Coincident γ-ray and gravitational wave observations

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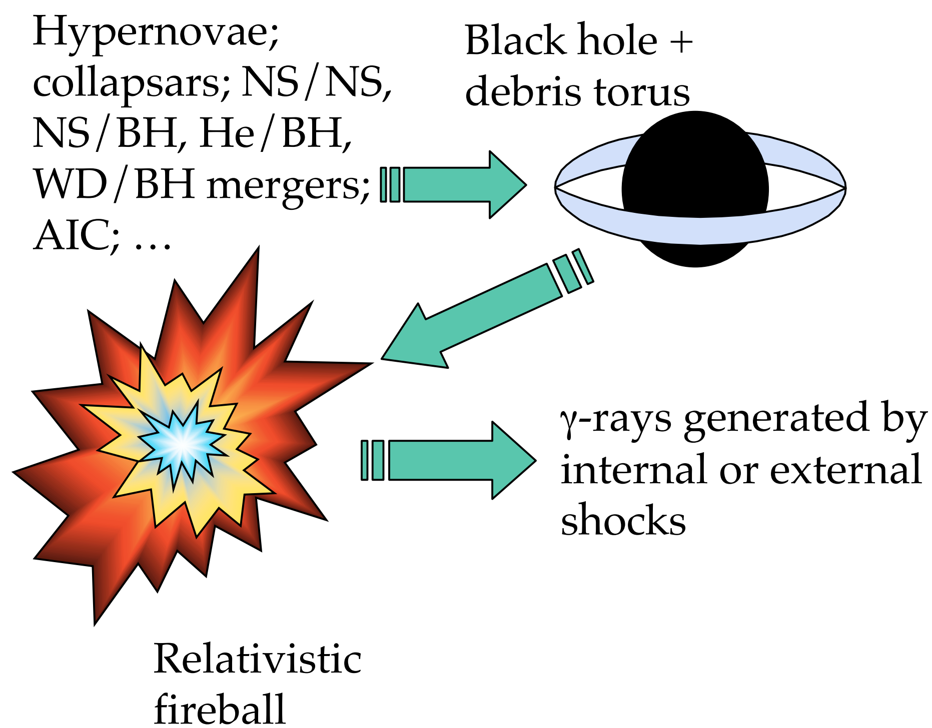
Executive Summary

- Principal γ-ray burst models all involve violent formation of solar mass black hole
  - Progenitor uncertain (coalescence, collapse, …)
  - Where, when of γ-ray producing shocks uncertain
- Violent formation of black hole is a likely gravitational wave source
  - High-end LIGO band
    - $f \sim 4$ KHz $(3M_{sol}/M)$
- Coincident grav., γ ray observations reveals details of burst model
  - Verify model, estimate gw conversion efficiency
  - From gravitational waves: nature of progenitor
  - From interval between grav., γ-ray burst: internal vs. external shocks
- Impact
  - Observation scheduling to maximize overlap with LIGO antenna pattern

Science Impact

- Observe association
  - Verify central feature of models
  - Estimate radiated gw power
- Distinguish triggers via grav. rad. spectra
  - Collapse: Peak grav. rad. spectral line l=2, m=0
  - Coalescence: Peak spectral line l=2, m=+/–2
- Internal vs. external shocks
  - Elapsed time between grav., γ-ray bursts ~0.1s for internal shocks, ~100s for external



Mission impact

- Detector antenna pattern is quadrupolar
  - Earth doesn't attenuate grav. waves
  - Beam orthogonal to detector plane
- In-beam more sensitive than uncoordinated observing
  - 10x source rate at same threshold