

## Recollections of Tihiro Ohkawa – Stephen O. Dean

I first met Tihiro in the early 1960s during a visit I made to the company now known as General Atomics, shortly after I joined the U.S. Atomic Energy Commission as a staff scientist in its fusion research program. Tihiro was one of the youngest scientists there among a group of some of the most distinguished U. S. fusion scientists who had gathered there under the private sponsorship of the Texas Atomic Energy Research Foundation (TAERF). Despite his age, he was already recognized for his innovative talent.

When TAERF notified the company in late 1966 that it would not be renewing funding after April 1967, the company approached the AEC fusion office asking for support. While we pondered this problem (all our money was already allocated to the AEC's labs and universities), all of the senior scientists left the company for appointments elsewhere. After much debate, and upon my recommendation, we decided that we would support Tihiro where he was.

Following the invention of the laser in 1960, the AEC mounted a classified program at its weapons labs (primarily the Lawrence Livermore lab) to see if lasers could be developed that would lead to a fusion energy source. Tihiro, a citizen of Japan at the time and without a security clearance, undertook on his own initiative to assess the prospects for "laser fusion". When security officials learned of his effort, they classified his calculations and forbid him to work further in this area. His calculations, which were not declassified until December 1984, were remarkably detailed and consistent with classified calculations of that era performed elsewhere and later published. To this day, Tihiro's calculations only exist in an internal GA Technologies report (GAMD-11006).

I left the AEC in 1969 to do research on laser plasmas at the U.S. Naval Research Laboratory. When I returned to AEC in 1972 as Assistant Director of the U.S. fusion program, I found that the General Atomics program, with Tihiro as head, had flourished. The 1970s were heady times for U.S. fusion. The world was in the thralls of an oil shortage and energy crisis. The AEC asked us to propose an ambitious program to move forward towards an energy source. The U.S. fusion budget grew tenfold during the 1970s and Tihiro was one of the national program leaders. His "Doublet" tokamak concept was very attractive to us (see photo 1: myself and Tihiro, with GA president John Landis on Tihiro's left and GA vice president Corwin Rickard on my right, standing in front of Doublet II in 1974). Based on Tihiro's proposal for a larger facility, called Doublet III, we built a major fusion research facility at General Atomics in LaJolla, CA, that today houses the largest operating U.S. fusion device, the DIII-D, which is still one of the most productive fusion research facilities in the world.

Tihiro had an extremely active mind and he was continuing to innovate. Even while Doublet III was being built, and the tokamak was becoming the dominant concept around the world, Tihiro invented a variation of the Reversed Field Pinch (RFP) concept he called OHTE. He obtained some funding from the private company Phillips Petroleum and built a small experiment at GA. He hoped that Phillips would then develop it further. Unfortunately, Phillips had to drop the idea when it was sold to another firm. The RFP remains a potential alternative to the tokamak to this day.

I left government in 1979 to form Fusion Power Associates (<http://fusionpower.org>). General Atomics was one of the founding corporate members and for many years Tihiro served on our Board of Directors. Fusion Power Associates presented its 1984 Leadership Award to Tihiro to recognize the leadership he had provided to fusion development over several decades (photo 2: presentation of Fusion Power Associates Leadership Award to Tihiro Ohkawa in 1984). In 1998 Fusion Power Associates presented its Distinguished Career Award to him.

No summary like this would be complete without my acknowledging the inspiration and pleasure I have taken in knowing both Tihiro, his lovely wife Yoko and his family. In 2013, about one year before Tihiro's death, I had dinner with Tihiro and Yoko in La Jolla. Tihiro spent most of the time telling me of a new idea he was pursuing with a colleague in Japan, while Yoko and I spent most of the time enjoying our dinner. (photo 3: Tihiro and Yoko, 1990).

I have not known many, if any, persons who have contributed so many insights to so many scientific fields of endeavor,

