P313b　遠いカイパーベルトの軌道構造の究明:未知の惑星の存在？

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Do the orbits of trans-Neptunian objects (TNOs) in the distant Kuiper Belt (¿50 au) indicate the existence of a new planet in the solar system? Three essential properties in the distant Kuiper Belt should be explained consistently: 1) A large population of TNOs with orbits too distant from Neptune’ s gravitational influence (with perihelia q ¿ 40 au; 2) The existence of extreme TNOs possessing peculiar orbits (e.g., Sedna); 3) TNOs with very high orbital inclinations (i ¿ 45 deg). Notably, these properties are difficult to explain in the current solar system. We performed N-body computer simulations of the outer solar system to investigate the effects of an undiscovered planet on the orbital structure beyond Neptune. We found that any resident planet should have at least 1 Earth mass and be located beyond 200 au to explain properties 1 and 2, and more massive and/or inclined planets (i ¿ 30 deg) are needed to explain property 3. We also confirmed that such planets could preserve the primordial resonant populations in the Kuiper Belt. This scenario also presents observationally testable predictions for new populations of TNOs that would exist due to the gravitational perturbations by this putative planet. These results will guide future astronomical surveys searching for undiscovered planets beyond Neptune.