The Origin Of The Mass-Metallicity Relation For GRB Host Galaxies

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Host Galaxy Demographics

- Fainter, bluer, low mass
  - Fruchter et al. 1999, 2006
  - Tanvir et al. 2002
  - Bloom et al. 2002
  - Castro Ceron et al. 2006, 2008

- High SSFR
  - Christensen et al. 2004
  - Savaglio et al. 2008

- Traces overall cosmic SFR
  - Jakobsson et al. 2006
  - Guetta & Piran 2007

Savaglio et al. 2008
Host Galaxy Metallicities

- Tend to be metal poor
  - Sollerman et al. 2005
  - Fynbo et al. 2006
  - Prochaska et al. 2007
  - Stanek et al. 2007

- Evidence for a bias?
  - Modjaz et al. 2008
    12+log(O/H)_{KD02} \sim 8.5

- Theoretical justification
  - Collapsar model

12+log(O/H)_{KD02} \sim 8.5

Modjaz et al. 2008
Host Galaxy M-Z Relation

- Mass-Metallicity Relation
- Tremonti et al. 2004
- High mass galaxies contain higher metallicities
- More stars produce more metals + feedback processes
- Host galaxies fall below the M-Z relation for star forming galaxies
- Show no sign of string Z “cut-off”

Levesque et al. 2010 (arXiv:1006.3560v1)
SFR-Z Relation

- **SFR-Z relation**: Lower metallicity galaxies produce more stars for their given galaxy mass

Mannucci et al. 2010
SFR Weighted M-Z Relation

\[ \text{SFR Weighted Metallicity Distribution} \]

\[ \text{SDSS Metallicity Distribution} \]

\[ \text{log}(\text{O/H}) + 12 = 10 \pm 0.1 \]

Kocevski - Annapolis, Nov 1st-4th 2010
GRB Host Galaxy SFR

Log SFR (M_☉ yr⁻¹)

12 + log(O/H)

Log(M_☉ /M_☉)

Savaglio et al. 2009
Levesque et al. 2010
Conclusions

- The GRB defined M-Z relation is offset to lower metallicities
- An anti-correlation between SFR-Z would explain this trend
- Lower metallicity galaxies produce more stars than their higher metallicity counterparts for a given galaxy mass
- GRB closely trace SFR and should produce a M-Z relation biased towards lower Z, higher SFR galaxies
- This trend should be true of all transient events that trace the SFR, including core collapse SNe, but not SN Ia!