[lex173] Magnetic ground state of some Lanthanide ions

According to the Periodic Table [lln10], The electronic configurations of four Lanthanide atoms are as follows:

$$\text{(i) Holmium} : [\text{Xe}]4f^{11}6s^2, \quad \text{Ho}^{3+} : [\text{Xe}]4f^{10},$$

$$\text{(ii) Cerium} : [\text{Xe}]4f5d6s^2, \quad \text{Ce}^{3+} : [\text{Xe}]4f,$$

$$\text{(iii) Praseodymium} : [\text{Xe}]4f^{3}6s^2, \quad \text{Pr}^{3+} : [\text{Xe}]4f^{2},$$

$$\text{(iv) Ytterbium} : [\text{Xe}]4f^{14}5d6s^2, \quad \text{Yb}^{3+} : [\text{Xe}]4f^{13}.$$

Xenon [Xe] has all shells closed (either filled or empty). A triply ionized ion of each Lanthanide element (except Lanthanium itself) leaves only the 4f shell open (partially filled), which then governs its magnetism.

Reason along the lines worked out for Dysprosium in [lln22] to determine the spin S, the orbital angular momentum L, and the total angular momentum J of each ion in its ground state as predicted by Hund's rules. Write the result in symbolic notation, but include all steps of inference.

Solution: