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AN IRON-RICH SUN AND ITS SOURCE OF ENERGY*

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"Make more, more, and yet more measurements." Data from this personal motto of Francis William Aston [1] form the basis for this conclusion that the Sun is Iron-rich and Hydrogen-fusion is not its primary source of energy [2]. In 1913 Aston [3] reported evidence of isotopes by showing that the atomic weight of Neon was lighter after diffusing through the walls of pipe clay. Neon and Xenon of light atomic weight were found in lunar samples returned by the Apollo mission in 1969 [4]. In 1983 [2] it was finally realized that the lighter mass (L) isotopes of He, Ne, Ar, Kr, and Xe implanted in the surfaces of lunar samples by the solar wind are all enriched relative to the heavier mass (H) isotopes by a common fractionation factor (***f***), where

$$\boldsymbol{f} = (H/L)^{4.56}$$

When this fractionation power law is applied to the abundance pattern of elements in the photosphere, the most abundant elements in the interior of the Sun turn out to be the same, even-numbered elements that William D. Harkins found in 1917 [5] to comprise 99% of the material in ordinary meteorites - - - Fe, Ni, O, Si, S, Mg and Ca. The probability (P) that this agreement is fortuitous is essentially zero, $P < 0.0000000000000000000000000000002$.

In the 1920's Aston developed the mass spectrograph, analyzing all but three stable elements in the periodic table and expressing his results as nuclear packing fraction (*npf*). These data yielded information on nuclear stability, thermonuclear energy, and an insight into the synthesis of elements. They showed, for example, that nucleons are too tightly bound in Fe, Ni, O, Si, S, Mg and Ca to generate solar luminosity by fusion. Later, in 1936 Aston visited Japan to view a solar eclipse and lecture at the Imperial University of Tokyo. A 19-year old student in the audience became interested in nuclear and solar studies, later moved to the US, and used the decay products of U, Th and extinct ^{244}Pu to show that these were made in a supernova ≈ 5 Ga ago, at the birth of the solar system [6].

Modern values of Aston's *npf* [7] reveal a likely source for luminosity in the iron-rich Sun. At each value of A>1, the parabola defined by plotting values of *npf* against values of Z/A yields an intercept value of *npf* at Z/A = 0 that is significantly higher than the *npf* of the free neutron [8]. Thus, spontaneous neutron-emission from the collapsed supernova core on which the Sun formed may trigger a series of reactions that produce solar luminosity and an outflow of neutrinos and H^+ ions from the solar surface [8].

H^+ ions, the neutron decay product made near the core of the Sun, move upward acting as a carrier gas that maintains solar mass separation. Similarity in the abundance pattern of non-volatile elements in the photosphere and in carbonaceous meteorites [9] suggests fractionation in the parent star that gave birth to the solar system, perhaps caused by an H^+ carrier gas arising from a neutron star at its core too. If so, the Big Bang likely compressed large units of matter unto giant nuclei that acted as centers on which galaxies or first generation stars formed.

In keeping with Aston's motto, the conclusions of this paper are based on experimental measurements of precise mass data for about 2,850 known nuclides [7] and thousands of analyses of elements and stable isotopes in the Earth, Sun, Moon, Mars, Jupiter, meteorites, the solar wind and solar flares [10].

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