GRB-triggered searches for gravitational-wave inspiral signals in LIGO data

Nickolas Fotopoulos (UWM) for the LIGO Scientific Collaboration

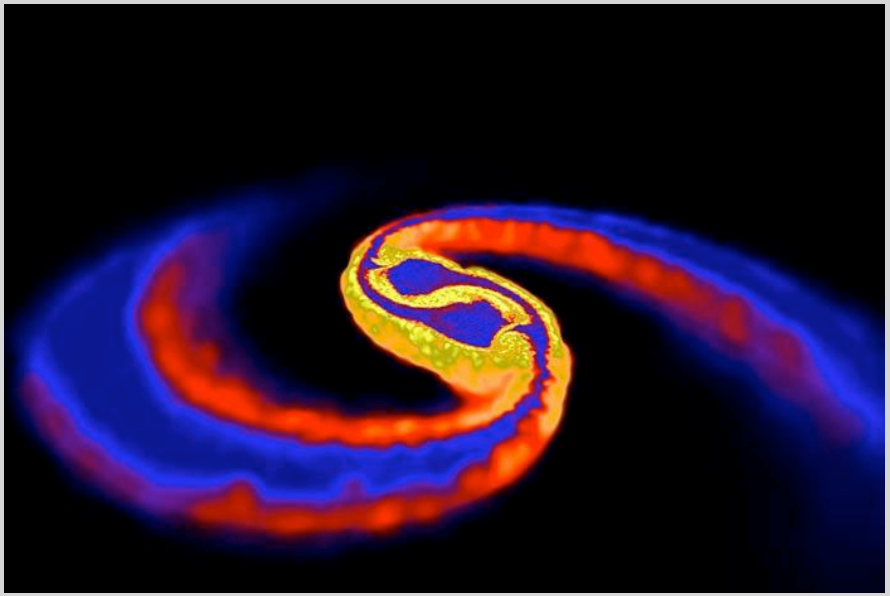
APS April 2008 meeting, St. Louis, MO

2008-04-12

LIGO-G080170-00-Z

Short GRBs: ideal targets for GW astronomy

- Most short GRBs are probably NSs disrupted by companions in the final stages of inspiral.
- The inspiral phase of GW emission is well-modeled and LIGO can detect nearby events.*
- GRB times and sky locations are published online.



NS-NS merger simulation
Credit: Daniel Price and Stephan Rosswog
@ New Scientist

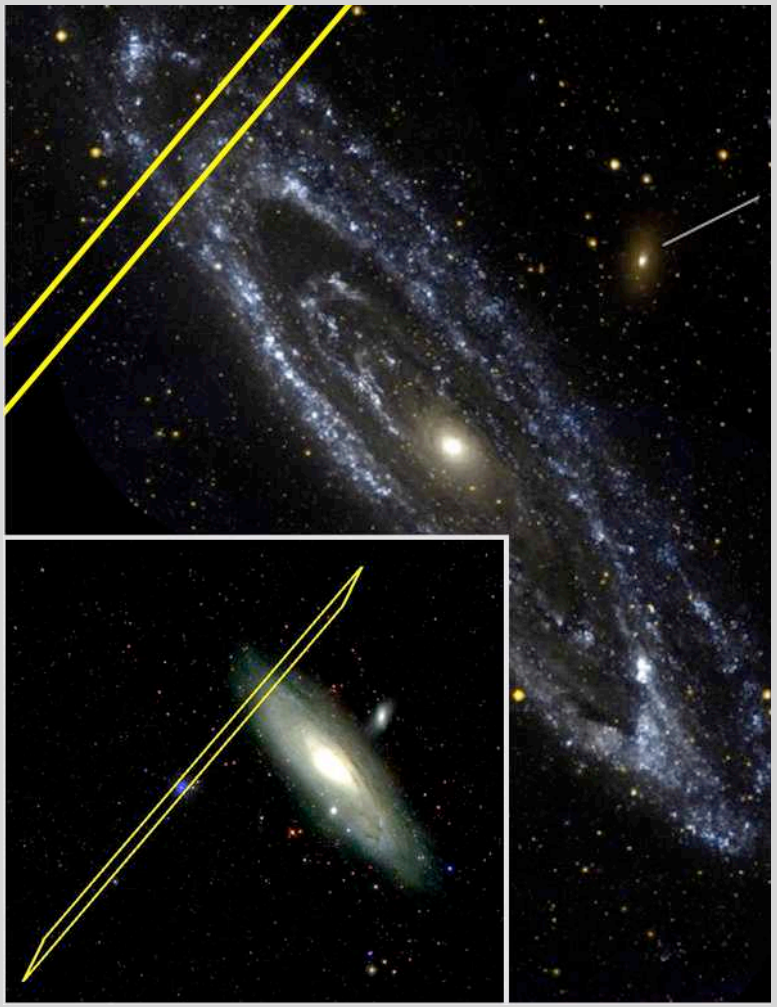
LSC

* It hasn't yet.

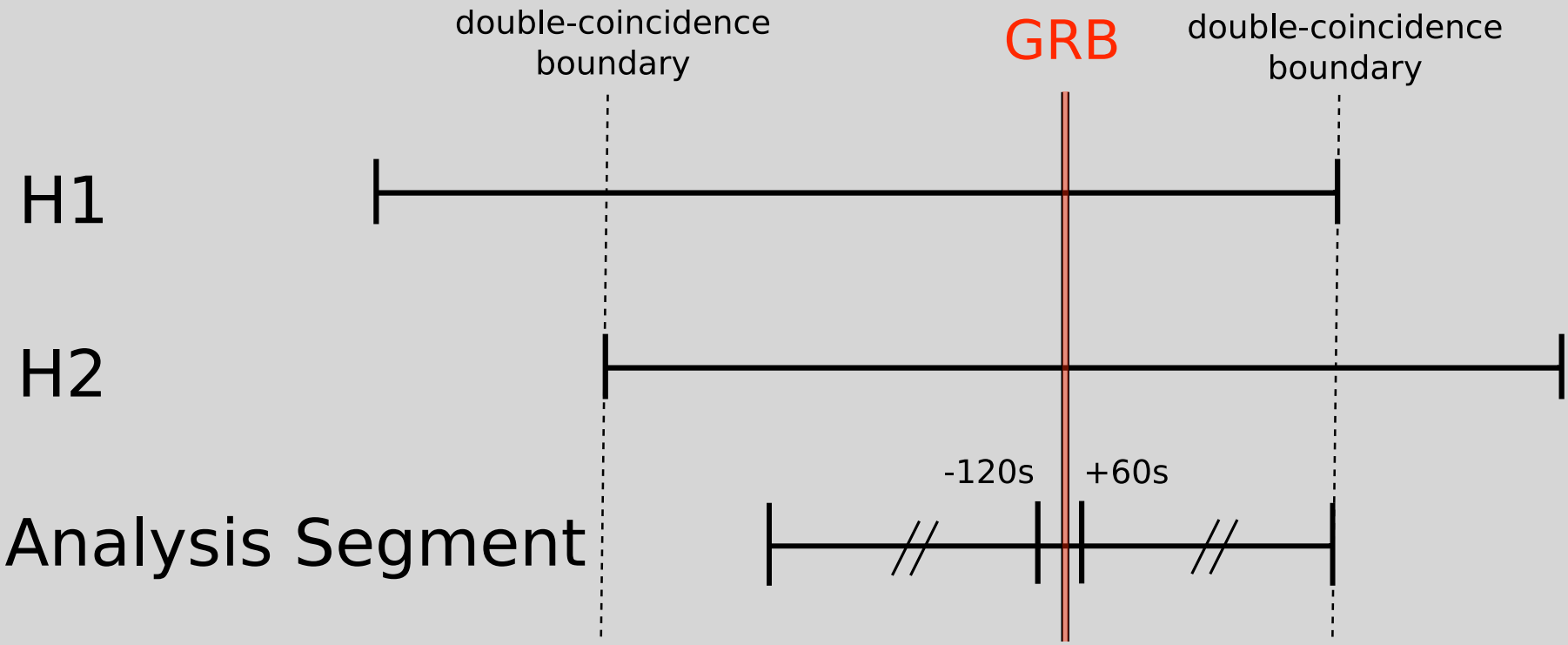
GRB 070201

- Short GRB detected by several space-based instruments
- Directional uncertainty covers part of M31. $D_{M31} \approx 770$ kpc !
- Energetics suggested that if the source is in M31 ($E_{iso} \approx 10^{45}$ erg), it is probably not an inspiral ($E_{iso} \approx 10^{51}$ erg). A soft gamma repeater (SGR) is more likely ($E_{iso} \approx 10^{44\text{-}46}$ erg).

- LIGO detectors H1 and H2 were online. Let's look anyway!



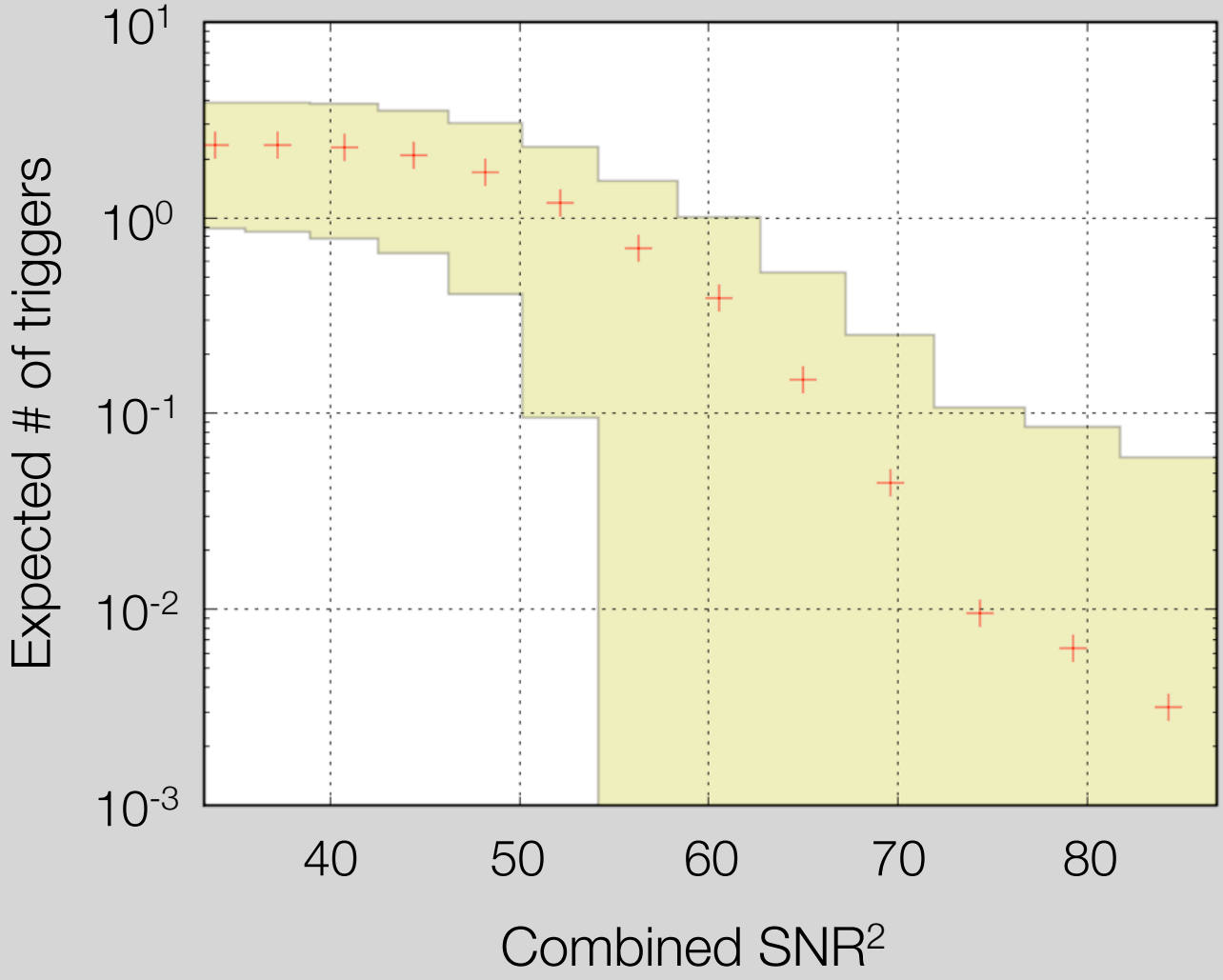
Larger: M31 in UV from GALEX
Inset: M31 in optical from SDSS



Analysis segment

Highly conservative choices

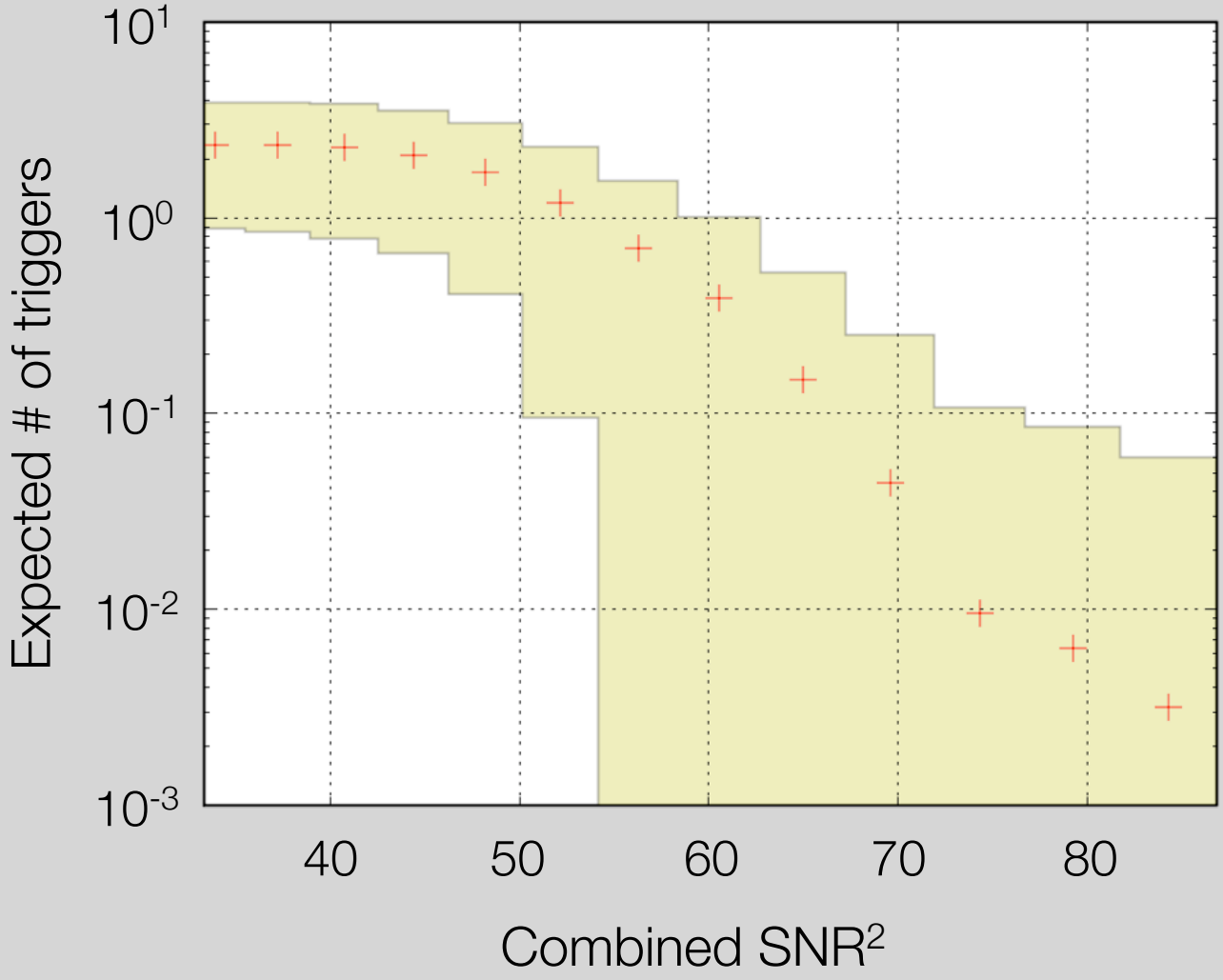
Used large off-source region (60,000 s) for unbiased background estimation



Background estimate

Estimated from 323 trials

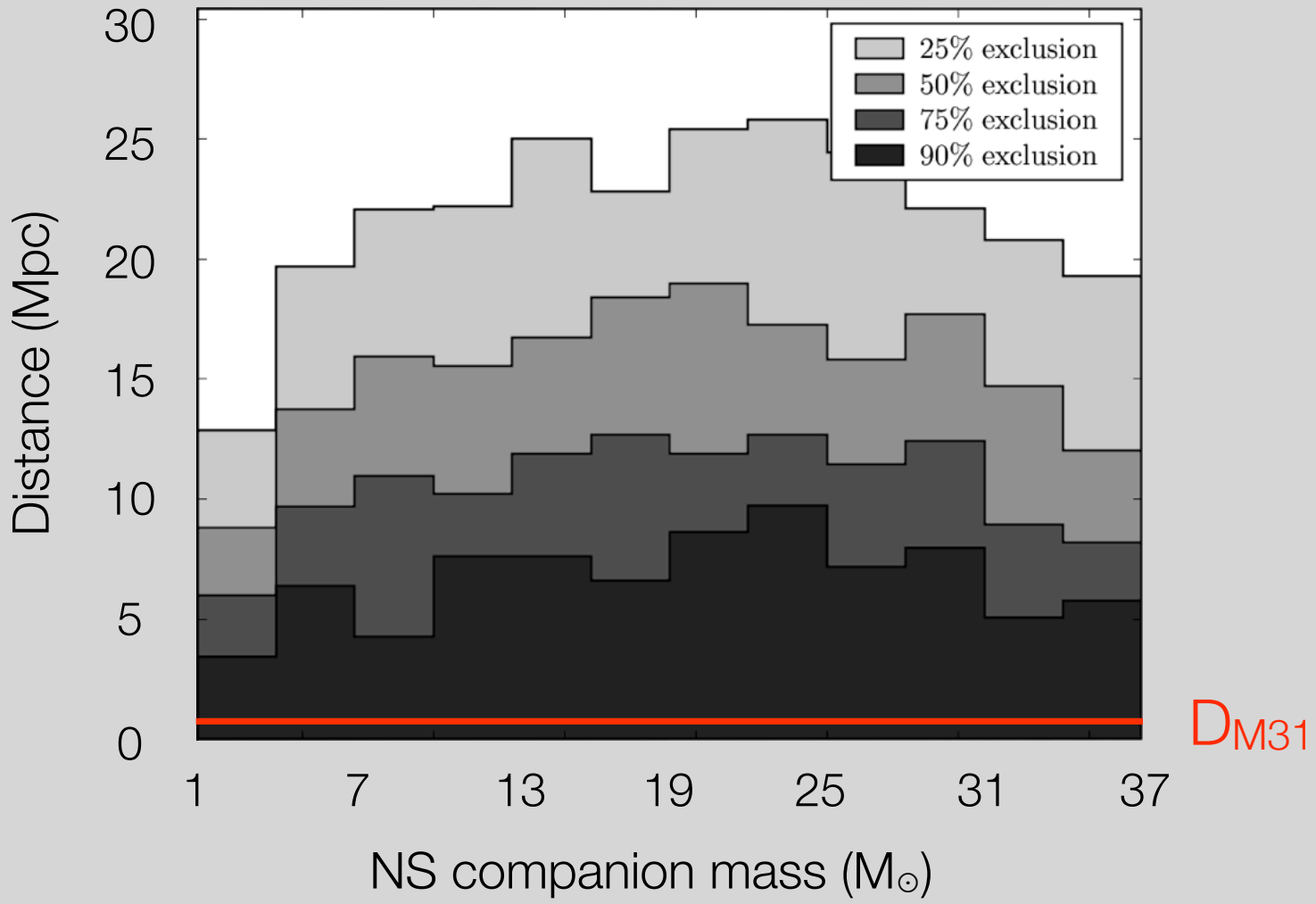
2.7 candidates expected



Results

2.7 candidates expected

0 candidates observed



Inspiral Upper limits

Inspiral in M31 ruled out with >99% confidence

The rest of S5: overview

- 213 GRBs (212 with sky localization)
- ~30 short GRBs
- ~20 short GRBs while two or more GW detectors were online

Plan: Analyze these short GRBs, then the rest

New requirements: Generalization and automation

Summary

- LIGO observations have ruled out GRB 070201 being a compact binary inspiral in M31 with >99% confidence (accepted by ApJ). A LIGO search for unmodeled GW bursts cannot exclude the event having been an SGR (soft gamma repeater) in M31.

http://arxiv.org/abs/0711.1163

- In the future, expect more GRBs with a smaller on-source time and a population statement.