Ammonia (1,1) Inversion Lines: Can They be Velocity Tracer?

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An ammonia (1,1) inversion line has 4 satellite lines and they often exhibit anomalous intensity ratios towards star-forming cores. This line-intensity anomaly can not be reproduced either the LTE assumption or even with a non-LTE treatment in the static core. In an attempt to investigate the effect of systematic motions inside the core on the hyperfine line intensity, we have constructed a radiative transfer code for ammonia molecule, fully taking into account the line overlap effect caused by systematic motions. It is shown that in a bundle of transitions from (2,2) to (1,1) levels, photons emitted from one transition is absorbed in another transition due to the systematic motion, resulting in a drastic change in the excitation conditions of (1,1) sub-states. Expansion (contraction) strengthens the satellite lines in the red (blue) side, while suppressing the ones in the blue (red) side. The line anomaly gets prominent as the column density of ammonia increases. It is concluded that the hyperfine line intensity could be a good probe to trace velocity field inside the star-forming cores, without relying on the detailed analysis of the line shape.