

hands-on training EBSS2010

nucleosynthesis calculations with the computational infrastructure for nuclear astrophysics

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system freely available at nucastrodata.org

work with nuclear information

- import cross sections
- gain match, normalize, extrapolate, combine with theory

work with rates

- numerical integrations, parameterizations, visualization
- modifications, combine into libraries for simulations

work with simulations

- easily set up, run, visualize simulations
- compare simulations with different input
- run sensitivity studies
- analyze simulation results
- find exotic effects like bottlenecks and waiting points

sample investigation: before & after study

before & after study: what was the impact of my measurement ?

useful for journal articles

- assume you just measured a new rate of the $^{18}\text{F}(p,\alpha)^{15}\text{O}$ reaction
- rate is 10 times lower than previous “best” rate
- how does this impact predictions of ^{18}F production in novae ?
- modify $^{18}\text{F}(p,\alpha)^{15}\text{O}$ rate appropriately and save into library
- combine into full library for a simulation
- choose a novae simulation, run with old rate & new rate
- compare final abundances
- draw your conclusion on the impact of the measurement
- variations: more nova models, different zones or all zones ...

sample investigation: sensitivity study

sensitivity study: how does this abundance depend on this rate ?

useful for proposals

- you just read an article on ^{22}Na observations in nova ejecta
- you wonder if measurements of $^{21}\text{Na}(p,\gamma)^{22}\text{Mg}$ and $^{21}\text{Ne}(p,\gamma)^{22}\text{Na}$ reaction would help clarify the nuclear uncertainties in ^{22}Na abundance predictions
- what are the sensitivities of these predictions on these rates ?
- choose a reference rate library and a novae simulation
- choose a set of variations of these two reactions (0.01, 0.1, 1.0, 10, 100 ...)
- run sensitivity studies with this simulation & these rate variations
- plot out the results, make conclusion on which to measure
- variations: more nova models, different rate variations, change other reference rates ...

sample investigation: uncertainty analysis

uncertainty analysis: what is the uncertainty on
this predicted abundance ?

useful for journal articles

- you have just made a fantastic measurement of the $^{14}\text{O}(\alpha,p)^{17}\text{F}$ reaction with an uncertainty that ranges from a factor of 2 higher to a factor of 20 lower
- what are the implications of this uncertainty for final abundance predictions in novae ?
- modify $^{14}\text{O}(\alpha,p)^{17}\text{F}$ rate to have “max” and “min” values
- save each into library, combine into full library for a simulation
- choose a novae simulation, run with reference, max, & min rates
- compare final abundances, the spread gives the uncertainty
- draw your conclusion on the impact of the uncertainty on $^{16}\text{O} / ^{18}\text{O}$ and $^{17}\text{O}/^{18}\text{O}$ abundance ratios, on ^{18}F and ^{22}Na abundances ...
- variations: examine different abundances; different nova models ...