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What If Planet Nine Is Currently Near Its Perihelion?

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The outer solar system is theoretically predicted to harbor an undiscovered planet, often referred to as Planet Nine (P9). Simulations suggest that its gravitational influence could explain the unusual clustering of Kuiper Belt Objects (KBOs). However, there has been no observational evidence for the existence of P9 so far, since its predicted orbit is distantly beyond Neptune's, where it reflects only a faint amount of Sunlight. As a result, P9 is expected to be very faint in optical wavelengths. In addition, P9 was suggested to have a semi-major axis of 700 AU and an eccentricity of 0.6, which means the heliocentric distance of P9 could vary between 280 AU and 1120 AU. Such a large distance led to the need for far-infrared all-sky surveys to detect the thermal radiation from P9. Our previous work searched for P9 using IRAS and AKARI and found one P9 candidate in the distance range of 500 –700 AU with $M_{P9} \leq M_{Neptune}$. In this work, we continue our search with a closer distance range of 280 –500 AU due to the uncertainty of P9's current heliocentric distance. If P9 is currently approaching or passing its perihelion, we will have a chance to detect it in this work. We aim to search for P9 candidates moving slowly from an IRAS position to another AKARI position over 23 years with an angular separation of 69.6'–166'. The expected flux and orbital motion of P9 were estimated based on assumptions for its mass, distance, and effective temperature to ensure that it can be detected in two surveys. After a rigorous selection process, we found 3 good candidates from 643 possible IRAS –AKARI pairs. The AKARI detection probability map indicated that these 3 good candidates are likely slow-moving objects, which is consistent with our expectation of P9's motion.

Section

Solar System/Exoplanets

Primary author: Mr PHAN, Terry Long (Institute of Astronomy, National Tsing Hua University, Hsinchu, Taiwan)

Co-authors: Prof. GOTO, Tomotsugu (Institute of Astronomy, National Tsing Hua University, Hsinchu City, Taiwan R.O.C); Dr YAMAMURA, Issei (JAXA, Japan); Dr NAKAGAWA, Takao (JAXA, Japan); CHEN, Yu-An (NTHU); WU, Kent-Wei; HASHIMOTO, Tetsuya (NCHU); HO, Simon C.-C. (The Australian National University); KIM, Seong Jin (NTHU)

Presenter: Mr PHAN, Terry Long (Institute of Astronomy, National Tsing Hua University, Hsinchu, Taiwan)

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