Spin-polarized hydrogen isotopes from UV molecular photodissociation, and nuclear-spin-polarized molecules from IR rovibrational excitation followed by hyperfine beating

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I describe two novel methods for the production of spin-polarized atoms and molecules, through the UV and IR optical excitation of molecules:

First, the UV photodissociation of hydrogen-isotope halides (e.g. HCl, DI, TBr), with circularly polarized light, can produce, at first, highly electron-spin-polarized H/D/T atoms [1,2,3]. Subsequently, the electron polarization is transferred to the nuclei via the hyperfine interaction. By ionizing at the appropriate time delay, highly spin-polarized H/D/T nuclei can be produced, at very high densities and production rates. I discuss proposals, based on this method, for measuring polarized laser fusion of D-T, D-^{3}He, and D-D reactions [4].

Second, the IR rovibrational pulsed-excitation of molecules, with circularly polarized light, followed by the hyperfine interaction, produces spin-polarized nuclei, after an optimal time delay [5,6,7]. The nuclear polarization can be isolated in the nuclei, by terminating the hyperfine beating, either by photodissociating the molecule or trapping them at surfaces. The large production rates possible using this method will be discussed.

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