CGWAS 2015: Simulating Stellar Collapse – Solutions

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1 Stellar Collapse to a Neutron Star and a Prompt Explosion

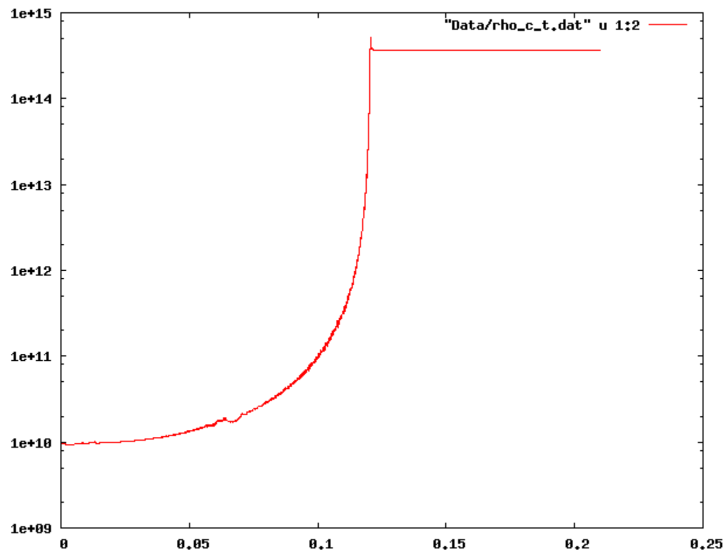

Figure 1: Evolution of the central density $\rho_c(t)$ in the collapse and explosion example. Core bounce is at ∼120 ms.

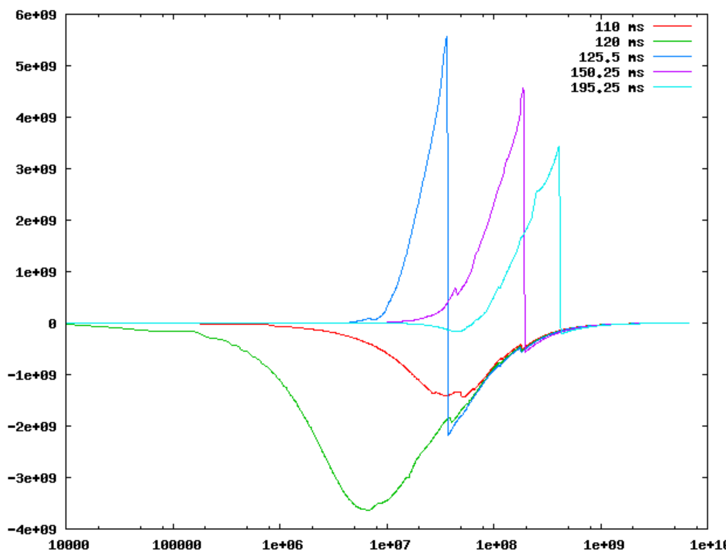

Figure 2: Velocity profiles at various times in the collapse, bounce, and postbounce explosion phases.

2 Stellar Collapse to a Neutron Star and subsequent Black Hole Formation

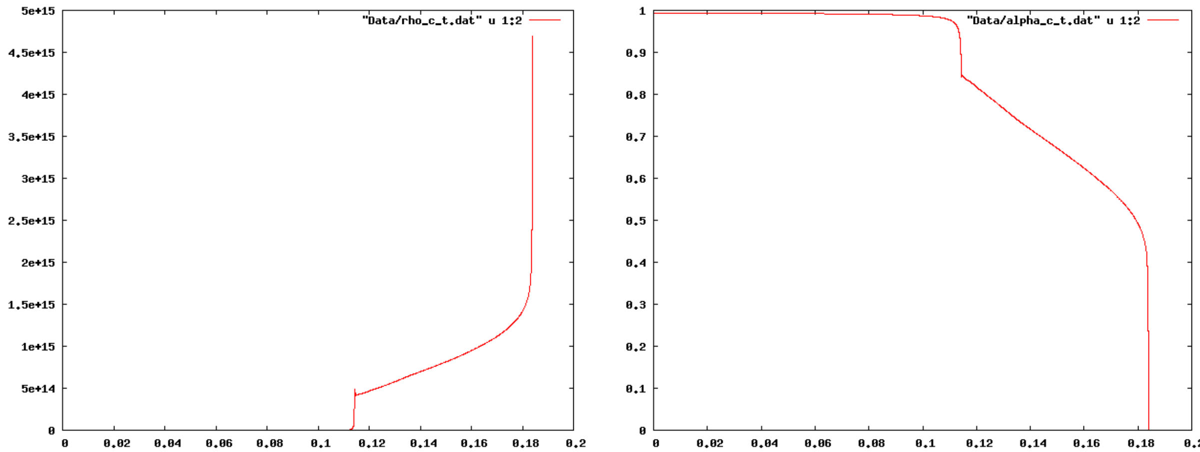

Figure 3: Left: Time evolution of the central density in the BH formation case. Right: Time evolution of the central lapse function in the BH formation case. The BH forms at around 184.0 ms.

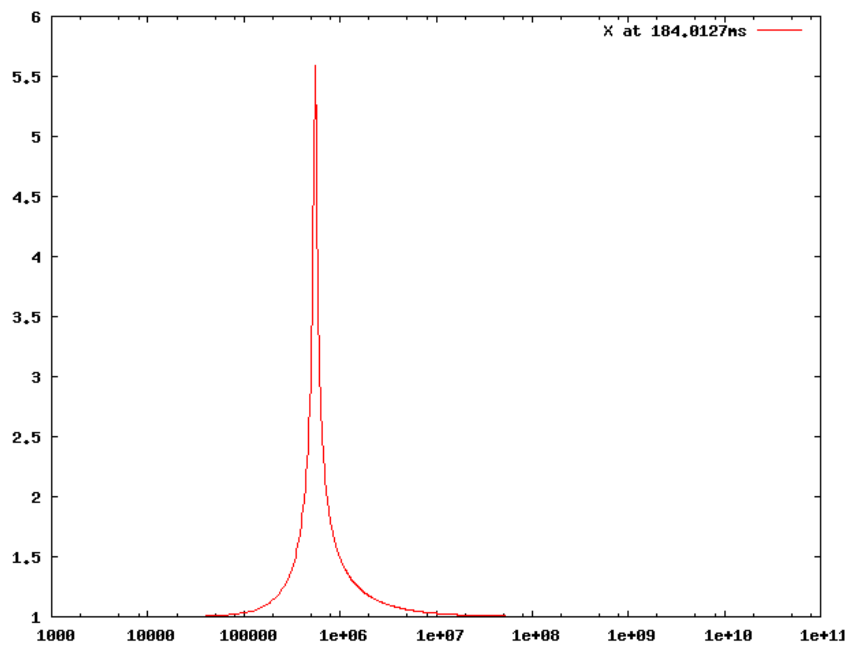

Figure 4: Radial profile of the metric quantity X at the time the code crashes. The peak of X indicates the approximate location of the BH horizon at the time of its formation. We can use the definition of X to infer that the birth-mass of the BH is only $\sim 1.8 - 1.9\,M_\odot$. However, we know from observations of neutron stars in binary systems that the maximum neutron star mass must be above $\sim 2\,M_\odot$.