Searches for Gravitational Wave Signals Associated to Gamma Ray Bursts

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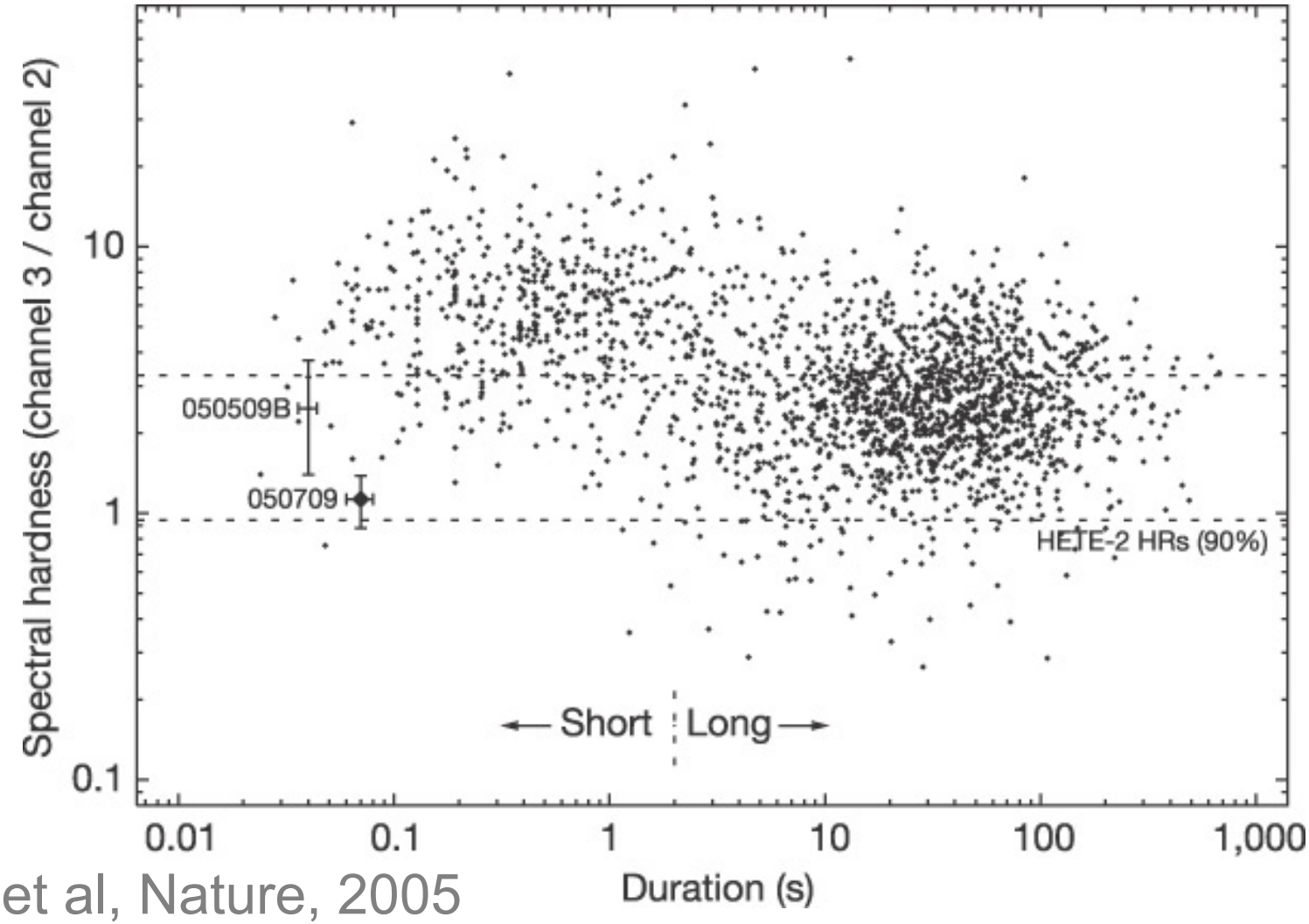
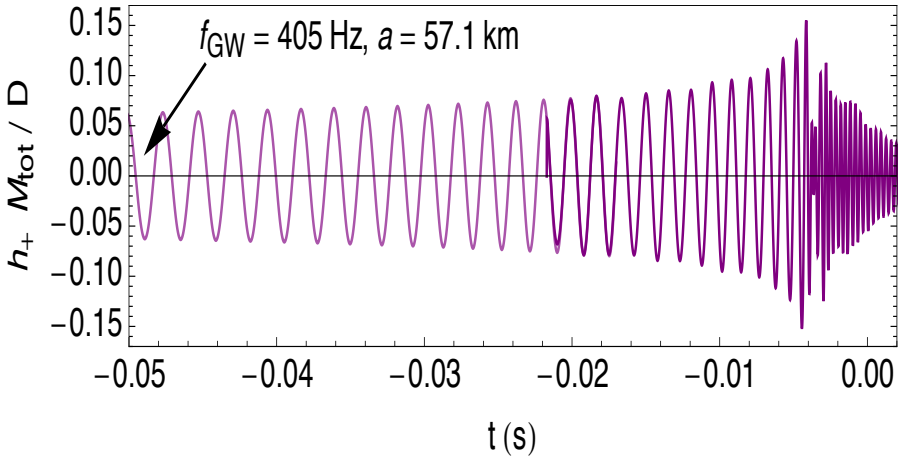
Gamma Ray Burst Classification



Hjorth et al, Nature, 2005

Gravitational Wave Emission

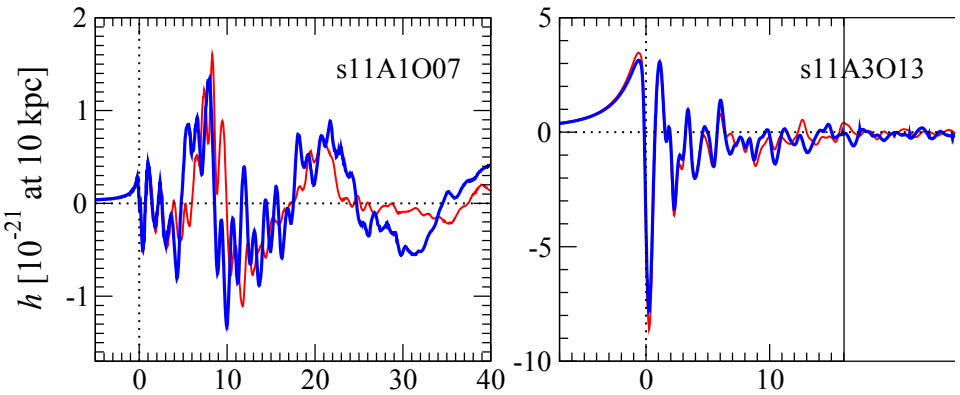
Short GRB: Merger of Neutron Star-Neutron Star or Neutron Star-Black Hole known GW emission



J Read/YITP (In Prep)

Long GRB: Collapsar uncertain GW emission

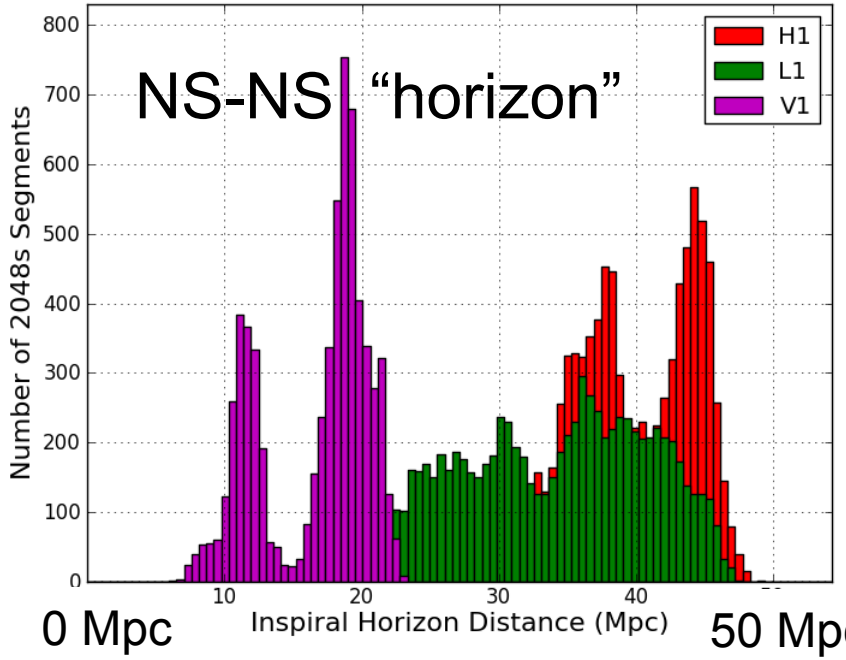
- Emission from $10^{-2} M_{\odot} c^2$
  Piro and Pfahl 2007, Davies et al 2002.
- To $10^{-8} M_{\odot} c^2$ Ott CGQ (2009)



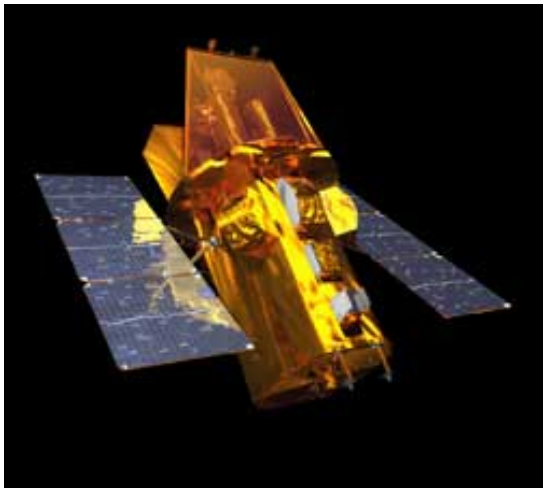
- Or less

Gravitational Wave Detectors

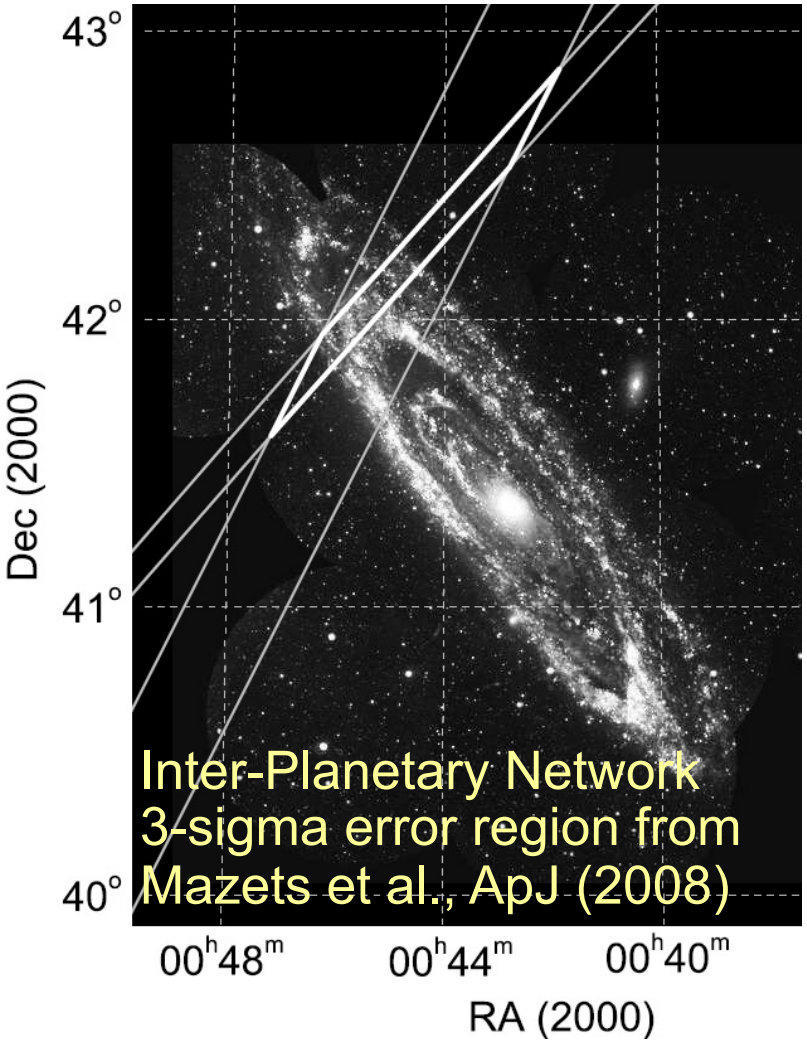
- Operated from Nov 2005 to Sept 2007 & July 2009 to Oct 2010
- Currently being upgraded
- From 2015, advanced detectors
  - 10x increase in (distance) sensitivity



Triggered Search



GRB 070201

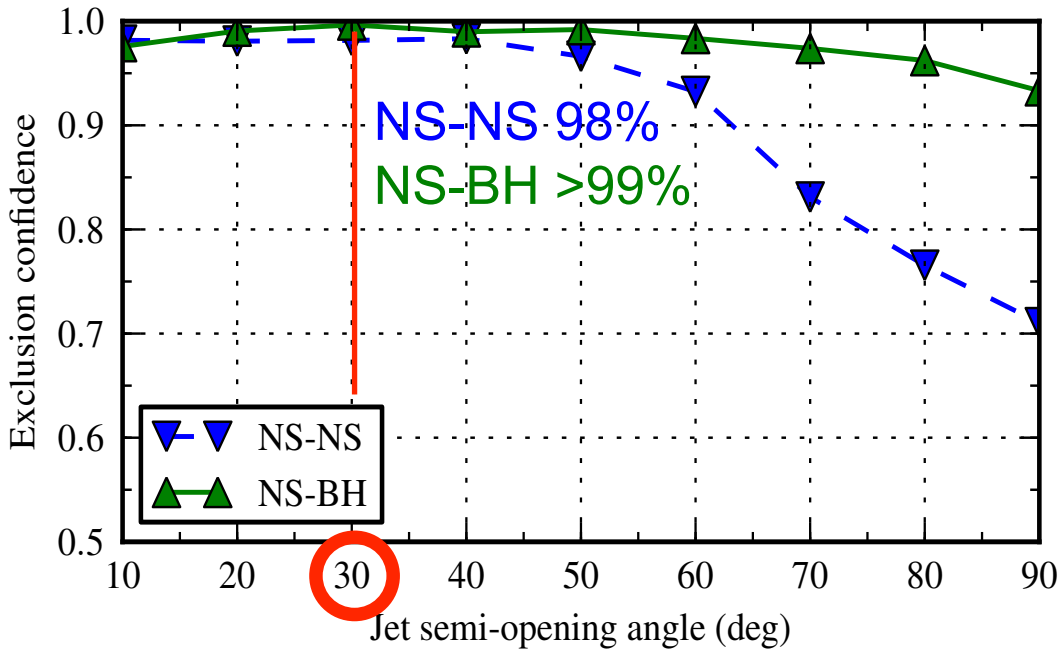


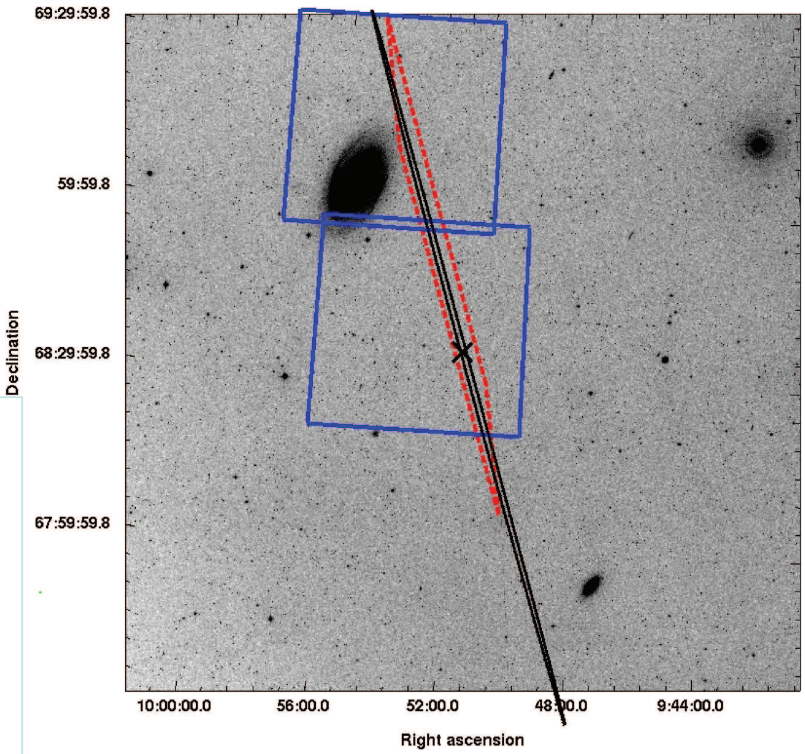
- Localization overlaps M31 (at 770 kpc)
- No GW signal observed
- Exclude NS-NS and NS-BH merger in M31 with 99% confidence
- Indirect support for hypothesis of soft gamma repeater in M31

Abbott et al. ApJ 2008

GRB 051103

- Localization overlaps M81 (at 3.6 Mpc)
- No GW signal observed
- Exclude binary merger progenitor as function of opening angle





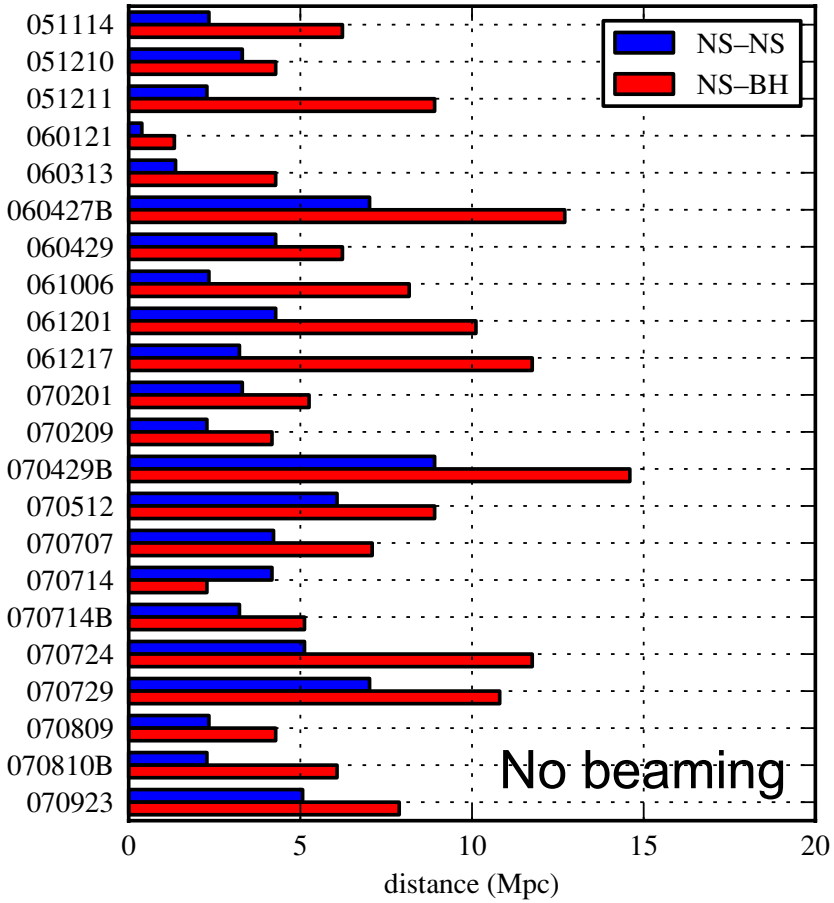
Abadie et al. 1201.1163

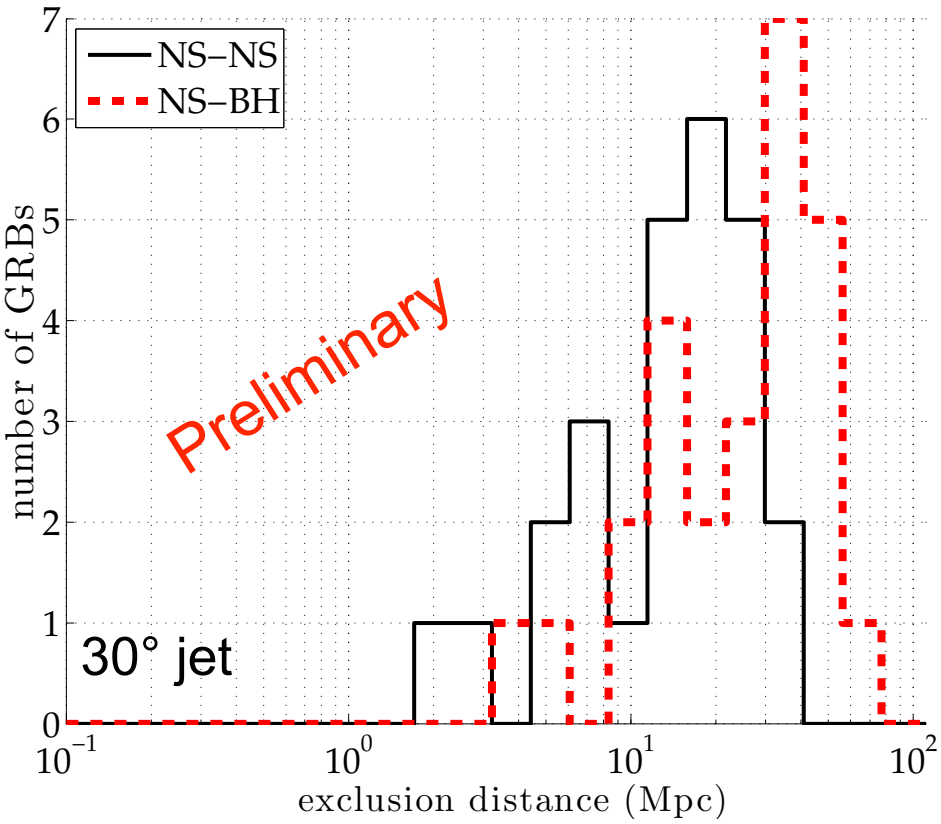
Short GRB exclusion distances

2005-7 run

Binary Merger Model

2009-10 run





Abadie et al ApJ (2010)

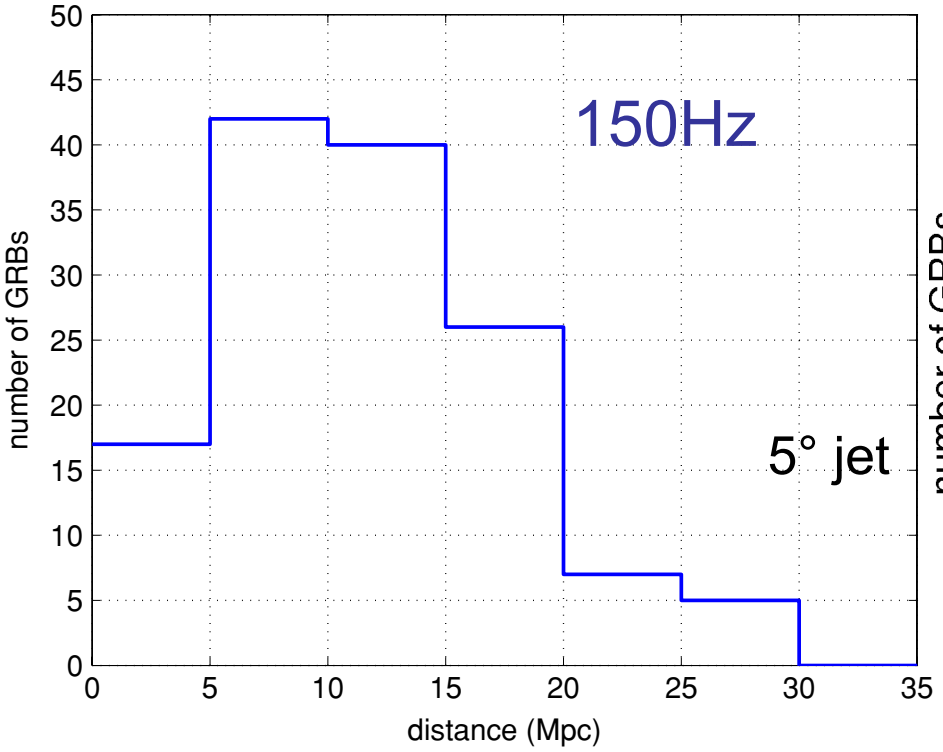
Exclusion distances for all GRBs

Unmodelled GW Burst

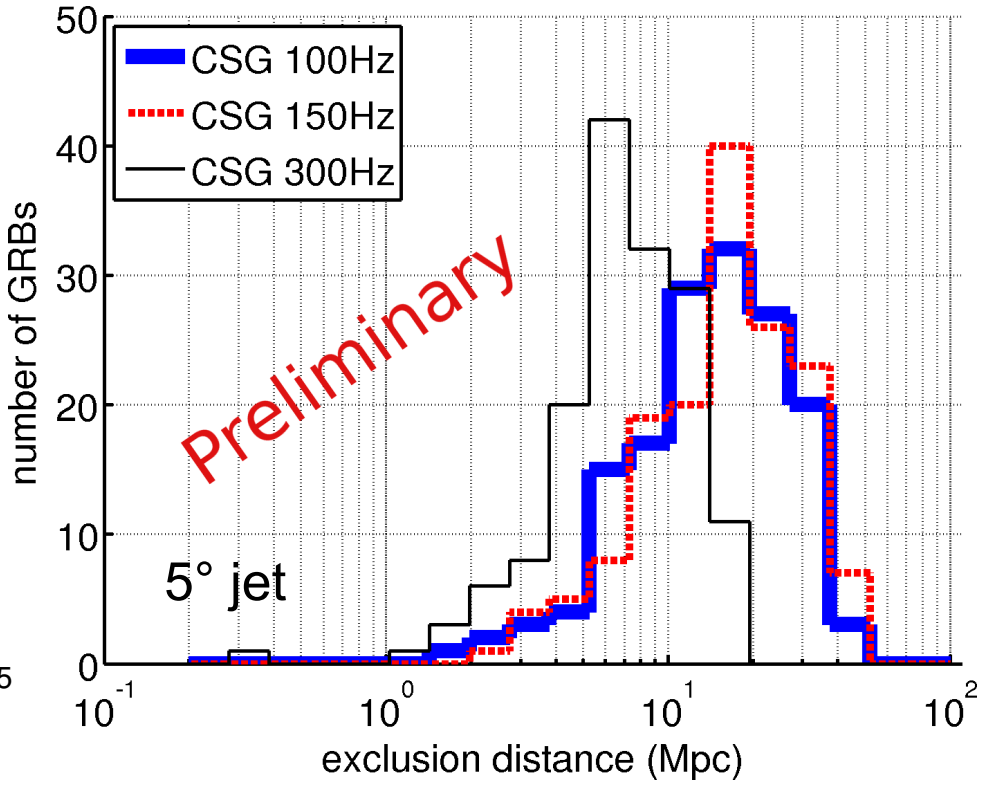
Assuming 10^{-2} $M_{\odot}c^2$ in GW;

emitted in small frequency band

2005-7 run

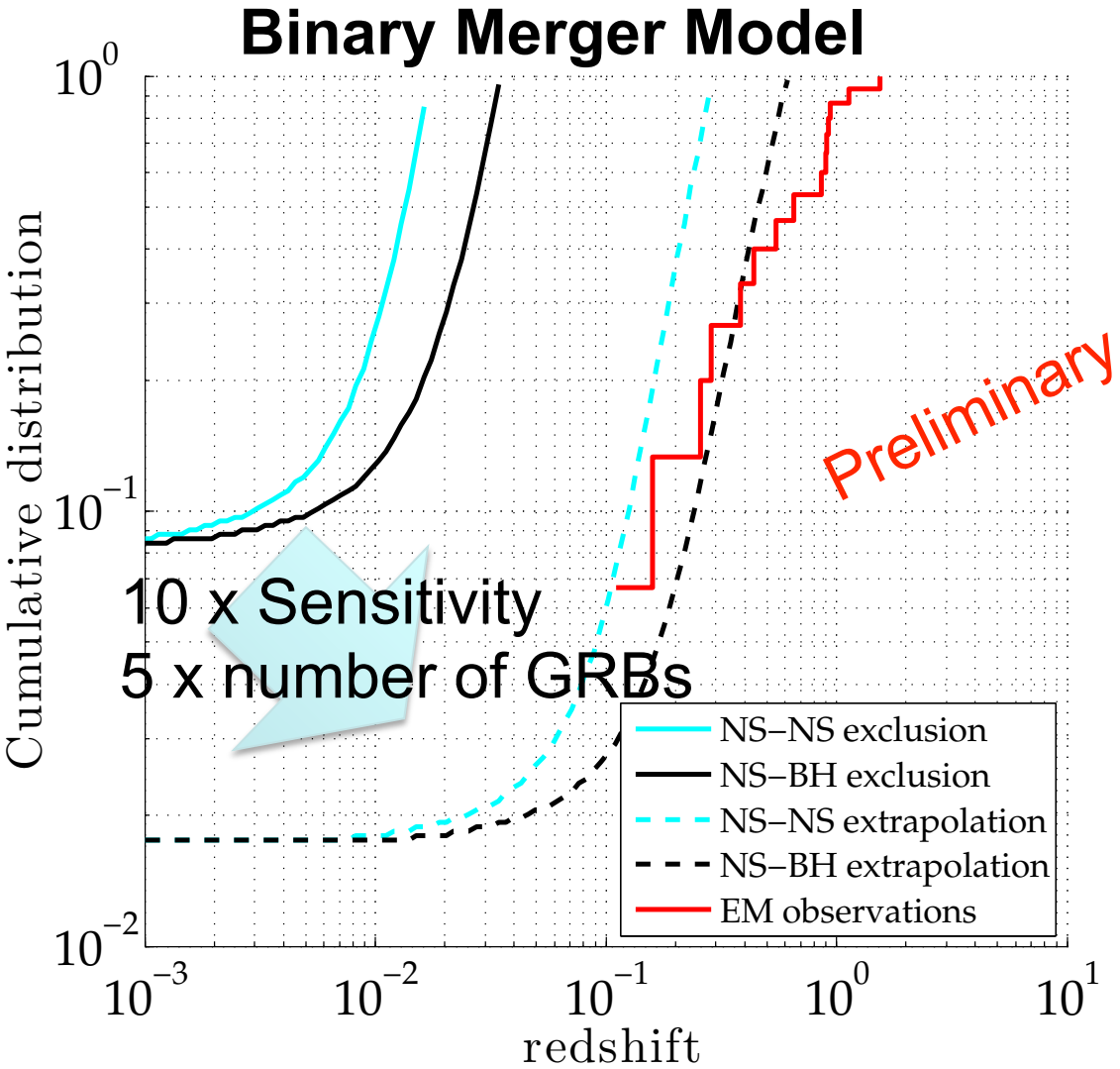


2009-10 run



Abbott et al ApJ (2010)

Future Prospects



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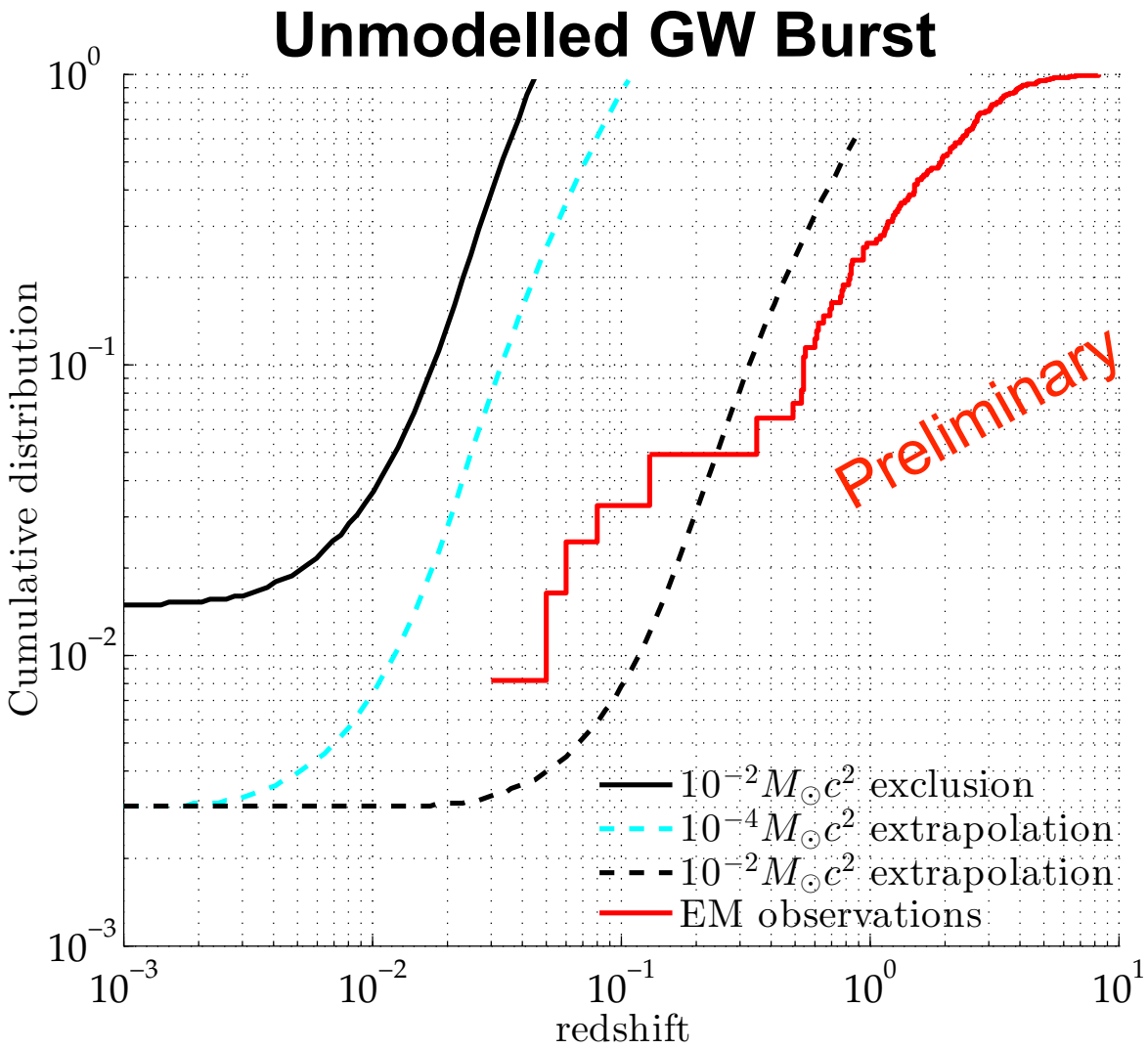

Future Prospects

- Advanced detectors may detect GW associated to GRBs
  - Confirm (or rule out) progenitor models

- Prospects are strongly dependent on number of GRBs observed electromagnetically.