

# Short GRBs in high- $z$ clusters?

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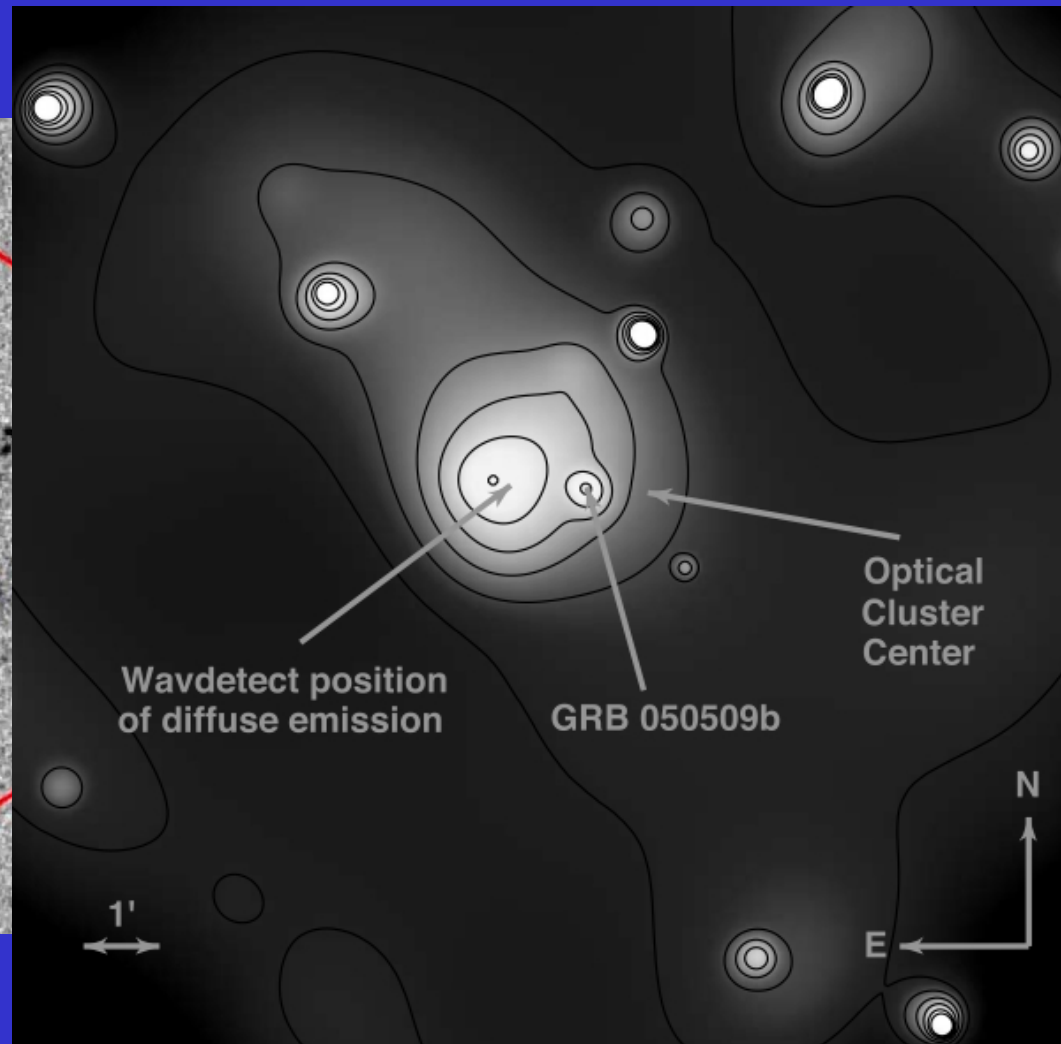
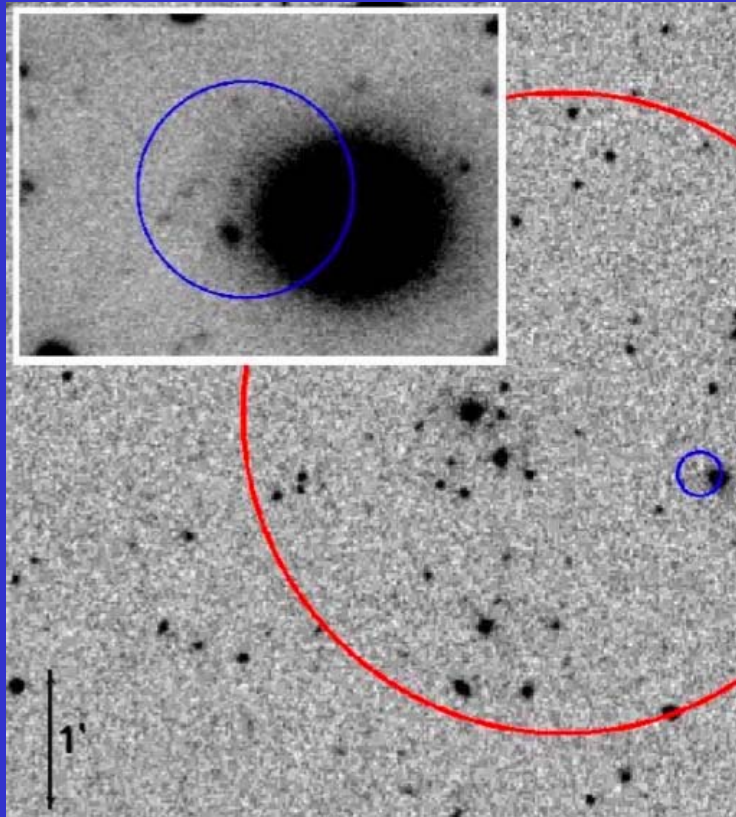
- **Long Bursts**

- All(?) from massive star collapses
- Star forming host galaxies
- Extremely luminous
- Trace star formation
- Obvious high- $z$  probes.

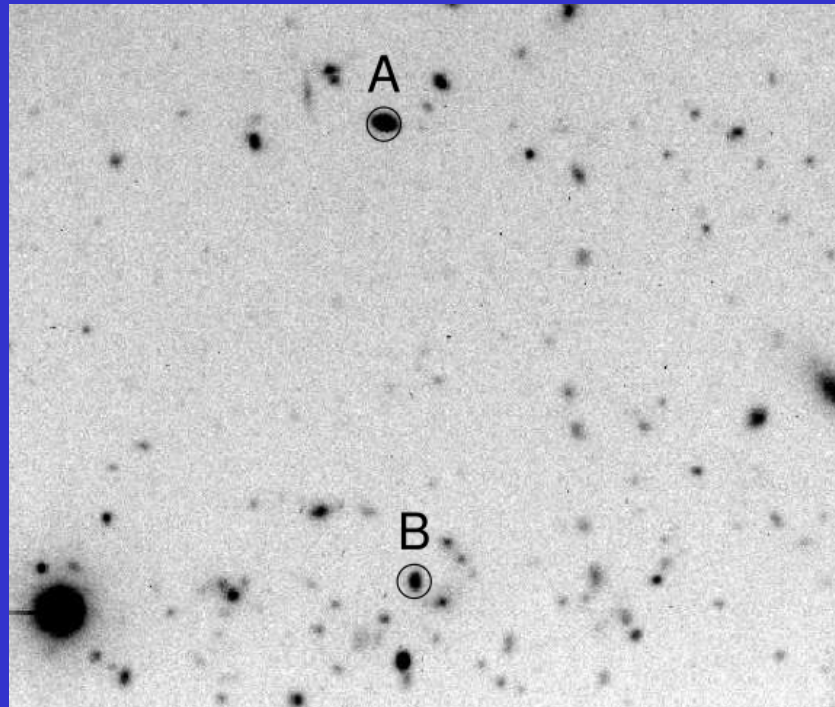
- **Short Bursts**

- Origin still largely unknown.
- Range of host galaxies including ellipticals
- Trace star formation convolved with delay distribution (ala SN Ia's)
- Apparently less luminous
- **Are they useful as probes?**
  - Gravitational Waves
  - Clusters

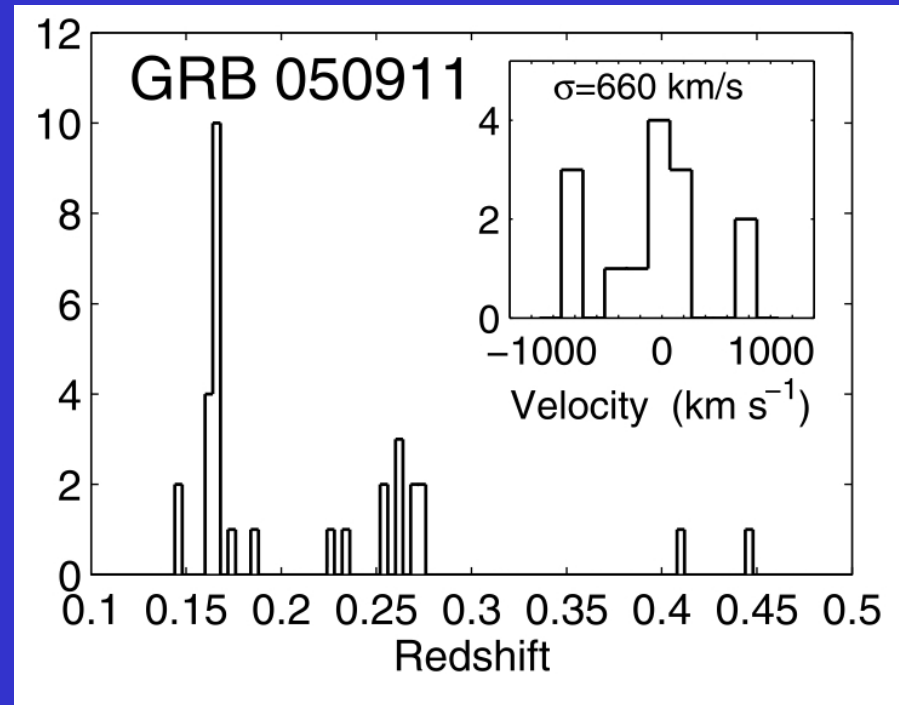
# A first hint



# More clusters?



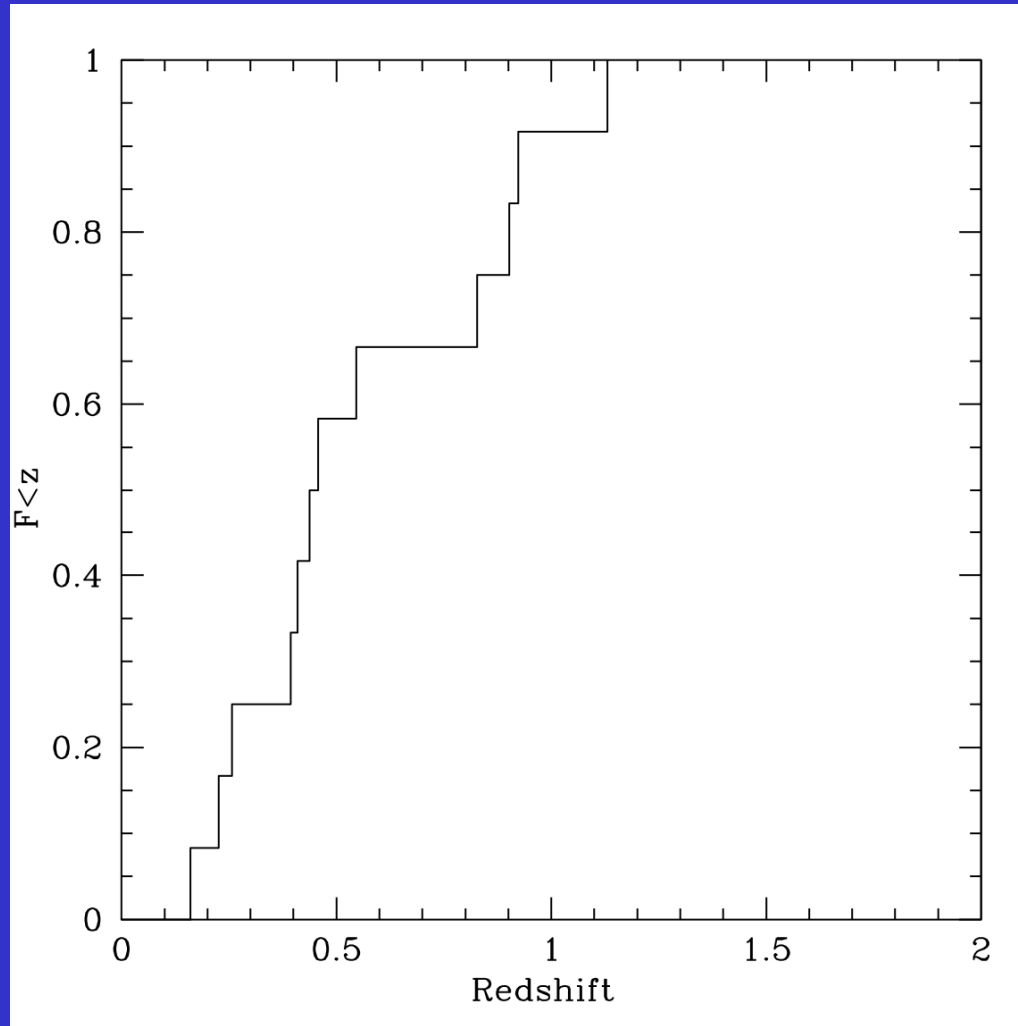
Levan et al. 2008



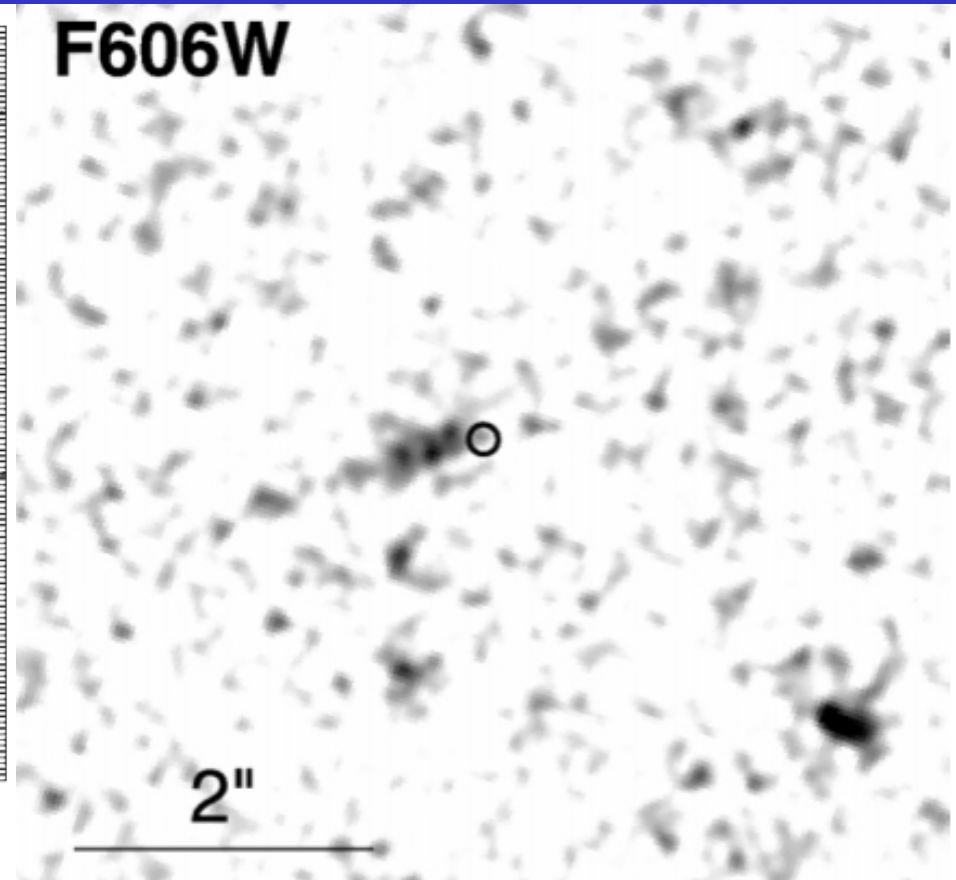
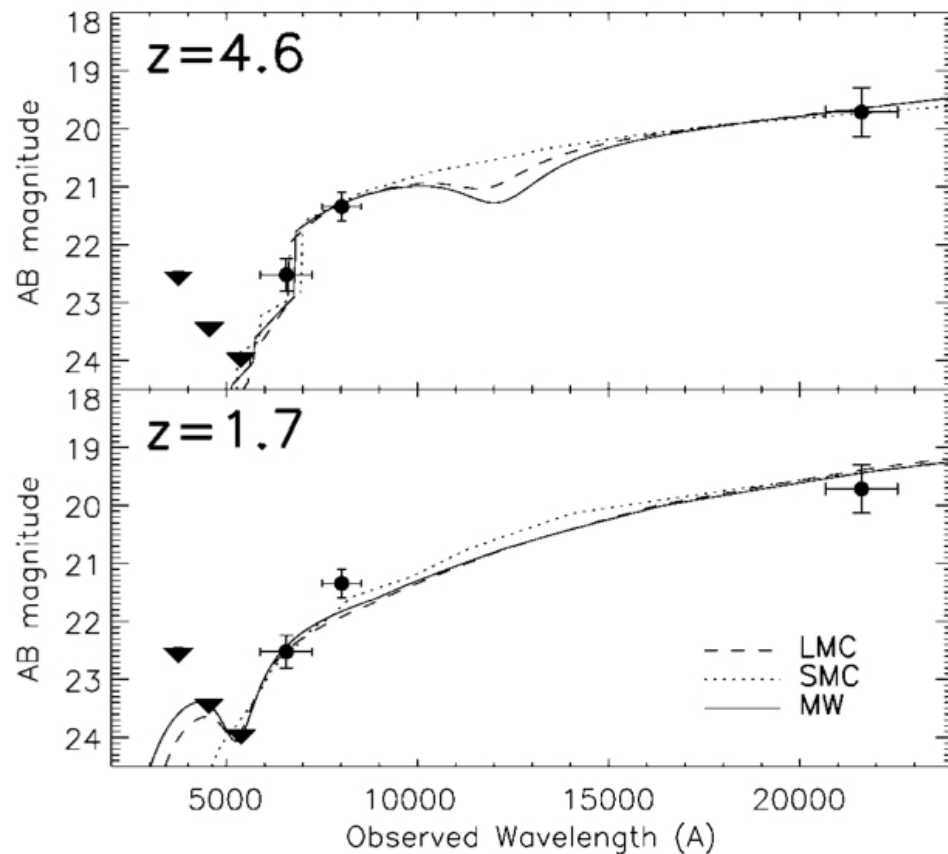
Berger et al. 2007

Perhaps ~10-20% of SGRBs appear in clusters (but uncertain)

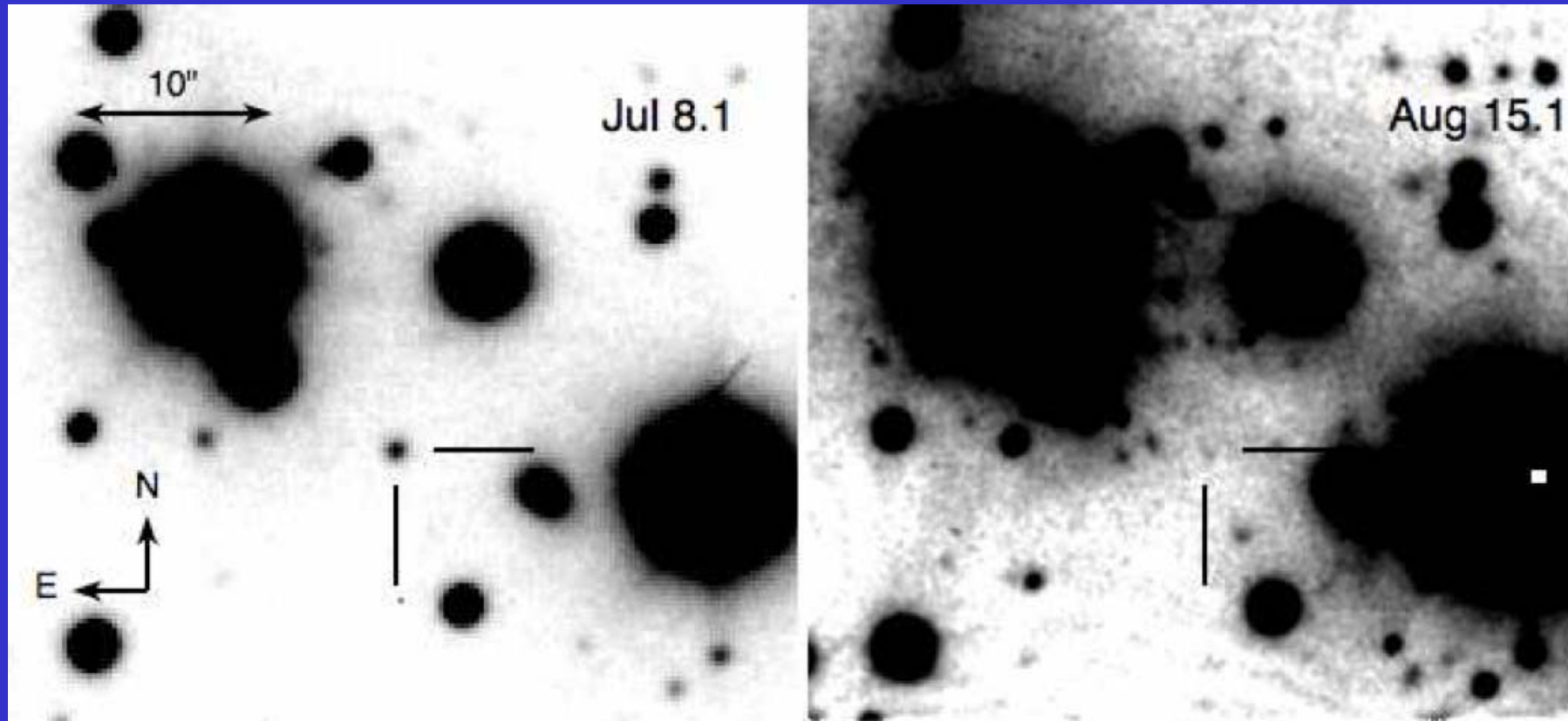
# But not very high-z.....

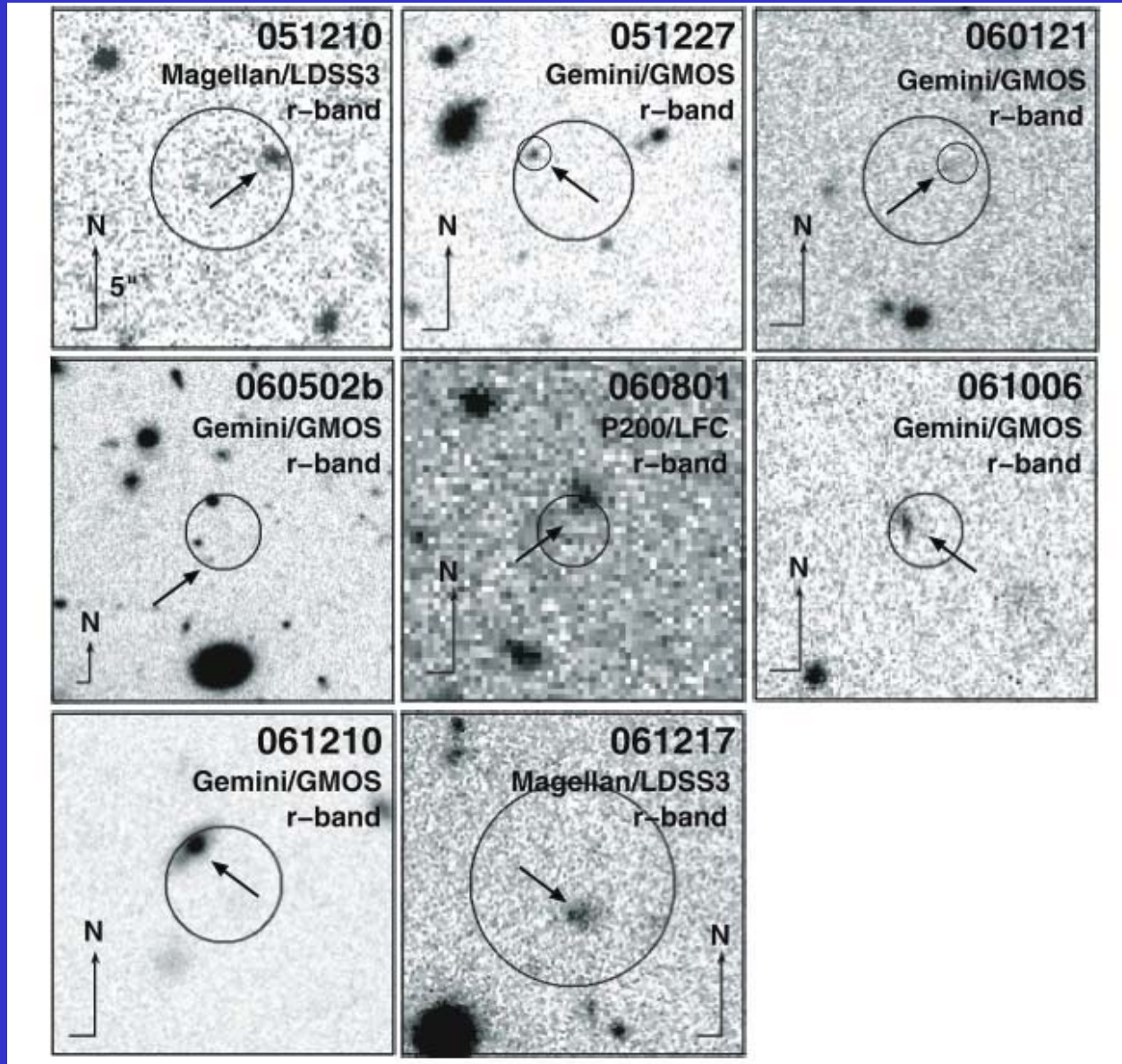


# Can we find high-z short bursts?



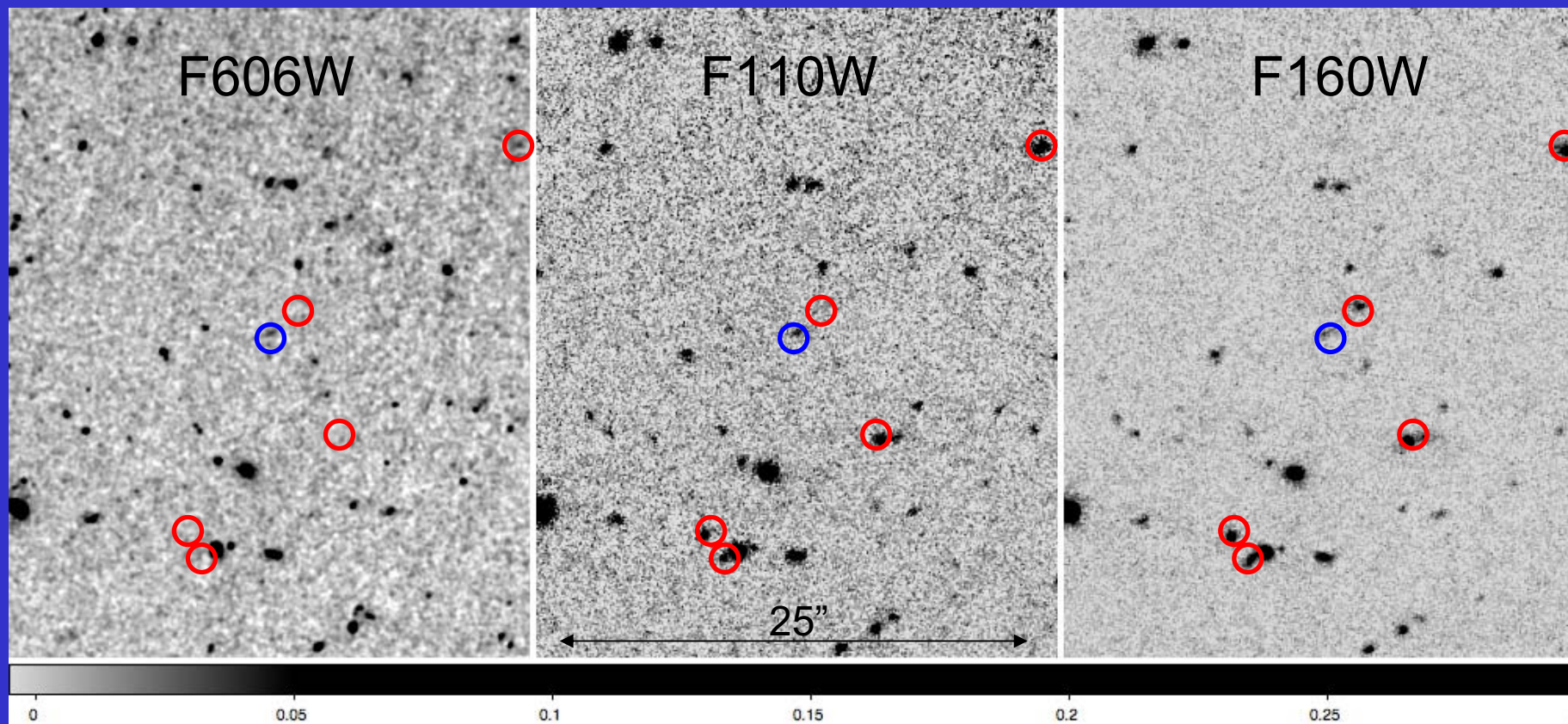
# 070707

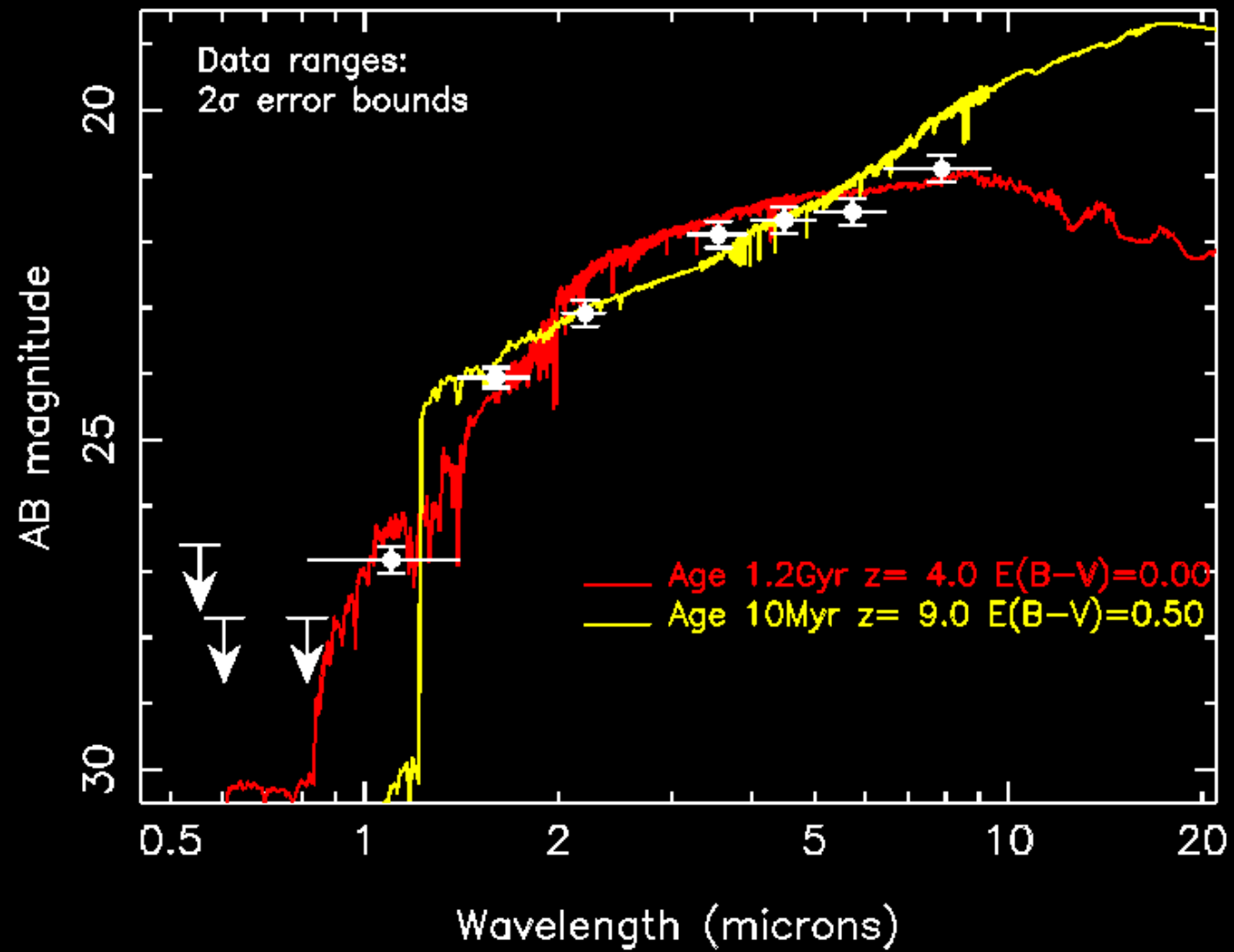


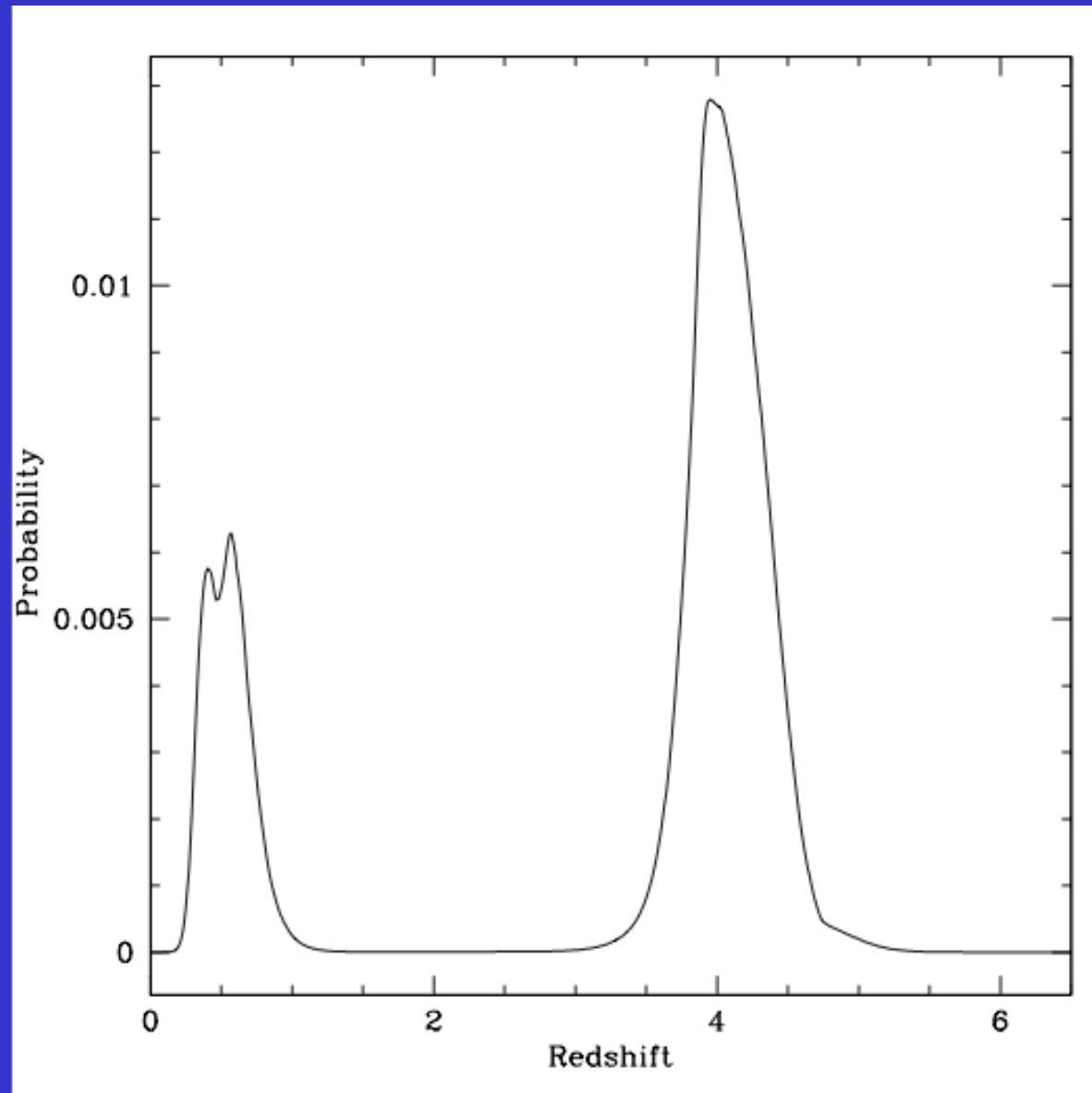




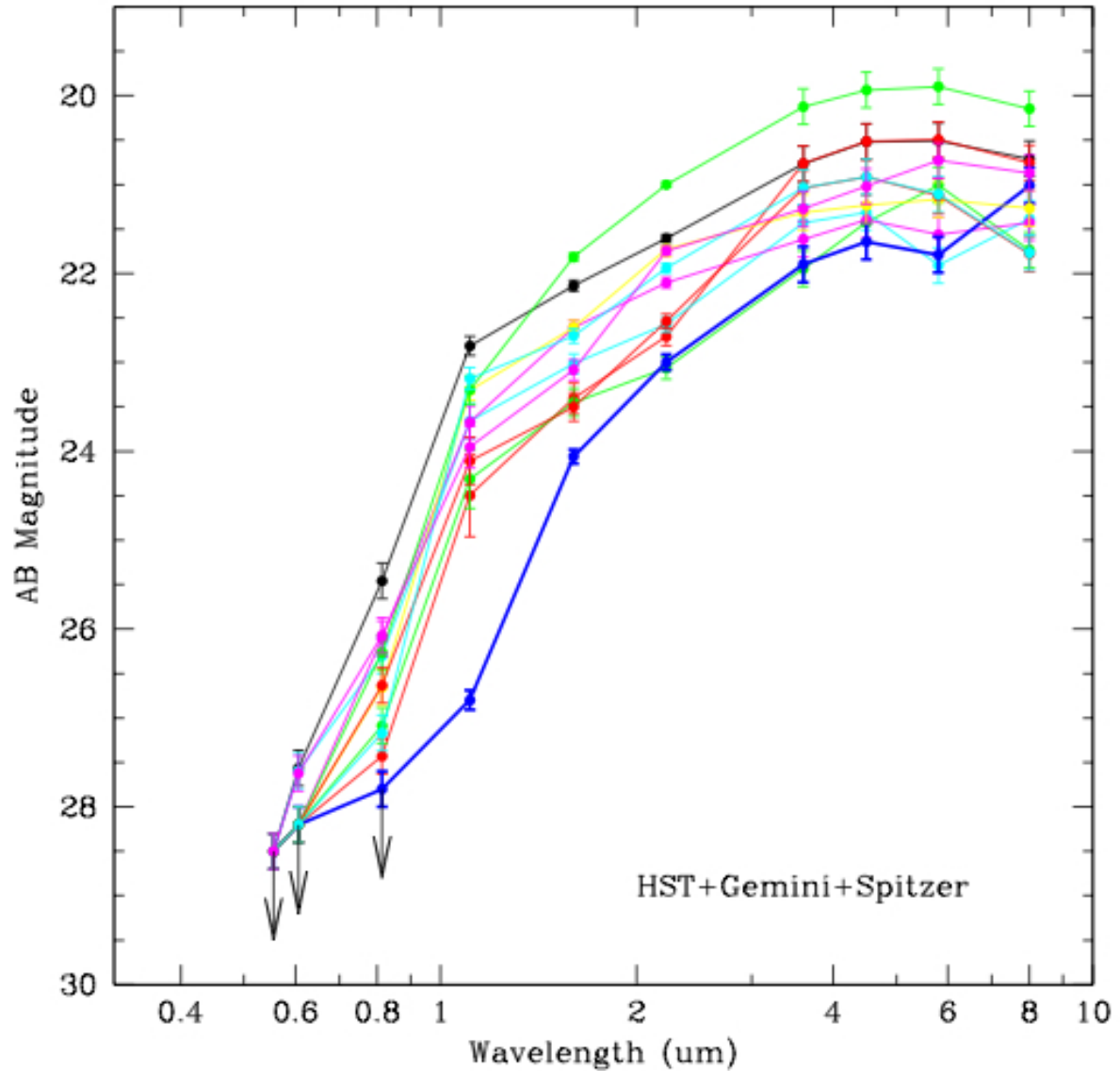
# GRB 060121







# SEDs



# Summary

- Some short GRBs apparently originate from massive, relatively local clusters
- Short GRBs can originate at much higher redshift
- Short GRBs at higher- $z$  might be a useful technique for the location of more distant overdensities ( $z > 1.5$ ).