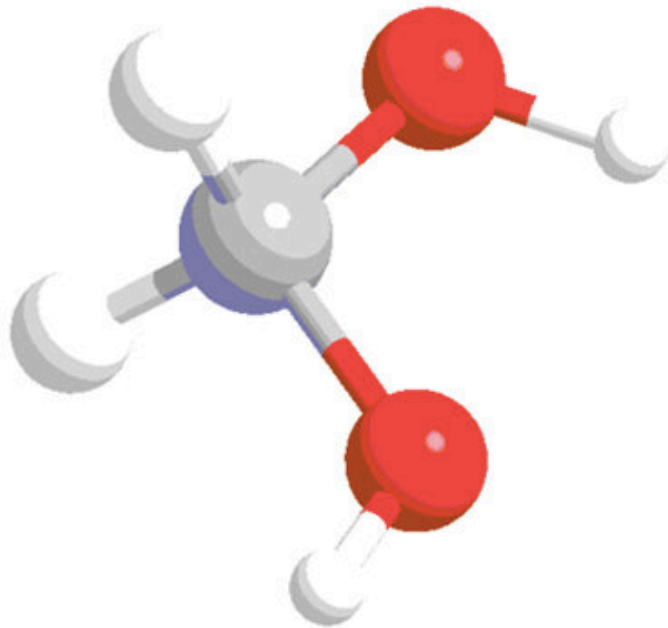


# Elusive atmospheric molecule produced in a lab for the 1st time

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Methanediol molecule. Credit: University of Hawaii

The previously elusive methanediol molecule of importance to the organic, atmospheric science and astrochemistry communities has been synthetically produced for the first time by University of Hawai'i at Mānoa researchers. Their discovery and methods were published in *Proceedings of the National Academy of Sciences* on December 30.

Methanediol is also known as formaldehyde monohydrate or methylene glycol. With the chemical formula  $\text{CH}_2(\text{OH})_2$ , it is the simplest geminal diol, a molecule which carries two hydroxyl groups (OH) at a single carbon atom. These [organic molecules](#) are suggested as key intermediates in the formation of aerosols and reactions in the ozone layer of the atmosphere.

The research team—consisting of Department of Chemistry Professor Ralf Kaiser, postdoctoral researchers Cheng Zhu, N. Fabian Kleimeier and Santosh Singh, and W.M. Keck Laboratory in Astrochemistry Assistant Director Andrew Turner—prepared methanediol via energetic processing of extremely low temperature ices and observed the molecule through a high-tech mass spectrometry tool exploiting tunable vacuum photoionization (the process in which an ion is formed from the interaction of a photon with an atom or molecule) in the W.M. Keck Laboratory in Astrochemistry. Electronic structure calculations by University of Mississippi Associate Professor Ryan Fortenberry confirmed the gas phase stability of this molecule and demonstrated a pathway via reaction of electronically excited oxygen atoms with methanol.

The findings, researchers said, advances their perception of the fundamental chemistry and chemical bonding of geminal diols and signifies their role as a key player in atmospheric and interstellar environments. Astronomers may now be able to use radio telescopes to identify elusive [molecules](#), such as methanediol, in [deep space](#).

This versatile strategy to first synthesize molecules, such as geminal diols, prior to their search in star forming regions, may eventually bring us closer to an understanding of the molecular structure and chemical bonding of exotic organic molecules, which according to textbooks "should not exist." The authors are also planning the investigation of the stability and preparation of methanetriol [ $\text{CH}(\text{OH})_3$ ] and methanetetraol

[C(OH)<sub>4</sub>].

**More information:** Cheng Zhu et al, Synthesis of methanediol [CH<sub>2</sub>(OH)<sub>2</sub>]: The simplest geminal diol, *Proceedings of the National Academy of Sciences* (2021). [DOI: 10.1073/pnas.2111938119](https://doi.org/10.1073/pnas.2111938119)

Provided by University of Hawaii

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