Highly-charged molecular ions: From aufbau principle and chemical bonding to fundamental physics

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Highly-charged atomic ions display a wealth of intriguing features, ranging from compressed level structures and altered level arrangements to enhanced relativistic effects and pronounced sensitivities with respect to a hypothetical change of fundamental constants in space and times. Their molecular counterparts would typically be driven towards Coulomb explosion, but near the stability edge the interplay between Coulombic repulsion and chemical bonding [1,2] can lead to molecules in high charge states that become promising candidates for precision spectroscopy featuring favourable sensitivities to fundamental physics [3].

In this talk, I will discuss chemical bonding in heavy-elemental diatomic molecules in various charge states, arrangements of electronically excited states in these molecules and opportunities to use them as probes for fundamental physics, for instance to search for a violation of symmetries with respect to spatial inversion and time reversal.

[1] D. Schröder, M. Diefenbach, T. M. Klapoetke, H. Schwarz, Angew. Chem. Int. Ed., 1999, 38, 137-140
[2] D. Schröder, H. Schwarz, J. Phys. Chem. A, 1999, 103, 7385-7394
[3] C. Zülch, K. Gaul, S. M. Giesen, R. F. Garcia Ruiz, R. Berger, arXiv:2203.10333