Nuclear Physics I: Nuclear Astrophysics
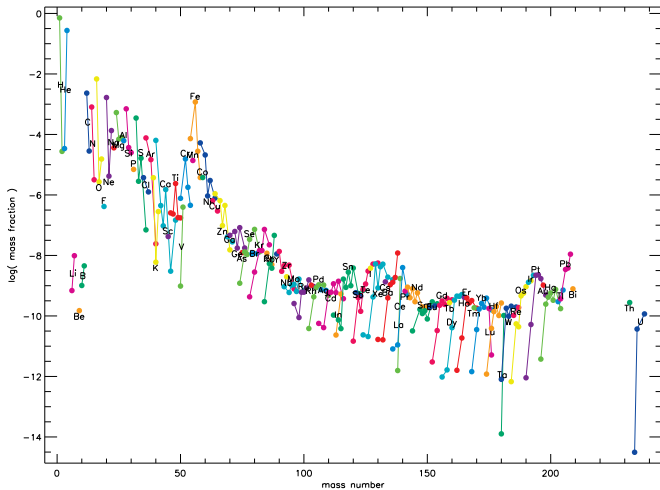## PHYS 8801

Alexander Heger[1]

[1]Minnesota Institute for Astrophysics
School of Physics and Astronomy
University of Minnesota
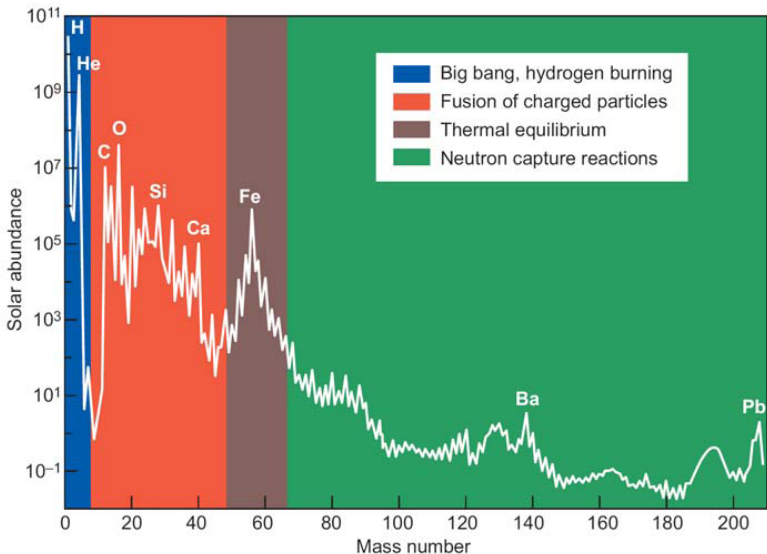
Nuclear Physics I: Nuclear Astrophysics, Spring 2012

Agenda

The Origin of the Elements

The Origin of the Elements

Burning stages in a 20 M$_\odot$ Star

Fuel	Main Product	Secondary Product	T (10^9 K)	Time (yr)	Main Reaction
H	He	^{14}N	0.02	10^7	4 H $\rightarrow$ ^{4}He (CNO)
He	O, C	^{18}O, ^{22}Ne s-process	0.2	10^6	3 He^4 $\rightarrow$ ^{12}C ^{12}C$(\alpha,\gamma)^{16}$O
C	Ne, Mg	Na	0.8	10^3	^{12}C + ^{12}C
Ne	O, Mg	Al, P	1.5	3	^{20}Ne$(\gamma,\alpha)^{16}$O ^{20}Ne$(\alpha,\gamma)^{24}$Mg
O	Si, S	Cl, Ar, K, Ca	2.0	0.8	^{16}O + ^{16}O
Si, S	Fe	Ti, V, Cr, Mn, Co, Ni	3.5	0.02	^{28}Si(γ,α)…

Explosive Nucleosynthesis in a 20 $M_\odot$ Star

Fuel	Main Product	Secondary Product	T (10^9 K)	Time (s)	Main Reaction
Innermost ejecta	r-process νp-process	-	>10?	1	(n,γ), β^-
Si, O	^{56}Ni	iron group	>4	0.1	(α,γ)
O	Si, S	Cl, Ar, K, Ca	3 - 4	1	^{16}O + ^{16}O
O, Ne	O, Mg, Ne	Na, Al, P	2 - 3	5	(γ,α)
		p-process ^{11}B, ^{19}F, ^{138}La, ^{180}Ta	2 - 3	5	(γ,n)
		ν-process		5	(ν, ν'), (ν, e$^-$)