EXCITATION AND DEPLETION OF Rb ATOMS ON SUPERFLUID HELIUM DROPLETS: A ROBUST SYSTEM FOR OPTICAL PUMPING?

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We measured laser induced fluorescence and beam depletion spectra of the D lines of rubidium atoms on the surface of superfluid helium droplets. Common wisdom predicts no difference between the two spectra or, when any, that depletion spectra should reflect the full excitation spectrum whereas fluorescence may be quenched or red-shifted beyond detection. We observe the opposite: there appear to be excitations resulting in fluorescence without depletion. Furthermore at the excitation energies where this difference is most pronounced, power saturation is slower. We interpret this as due to the fact that some atoms may be excited with insufficient translational energy to be desorbed, nor can they gain the necessary energy from the formation of a Rb-He excimer, due to the presence of barriers to formation. Such atoms would then remain available for multiple excitation-relaxation cycles. We are in the process of testing this interpretation with one-color two laser experiments. We expect pump-and-probe measurements to give different results depending on the relative polarization (circularity) of the two lasers in the presence of a quantizing magnetic field, what will represent the first instance of optical pumping on a helium droplet.