

Production of polarized HD molecules in different spin states

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An atomic beam source (ABS) following the Stern-Gerlach effect is normally used to produce a beam of hydrogen or deuterium atoms in single hyperfine states. In our apparatus these atoms can recombine on different surfaces into molecules. Depending on the chosen surface material the former nuclear polarization of the atoms is at least partially preserved in the molecules.

In recent experiments we run our ABS with hydrogen and deuterium atoms in parallel and could polarize both isotopes separately. When those atoms recombine into molecules we produce H_2 , D_2 and HD molecules at the same time.

After ionization and acceleration of these molecules we could separate the HD^+ ions from the other ions with a Wien-filter and measure the nuclear polarization of both nucleons with the Lamb-shift polarimeter simultaneously. Depending of the hyperfine states that are determined by the ABS different spin-isomers, the HD could be produced and used for further measurements. E.g. the shifting of the rotation axis in the HD molecule closer to the deuteron was determined in dedicated measurements.

In a next step we will try to freeze out the polarized molecules on a cold surface at about 3K to collect the HD gas as polarized ice. With NMR sensors the polarization can be observed and the relaxation time be measured. Due to the similar spin of hydrogen and tritium the HD molecule is a nice tool to study the behavior of polarized DT molecules, which would be the perfect polarized fuel for future fusion reactors.