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Detailed Models of Recurring Superbursts from Neutron Stars[1]

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— Superbursts are the most energetic thermonuclear bursts observed from accreting neutron stars. Deep inside the envelope, close to the crust, a thick carbon-rich layer flashes. Afterwards it takes over a day for the neutron star surface to cool down. Because ignition takes place close to the crust, superbursts are sensitive to crustal heating. The amount of crustal heating depends on the nuclear physics in the crust and core, such as the heating processes, thermal conductivity of the crust, and neutrino cooling in the core. Superbursts provide an observational measure to probe this. We present the first multi-zone models of series of recurring superbursts created with a hydrodynamic stellar evolution code that includes a large network of nuclear reactions. We obtain constraints for crustal heating by comparing our models to the scarce observational data. We discuss how our model reproduces characteristics of the observed light curve, such as details of the precursor burst that is seen just prior to the superburst, and the return of normal bursts after an absence caused by the superburst.

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