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Subject: Fusion program input and a couple of ICF ideas

Bob,

If ITER and/or NIF pointed the way to a viable commercial reactor, I would then urge the fusion program to put all of its eggs in those two baskets. But ITER is too expensive and complex. NIF does not have high-rep drivers; and it is likely that laser drivers never will be. Also, exotic targets like hohlraums are orders of magnitude too costly at the moment, and cost reductions remain uncertain.

While ITER and NIF are valuable learning tools, I urge the fusion program to diversify to find something with better commercial potential. This requires increased risk and probably many failures. But that's research, and it always conflicts with the wishes of program managers who want to follow a linear path from start to finish. So be it. MTF is a step in the right direction. But it too has its issues and therefore other avenues should also be explored.

Earlier this week I submitted a magnetic confinement concept that looks attractive as a reactor. Obviously a lot more work is needed on it. Here I suggest two innovations for ICF targets.

The first relates to geometry: Make the target in the form of two shaped charge cones pointing toward each other. The very high velocity jets that are formed on axis collide in the middle, and are inhibited from expanding radially by another jet moving radially inward from the junction of the cone edges. This collision would act as a spark plug. The geometry is ideal for two-side illumination.

The second relates to target material. Use methane, that is, CD2T2, instead of D-T (or a mix of CD4 and CT4 – it shouldn't matter). D-T is solid at 20 K, making it challenging to inject into a reactor chamber surrounded by a hot blanket. Methane is solid at about 110 K and, with a much higher heat capacity, is easier to inject (and ought to be easier to make). Solid CD2T2 actually has a higher hydrogen density that solid D-T. With the carbon, a separate ablator/protector may not be needed, compensating for the higher mass (2.2 times more for a given amount of hydrogen). The higher mass carbon, with its higher momentum for a given kinetic energy, should result in slower injection velocities and longer dwell intervals at full compression, compensating for likely lower power density and giving comparable total fusion energy release. While the carbon will increase Bremsstrahlung radiation, it should also aid in reabsorption of that radiation away from the center thereby spreading out the temperature and power density. The carbon might also increase neutron energy absorption in the target. One might consider carbon ion beams as a driver, which should have good coupling and high efficiency. Because of the longer time constants, beam instantaneous power can be reduced for a given total beam energy on target.

It is easy to dismiss these two target concepts with glib statements. But the only way they can be fairly evaluated is with a fully functional dynamics code that has all the necessary features. LANL no doubt has this capability. And it sure would be fun.

Bob Bourque