【Grant-in-Aid for Specially Promoted Research】

Science and Engineering (Mathematics/Physics)

Title of Project : Search for cold exoplanets and free-floating planets by near infrared gravitational microlensing observation

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Research Area : Astronomy
Keyword : Exoplanet, gravitational microlensing, Infrared

【Purpose and Background of the Research】

Since the first discovery of exoplanets orbiting main-sequence stars in 1995, more than 3,000 exoplanets have been discovered by the radial velocity, transit and other techniques. Most of them have Neptune-Jupiter mass. Super-earths or Earth-radius planets have been discovered only near the host stars. The gravitational microlensing is uniquely sensitive to cold, low-mass planets and planets not orbiting any host star, called "free-floating planets", thus complementary to other techniques.

The MOA collaboration is carrying out the microlensing exoplanet survey by using a 1.8m wide field of view (FOV) telescope at Mt. John Observatory in New Zealand. We found the first exoplanet via microlensing and a 5.5 Earth-mass planet which was the lowest mass at that time, etc. We found that cold Neptunes are the most common type of exoplanet yet discovered. But we have detected planets only down to two Earth-mass, we do not know frequency of Earth-mass planets. To increase the planet discoveries, we need to observe stellar-crowded fields near the Galactic center. This cannot be done in optical due to the high interstellar dust extinction and needs IR surveys.

【Research Methods】

When a foreground "lens" star aligns almost perfectly along the line of sight toward a background source star, the gravity of the lens star magnifies the light from the source star. If a planet orbits around the lens star, we can see a brief disturbance in the light curve due to the gravity of the planet (Fig.1) by long continuous and high cadence monitoring of millions of stars. In this research, we conduct the IR microlensing exoplanets search for the first time by construction a new 1.8m wide FOV telescope equipped with the world largest-class IR camera at South Africa. This becomes possible by making use of existing large IR detectors loaned from the team of NASA's future WFIRST space-mission.

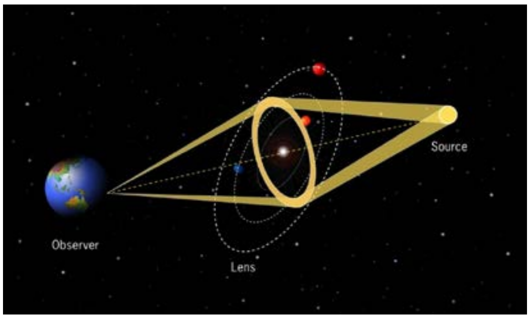

Fig 1 : A schematic of the microlensing exoplanet search technique.

【Expected Research Achievements and Scientific Significance】

By conducting the first IR microlensing exoplanet search toward the galactic bulge, we increase the event rates and expect to detect a few tens of exoplanets including Earth-mass planets and free-floating planets. This allow us to understand the formation mechanism and evolution of exoplanets. We can also compare the planet abundance in the stellar crowded region in the bulge to that of other fields. This dataset also allows us to optimize the observational fields for the future WFIRST microlensing exoplanet search.

【Publications Relevant to the Project】

"Unbound or distant planetary mass population detected by gravitational microlensing", Sumi, T. et al., Nature, 473, 7347, 349-352, 2011
"A Cold Neptune-Mass Planet OGLE-2007-BLG-368Lb: Cold Neptunes Are Common", Sumi, T., et al., The Astrophysical Journal, 710, 1641-1653, 2010

【Term of Project】 FY2016-2020

【Budget Allocation】 450,400 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.phys.canterbury.ac.nz/moa/