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Strategies for Rapid Implementation of Interstellar Missions: Precursors and Beyond (4)

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DARK EARTHS: INITIAL GOALS FOR INTERSTELLAR EXPLORATION

Abstract

Gravitational microlensing surveys have revealed the existence of a substantial and widespread population of "nomadic" planets, bodies not in orbit around any star. Nomadic Jupiter-mass objects are apparently more common than main sequence stars, immediately implying that there should be one or more Jupiter-mass nomadic objects closer to us than any stellar system. The microlensing results also reveal that the mass spectrum of these objects follows power laws such that smaller nomadic planets should be more common that Jupiter-sized bodies. Strigari *et al.* (2012) extrapolated these power laws to estimate that there could be as many as 1000 Earth-mass, and 100,000 Lunar-mass, nomadic bodies per main sequence star.

Interstellar nomadic planets, if they can be found close to the Sun, would offer compelling destinations for initial interstellar missions. With the Strigari *et al.* population estimates, the nearest "dark Moon" could be within 0.1 light years (ly), the nearest "dark Earth" 0.5 ly, and the nearest "dark Jupiter" 3 ly, of the Solar System. Theoretical analysis also indicates that Earth-sized and larger nomadic planets, although likely very cold on the surface or at the top of their atmosphere, should have sufficient sources of internal heat to support biospheres for durations comparable to the age of the solar system.

Nearby nomadic planets within a few tenths of a ly of the solar system, potentially possessing biospheres and much easier to reach than the nearest stellar systems, are likely to be the natural targets for early interstellar missions, if they can be found. An immediate goal of interstellar exploration should thus be to find the dark nomadic planets within 1/2 ly of the Earth. These bodies would be typically too close to be detected with gravitational microlensing, but could be detected via stellar transits and confirmed with the ALMA interferometer, which is sensitive to cold body thermal emissions at millimeter and sub-millimeter wavelengths.