초청강연

Impact of Comet Shoemaker-Levy 9 on Jupiter

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The collision between comet Shoemaker-Levy 9 and Jupiter is now certain to occur between July 16 and 23, 1994, and there is also a more than 99% certainty that the collision will occur at the night side of Jupiter's southern hemisphere. The comet had been tidally shattered in July 1992 during its last close encounter with Jupiter. It is now bound in Jupiter's gravitational field and is aligned linearly consisting of more than a dozen fragments. Currently, the size of the progenitor claimed by several planetary astronomers varies from 5 to 10km in diameter, and the size distribution of the cometary fragments is not accurately known. According to an updated prediction, the length of the cometary nuclear train in July 1994 will be approximately 10 arcminutes, and the fragments will all strike Jupiter. Recently, HST images show coma and tail around each fragment suggesting continuous but modest dust production. Cometary dust may start colliding with Jupiter 2-3 months before the major collisions. According to recent calculations, the collision of a major fragment will release about $\sim 10^{29}$ ergs, and the temperature of the fireball might reach 30,000K. If the initial temperature of the explosion flash is approximately 30,000K, as predicted by Zahnle et al. (1993), the Planckian peak occurs at 1000 A . However, the nightside collision prohibits direct observation, although the Jovian satellites's reflection of the explosion flash may be detectable, and secondary pheonmena triggered by terminal explosions near the limb may be observable from the Earth. Observations of the Jovian satellites' reflection of the explosion flash in the visible range using sensitive photometers will be important in deriving the temperature of the fireball as a function of time. During the entry phases, the collisions between the Jovian high-altitude atmosphere and cometary dust, gas, and fragments will generate a significant amount of ionizde gases, which will be injected into the ionosphere. According to estimates from Zahnle et al., after the major fragment collision, the speed of the rapidly upwelling fireball will be more than 10km/sec, and its ejected material will reach a few thousand kilometers (into the magnetosphere) within several minutes. Therefore, the fireball will bring up not only Jupiter's tropospheric molecules(such as NH_3, PH_3, CH_4, and H_2O), but also cometary molecules (such as H_2O, CO, and CO_2)into the high altitudes of Jupiter. During the violent collision, the high temperature of the fireball will ionize and dissociate the molecules. As the fireball is rapidly cooled by rapid adiabatic expansion, the recombination process will produce neutral molecules, and condensation will produce high altitude hazes and H_2O clouds. Because of these thick hazes and clouds, we cannot observe low stratosphere and troposphere in the UV, visible, and infrared ranges. Therefore it is extremely important to investigate high altitude atmosphere including ionosphere. Within an hour, the extended atmosphere will subside by Jupiter's gravitation. Hours after the collision, Jupiter will rotate and directly face the Earth revealing the enormous disturbance of the Jovian atmosphere.