:general—white dwarfs:stars: Wolf-Rayet—supernovae:general— supernovae:individual (SN 1987A)

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1. Introduction

Type Ia supernovae (SNe Ia) have been used by at least two groups, and all without any explicit foreknowledge of their progenitors,\(^1\) to argue that the expansion of the universe is accelerating, and hence for the existence of “dark energy,” or a cosmological constant, $\Lambda$ (see, e.g., Riess et al. 1998; Perlmutter et al. 1999). This has the appearance of convenience, as it helps several other lines of inquiry, including the scale size of the fluctuations of the surface of last scattering of the cosmic microwave background (CMB), and measurements of the clustering mass on large scales (see, e.g. Eisenstein et al. 2005), converge to a consistent set of parameters, generally $\Omega_m \sim 0.3$ and $\Omega_\Lambda \sim 0.7$. However, at present SNe Ia represent the only firm, direct evidence for the existence of dark energy (see, e.g., Conley et al. 2006).

If dark energy has been convenient for cosmologists, it is certainly not so for the Standard Model, which allows no such subtle effect by 120 orders of magnitude (Weinberg 1989). Still, a lot of other recent efforts have gone into shoring up the case for cosmic acceleration (see, e.g., Clocchiatti et al. 2006), and there is no doubt that all are seeing the same effect. In addition, many have pointed out that the effect is still present even without using the width-luminosity (WL) relation, determined for local SNe Ia a decade earlier by Phillips and others (see, e.g., Phillips et al. 1999, and references therein), to correct the Ia luminosities. However, recent observations have shown that SNe Ia have high velocity and polarized line features (HVF's & PLF's) at the few % level (Leonard et al. 2005; Mazzali et al. 2005a), as well as a few tenths of a % mean continuum polarization. In addition, core-collapse (CC) in Ia’s may be necessary to explain many of the ms pulsars (MSPs) in the globular clusters (GCs – see §2), and the abundance of Zn (Kobayashi et al. 2006).

In this letter I argue that many SNe Ia are caused by double-degenerate merger-induced CC (DD) which are classified as Ia/c’s when viewed from the merger equator/poles, the latter occurring only when sufficient matter exists in excess of that lost to the CC to screen the Ia thermonuclear (TN) products. This complicates the use of SNe Ia in cosmology. I also argue that nearly all gamma-ray bursts (GRBs) are due to DD, with all starting as the short duration and hard spectrum variety (sGRBs), and only later are some modified to the long duration/soft spectrum variety ($\ell$GRBs), by interaction with the common envelope (CE) and previous polar ejection.

\(^1\)In a Las Campanas 2.5-m run on SN 1987A during 1995 Feb. my late colleague, Dr. Jerry Kristian, mentioned to me that he considered the Ia cosmology effort “a perversion of the science,” because no one knew what SNe Ia really were.
2. What are SNe Ia/Ic?

In spite of initial mass estimates as high as 40 $M_\odot$ for some SNe Ic progenitors (SN 2002ap, 2003dh – Mazzali et al. 2002, 2003), no Ia or Ic progenitor has ever been identified (see, e.g., Maund et al. 2005), and much lower mass binaries, such as CE Wolf-Rayet (WR) stars, (see, e.g., DeMarco et al. 2003; Howell et al. 2001; and the data in Górny & Tylenda 2000), have never been eliminated as Ia/c progenitors (Gal-Yam et al. 2005). The “usual” Ia paradigm, (gradual) accretion-induced collapse of a white dwarf (WD), or single degenerate (SD), requires ignition and burn without core-collapse at the Chandrasekhar mass ($1.4 M_\odot$), and also has difficulty explaining the absence of H and He from the WD and/or advected from the mass-donating companion star (Mattila et al. 2005), the unsuitability of cataclysmic variables as progenitors (Scannapieco & Bildsten 2003), the four Ia’s in the last 26 years of the colliding elliptical/spiral galaxies of NGC 1316 (see, e.g., Tsvetkov et al. 2005, and references therein), and Ia’s which produce much more than 0.1 $M_\odot$ of $^{56}$Ni from a single ignition source (Brown et al. 2005), though multiple sources of ignition have been discussed by Röpke et al. (2006). Finally, in addition to their HVFs and PLFs, Ia’s also show a broad range of diversity in their velocity gradients and correlations with Si line ratios and $\Delta m_{15}(B)$ (Hachinger et al. 2006; James et al. 2006), all unlikely side effects of simple TN disruption.

The morphology of the explosion of SN 1987A has now been clear for a number of years (NASA et al. 2003; Wang et al. 2002; Middleditch 2004, hereafter M04). A polar blowout feature (PBF) approaches at about 50° off our line of sight (see, e.g., Sugerman et al. 2005). It partially obscures an equatorial bulge/ball (EB), behind which a part of the opposite, receding PBF is visible. The PBFs and EB are approximately equally bright.

SN 1987A is thought to have ejected about $10–15 M_\odot$ (see, e.g., Woosley 1988)\(^2\) and, because of the blue supergiant nature of the progenitor (Sanduleak 1969), the rings (Burrows et al. 1995), the “mystery spot” (Meikle et al. 1987; Nisenson et al. 1987)\(^3\) the mixing (Matz et al. 1987; Cook et al. 1988), the polarization (Schwarz & Mundt 1987; Barrett 1988), and the possible 2 ms pulsar remnant (Middleditch et al. 2000b)\(^4\) is very likely to have been the result of a DD merger of two stellar cores. Occam’s Razor alone would

\(^2\)All such models are, of course, invalid for DD due to the differences in mixing and the CC process.

\(^3\)This feature still contained $10^{49}$ ergs some six weeks after being hit with a relativistic jet/beam (M04 – the deviation off the line of sight taking only 8 extra days). In this interpretation, the “mystery spot” corresponds to the GRB “afterglow.”

\(^4\)On two occasions shortly before his death, I discussed the pulsar search effort on SN 1987A with Kristian, and the only thing both of us could conclude was that the 2.14 ms signal was very likely real. This is still the case.
argue that Ia’s and Ic’s are the result of the same process(es), but there are many other good reasons. If Ia’s and Ic’s are the result of common-envelope WR DD mergers or CO-CO WD mergers common in GCs (which leave MSPs – see, e.g., Chen et al. 1993), then the limit for mass ejected is near $1.5 \, M_\odot$, consistent with the $\sim 1 \, M_\odot$ limit of $^{56}\text{Ni}$ produced in SNe Ia (Howell et al. 2006).

If SNe Ia/c are the result of the same explosive process that underlay 10–15 $M_\odot$ in SN 1987A (CC), but which instead only underlies 0.5 $M_\odot$, the outcome will be even more extreme than the geometry of the SN 1987A remnant. The PBFs will have higher velocities, and the equatorial/TN ball (TNB) will be much brighter due to the greater concentration of $^{56}\text{Ni}$, but its expansion velocity will not necessarily be higher than in IIs, as the mean Z for the outer ejecta will be higher. Thus, there is no need to invoke exotic mechanisms such as “gravitationally confined detonation” to explain SNe Ia (Plewa et al. 2004). When viewed close to the poles of the merger, one of the two PBFs will obscure the TNB (if there is sufficient mass above the merger pole(s)), and show lines of r-process intermediate mass elements (IMEs) from its end, and the SN will be classified as a Ic, and for views very close to the poles, a hypernova signature will be seen, in addition to a GRB (M04)\textsuperscript{5}.

WR and CO-CO mergers could account for GRBs in both young and old populations (I and II – see, e.g., Mannucci et al. 2006). And although the Ia:Ic ratio in elliptical galaxies is $>30$ (see, e.g., the tables in van den Berg et al. 2005), matter in excess of 1.4 $M_\odot$ from two WDs in older populations (II) is rare. This picture of “leaner” mergers in non-actively star-forming galaxies is consistent with Hamuy et al. (2000), Sullivan et al. (2005), and Wang et al. (2006a), and may mean that the PBFs run out of sufficient matter to obscure the TNBs before these, in turn, run out of ejected TN ash, leading to relatively more Ia’s. Because only sGRBs have ever been seen in elliptical galaxies, and globular clusters (GCs) require DD events to make many of their MSPs (with “recycled” MSPs restricted mostly to core-collapsed clusters [CCd] such as Ter 5)\textsuperscript{6} four remarkable, fairly robust conclusions can be drawn. First, many SNe Ia in older populations must in fact be such CC events. Second, because DD events must occur in elliptical galaxies and numerically exceed by far NS-NS merger events, the vast majority of the sGRBs in ellipticals result from their lean, DD events. Third, all GRBs start as sGRBs, and some convert to $\ell$GRBs by impacting

\textsuperscript{5}Thus it should not be surprising that the faint GRB 031203 was associated with the bright SN Ic 2003bw (Malesani et al. 2004), but the other way around would be, as long as there were no late rebrightening, as was the case for GRB 050525A and SN 2005nc (Della Valle et al. 2006a).

\textsuperscript{6}Ter 5’s lower luminosity/duty-cycle (the latter so much so as to overcome the effects of the former) MSPs (Ransom et al. 2006), and many of those of M15 are consistent with this picture, but others and all of those in non-CCd clusters such as 47 Tuc are not (Chen & Ruderman 1993; M04).
the CE, and some are further modified by impacting previous polar ejecta. Fourth and finally, sGRBs can be produced by DD events without distantly observable afterglows or SNe (Gal-Yam et al. 2006; Fynbo et al. 2006; Della Valle et al. 2006b; Gehrels et al. 2006).

Unless the view is very near polar, this geometry will have no difficulty in producing split emission line(s) on rare occasions, as was seen in SN 2003jd, and thus again there is no need to invoke other explosion mechanisms (Mazzali et al. 2005b). When viewed sufficiently far from the poles, the TNB will dominate the luminosity, S/Si absorption lines will appear/deepen, the SN will be classified as a Ia, but similar high velocity lines will also appear from the sides of the PBFs due to material advected from the TNB, in addition to IME lines, including Si again. The assumption implicit in Ia cosmology is that the TNB will be a standard candle (Pinto & Eastman 2001), which can be compared to the redshift of the host galaxy to determine the expansion properties of the universe.

3. The Evidence

3.1. The Ubiquitous High Velocity Features in Ia’s

In the DD paradigm these (Mazzali et al. 2005a) result from SNe Ia having two PBFs of finite angular width. The half width angle of the PBFs can be estimated from the ratio of the numbers of nearby SNe from catalogs. If we let $R_1$ be the TNB radius, below which sufficient visible EW in Si and Fe lines would result in the SN Ia/c being classified as a Ia, $R_2$ the radius of the limit cones of the PBFs at the same given time, $\theta$ the half angle of the PBF cones, $\zeta$ the half angle of the cone circumscribed around the (assumed spherical) TNB and containing the circular boundary of the base of one PBF limit cone (the visibility divider between Ia’s and Ic’s), and $\phi = sin^{-1}(R_1 R_2^{-1})$, then $\theta = \zeta + \phi$.

Counting SNe with radial velocities < 10,000 km s$^{-1}$, from SN 1995O to 2004cg in the SAI catalog (Tsvetkov et al. 2003), gives 282 Ia’s, 66 Ic’s, and 301 Type II SNe for a Ia:Ic ratio of 4.27:1, consistent with a 2:1 Ia:Ibc ratio in spirals from Capellaro et al. (1997). Using a 1:5 ratio for $R_1$ vs $R_2$ (which might be an overestimate) gives $1 - cos\zeta = 5.27^{-1}$, or $\zeta = 35.9^o, \phi = 11.5^o$, and $\theta = 47.4^o$, a value consistent with the image of SN 1987A, and big enough so that HVFs from the PBFs will almost always occur, no matter what the orientation from which SNe (classified as Ia) are viewed.

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7And there is absolutely no need to invent an entire population (III) to account for GRBs (Conselice et al. 2005; M04).

8Excluding Type IIn’s.
Benetti et al. (2005; hereafter B05) have divided SNe Ia into three categories, FAINT, and the brighter high and low velocity gradient (HVG and LVG) SNe. In the PBF/TNB paradigm, FAINT Ia’s are indeed intrinsically faint, producing little $^{56}$Ni, and their high velocity gradients and $\sim$9,000 km s$^{-1}$ expansion velocities are the result of only a small amount of material in their ejecta, and thin polar ejecta and/or a near-equatorial view. The HVG SNe Ia are brighter, due to more $^{56}$Ni, and have $\sim$12,000 km s$^{-1}$ expansion velocities, but are viewed substantially off the DD merger equator, where the opacities of conal PBF and advected TNB material diminish rapidly with time. The LVG SNe Ia are also bright, but have a low velocity gradient and $\sim$10,000 km s$^{-1}$ expansion velocities because they are observed from near the equator of the DD merger. The increasing/decreasing evolution of $R$ (Si II) (i.e., temperature) with time of HVG/LVG SNe Ia is consistent with this interpretation (Figure 2 of B05).

Four out of five of the FAINT Ia’s in B05 fall below the WL relation by 1–2 whole magnitudes, and yet their $\Delta m_{15}(B)$’s fall just barely outside the validity range for the WL relation (<1.75). However, the spectra of all of these show a deep TiII trough between 4,000 and 4,500 Å, visible even at cosmological distances, and thus can be safely excluded from the sample used for cosmology. But problems could still arise if a continuous class exists between FAINT and HVG and/or LVG, as might reasonably be expected.

In this case, it might be possible that, because of the assumption of an invalid paradigm for SNe Ia (SD), and the desire to avoid contaminating the sample of Ia’s by including SNe which appeared too “Ic-ish,” with too much EW in IME lines, and too little in the SII and SiII lines, a local sample of Ia’s was selected in which many were viewed very close to the equator of the DD merger. When the high velocity of the small amount of matter in near-polar ejecta of Ia’s exposes a fraction of the TNB to non-equatorial views during the interval when $\Delta m_{15}$ is measured, insufficient WL corrections could result in distant Ia’s which appear to faint for their redshifts.

### 3.2. Polarization

Continuum polarization near the 0.9–0.4% level was detected in the Type IIP SN 1987A (Schwarz & Mundt 1987; Barrett 1988), two out of three Type IIs observed by Wang et al. (1996), 1994Y, and 1995H, at nearly twice that level in the Type IIb SN 1993J (Trammell et al. 1993) and 0.2–0.5% in the Type IIP SN 1999em, 7 to 159 days after

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9In the case of SN 1993J, the PBFs are, and/or appear longer due to the low amount of H, and/or a near equatorial view, or both. Thus 1993J is a “missing link” between Type II and Type Iabc SNe.
maximum, by Leonard et al. (2001). Thus, continuum polarization in IIs is (and should be) common due to their PBFs having approximately equal brightness as their EBs.

Continuum polarization is markedly low or absent in Ia’s, typically <0.2%, with the exceptions of SN 1996X at 0.3% (Wang et al. 1997), the FAINT SN 1999by at 0.3–0.8% (Howell et al. 2001), the LVG SN 2001el, near 0.2–0.3% (Kasen et al. 2003), the LVG SN 2003du at 0.3% (Leonard et al. 2005), and SN 2005hk at 0.4% (Chornock et al. 2005). This is exactly what is expected for Ia’s because the TNB is roughly spherical, and dominates the luminosity of Ia’s, where the PBFs are viewed from the sides, but are not bright enough to matter. SN 1999by was highly polarized because it was a faint SN Ia, and the PBFs did matter. SN 2005hk was less luminous (likely a member of the FAINT class) than 2001el, and thus its level of continuum polarization is higher.

In contrast, the Ca II 800 nm IR triplet and the Si II \( \lambda 6355 \ \text{Å} \) (absorption) lines in nearly all SNe Ia show higher polarizations, particularly those with high velocities, which is a result of the lines preferentially originating from the sides of the PBFs, visible (by definition) in all Ia’s (Kasen et al. [2003] on SN 2001el “The high velocity triplet absorption [800nm Ca II] is highly polarized . . . ”; Wang et al. [2003] “. . . is distinct in velocity space from the photospheric Ca II IR triplet and has a significantly higher degree of polarization (≈0.7%) and different polarization angle than the continuum . . . kinematically distinct feature with matter distributed in a filament . . . almost edge-on to the line of sight . . . ”).

Line polarization occurs in increasing strength in overluminous, normal, subluminous, and high velocity SNe (HV – broad lines, blueshifted up to 15,000 km s\(^{-1}\)) in observations (Leonard et al. 2005), as well as naturally in the TNB/PBF paradigm. Clearly the polarization of Ia’s should increase as apparent luminosity (the visible TNB) decreases, until so little matter remains to be ejected into the PBF that it becomes optically thin (see \( \S 2 \)). Thus the strength of the line polarization is only 0.2% in the overluminous SN 2003du, but is 2% in lower luminosity HV SNe such as 2004dt (Wang et al. 2004), again consistent with the PBF/TNB paradigm for Ia/c’s.\(^{10}\)

Polarization in Ic’s is more complicated, as those seen most end-on will also have blueshifted HV lines, but will appear to be spherical, so little polarization will result. However, when both PBFs are visible, the extension in one direction will produce polarization,\(^{10}\)

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\(^{10}\)Kasen and Plewa (2005) interpret the features of 2001el through gravitationally confined deflagration-induced detonation. However, this mechanism is unlikely to produce the inverse relation between polarization and Ia luminosity described above, although Wang et al. (2006b), having communicated about this work on 2006, August 21, explore the relation for SiII in greater detail (on 2006, Nov. 29, and without citing this work!), and surmise “strong” support for delayed detonation (see, e.g., Khokhlov 1991).
just as it does in Type IIs, and may exceed that in IIs due to the rapid extension of the higher velocity PBFs and the obscured, or even the non-obscured, but faded, EB/TNB. These are the Ic analog of the HV Ia’s. The continuum polarization of the Ic SN 2002ap rose from 0 to 0.5% from -6 to +3 days from maximum (Wang et al. 2003), and later to 1.0% and 1.6% on days 16 and 37 respectively (Leonard et al. 2002).

3.3. The Merger Paradigm and the Luminosities of SNe

The merger paradigm also explains why Types Ib and II SNe produce relatively little $^{56}\text{Ni}$, because their C and O layers are diluted with He, in addition to H for IIs, due to the merger process. Aside from Type II-L SNe, Type IIs, initiated through Fe photodissociation catastrophe, suspected for SN 1986J (Bietenholz et al. 2004), may so far be the only known exceptions to the merger paradigm, and the vast bulk of these, i.e., those which do not continue to collapse into black holes, should be brighter than DD Type IIs due to their C and O layers remaining relatively undiluted at the time of CC, in addition to their embedded, strongly magnetized pulsars. In DD Ia/c, which all lack H and He, not only are the C and O layers undiluted, they are intimately mixed. So if IIs manage to produce some $^{56}\text{Ni}$, then even CC Ia’s ought to produce much more.

3.4. Conclusion

I have argued above that many SNe Ia and Ic are the result of the same process, DD events of WR or CO-CO WD binaries, in order to produce their HVFs and PLFs, and their inverse relation to Ia luminosity, many of the MSPs in old populations, sGRBs and $\ell$GRBs, the four recent Ia’s of the colliding spiral/elliptical galaxies of NGC 1316, the $>1 \, M_\odot$ of $^{56}\text{Ni}$ produced in SN 2003fg, and possibly the observed abundance of Zn. This complicates the utility of Ia’s to cosmological efforts, with at least one possible systematic effect which could produce distant Ia’s which appeared to be too faint for their redshifts (see the end of §3.1), potentially adding to other systematics, some of which could have the opposite effect, such as Malmquist bias. In addition, a 7% Ibc contamination level is sufficient to produce $\Omega_\Lambda = 0.7$ from no effect (Homeier 2005). Small wonder then that statistical considerations alone may rule out any cosmology derived from SNe Ia (Vishwakarma 2005). Is there likely still any $\Omega_\Lambda$ effect at all left in Ia cosmology? Only time will tell.

I have also argued above that all GRBs begin as sGRBs before some are changed into $\ell$GRBs by interaction with matter in the binary merger CE and previous polar ejection. This
could help to greatly simplify the study of GRBs because the initial photon energy spectrum of the vast majority of GRBs is now more-or-less known.

Using astronomical sources of any kind to determine the nature of the universe is a tough business. Divining the structure of SNe using only spectroscopic data (and even the occasional polarization spectrum), an inverse problem for which very little progress has been made over several past decades, only increases the difficulty immeasurably. In SN 1987A nature has revealed the origin and structure of most SNe, including SN 1993J, and all we have to do is to pay attention. The SN Ia cosmology effort sets all records for blood and treasure spent on a problem in astronomy. It was a gamble, but one that may not pan out. The attempt to use a misunderstood phenomenon to measure cosmological parameters is perhaps understandable, but ultimately unwise.

Supernovae are indeed wondrous objects, with up to 99% resulting from DD events. These may all produce ∼2 ms pulsars which, in their first few seconds after birth, may very well be the only frequently detectable gravitational radiation sources, and which, for at least a few years, shine in the optical band (Middleditch et al. 2000b). Many of their progenitors are not massive stars, and many produce jets, GRBs, and what astronomers have dubbed “mystery spots,” “GRB afterglows,” “Type II-P plateaus,” “hypernovae,” “collapsars,” “supranovae,” and my personal favorite, “The Beam from Hell,” from what could appear to be unremarkable 20th magnitude blue stragglers, which can incinerate half the planet from a great distance with little or no warning. What they are not, however, are easily utilized standard candles, and Ω_Λ = 0.7 may not be the “correct” answer. It may be impossible to get a “clean” sample of SNe Ia (Benetti et al. 2004; Blondin et al. 2005).

The attempt to use SNe IIP to measure cosmological parameters (see, e.g., Höflich et al. 2001; Nugent et al. 2006), faces the difficulty that even though most of these result from DD mergers of more massive stars, then, like SN 1987A (and possibly 1993J), they will still manage to produce beams/jets which may or may not impact their previous polar ejection to produce a “mystery spot,” (or two).

I have had the time to write this course correction for science only because CCS-3 has supported me during this interval when I was without funding, and for that I am extremely grateful. I would like to thank Drs. Geoffrey Burbidge, Falk Herwig, Peter Nugent, and an anonymous referee for useful suggestions which helped me to improve this manuscript. I would also like to thank Jerry Jensen for conversations and bringing this issue to my attention. This research was performed under the auspices of the Department of Energy.

\[\text{We're all a decade older.}\]
4. Appendix – The Anatomy of a Rejection

Dear John:

Title: Core-Collapse, GRBs, Type Ia Supernovae, and Cosmology Authors: John Middleditch

Your revised manuscript was sent to a new expert referee. This person was chosen as much as possible to have no research or personal ties to the first referees and thus could provide an independent view of your paper. The new referee has returned a report that is appended below. Unfortunately, this referee comes to the same conclusion as did the first two referees. The present reviewer finds substantial problems in your work, and does not believe that the paper can be repaired. He/she recommends rejection of the paper, as did the previous referees. Therefore I regret to tell you that the Astrophysical Journal Letters will not be able to publish this manuscript. We will be happy to consider new manuscript submissions from you in the future.

Regards, Chris Sneden, Letters Editor THE ASTROPHYSICAL JOURNAL LETTERS

Dear Chris,

I actually missed the rejection msg until yesterday! Saw the title but thought it was more apology fluff related to the other msg on the same day (2006 Dec. 19).

Anyway, the following is an FYI for the record.

Do with it what you will.

I am severely disappointed that ApJL does not see it as their duty to publish legitimate scientific dissent, particularly against a large group of astronomers who have gotten more paranoid about such dissent, particularly in light of two very recent SN developments, than Richard M. Nixon just prior to his resignation.

-John Middleditch

On Tue, 2006-12-19 at 14:41, apjletters@letters.as.utexas.edu wrote:

This paper should not be published and the debate should end.

Four Type Ia SNe in NGC 1316 within 26 short years, 1.2 solar masses of $^{56}$Ni from 2003fg, and the debate should end?? That’s a version of Bob Kirshner’s reply on 2005, Aug. 9: “Well gee, we got the right answer!”

I am sure the author will complain that this is just the establishment resisting new ideas.
It isn’t. Current paradigms, which are in fact continuously evolving, are a consequence of decades of observations and theory by the community, no one or small group of people. They can be overturned, one by one, by hard work and compelling arguments, but not in one broad swath based chiefly upon opinion and not calculation.

Putting tons of publications, numbers thrown at a problem, especially calculations, even decades of work by many people, above observational fact, strikes me as staggering arrogance. Doing so while at the same time ignoring perfectly valid observations of others (see below re: 2.14 ms pulsations from SN 1987A), strikes me as hypocrisy, never mind that in one instance the vulnerability is systematics while in the other it is the absence of an individual overwhelmingly significant result. It doesn’t matter how many people have published on Ia cosmology for how long. A systematic exclusion of certain types of Ia’s, which ought to exist, from the local sample will take down everyone’s results, one of the points made in this paper. Observational fact trumps everything else. Calculations will never fail to err without rigorous observational constraint. ApJL is intended as a mechanism to overturn or reinterpret just such decades of hard work/science, using just such cogent arguments:

”Timeliness – A Letter should have a significant immediate impact on the research of a number of other investigators or be of special current interest in astrophysics. ... A Letter can be more speculative and less rigorous than an article for Part 1 but should meet the same high standard of quality.”

The author attempts a grand synthesis that brings together aspects of SN 1987A, Type Ia supernovae, long gamma-ray bursts, short gamma-ray bursts, and core collapse supernovae of all kinds. At the heart of this is a merger model - either of two WR stars or two white dwarfs.

He argues - or states - among other things that SN Ia’s are WD mergers accompanied by core collapse. He is probably right that such a merger would lead to neutron star formation if over 1.4 solar masses stayed bound, but quite wrong about the Ni mass. Spectra and light curves demand about 0.7 to 0.8 Msun plus a few tenths solar mass of Si through sulfur. The result of the merger of two white dwarfs would not give enough mass in close proximity to the collapse to make these elements. Please present or reference a calculation that proves otherwise.

Given the circumstances, I’m cynical about what spectra and light curves “demand.” These are inverse problems, tough ones. In any case, just because nobody is ready to calculate merger/core-collapse doesn’t mean it can’t or doesn’t happen, and in such a way that it doesn’t produce the few tenths of a solar mass of Si and S. Accepting the ”demand”
of spectra and light curves leaves the ONLY answer to a Ia (SN 2003fg) with more than 1.2 solar masses of $^{56}\text{Ni}$ as a "super-Chandrasekhar mass" white dwarf – i.e., inventing new physics! That’s far worse!

He argues that the presence of pulsars in globular clusters suggests core collapse in Ia’s, but it is possible to get either thermonuclear explosion (Ias) or or accretion induced collapse (pulsars) from very similar models in which only the accretion rate is changed. Or the DD mergers may make pulsars while another event makes SN Ia’s.

Always apply Occam’s Razor. Always. Whether it’s possible to get TN explosion or CC depending on accretion rate is still an open question. Only models exist, and these have been developed by those with an axe to grind. An observation: the recycled pulsars in the core-collapsed (CCd) GC Ter 5 with determined masses weighed in at 1.7 solar – more than 1/4 solar mass above 1.4 (Scott Ransom 2006). That’s a LOT of mass needed to spin things up. Thus the "superaccretion" gambit is dead. There never was any evidence for it in the first place. It had been moribund ever since my colleagues and I discovered the first pulsar in the non-core-collapsed (nCCd) GC, M28, in 1987, and since SN 2006mr dead and moldy. Astronomers just keep inventing stuff so that they can continue to get grants to work on what they want to work on in a grant system that is broken through no fault of their own. (“I’ll support your BS if you support my BS,” etc.) In this way they become part of the problem, and it takes a good hard kick to bring them back to reality. Now events in the universe have occurred so quickly that they can’t invent things fast enough. And without superaccretion, there are just TOO many ms pulsars in the nCCd GCs to not have most of them born fast. Aside from that, Middleditch, J. 2004, ApJL, 601, L167, has been published for three years now, and it suggests just this. Nothing wrong with it then. Nothing wrong with it now.

He argues that 87A was a DD merger of two stellar cores. What is that? Does DD stand for "double degenerate”? Sanduleak 202-69 [sic] was a RSG just 20,000 years before it was a BSG. There are merger models for 87A, but neither of the merging counterparts is degenerate in any model of which I am aware. At a minimum more details of this "model" are needed.

DD does indeed stand for double degenerate, last paragraph of the Introduction. Also Sanduleak -69 202. The astrophysically negligible 10 km/s expansion of the equatorial ring, the thermal velocity of H at 10,000 K, is a big clue here. Never was an RG because of overflow out of common envelope through 1 or both outer mass-axis Lagrangean points. The lack of any strongly magnetized pulsar remnant, unlike SN 1986J, is another clue that 87A (and damn near all others) did not result from Fe photodissociation catastrophe. The excess of N seen in SNe may also be a signature of merger.
He uses the observation of polarization and high velocity lines in SN Ia to argue for a merger, but does not present a model to back up the claim nor consider other explanations given in the literature (asymmetric ignition and explosion).

It’s an ApJ Letter, 4 pages TOPS! The model is staring us in the face as the picture of SN 1987A (www.stsci.edu). Better than a model in many ways.

He argues in a few throw away lines that a long soft GRB results when a short hard GRB (produced how?) happens inside a lot of matter.

“Throw away lines”???? This is a version of the dreaded “You can’t just SAY that!” (YCJST) objection. You know you’ve really hit home when they are desperate enough to raise that one. People use this when it would look like they’ve been idiots in the past. Who hasn’t? The line: “Chen & Ruderman (1993[, ApJ, 408, 179]) suggested that the formation mechanism for millisecond pulsars in the Galactic disk and globular clusters might be different.” from Camilo et al. 2000, ApJ, 535, 975, is a throw away line because in this particular case it, and the following text misrepresent what Chen & Ruderman said. Namely, that the nCCd GCs don’t produce pulsars like 1920+57, 1937+21, M15 A,B,C, & G, because these are likely to have been “recycled,” via accretion, leading to magnetic pole migration toward the rotational axis due to accretion stresses, and not born fast, via merger, leading to wider, more frequently double pulse profiles. Confirming this is the low luminosity of pulsars found in Ter 5, relative to pulsars in nCCD GCs (Ransom 2006), which is very likely a selection effect in favor of narrow pulses because of their Fourier properties, making them more detectable even than higher luminosity, higher duty cycle pulsars. So a throw away line is a line whose flaws are easily pointed out, which the referee has not done with the lines he has noted, except his own throw away line about the “how” issue.

As for that, does anyone really doubt that GRBs can be softened by transmission through matter and viewed slightly off axis? In any case, witness the “mystery spot from SN 1987A. $10^{49}$ ergs of energy in it even 50 days after the SN (takes only 8 extra days for a polar beam/jet to get to it and thence on to the Earth). We’ll be figuring this out over the next few decades. Again, this is already published in ApJL, 601, L167.

I am not inventing anything, or claiming new physics, just trying to get people to pay attention to perfectly valid observations and airtight logic:

A. SN 1987A tried to make a gamma-ray burst, (witness the mystery spot), and would have succeeded were it not for the Hydrogen and Helium sandbags in its common envelope.

B. No long, soft GRBs are seen in elliptical galaxies.

C. The dominant mechanism for producing objects more compact than white dwarfs
(WDs) in galaxies, particularly ellipticals, is WD-WD merger to supernova (as occurred with the cores of the two stars which merged to produce Sk -69 202), dominated in these populations, as always, by binary-binary collisions.

D. But these tried to make a GRB within SN 1987A.

E. Therefore, WD-WD merger in ellipticals must produce some kind of GRBs.

F. But only short, hard GRBs happen in ellipticals.

G. Therefore WD-WD mergers produce short, hard, GRBs.

He states a lot of opinions that have nothing to do with making his case - a cosmological constant is "unnatural"; people using SN Ia’s to do cosmology are "unwise". He brings back the 2 ms pulsar in 87A which he, and only he was ever able to detect. He dismisses other observations of the CMBR that have also provided evidence for a cosmological constant nearly equal to what the SN Ia groups found.

The CMBR first:

Yes, but they keep saying that Ia cosmology is the only direct evidence for DE (e.g., Conley et al. 2006, Sullivan et al. 2006). Why do you suppose they do that?

Now 87A:

The object was found in data from many telescopes and observatories. Sure, I did the first pass analyses, but reputable collaborators have also verified the signals, and the data have been offered to anyone who requests it.

We’ve even had a night in common with another group, with an agreement to share the data (I have a slide of the guy with Jerry Kristian on the afternoon of 1992, Nov. 6, in the Las Campanas 2.5-m control room). The promised data was never delivered, even though we did ask for it. (WHY? Written over inside the laptop? Lost? Absolute verification of the signal too damaging to astronomers? Ergo decades of work down the drain?)

I also pointed the HST/HSP collaboration to candidate frequencies for which we found a signal in their data on June 2, 1992, and March 6, 1993. For whatever reason they did not respond then, wrote a paper claiming an upper limit of 27th magnitude, which Kristian and I refereed, and we informed them that it was really 22 (100 times brighter – the HSP count rate on any object of known magnitude will verify that the instrumental throughput is 1%, and from this, limits can be set from the total number of counts in any observation), and told ApJ that we’d like to see the paper again before it got published. Next time we saw the paper it was published with a limit of 24.5 (still exaggerated 10 times too dim). A
representative of the collaboration showed up at the SN 1987A – 10 Years After conference in La Serena, Chile, and tried to argue for this limit, at least until he showed a power spectrum of his calibration object. When I informed him that the object had 10 times less background than SN 1987A, and was also integrated over a 50% longer time interval, he could only leave the stage, muttering.

Manchester and Peterson published on not seeing a signal in Dec. of ‘94 (I looked at their data, they really didn’t see anything.) But they spent only part of the two nights on 87A. In fact, at the Aspen SN 1987 & GRBs Conference during Feb. 19-23), Manchester made a whole contributed talk on the basis of this observation, plus the published times 10 exaggerated faint limit (24.5) from the HSP. I had to correct that hearsay claim on the spot.

Aside from that, it’s not like there aren’t 10 solar masses of starguts moving around, or any pulsar remnant isn’t precessing and potentially changing its beaming. As far as I know, they had no observations during the interval from Feb. of ‘92 through Sep. of ‘93 (they tried on September 15, 1993, but were clouded out – signals were seen from Tasmania on the 12th and 24th), when we were detecting the signal most consistently. Remember, HST was still nearsighted during that interval.

So THAT was our competition!

In short, if he had taken any single one of his claims, e.g., that the SN Ia sample might be biased by including some core collapse events along with the rest, and treated that claim carefully, maybe even joined with a model builder to flesh out the claim, a worthy publication might have resulted.

Again: It’s an ApJ Letter, 4 pages tops. See above for ApJL policy.

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