Master OAM – Proposition de projet M1

INPHYNI
Université Côte d'Azur

Where are the lowest excited states in Fr^+ ?

Theoretical study

General context.— Francium is the heaviest observed alkali atom, and it lacks stable isotopes. The most long-lived isotopes have half-lives of just over 20 minutes. This means that the production, and the experiments, have to be done at a facility for heavy radioactive ions.
To prepare experiments with an atom, or an ion, one first have to make a proper survey of what data that is already measured, with what precision, and also what theoretical estimates that exist. Continuing from that, one can make further plans. In the case of singly ionised francium, there is a problem with this.

As it happens, for the Fr ion, nothing at all has ever been measured. This is partly because the difficulties associated with the production, but also because singly ionised Fr has the spectroscopic properties of a noble gas (filled valence orbital, iso-electronic with Rn). It is possible to make a theoretical calculation, but it is extremely complex. Therefore, it is best to start to guess the most important features of the structure by extrapolating from data existing for other atoms and ions.

Objectives.

1. Becoming familiar with existing databases on atomic spectra, and to learn how to use them.
2. Learn to understand the basics of the electronic structure for the ground state and lowest excited states of Fr^+, by studying published data on Rn, Cs^+, Fr, Cs and other elements.
3. Make predictions for the energy of the first excited state, and the ionisation limit using extrapolation.

Contact.— Anders KASTBERG : `anders.kastberg@unice.fr`

Références :

[1] A. Kastberg, *Structure of Multielectron Atoms*, (Springer, New York, 2020)

[2] NIST Atomic Spectra Database : https ://www.nist.gov/pml/atomic-spectra-database