58th International Astronautical Congress 2007

36th Symposium on the Search for Extraterrestrial Intelligence (SETI) – The Next Steps (A4.)
SETI I – Technical Aspects (1.)
Exclude Poster: No
Student: No
Includes Video: No

Author: Mr. Robert L. DeBiase
DeBiase Entreprises, Staten Island, NY, United States, rldebiase@earthlink.net

CONSTRAINTS AND COST / BENEFITS OF THIN FILM DYSON SPHERES

Abstract

Dyson Spheres are hypothetical structures that advanced civilizations can build for habitation purposes that capture and use a significant portion of the output of their star. Solid shelled Dyson Spheres that human-like creatures could inhabit, with atmosphere and gravity, probably can't be built. However, if the shell were sufficiently thin, stellar radiation pressure could balance the stars gravitational force. Since both are inversely proportional to the distance to the star, the shell could be built almost any distance from the star. Such a structure is a thin film Dyson Sphere and is sometimes called a Dyson Bubble. The simplest modular structure that could be incrementally built would be an array of solar sails or statites that envelope a star at a particular radius. Inhabitants would be machines or possibly virtual – the products of a prior technological civilization of biological origins. Although the Dyson Bubble itself would not be habitable by biological entities, infrastructure capable of supporting biological life, such as planets, would not be incompatible with the bubble. A Dyson Bubble held in place by radiation pressure could be stable for long periods of time, degrading gracefully if not maintained, and if maintained, lasting at least as long as its star is on the main sequence.

This paper features a model that integrates various costs and constraints to building such a Dyson Bubble. The primary constraint is the mass of the star the Dyson Bubble surrounds. Given that constraint, estimates can be made of the power output of the star and its life span on the main sequence. For a particular stellar mass, a Dyson Bubble radius determines the temperature of the Dyson Bubble, the areal density of the materials composing the Dyson Bubble and the total mass required to construct it. Areal density and Dyson Bubble temperature have technological implications that can impact on the cost of building the structure. Benefits of building such structures include the previously mentioned long life span, the ability to beam power interstellar distances enabling interstellar travel, interstellar communications and its unprecedented power as a telescope. The overall results of the analysis show that this form of Dyson Sphere can be built a large number of ways around a wide range of stars with relatively small amounts of mass compared to a conventional Dyson Sphere. These lower costs and the ensuing benefits increase the plausibility of such objects existing.