Abstract Submitted
for the APR11 Meeting of
The American Physical Society

Relativistic SPH Simulations of Black Hole – Neutron Star Binary Mergers F. RASIO, Northwestern University, EMMANOUELA RANTSIOU, Princeton University, P. LAGUNA, Georgia Tech — We investigate numerically the mergers of Black Hole – Neutron Star (BH–NS) binaries with small mass ratios ($q \equiv M_{NS}/M_{BH} \simeq 0.1$). We are interested in how the binary characteristics (such as the BH spin, the orbital inclination, and the NS equation of state) affect the evolution and outcome of such mergers, and under which conditions they can be viable progenitors of short gamma-ray bursts (GRBs). We use a 3-D relativistic SPH (Smoothed Particle Hydrodynamics) code to perform a series of simulations, varying the BH spin a, from $a/M = 0$ to $a/M = 0.99$, and changing the NS orbital inclination with respect to the BH spin, in the full range $0 - 180^o$. Furthermore we experiment with different polytropic equations of state for the NS. We find that the formation of a disk or torus of significant mass around the BH (massive enough that its subsequent accretion onto the BH can power a short GRB event) can take place only for highly spinning BHs ($a/M > 0.9$) and small to moderate orbital inclinations ($< 40^o$). Smaller BH spins will lead to accretion of the entire NS prior to or shortly after the NS disruption. Similar outcomes are seen for higher orbital inclinations. We also extract the gravitational-wave (GW) signal emitted during the final inspiral and merger phases. The waveforms are calculated using a post-Newtonian approximation at PN3.5 order. We show the distinct imprint of the orbital inclination on the waveforms, and the effect of both the BH spin and the NS equation of state on the GW energy spectra from these mergers. Supported by NSF Grant PHY-0855592.

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Date submitted: 18 Jan 2011 Electronic form version 1.4