Effects of Fabry-Perot Etalon Fringes in Astronomical Photometry. T. Linder[12], R. Holmes[2], and R. Fevig[1] [1]University of North Dakota, 4149 University Avenue, Stop 9008. Grand Forks, ND 58202-9008, tlinder34@gmail.com, [2]Astronomical Research Institute, 7168 NCR 2750E, Ashmore, IL 61912.

Introduction: Our research goal was to collect filtered photometry on a series of main-belt asteroids that SDSS MOC4 list as taxonomically ambiguous, [1-3]. Our method was to collect data over a range of phase angles and determine if our data supported the MOC4. We used the SMARTS 1.0m telescope at CTIO with Astrodon griz filters.

Our results showed instability in the i and z filters. Initially, we thought this was proof of taxonomically ambiguous asteroids. However, we identified the source of the instability as Fabry-Perot Etalon fringes. Fabry-Perot etalons only affect data beyond 700nm when using a Silicon-based CCD. Constructive and destructive interference occurs between the CCD and the cooling chamber faceplate. We discover that these etalons are not removed during standard flats, and we have yet to be able to develop a successful image mask to offset the effect. Therefore the etalon fringe must be handled during the data analysis process, [4, 5].

We will present two different results on the effects of etalons. First, analysis software like source extractor requires particular care not to identify etalon fringes as sources. Second, the etalon fringes affect photometry results and requires the addition of a second source of error.

The effect on photometry is the more serious issue as there are no outside clues that the photometry would not be reliable. Only during close inspection of the image photometry calibration results will one identify any problems. Second, the etalon effect is small on the order of +/- ~8 counts per pixel. Therefore, the effect size of the etalon fringe depends on the signal from the source. If a 12-pixel aperture is selected, the etalon fringe will account for a possible +/- 900 variation in source counts. A 100 SNR source has 10,000 counts; therefore, the effect represents only 9% and is almost impossible to detect. However, the etalon effect will be the primary source of counts below ~30 SNR. Note: 30 SNR is not the cutoff as multiple factors go into the photometry results.

References:

[1] J. M. Carvano and J. A. G. Davalos, A & A, 2015. 580. [2] J. M. Carvano, P. H. Hasselmann, D. Lazzaro and T. Mothé-Diniz, A & A, 2010. 510. [3] P. H. Hasselmann, J. M. Carvano and D. Lazzaro, (2012) NASA Planetary Data System. [4] O. Instruments,(2021) From: https://andor.oxinst.com/learning/view/article/optical-etaloning-in-charge-coupled-devices. [5] L. IS-Instruments, (2021) From: https://www.azom.com/article.aspx?ArticleID=14009.