52nd IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps (A4)
Interactive Presentations - 52nd IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps (IP)

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HABITABLE MEGASTRUCTURES VERSUS HABITABLE PLANETS

Abstract

Introduction: In 1960, Freeman Dyson suggested a scientific way to Search for Extraterrestrial Intelligence (SETI) by looking for sources in infrared region that are radiating at temperatures suitable for life, but at the total power output of a star. When the population and energy demands increase exponentially, advanced species might use the energy of their star (like Sun) to destroy one of their giant planets (like Jupiter) for resources to build a shell around their star. Thus, Dyson introduced his famous megastructure, which is commonly known as Dyson sphere (DS). DS is a large collection of habitats around the sun, collecting the energy from the star.

Drawbacks: Building a DS around the sun will trap the solar wind inside, allowing the ISM and stray cosmic rays to hit the DS. There would be no protection from flares, CMEs, solar wind, etc., as there would be no natural magnetic field. Even for the slightest perturbations, the DS will become unstable and can collide with the central star. Since most of Jupiter's mass is hydrogen and helium, the possibility of building such structures is very low.

Alternative: Dyson wrote the article more than three decades before exoplanets were discovered. It took more than 20 years to realize that nature has no problem making in planets. The total number of planets in the Galaxy is estimated to be in billions, while the free-floating planets (FFPs) even exceeding the number of bound ones. With such abundance of planets, the earlier concerns about building such megastructures seem unnecessary. A civilization can expand to a neighbouring system that has planet(s) in the habitable zone (HZ), or a planet can be moved into it. For example, Mars is just less than 0.5 AU from the HZ. It can be nudged into the HZ, spending just one billionth of the energy required to disassemble Jupiter to make a DS. Shifting Pluto would require two orders of magnitude less energy than shifting mars. Alternatively, a nearby FFP can be captured and moved into the HZ. These shifts can be performed at a constant low-thrust acceleration, which results in a gradual spiral transfer from one orbit to another, using directional exawatt lasers. Since petawatt lasers are already available, this seems to be certainly feasible within a century or so!