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Time: Tuesday 2:30 PM, Oct. 22th Location: A601, NAOC

Venus as Earth's Twin Sister

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Yuk Ling Yung is a professor at the Division of Geological and Planetary Sciences, California Institute of Technology. He obtained his Ph.D. in physics from Harvard University in 1974. A trail-blazing leader and world-renowned scholar, he's career coincided with the space exploration that began in the second half of the last century. Using the database provided by spacecraft missions, he contributes to the elucidation of the physical and chemical processes that control the origin and evolution of atmospheres, emphasizing the fundamental processes at planetary scales. The range of work is enormous, encompassing the giant planets, the highly evolved terrestrial planets, small bodies, extrasolar planets and the fate of our own planet. He was elected academician of Academia Sinica in 2010. He received NASA's medal for Exceptional Scientific Achievement in 2004. In 2015, he won the Gerald P. Kuiper Award of the American Astronomical Society and was named asteroid 19370.

Abstract

Planetary atmospheres are profoundly influenced by the photochemical action of solar radiation. On Earth, a major effect of solar ultraviolet absorption is the creation of the ozone layer in the upper stratosphere. This broad band of ozone in the region from 15 to 40 kilometers protects the surface of Earth from harmful ultraviolet radiation, which would otherwise be incompatible with the existence of the biosphere in its present form. Venus presents a novel and challenging problem to the atmospheric scientist because its atmospheric composition is very different from that of Earth and yet there are many similarities Although it might be assumed that the photochemical mechanisms of the two planets are very different, we will show that many of the important properties of the two upper atmospheres are controlled by related processes. The photochemistry of sulfur species in the upper atmosphere of Venus is not well understood. The parent molecules originating in the deep atmosphere are most likely SO_2 and OCS. At and above the cloud tops, these molecules are photolyzed, leading to the production of S, SO, SO_3 and H_2SO_4 (Mills et al. 2007). Recent work (Frandsen et al. 2016) suggests that the SO dimer (OSSO) could be as abundant as SO between 50 and 70 km. We explore the effects of new reactions involving OSSO and S_2O, which could provide important new sources of S_2 in the upper atmosphere of Venus. With these new sources of S_2, production of S_2 and hence polysulfur (S_x) could be much larger than in the earlier model of sulfur chemistry (Yung et al. 2009), where S_2 is mainly derived from OCS + hv = CO + S, followed by OCS + S = CO + S_2. The implications of our new model are that more complex sulfur compounds, beyond OCS, SO, SO_2, SO_3 and H_2SO_4, could contribute to the absorption of UV in the enigmatic 320-400 nm range. These results may be useful for interpreting new observations obtained from ESA's Venus Express and Japan's Venus Climate Orbiter, Akatsuki. We argue that the sulfur chemistry on Venus may resemble that of Earth before the rise of oxygen and that Venus may be the ultimate fate of all terrestrial planets.

All are welcome ; Tea and coffee will be served at 2:15 PM.