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Long Range Rydberg Molecules[1] HYUNWOOK PARK, THOMAS GALLAGHER, University of Virginia — A pair of Rydberg atoms can interact through the long range dipole-dipole interaction, leading to both attractive and repulsive potential curves at long range. Since there are many Rydberg levels, there are at shorter range avoided crossings between potentials of the same symmetry, forming potential wells. The depths and locations of the wells are dictated by the spacings of the atomic levels. Here we describe how the application of a static (or off resonant) rf field can be used to create such wells. Consider a pair of stationary atoms in the $ns_{1/2}$ and $np_{3/2}$ states. A weak electric field lifts the degeneracy of the $np_{3/2}m_j$ levels, splitting them by Δ. Choosing the field direction as the quantization axis, there are four states of total M_Z=1. Two of the states connect to R=∞ states containing m_j=1/2, and two to states containing m_j=3/2. The latter two states have no dipole-dipole interaction with each other, only with the states connected to m_j=1/2 at R=∞. Thus, for large R their potential curves are flat, and if the R=∞ $m_j = 3/2$ level lies above the m_j=1/2 level a potential well is formed by the intersection of the M_Z =1 curves. Its depth and the location of its minimum are controlled by the Stark shift. Calculations show that the well is quite broad in θ, the angle between the quantization axis and the internuclear axis. Other examples of wells will be given.

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