



# GRB triggered searches for gravitational waves in LIGO data

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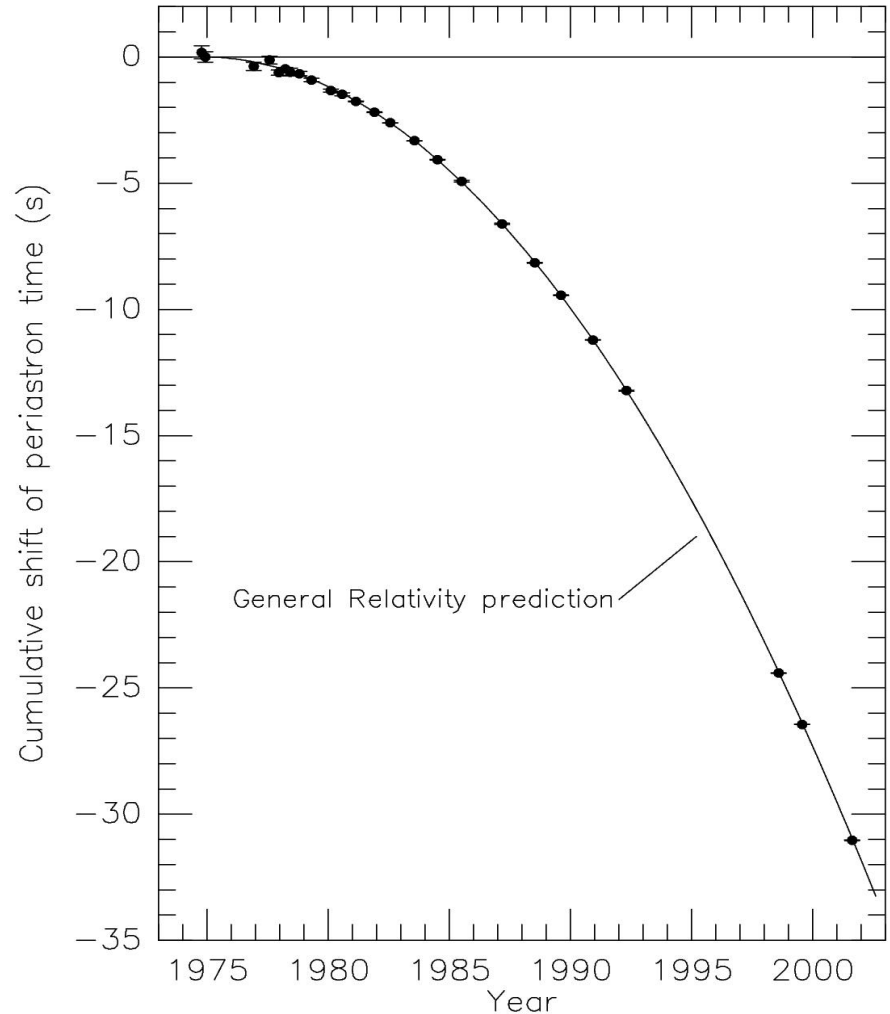
**for the LIGO Scientific Collaboration**

*Cardiff University*

*United Kingdom*

- Gravitational waves and LIGO
- GRB-triggered searches
- Analysis and results for GRB 070201

- Predicted by theory  
General Relativity
- *Ripples* in space-time
- Caused by  
accelerations of  
masses
- Strong indirect hint:  
Hulse-Taylor Binary  
Pulsar:



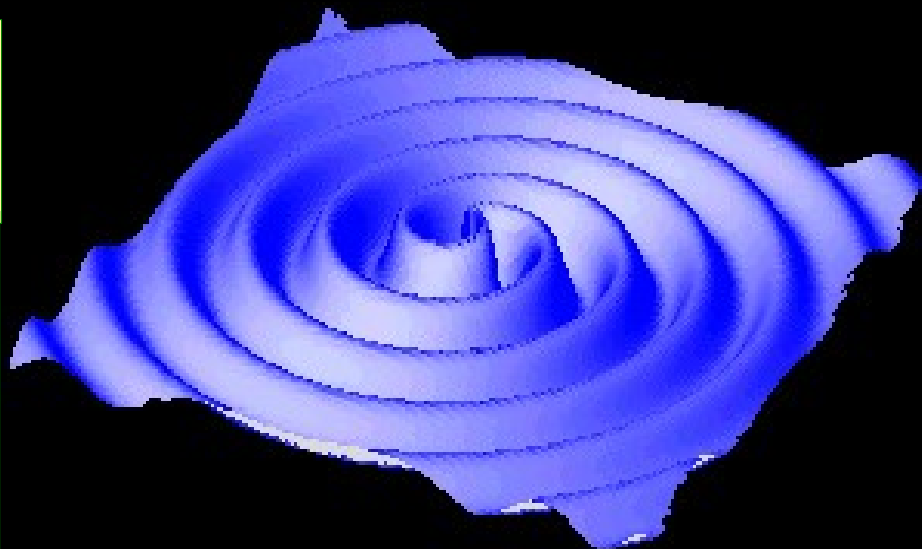
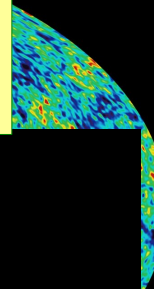
Burst searches

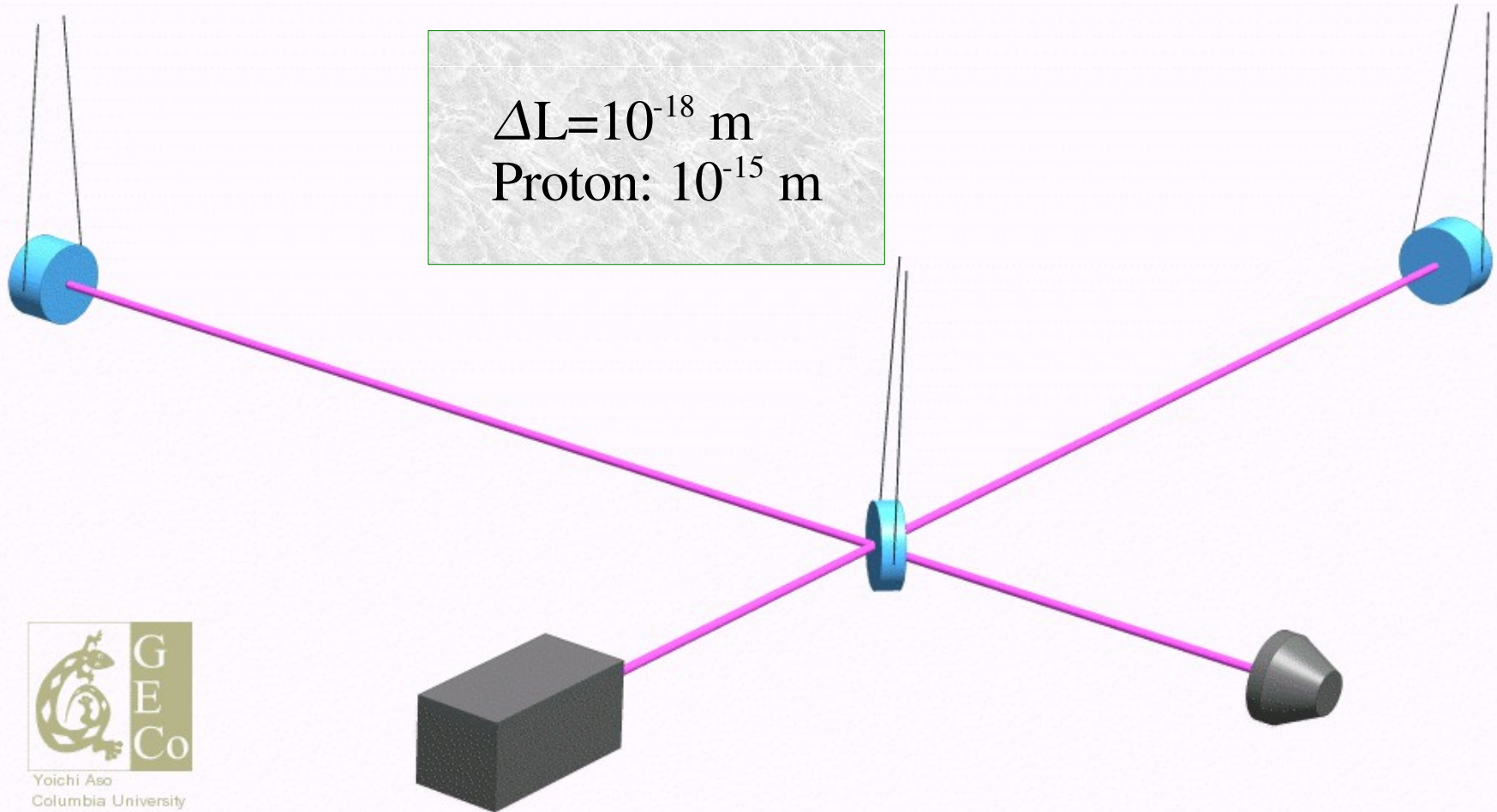
Stochastic searches

Inspiral searches

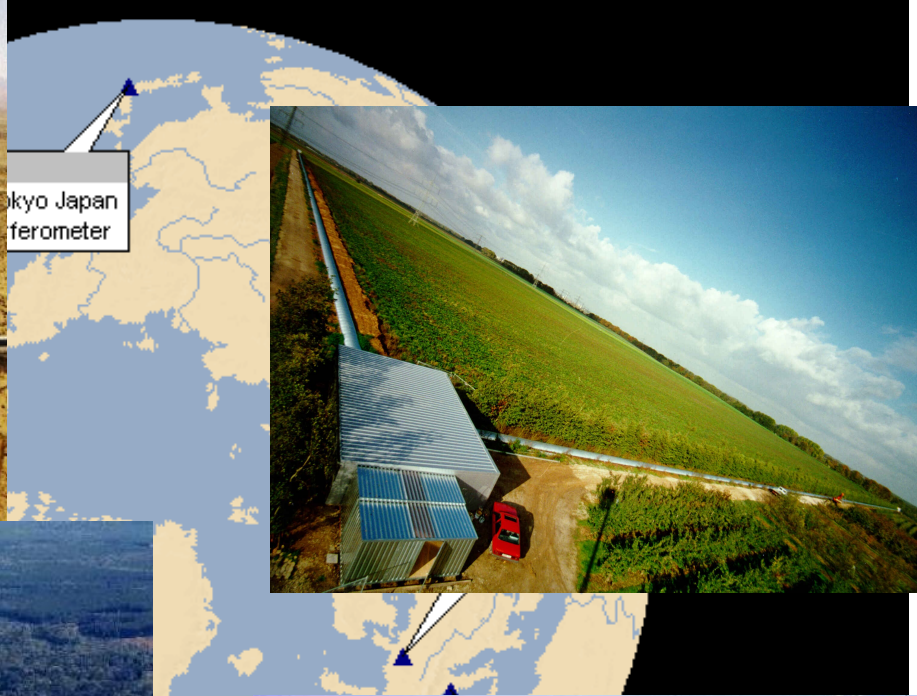
The unknown...

?







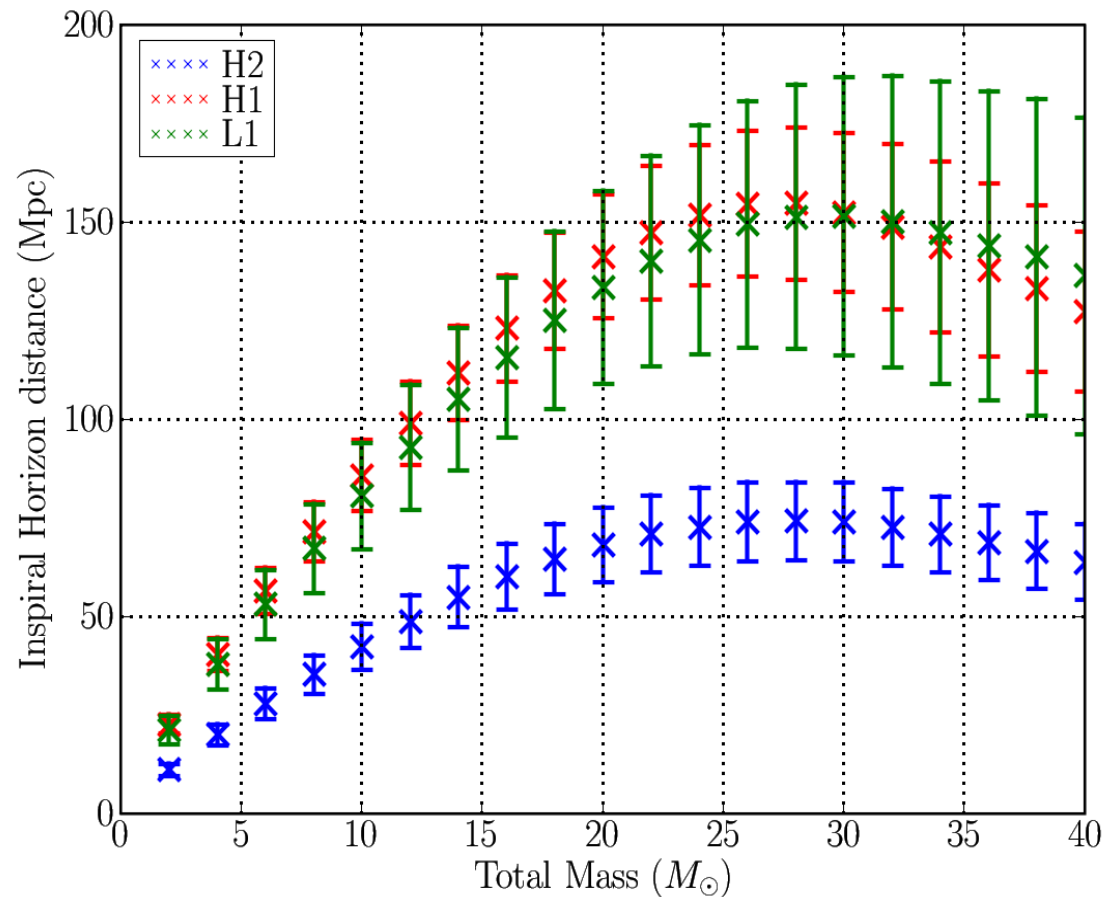
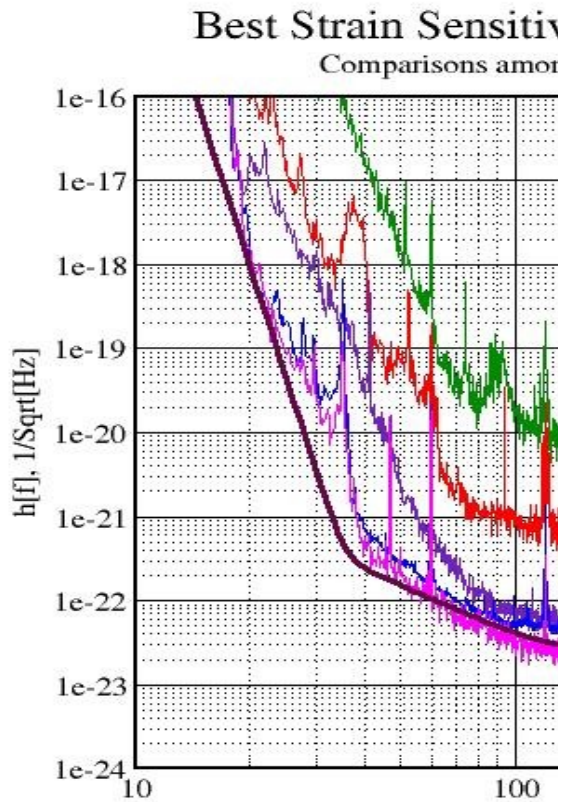


kyo Japan  
ferometer



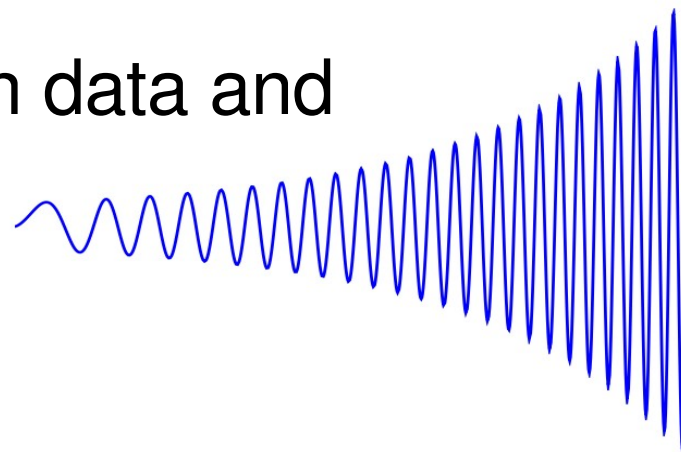
s-supplier

- LIGO recently finished a 2 year science run (S5)
- Including data





- ◆ Burst Search:
  - ◆ Search for un-modeled burst of GW
  - ◆ Cross-correlation between two data streams
  
- ◆ Inspiral search:
  - ◆ Search for a modeled GW (post-Newtonian waveform)
  - ◆ Cross-correlation between data and waveform



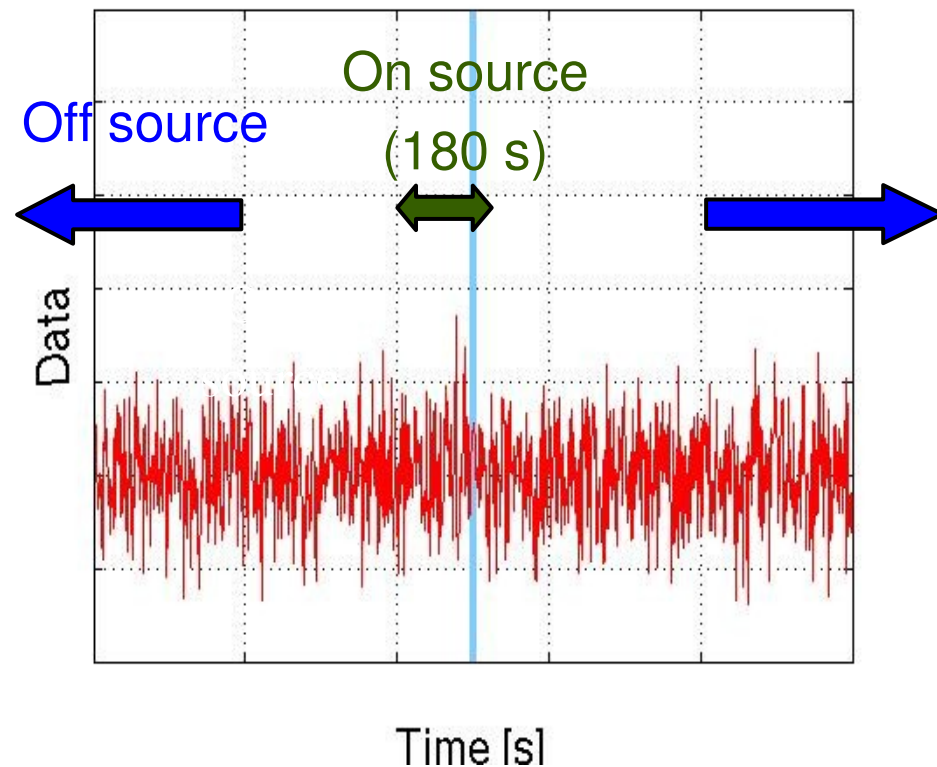


- ◆ Un-triggered search

- ◆ Location and time of a putative GW source unknown

- ◆ Triggered search:

- ◆ GRB gives time and sky location
- ◆ Gives geometrical time-delay between different detectors
- ▶ The GRB triggered search can probe deeper into the data



- Short GRB ( $T_{90}=0.15$  s)
- Possible compact binary merger (NS/BH)
- Possible SGR
- Error-box of location overlay M31 ( $D \simeq 770$  kpc)

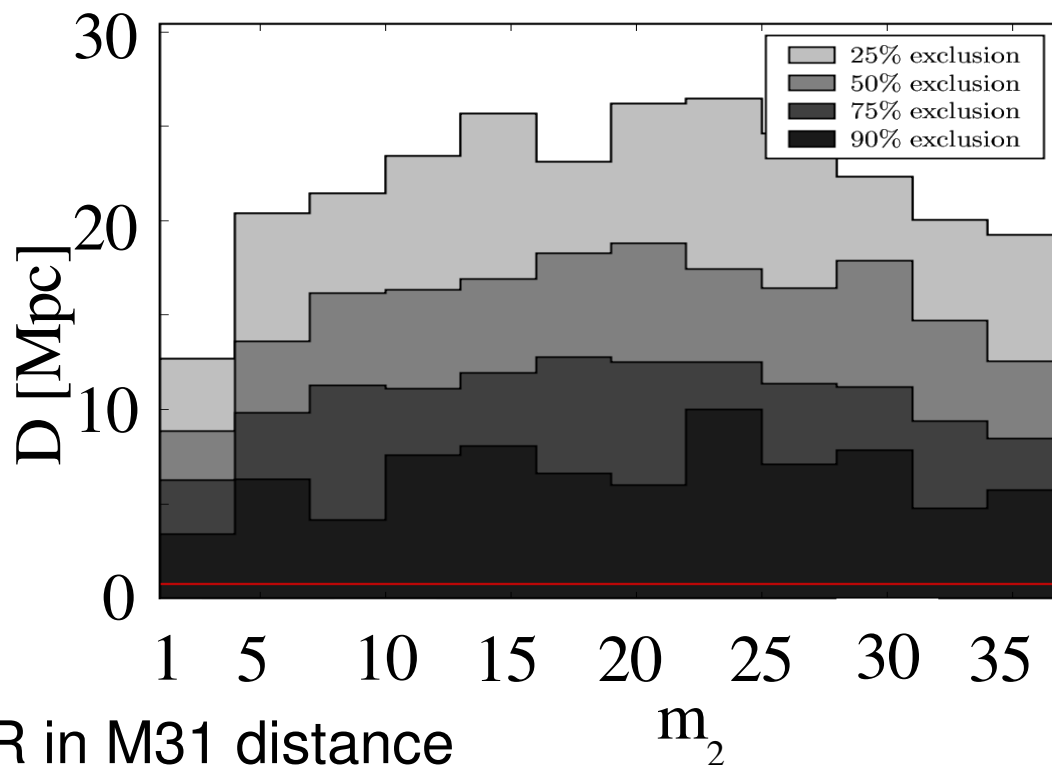


Final results approved on Monday  
arXiv:0711.1163v1 (today)

No gravitational wave detected

## Inspiral search:

- Binary merger in M31 scenario excluded at >99% level
- Exclusion of merger at larger distances: see plot



## Burst search:

- Cannot exclude a SGR in M31 distance
- Upper limit:  $8 \times 10^{50}$  ergs ( $4 \times 10^{-4} M_{\odot} c^2$ ) (emitted within 100 ms for isotropic emission of energy in GW at M31 distance)

- LIGO detectors:
  - Working at design sensitivity
  - enhanced LIGO (~2009), factor of 2 improvement
  - advanced LIGO (~2014), factor of 8 improvement
- GRB 070201: ([arXiv:0711.1163v1](https://arxiv.org/abs/0711.1163v1))
  - No GW signal for merger in M31
  - Cannot exclude SGR in M31

## ★ Future:

- ★ Analyses on data underway (all different searched)
- ★ Triggered search ongoing for all short GRBs in S5
- ★ Extend search to *all* GRBs with LIGO data available



# Questions?