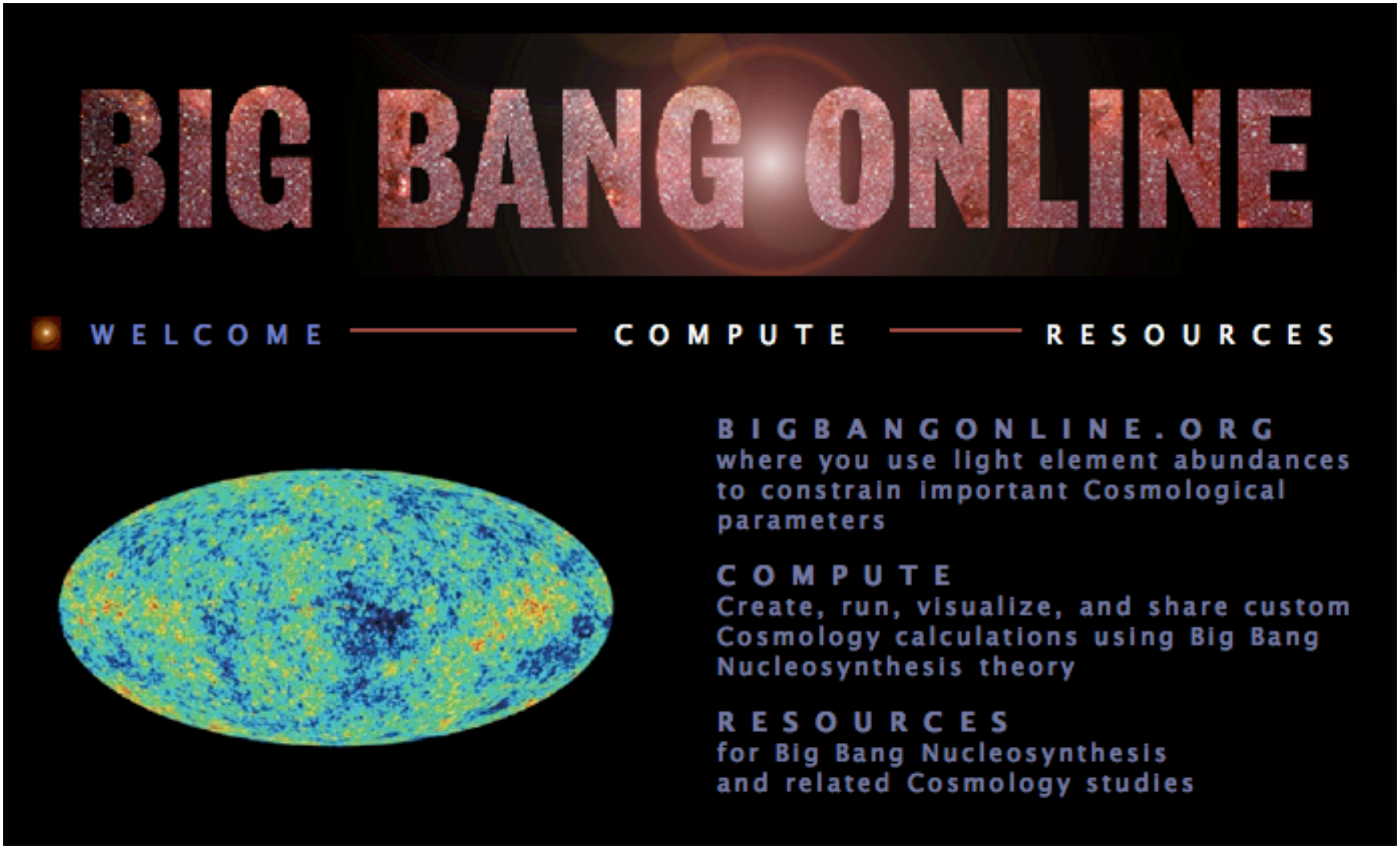
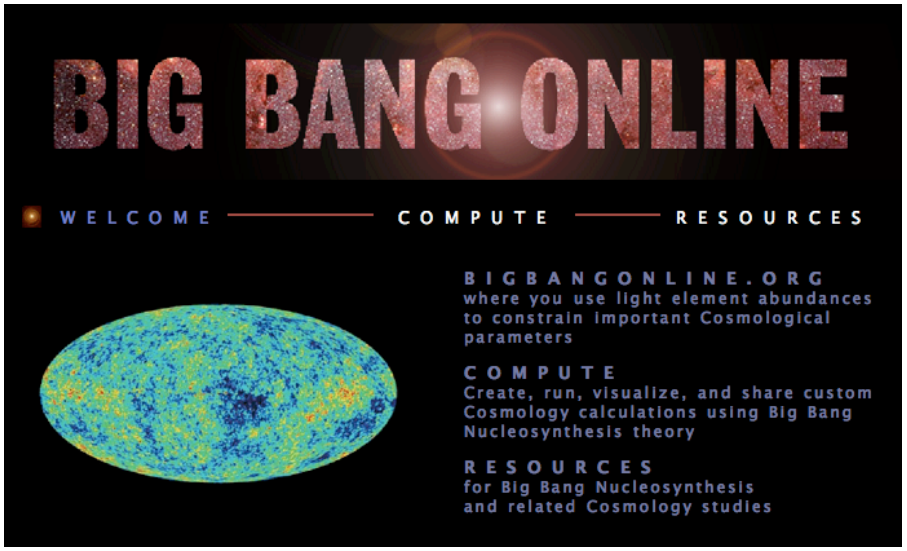
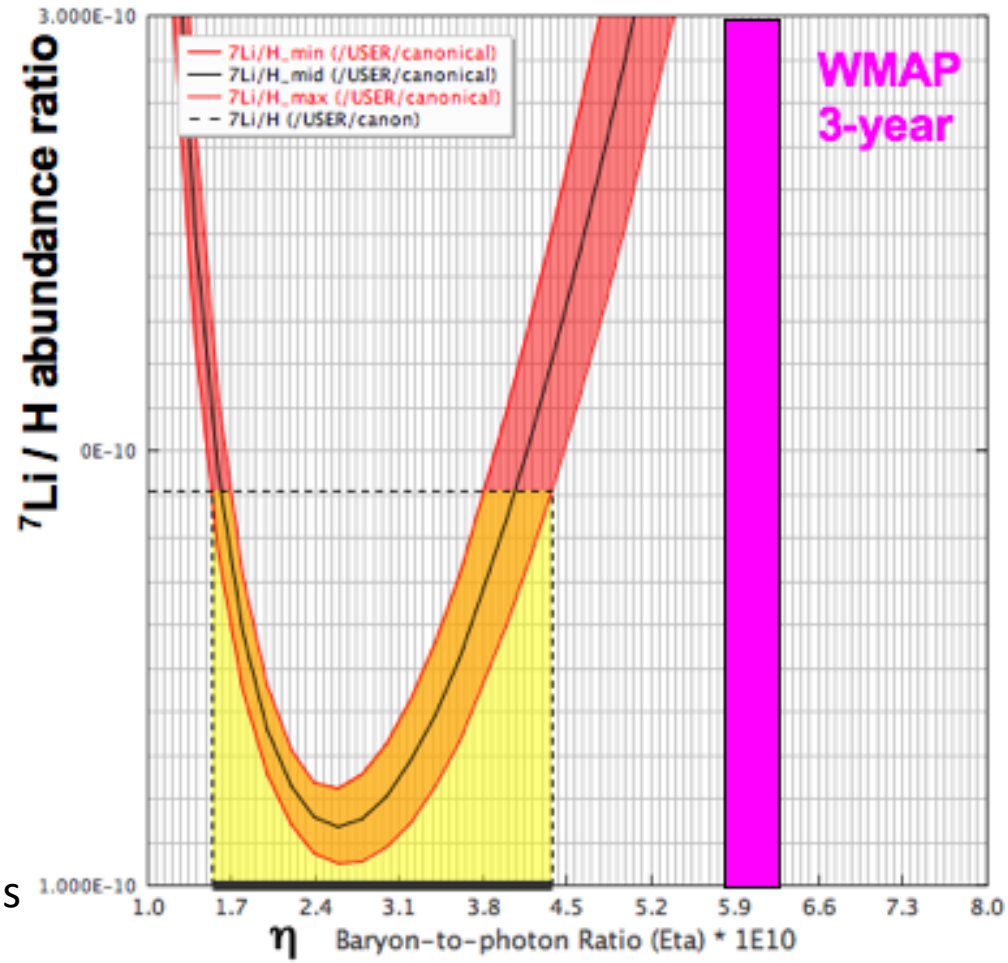


new online suite of cosmology codes
available **freely** to all at **bigbangonline.org**

Michael Smith, Physics Division, Oak Ridge National Lab

coordinator@bigbangonline.org



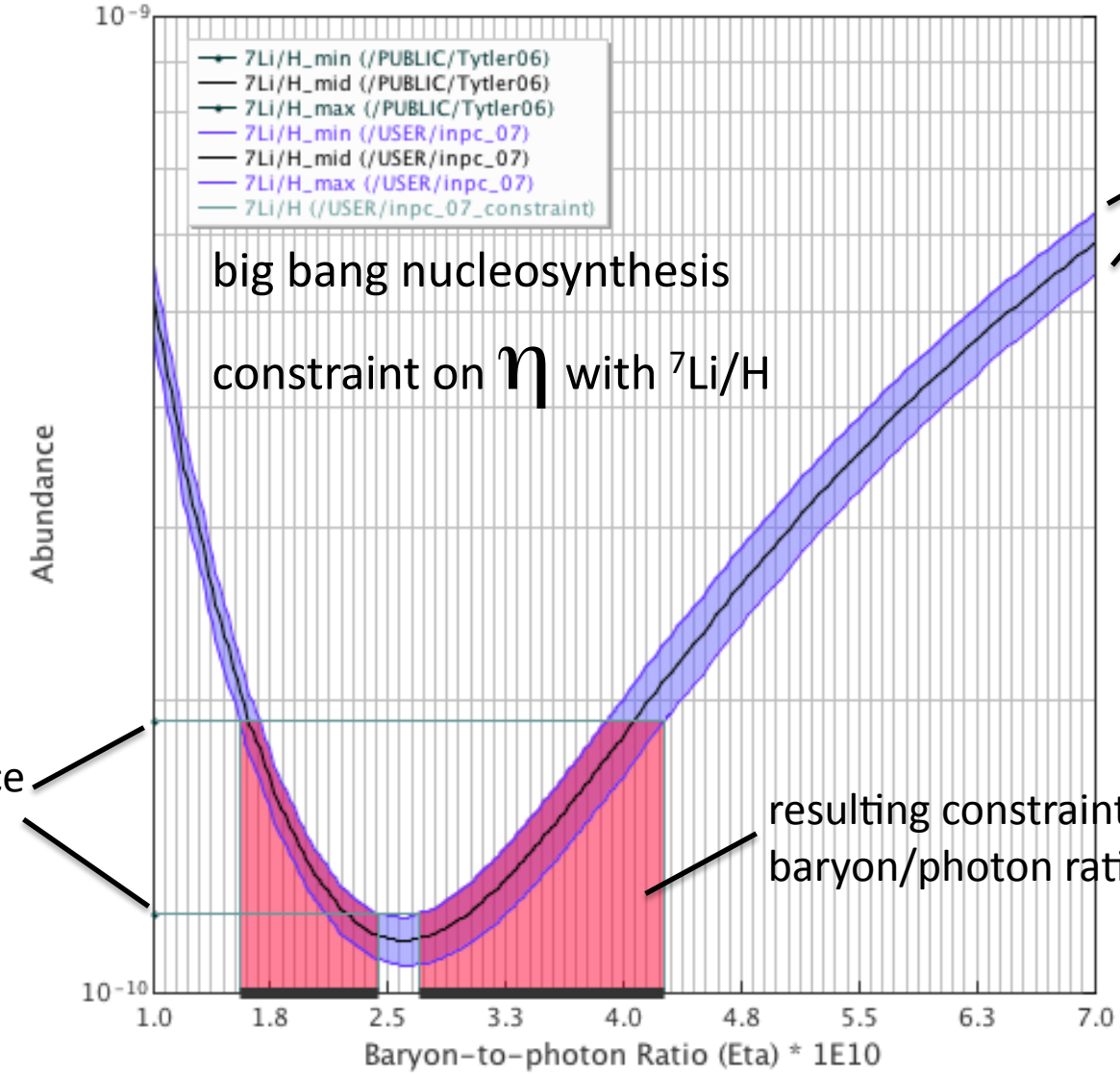


run and **visualize** CUSTOM BBN calculations

choose reaction rates
choose primordial abundance observations
choose standard or non-standard model

quickly perform exploratory "what-if" calculations
run Monte Carlo simulations
comment on & quickly share results with colleagues

BIG BANG ONLINE

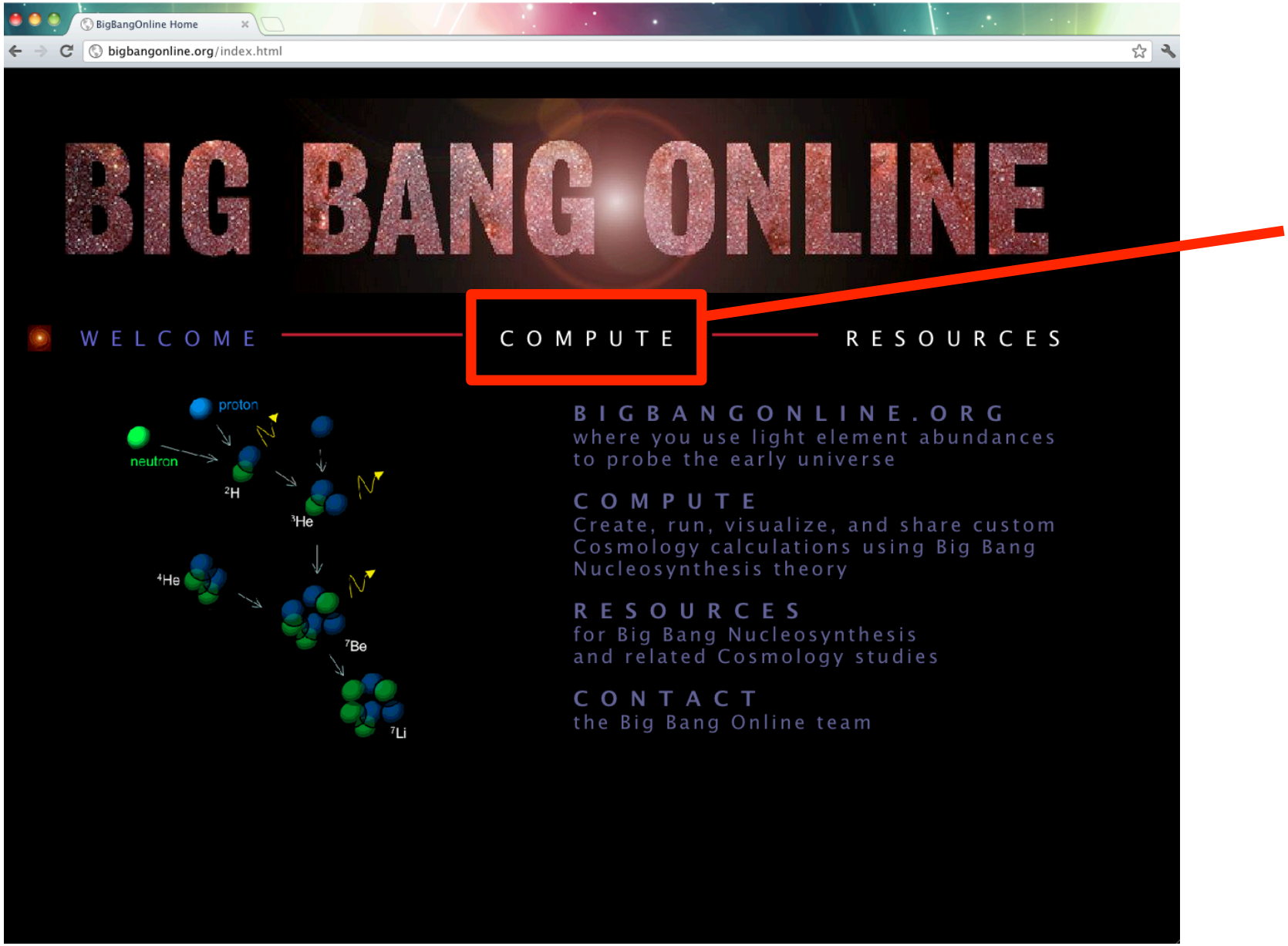


width of abundance prediction from Monte Carlo calculation

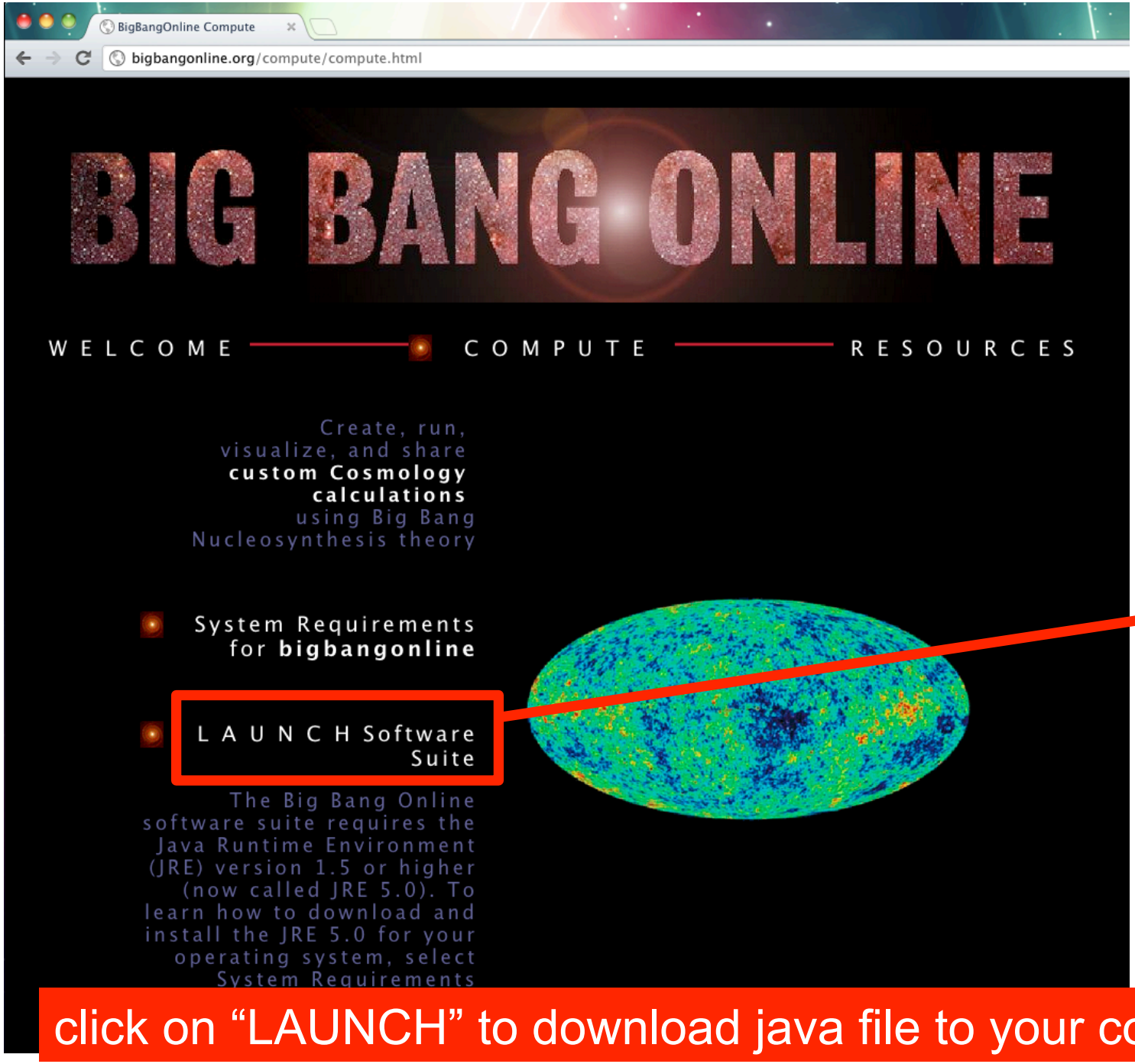
customized color scheme

input abundance limits

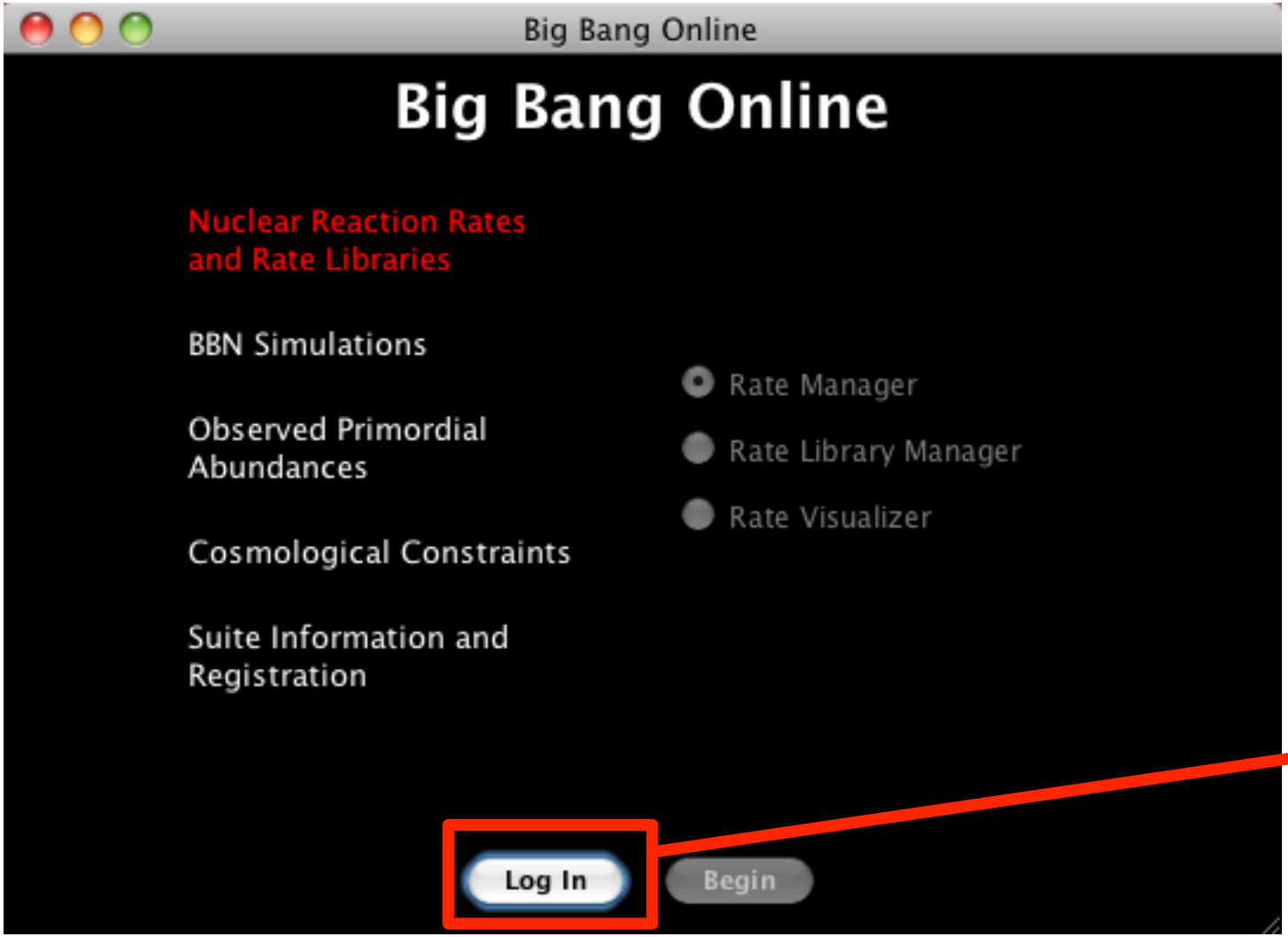
resulting constraint on baryon/photon ratio



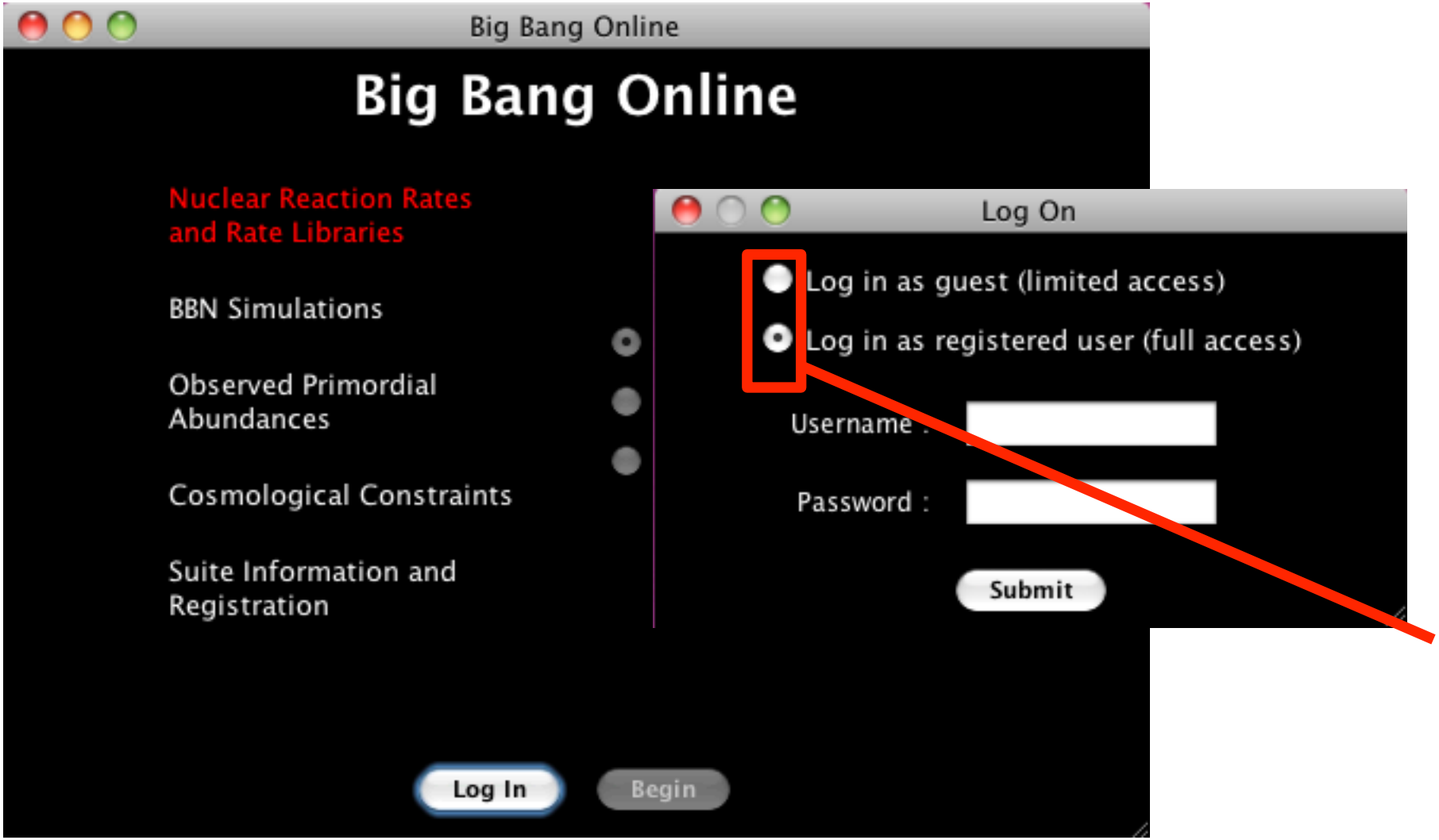
go to bigbangonline.org click on “COMPUTE”



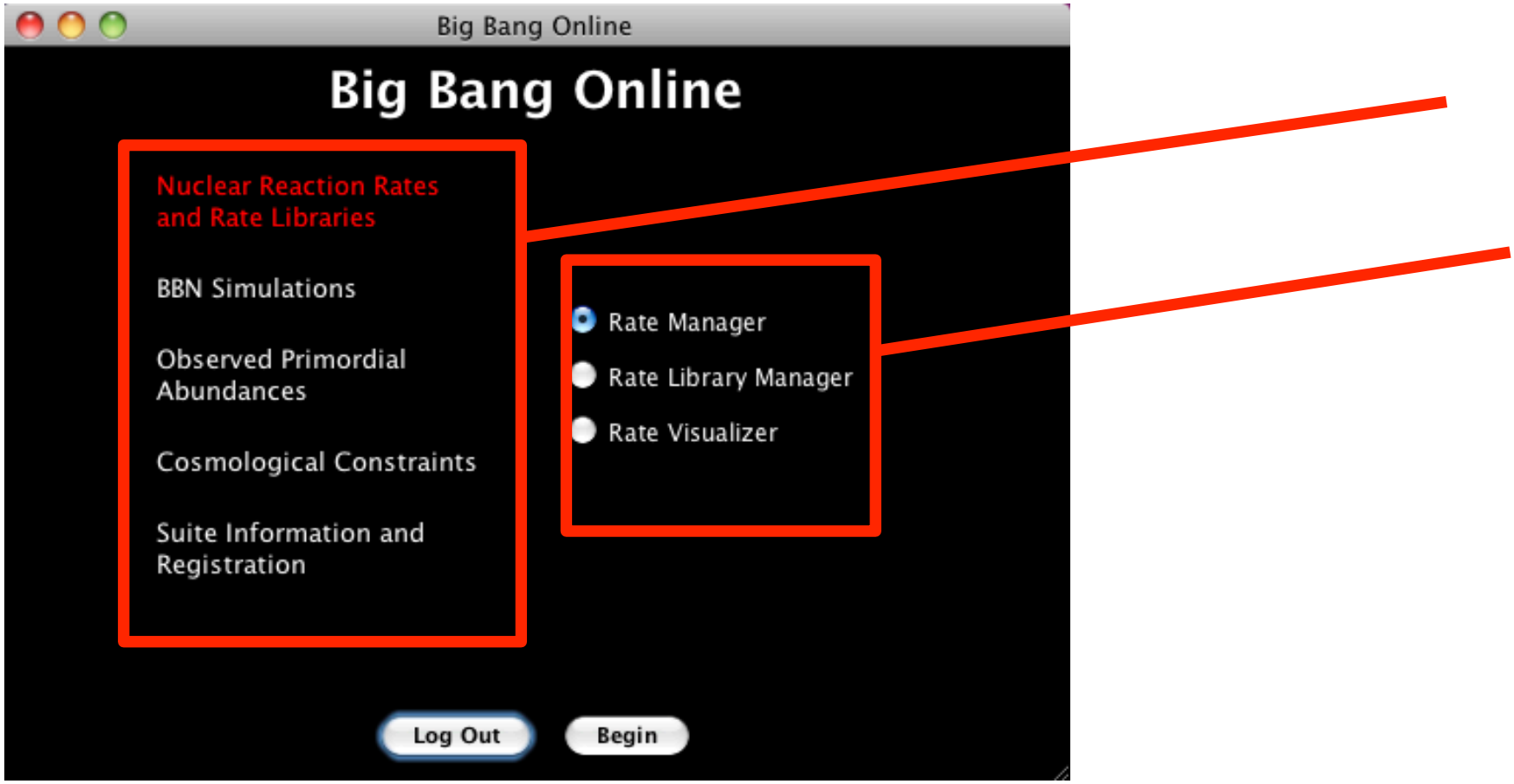
click on “LAUNCH” to download java file to your computer



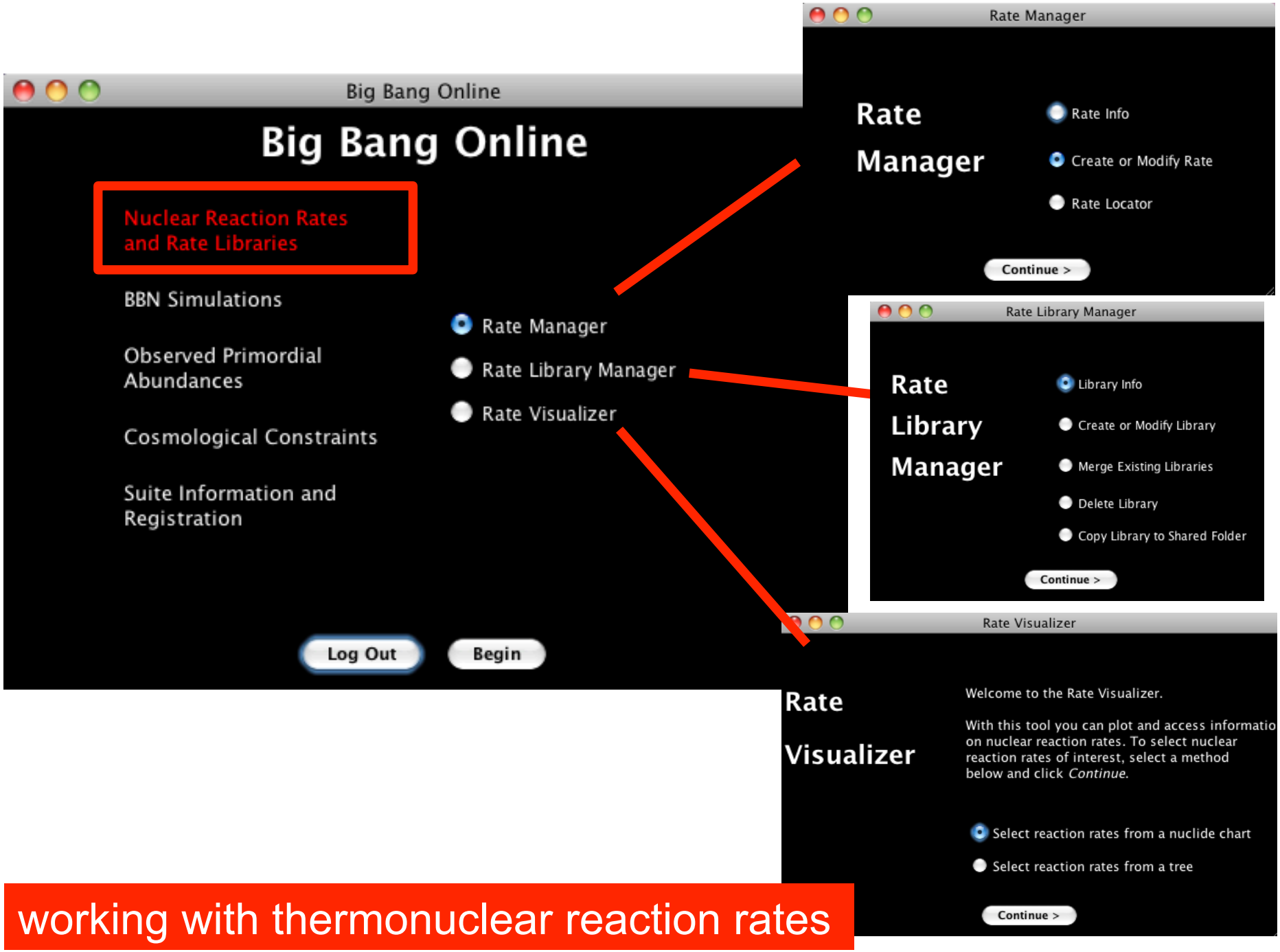
click on “LOGIN” to start



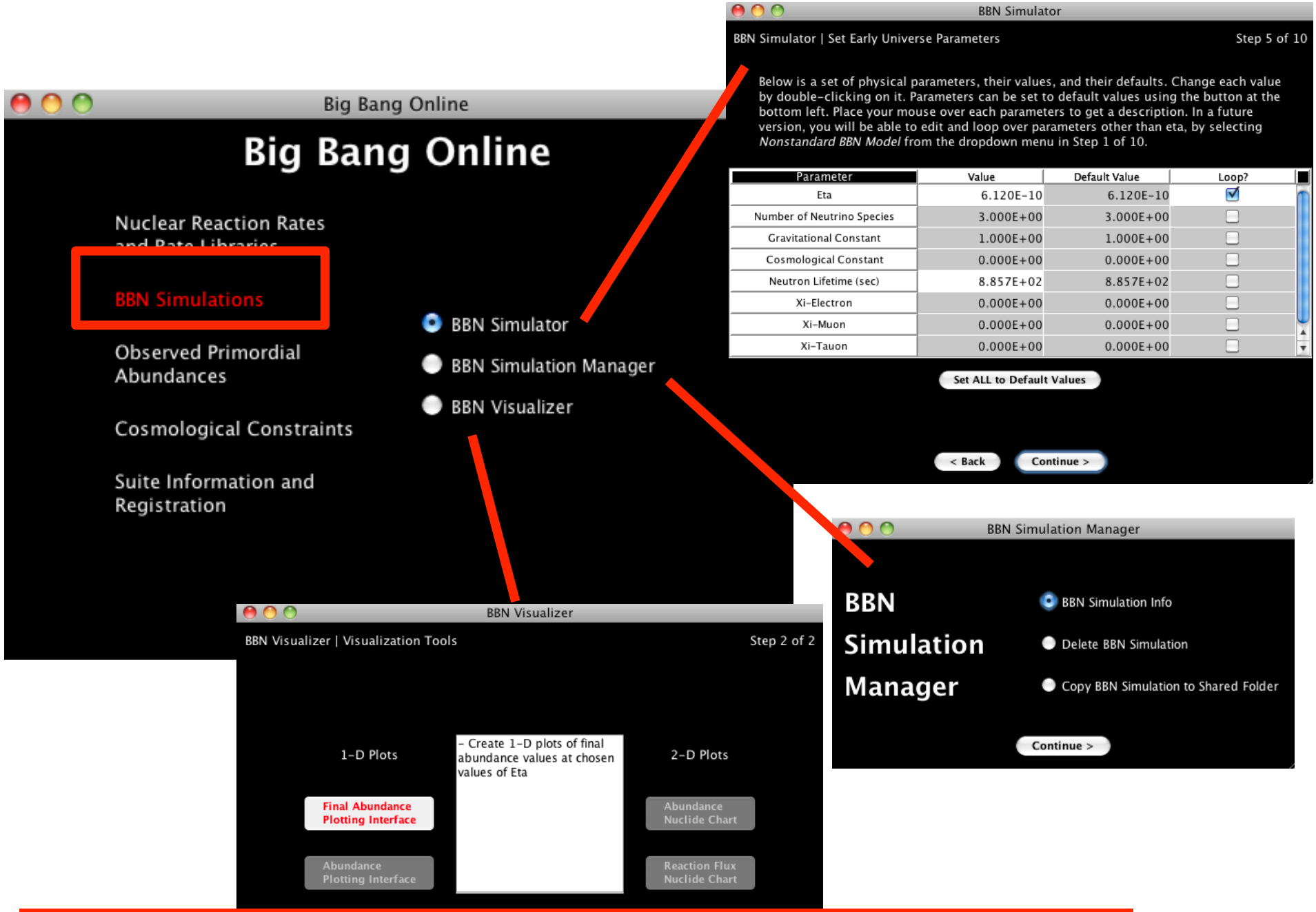
“LOGIN” as guest to start; registered users get disk space



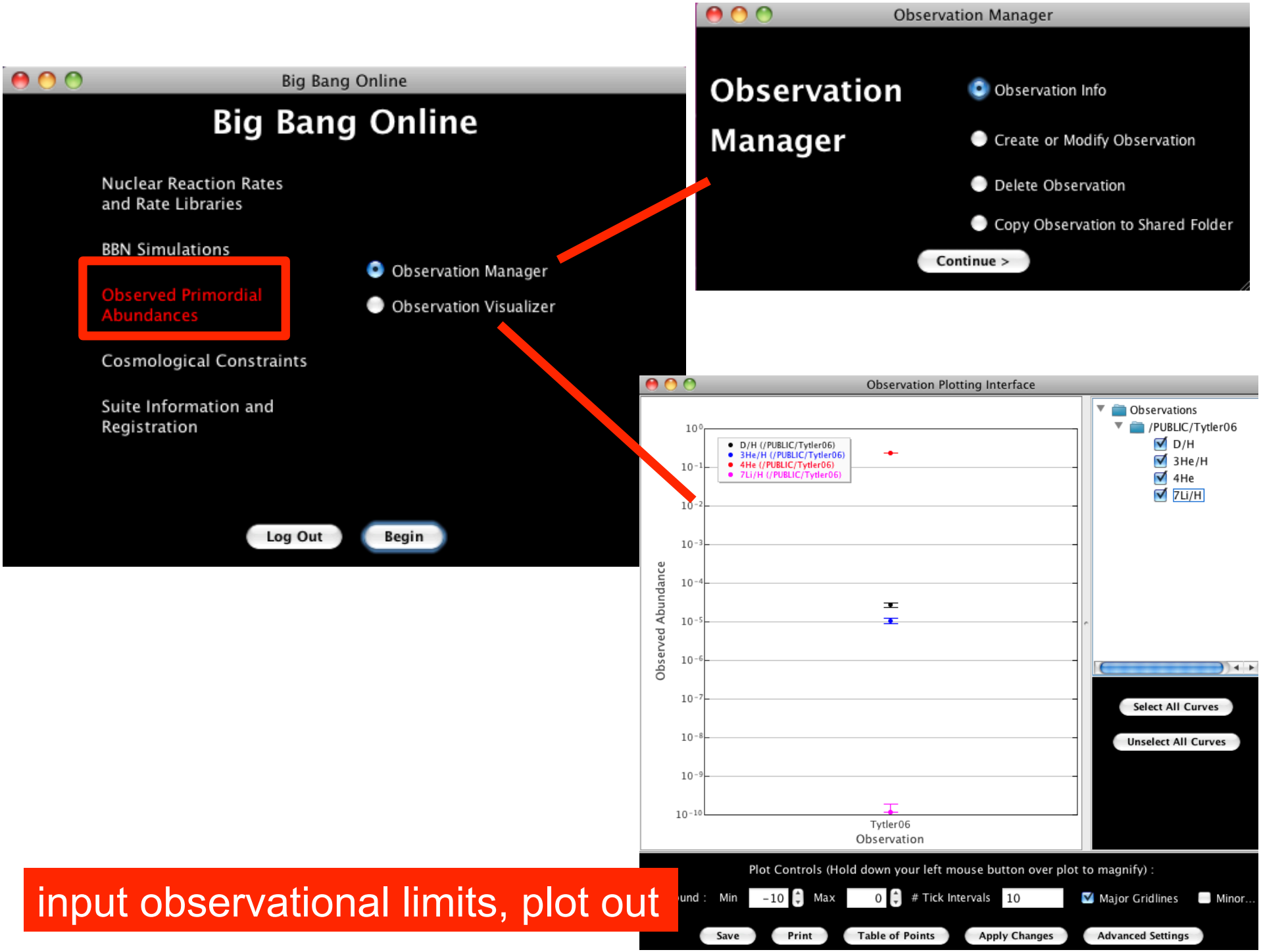
five sets of tools, each with a list of functions



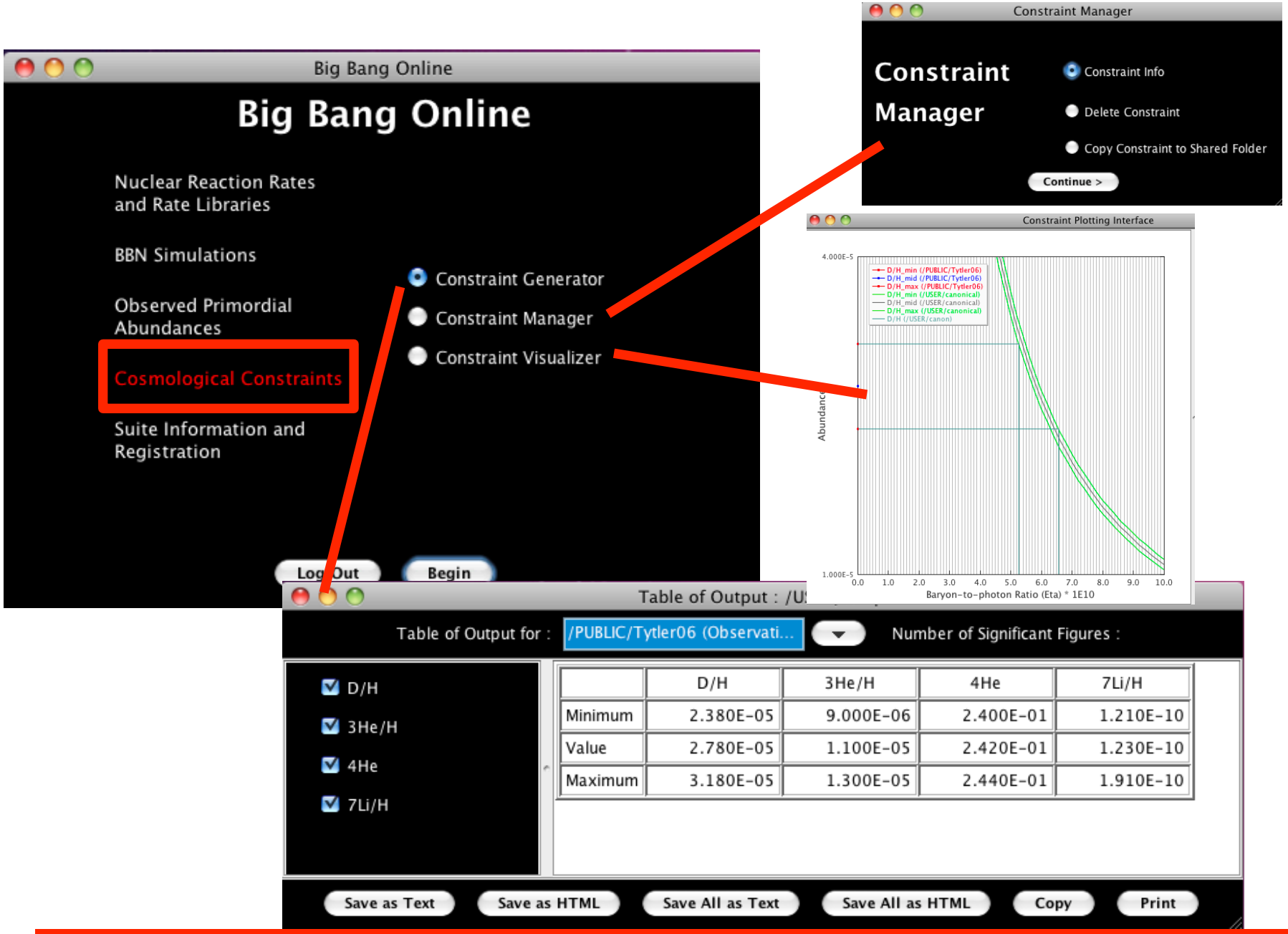
working with thermonuclear reaction rates



set up, run, manage, visualize custom BBN simulations



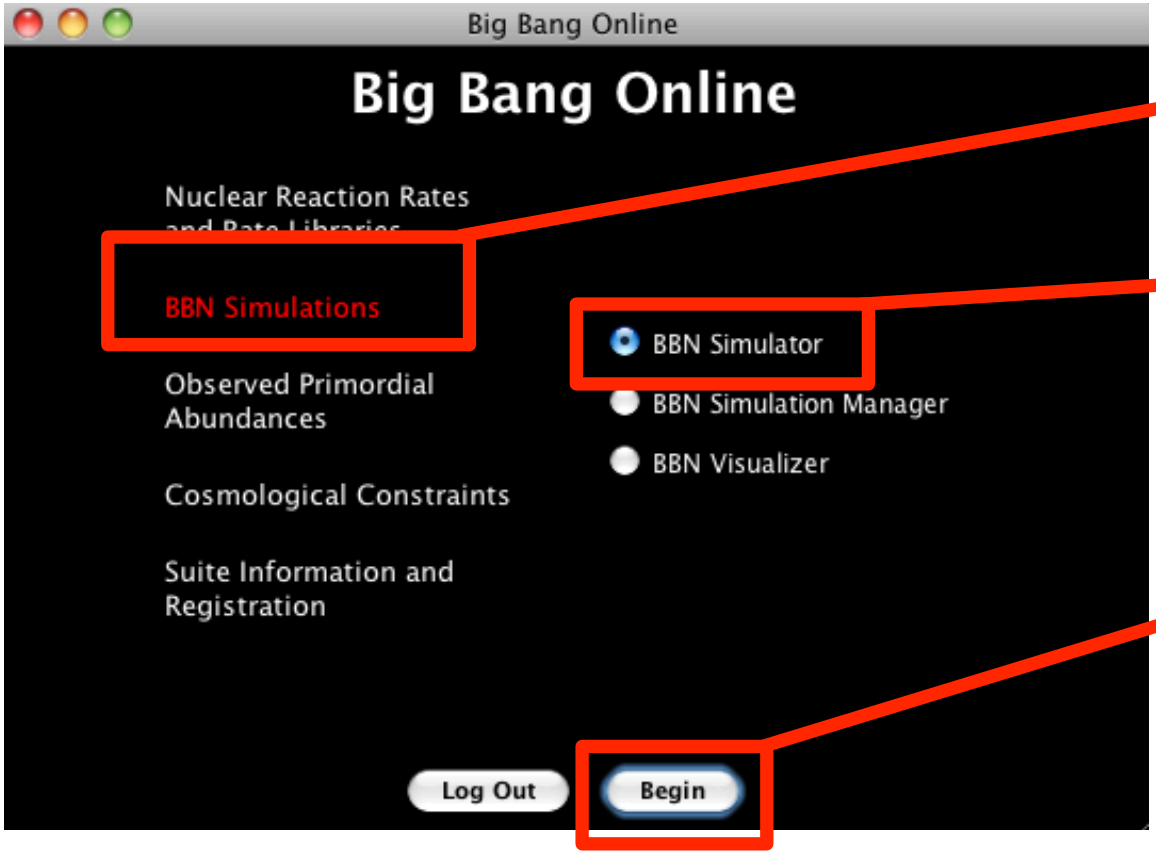
input observational limits, plot out



	D/H	3He/H	4He	7Li/H
Minimum	2.380E-05	9.000E-06	2.400E-01	1.210E-10
Value	2.780E-05	1.100E-05	2.420E-01	1.230E-10
Maximum	3.180E-05	1.300E-05	2.440E-01	1.910E-10

generate constraints from abundance predictions & observations

step-by-step instructions

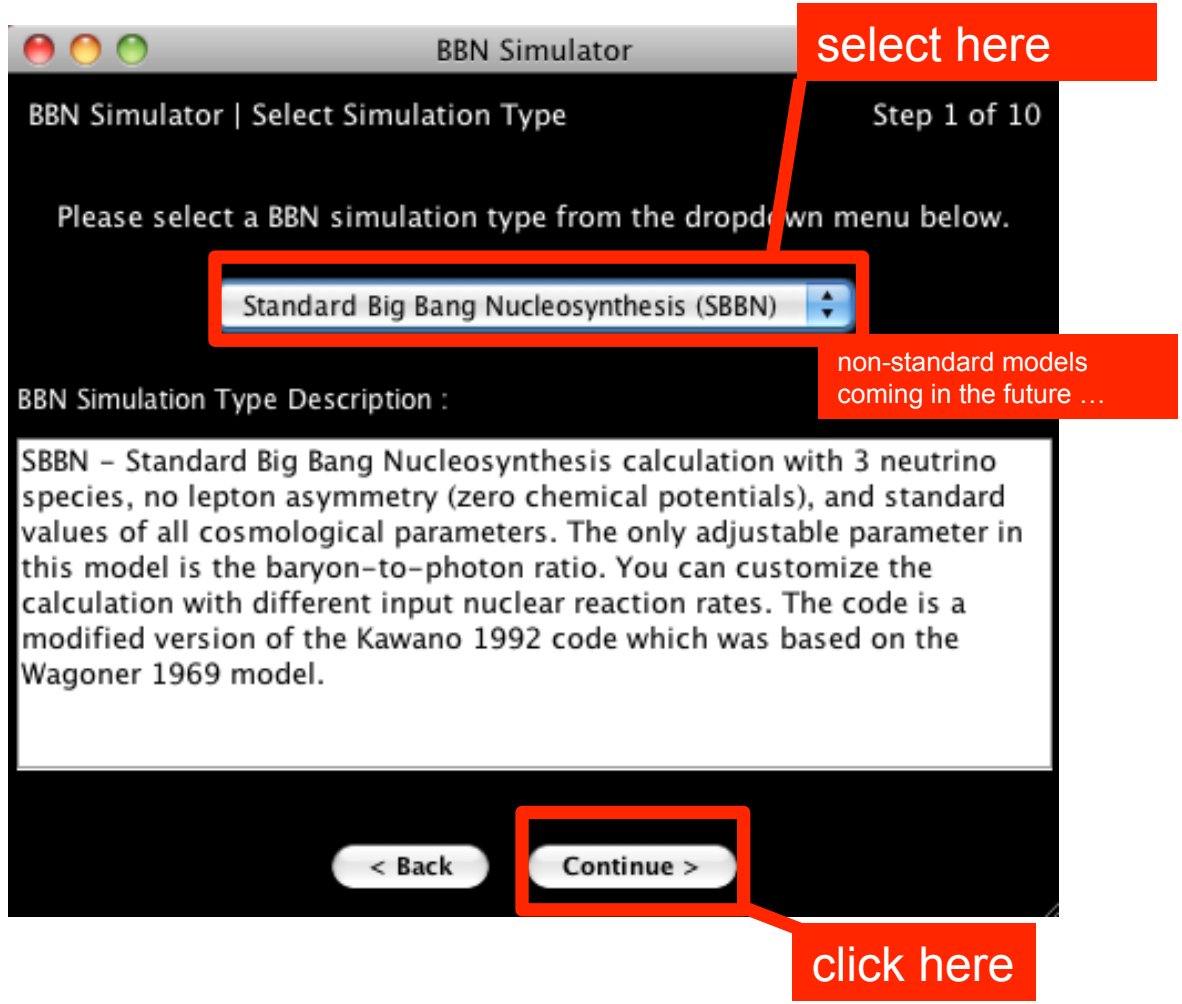


mouse-over here

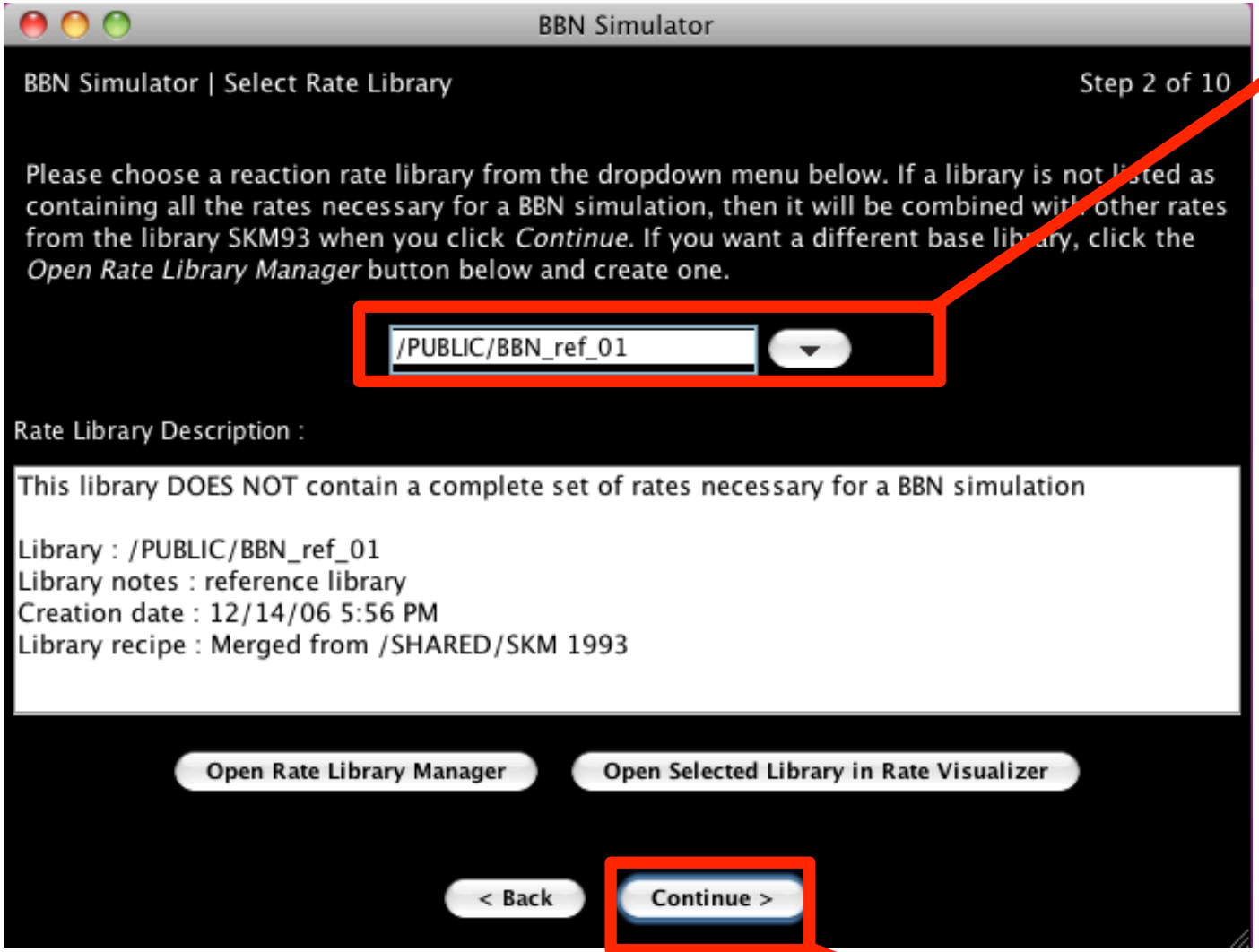
click here

click here

setting up a simulation



setting up a simulation – choose model

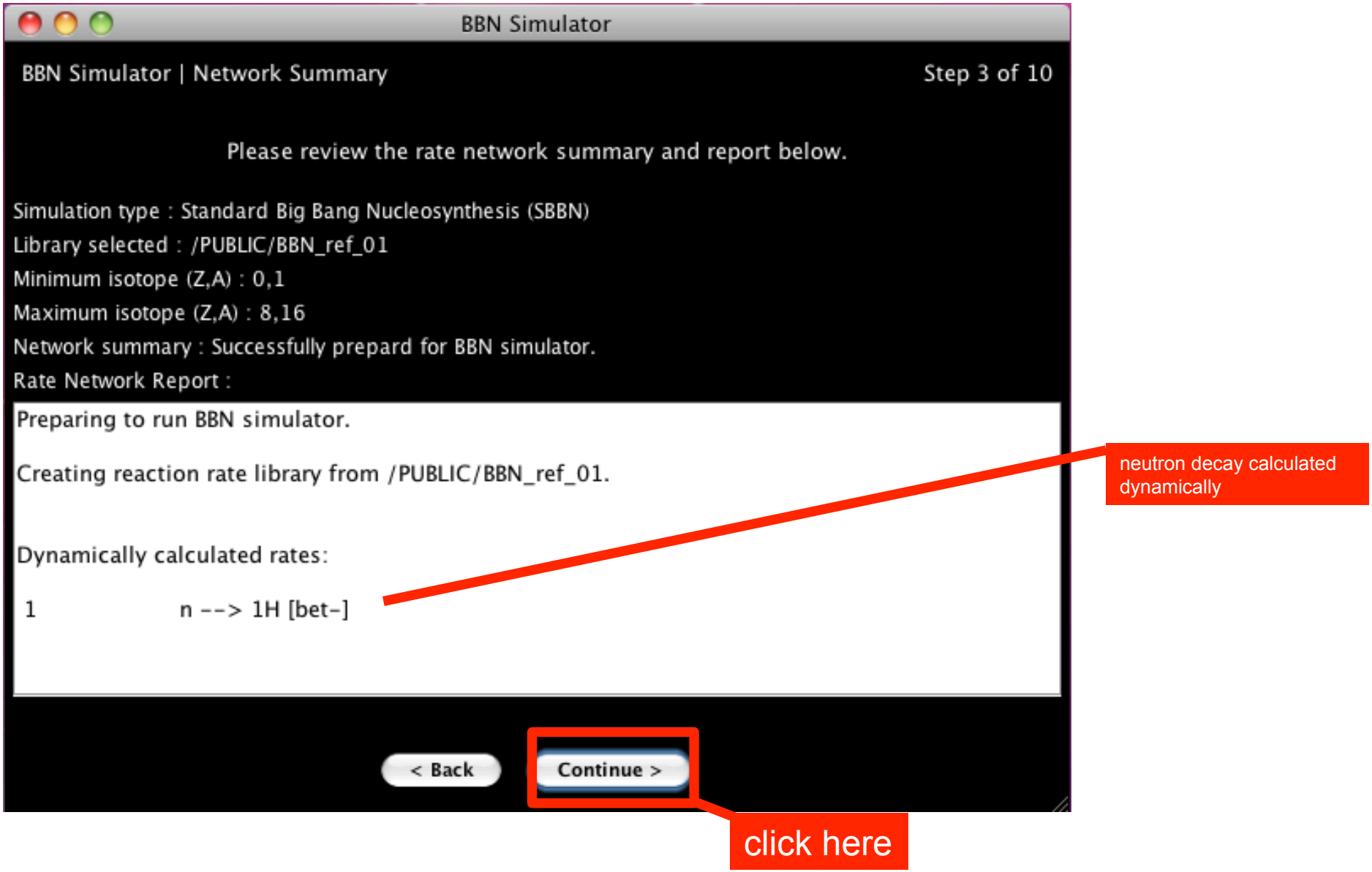


select here

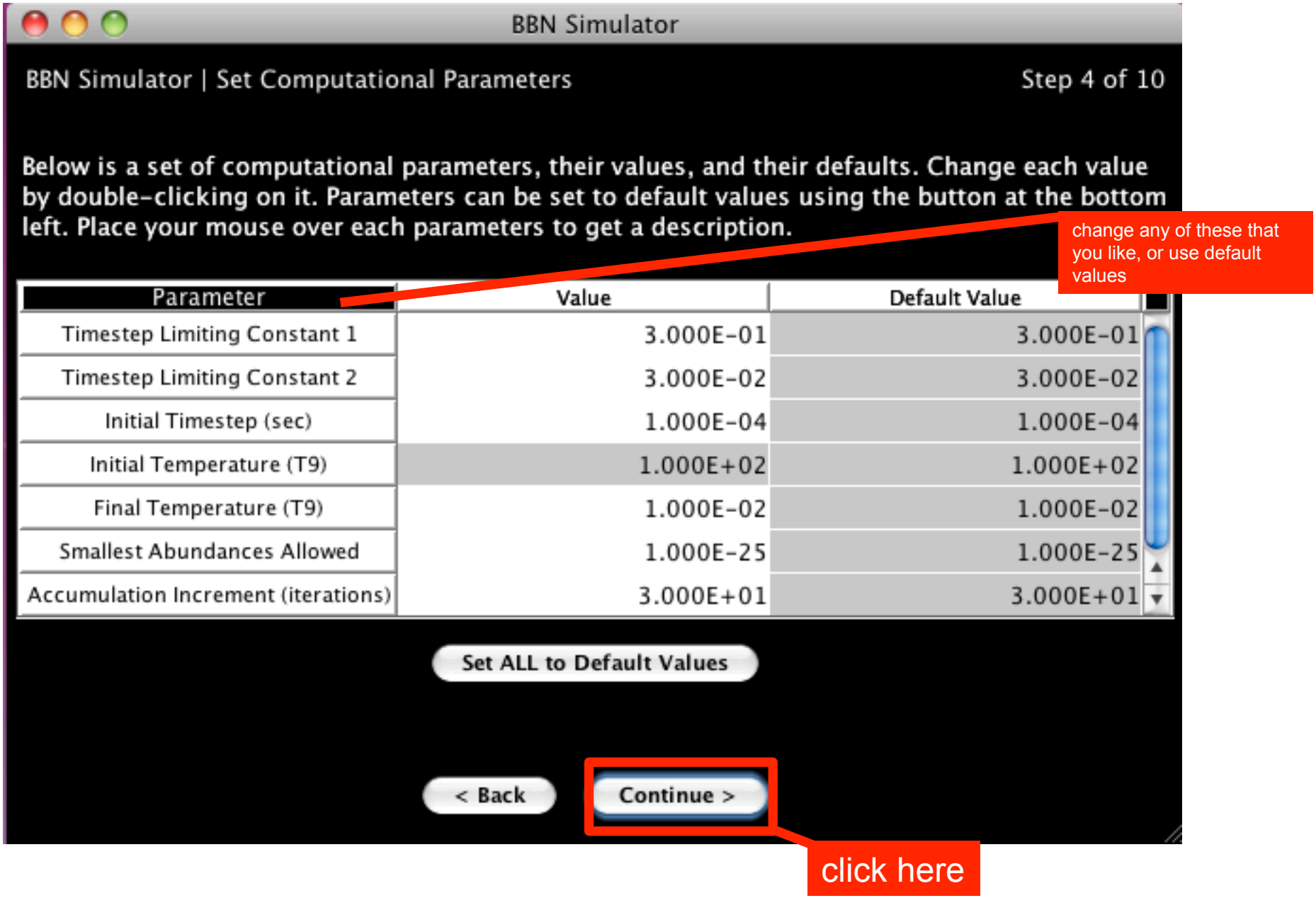
use a reference library or your own library of modified rates

click here

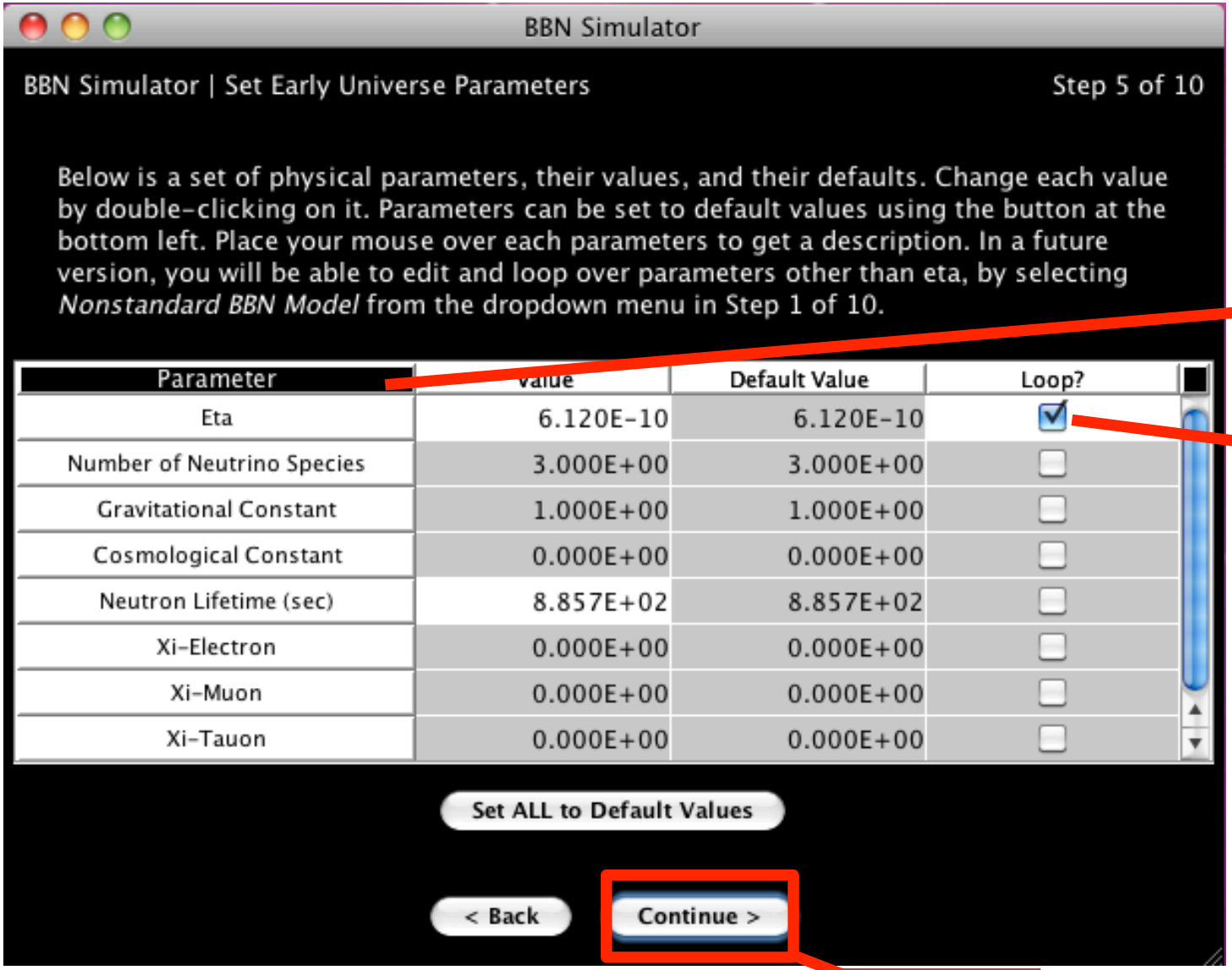
setting up a simulation – choose a library of rates



setting up a simulation – report on setup



setting up a simulation – change computational parameters

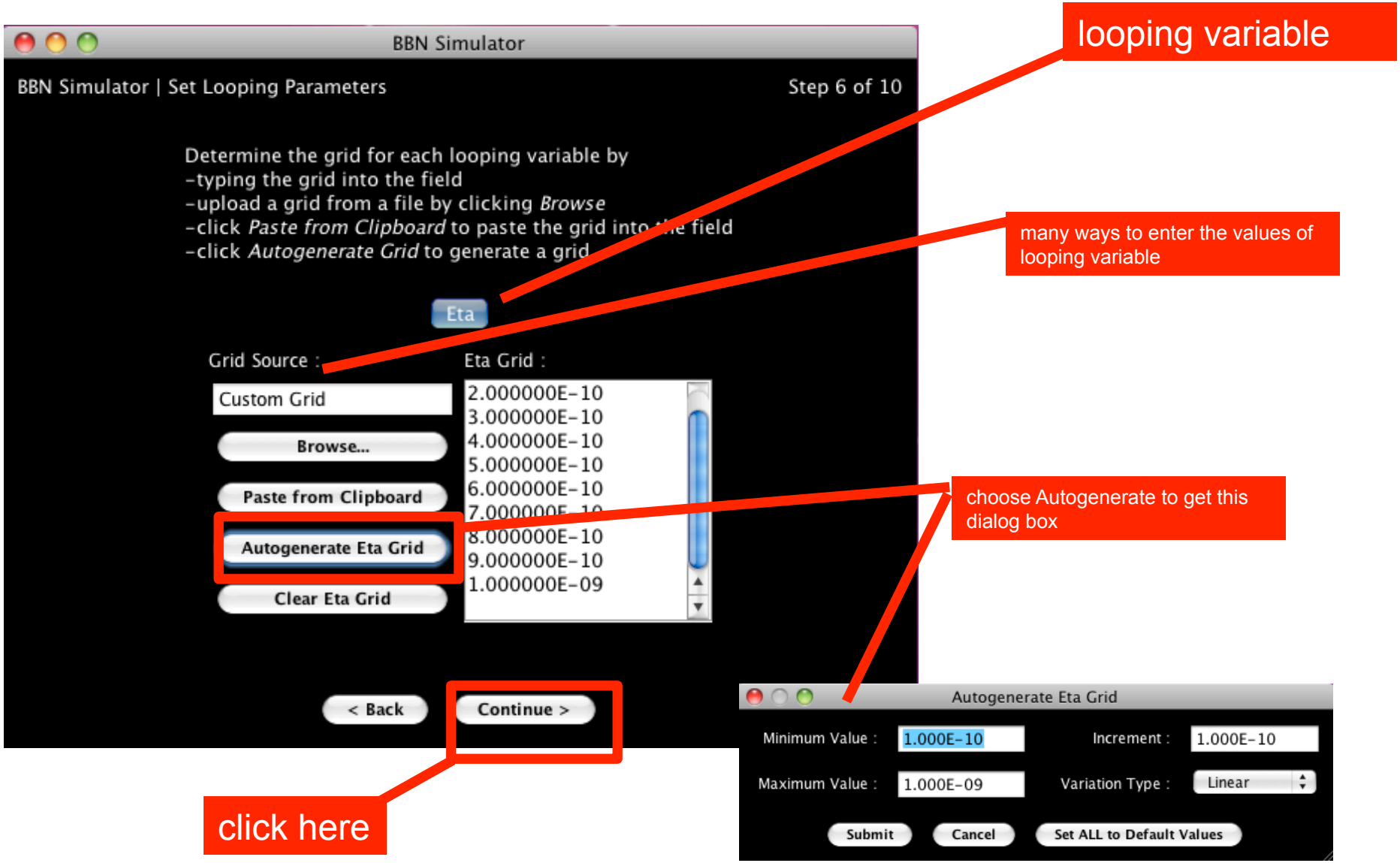


change baryon to photon ratio eta, or neutron lifetime, in standard BBN

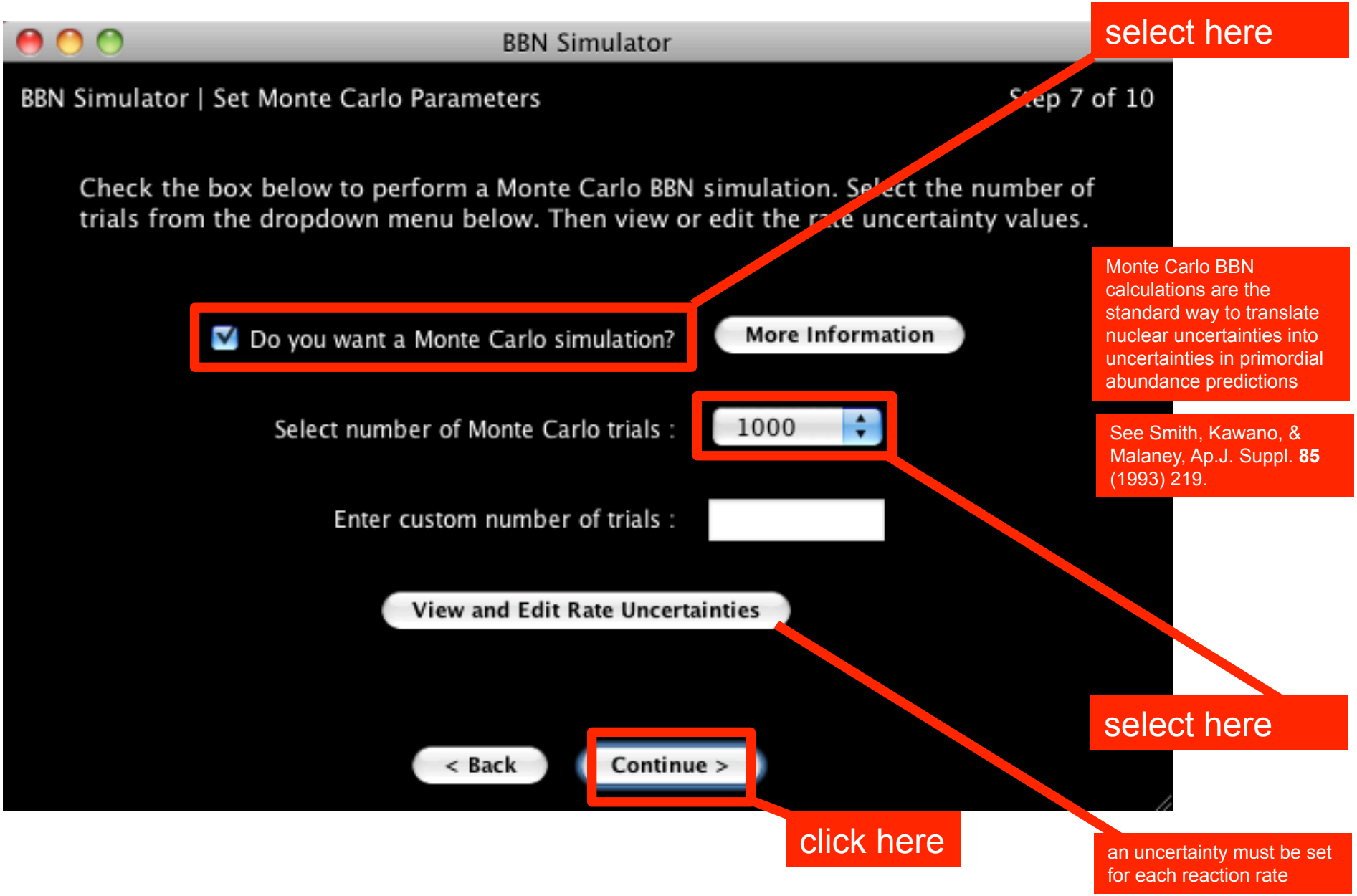
usually we loop over eta, the one free parameter in standard BBN

click here

setting up a simulation – change physical parameters



setting up a simulation – choose values of looping variable (eta)



select here

Monte Carlo BBN calculations are the standard way to translate nuclear uncertainties into uncertainties in primordial abundance predictions

See Smith, Kawano, & Malaney, Ap.J. Suppl. **85** (1993) 219.

select here

click here

an uncertainty must be set for each reaction rate

setting up a simulation – set up a Monte Carlo run

BBN Simulator

BBN Simulator | Review Simulation Selections

Step 8 of 10

Please review your selections in the report below. Click on the *goto and change* links to edit your selections. When you are satisfied with your selections click *Continue* to run the BBN simulation.

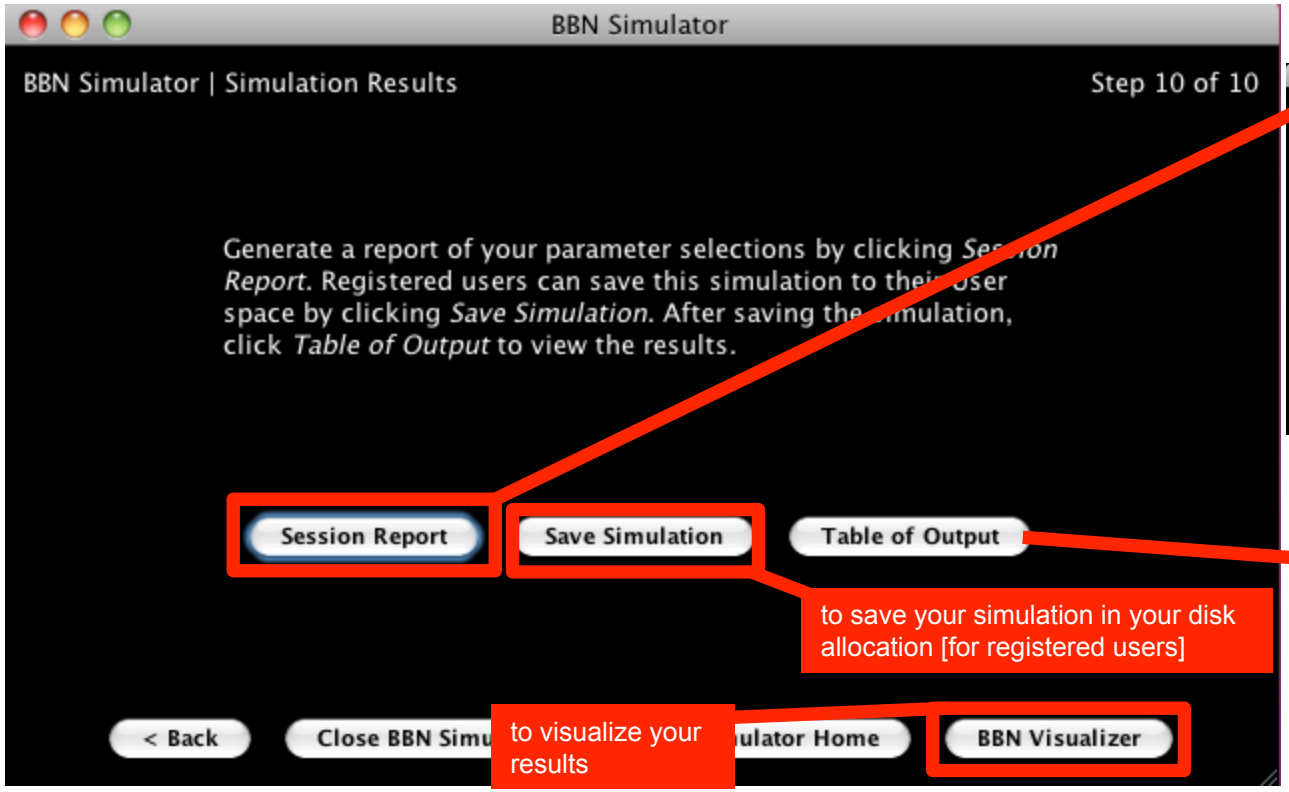
Simulation Type	Standard Big Bang Nucleosynthesis (SBBN)	goto Step 1 and change
Reaction Rate Library	/PUBLIC/BBN_ref_01	goto Step 2 and change
Computational Parameters		goto Step 4 and change
Parameter	Value	Default?
Timestep Limiting Constant 1	3.000E-01	yes
Timestep Limiting Constant 2	3.000E-02	yes
Initial Timestep (sec)	1.000E-04	yes
Initial Temperature (T9)	1.000E+02	yes
Final Temperature (T9)	1.000E-02	yes
Smallest Abundances Allowed	1.000E-25	yes
Accumulation Increment (iterations)	3.000E+01	yes
Early Universe Parameters		goto Step 5 and change
Parameter	Value	SBBN Default?
Eta	looped	
Number of Neutrino Species	3.000E+00	yes
Gravitational Constant (6.67E-8 $cm^3 g^{-1} s^{-2}$)	1.000E+00	yes

click here

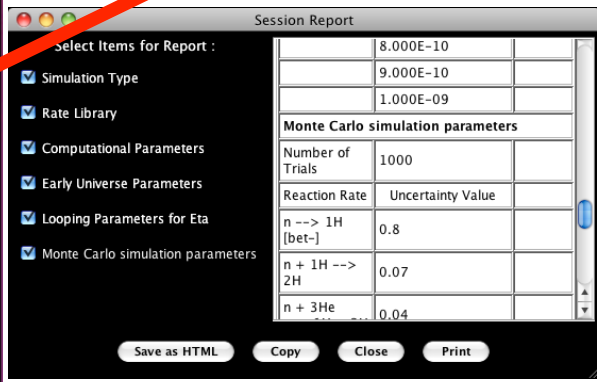
< Back Continue >

setting up a simulation – complete report before the run

setting up a simulation – status report of simulation



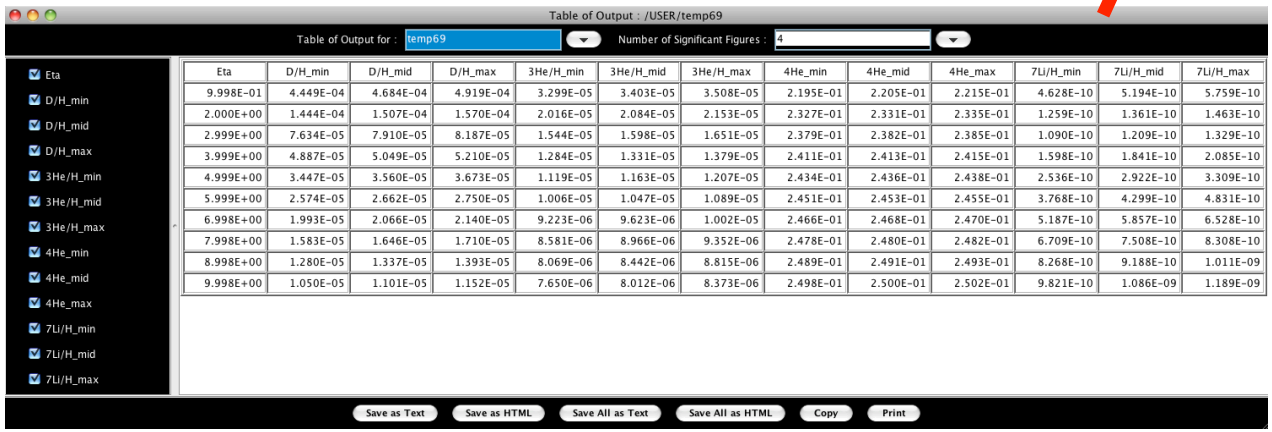
for a report



tabular output

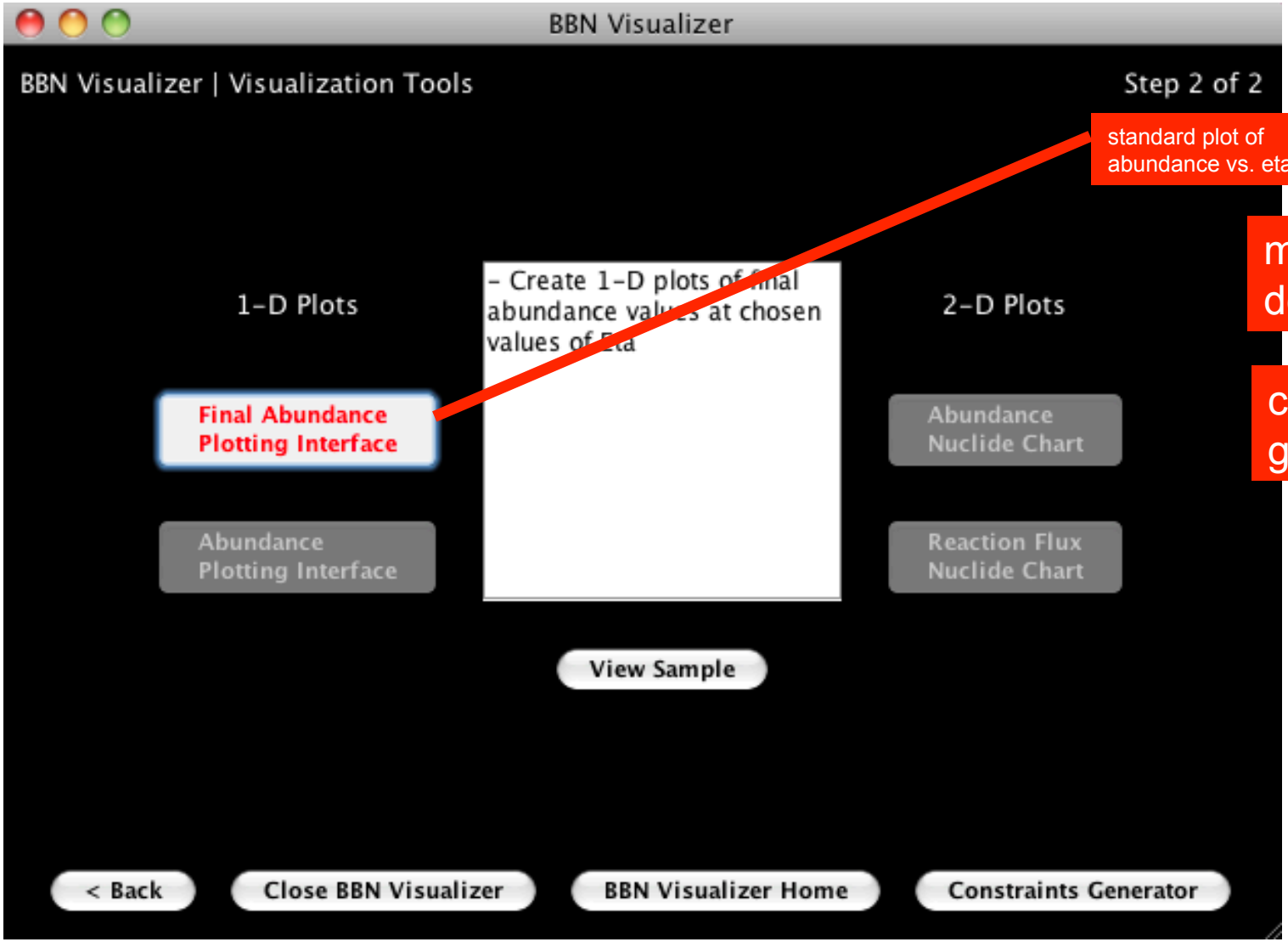
to save your simulation in your disk allocation [for registered users]

to visualize your results



Eta	D/H_min	D/H_mid	D/H_max	3He/H_min	3He/H_mid	3He/H_max	4He_min	4He_mid	4He_max	7Li/H_min	7Li/H_mid	7Li/H_max
9.998E-01	4.449E-04	4.684E-04	4.919E-04	3.299E-05	3.403E-05	3.508E-05	2.195E-01	2.205E-01	2.215E-01	4.628E-10	5.194E-10	5.759E-10
2.000E+00	1.444E-04	1.507E-04	1.570E-04	2.016E-05	2.084E-05	2.153E-05	2.327E-01	2.331E-01	2.335E-01	1.259E-10	1.361E-10	1.463E-10
2.999E+00	7.634E-05	7.910E-05	8.187E-05	1.544E-05	1.598E-05	1.651E-05	2.379E-01	2.382E-01	2.385E-01	1.090E-10	1.209E-10	1.329E-10
3.999E+00	4.887E-05	5.049E-05	5.210E-05	1.284E-05	1.331E-05	1.379E-05	2.411E-01	2.413E-01	2.415E-01	1.598E-10	1.841E-10	2.085E-10
4.999E+00	3.447E-05	3.560E-05	3.673E-05	1.119E-05	1.163E-05	1.207E-05	2.434E-01	2.436E-01	2.438E-01	2.536E-10	2.922E-10	3.309E-10
5.999E+00	2.574E-05	2.662E-05	2.750E-05	1.006E-05	1.047E-05	1.089E-05	2.451E-01	2.453E-01	2.455E-01	3.768E-10	4.299E-10	4.831E-10
6.998E+00	1.993E-05	2.066E-05	2.140E-05	9.223E-06	9.623E-06	1.002E-05	2.466E-01	2.468E-01	2.470E-01	5.187E-10	5.857E-10	6.528E-10
7.998E+00	1.583E-05	1.646E-05	1.710E-05	8.581E-06	8.966E-06	9.352E-06	2.478E-01	2.480E-01	2.482E-01	6.709E-10	7.508E-10	8.308E-10
8.998E+00	1.280E-05	1.337E-05	1.393E-05	8.069E-06	8.442E-06	8.815E-06	2.489E-01	2.491E-01	2.493E-01	8.268E-10	9.188E-10	1.011E-09
9.998E+00	1.050E-05	1.101E-05	1.152E-05	7.650E-06	8.012E-06	8.373E-06	2.498E-01	2.500E-01	2.502E-01	9.821E-10	1.086E-09	1.189E-09

setting up a simulation – save it, view results, visualize it …

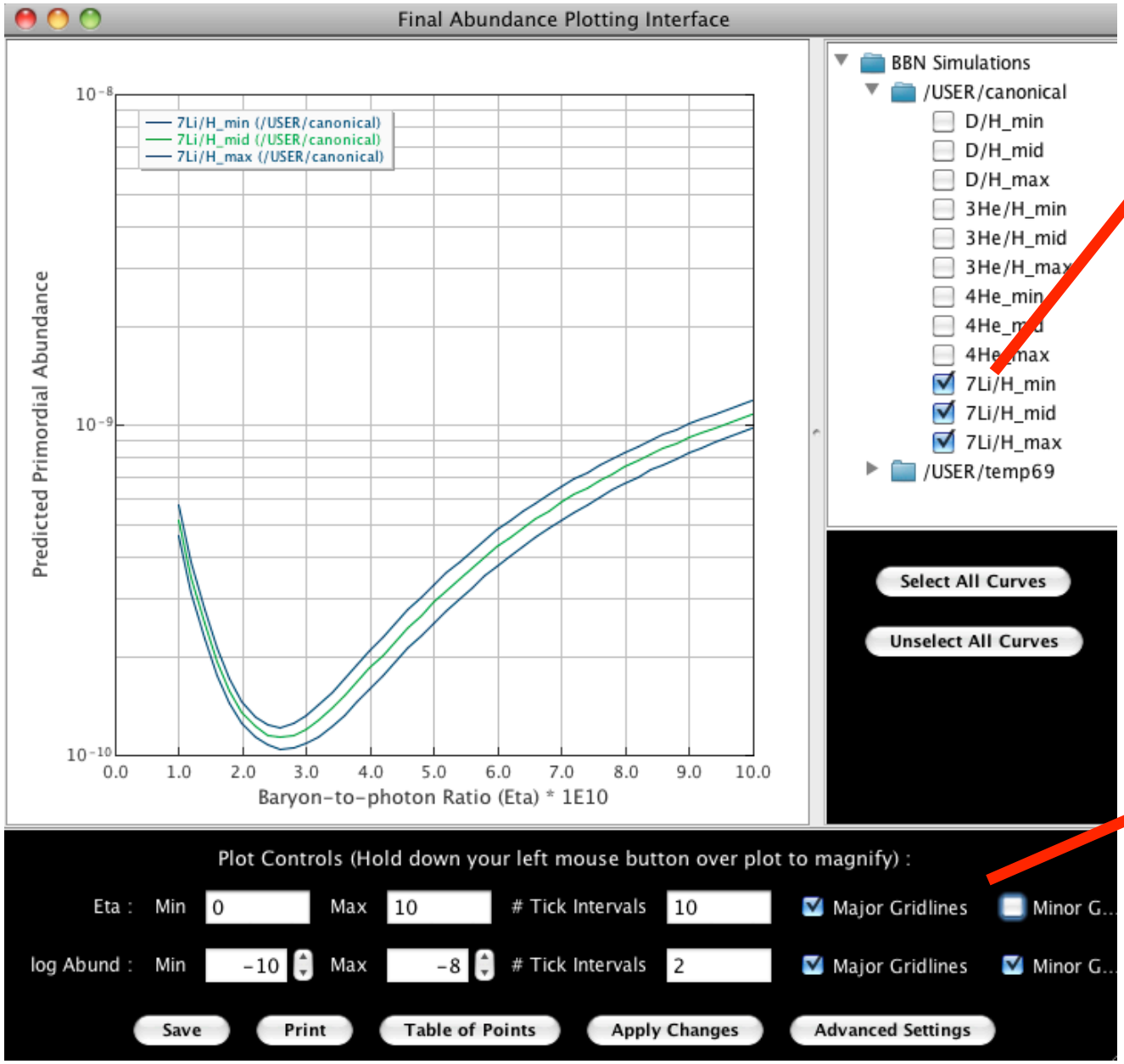


standard plot of abundance vs. eta

mouse over for description

click to generate plot

visualizing up a simulation

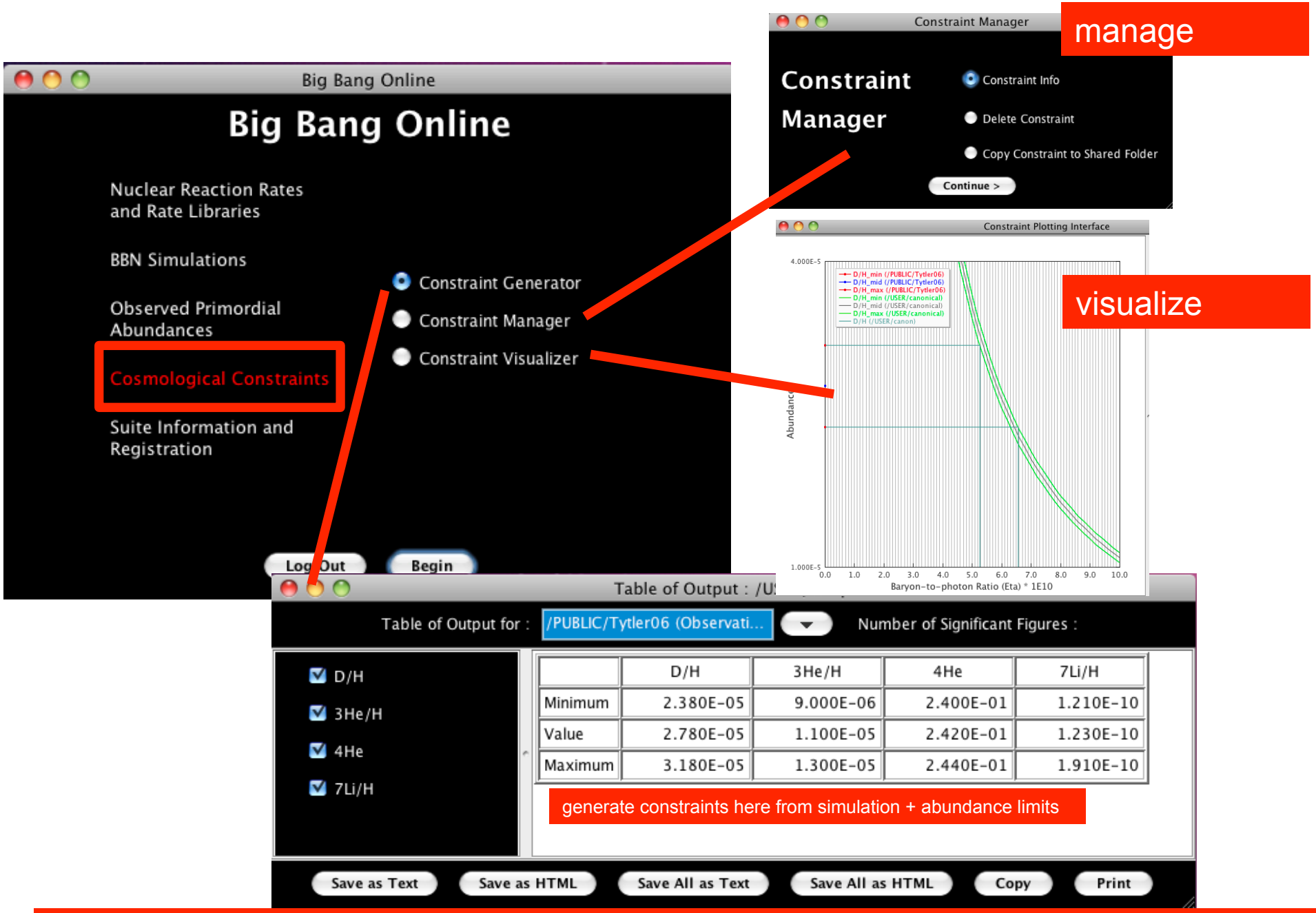


select here

minimum, middle, and maximum values from the Monte Carlo runs

adjust here

visualizing up a simulation



	D/H	3He/H	4He	7Li/H
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Value	2.780E-05	1.100E-05	2.420E-01	1.230E-10
Maximum	3.180E-05	1.300E-05	2.440E-01	1.910E-10

generate constraints here from simulation + abundance limits

generate constraints from abundance predictions & observations

BIG BANG ONLINE

Online BBN Software

First suite of online computer codes to enable ANYONE interested in cosmology to explore the details of big bang element synthesis for themselves

Increase Accuracy and Productivity -

ANYONE can quickly perform these calculations

Consensus Building -

exchange comments on comparisons of parameter constraints

Community Building -

file sharing & comments aid research & mentoring

Questions ? write to coordinator@bigbangonline.org