Statistics of Saturn Ring occultations

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We give calculations for the excess variance, excess skewness and excess kurtosis with formulas that combine the effects of cylindrical shadows, along with gaps, ghosts and clumps (all calculated for the granola bar model for rectangular clumps and gaps). Wherever the rings have significant gaps or clumps, those will dominate the statistics over the individual ring particles contribution. We have refined an overlap correction for multiple shadows, which is important for larger optical depth. This correction results from summing a geometric series, and is similar to the empirical formula, eq. (22) in Colwell et al (2018). The comparison to Monte Carlo calculations is improved for large particle size by including the edge effects when large particles cross the edges of the viewing area A in Cassini UVIS occultations. As a check, we can explain the upward curvature of the dependence of normalized excess variance for Saturn's background C ring by the observation of Jerousek etal (2018) that the increased optical depth is directly correlated with effective particle size. Assuming a linear dependence $R_{\text{eff}} = 12 \times (\tau - 0.08) + 1.8 \text{m}$, we match both the curvature of excess variance E and the skewness Gamma in the region between 78,000 and 84,600km from Saturn. This explanation requires no gaps or ghosts (Baillie etal 2013) in this region of Saturn's C ring.