

Dyson Dots: Changing the Solar Constant to a Variable with PV Lightsails

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No study of coping with climate change is complete without considering geoengineering. Following up on Tsiolkovsky's and Tsander's 1920s idea to use mirrors in space for propulsion, Glaser's 1970s study of solar power satellites, and Forward's 1990s concept of radiation-levitated "statites", we propose placing a large lightsail(s) in a radiation-levitated non-Keplerian orbit just sunward of the Sol-Earth L1 point. Building, placing, and controlling a solar sail of 300,000 km² area or more, massing millions of tons, would be greatest single engineering project yet tackled by the human race, but so is the challenge of worldwide climate change. The purpose of this syncretic concept, which we call "Dyson Dots", is twofold:

(1) Acting as a parasol, the Dyson Dot of this size would reduce insolation on Earth by about 0.25%, which is thought to be the magnitude of the solar flux fall which led to a 1.8 deg C (2.7 deg F) drop in average recorded temperatures during the "Little Ice Age" (~1600-1800). Not coincidentally, 1.8 deg C was also the middle estimate for global warming by 2050 in the IPCC's Third Report. – in essence, the Dot makes a Mirrored Maunder Minimum. Rather than stationkeeping with conventional reaction engines which require continual expensive shipments of fuel, the Dot would utilize the very photons it diverts from Earth to maintain its position for free. The value of avoiding the worst of climate change should exceed the cost of the Dot by a couple orders of magnitude.

(2) Acting as a power station by generating electricity on its sunny side covered with photovoltaics, then beaming that maser to rectennas on Earth, the Dot would displace about 300 EJ/a (~300 quadrillion Btu/yr) of electricity demand -- roughly equivalent to the entire forecast baseload capacity on Earth by mid century. This would in turn displace most big carbon burners from the terrestrial grid as well as providing the revenue stream from clean energy sales to pay for the scheme. (Hence the original title 10 years ago, Mirrors and Smoke.) Maser energy can be transmitted to consumers anywhere else in the inner solar system, too, or subsequent Dots can be built specifically for space-based industry.

This approach to geoengineering is:

- scalable (twice the mirror offsets twice the solar forcing function)
- uncoupled (Dots work independently of others)
- incremental (pay-as-you-go)
- customizable (selectively permeable shields to tailor light or filter out harmful wavelengths)
- minimally intrusive (an array of space mirrors would look like symmetric sunspots), and above all,
- reversible (Dots can easily be shifted to let sunshine through again).

If a Tellurian spacefaring civilization continued to construct photovoltaic lightsails in various radiation-levitated orbits to harvest sunlight, in order to fuel continued exponential growth after this initial bootstrapping, then there might be enough of them in the distant future to have a detectable effect on Sol's apparent luminosity seen from far away, similar to the famous Dyson Sphere. For this reason, we have dubbed our parasol with the moniker, "Dyson Dot".