Orbital Debris

includes things such as hatches blown off space modules, paint fragments from the space shuttle, or satellites that are no longer in use. Most space junk is very small (for example, paint flecks). But there are over 7,500 objects orbiting Earth that are bigger than a baseball. These objects are tracked by ground-based radars. Man-made debris orbits at a speed of roughly 17,500 miles/hour (28,000 km/h)! Think of the damage even a small speck of paint could do if it hit a spacecraft at such a high speed! Even an object as small as small as a grape has enough kinetic energy to permanently hurt a medium-sized spacecraft! There are about 500 working spacecraft, including the International Space Station (ISS), that must be protected from space debris. Mostly, they are protected by shields that are not hurt by space junk. NASA tested different types of shielding in the Long Duration Exposure Facility (LDEF). The LDEF was put in orbit April 1984 by the Shuttle Challenger. It was collected 5.7 years later. Besides having shielding from space junk, a spacecraft can move out of the way to avoid getting hit by debris. Currently, the Center for Orbital and Reentry Debris Studies (CORDS) helps space mission controllers plan so as to avoid impacts between their spacecraft and space junk. Clearly, space debris is a danger to operating spacecraft in orbit around Earth. Is space junk a danger to life here on Earth? Though pieces of space junk have been known to fall to Earth from Oregon, U.S., to Uganda, Africa, falling space junk isn't likely to endanger humans or other life on Earth. Most space debris is small enough that it burns up in the atmosphere of Earth. Otherwise, it usually falls into the ocean which covers 2/3 of the planet. The North American Air Defense Command (NORAD) and United States Space Command (USSPACECOM) do monitor man-made objects in space using radar. They also track when space debris falls into the Earth's atmosphere or onto Earth. Orbital debris generally refers to material that is on orbit as the result of space missions, but is no longer serving any function. There are many sources of debris. One source is discarded hardware. For example, many launch vehicle upper stages have been left on orbit after they are spent. Many satellites are also abandoned at the end of useful life. Another source of debris is spacecraft and mission operations, such as deployments and separations. These have typically involved the release of items such as separation bolts, lens caps, momentum flywheels, nuclear reactor cores, clamp bands, auxiliary motors, launch vehicle fairings, and adapter shrouds. Material degradation due to atomic oxygen, solar heating, and solar radiation has resulted in the production of particulates such as paint flakes and bits of multilayer insulation. Solid rocket motors used to boost satellite orbits have produced various debris items, including motor casings, aluminum oxide exhaust particles, nozzle slag, motor-liner residuals, solid-fuel fragments, and exhaust cone bits resulting from erosion during the burn. A major contributor to the orbital debris background has been object breakup. More than 124 breakups have been verified, and more are believed to have occurred. Breakups generally are caused by explosions and collisions with other objects in space, but the majority of breakups have been caused to explosions. Explosions can occur when propellant and oxidizer inadvertently mix, residual propellant becomes overpressurized due to heating, or batteries become overpressurized. Some satellites have been deliberately detonated. Explosions can also be indirectly triggered by collisions with debris. Three collisions are known to have occurred since the beginning of the space age. In addition, the debris research community has concluded that at least one additional breakup was caused by collision. The cause of approximately 22 percent of observed breakups is unknown. Approximately 70,000 objects estimated to be 2 cm in size have been observed in the 850-1,000 km altitude band. NASA has hypothesized that these objects are frozen bits of nuclear reactor coolant that are leaking from a number of Russian RORSATs. At altitudes of 2,000 km and lower, it is generally accepted that the debris population dominates the natural meteoroid population for object sizes 1 mm and larger. Shahram Yazdanpanah

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