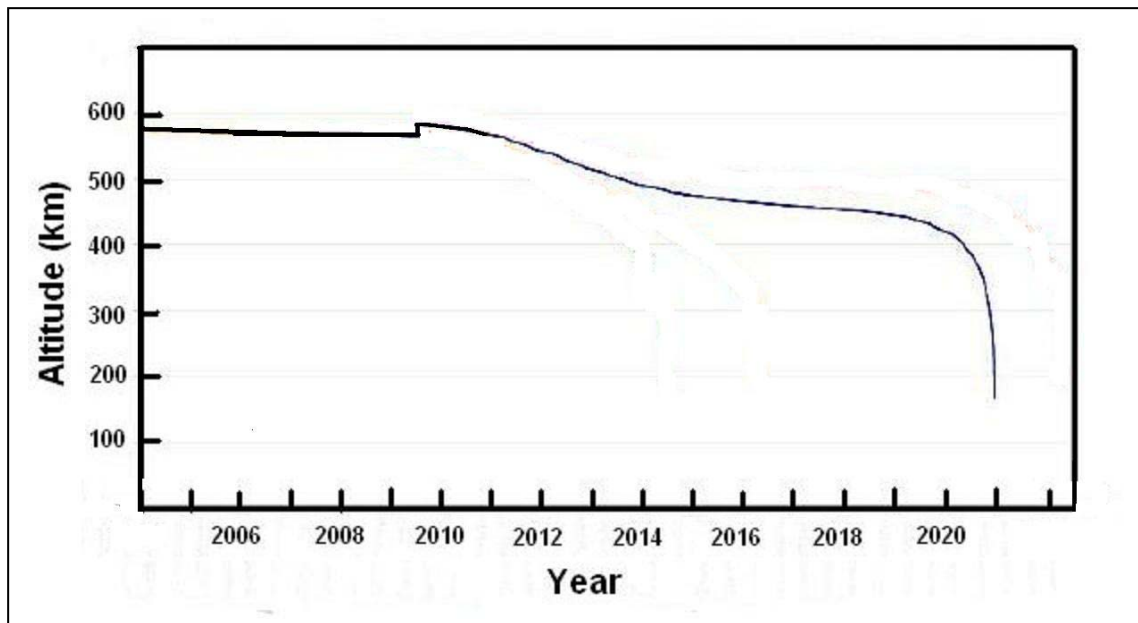


The Hubble Space Telescope was never designed to operate forever. What to do with the observatory remains a challenge for NASA once its scientific mission is completed in 2012. Originally, a Space Shuttle was proposed to safely return it to Earth, where it would be given to the National Air and Space Museum in Washington DC. Unfortunately, after the last Servicing Mission, STS-125, in May, 2009, no further Shuttle visits are planned. As solar activity increases, the upper atmosphere heats up and expands, causing greater friction for low-orbiting satellites like HST, and a more rapid re-entry.

The curve below shows the predicted altitude for that last planned re-boost in 2009 of 18-km. NASA plans to use a robotic spacecraft after ca 2015 to allow a controlled re-entry for HST, but if that were not the case, it would re-enter the atmosphere sometime after 2020.



Problem 1 – The last Servicing Mission in 2009 will only extend the science operations by another 5 years. How long after that time will the HST remain in orbit?

Problem 2 – Once HST reaches an altitude of 400 km, with no re-boosts, about how many weeks will remain before the satellite burns up? (Hint: Use a millimeter ruler.)

Problem 1 – The last Servicing Mission in 2009 will only extend the science operations by another 5 years. How long after that time will the HST remain in orbit?

Answer: The Servicing Mission will occur in 2009. The upgrades and gyro repairs will extend the satellite's operations by 5 more years, so if it re-enters after 2020 it will have about 6 years to go before uncontrolled re-entry.

Problem 2 – Once HST reaches an altitude of 400 km, with no re-boosts, about how many weeks will remain before the satellite burns up? (Hint: Use a millimeter ruler.)

Answer: Use a millimeter ruler to determine the scale of the horizontal axis in weeks per millimeter. Mark the point on the curve that corresponds to a vertical value of 400 km. Draw a line to the horizontal axis and measure its distance from 2013 in millimeters. Convert this to weeks using the scale factor you calculated. The answer should be about 50 weeks.

"HST science lifetime could potentially be limited by HST spacecraft orbital decay. Long-term orbit decay predictions are developed based on atmospheric models and solar flux predictions. All contributing combinations of solar flux strength and timing are run in order to bound the orbit decay predictions from a best case atmosphere to a worst case ("unkind") atmosphere. The predictions also consider the effects of Space Shuttle re-boost during HST Servicing Missions. The figure shows the model results for a worst case, 2-sigma high solar cycle (Cycle 24), followed by an early Cycle 25 of average intensity. Figure 3 depicts four curves for various shuttle re-boost scenarios. For the case of no further HST re-boost in any future servicing mission, the prediction is that HST will reenter the Earth's atmosphere in late 2013 or early 2014. The HST science program will cease approximately one year prior to re-entry due to loss of the precise attitude control capability required for science observing, as the atmospheric drag increases. The earliest expected end of the HST science program due to orbital decay is thus late 2012. Further information about this topic is contained in the accompanying Hubble Fact Sheet, entitled "HST Orbit Decay and Shuttle Re-boost." [From 'Expected HST Science Lifetime after SM4', HST Program Office; July 21, 2003]