On internal heat production in exo-planets, fission triggered stars, etc.!

Herndon makes a hypothesis about the internal heat production of hot exo-planets[1]. He had earlier suggested planetary scale nuclear fission reactors[2] as their energy source! He now also suggests that thermonuclear fusion reactions in the sun and stars are first triggered by nuclear fission chain reactions, like in the case of the H-bomb! It is surprising that there is no estimate of the various parameters, like the amounts of fissionable isotopes present, the energy produced in the reactions, etc. Ideas such as these are highly misleading, completely contrary to astronomical observations and are easily falsifiable!

First of all, the fission bomb which triggers thermonuclear reactions (in an H-bomb) is made of pure fissionable isotopes like ^{235}U, which are very rare and have to be separated as everyone knows with a lot of technological effort, to produce a critical mass of tens of kilograms. The other isotopes like that of plutonium are unstable and do not occur in nature and are synthesized in terrestrial reactors on earth!

Again ^{235}U has a lifetime of $\sim 7 \times 10^8$ years, an order of magnitude less than the non-fissionable isotope ^{238}U and that is the reason why it is only 0.3% abundant of the heavier isotope ^{238}U.

What happens in the Oklo phenomenon[3–5] is that the proportion of ^{235}U being higher (in natural rocks) two or three billion years ago, there was a slow nuclear reaction in the rocks, leaving remnants of the fission reactions (like the isotope of Samarium). These were essentially low power natural reactors which ceased long ago. It is incorrect (as an explanation of this) to suggest that in stars, fission reactions trigger the fusion reactions in hydrogen.

One of the remarkable results in astronomical spectroscopy (and related analysis) is that the relative abundance of the various elements is more or less the same everywhere (within an order of magnitude). Thus, elements like gold or uranium occur in only one part in a hundred billion (as compared to hydrogen) in the sun, for example. These heavy elements are indeed difficult to detect in stellar spectra, etc. Thus even if uranium were to be concentrated in the core of the sun, there would be hardly 10^8 kg of it present.

Of course there would be no way of having only pure uranium at the sun's core. Hydrogen and helium (which together constitute 98% of the sun's composition) would be present along with the uranium. So, the neutrons produced in each fission process would far more likely be absorbed by protons to form deuterium and there would be no chain reaction to perpetuate the fission among uranium nuclei! This is very easily calculated. There just cannot be a rapid fission reaction to trigger the solar H-bomb.

Besides, now that the solar neutrinos have all been observed, this shows the conventionally accepted chain of nuclear fusion reactions is the correct one. Incidentally, the 10^8 kg of uranium, even if concentrated in the core and even if it undergoes complete fission, can barely provide a total energy of $\sim 10^{29}$ Joules, hardly sufficient to supply the sun's observed luminosity for a few minutes!

Not only are fissionable isotopes very rare (one part in 10^{11} compared to hydrogen) but they also release an order of magnitude less energy than nuclear fusion! One can also calculate that this much of fission energy can hardly heat the rest of the hydrogen core to the required fifteen million degrees to trigger the fusion reaction.

Similar arguments also apply to the exo-planets. In fact, some years ago claims that cold fusion (of heavy hydrogen) can provide the excess heat radiated by Jupiter was decisively demolished[6].

Herndon has also invoked nuclear fission everywhere, from jets in galaxies (powered by fission!) to dark matter in galactic halos which he proposes are dark stars not yet triggered by fission!

To sustain a single extra galactic jet of $\sim 10^{53}$ Joules (by fission power) would require more uranium than is present in the whole universe! Again the halo dark matter cannot be in the form of dark stars (whatever they are!) as there would be far more micro-lensing events than have been detected.

Indeed, if there were widespread ejection of fissionable elements (from galactic centres and so on) the spectroscopic signatures for such elements would have been far stronger.

While understanding that there are many unresolved issues in astrophysics, the hypothesis of Herndon is clearly untenable.

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