Does the new neutrino model ignore helioseismic data and imply a billion-year age for the Sun?

I am concerned that the paper by Robert Newton entitled. *'Missing' neutrinos found! No longer an 'age' indicator*[1] has not properly addressed all the relevant evidence. Specifically, he made no mention of current knowledge of helioseismology and whether these models support the concept of a hydrogen burning core for the Sun. Details of helioseismology and it implication for a young Sun have been summarized in the paper *Evidences for a young Sun.*[2] I am not aware of any 'hard' helioseismology data that overturns the material contained in this 1996 report.

For Robert Newton's position on solar neutrinos to be valid, the Sun requires a hydrogen burning core at a temperature of some 15.7×10^6 K. The core temperature can be measured theoretically via helioseismology, the speed of sound profile from the surface to the core. It seems to me that there is a conflict between the new solar neutrino data neutrino model and the helioseismology data, which does not support the existence of a hydrogen burning core at 15.7×10^6 K. This does not appear to have been addressed. I would be very careful before accepting this new solar neutrino model as having solved the missing neutrino problem.

As mentioned, this new neutrino model means a hydrogen burning core at 15.7×10^6 K. Does it also mean that we need to accept the Faint Young Sun Paradox, which is a direct consequence of these evolutionary models of the Sun? Robert Newton suggests not, claiming that new solar neutrino model does not indicate the Sun is 4.5 billion years old. However, stellar evolutionists do not understand the models like this. For the Sun to be young (i.e. created some 6,000 years ago) and possess a 15.7×10^6 K core temperature, we need to propose a serious change in physical law during the 4th day of Creation Week—a supernatural act similar to that needed to explain the numerous white dwarfs in the Milky Way Galaxy.

For example, it may be suggested that the Sun was created in a state of equilibrium. That is, on the 4th day of Creation week, the Sun was created instantly with a hydrogen burning core at 15.7×10^6 K, the temperature necessary for the fusion reactions to proceed. However, there is a problem for the Sun/Earth system with such Sun that is only 6,000 years old.

The luminosity of the Sun today is about 3.86×10^{33} erg s^{-1}. The new solar neutrino model means that this luminosity is 100% fusion powered. *Question:* How long would it take for fusion energy in the core to reach the surface and generate a luminosity of 3.86×10^{33} erg s^{-1}? My sources suggest it would take 10^5–10^7 years. So this will not work for a 6,000-year-old Sun. Stellar evolutionary models for the core of the Sun imply a billion-year-old star.

Does Robert Newton acknowledge these implications of the new neutrino model, which he proposes has solved the missing neutrino problem?

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Courtesy NASA

Robert Newton replies:

The conclusion of my neutrino article[3] is that the former deficit of neutrinos should not be used as evidence that the Sun is not powered entirely by fusion. The reason is simple; there is no longer any deficit of neutrinos. Neutrino evidence is consistent with a Sun that is powered entirely by fusion, and inconsistent with a Sun that is partially powered by gravitational collapse. While both a gravitational-collapse-powered Sun and a fusion-powered Sun are compatible with the Biblical timescale, only the latter is consistent with current evidence.

A simple order-of-magnitude estimate from basic physics can establish that the solar core should indeed be hot enough to sustain fusion.[3] This has been reported in the creationist literature.[4] Moreover, solar neutrinos can be produced only by fusion, and we have been able to detect at least some of these neutrinos for several decades now. So it has long been known that at least some solar fusion does occur. A solar model that is entirely powered by fusion is currently the best fit to the available evidence.

Rod Bernitt asks if helioseismological evidence is consistent with these results. It is possible to determine the internal sound speed of the Sun at multiple depths by measuring the Sun's internal sound waves (called p-modes). The p-modes can be detected directly by the Doppler shift they create when they reach the solar surface. Some of these observed p-modes penetrate into the deep solar interior—to within 5% (by radius) of the Sun's center.[5] By observing p-modes for a long period of time as they are readily visible on the solar disk, it is possible to mathematically reconstruct the sound speed as a function of radius—and thus temperature which goes as the square of sound speed.[6] We can therefore determine the temperature profile of the Sun as a function of radius to great depth. Helioseismology has become quite advanced recently due to the high-precision data made possible by the SOHO[7] spacecraft and the ground-based GONG[8] project.

The measured temperature profile of the Sun as deduced from helioseismology is consistent with the ~15 million Kelvin core temperature required for a Sun that is entirely powered by fusion. The expected and measured temperature profiles agree to within 1% over the entire range of measurements.[9,10] So, as with the neutrino evidence, helioseismology strongly supports a Sun that is entirely fusion-powered since the p-mode observations confirm the near-core temperature.

It is also noteworthy that the neutrinos themselves are indicative of the core temperature of the Sun. Solar neutrinos are produced by a variety of nuclear fusion processes—each with its own temperature dependence. The flux of ^{8}B solar neutrinos is proportional to the ~24th power of temperature.[11] Since the SNO detects these ^{8}B neutrinos at the expected rate,[12] the core temperature of the Sun must be well constrained.

Rod Bernitt also asks about the Faint Young Sun paradox. This paradox (for evolutionists) asks how the Earth could be so warm in the distant past if the Sun was less luminous at that time. In a fusion-powered star, the composition of the core gradually changes as hydrogen is converted to helium. There is very little change on a 6,000-year timescale, but the composition changes drastically on a billions-of-years timescale. Stellar evolutionists propose that stars respond to this gradual change in core composition by becoming more luminous over billions of years—and I agree that this would be the natural result of the physics if a star were to exist that long. From an evolutionary perspective, the Sun would have been about 25% fainter 3.8 billion years ago—hence the paradox. But the effect is negligible on a 6,000-year timescale. So, this paradox is unaffected by the latest neutrino evidence. The Faint Young Sun paradox is still a valid argument against a solar system billions of years old.[13] It's an example of how the evolutionists' own assumptions lead to contradictions. It is not a problem for a 6,000-year-old hydrogen-burning star.

The energy diffusion timescale for the Sun, however, does exceed six thousand years. Calculations show that energy produced in the core of the Sun today should take more than six thousand years to diffuse to the solar surface. Does this demonstrate that the Sun is older than 6,000 years, or is not powered by fusion? Not at all. Apparently, energy being released from the photosphere today was never produced by fusion, but is energy that has come from a subsurface layer—created on Day 4 of the Creation Week. God created the Sun in a stable state with an energy and temperature profile similar to those of today. The solar photosphere is constantly emitting its energy into space by thermal radiation, and would quickly cool—except this energy is replenished by energy from a hotter layer beneath the surface. This underlying layer obtains its energy from a still hotter, deeper layer, and so on to the core, which obtains energy directly from fusion.

So, the primary purpose of fusion is *stability*. Energy produced by fusion precisely matches energy released from the surface so that the internal temperature profile of the Sun remains constant. The fusion energy flux balances the force of gravity and maintains the stable temperature profile. Energy produced by fusion is not directly responsible for heating the solar photosphere today (because there has not been enough time) though it would eventually serve that purpose if the Sun were allowed to continue far enough into the future. So, a 6,000-year-old hydrogen-burning star does not require any unusual physics during the Creation Week. A fusion-powered Sun is perfectly consistent with the Biblical timescale, and with the available evidence.

References

1. Newton, R., 'Missing' neutrinos found! No longer an 'age' indicator, *TJ* **16**(3):123–125, 2002
2. Davies, K., Evidences for a young Sun, Impact No. 276, ICR 1996. (Available at <www.icr.org>, 10 February 2003.)
3. Hansen and Kawaler, *Stellar Interiors: Physical Principles, Structure, and Evolution,* Springer-Verlag, New York, pp. 16–20, 1994.
4. DeYoung and Rush, Is the Sun an age indicator? *CRSQ* **26**(2):49–53, 1989.
5. Bahcall, Basu, and Pinsonneault, How uncertain are solar neutrino predictions? *Physics Letters B*, **433:**1–8, 1998.
6. The Sun also has g-modes. If these modes were easily observable, they would provide an even better estimate of the core temperature than p-modes. Unfortunately, g-modes are currently nearly impossible to detect because they do not easily penetrate the solar convection zone on their way to the solar surface.

   See: Kumar, Quataert, and Bahcall, Observational searches for solar g-modes: some theoretical considerations, *Astrophysical Journal* **458**:L83–L85, 1996.
7. SOHO—the Solar and Heliospheric Observatory is a joint project of the ESA and NASA.
8. GONG—the Global Oscillation Network Group.
9. Bahcall and Pinsonneault, Status of solar models, *astro-ph/0209080,* <www.sns.ias.edu/~jnb>, 3 March 2003.
10. Bahcall, Pinsonneault, Basu, and Christensen-Dalsgaard, Are standard solar models reliable? *Phys. Rev. Letters* **78**:171–174, 1997.
11. Bahcall and Ulmer, Temperature dependences of solar neutrino fluxes, *Physical Review D* **53**, 8, 1996.
12. The SNO collaboration, direct evidence for neutrino flavor transformation from neutral-current interactions in the Sudbury Neutrino Observatory, 19 April 2002. <www.sno.phy.queensu.ca/sno/results_04_02/>, 3 June 2002.
13. Faulkner, D., The young faint Sun paradox and the age of the solar system, *TJ* **15**(2):3–4, 2001.

Can more dark matter solve some problems?

Thanks for some very informative articles on cosmology in *TJ* **16**(3), 2002.

Two possible sources of dark matter with observational support were mentioned.