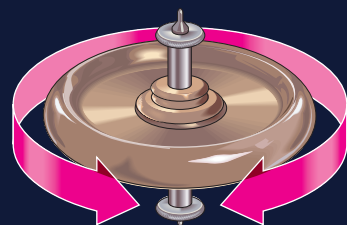


Hubble awaits repair mission

Shuttle Discovery's mission to the Hubble Space Telescope will enable a space-walking repair crew to replace the \$3.5bn spacecraft's failed gyroscope-pointing system, install a new computer, data recorder and radio, and patch up Hubble's damaged outer skin

Pointing Control System:

Thrusters cannot be used to position the Hubble because exhaust gas would damage its delicate mirrors. Instead, the HST uses gyroscopes, reaction wheels and basic physics to point at objects millions of light-years away – all while travelling at 17,500mph, 370 miles above the Earth



Action and reaction: Flight computer activates heavy reaction wheels which spin and generate momentum. In 1687 Isaac Newton established his *Third Law of Motion* – every action has an opposite and equal reaction – so, as Hubble spins its reaction wheels in one direction, the reaction wheels spin Hubble in the opposite direction. Hubble turns at similar speed to minute hand on a clock

Servicing mission: Robot arm used to grab HST and place it in Shuttle payload bay

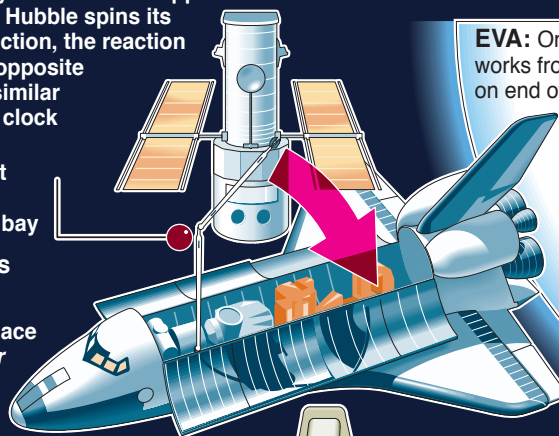
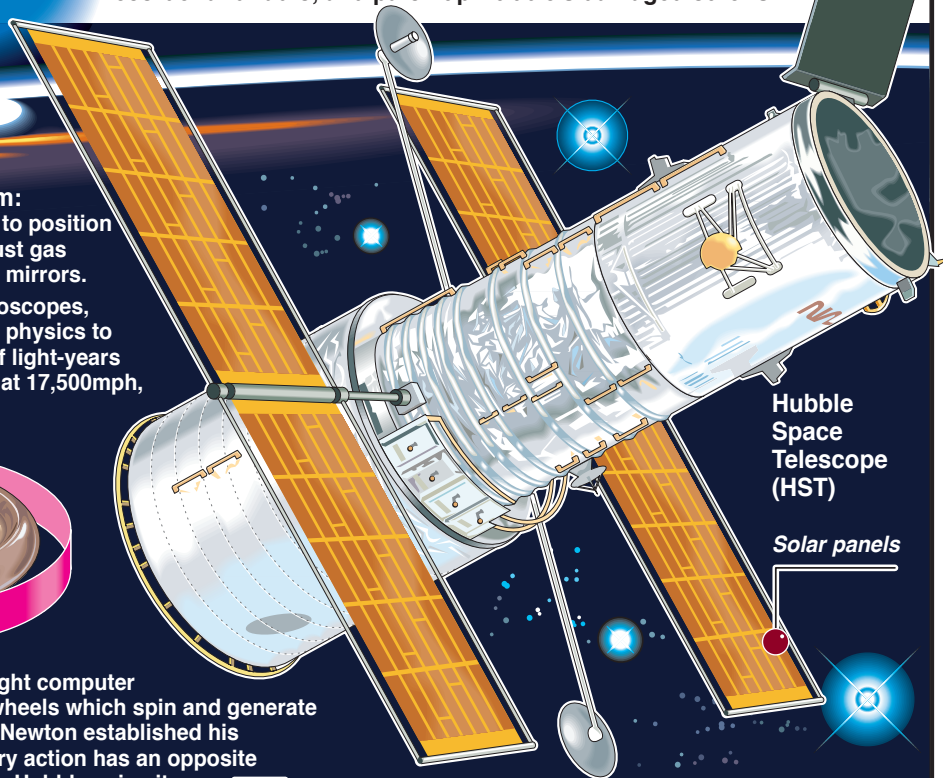
Extra-vehicular Activities
Four six-hour spacewalks

EVA Day 1: Astronauts replace Hubble's three *Rate Sensor Units* and install *Voltage/Temperature Improvement Kits* on HST's six batteries

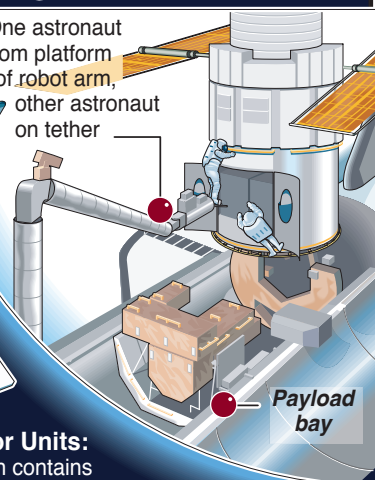
EVA Day 2: Second team replaces *Flight Computer* and *Fine Guidance Sensor* – system that locks onto a star

EVA Day 3: First pair of spacewalkers go out again to replace *Transmitter* and *Data Recorder*, upgrade electronics, and begin reinforcing Hubble's thermal skin

EVA Day 4: The second team returns to to finish attaching new thermal protection

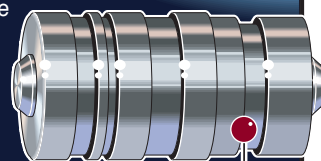
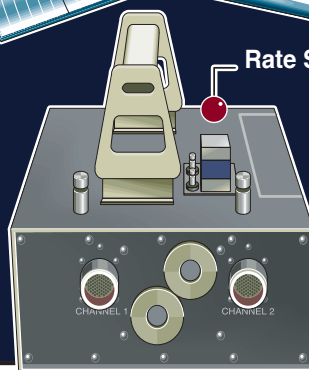


EVA: One astronaut works from platform on end of robot arm, other astronaut on tether



Rate Sensor Units:

Each contains two gyroscopes. Gyros sense movement of HST and send information to flight computer which calculates HST's exact position



Gyroscope