Supernova Environmental Impacts
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Heavy Elements Produced in Supernova Explosion and thier Propulsion in the ISM

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Abstract. We study the r-process path at temperatures from $1.0 - 3.0 \times 10^9$K and neutron number density from 10^{20}-10^{30} cm^{-3}. At low density of 10^{20} cm^{-3} and $T_9 = 2.0$, the path contains all the elements as given by experimental data of Wapstra *et al.* (2003). The element $_{98}Cf^{254}$ shown by supernova light curves is found in our results. We take iron (Z = 26) as seed for calculation of abundances for supernova.

Keywords. r-process, light curves, abundances

Supernova Explosion

Due to successive fusion, once the inner core is converted to iron/nickel, no more energy is available from the fusion process and the inner core collapses catastrophically to form a neutron star or black hole. In the resulting explosion, the outer layers of the star are blown out into space with a velocity of upto $15,000$ km s^{-1}. Here the r-process nucleosynthesis takes place producing the heavy elements as shown. The enormous amount of energy released in a supernova explosion has major effects on the interstellar medium.

Under the assumption that in a steady state the abundances of elements in the neutron capture path are proportional to β^- decay lifetimes, the computed abundances of all the r-process elements are compared with observed universal abundances taken from Lodders (2003) for different values of Q_n i.e. different T_9 and n_n.

Results

• Peaks at A $\simeq$ 80 and A $\simeq$ 130 are well produced; which corresponds to isotones N = 50 and N = 82, the neutron magic numbers (Z = 28,29,30 and Z = 47,48,49,50). A peak at A $\simeq$ 195 is seen, quite in agreement with the observed data.

Table 1. Chemical elements at the r-process site

Element	T_9 (10^9 **K**)	n_n (cm^{-3})
$_{56}Ba^{137}$	2.5	10^{20}
$_{82}Pb^{207}$	2.5	10^{22}
$_{92}U^{236}$	3.0	10^{22}
$_{98}Cf^{254}$	1.9	10^{20}
For double magic nuclei		
$_{28}Ni^{78}{}_{50}$	1.0	10^{20}
	1.1	10^{22}
	1.2	10^{24}
	1.4	10^{26}
	2.0	10^{28}
$_{50}Sn^{132}{}_{82}$	1.7	10^{20}
	1.9	10^{22}

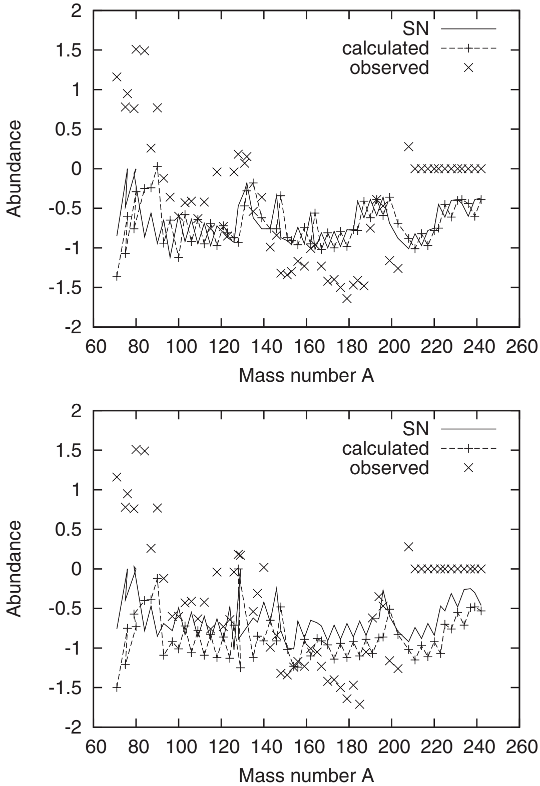

Figure 1. Global r-abundance curve, with waiting point and steady flow approximation at (a) $T_9 = 1.98$ and $n_n = 1.28 \times 10^{26} cm^3$; (b) $T_9 = 1.6$ and $n_n = 1.25 \times 10^{24} cm^3$

- A small peak at A $\simeq$ 210 is noticed; which may be proposed as due to neutron magic isotones N = 126 (Z = 79,80,81,82,83,84,85,86). A peak at A $\simeq$ 235 is observed; which is beyond the scope of discussion as not much nuclear data is available beyond A > 209. We want to propose that this peak is justified considering the fact that U^{235} is a stable element found in nature.

Discussion

In the calculation, we note an element of mass 273 as a termination element of an r-process path, corresponding to atomic number 115. Experimentally some new elements were synthesized at the Lawrence Berkley laboratory e.g. element with Z = 116, 118 etc. As the high density conditions do not show much of the experimentally observed elements, we propose that the heavy elements produced during extreme conditions of SN explosion instantly undergo photodisintegration. In the later expansion stages, they were distributed all over the universe.

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