Metastable Oxygen Production by Electron-Impact of Oxygen

JEFFREY HEIN, PAUL JOHNSON, ISIK KANIK, Jet Propulsion Laboratory, CHARLES MALONE, California State University, Fullerton — Electron-impact excitation processes involving atomic and molecular oxygen are important in atmospheric interactions. The production of long-lived metastable O($^1S$) and O($^1D$) through electron impact of atomic O and molecular O$_2$ play a significant role in the dynamics of oxygen-containing atmospheres (Earth, Europa, Io). Emissions from metastable O ($^1S \rightarrow ^1D$) produce the well-recognized green light from terrestrial aurora. Electron-impact excitation to $^1S$ and $^1D$ are sensitive channels for determining energy partitioning and dynamics from space weather. Electron-impact excitation cross sections determined through fundamental experimental studies are necessary for modeling of natural phenomena and observation data. The detection of metastable states in laboratory experiments requires a novel approach, since typical detection techniques (e.g., fluorescence by radiative de-excitation) cannot be performed due to the long-lived nature of the excited species. In this work, metastable O is produced through electron impact, and is incident on a cryogenically cooled rare gas matrix. The excimer production and subsequent rapid radiative de-excitation provides measurable signal that is directly related to the originating electron-impact excitation process

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