RESEARCH NOTES: Merging Binary Neutron Stars

Ian has always been fascinated by his place in the universe, universe now known to be awesome in its size, age and ower. Among the strangest denizens of this new world of stronomical superlatives are the neutron stars.

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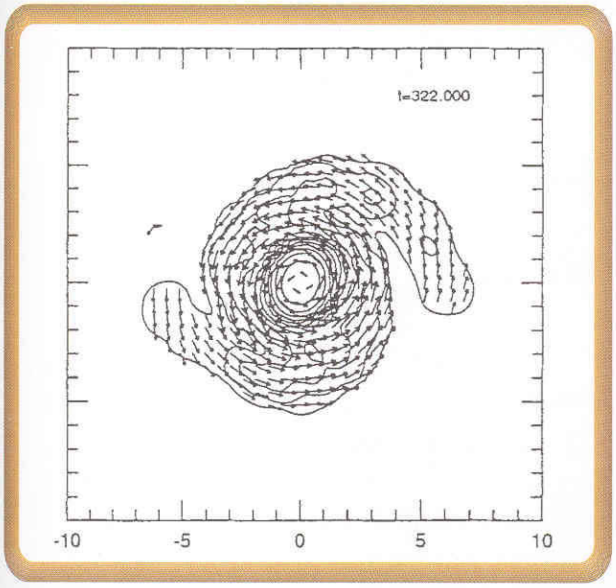

ormed by the violent gravitational collapse of extra- iassive stars, neutron stars are unbelievably dense – a cubic ich would weigh some 1500 billion kilograms! – and nergetic. In the rare case of a binary star system composed f two neutron stars (NS), such as the binary pulsar PSR 916+13, the two NS spiral around each other until they ierge in one of the most catastrophic and energetic events i the universe. Most of the ~10^{53} ergs (100,000 trillion- illion-trillion-trillion ergs) involved is released as ravitational waves and neutrinos, both very hard to detect. ortunately, even the small fraction (about 0.1%) of this nergy released as gamma rays from neutrino-antineutrino nnihilation is sufficient to produce huge gamma-ray ursts, observable even at cosmological distances.

lthough such conditions can obviously not be reproduced i the laboratory, Israel NSF grantee Prof. Tsvi Piran and olleagues have carried out important new computer-based mulations that clarify many aspects of this process. For example, they find that the NS coalesce after only a few orbits around each other, and that they shed considerable material to form a thick disk around the final compact central object (see figure). The amount of material in the disk, which contains a doughnut-like bulge, increases with the spin rates of the initial NS.

For earth-bound observers, a particularly important feature is the formation of an almost empty centrifugal funnel in the center of the rotating disk. Considerable detectable gamma-radiation could escape from the poles of the central object through this channel. Work is continuing both on developing these scenarios and comparing them to observations, especially once the new generation of gravity wave detectors comes on line. The Israeli investigators' results have been published in the prestigious *Astrophysical Journal* and, in a more popular form, in *Scientific American.*