

## Atomic Computations — Tasks

**Task 1:** Calculate the low-lying levels of two elements magnesium (Mg) and nobelium (No) with regard to their  $^1S_0$  ground level.

- a) Compute the lowest 10 levels of neutral Mg and compare their excitation energies with the NIST data tables.
- b) Compute a number of low-lying levels of neutral No. Analyze the excitation of the  $7s$  electron to the  $6d$ ,  $7p$ ,  $7d$  shell.
- c) Why are these elements NOT homologous, although they share rather an analogue valence shell structure ?

**Task 2:** Compute and analyze the isotope shifts of  $\text{Sc}^+$ .

- a) Compute and analyze the low-lying levels levels of  $\text{Sc}^+$ .
- b) Compute the (radiative) lifetimes of all  $[\text{Ar}] 3s3p$ ,  $3s3d$  and  $3p^2$  levels.
- c) Compute and discuss the mass- and field-shift parameters for the two  $3s^2 \ ^1S_0 - 3s3p \ ^{1,3}P_1$  transition lines.

**Task 3:** Compute the  $K - LL$  Auger lines and rates for neutral neon as well as for neon-like argon and krypton.

- a) Compare the energies and rates for these three ions.
- b) Compare the same Auger lines but for phosphorus-like krypton. Compare the lifetimes of the initial  $1s$  hole.