Speaker:
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Abstract:
Titan has remarkable features – a dense N_2 atmosphere and hydrological cycles of CH_4 – that are resemble to those of Earth. How did the atmosphere develop on Titan? Was its origin similar to that of Earth's atmosphere? Although these questions remain unsolved, the Cassini-Huygens mission has provided important clues to understand the origin of Titan's atmosphere. 1) The low abundance of primordial Ar indicates that Titan's N_2 would have been delivered in less volatile form, probably as NH_3. 2) Titan's interior may have been only partially differentiated or may consist of low-density rock materials, suggesting that the interior would have been cooler than previously thought. 3) Observations of Enceladus' plume suggest that the chemical composition of building materials of the Saturnian satellites would have been similar to that of comets; i.e., CO_2 would have been more abundant than CH_4 in the satellitesimals. 4) Relatively young surface age, high levels of radiogenic Ar, and the absence of global CH_4 oceans suggest recent degassing of CH_4 from the interior.

The observations 1) and 2) imply the importance of conversion process of NH_3 to N_2 on Titan while maintaining the interior cool. However, because all of proposed mechanisms converting NH_3 to N_2 (e.g., photolysis, shock heating, and impact) also dissociate primordial CO_2 to CO, the lack of abundant CO in the present atmosphere is a big issue. Furthermore, if Titan's interior is undifferentiated, this is apparently inconsistent with a view of young surface and recent degassing. So far, there is no model which explains the above observations consistently. In this paper, we review the proposed mechanisms to create a N_2-CH_4 atmosphere on Titan and discuss new problems raised by Cassini. Then, we will discuss a plausible history of Titan's atmosphere on the basis of the new observations.