Homework 3 GCE 2025, IAG-USP. Deadline: April 17, 2025

1. As discussed in the class, there has been about 10^8 SN Ia in the Milky Way, for which you can adopt a total stellar mass of 2×10^{11} solar masses (and assume that 75% of that mass is due to hydrogen).

Use the yields below to compute the mass fraction of O, Mg, Si, S, Ar, Ca, Fe and Ni. For iron, add the yields from ^{54}Fe and ^{56}Fe. For the SN II yields, you do not need to use a mass function. Simply adopt as the representative yields of a SN II, the average yield of the SN based on 13 and 40 solar masses. Estimate what is the ratio *r* of the number of SN II to SNIa, that best reproduce the solar mass fractions of the above elements. Make a plot, showing in the vertical axis the log of the ratio between your computed mass fractions (for your best value of "*r*") and the observed solar mass fractions, meaning, $\log_{10} (X_i^{computed}/X_i^{Sun})$. In the horizontal axis plot the atomic number.

1) What *r* gives the best overall fit?
2) What *r* is required to reproduce the observed iron mass ratio in the Sun?
3) What *r* is required to reproduce the observed oxygen mass ratio in the Sun?

	SN Ia yields (Maciel´s book)	SN II yields (Nomoto et al. 1997, Nuclear Physics A 616, 79)	
Isotope	M ($M_\odot$)	M = 13 $M_\odot$	M = 40 $M_\odot$
^{16}O	0.00	0.15	9.11
^{24}Mg	0.09	0.009	0.35
^{28}Si	0.16	0.07	0.43
^{32}S	0.08	0.015	0.18
^{36}Ar	0.02	0.002	0.03
^{40}Ca	0.04	0.002	0.025
^{54}Fe	0.14	0.002	0.009
^{56}Fe	0.61	0.15	0.075
^{58}Ni	0.06	0.006	0.003