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PROJECT BAIR: BLACK HOLE AUGMENTED INTERSTELLAR RAMJET

Abstract

Interstellar flight presents many physical and technological challenges. These include long flight times and vast distances. Many solutions have been proposed to help reduce flight times. One of these is the interstellar ramjet, first proposed by Robert Bussard in 1960. Collecting and fusing the nuclei of Hydrogen and other gas particles that make up the interstellar medium in order to produce thrust in an exhaust stream, this ramjet is - in principle - able to reach significant fractions of the speed of light without needing to carry fuel onboard. However, several problems with this system exist. One problem is that the system is expected to produce more drag than thrust, making the ramjet ineffective. Another problem involves the fact that proton-proton collisions have a very small reaction cross section, making fusion difficult.

One potential solution to these difficulties is to use subatomic black holes to supplement the ramjet. Such subatomic black holes are predicted to exist theoretically and would be capable of producing large amounts of radiated power via Hawking Radiation because of their extremely small size (diameter less than 10-18 meters).

This paper summarizes the background to the interstellar ramjet and examines the physical properties of subatomic black holes to determine whether, in theory, they could be applied to augment or replace the interstellar ramjet and present some preliminary conceptual designs for the resulting vehicles. Three different concepts will be analyzed and compared in terms of mass, engineering efficiency, thrust, final velocity, and feasibility. These are Bussard's original interstellar ramjet with fusion propulsion, an augmented ramjet that uses a subatomic black hole to heat and energize the incoming interstellar particles, and a starship that uses the Hawking radiation from a subatomic black hole directly as thrust.