Coronagraphic Search for Young Brown Dwarfs and Proto-Planets around T Tauri Stars. Y. Itoh1, M. Hayashi2, M. Tamura3, Y. Oasa1, M. Fukagawa4, S. S. Hayashi2, T. Kudoh, S. Mayama5, 1 Graduate School of Science and Technology, Kobe University, 1-1 Rokkodai, Nada, Kobe, Hyogo 657-8501, Japan (yitoh@kobe-u.ac.jp), 2 Subaru Telescope, Hilo, Hawaii 96720, USA, 3 National Astronomical Observatory of Japan, Mitaka, Tokyo 181-8501, Japan, 4 Spitzer Space Center, California Institute of Technology, Pasadena, CA 91125, USA, 5 Graduate University for Advanced Studies, Mitaka, Tokyo 181-8501, Japan.

Introduction: Physical characteristics of the extra-solar planets, such as mass and orbital elements, are quite different from those of the planets in the Solar System. The diversity of the extra-solar planets might be attributed to the formation process of the planetary system. We have started near-infrared survey of young brown dwarfs and proto-planets around T Tauri stars. Planets and brown dwarfs are bright when they are young. However, they are still much fainter than the primary star, and are believed to be located in close vicinity to the primary. Therefore observations with high spatial resolution and high dynamic range are required.

Observations: Near-infrared coronagraphic observations were carried out on 30 nights during 2002 to 2004. Targets are 79 T Tauri stars associated with the Taurus molecular cloud. We used a coronagraphic camera, CIAO, mounted on the Subaru Telescope. The field of view of CIAO is 22" x 22". The spatial resolution provided by the adaptive optics system was 0.1" (15 AU) under the natural seeing of 0.5". An occulting mask has a diameter of 0.6", within which the transmittance was a few tenths of a percent. This allowed us to measure the accurate position of the central object. The total exposure time is 24 minutes for each object. Limiting magnitudes are around 22 mag at the H-band.

Successive near-infrared spectroscopic observations of 20 companion candidates were carried out with CISCO and IRCs mounted on the Subaru Telescope. We used a grism with a spectral resolution of about 300 at 2.2 um. The total integration times are 20 to 60 min.

Results and Discussion: We have detected 56 point sources around 29 T Tauri stars. By the Galactic star count model, the expected number of background stars is only 0.3 per the field of view. It is unlikely that all of the point sources detected are background stars. The H-band magnitudes of the objects are around 15. Assuming ages of 1 Myr and without extinction, most of the objects are estimated to have planetary mass.

Near-infrared spectrum of DH Tau B has prominent water absorption bands around 1.4 um and 1.9 um [2]. These absorption bands are prominent in the H-band spectrum of the giant planet candidate around a young brown dwarf [1]. The absorption lines of KI and NaI are also detected at 1.25 um and 2.21 um, respectively. These characteristics suggest a low temperature of DH Tau B. By comparing the observed spectra with model spectra [2], we estimated that DH Tau B has Teff=2700—2800 K and log g=4.0—4.5.

The bolometric luminosity of DH Tau B is derived to be 10-2.44. From this luminosity together with the effective temperature, we estimated its mass and age of 0.04—0.05 Msun and 107 yr, respectively, by comparing with an evolutionary track [3]. DH Tau B is thus a young brown dwarf companion to DH Tau A. We will also discuss on nature of the other companion candidates.

K-band coronagraphic image of DH Tau A&B. A young brown dwarf is located 330 AU away from the primary.