Relativistic effects in atomic structure theory

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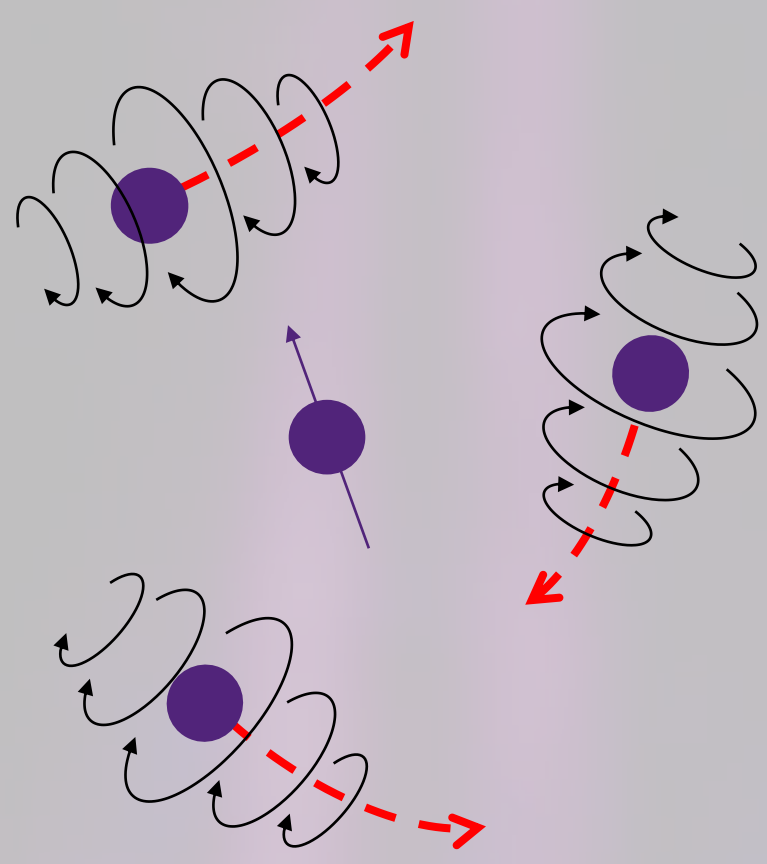
The Breit interaction

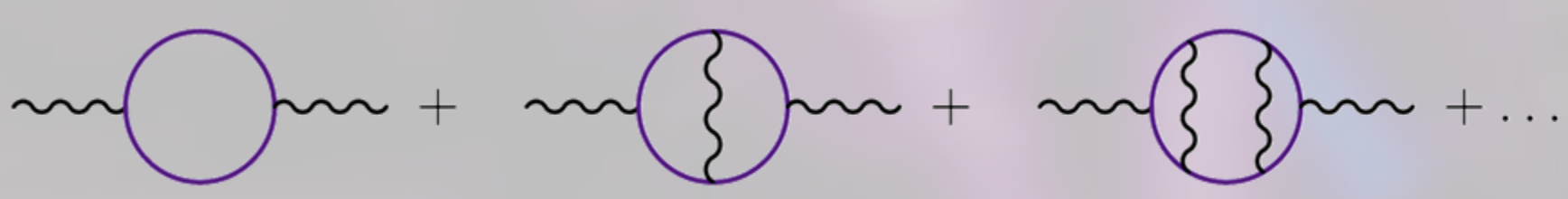
- In atomic calculations, electron interactions are often modelled via the **(non-relativistic)** Coulomb interaction
- Works well for light and neutral atoms, but fails for **highly relativistic** systems
- The **Breit interaction** is the first-order relativistic correction to the Coulomb interaction
- Captures magnetic (**spin-spin** and **spin-orbit**) interactions to order $(v/c)^2$



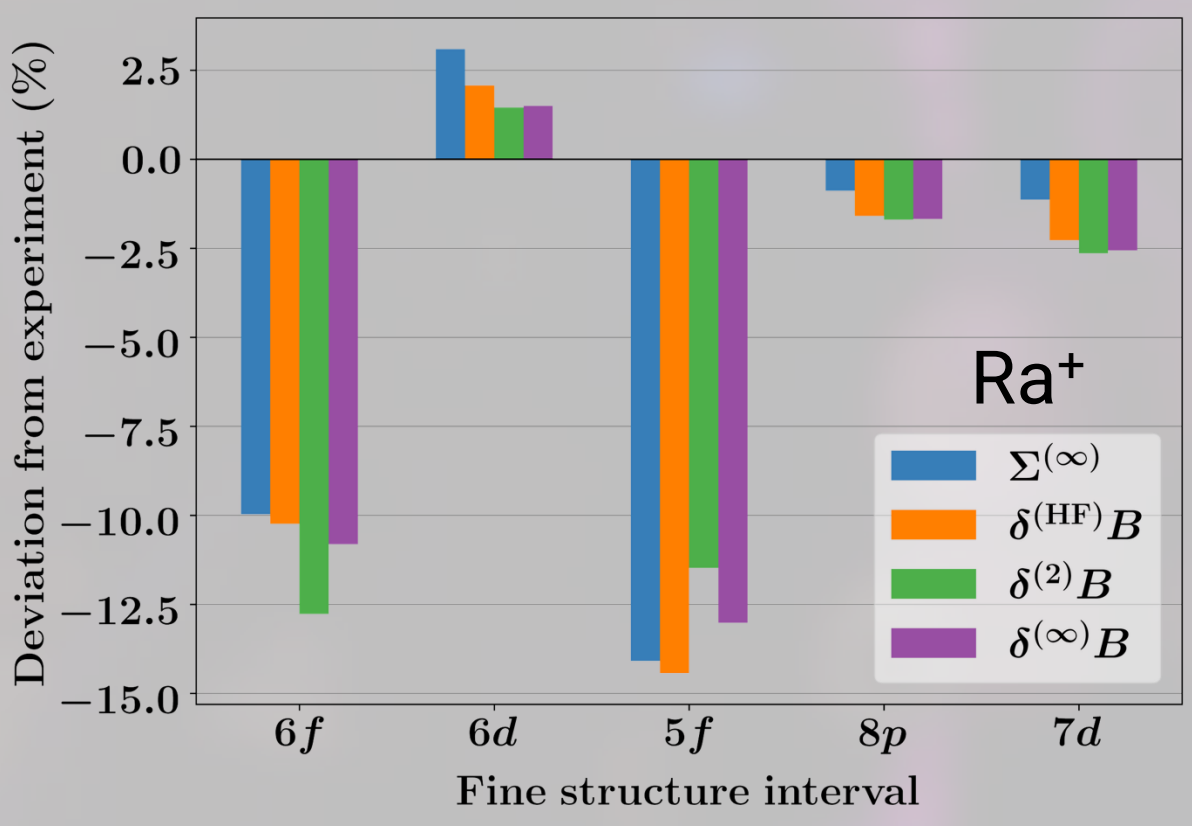
How do we include Breit into calculations?

- Including Breit to 2nd order in perturbation theory is known to converge for atoms like ^{133}Cs
- It does **not** seem to converge in heavier ions like ^{226}Ra and ^{229}Th
- I want to use the **Feynman diagram** method to include Breit **exactly** to **all orders** in certain diagrams, e.g.,

and



Results and conclusions



- Including Breit to all orders does **not** seem to meaningfully **reduce deviation from experiment**
- Could be that there are **other many-body** or **relativistic effects at play**
- May be important for the development of the **first nuclear clock**, potentially using ^{229}Th^{3+}