Nucleosynthesis: modelling of the sun

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Background and Methodology:

Nuclear astrophysics bridges the gap between nuclear structure and astrophysics, here you will be working on the interface between astrophysics and nuclear astrophysics. Stellar models exist in various formats. In this project you will create an astrophysical stellar model to output the abundances of isotopes within our sun.

The simulations can be made in whichever coding language that you see as most appropriate. You will need to consider each of the most abundant isotopes and consider their most dominant reaction pathways. These selected reaction rates should be based upon literature values, extracted from peer-reviewed journal articles or reliable textbook sources. An example of a useful textbook for nuclear astrophysics is "Nuclear physics of stars" [1].

The decision on the exact format of the modelling should be made as the project progresses. Considering the complex nature of a stellar environment the choice of which details are most important to include are yours to make, it is certainly not expected that every effect is considered.

Suggested outputs:

This project will involve detailed literature searches and modelling. You should create a theoretical abundance model of the stellar environment within our sun considering the nuclear physics behind formation mechanisms. The output should ideally be a map of isotope density with a time period to be defined by the group – there is scope for discussion here.

1) Literature search should include:
    a. Careful consideration of current stellar composition
    b. Extraction of the reaction rates or cross-sections for key reaction pathways
    c. Consideration of effective simulation techniques.
2) The simulation could contain:
    a. An output isotropic density plot
    b. The key reaction mechanisms for the most abundant isotopes
    c. An output of energy emission
    d. The following processes:
        i. P-p chains
        ii. Triple alpha process
        iii. A choice of key alpha capture reactions (if applicable)
        iv. Consideration of how the heavier elements are formed

↳ run on past data ?

Initial suggested literature

[1] Iliadis, C. (2015). *Nuclear physics of stars*. John Wiley & Sons.