Fusion Goes Forward From the Fringe

By Alan Boyle, May 10, 2011; http://cosmiclog.msnbc.msn.com/

A Navy-funded effort to harness nuclear fusion power reports that its unconventional plasma device is operating as designed and generating "positive results" more than halfway through the project.

The latest quarterly update from EMC2 Fusion Development Corp. comes amid other signs that seemingly oddball approaches to fusion research may not be all that oddball after all. Just last week, General Fusion announced that Amazon.com's billionaire founder, Jeff Bezos, was part of a $19.5 million investment round to further the company's plan to take advantage of a technology called magnetized target fusion. Another billionaire, Paul Allen, is an investor in Tri Alpha Energy, which is working on its own hush-hush fusion project (and occasionally publishing its research).

Plasma shines within EMC2 Fusion's WB-7 device, the predecessor to the WB-8 inertial electrostatic confinement vessel currently being used for fusion experiments.

EMC2 Fusion doesn't have tens of millions of venture capital to play with — but it does have a $7.9 million Navy contract to test a plasma technology known as inertial electrostatic confinement fusion, also known as Polywell fusion. The idea is to accelerate positively charged ions in an electrical cage to such an extent that they occasionally spark a fusion reaction, releasing energy and neutrons. The concept was pioneered by the late physicist Robert Bussard, and carried forward by the EMC2 Fusion team in Santa Fe, N.M.

Some of the leading team members went on leave from Los Alamos National Laboratory to work on EMC2. Rick Nebel, the Los Alamos engineer who led the company since Bussard's death in 2007, retired from the company last November. Taking his place as acting chief executive officer is Jaeyoung Park. The 41-year-old physicist says he's given up his position at Los Alamos to focus fully on EMC2.

"We had a lot of milestones to meet in the last six months or so," Park told me today. "It's been pretty hectic."

Working on a Wiffle Ball

The company currently employs eight or nine full-time technical staff members, and relies on about two dozen external consultants, Park said. The ultimate objective is to build a 100-megawatt demonstration fusion reactor, and Park hopes that the current small-scale experiment will show EMC2's scientists and their "customers" in the Navy whether this is realistic.

"If this machine works as we hope it will work, it will probably establish a firm technical foundation," he said. "People may say, 'It's a big jump and you shouldn't be doing this.' But every year that the energy problem doesn't get solved ... costs tens of billions of dollars. Sometimes waiting too long is not a good thing. If you look at the solutions, you might say, 'Can we afford to wait?'"

So how far along is EMC2? The current experiment is known as WB-8, which follows up on WB-5, 6 and 7. "WB" stands for "Wiffle Ball," which describes the spherical swiss-cheese look of the plasma containment cage. The $7.9 million contract covers work to see whether Bussard's fusion concept can be scaled up to a size capable of putting out more power than it consumes.

Although fusion is the process behind the power of the sun and an exploding H-bomb, physicists have never been able to achieve a net energy gain in a controlled fusion reaction. But based on the experiments so far, Park thinks there's a chance that it could be done in a sufficiently large Wiffleball reactor, costing on the order of $100 million to $200 million. That sounds like a pretty good deal, especially in comparison with the $3.5 billion that's been spent so far on fusion research at the National Ignition Facility and the $20 billion expected to be spent on the international ITER fusion project.

Driving the fusion Ferrari

WB-8 didn't cost anywhere near that much. Park estimated that the parts alone cost on the order of $2 million, which he compared to the cost of a vintage Ferrari. "I'll take this machine any day over a Ferrari," he joked.

"It's a very nice machine," he said. "I like what we have so far. It's quite well-built, relatively flexible to actually explore a lot of areas and find what's best. Achieving the plasma for fusion is obviously a tall order. ... You don't just push the pedal on a Ferrari and drive the car. Like an F-18 or a stealth bomber, you have to learn how to operate it properly."

Park said that the WB-8 experiment was about 60 percent complete, which roughly matches how much of the $7.9 million has been spent so far. He acknowledged that EMC2 was originally aiming to finish the experiment by this time, but said the realities of government funding — including continuing resolutions, shutdown threats and other budgetary snags — have dictated a slower pace.

"We decided at some point that it's not a good idea to follow the timeline directly, because if you follow the timeline and not the moneyline, you've got a big problem," he told me. "The reality is that we have to follow the timeline given by the funding profile rather than the timeline given by the date."

The last little experiment?

Park figures that the money provided under the WB-8 contract should last until the end of the year, depending on how efficiently the EMC2 team is able to stretch the money out. By then, the engineers in New Mexico and their backers in the Navy should know whether it's worth going ahead with the next step, perhaps even with the big demonstration reactor. Park hopes that WB-8 will be the last small-scale experimental machine EMC2 will have to build.

"This machine should be able to generate 1,000 times more nuclear activity than WB-7, with about eight times more magnetic field," said Park, quoting the publicly available information about WB-8. "We'll call that a good success. That means we're on track with the scaling law."

Don't expect weekly updates about EMC2's progress. "Currently all our funding comes from the Navy," Park said. "That's our customer. Our customer desired that we keep most of our progress confidential. ... They're somewhat concerned about making too much hype without delivering an actual product."

But if WB-8 and the follow-up studies are successful, the Navy won't stand in EMC2's way.

"Our understanding is they want us to be successful," Park said. "They want us to provide something for our sponsors. They also want us to do well commercially as well, as long as we remain US-owned and control the technology."

And if WB-8 fails?

"Sometimes breakthroughs happen, and sometimes you can never solve it, and then maybe it's time to give up — at least for me," Park said. "But I can positively say I tried everything."