# A Constellation of Bright Orbiting Beacons for Imaging and Characterizing Rocky Earth-size Exoplanets Orbiting Sun-like stars with Ground-Based Telescopes

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**Abstract**

Detecting and characterizing Earth-size exoplanets by imaging around Sun-like stars to search for life signatures is a formidable challenge, requiring advanced coronagraph designs and picometer-level wavefront control to reach 1E10 contrast at a few lambda/D separation. While a dedicated highly-stable space observatory may be required to achieve such extreme observations, I will present a new concept to achieve an intermediate sky-limited _˜1E8 visible-band contrast on ground-based 8 to 30-m class telescopes. The idea consists of using a constellation of orbiting _˜30-cm beacons located on highly eccentric _˜100,000-km orbits to allow for hour-long observations of nearby Sun-like stars. These beacons will surround the science target and generate extremely bright unresolved off-axis guide stars for _˜in-band $>$ 10 KHz adaptive optics, with a goal to reach closed-loop Angstrom-level residuals on the science target. A sequence of images during the constellation transit will be post-processed and combined to reach 1E10 contrast inside the generated "dark hole" in a narrow _˜1% bandpass, allowing for targeted color imaging to identify key biomarkers in the planet's atmosphere. With up to _˜5x greater aperture compared to a future space observatory, ground-based 30-m class observatories could expand the imaging discovery of rocky planets closer to stars (i.e. discovering warmer inner planets, or observing later type stars), or probe systems up to 5x further away, significantly increasing the star sample size to search for and characterize Earth-size exoplanets. I will present the concept, discuss its various challenges, and showcase current projects and upcoming laboratory experiments at the NEW EARTH Laboratory to develop the technologies needed for such "extreme" instruments.

**Keywords:** adaptive optics, imaging, focal plane wavefront sensing, extreme contrast, exoplanets, habitable zone, biomarkers

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