Compact binary mergers (nsns, nsbh)

a) Fundamental physics

- Tests of theory of gravity
- Direct detection of gravitational waves (LIGO, VIRGO, GEO,...; in advanced stages: detection out to z~ 0.1)
- Maximum neutron star mass: hadronic interaction at high density ($\rho >> \rho_{nuc} \approx 2 \times 10^{14}$ g/cm^3)

b) Astrophysics

- Nucleosynthesis: are compact binary mergers sources of rapid neutron capture ("r-process") nuclei?
- Gamma-ray bursts: do they power (about 1/3 of) short GRBs?

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task: combine different areas into multi-messenger picture

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One example

- June 03 2013:
  - short Gamma-ray Burst GRB130603B, $T_{90} \approx 0.18$ s, $z = 0.356$
  - nIR-transient, present at ≈9 days, but faded away after 30 days

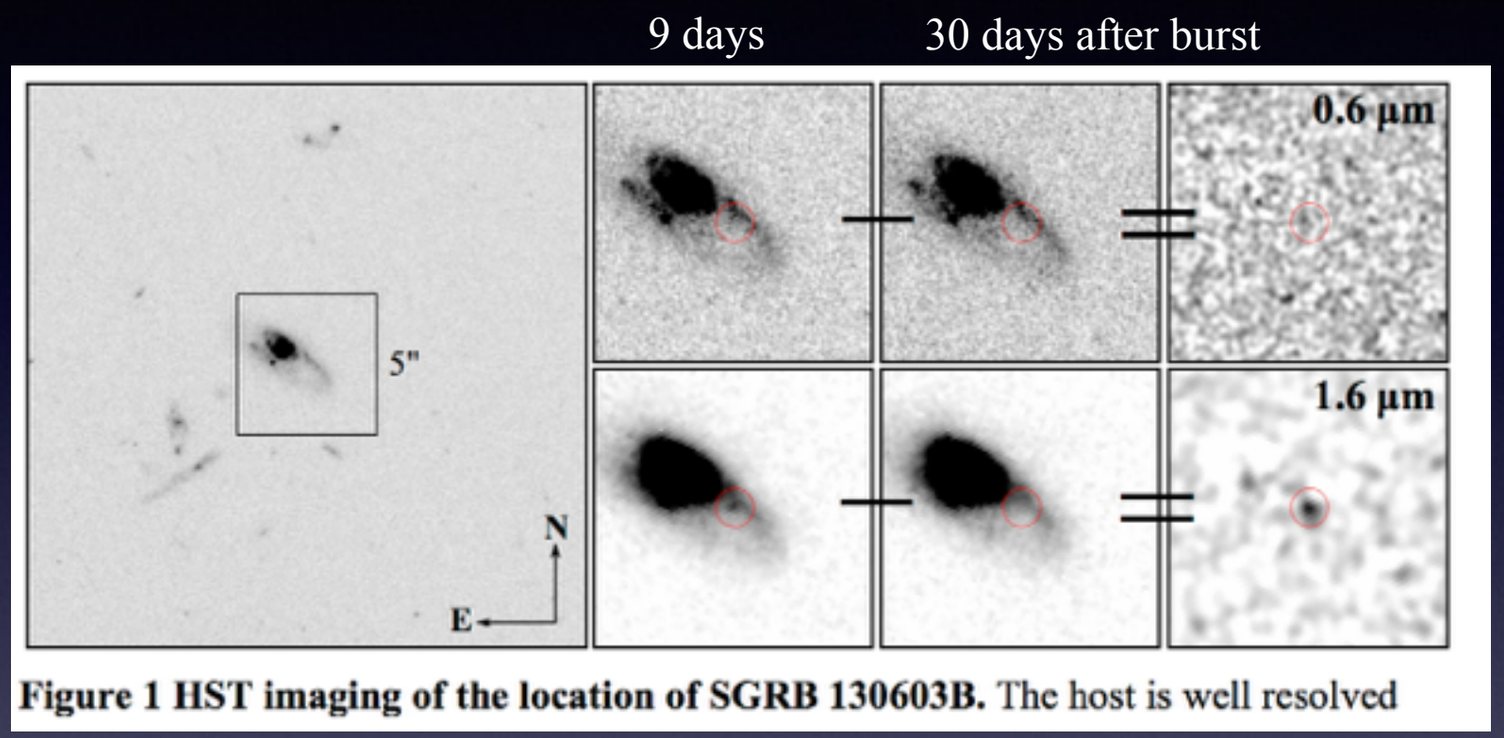

Figure 1 HST imaging of the location of SGRB 130603B. The host is well resolved

⇒ "most natural explanation": macronova event

- If true:
  - short Gamma-ray Bursts caused by compact binary mergers
  - compact binary mergers are a major source of rapid neutron capture elements
  - isotropic macronovae promising accompanying signature for "chirp" GW signals

Some open issues…

- sGRBs:
  - How is ultra-relativistic outflow launched?
  - Are there "non-standard" engines"?
  - (How) Can mergers trigger "late time activity" ($\tau \sim 100\mathrm{s} \gg \tau_{\mathrm{dyn}} \sim 1\mathrm{ms}$)?
  - HMNS: how can baryonic pollution be avoided?

- nucleosynthesis:
  - Are compact binary mergers the main r-process channel?
  - Strong and weak r-process?
  - Mass ejection channels? (dynamic, nu-winds, disk dissolution,…)
  - Related EM transients? ⇒ identify GW-waves?
  - Can the related physics be tested by clear signatures?
  - By "Macronovae" (see GRB130603B)? Related expansion opacities? Geometry?