Effect of disorder on the valley splitting on hydrogen terminated silicon (111) surfaces Binhui Hu, Tomasz M. Kott, Robert N. McFarland, Bruce E. Kane, University of Maryland, College Park — High quality hydrogen terminated Si (111) surfaces provide us with a new material system to study a two-dimensional electron system with multi-valley interactions. In our field effect structure where a H-Si(111) substrate is bonded to a SOI substrate, two-dimensional electrons are confined at the hydrogen-terminated Si(111) surface with a vacuum barrier. In our previous work, a high-mobility ($\mu=110,000 \text{cm}^2/\text{Vs}$) sample shows sixfold degeneracy,\textsuperscript{[1]} while on a sample with $\mu=24,000 \text{cm}^2/\text{Vs}$, the sixfold degeneracy is broken.\textsuperscript{[2]} In order to find out the relationship between the electron mobility and the valley splitting, we have investigated a number of devices with mobility ($\mu=10,000\sim25,000 \text{cm}^2/\text{Vs}$), and observed that most of them show the sixfold degeneracy, while a few of them show large asymmetry. Possible explanations will be presented. We will also compare the temperature dependence of the electron mobility between the high-mobility sample and a moderate-mobility sample, and discuss the possible different limiting factors behind them. \textsuperscript{[1]} R. N. McFarland et al., Phys.Rev.B 161310R (2009). \textsuperscript{[2]} K. Eng, et al., Phys. Rev. Lett. 99, 016801 (2007).