InfraRed Doppler (IRD) for the Subaru telescope: Search for Earth-mass planets around late-M dwarfs

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We are going to conduct a precise Doppler survey to search for Earth-mass planets orbiting late-M dwarf stars. The survey aims detecting many super-Earths and Earth-mass planets in the habitable zone and understanding configurations of planetary systems with low-mass planets around low-mass stars. The targets of our survey are late-type (red) dwarf stars suitable for measuring their radial velocities (RV) very precisely by infrared observations because the stars have a flux peak in infrared and many absorption lines in their infrared spectrum enough to reach RV measurement precision of 1m/s. The targets are also favorable to detect and confirm low-mass planets by the Doppler technique due to their low stellar masses and then relatively large amplitude of the stellar motion caused by the planets.

For the large RV survey of late-M dwarfs, we are contracting a new astronomical instrument optimized to infrared precise RV measurements for the Subaru telescope (InfraRed Doppler, IRD). IRD is composed of a fiber-fed near-infrared high dispersion echelle-spectrograph and a laser-frequency comb as a precise wavelength calibrator covering the wavelength range of 0.97-1.75 micron. The instrument would achieve the stability level of 1m/s on the precise RV measurements due to highly controlled temperature of the spectrograph and stabilized spectrum of the laser-frequency comb.

The installation of the instrument on the Subaru telescope was finished and we have done the first-light of the spectrograph using the Subaru telescope last August. Since this February, we have started on-sky engineering observations using a full instrument system with the stabilized spectrograph and the leaser frequency comb as a precise wavelength calibrator. In order to confirm the RV stability of the observations using IRD, we are performing the RV stability test of the instrument with on-sky observations and laboratory experiments and confirmed the RV stability of the instrument less than 2m/s for two weeks. We are going to start a large RV survey from 2019 in the framework of the Subaru Strategic Program (SSP).

According to survey simulations based on results of population synthesis of planet formations around low-mass stars and our survey strategy using the IRD, we expect to detect more than 20 super-Earths and Earth-mass planets during the long-term survey for five years. In this presentation, we show you current status of the IRD project, details of the instrument and, strategy and simulated results of IRD/Subaru planet search program.

Keywords: Earth-mass planets, Precise radial velocity measurement, Low-mass stars, Late-M dwarf stars, Habitable zone, Doppler method

