Einstein, for Experts and Beginners

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Merging BH-NS binaries

- Relativistic binaries projected to be a primary source of GW detections
- GRB050509b may be located 35kpc from center of elliptical with low SFR -> binary compact object merger
  - 3 other mergers in galaxies with low SFR
- More massive than NS-NS-> seen at greater distance (10-100/yr for LIGO II; Belczynski et al. 2002, Voss +Tauris 2003)
- May shed light on internal structure of NS, behavior of matter at high density
  - Violent disruption process exposes interior of NS for study
Description of method

- We assume an extreme mass ratio (Baumgarte et al.)
  - $M_{BH} \gg M_{NS} \rightarrow$ BH is fixed in place
  - BH is more than a background: spacetime around NS is dynamical and self-consistent field solution

- Conformally Flat gravity (Isenberg; Wilson+Mathews):
  - Exact for spherically symmetric systems (Schwarzschild)
  - Einstein's Equations reduce to 5 linked non-linear elliptic eqs.
  - Time-symmetric scheme: gravitational waves by hand
Disruption at the ISCO

- Tidal disruption and mass transfer vs. gravitational radiation
- Tidal gravity at ISCO is *weaker* for more massive BH
- For physical value of $M/R=0.15$, disruption at ISCO for $M_{BH} \sim 3M_{NS}$
- Disruption near ISCO does not necessarily imply NS gets swallowed whole...
  ...just mostly whole.

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Compact NS models: $M/R=0.15$

- NS intact within ISCO
- Very little matter into an accretion disk
  - Poor GRB candidate
- Upper limit on BH mass for disk formation
Semi-compact NS models: $M/R = 0.10$

- NS disrupts just within ISCO
- Some matter into accretion disk
  - $0.01 \, M_{\text{NS}}$ (?)
- GRB formation for low-mass BHs?
Einstein for Beginners

- Einstein day at the Orpheum Children's Science Museum
- Relativity by extremely crude, but correct, analogies
- Needs to include balloons
The Photoelectric effect, with a little help from my friends

- Thanks to the UIUC Physics Van
Public Service Announcements

- Estimated taxes for 4th quarter due Jan 17
- E-mail jfaber@uiuc.edu to
  - get on the AAPF mailing list
  - have something posted to the NSF AAPF website