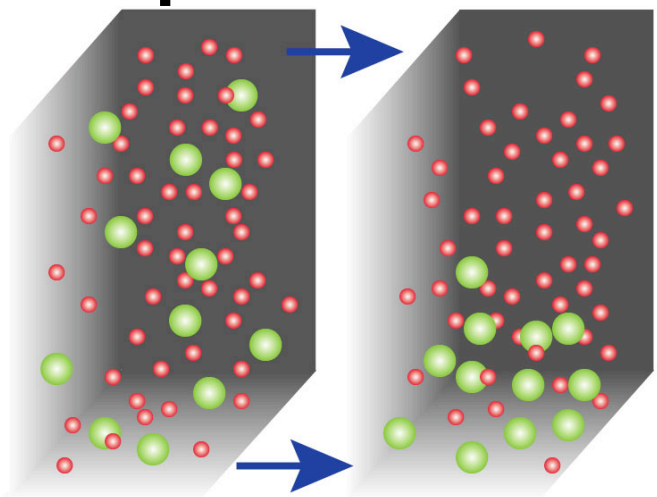
Sedimentation in Neutron Star Atmospheres



Many observed neutron stars accrete gas from a companion star. Once enough gas has piled up on the neutron star surface, nuclear reactions ignite and trigger an explosion known to astronomers as an *X-ray burst*. Graduate student Fang Peng (University of Chicago) has been calculating how the sedimentation of isotopes such as carbon, nitrogen and oxygen affects the "fuel" for these bursts. The above picture illustrates the problem: over time (represented by the arrows) the heavier nuclei (in green) in the accumulated fuel layer settle downwards and the lightest nuclei, hydrogen (in red), float upwards. By lowering the abundance of hydrogen relative to heavier isotopes, sedimentation changes the ashes of the unstable nuclear reactions. This depletion of hydrogen might make the ashes of the burst more enriched in carbon, a necessary ingredient to explain the recently discovered "superbursts." Although these initial calculations are unable to follow the spatial structure of the burning through multiple bursts, Fang is now working with Dr. Alexander Heger, Los Alamos National Laboratory, to incorporate this process into an X-ray burst simulation.

Credit: *F Peng (University of Chicago), E F Brown (Michigan State University* and *National Superconducting Cyclotron Laboratory)* and *J W Truran (University of Chicago)*; *the Joint Institute for Nuclear Astrophysics*