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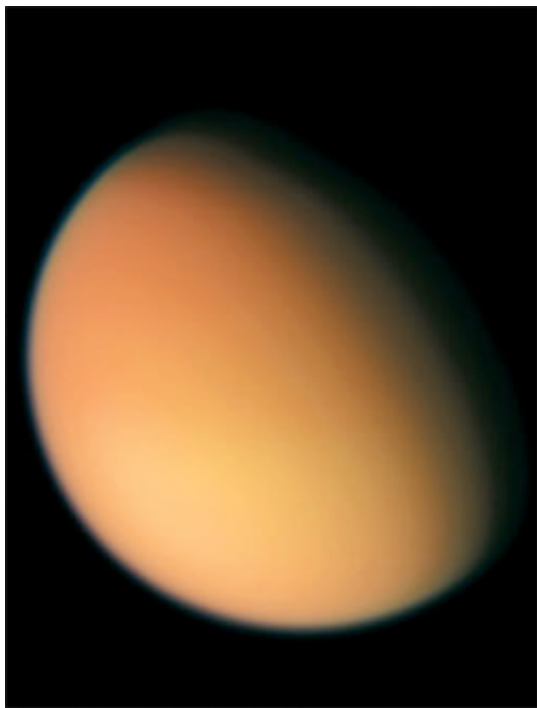
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Precursors To Titan's Smog

Planetary Science: Scientists begin to unravel the chemistry behind the orange haze cloaking saturn's moon

[Elizabeth K. Wilson](#)



NASA/JPL

Under visible light, Titan appears covered in a smoggy hydrocarbon haze.

Scientists have discovered a chemical reaction that may be responsible for producing some of the orange hydrocarbon haze on Saturn's giant moon, Titan.

In a lab here on Earth, University of Hawaii, Manoa, chemistry professor [Ralf I. Kaiser](#) and an international team of colleagues show that a simple bimolecular gas-phase reaction of the ethynyl radical (C_2H) with diacetylene (C_4H_2) produces the polyne triacetylene (C_6H_2) under ultracold conditions mimicking those on Titan (*Proc. Nat. Acad. Sci. USA* **2009**, *106*, 16078). Such a reaction, the researchers suggest, could produce in Titan's atmosphere a ready supply of precursors to a host of more complicated polyynes. Scientists have predicted for decades that polyynes contribute to the aerosol smog that envelops the moon.

Although Titan's atmosphere is composed largely of nitrogen and methane, a complex chemical system produces the hydrocarbon aerosols that give the moon its orange-brown tinge. Models predict that polyne chemistry dominates this

system in the middle region of Titan's atmosphere, around 600–800 km above the moon's surface.

This new piece in the puzzle still leaves questions, says [Sushil K. Atreya](#), director of the planetary space laboratory at the University of Michigan, Ann Arbor.

For example, whether the simple polyynes triacetylene can readily form the more complicated polyynes thought to give rise to Titan's smog still needs to be tested. "This experiment is a promising first step in that direction," Atreya says.

The picture is further complicated by the likelihood that in higher atmospheric regions (above 900 km), a different chemistry dominates, producing aerosols via negative-ion chemistry. Below the 600-km region, nitrile and polycyclic aromatic hydrocarbons (PAHs) play a key role in generating the haze.

The complex mixture of hydrocarbons in Titan's atmosphere is largely unexplored, Atreya says. Experiments like those by Kaiser's team "can shed some light on their nature," he adds.

"This is just the beginning," Kaiser tells C&EN. The next step, he says, will be to study how aromatic molecules such as benzene and PAHs can be formed in the gas phase and at the low atmospheric temperatures found on Titan.

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