Effect of the magnetic anisotropy on magnons in the VSe_2 bilayer antiferromagnet

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The magnon properties in a two-dimensional antiferromagnetic bilayer magnetic system based on the ferromagnetic insulator VSe_2 is investigated. The both T and H-type bilayer stackings are considered within the Heisenberg model including additionally terms describing the single-ion anisotropy as well as the term that describes the effective in-plane anisotropies due to spin-orbit interactions. The applied magnetic field is also taken into account to split the degenerated magnon modes. Magnon energy spectra are derived from the eigenvalue problem for the bosonic system, obtained within an eight-dimensional Bogoliubov transformation combined with a Holstein-Primakoff transformation applied to the assumed model Hamiltonian. For numerical analysis the density functional theory (DFT) calculations were used to evaluate the single-ion anisotropy energy as well as the parameter describing the interlayer antiferromagnetic coupling in both the T and H phases. It is shown that an interplay between the in-plane and out-of-plane anisotropies modifies qualitatively the magnon behaviour in the vicinity of the Γ point. The evolution of the magnon modes due to the applied magnetic field is also discussed and their behaviour is explained for dispersion relations calculated along the high-symmetry paths in the Brillouin zone.