Searching the LIGO data for coincidences with Gamma Ray Bursts

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Gamma Ray Bursts

- Properties of the bursts
  - Known to be cosmological in origin
  - Last from few milliseconds to several minutes
- Two classes:
  - Long GRBs
    - Last more than 2 seconds
    - Associated with stellar collapse
  - Short GRBs
    - Last less than 2 seconds
    - Evidence for compact binary progenitors

Learning about GRB progenitors with LIGO

- LIGO provides a way to look for GRB progenitors
  - Coincident detection of a GRB and a gravitational-wave signal

Would confirm compact binary as progenitor

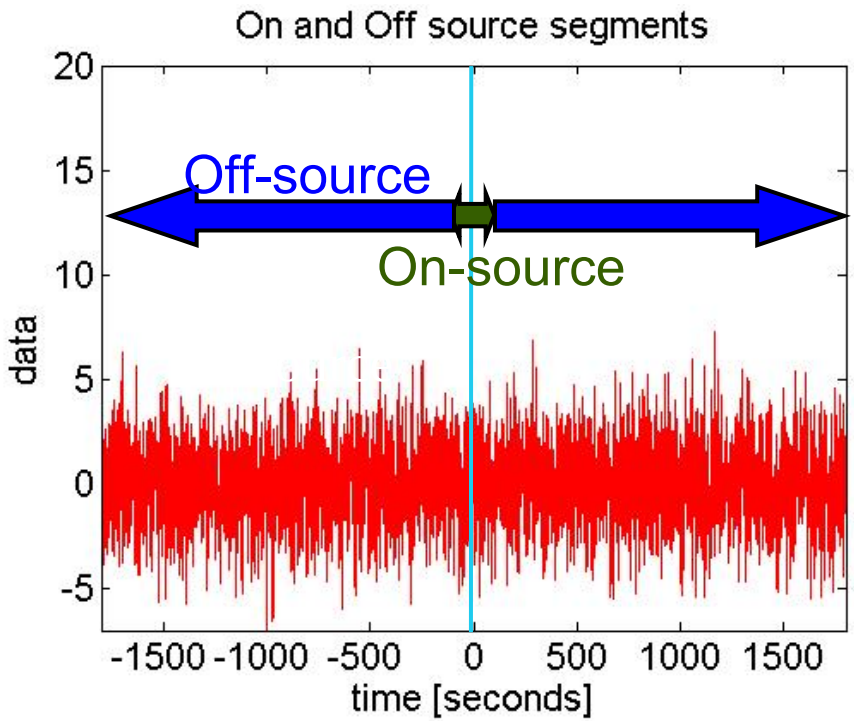
Gravitational-wave observation can *at least* bound the distance to the GRB

  - If a close GRB is confirmed without LIGO detection

Rule out broad class of compact binaries as progenitor

How is the search done?

- GRB trigger gives estimate of binary merger time.
- Assume GW signal is in 180s segment around GRB trigger
- Compare triggers from on-source to off-source
- Done in S5 at design sensitivity



Advantages of the triggered search

- Other inspiral searches are blind
  - Location and time of binary inspiral & merger are unknown
- GRB triggered search:
  - Sky location gives time-delay between sites
  - Relative amplitude known in each instrument
  - Quite rare events (one short GRB per month)

→ The GRB triggered search can probe deeper into the noise than the blind search!

  - Burst search: *(see last talk by Isabel Leonor)*

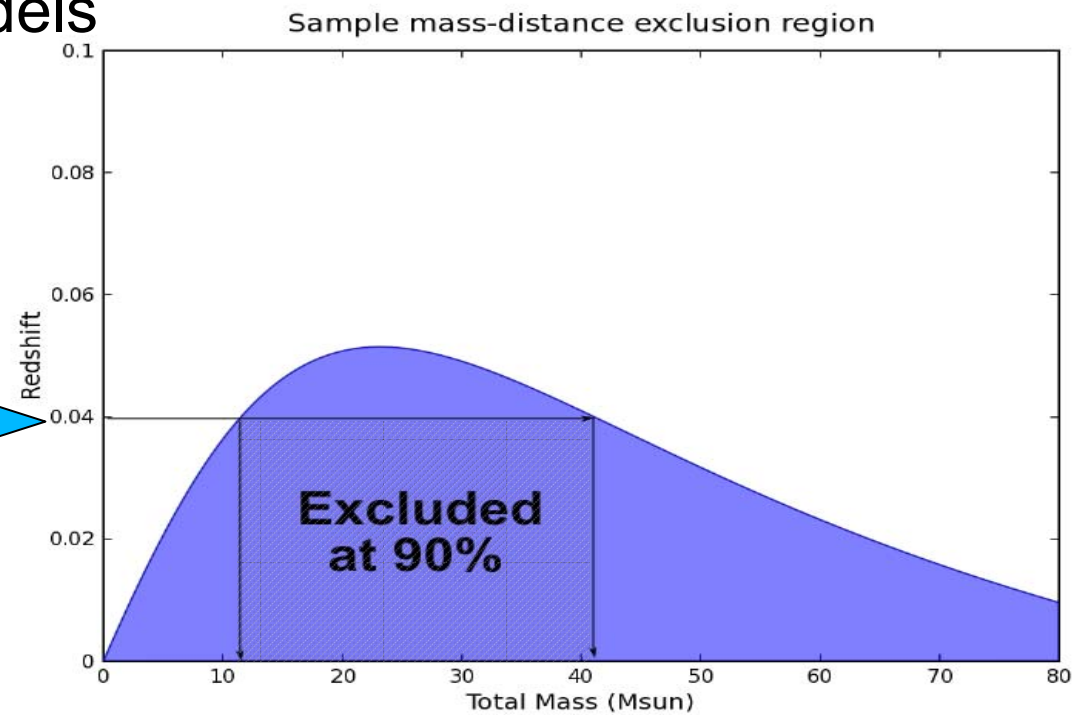
Inspiral search pipeline

- Same pipeline as blind inspiral searches
  - *(see prev. talk by Duncan Brown)*
  - Searching component masses between 1 and 30 $M_\odot$
- Some parameters chosen differently
  - Only analyze data around GRB trigger
  - Use lower SNR threshold in filtering step
- Advantage:
  - Decrease SNR threshold to 4 would increase range of search by factor of 2

What can we expect?

- Even in the case of no-detection:
  - Derive conclusion for masses, assuming merger and common models

Case of GRB with z=0.04



Summary & Outlook

- Uses same pipeline as other inspiral searches
- GRB triggered search: Location and time known
- Much deeper search possible with much higher detection range (redshift ~ 0.04)
- Simulations and background estimations are almost ready

❖ To be done for S5 analysis:

- Refine pipeline parameters (coincidence window)
- Simulate a real GRB
- Compare foreground with background