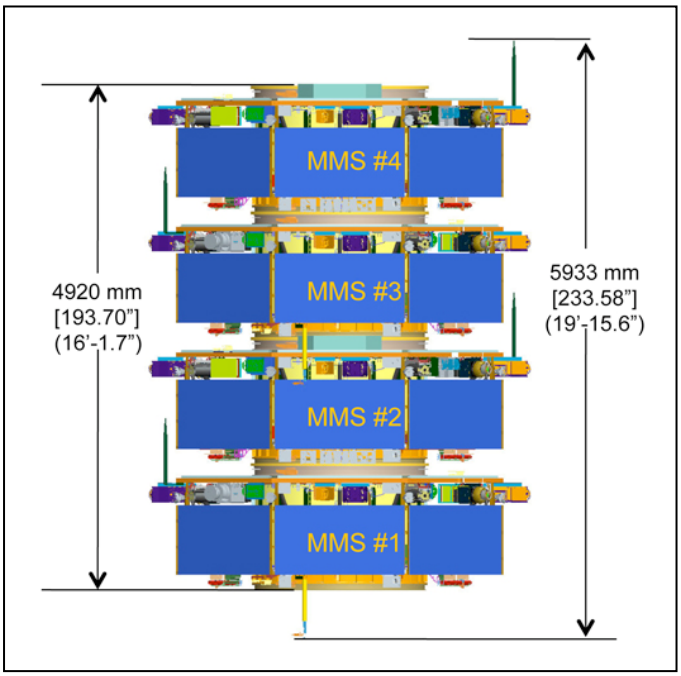
The Magnetosphere, Multi-Scale Constellation



In 2014, NASA will launch the 4-satellite constellation called the Magnetosphere, Multi-Scale Mission (MMS) to study the magnetic field of Earth. The four octagonal satellites can be approximated as cylinders, which will have to be stacked on top of an Atlas V rocket. The diameter of cylindrical volume inside the third-stage shroud is 4 meters in diameter, and 4.9 meters tall.

Problem 1 - The volume of each satellite is 12 cubic meters, and they are stacked at equal distances spanning the 4.9-meter height of the third stage. How much extra volume is there between the shroud and the satellites?

Problem 2 - What is the diameter of the satellite stack inside the shroud?

Answer Key

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Answer: The total volume occupied by the four satellites is just 4 x (12 cubic meters) = 48 cubic meters. The volume enclosed by the shroud has a diameter of 4 meters and a height of 4.9 meters, so as a cylinder, its volume is just V = (3.14) (2 meters)^2 (4.9 meters) = 62 cubic meters. The stacked satellites take up less volume than the shroud (48 < 62) by a difference of **14 cubic meters**.

Problem 2 - What is the diameter of the satellite stack inside the shroud?

Answer; V = 48 cubic meters, but the height is 4.9 meters, so 48 = (3.14) R^2 (4.9) and so R = 1.8 meters, and the diameter is **3.6 meters**. Since the shroud has a radius of 2, meters, there is about 0.2 meters of clearance around the spacecraft stack inside the shroud.