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Flyer Acceleration using Underwater Wire Explosions

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We present early results for a novel flyer acceleration method using pulsed power. Flyer plate impact is of interest for material equation of state research, and more recently for a novel fusion ignition scheme being developed at First Light Fusion Ltd. Generation of the desired planar shock is dependent on maintaining a symmetric flat flyer face, with the front surface of the flyer in a solid state at impact. Flatness can be compromised by non-uniform driving force, and the front surface of the flyer can be melted by shocks, either imparted directly into the flyer or formed within by steepening of a compression wave.

In this method, an underwater planar wire array is exploded using a current pulse, generating an approximately planar shock in the water that reaches and accelerates the flyer. This method may provide more control over the spatial profile of the force accelerating the flyer than other methods such as magnetic stripline acceleration, by controlling the current path using wires of varying diameter, material and position. Reverberation of the shocks between the front and back of the water-filled cavity allows the use of multiple weak shocks to accelerate the flyer –aiming to provide a quasi-isentropic drive and prevent damage to the front surface.

Initial results indicate velocities of around 400 m/s using a 10 mm by 10mm, 1 mm thick aluminium flyer, with a peak current of ˜600kA. Work is in progress to improve and further diagnose this, as well as investigate the energy coupling efficiencies between the wires, water and the flyer plate.

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