UNIVERSITÀ DI TRENTO | Department of Physics

A Quantum of Matter

Microscopic Dynamics of Atomic Oxygen Reactions with Aromatic Molecules: From High-Temperature Chemistry to Astrochemical Environments

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Aula A205 – Polo Ferrari (Povo 1), Povo

Understanding the oxidation mechanisms of aromatic molecules at the microscopic level is crucial for a broad range of chemical environments, from high-temperature systems to planetary atmospheres and interstellar chemistry. In this seminar, I will present recent experimental investigations on the reactions of atomic oxygen with aromatic and heteroaromatic compounds, focusing in particular on thiophene as a model sulfur-containing system. The study is carried out using the crossed molecular beam (CMB) technique under single-collision conditions, allowing a detailed characterization of reaction pathways, product branching ratios, and energy partitioning among translational and internal degrees of freedom. Special attention will be devoted to the competition between $O(^3P)$ and $O(^1D)$ electronic states and their role in driving distinct reaction mechanisms, including CO formation and ring-contraction processes. The results provide new insights into the microscopic mechanisms governing the oxidative degradation of complex organic molecules, with implications for soot formation, gasification processes, and the chemical evolution of planetary surfaces such as Mars, where reactive oxygen species are expected to contribute to the chemical processing of refractory organic matter. The seminar will also highlight how experimental observables can be used to disentangle reaction dynamics and provide stringent benchmarks for theoretical and statistical models.

Who is Gianmarco Vanuzzo?
Gianmarco Vanuzzo is a postdoctoral researcher in physical chemistry at the University of Perugia, working in the group of Prof. Nadia Balucani. His research focuses on experimental studies of bimolecular reaction dynamics in the gas phase using crossed molecular beams. His work addresses fundamental reaction mechanisms relevant to high-temperature chemistry, astrochemistry, and materials degradation in extreme environments, including low Earth orbit conditions. He has extensive experience in high-vacuum instrumentation, mass spectrometry, and the study of reactive species such as atomic oxygen and radicals. He has served as principal investigator for experiments at synchrotron facilities, where he investigated ion–molecule reactions under controlled conditions. He has also presented his research at several international conferences, including invited lectures on gas-phase oxidation chemistry in astrochemical and high-temperature environments.

A Quantum of Matter is a series of events dedicated to the research in Physics of Matter that is carried out in the **Physics Department of the University of Trento**. The goal of **A Quantum of Matter** is to develop synergies and collaborations between research groups: for this reason, the seminars will focus not only on the results obtained, but also on the techniques employed by the groups and on the possible research themes that could be developed in partnership, leaving plenty of room for exchange of opinions and discussion.

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