July 16-21, 2017 at UC San Diego, CA, USA

Searching for Signs of Life on Exoplanets

*S. Seager
Massachusetts Institute of Technology

The search for life in other planetary systems is a relatively new but exciting endeavor. Thousands of exoplanets are known to orbit nearby stars and small rocky planets are established to be common. The ambitious goal of identifying a habitable or inhabited exoplanet is within reach. But how likely are we to succeed? We need to first discover a pool of planets in their host star's "extended" habitable zone and, second, use the James Webb Space Telescope to provide evidence of atmospheric biosignature gases. A biosignature gas is defined as one that is produced by life and accumulates in an atmosphere to detectable levels. Any kind of ab initio approach to predicting what biosignature gases might be is so challenging that nearly all work done to date basically follows the "We know what Earth life produces, so how would the signature of these products appear if transplanted to another, slightly different, Earth-like planet" (Earth-like refers to a planet with about the same size and mass as Earth, with oceans and continents, a thin N_2-CO_2-O_2 atmosphere, and a similar radiation environment). Gases studied in this context include oxygen, the otherwise unexplained simultaneous presence of gases out of thermodynamic equilibrium (specifically methane with oxygen), methyl halides, sulfur compounds, and others. For successful detections, transiting exoplanets require fortuitous alignments and this near-term approach is therefore only the first step in a long journey. The next step is sophisticated starlight suppression techniques for large ground-and space-based based telescopes to observe small exoplanets directly. Assuming that we can identify some of the above "biosignatures" in an exoplanet atmosphere, what are the implications for origin of life's research?