

under-estimated in X-ray observation due to projection effects, or if pre-existing electrons with a flat spectrum are re-accelerated by a weak shock, retaining the flat spectral form. In this study, we explore these two scenarios by comparing the results of shock acceleration simulations with observed features of the so-called Toothbrush relic in the merging cluster 1RXS J060303.3. We find that both models could reproduce reasonably well the observed radio flux and spectral index profiles and the integrated radio spectrum. Either way, the broad transverse relic profile requires additional post shock electron acceleration by downstream turbulence.

### [7 HA-03] General Relativistic Effects on Pulsar Radiation

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We consider a magnetic dipole model of a pulsar and investigate general relativistic effects on electromagnetic radiation from the pulsar. The general relativistic modifications should be found applicable to many well-known issues in pulsar astronomy. Among other things, the modifications of Goldreich-Julian model and subpulse drift would be of significant interest and challenging issues. The electromagnetic fields in the pulsar magnetosphere are computed by solving Maxwell's equations defined in the strongly curved spacetime around the pulsar, hence containing the properties of strong gravitational effects. On top of these effects, we also investigate the effects from rotation and obliqueness of the pulsar to work out the general relativistic versions of Goldreich-Julian model and subpulse drift.

### [7 HA-04] Gravitational Radiation Capture between Unequal Mass Black Holes

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The gravitational radiation capture between

unequal mass black holes without spins is investigated with numerical relativistic simulations, and compared with the Post-Newtonian approximations. The parabolic approximation which assumes that the gravitational radiation from a weakly hyperbolic orbit is the same as that from the parabolic orbit is adopted. Using the radiated energies from the parabolic orbit simulations, we have obtained the impact parameters ( $b$ ) of the gravitational radiation captures for weakly hyperbolic orbits with respect to the initial energy. The most energetic encounters occur around the boundary between the direct merging and the fly-by orbits, and we find that several percent of the total ADM initial energy can be emitted at the peak. The equal mass BHs emit more energies than unequal mass BHs at the same initial orbital angular momentum in the case of the fly-by orbits. The impact parameters obtained with numerical relativity deviate from those in Post-Newtonian when the encounter is very strong ( $b \leq 100M$ ), and the deviations are more conspicuous at the high mass ratio.

### [7 HA-05] Search for broadband extended gravitational-wave emission bursts in LIGO S6 in 350-2000 Hz by GPU acceleration

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We present a novel GPU accelerated search algorithm for broadband extended gravitational-wave emission (BEGE) with better than real-time analysis of H1-L1 LIGO S6 data. It performs matched filtering with over 8 million one-second duration chirps. Parseval's Theorem is used to predict the standard deviation  $\sigma$  of filter output, taking advantage of near-Gaussian LIGO (H1,L1)-data in the high frequency range of 350-2000 Hz. A multiple of  $\sigma$  serves as a threshold to filter output back to the central processing unit. This algorithm attains 80% efficiency, normalized to the Fast Fourier Transform (FFT). We apply it to a blind, all-sky search for BEGE in LIGO data, such as may be produced by long gamma-ray bursts and superluminous supernovae. We report on mysterious features, that are excluded by exact simultaneous occurrence. Our results are consistent with no events within a radius of about 20 Mpc.