Simulations of collisions proto-planets using smoothed particle hydrodynamics

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Protoplanet is celestical object that accrete from planetesimal disk around proto sun by runaway accretion. In the proto sun disk of minimum mass model of the solar system, a few tens of Mars to Moon sized protoplanets are formed in the terrestrical area. (Wetheril and Stewart, 1993; Kokubo and Ida, 1998, 2000, 2002) After this, by orbital crossing of these protoplanets, they fall down to the sun, escape from solar system, or collide with each other to be the solar system. (Chambers and Wetheril, 1998; Chambers, 2001; Iwasaki et al. 2002; Kominami and Ida 2002, 2004)

Therefore, collision between protoplanets occures the last stage of planetary formation. At least, the Earth-Moon system experienced these collision so-called giant impact, because the Earth-Moon system has large specific angular momentum, and depletion of iron and volatile element in bulk component of the Moon.

According to the simulations of impact and accretion of Earth's Moon using smoothed particle hydrodynamic (SPH) or N-body simulation, circum terrestrical disk enough to accrete the Moon is generated when the celectical object which has mass 0.1 times of proto-earth collides to the proto-earth. (Benz et al. 1986, 1987, 1989; Cameron and Benz 1991; Cameron 1997; Ida et al. 1997; Kokubo et al. 2000; Canup et al. 2001; Canup and Asphaug 2001; Takeda and Ida 2001; Canup 2004)

However, these simulations deals with narrow range of parameters because they are intended for the Earth's Moon. Therefore, we study impact simulations using SPH with plenty of simulations in wide range of parameters. In this case, the mass of centered proto-planet and colliding celestical object is fixed to 1 and 0.06 of present earth mass, respectively, and we deal with the case of eccentricity is 1, and varying distance of pericenter. As a result, profile of collision is largely changes by distance of pericenter. We introduce these results with analyse methods. We also introduce the mass re-distribution concerned with impact parameter. We show only dependence of distance of pericenter, because this study is the first case of our collision simulations. After this study, we will investigate the dependence of the other parameters inculding equation of state.