## Chemical Processes in the Space Environment

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**Abstract:** The present report discusses a series of ion-neutral collision experiments conducted in direct collaboration between Orion researchers and USAF customer affiliated sequentially with: PL/WSSI, PL/GPID, PL/GPOS, AFRL/VSBM, AFRL/VSBS. The work addresses hyperthermal chemical processes of importance in the space environment. The reaction between ionospheric ions and water were studied in detail as to the potential source of infrared radiation and ionospheric holes. New experiments were developed to study the reactions of **atmospheric** ions with metal **vapors** and to investigate metastable formation in the nonequilibrium environments of supersonic jets. The energy dependence of **atmospheric** ion + Na charge-transfer reactions were measured using a novel high- temperature octopole for which a US patent was granted. The results were transitioned to a model of **atmospheric**, meteoric metal layers. The methodology was developed to elucidate molecular ion excited state surface topography using photofragment recoil velocity analysis in an octopole ion guide.



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« Back to search