

Astronomy and Physics Underground¹

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Thank you Secretary Abraham and thank you friends.

Neutrinos interact very weakly with matter. Every second about ten billion solar neutrinos pass through your thumb nail and you don't even feel them. Ray Davis and other experimentalists go deep underground to do their work so that only neutrinos reach their detectors.

The basic idea of Ray's experiment is to use neutrinos to look deep inside the nearest star, the Sun, and see how the Sun's energy is created. This is analogous to what your doctor does when she uses ultra-sound or x-rays to look inside your body.

I want to tell you an illustrative story about neutrino research. Sometime in early 1968, Ray and I were visiting the Homestake Gold Mine in South Dakota where his experiment was being performed. We were sitting on a bench putting on our miner's gear: helmets, goggles, and heavy overalls. The miners were very friendly because Ray treats everyone with the same courtesy, respect, and kindness, whether they are an apprentice miner or a distinguished professor.

One of the miners came over to our bench and said: "Hello, Dr. Davis. How is it going? You don't look too happy." And, Ray replied: "Well, I don't know... I am capturing in my tank many fewer of those neutrinos than this young man says I should be capturing." The miner looked really distressed, much more worried than Ray. After a long pause, he finally said: "Never mind, Dr. Davis, it has been a very cloudy summer here in South Dakota."

In the end, Ray got a few atoms out of his Olympic sized swimming pool of chlorine every month. His number turned out to be right. My calculations of how many neutrinos the sun produces turned out to be right. We learned that the laws of neutrino physics needed correcting, but that our model for energy production in the Sun was accurate.

Even today, I find this amazing.

¹ Remarks made on receiving the Fermi Award on October 22, 2003.