EXPLORING WORLDS AROUND OTHER STARS. M. Swain[1], [1]Jet Propulsion Laboratory (4800 Oak Grove Drive, Pasadena, CA, 91109, mark.r.swain@jpl.nasa.gov).

Introduction: Since the first discovery of an exoplanet orbiting a solar-type star in 1995 the field of exoplanets has grown significantly; today, the rapidly growing number of known exoplanets is over 700, and the process of more detailed study of these worlds has begun. The technique that is revolutionizing our understanding of exoplanet atmospheres focuses on transiting exoplanets. These are planetary systems that are oriented so that the planet appears to pass in front of the parent star in an event termed primary eclipse. For transiting exoplanets in near circular orbits, the planet also disappears behind the parent star in an event termed secondary eclipse. Observing the primary eclipse probes the transmission of the terminator region atmosphere, while observation of the secondary eclipse probes the emission and/or reflected-light component of the dayside atmosphere. In some cases, this approach of measuring temporal light curve variations can be extended to (1) map the planet's longitudinal emission and to (2) image the dayside atmospheric features.

Infrared spectroscopic observations of transiting exoplanet systems have provided insight into the conditions, composition, and chemistry of exoplanet atmospheres. Infrared wavelengths are particularly well suited to detect molecular ro-vibrational band features, and the spectral region between 1 and 15 microns contains many molecular features. These wavelengths also probe the troposphere and, when present, stratosphere, and they are sensitive to emission from the exoplanet. Molecules such as water, methane, carbon dioxide, and carbon monoxide have been detected by infrared spectroscopy in three exoplanets. In some cases, there are infrared spectroscopic measurements of both the dayside emission and terminator region transmission spectrum – a combination that places useful constraints on atmospheric models.

The initial detection of molecules using this technique was made by targeting hot-Jovian type exoplanets. Currently, groups are targeting Neptunian and Super Earth class exoplanets using the same technique. Some teams are also working on spectral imaging of dayside atmospheric features; this has the potential to spectrally probe individual features associated with dynamical processes and to measure how the temperature and composition of these features differs from other regions of the atmosphere. A challenge for characterization via infrared transit spectroscopy is that typical instruments are optimized for other kinds of science. Frequently, general purpose instrumentation does not have the measurement stability or the broad instantaneous wavelength coverage needed to detect spectral features when properties of both the planet and the parent star can vary on time scales of days. This limitation is being addressed with proposals for purpose-built instrumentation with the capability to survey a large sample of exoplanets and enable comparative planetology of exoplanets as a class of objects with a high-stability, uniform, and systematic measurement approach.