

## VENICE IS A GREAT PLACE FOR A CONFERENCE

*F. Reines*

University of California, Irvine, CA

“Oh”, said the accompanying companion to the 4<sup>th</sup> International Symposium on Neutrino Telescopes and the 400<sup>th</sup> Anniversary of Galileo. “I am so pleased to have an excuse to visit Venice, one of my favorite places on this earth. However (she continued) I must confess that I never did understand this great fuss about a particle which is reputed to do so little”. This remark set me thinking. The neutrino venture heralded by Pauli’s bold hypothesis and Fermi’s famous formulation has indeed been full of surprises some of which will be described at this Symposium.

The field has been broad and deep, encompassing astrophysical and particle consequences and ranging from the distant nebulae to the unification of the elementary forces. The searches have led from the ocean deeps to deep inside the earth and sun.

Why indeed should such a weakly interacting particle play such an important role in furthering our understanding of so much of our universe?

As we are beginning to understand, the very weakness which characterizes this class of particles is the reason for its unique role!

*Most marvelously* this weakness may enable the mysterious missing matter which most of the universe to conceivably be built in large measure of neutrinos.

What started out as an excuse for the apparent lack of energy and momentum conservation in the weak interaction has evolved into a vast subject replete with multiple meetings and a literature to match.

When one ventures into uncharted territories it may happen that the unexpected might occur. And so it did that day in 1955 when Clyde Cowan and I first turned on the detector near the Savannah River Reactor.

*No signal was observed!*

Was there no neutrino?

or Was the neutrino unstable so that it was unable to survive the journey from the reactor to the detector?

Our excitement, though great, was short-lived as we tuned the system and a signal not inconsistent with expectations appeared!

Little did we know that some 20 odd years later there would be an industry called the search for neutrino oscillations in which a deficiency of neutrinos was the focus of a world wide effort!

How strange indeed are the various conjectures that have been put forth over the years to account for the antics of the neutrino!

And now we are gathered to partake of yet another chapter in the rich feast centered on the once upon a time hypothetical particle.

As I end these introductory remarks I am reminded of an ancient dialogue put forth by the sage Galileo who graced these very halls some 400 years past. In modern parlance these shades of Galileo might speak somewhat as follows:

What, asked Simplicio, he of Galileo's dialogues, is this thing called Science? That, responded Salviati, is a surprisingly good question, the answer to which you are not at all well equipped to receive. But an answer must be attempted because it touches so directly on the deepest of all man's activities, the search for truth. Science, Simplicio, is the search for the eternal verities - those things which are constant despite the appearance of change - which are dealt with and described by a set of statements called conservation laws which in turn are embedded in the "theological" assumption that nature is knowable.

Consider, for example the concept labelled the Conservation of Energy. First stated in the macroscopic realm, this concept or principle (i.e. "truth") was generalized to the microscopic, proceeding from a known to an untested realm. Indeed our very presence here today is a tribute to the imagination and courage of Wolfgang Pauli and Enrico Fermi whose belief in the more general validity of conservation laws in the nuclear domain of that which is called beta decay has revealed a richness of unsuspected beauty. We, the benefactors and custodians of this treasure trove, should remember that the trail leading to this elegant solution to the beta decay puzzle was not simple or direct. How in the first place was the concept of energy to be defined? How remarkable it was that once defined in terms of such forms as mechanical, kinetic and potential energy it was generalized to account for the concept of heat as a form of energy and then of electromagnetic phenomena! How surprising that each apparent departure from conservation of energy was rescued by an appropriate generalization. How marvelous and unexpected were some of the developments of the Pauli/Fermi assumptions. How unforeseen they were even by the founders: "I cannot believe that God is a weak left hander". How suggestive the possibilities which flowed from the surprising shocks to intuition brought to light by Lee and Yang, which suggests the question: Are symmetry or conservation laws only approximations after all?

Science, Simplicio, is based on and embodies the assumption that nature is knowable, that it can be understood, albeit incompletely, but ever more so as we observe and probe the universe around us.

Most learned Salviati I find the depth of your belief most touching, albeit incomprehensible. If I may suggest, you would do well to be more humble in your claims.

And now, on with the business of the day.