

A Centrifugal Nuclear Thermal Propulsion (CNTP) system, which confines high-temperature liquid fuel with centrifugal force, is ideal for deep space travel and space exploration due to the high specific impulse. This current project focuses on conducting a preliminary investigation into the behavior of bubble dynamics while they are being injected into a fast-spinning cylinder. The project begins by developing a benchtop experimental setup that can demonstrate the physics within the CNTP system, primarily focusing on the flow of the liquid at very high rotational speeds in a cylinder. During initial experiments, the cylinder is filled with 10% of water and rotates at 700-1,300 RPM. A high speed camera records the starting sequence at 12,800 frames per second. An LED lighting illuminates the flow field within the cylinder. Results have shown that for rotational speeds above 700 rpm, a free surface was consistently formed and sustained within a few seconds. Bubbles will be injected into this thin layer of fluid in the next phase of the experiment and their dynamics behavior will be studied. This more accurate knowledge of bubble dynamics under high centrifugal force will be incorporated into a computational model that combines neutronics (OpenMC) and thermal-fluid (OpenFoam) simulation, to better predict the performance of CNTP. The ultimate goal is to optimize the CNTP design to achieve the highest possible performance.