Yongtao Zhao

A much-higher-than-predicted Measurement of Proton-Boron Fusion at Extremes

Abstract:

Fusion energy is the ultimate solution of energy source for human kind in future. We are well aware of the fact that Proton-Boron fusion energy can hardly work under thermal equilibrium conditions. Therefore, we designed an experiment based on non-equilibrium conditions and suprathermal plasma state with an ultra-intense proton beam.

Paramount to the success of our experiment was the combination of intense proton beam, nano-structured foam target and the plasma state. Our result presently constitutes the world record on Proton-Boron fusion yield per laser energy. From the experiment we show clearly that the beam intensity is essential to achieve such high yields by creating the high electric fields and non-thermal conditions. At low beam intensity as shown in our experiment, the yield is of the same order as the beam-target reaction prediction. The observed yield, normalized by the beam intensity, is up to 4 orders of magnitude higher than prediction, due to the non-linear effect of the high beam intensity.

The current fusion energy gain (over the proton beam energy) is 14%. If we optimize the experimental setup, we are confident that a further substantial enhancement could be achieved.

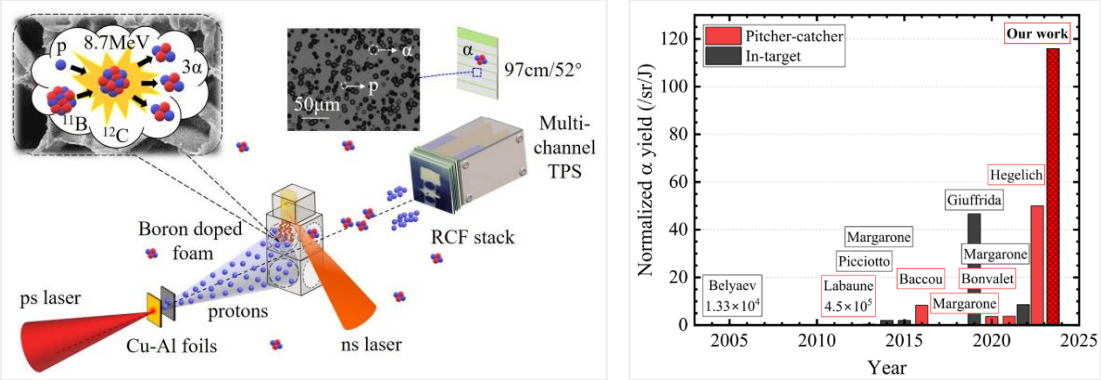

Figure: Experimental scheme (left) and the measured fusion yields per laser energy