

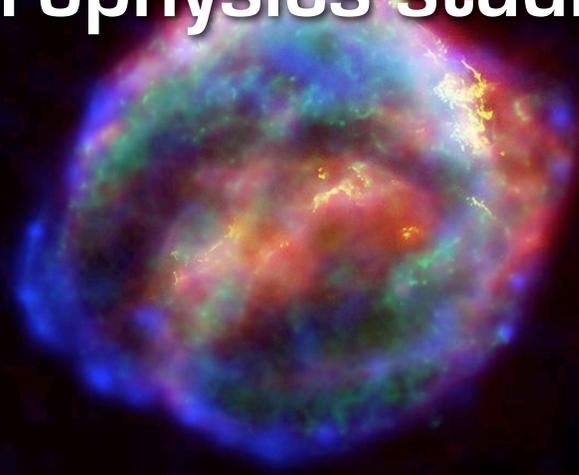
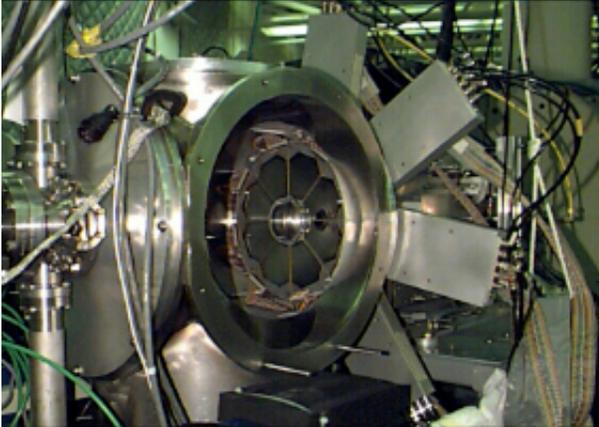


**Using the
Computational Infrastructure
for Nuclear Astrophysics
for
Proposal Development & Research**

Michael Smith

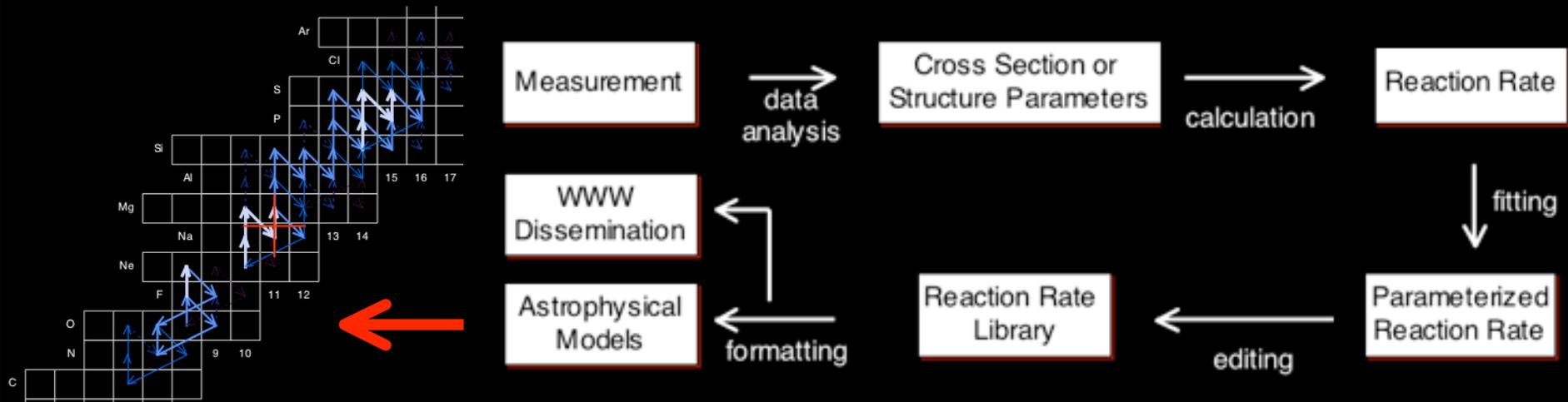
Physics Division, Oak Ridge National Laboratory

nuclear information for astrophysics studies



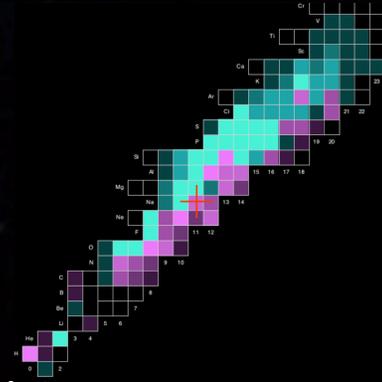
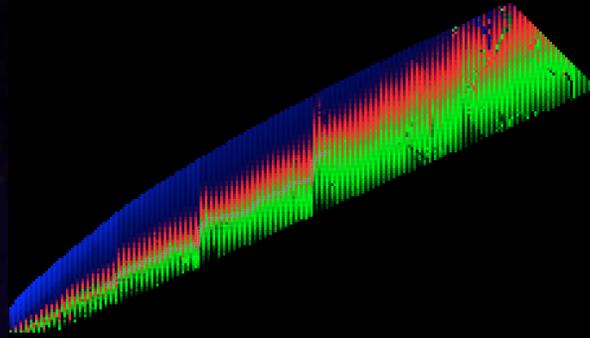
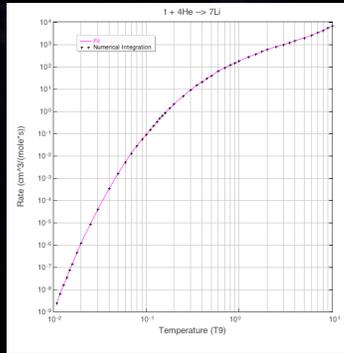
- nuclear information is crucial input for element burning calculations
- some important information processing is necessary before lab results can be used in astrophysical simulations
- simulations are important to
 - determine astrophysical impact of a recent measurement
 - determine POSSIBLE astrophysical impact of a FUTURE measurement

nuclear data in astrophysics studies



- **The Computational Infrastructure for Nuclear Astrophysics**, freely available at nucastrodata.org, facilitates
 - processing of nuclear data
 - running & visualizing simulations
 - quickly exploring “what-if” scenarios

Computational Infrastructure for Nuclear Astrophysics



- user friendly Java **Graphical Interface**, extensive online help
- With a few mouse clicks, the suite enables Users to:
 - **store, renormalize, combine, extrapolate** cross sections & s-factors
 - **calculate** reaction rates from cross sections & s-factors
 - **parameterize** reaction rates or generate values on a temp grid
 - **plot & modify** reaction rates
 - **insert** rates into new or existing libraries
 - **create, store, modify, document, merge, & share rate libraries**
 - **run, store, compare, & visualize** element synthesis calculations
 - **quickly share** this information with colleagues

Computational Infrastructure for Nuclear Astrophysics

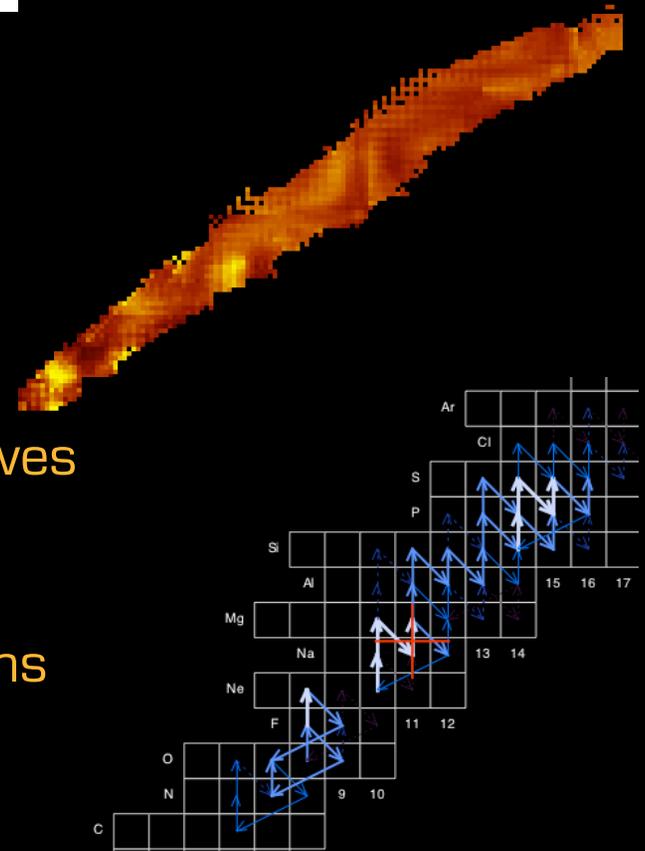
Subject	User
test comment on distinct rate 2	Michael Smith
Re: test comment on distinct rate 2	Michael Smith
compare to Coc et al. rate	Michael Smith

Subject: compare to Coc et al. rate
Posted by: Michael Smith
Date: 2006-03-29 15:08:34

This is the $^{18}\text{F}(p,\alpha)^{15}\text{O}$ rate that we compared to REACLIB and the Coc et al. 2006 $^{18}\text{F}(p,p)$ thick target information, the $^{18}\text{F}(d,p)$ results, the $^{15}\text{N}(\alpha,\alpha)$ results, etc.

- **Newest features**

- Rate Investigator
- Commenting Interface
- Nuclear Mass Models
- Enhanced Rate Parameterization
- Element Synthesis - Reaction Fluxes
- Element Synthesis - Abundance Derivatives
- Element Synthesis - Enhanced Animations
 - r-process
 - rp-process
 - neutrino - p process



Utilization of Infrastructure for Proposal Preparation

- **Example: If you ALREADY KNOW which rate to investigate**
 - Rate Locator: find all instances of rates for this reaction
 - Rate Modifier: scale up / down one of these rates and save
 - Rate Library Manager: make new rate library with modified rate
 - Simulator: run simulations with new & old libraries and save
 - Visualizer: compare final abundances in two simulations
 - repeat with different modifications of old rate

Rate Locator

Quickly generate list of all rates for a given reaction and plot them out

The screenshot displays the 'Rate Manager' software interface, specifically the 'Rate Locator' and 'Reaction Rate Plotting Interface' windows.

Rate Manager - Rate Locator (Step 3 of 3):

You have selected $p + 18F \rightarrow 4He + 15O$ for investigation. Select rates by library name from the checkbox list below.

- chafa_pseudo_full
- Distinct Rate #2
- ORNL Canonical-2000-Beta-0.1
- MSS_18fpa_Oct04
- MSS_18f_Oct04
- temp_feb_06
- Distinct Rate #3
- ORNL Canonical w Coc F18
- Coc_2000

Buttons: Plot Selected Distinct Rate, Rate Info, List of Distinct Rate, View or Add Comments, Help on This Interface.

Navigation: < Back, Rate Manager Home, Rate Commentor

Reaction Rate Plotting Interface:

Reaction: $p + 18F \rightarrow 4He + 15O$

Plot: Rate vs. Temperature (T9) on a log-log scale. The y-axis (Rate) ranges from 10^{-22} to 10^6 . The x-axis (Temperature (T9)) ranges from 10^{-2} to 10^0 . Three curves are shown: Distinct Rate #1 (black), Distinct Rate #2 (magenta), and Distinct Rate #3 (red).

Legend:

- Distinct Rate #1
 - Distinct Rate #1 (r)
 - Distinct Rate #1 (r)
- Distinct Rate #2
 - Distinct Rate #2 (nr)
 - Distinct Rate #2 (r)
 - Distinct Rate #2 (r)
- Distinct Rate #3
 - Distinct Rate #3 (nr)
 - Distinct Rate #3 (r)

Plot Controls (Hold down your left mouse button over plot to magnify):

Temperature: log Rate min: -22, log Rate max: 6, Rate: Major Gridlines, Minor Gridlines

log, lin, log Temp min: -2, log Temp max: 0, Temperature: Major Gridlines, Minor Gridlines

Buttons: Print, Save, Table of Points

- Rate Locator: find all instances of rates for this reaction

Rate Modifier

scale up / down one of these rates and save

Rate Manager | Modify Existing Rate Step 3 of 3

Number of Parameters : 21 Scale Factor : 1

1-7 8-14 15-21

Nonresonant a1 : 139.4060 a5 : 33.6495

Resonant a2 : -4.76125 a6 : -4.58467

a3 : 132.019 a7 : 114.457

a4 : -284.374

Open Plotting Interface Save Rate

< Back Rate Manager Home Rate Commentor

Rate Manager | Modify Existing Rate Step 3 of 3

Number of Parameters : 21 Scale Factor : 10

1-7 8-14 15-21

Nonresonant a1 : 141.7086 a5 : 33.6495

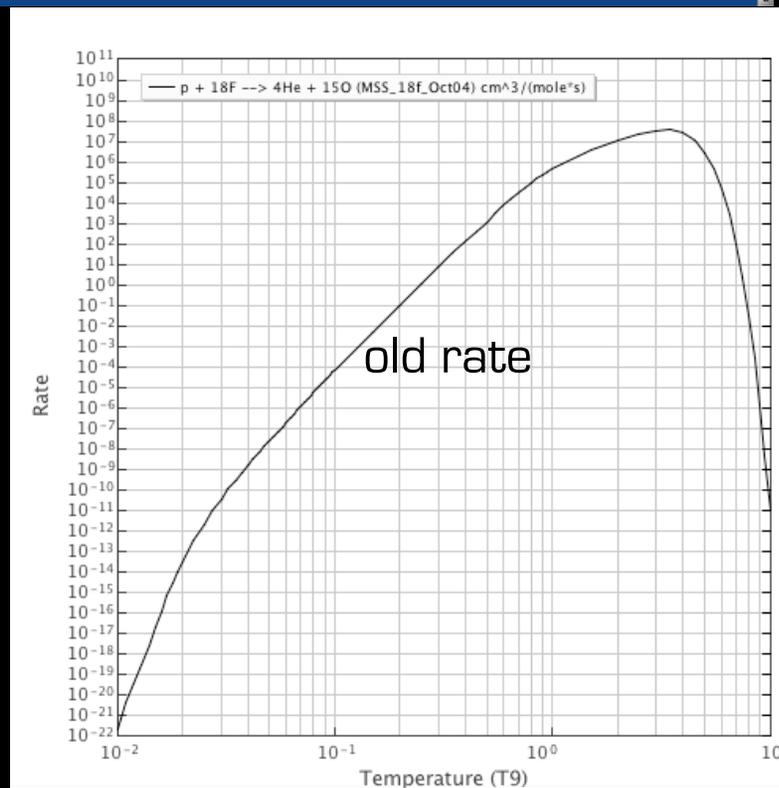
Resonant a2 : -4.76125 a6 : -4.58467

a3 : 132.019 a7 : 114.457

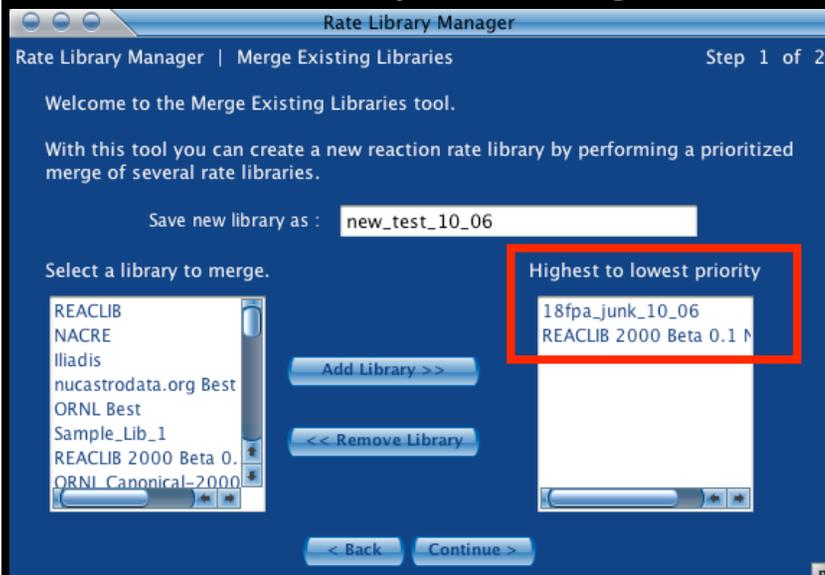
a4 : -284.374

Open Plotting Interface Save Rate

< Back Rate Manager Home Rate Commentor



Rate Library Manager



Rate Library Manager | Merge Existing Libraries Step 1 of 2

Welcome to the Merge Existing Libraries tool.

With this tool you can create a new reaction rate library by performing a prioritized merge of several rate libraries.

Save new library as :

Select a library to merge.

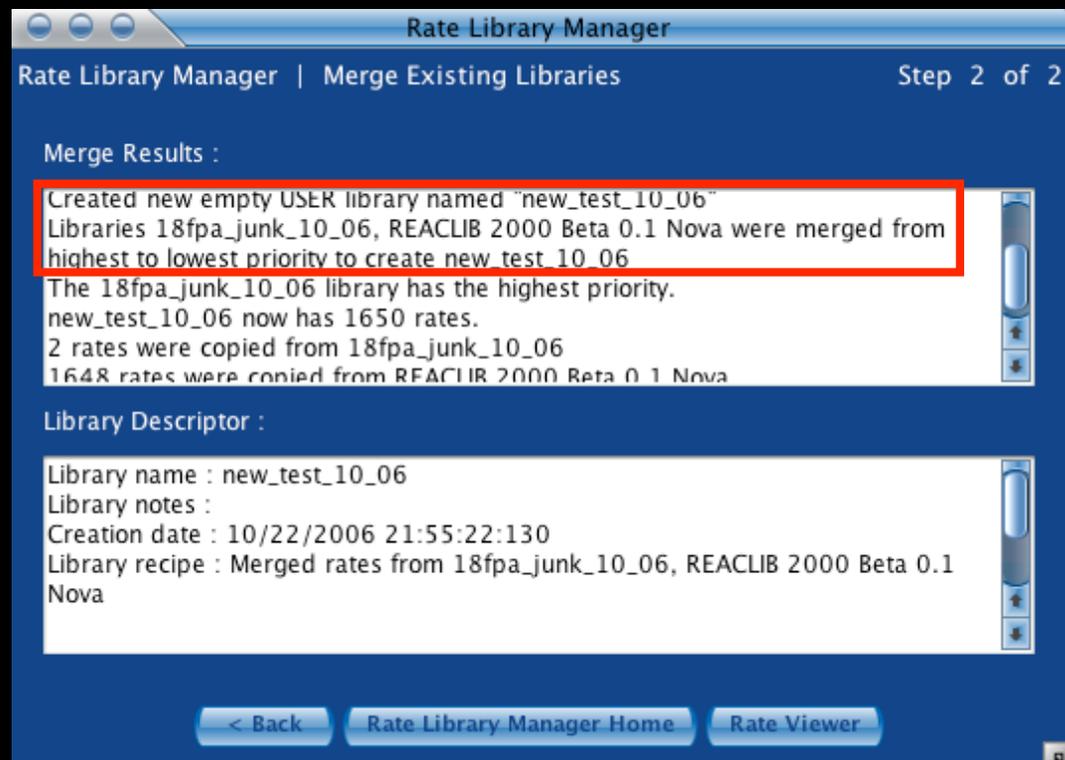
Highest to lowest priority

- 18fpa_junk_10_06
- REACLIB 2000 Beta 0.1 N

REACLIB
NACRE
Iliadis
nucastrodata.org Best
ORNL Best
Sample_Lib_1
REACLIB 2000 Beta 0.1
ORNL Canonical-2000

Add Library >>
<< Remove Library

< Back Continue >



Rate Library Manager | Merge Existing Libraries Step 2 of 2

Merge Results :

Created new empty USER library named "new_test_10_06"
Libraries 18fpa_junk_10_06, REACLIB 2000 Beta 0.1 Nova were merged from highest to lowest priority to create new_test_10_06

The 18fpa_junk_10_06 library has the highest priority.
new_test_10_06 now has 1650 rates.
2 rates were copied from 18fpa_junk_10_06
1648 rates were copied from REACLIB 2000 Beta 0.1 Nova

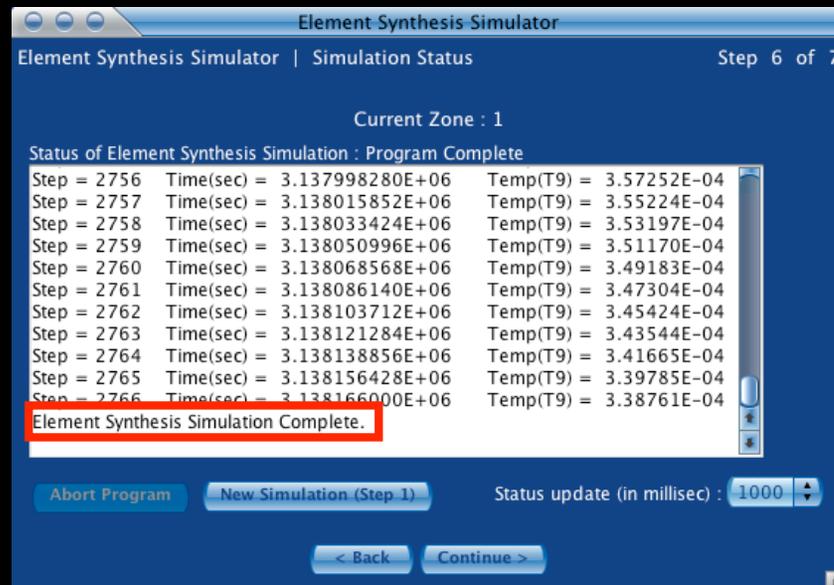
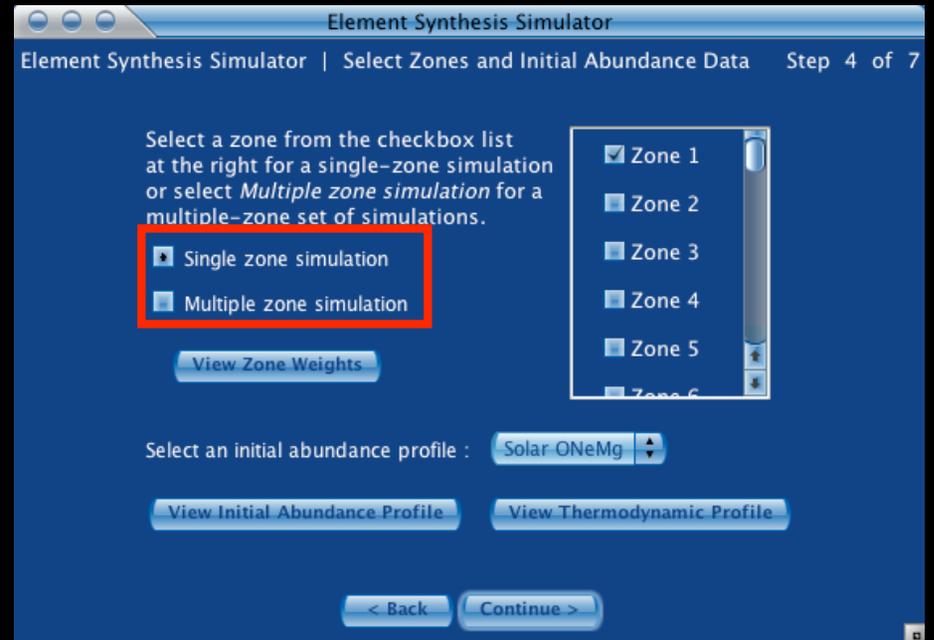
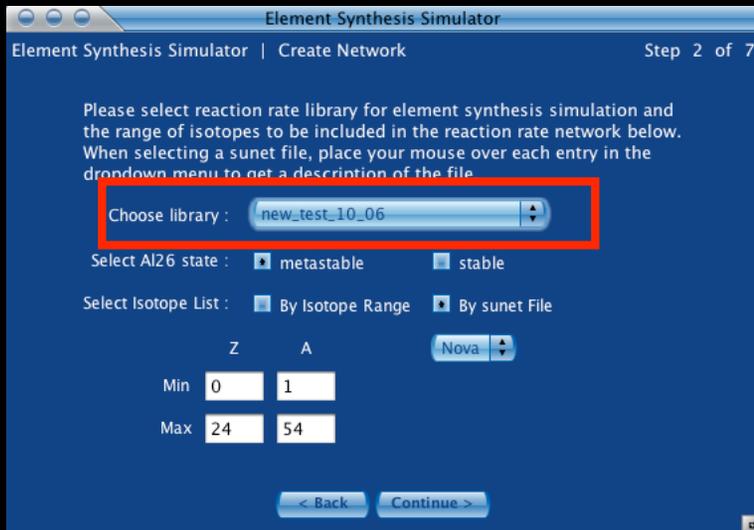
Library Descriptor :

Library name : new_test_10_06
Library notes :
Creation date : 10/22/2006 21:55:22:130
Library recipe : Merged rates from 18fpa_junk_10_06, REACLIB 2000 Beta 0.1 Nova

< Back Rate Library Manager Home Rate Viewer

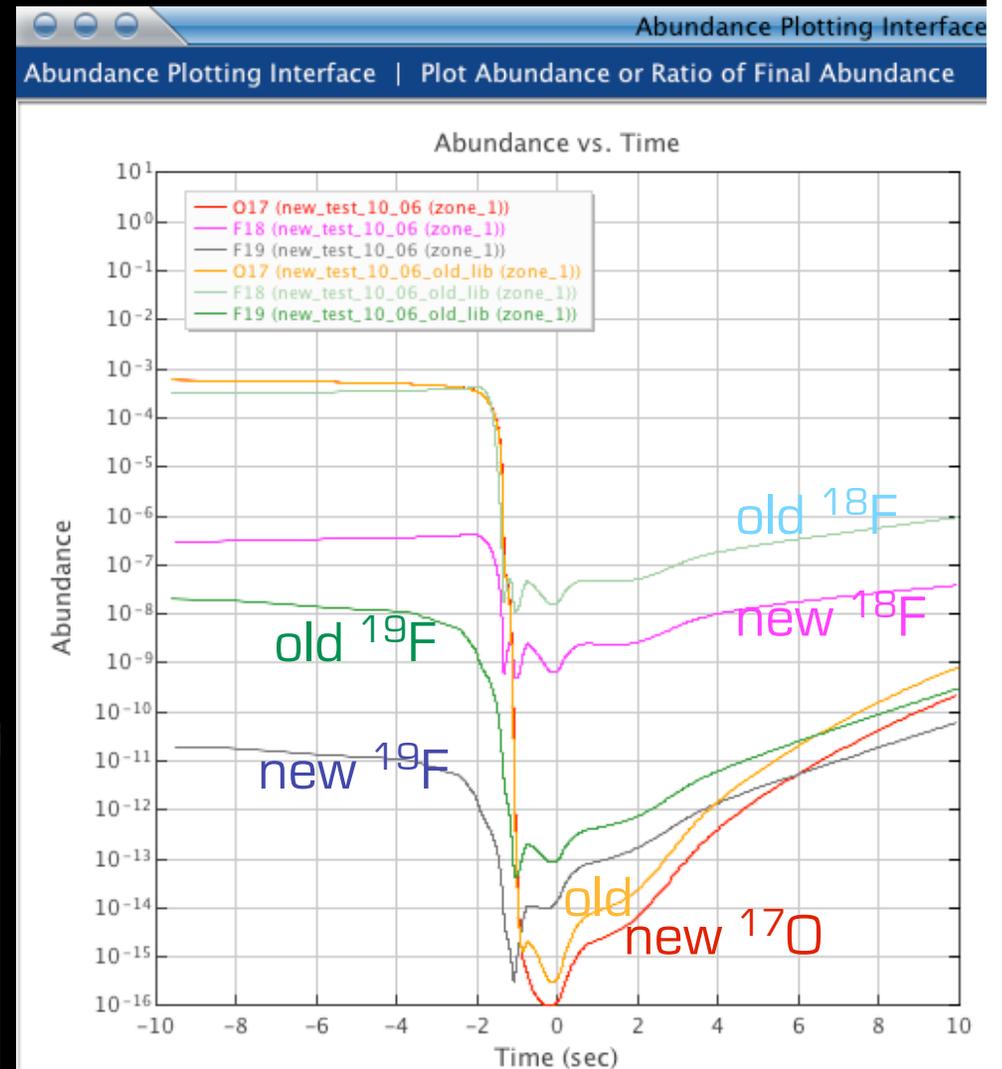
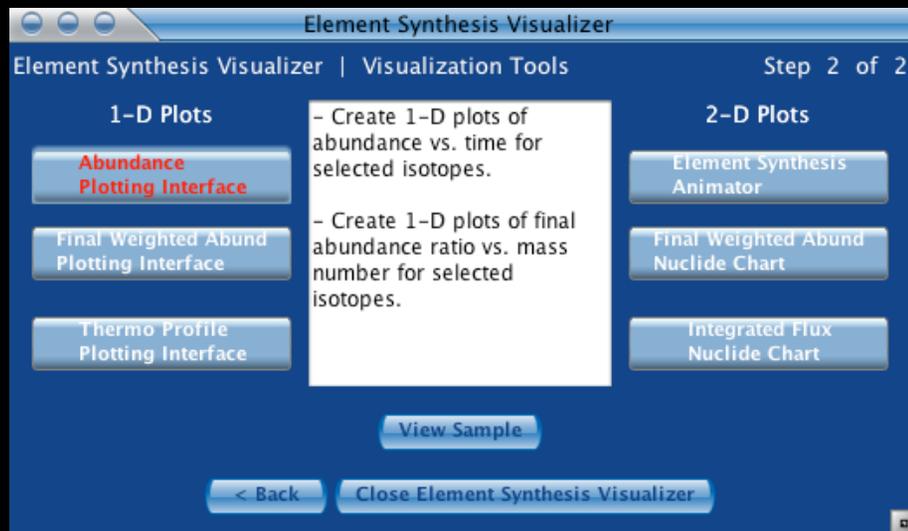
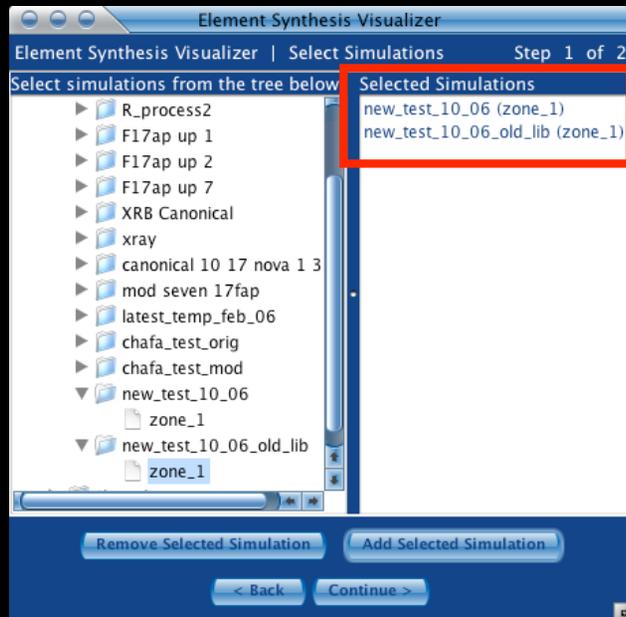
- Rate Library Manager: make new rate library with modified rate

Simulator



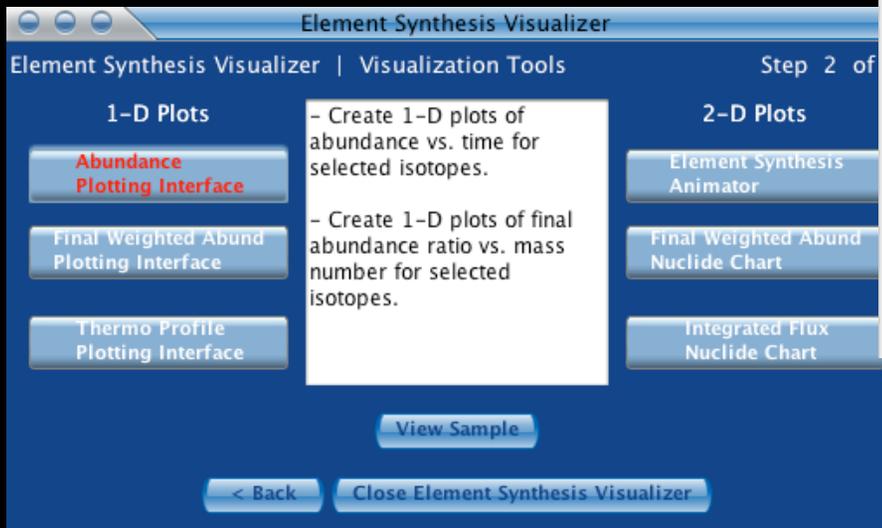
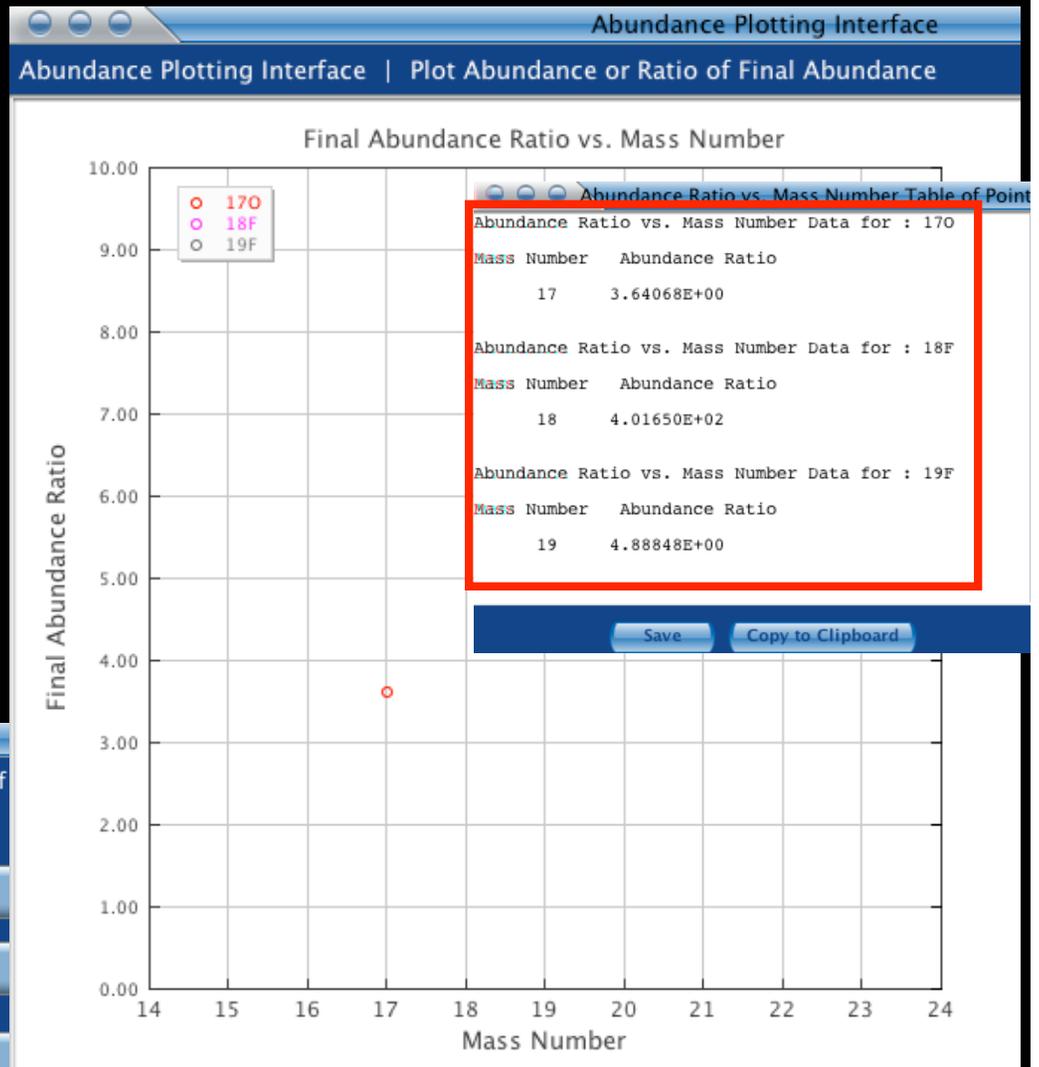
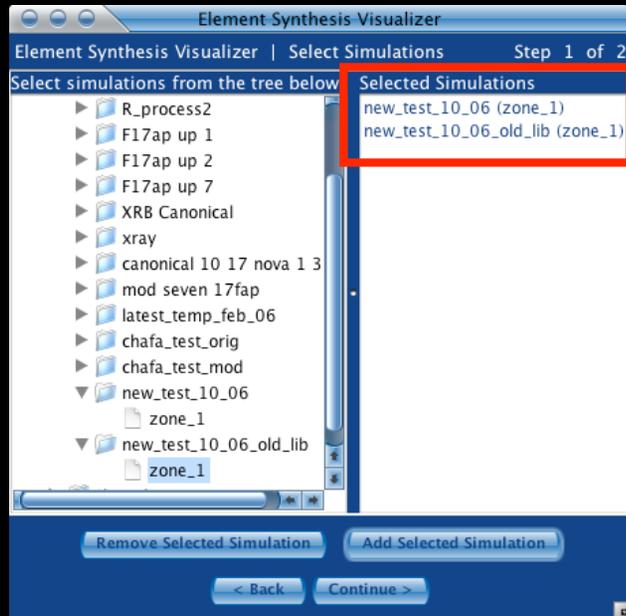
- Simulator: run simulation with new, old libraries and save

Visualizer



- Visualizer: compare final abundances in two simulations
- repeat with different modifications of old rate

Visualizer



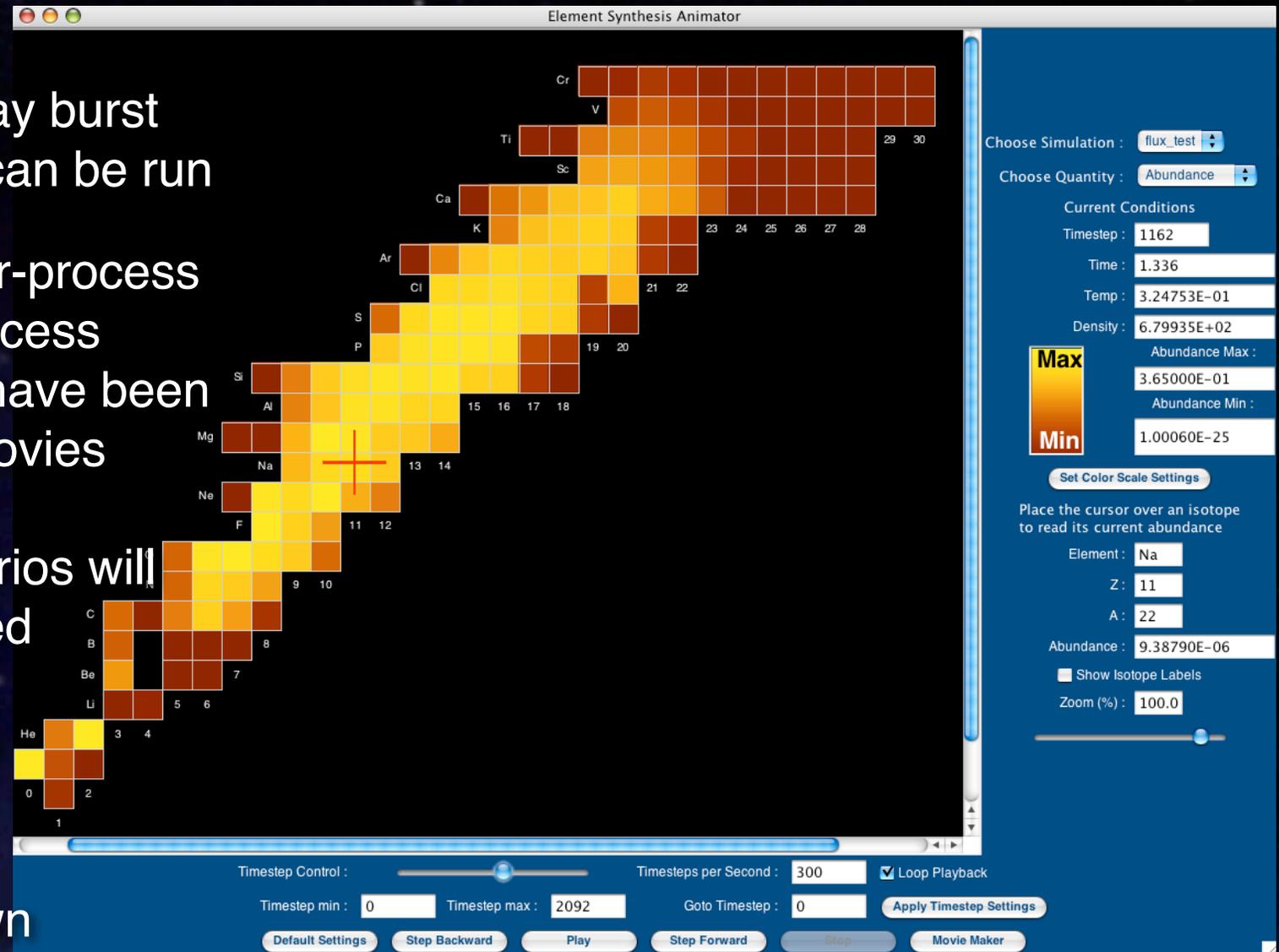
- Visualizer: compare final abundances in two simulations
- repeat with different modifications of old rate

Utilization of Infrastructure for Proposal Preparation

- **Example: If you want to CHOOSE which rate to investigate**
 - Simulator: run simulation with existing rate library and save
 - Visualizer: examine reaction flux animations for high flux reactions
 - Visualizer: examine abundance animations for waiting points
 - Visualizer: examine abundance derivative animations for interesting reactions
 - Rate Commentor: read comments to see which reaction rates are being worked on
 - Rate Locator: use to determine which reaction rates have discrepancies

element synthesis animator

- nova & X-ray burst simulations can be run
- supernova r-process and nu-p process simulations have been made into movies
- more scenarios will soon be added
- movies can be created with output from your own simulation code



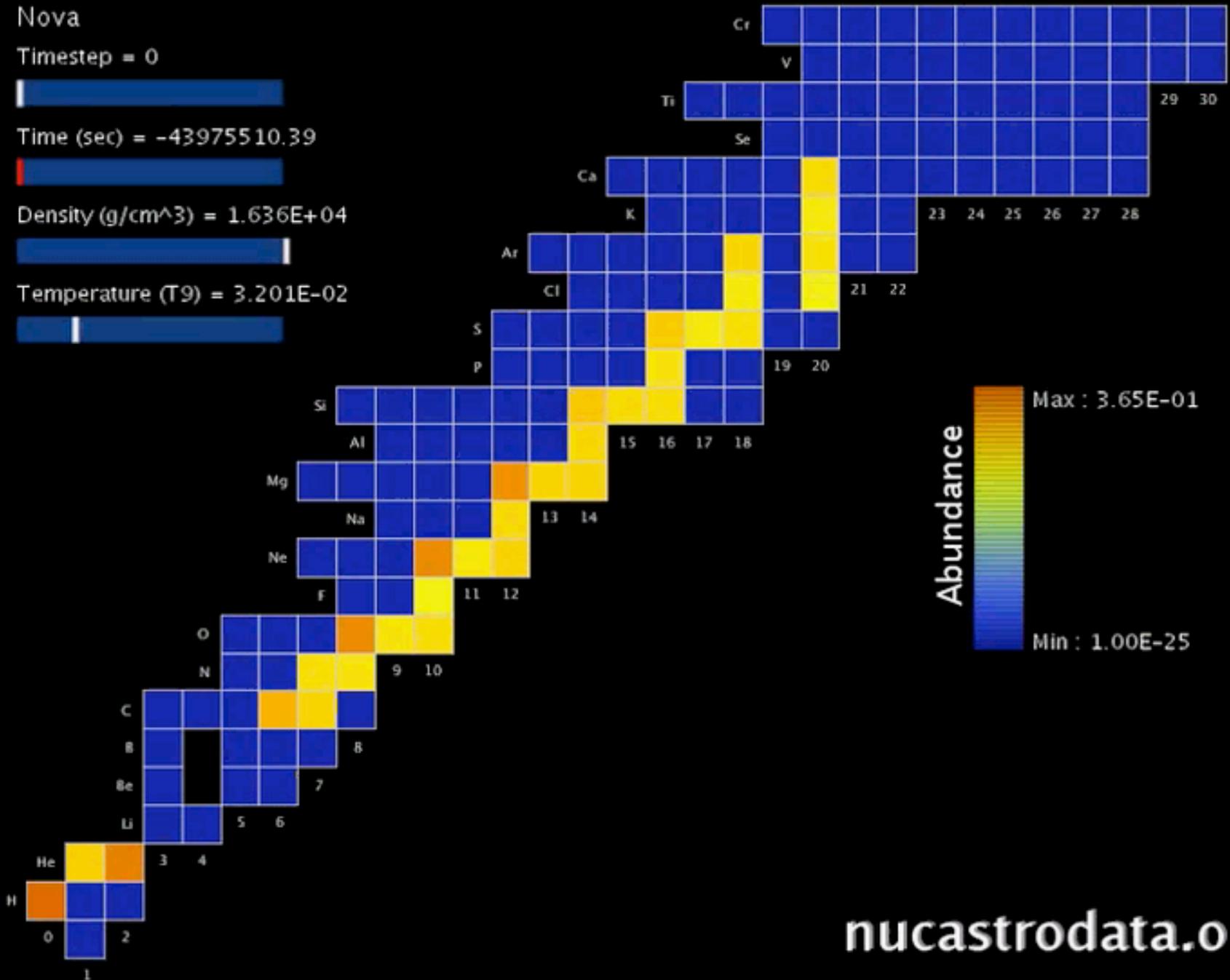
Nova

Timestep = 0

Time (sec) = -43975510.39

Density (g/cm³) = 1.636E+04

Temperature (T9) = 3.201E-02



nucastrodata.org

element synthesis animator: r-process movie

Josh Buen / Raph Hix

color indicates
time-dependent abundance

screen animations are
generated in realtime

movie files can be automatically created and user downloads later

r-process

Timestep = 0

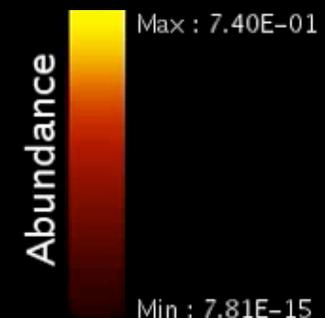


Time (sec) = 0.000E+00



Density (g/cm³) = 3.736E+06

Temperature (T9) = 9.926E+00



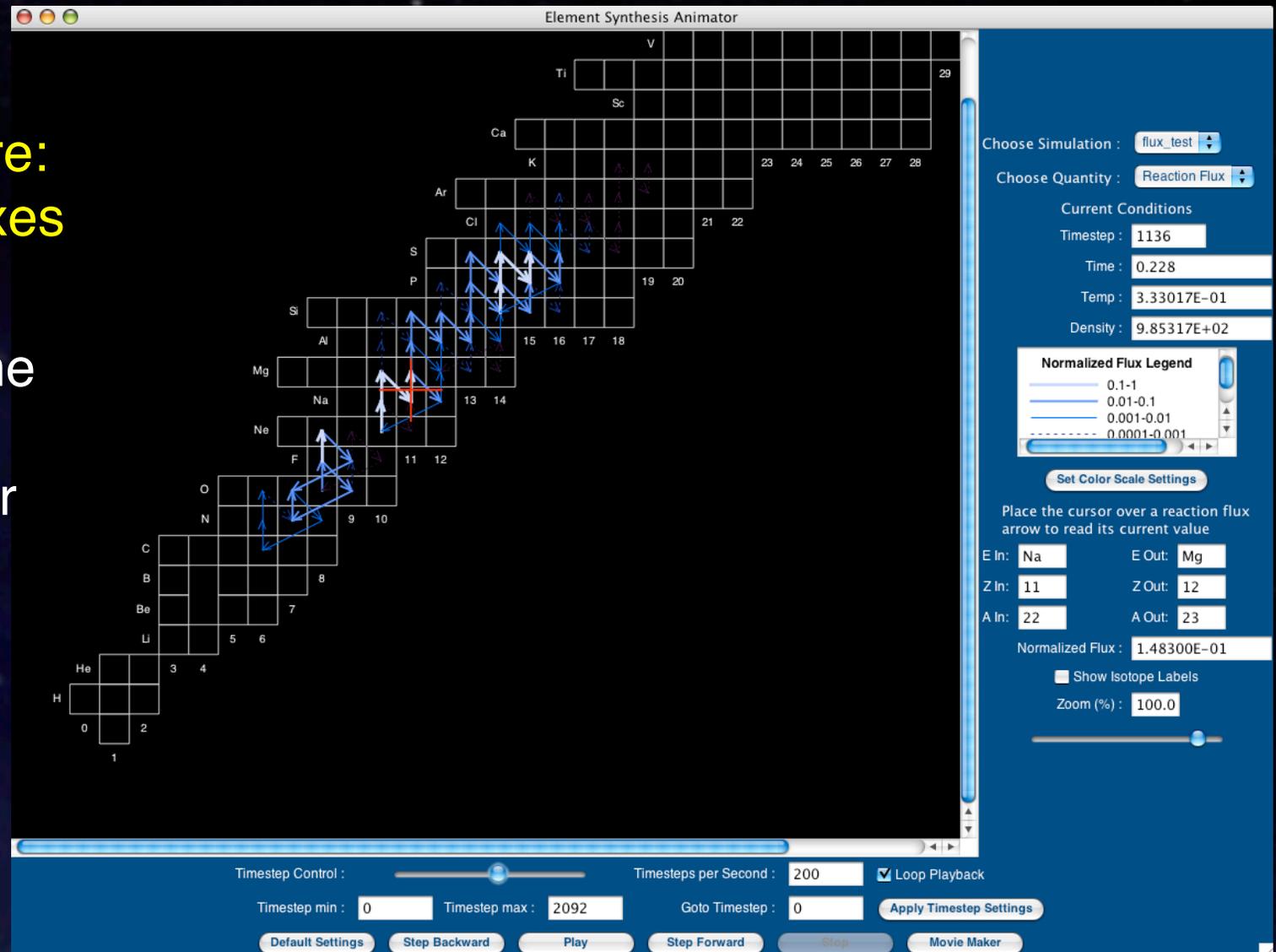
nucastrodata.org

element synthesis animator: reaction fluxes

- new feature: reaction fluxes

- flux vs. time can be animated or integrated

- color schemes can be continuous or binned



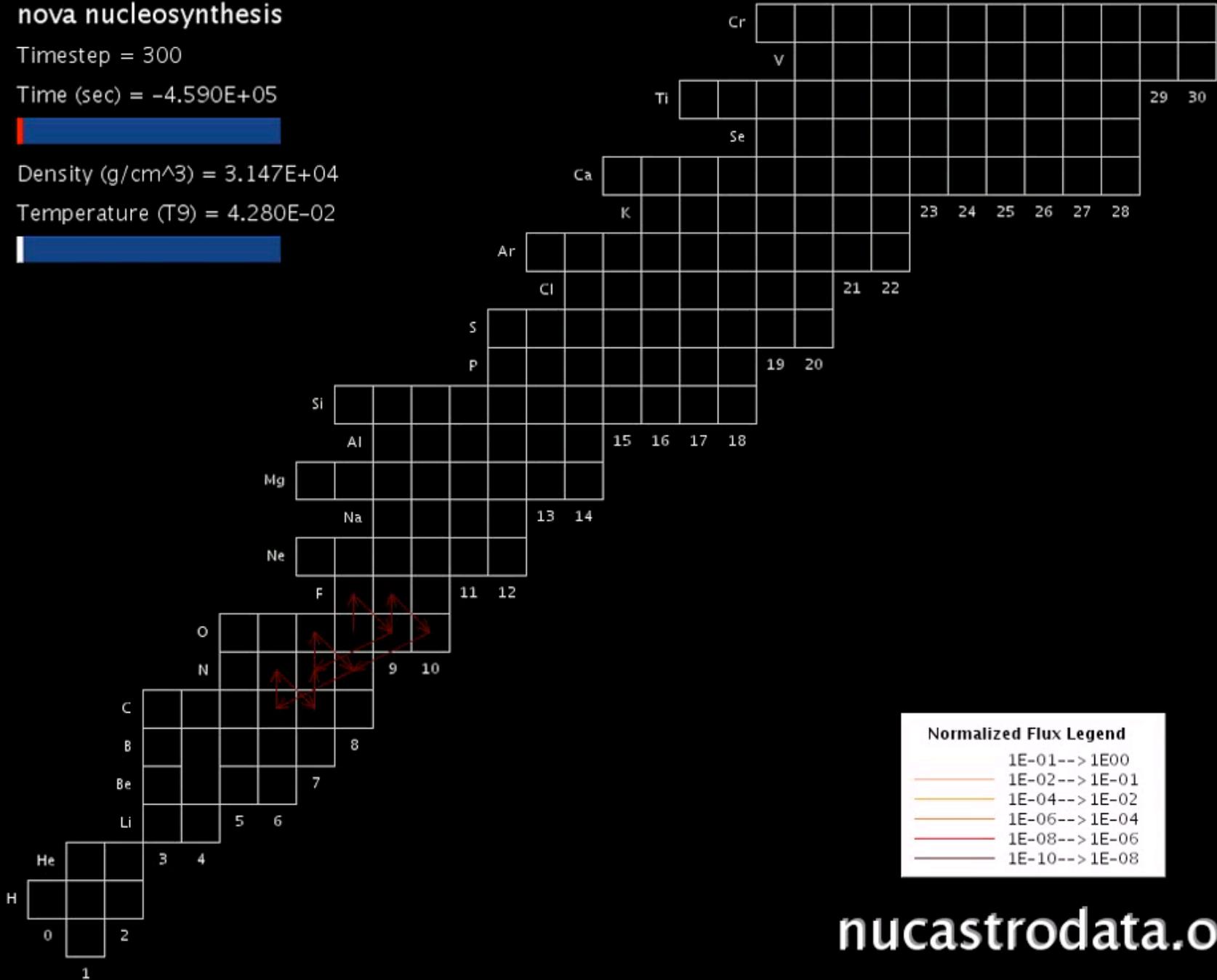
nova nucleosynthesis

Timestep = 300

Time (sec) = $-4.590E+05$

Density (g/cm³) = $3.147E+04$

Temperature (T9) = $4.280E-02$

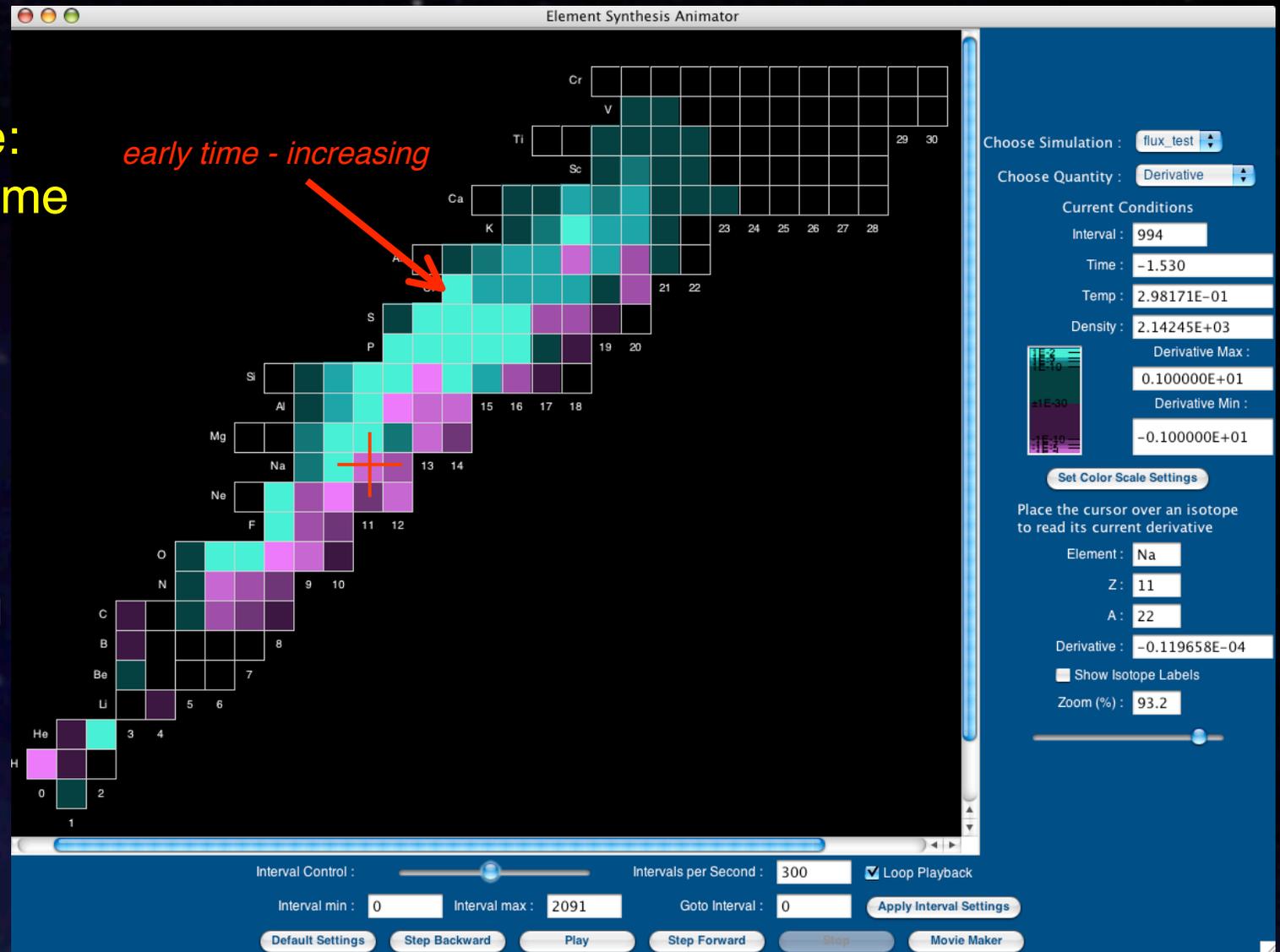


element synthesis animator: derivatives

- new feature: abundance time derivatives

- useful to identify which abundances are changing the fastest

- color schemes can be continuous or binned

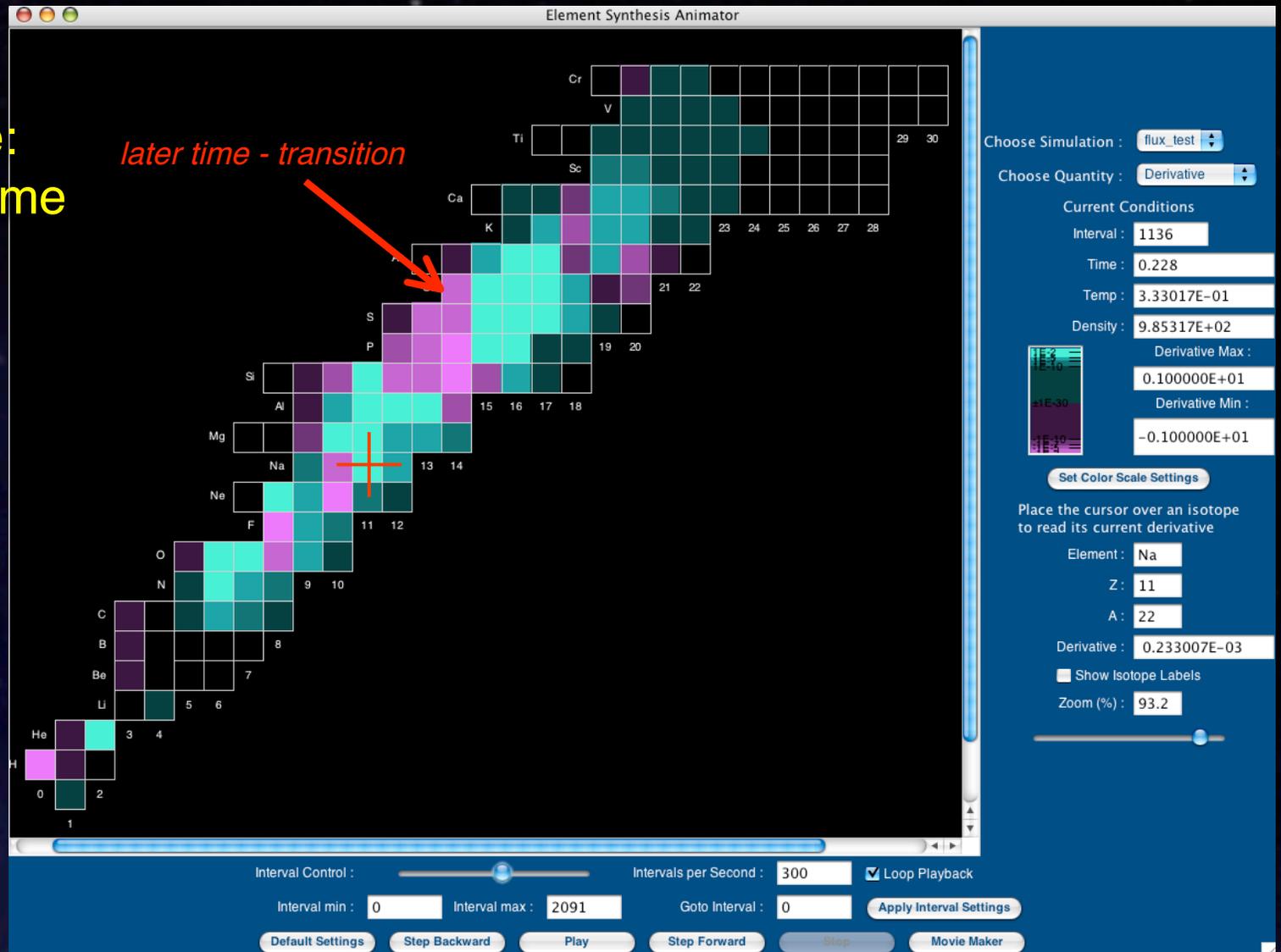


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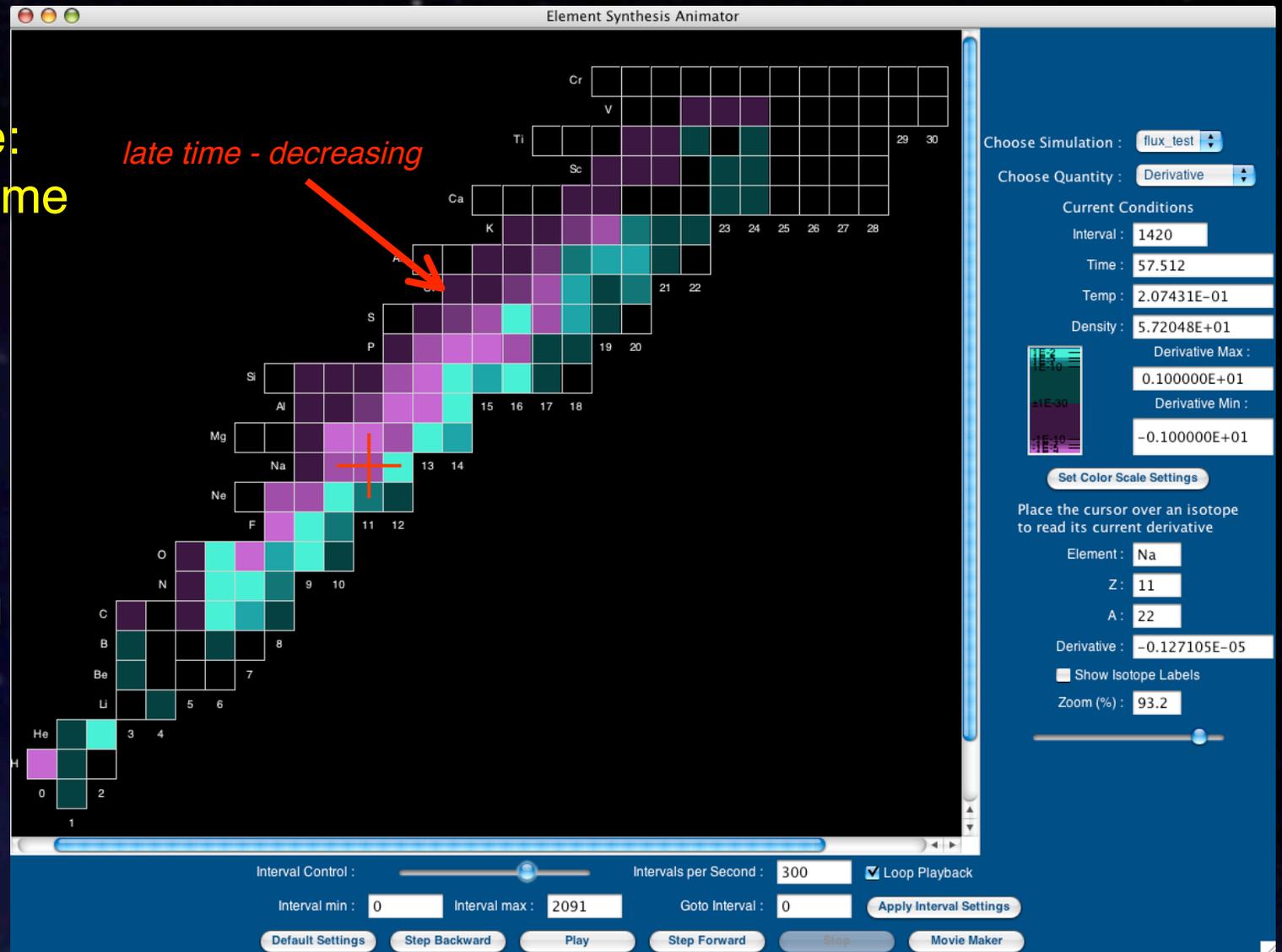


element synthesis animator: derivatives

- new feature: abundance time derivatives

- useful to identify which abundances are changing the fastest

- color schemes can be continuous or binned



rate commentor

view comments on rates with an email-type interface

Subject	User	Folder	Date
test comment on distinct rate 2	Michael Smith	p + 18F --> 4He + 150/Distinct #2	2005-05-24 11:49:02
Re: test comment on distinct rate 2	Michael Smith	p + 18F --> 4He + 150/Distinct #2	2005-05-24 11:55:24
compare to Coc et al. rate	Michael Smith	p + 18F --> 4He + 150/Distinct #2/MSS...	2006-03-29 15:08:34

Subject: compare to Coc et al. rate
Posted by: Michael Smith
Date: 2006-03-29 15:08:34

This is the 18F(p,α)15O rate that we compared to REACLIB and the Coc et al. 2000 rate for the element synthesis calculations, but this rate does not have the absolute latest 18F(p,p) thick target information, the 18F(d,p) results, the 15N(α,α) results, or the Fortune & Sherr 2005 calculation results.

comments can help reach consensus on difficult rate issues

comments can serve as tutorials

add comments of your own

Public Libraries are BLUE.
Shared Libraries are GREEN.
User Libraries are RED.

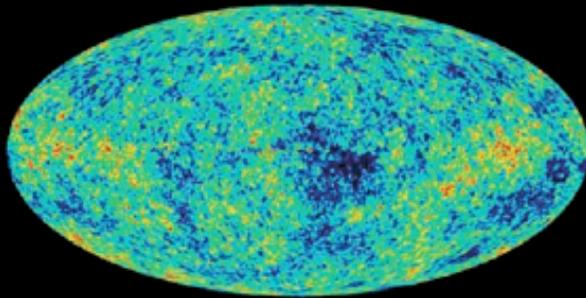
Post New Comment Reply to Comment Export Comments Copy Comments to Clipboard Help on This Interface
< Back Close Rate Commentor Rate Library Manager

Summary

- the Computational Infrastructure for Nuclear Astrophysics is a **freely available system online at nucastrodata.org**
- With a few mouse clicks, you can
 - rapidly incorporate nuclear results into element burning models
 - run models and visualize the impact of changed nuclear information
 - share results and comments with an online community
- You can use it to
 - Quickly determine the astrophysical impact of measurements
 - Plan future measurements
 - Build consensus on best reaction rates & element burning calculations
- Newest features in commenting, parameterization, and element synthesis visualization enhance the utility for nuclear astro research

BIG BANG ONLINE

WELCOME ——— COMPUTE ——— RESOURCES



BIGBANGONLINE.ORG
where you use light element abundances
to constrain Important Cosmological
parameters

COMPUTE
Create, run, visualize, and share custom
Cosmology calculations using Big Bang
Nucleosynthesis theory

RESOURCES
for Big Bang Nucleosynthesis
and related Cosmology studies

bigbangonline.org

will **SOON** enable users to

run and **visualize** CUSTOM BBN calculations with

choice of **reaction rates**

choice of **primordial abundance observations**

quickly perform **exploratory** “what-if” calculations

run **Monte Carlo** simulations

comment on & **quickly share results** with colleagues