

Simulation of stellar explosions and stellar nucleosynthesis

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LIP Summer Internship



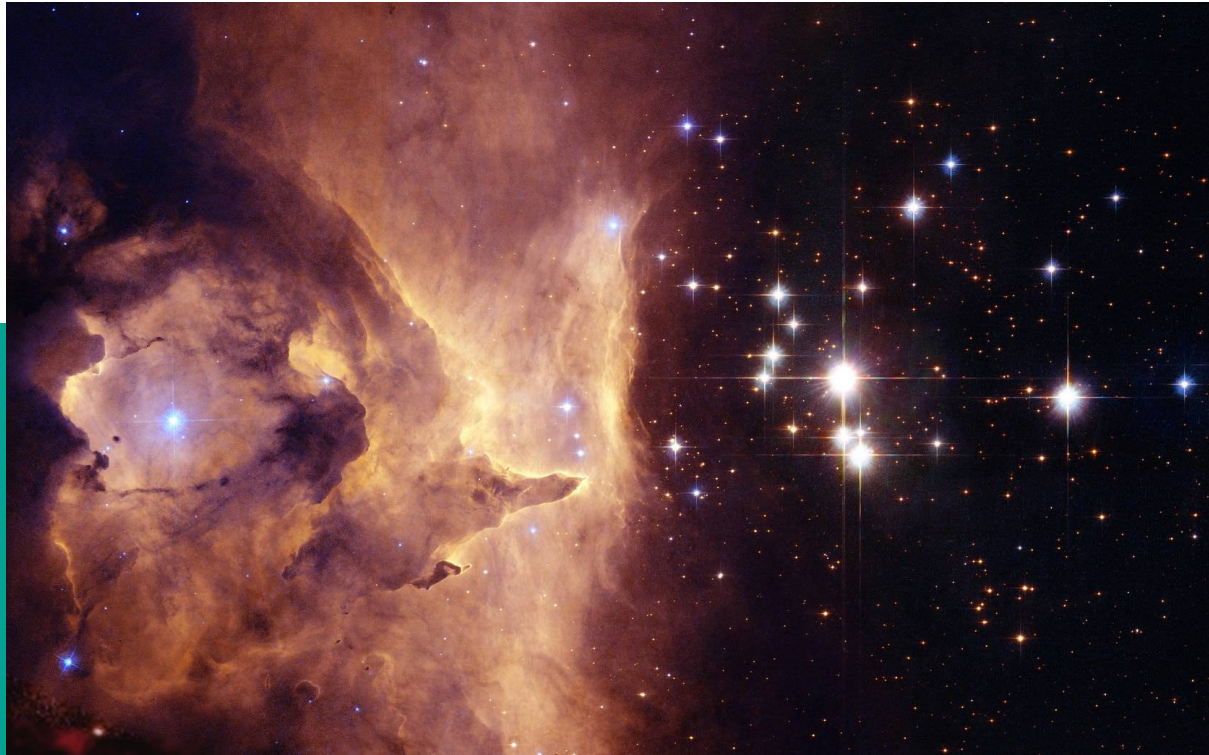
Ciências
ULisboa

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Motivation



Small open star cluster Pismis 24, in the core of the NGC 6357 nebula in Scorpius

NucNet Tools - What it is

```
#####
# PAULI Login Service
# CentOS 7.9 x86_64
# helpdesk@lip.pt
#
#
#
# Auto logout after 12 hours
# with no activity
#
#-----#
# NOTICE:
#   NVidia Quadro K2200 available on this host
#
#   Computing power availability:  #nodes: 63
#                               #cores: 696
#-----#
#
# WIKI:
#   https://wiki-lip.lip.pt/Computing/LIP\_Lisbon\_Farm
#-----#
#####
```

LIP terminal



Programing Languages
of NucNet Tolls



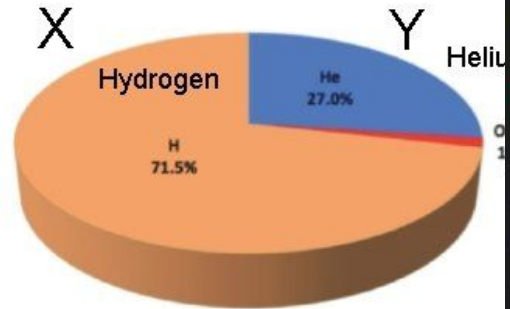
Prof. Bradley S. Meyer

NucNet Tools

NucNet Tools

- Data Pub
- Remaining folders
- Examples

Zones



Solar chemical composition
Protosolar bulk abundances by mass
Asplund et al. 2009, ARAA, 47, 481

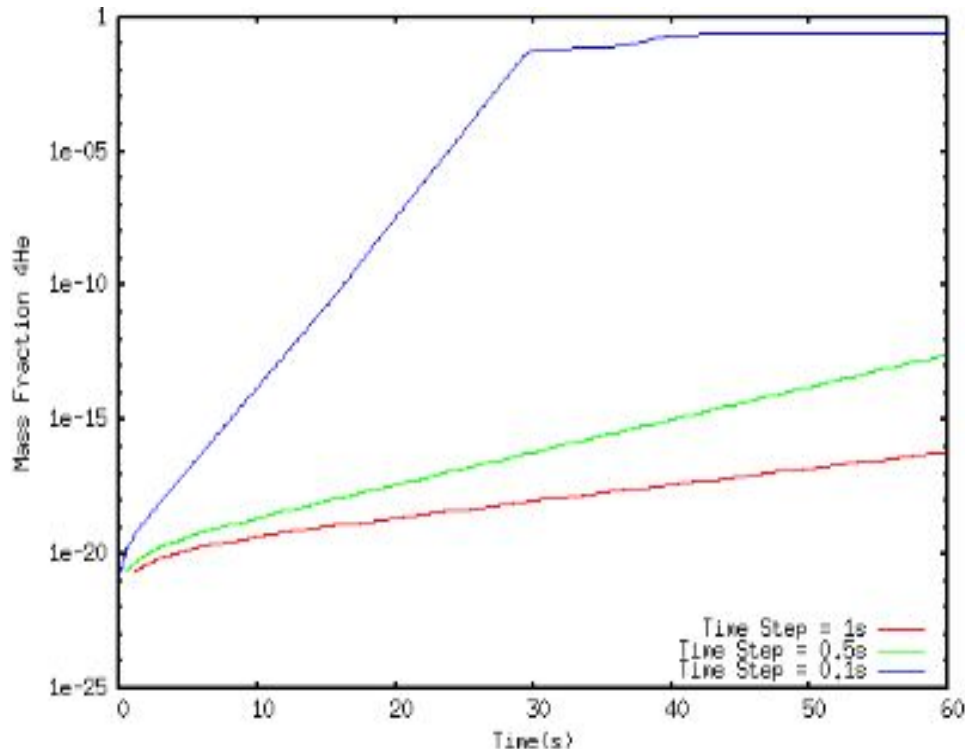
```
<nuclear_data>
<!--n-->
<nuclide>
```

```
run_constant_entropy.cpp
run_energy_generation.cpp
run_entropy.cpp
run_multiple_zone_omp.cpp
run_single_zone
run_single_zone.cpp
s10^10mf0_t10^11.xml
s10^10mf2_t10^18_gif.txt
s10^10mf2_t4610^17_gif.txt
s10^11mf2_t46^17_gif.txt
s10^13mf2_t10^18_gif.txt
s10^13mf2_t10^18.xml
s10^13mf2_t46^17_gif.txt
s10^13mf2_t46^17.xml
s10^15mf2_t10^18_gif.txt
s10^15mf2_t10^18.xml
s10^15mf2_t46^17_gif.txt
s10^15mf2_t46^17.xml
s10^2mf2_t10^6.xml
s10^4mf2_t10^6.xml
```

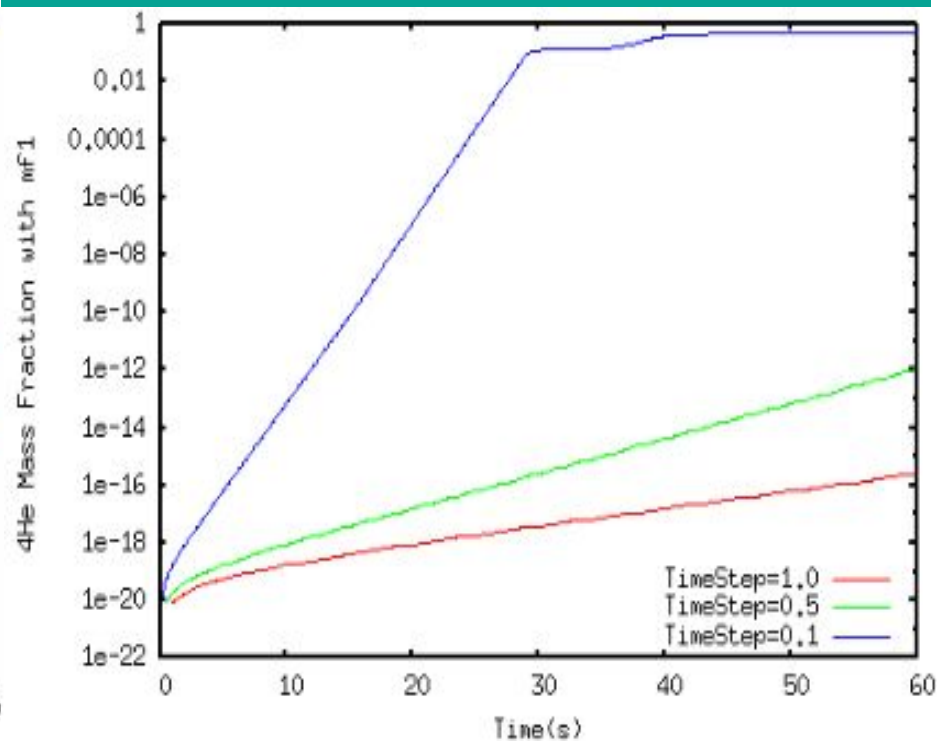
Time Step



Evolution of the mass fraction of ^4He with initial mass fractions of...

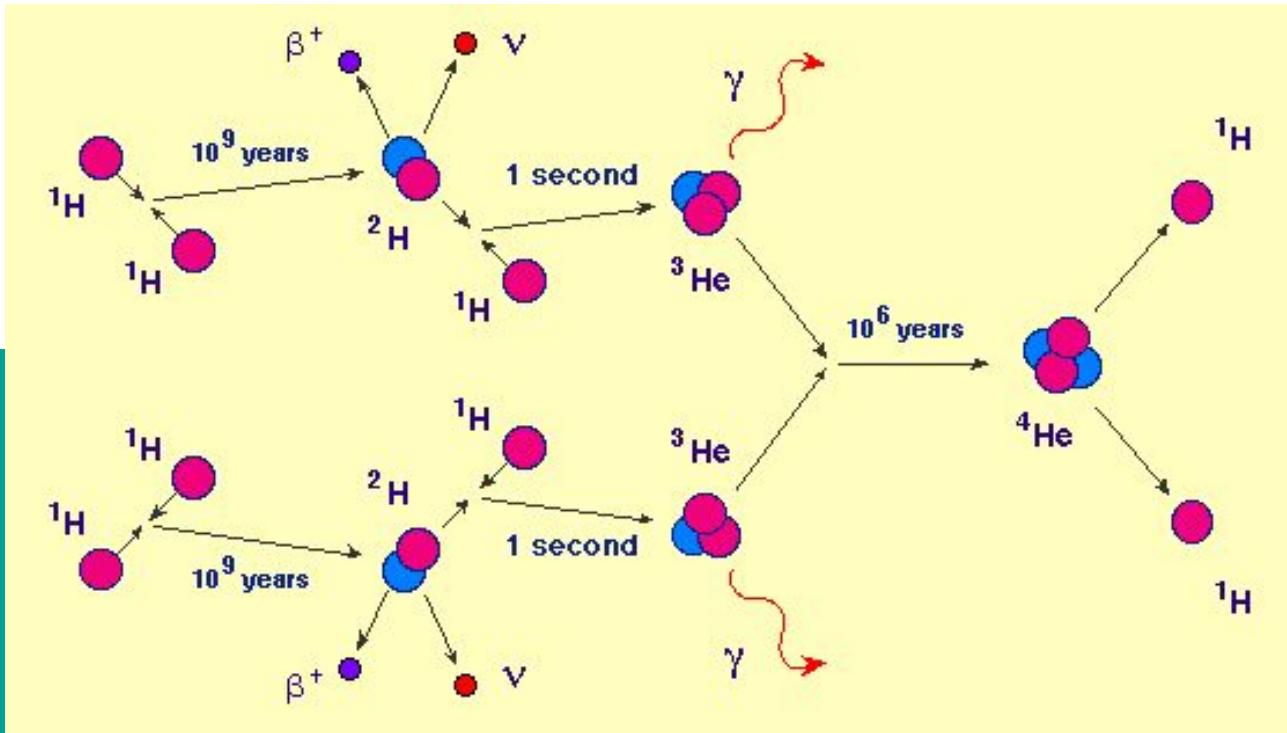


... ^1H 0.75, ^2H 0.2 and ^3He 0.05



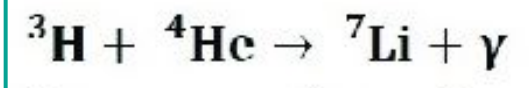
... ^1H 0.5, ^2H 0.4 and ^3He 0.1

pp chain

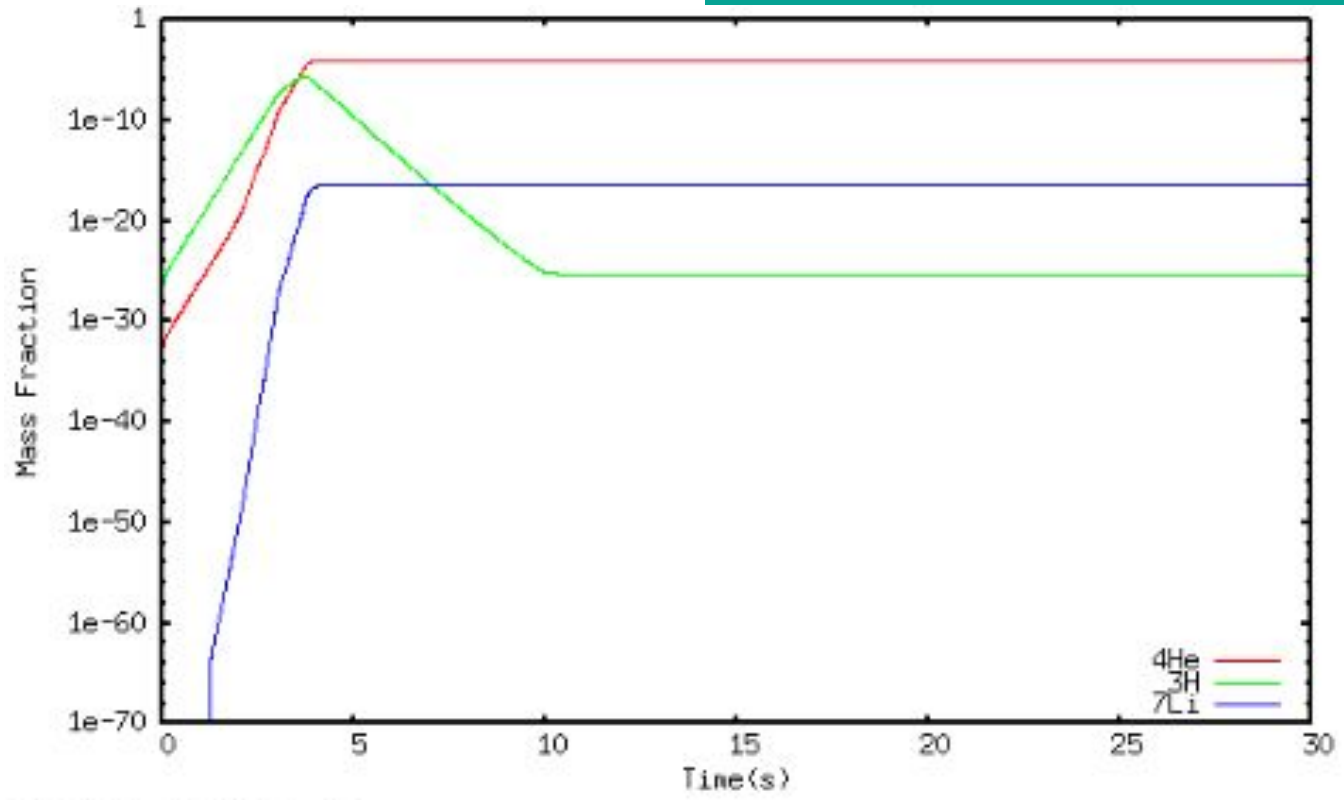


Main branch of the proton-proton chain

Little ^4He

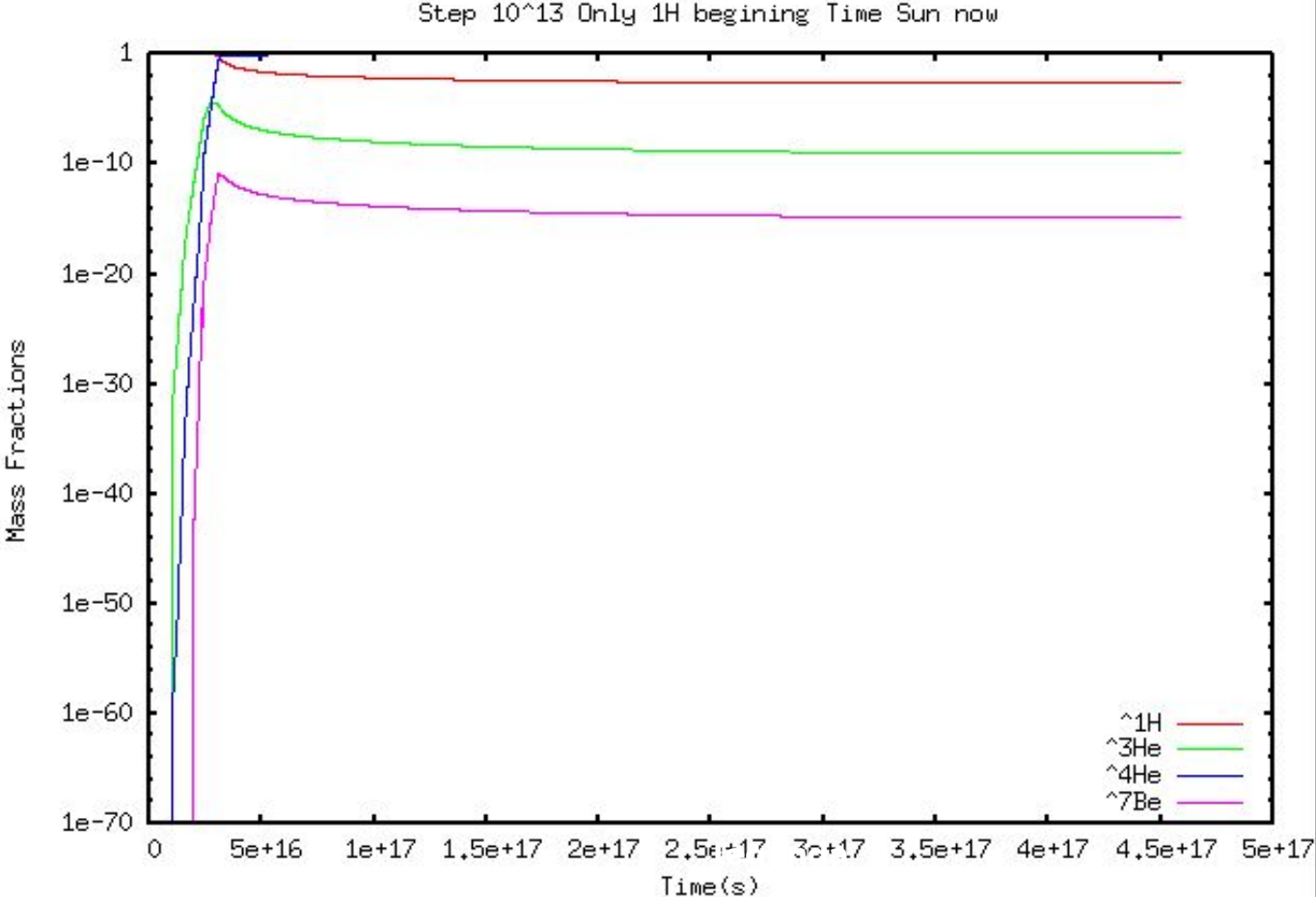


Nuclear Reaction with ^4He .



Graphic with total time 30s, time step 0.01s, and initial mass fractions calculated in the sun but with 0% of ^4He .

Sun Simulations

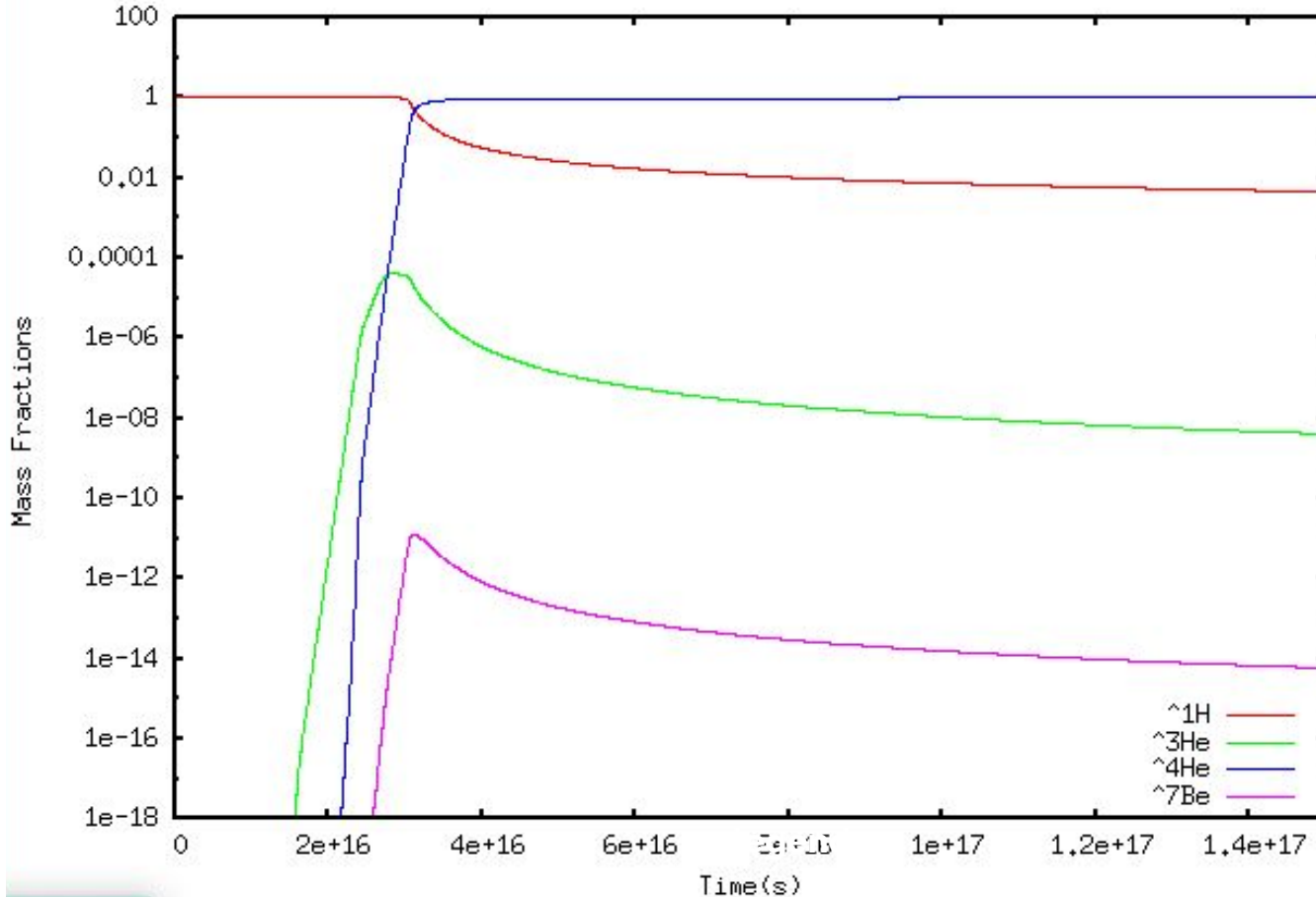


Graphic with total time 4.6×10^{17} time step 10^{13} and initial mass Fraction 100% ^1H .

Sun Simulations

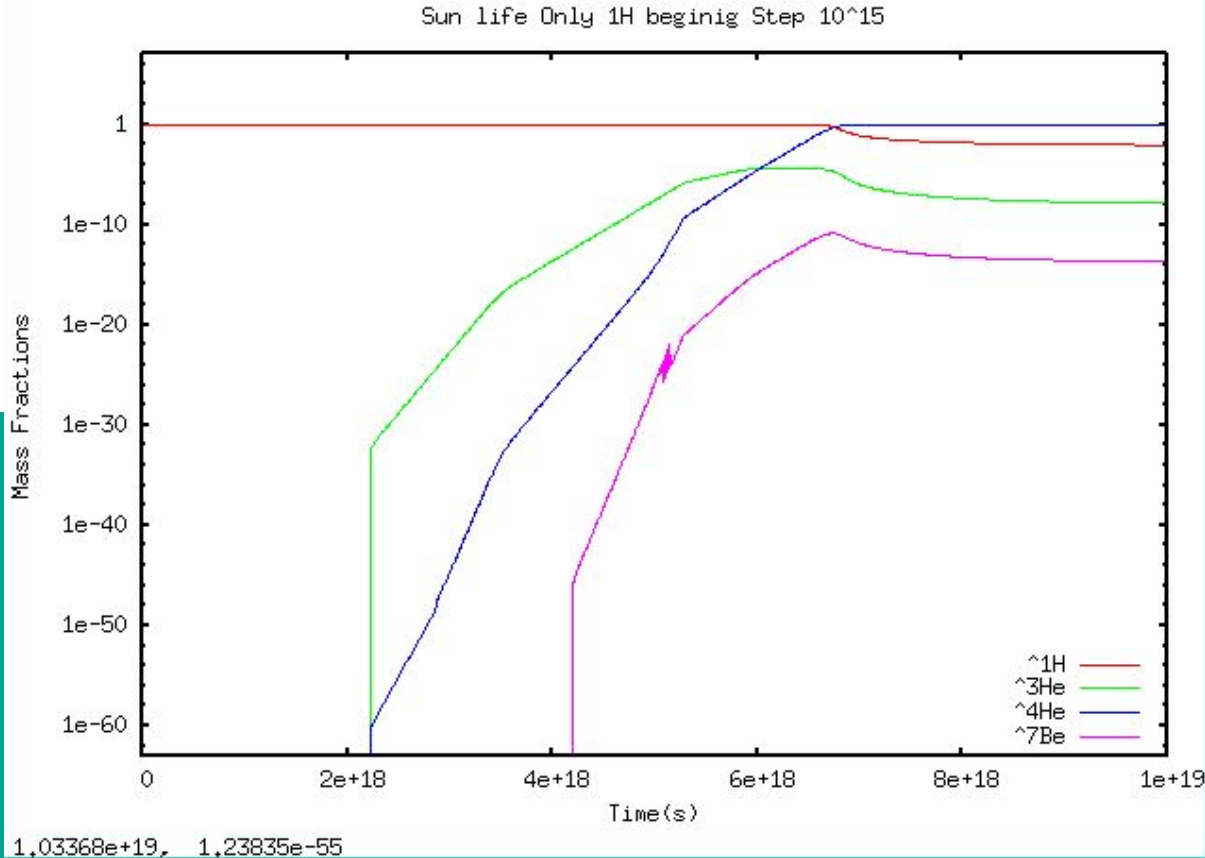


Zoomed Step 10^{13} Only 1H beginning Time Sun now



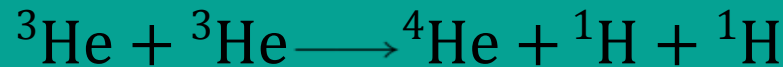
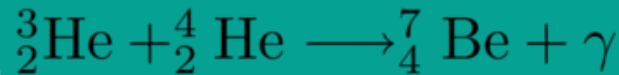
Zoomed graphic with total time 4.6×10^{17} time step 10^{13} and initial mass Fraction 100% ^1H .

Sun Simulations

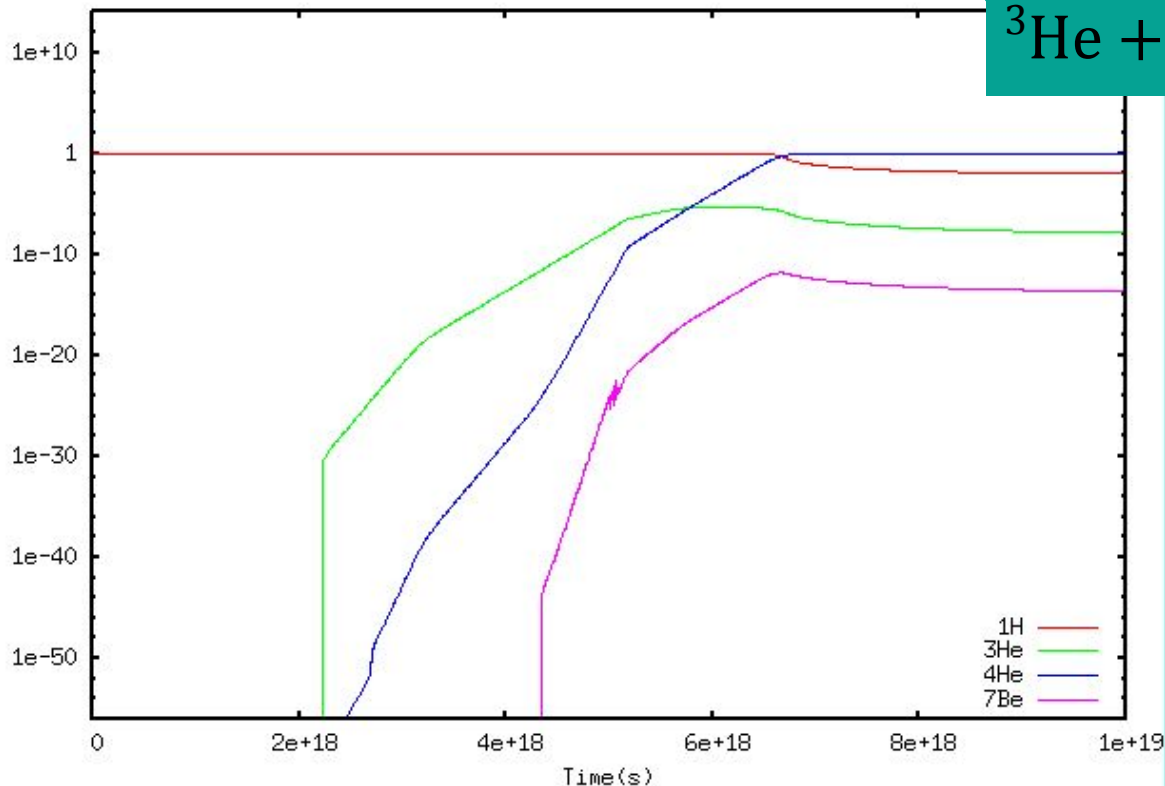


Graphic with total time 10^{19} time step 10^{15} and initial mass Fraction 100% ^1H .

Reaction Rates

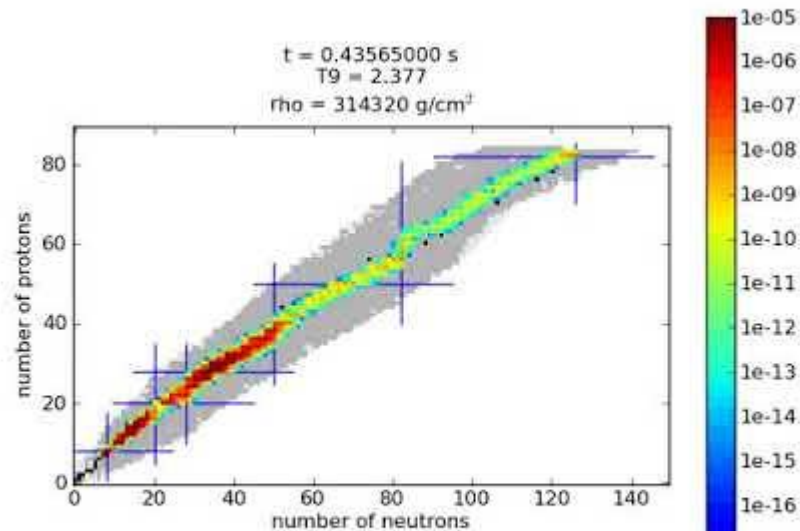


100Rate Sun life Only 1H beginig Step 10¹⁵



*2
 Reaction *10
 Rates *50
 *100

Future Work



Illustrative Video of Mass Fraction Heatmap



Obrigada! Thank you!

Questions?

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open cluster NGC 290

Webgrafia

- <https://slideplayer.com/slide/12908644/>
- <https://sourceforge.net/projects/nucnet-tools/>
- <https://www.youtube.com/watch?v=TMogiOCtepl>
-

Images

- <https://developers.redhat.com/blog/2020/06/02/the-joys-and-perils-of-c-and-c-aliasing-part-1>
- <https://www.britannica.com/science/star-astronomy>
- <http://www.pas.rochester.edu/~blackman/ast104/ppchain.html>
- <https://scholar.harvard.edu/michaelfoley/primordial-nucleosynthesis>
- https://www.researchgate.net/figure/Comparison-between-SBBN-predictions-and-observations_tbl1_326061989
- https://www.nasa.gov/multimedia/imagegallery/image-feature_1818.html
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