

Investigating the link between N₂O ionization and ozone depletion

August 2 2024, by Samuel Jarman





Schematic view of the experimental setup. The electron gun and Faraday cup (FC) were fixed in position, while the electron spectrometer was mounted on a turntable. The scattering (emission) angle θ of electrons to be detected was adjusted by rotating the turntable. Credit: *The European Physical Journal D* (2024). DOI: 10.1140/epjd/s10053-024-00880-0

Man-made emissions of nitrous oxide (N_2O) are rapidly increasing globally and are predicted to pose a growing threat to Earth's ozone layer. In the 1970s, it was discovered that N_2O in the upper atmosphere can trigger ozone-depleting reactions through its interaction with lowenergy electrons. However, the full impact of this process on the ozone layer remains poorly understood.

New research <u>published</u> in *The European Physical Journal D*, led by Mareike Dinger at the national metrology institute of Germany (PTB) in Braunschweig, Germany, provides extensive experimental data on the interaction between N_2O and these low-energy electrons. Their <u>measurements</u> could offer deeper insights into the influence of manmade N_2O emissions on the future state of Earth's ozone layer.

 N_2O is chemically inert, allowing it to rise into the stratosphere without being degraded by other gases. Here, it can be ionized by low-energy electrons, which are generated from <u>cosmic rays</u> from space interacting with atoms and molecules in the atmosphere. This causes the gas to fragment into substances like <u>nitric oxide</u> (NO), which then acts as a catalyst in reactions that convert ozone into other forms of oxygen.

To investigate this process, Dinger's team studied the "electron-impact ionization cross-section" of N_2O , which measures the probability of N_2O



ionization by an electron, accounting for the directions and energies of the in- and out-going electrons.

The researchers compared their measurements with theoretical calculations and previous experimental results. Through these comparisons, they created new datasets of expected values for N_2O ionization cross-sections, which could improve simulations of interactions between man-made N_2O and electrons in the <u>upper atmosphere</u>.

The team hopes their results will help researchers make more accurate predictions about how atmospheric ozone levels will be impacted by manmade N_2O emissions, contributing to efforts to protect Earth's <u>ozone</u> <u>layer</u> in the coming decades.

More information: M. Dinger et al, Differential elastic scattering and electron-impact ionization cross sections of nitrous oxide, *The European Physical Journal D* (2024). DOI: 10.1140/epjd/s10053-024-00880-0

Provided by SciencePOD

Citation: Investigating the link between N₂O ionization and ozone depletion (2024, August 2) retrieved 2 August 2024 from <u>https://phys.org/news/2024-08-link-ionization-ozone-depletion.html</u>

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