# N-body simulations of planetary accretion around M dwarf stars

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We have investigated planetary accretion from planetesimals in terrestrial planet regions around M dwarf stars through *N*-body simulations including the effects of disk gas. Because of low luminosity of M dwarfs, habitable zones (HZs) are located at inner regions (0.1 AU). In the HZs, in spite of lower disk mass around M stars, the orbital decay due to gas drag and type-I migration is efficient. The migrating protoplanets are trapped at the disk inner edge that is close to the HZs, so the trapped protoplanets interact with protoplanets/planetesimals formed in the HZs. Ice lines are also in relatively inner regions at 0.3AU. Due to the small orbital radii, icy protoplanets accrete rapidly and undergo type-I migration. The effective orbital decay, the proximity of inner edge, and large amount of inflow of icy protoplanets are characteristic in planetary accretion in terrestrial planet regions around M dwarfs.

We have carried out *N*-body simulations of planetesimal accretion, including the damping of eccentricities, inclinations and semimajor axes due to aerodynamic and gravitational drag directly in orbital integrations as forces acting on the bodies. We found that after repeated close scatterings and occasional collisions, 3 to 4 planets eventually remain in orbits near the disk inner edge in mutual mean motion resonances and their orbits are stable both before and after disk gas decay. In the limiting case where type-I migration is negligible, more than 10 small protoplanets remain in mutual mean motion resonances, but they start orbit crossing and finally several non-resonant planets are formed. Thus, the final configuration of the planets near the inner edge sensitively depends on strength of type-I migration. We also show that large amount of water-ice is delivered from outer regions and final planets near the inner disk edge around M dwarfs would be generally abundant in water-ice except for the innermost one that is guarded by the outer planets.