State changing through very-long-range interactions in high-$n$, $n \geq 300$, Rydberg-Rydberg collisions\(^1\) SHUHEI YOSHIDA, J. BURGDORFER, TU Wien, ROBERT FIELDS, ROBERT BRIENZA, F.B. DUNNING, Rice University — State changing in thermal-energy collisions between atoms in very-high-$n$, $n \geq 300$, Rydberg states is studied by observing the quantum beats induced by sudden application of a small dc electric field. These so-called Stark beats are shown to be sensitive to angular momentum $L$ and are used to probe the evolution of $L$ during collisions. The data show that, even for impact parameters as large as 50 $\mu$m, collisions lead to rapid $L$-changing highlighting the long-range nature of the interactions responsible. The corresponding $L$-changing cross sections are large, $10^{-4}$ cm$^2$, and much greater than the “hard-sphere” cross sections $4\pi r^2$, where $r \approx n^2$ is the atomic radius. The results also show that measurements of quantum beat amplitudes can provide a valuable complement to selective field ionization when investigating state-changing reactions.

\(^1\)Research supported by the NSF, Robert A Welch Foundation, and FWF (Austria)