# Isotopes Tell Sun's Origin and Operation

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Measurements of isotope abundances and masses offer these conclusions on the Sun. **Abundances:** The Sun and its planets formed out of highly radioactive, poorly mixed debris of a supernova that exploded 5 Gy ago. This conclusion is based on measurements of a) the decay products of actinide elements ($^{235,238}U$, $^{244}Pu$) [1] and short-lived isotopes in meteorites and in the Earth [2,3], b) residual excesses in meteorites of stable isotopes made by the α-, r-, p- and s-processes of stellar nucleosynthesis [4], c) excess $^{16}O$ [5] and excess $^{136}Xe$ [6] in the Sun itself, and d) linked chemical and isotopic heterogeneities preserved in meteorites and planets [4]. Measurements on 22 atoms in the solar wind [7] and 72 s-products in the photosphere [8] show that the Sun acts as a huge plasma diffuser that selectively moves lightweight elements and isotopes of each element to its surface. Iron is the most abundant element in the Sun, in rocky planets and in ordinary meteorites. **Masses:** Fusion cannot be the main source of luminosity in the Sun and Sun-like stars. The most abundant isotope of iron, $^{56}Fe$, has tightly bound nucleons, and abundances of other elements in the Sun correlate with nuclear stability [9]. The discovery of rocky planets orbiting pulsar, PSR 1257+12 [10], and systematic properties in the rest masses of the 2,850 known nuclides [11] suggest that neutron repulsion drives solar luminosity, solar mass separation, solar neutrinos, and the H-rich solar wind leaving the surface of an Fe-rich object that formed on the collapsed core of a supernova [12]:

- Neutron emission from the solar core: $\langle n \rangle \rightarrow n + 10\text{-}22$ MeV
- Neutron decay: $n \rightarrow H^+ + e^- + \text{anti-}\nu + 0.782$ MeV
- $H^+$ upward migration and fusion: $4\ {}_1^1H^+ + 2\ e^- \rightarrow {}_2^4He^{++} + 2\ \nu + 27$ MeV
- $H^+$ that reaches the surface: $2.7 \times 10^{43}\ H^+/yr \rightarrow$ Departs in the solar wind

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