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Gas dynamics in high-luminosity polarized He-3 targets using diffusion and convection

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The dynamics of the movement of gas is discussed for two-chambered polarized He-3 target cells of the sort that have been used successfully for many electron scattering experiments. A detailed analysis is presented showing that diffusion is a limiting factor in target performance, particularly as these targets are run at increasingly high luminosities. Measurements are presented on a new prototype polarized He-3 target cell in which the movement of gas is due largely to convection instead of diffusion. NMR tagging techniques have been used to visualize the gas flow, showing velocities along a cylindrically-shaped target of between 5-80 cm/min. The new target design addresses one of the principle obstacles to running polarized He-3 targets at substantially higher luminosities while simultaneously providing new flexibility in target geometry.

Comments: First revision: 14 pages, 9 figures, submitted to Phys. Rev. C. We have shortened our discussion of the limitations inherent in various historical He-3 targets, and we have added a discussion exploring the optimal performance that can be expected from a suitably modified target based on diffusion-based mixing. A reference (Jones et. al.) was added. The results we present have not changed

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