rp-process movie:

What is this about ?

Neutron stars are extremely compact stars - they have about the mass of the sun, but only the size of a small city. A table spoon of neutron star matter weighs as much as 8000 aircraft carriers. If neutron stars are orbited by a normal companion star they can suck matter from the companion. This matter gets compressed and heated as it reaches the neutron star surface and if enough has accumulated it explodes in a gigantic hydrogen bomb. The explosion can be observed from earth as an X-ray burst with duration of 10-100s. The movie shows how hydrogen and helium are converted into heavy elements by nuclear reactions during the outburst. It is this conversion that generates the energy that we can observe. The ashes of the burning remains on the surface of the neutron star and can modify its properties.

Calculation:

Calculated is the abundance evolution during a type I X-ray burst using a 1D one zone model with a complete nuclear reaction network. This calculation assumes an accretion rate of 1/10 Eddington, a flux from the neutron star interior of 0.15 MeV/u and accreted matter with solar composition and metallicity.

Details can be found in Schatz et al. Phys. Rev. Lett. 86 (2001) page 3471.

The calculation stops once the temperature cooled down to its ignition value. There are still unstable nuclei at the end of the calculation that will continue to decay.

Displayed:

Shown is the evolution of the nuclear abundances on the chart of nuclides. Each square is a nucleus - proton number is the vertical axis, neutron number the horizontal axis. The thick framed squares are the stable nuclei. The colors indicate the abundance of the nucleus:

red	>= 1e-3
yellow	~ 1e-4
green	~ 1e-5
turquise	~ 1e-6
medium blue	~ 1e-7

Collaboration:

H. Schatz, M. Ouellette, Department of Physics and Astronomy and NSCL, Michigan State University
L. Bildsten, Department of Physics and Kavli Institute for Theoretical Physics, University of

California at Santa Barbara
A. Cumming, Dept. of Astronomy, University of California at Santa Cruz
A. Aprahamian, V. Barnard, M. Wiescher, Dept. of Physics, University of Notre Dame
F.-K. Thielemann, T. Rauscher, Dept. of Physics and Astronomy, Universitaet Basel, Switzerland