Which nuclear reactions are important for X-ray bursts?

X-ray satellites such as Chandra and XMM-Newton regularly observe so-called Type I X-ray bursts (XRB) that occur when the hydrogen and helium that has been accumulated on the surface of an accreting neutron star reaches a themonuclear instability and ignites. This ignition leads to a process of successive proton captures and competing beta decays, also known as the rp-process, which results in hundreds of proton-rich isotopes with masses up to A ~ 100.

The dependable recurrence of these bursts turns the accreting neutron stars into astrophysical nuclear physics labs allowing us to indirectly observe reactions between highly radioactive isotopes which are difficult to measure in terrestrial laboratories.

However, due to upgrades of existing experimental facilities and the construction of new facilities, some of these radioactive isotopes are now coming into the reach of experimental facilities. Yet from an astrophysical perspective not all reactions are equally relevant to the reaction flow. So the question is which of these thousands of potential reactions are the most relevant to measure to further the astrophysical understanding of the problem?

In the talk, I will describe the detailed nuclear reaction flow using a self-consistent model of an accreting neutron star. I will explain what the different shapes of the observed light curves can tell us about specific nuclear reactions. Finally, I will determine the biggest uncertainties and the most important reactions to guide future experiments.