Circular Dichroism of RbHe and RbN$_2$ Molecules$^1$ BRIAN LAN-COR, University of Wisconsin-Madison, EARL BABCOCK, Juelich Center for Neutron Science, ROBERT WYLLIE, THAD WALKER, University of Wisconsin-Madison — Spin exchange optical pumping (SEOP) is a method for producing spin polarized $^3$He through collisional transfer of angular momentum from an optically pumped Rb vapor. A long standing concern is that SEOP is much less efficient than theoretically predicted; it takes more laser power to polarize a given number of $^3$He nuclei than expected. We have investigated the effect of Rb-He and Rb-N$_2$ collisions on the quality of the dark state necessary for efficient optical pumping. N$_2$ and $^3$He collisions break the angular momentum selection rules and make the dark state weakly absorbing. With direct transmission measurements of a probe beam propagating through highly polarized atoms, along with precise Rb spin polarization measurements, we have deduced the circular dichroism for Rb with $^3$He and N$_2$ buffer gases. Simulations show that the molecular absorption of pump light by atoms in the nominally dark ground state accounts for a significant amount of the observed inefficiency, particularly with broadband pump sources.

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