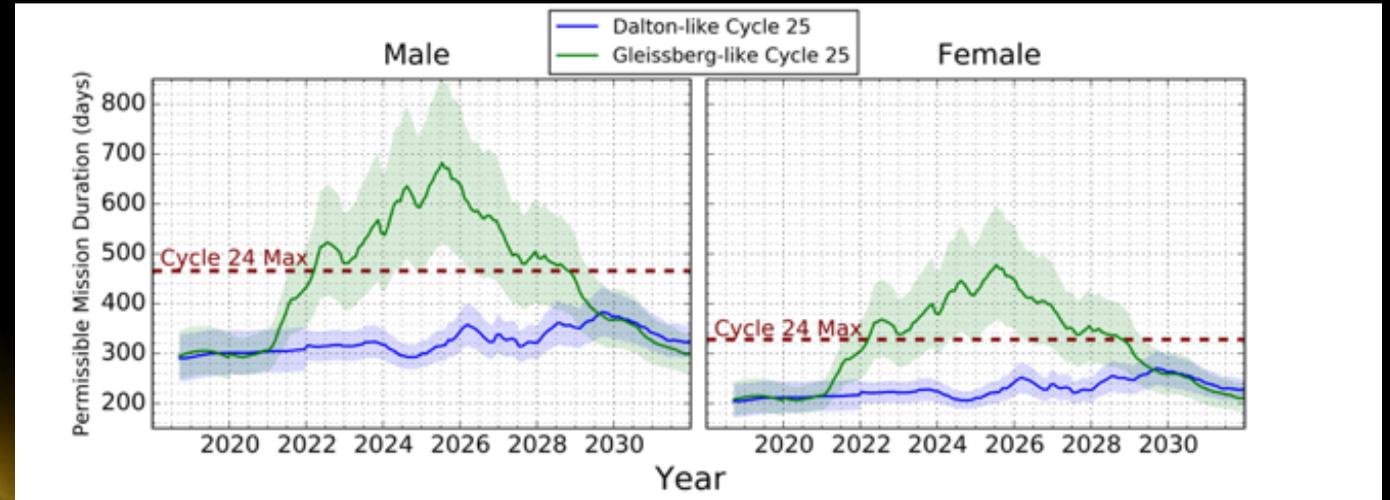


# Weaker Solar Cycles Will Affect Astronauts' Radiation Exposure



The sun has an 11-year cycle of activity, and we have just begun a new solar cycle. Over the last 70 years, the solar cycle has been consistently weakening, with fewer sunspots, flares, etc. The reason for this is unknown. A less-active sun means that the sun's magnetic field is not as extended as it might be. The sun's magnetic field protects the solar system from extremely high-energy particles coming in from other parts of our galaxy (cosmic rays). Galactic cosmic ray exposure for astronauts is already higher than it was in the 1960's and will most likely continue to get higher, limiting their time in space.

- In the 1990s, astronauts could travel through space for as much as 1000 days before they reached NASA safety limits on radiation exposure.
- For long-term missions, solar maximum is safer since galactic cosmic radiation falls to lower levels.
- Lunar missions are less limiting as transiting to the Moon and back takes a shorter time than the values found here, and shielding is provided by the lunar mass.
- Transit from Earth to Mars and back is 540 days.



This diagram shows two rates of solar activity for the next 15 years, based on an active (green) cycle and a quiet (blue) cycle. Dotted lines in red show maximum exposures for men and women. Based on UNH models of accumulated dose, in the coming years, cosmic rays could limit trips to as little as 290 days for 45-year old male astronauts and 204 days for females. For data about the difference in exposure for men and women, see:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6509159/>

F. Rahmanifard, et al., Galactic Cosmic Radiation in Interplanetary Space Through a Modern Secular Minimum, *Space Weather*, 10.1029/2019SW002428.

<https://spaceweatherarchive.com/2020/08/11/cosmic-rays-are-about-to-get-worse/>

Background image shows a quiet versus active sun, from NASA's SDO.