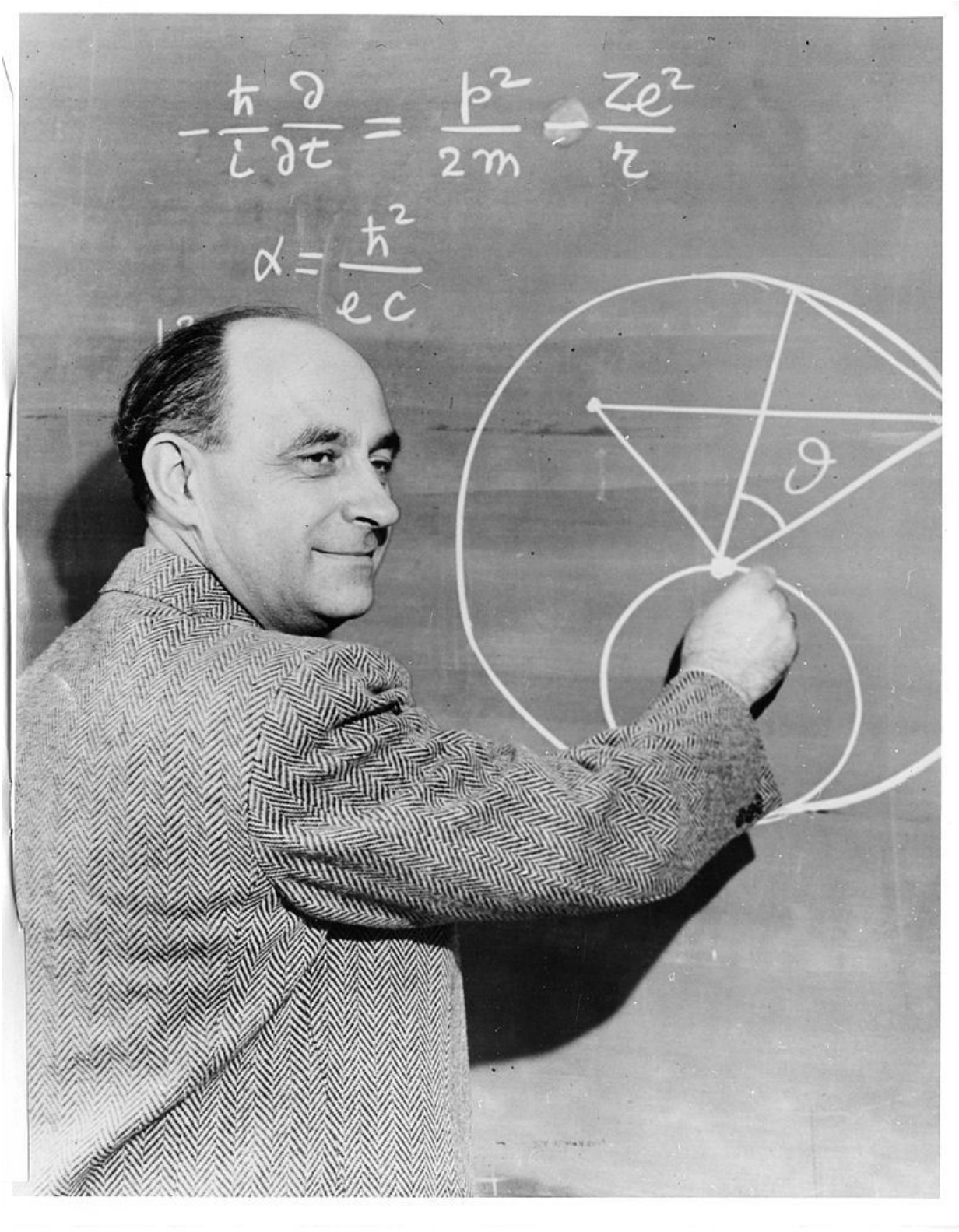
Enrico Fermi and extraterrestrial intelligence

April 8 2015, by Paul Patton



Nuclear physicist Enrico Fermi won the 1938 Nobel Prize for a technique he

developed to probe the atomic nucleus. He led the team that developed the world's first nuclear reactor, and played a central role in the Manhattan Project that developed the atomic bomb during World War II. In the debate over extraterrestrial intelligence, he is best known for posing the question 'Where is everybody?' during a lunchtime discussion at Los Alamos National Laboratory. His question was seen as the basis for the "Fermi Paradox". Credit: Smithsonian Institution Archives

It's become a kind of legend, like Newton and the apple or George Washington and the cherry tree. One day in 1950, the great physicist Enrico Fermi sat down to lunch with colleagues at the Fuller Lodge at Los Alamos National Laboratory in New Mexico and came up with a powerful argument about the existence of extraterrestrial intelligence, the so-called "Fermi paradox". But like many legends, it's only partly true. Robert Gray explained the real history in a recent paper in the journal *Astrobiology*.

Enrico Fermi was the winner of the 1938 Nobel Prize for physics, led the team that developed the world's first nuclear reactor at the University of Chicago, and was a key contributor to the Manhattan Project that developed the atomic bomb during World War II. The Los Alamos Lab where he worked was founded as the headquarters of that project.

The line of reasoning often attributed to Fermi, in his lunchtime conversation, runs like this: There may be many habitable Earth-like planets in our Milky Way galaxy. If intelligent life and technological civilization arise on any one of them, that civilization will eventually invent a means of interstellar travel. It will colonize nearby stellar systems. These colonies will send out their own colonizing expeditions, and the process will continue inevitably until every habitable planet in the galaxy has been reached.

The fact that there aren't already aliens here on Earth was therefore supposed to be strong evidence that they don't exist anywhere in the galaxy. This argument actually isn't Fermi's and was published more than 25 years later by astronomer Michael Hart. It was elaborated in a paper published by the cosmologist Frank Tipler in 1980.

Fermi's lunch conversation really did happen. Although he died just four years later of cancer, physicist Eric Jones published the recollections of the physicist's luncheon companions more than thirty five years later. Among these companions were Edward Teller, Emil Konopinski, and Herbert York, all eminent physicists and veterans of the Manhattan Project. Teller played a central role in the development of the hydrogen bomb. Konopinski studied the structure of the atomic nucleus, and York became director of Lawrence Livermore National Laboratory.

During the walk to the Fuller Lodge, the physicists discussed a recent spate of UFO sightings, and a cartoon in the New Yorker Magazine depicting aliens and a flying saucer. Although the topic of conversation moved on as the group sat down for lunch, Edward Teller recalls "in the middle of the conversation, Fermi came out with the quite unexpected question 'Where is everybody?'…The result of his question was general laughter because of the strange fact that in spite of Fermi's question coming out of the clear blue, everybody around the table seemed to understand at once that he was talking about extraterrestrial life".

In his account of the famed luncheon, Teller wrote "I do not believe much came from this conversation, except perhaps a statement that the distances to the next location of living beings may be very great and that, indeed, as far as our galaxy is concerned, we are living somewhere in the sticks, far removed from the metropolitan area of the galactic center".

York recalled a somewhat more expansive discussion in which Fermi "followed up with a series of calculations on the probability of earthlike

planets, the probability of life given an earth, the probability of humans given life, the likely rise and duration of high technology, and so on. He concluded on the basis of these calculations that we ought to have been visited long ago and many times over".

According to York, Fermi supposed the reason we hadn't been visited "might be the interstellar flight is impossible, or if it is possible, always judged not worth the effort, or technological civilization doesn't last long enough for it to happen".

So Fermi, unlike Hart, wasn't skeptical about the existence of extraterrestrials, and didn't view their absence from Earth as paradoxical. There is no Fermi paradox, there is simply Fermi's question "Where is everybody?", to which there are many possible answers. The answer that Fermi preferred seems to be that, either interstellar travel isn't feasible because of the enormous distances involved, or Earth simply had never been reached by alien travelers.

Interstellar distances are truly vast. If the entire solar system out to the orbit of Neptune were reduced to the size of an American quarter, the nearest star, Proxima Centauri, would still be about the length of a football field away. A practical starship would either need to travel very fast, at an appreciable fraction of the speed of light, or be capable of supporting its crew for a very long time. While either is theoretically possible, interstellar travel seems to present day humanity to be such a grandiose undertaking that it's not clear whether any civilization would be able or willing to muster the enormous resources needed.

Where did the confusing of Fermi's question with Hart's argument come from? Carl Sagan mentioned Fermi's question in a footnote to a 1963 paper. After the publication of Hart's paper in 1975, Fermi's question and Hart's speculative answer became associated in many writer's minds. Fermi's question seemed to beg Hart's answer, and "Fermi's paradox"

was born. According to Robert Gray, the term was coined by D. G. Stephenson, in a paper published two years after Hart's.

More information: "The Fermi Paradox Is Neither Fermi's Nor a Paradox" *Astrobiology*. March 2015, 15(3): 195-199. DOI: 10.1089/ast.2014.1247

Source: Universe Today