How can a magnetic field influence the evaporation of water?

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A static magnetic field should not be expected to have any appreciable influence on the evaporation rate of water because the magnetic energy per mole $(1/2\mu_0)c_{mol}B_2$ in 1 T is seven orders of magnitude less than the energy of the hydrogen bonds. Nevertheless when evaporation from half-filled beakers ia compared in a field of 0,5 T and no field. the evaporation rate in-field is 12 ± 7 greater. However, in-field evaporation from 6M urea or 1M NaCl solutions is about 20% slower than no field evaporation [1]. The critical feature is whether or not the water is evaporating into its own vapour. The field effect is up to an order of magnitude greater when the evaporation from a water droplet at the centre of a microchannel is measured [2]. The explanation is related to an influence of magnetic field on the symmetry of the wave function of water vapour. There are two nuclear isomers, *ortho* water vapour with parallel spins of the hydrogen protons forming a triplet state and *para* water vapour where the spins are antiparallel. In thermodynamic equilibrium the *ortho* /*para* ratio is 3:1 but the two isomers behave as quasi-independent gasses and equilibrium takes weeks to establish. Analysis of the field and time-dependence of the evaporation rate of deionized water indicates that the isomeric ratio in fresh water vapour is 39:61 rather than 75:25. The field effect is due to dephasing of the nuclear Larmour precessions of the two protons in a water molecule, which tends to equalize their populations.

References:

[1] S. Poulose *et al.* J. Colloid Interface Science **619** 814-824 (2023) 10.1016/j.jcis.2022.09.021
[2] S. Poulose *et al.*, IEEE Magnetics Letters **14** 1-5 (2023) 10.1109/LMAG.2023.3262976