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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characterization of dark current signal measurements of the ACCDs used on-board the Aeolus satellite" *by* Fabian Weiler et al.

Anonymous Referee #2

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The focus of this paper is on analyzing the on-orbit hot pixel characteristics and emergence trends in the novel ACCD launched on the space-based wind lidar ADM-Aeolus, and mitigation of hot pixel effects on wind retrieval accuracy. Though the paper does not draw any firm conclusions about the potential root cause(s) of hot pixel emergence, this paper nicely sets the stage for such a discussion. Most of my comments are geared towards this discussion. I should mention that, in my opinion, a discussion of the root cause(s)/damage mechanism(s) is optional, as the authors' description of the strategies for mitigating the impact of hot pixels on wind retrievals, and detailed characterization of these anomalies, make this a valuable work in its own right. In fact, the author

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could consider de-scoping some of the discussion on the root cause from this paper, and deferring it to a future work, if the author so wishes. A more detailed discussion of the root cause might be beyond scope, but I offer the following comments/questions to address (optionally) that might aid a future publication/study on the issue, or satisfy a curious reader of this paper. General questions: -How much shielding exists around the ACCDs on Aeolus, and/or what is the shielded radiation environment/dose (yearly DDD, TID)? -Has there been a detectable, steady trend/increase in the dark current observed over the course of the mission for pixels that have not experienced an anomaly? -What design deltas between the ACCD and previously flown CCDs (e.g., Hubble) might explain the observed anomalies? Inversely, what design elements do the ACCDs share with the CCD detectors of GOMOS on ENVISAT? -What radiation testing was conducted on the ACCDs prior to launch (proton energies and fluence steps, TID dose steps, heavy ion, un/biased, un/cooled, etc.), and what were the results? Does the observed, on-orbit rate of hot pixel emergence, or anomalous behavior, align with expectations from ground testing? I assume not, but am curious as to why. -The memory zone pixels are ∼half the area of the imaging pixels. Are they "hit" half as often, or is it impossible to tell? -Will a version of these ACCDs fly on ATLID/EarthCARE? Have the observations/findings in this paper inform the design, testing, or con-ops of ATLID? Will similar mitigation strategies as herein need to be employed for ATLID? Referring to Section 4.1: -Which space weather variables were considered for correlation with the rate of damage/hot pixel emergence? (Line 512) -Can damage events be geolocated, like was done for the transient events in Section 4.3 (Fig. 18)? This might be helpful to show. -Did damage occur more frequently on the day/nightside of the orbit? If no correlation with the poles or SAA is observed, this might be suggestive of damage by untrapped particles, either energetic solar protons or galactic cosmic rays (GCRs). A day/night difference might be suggestive of a spacecraft charging connection. An anti-correlation of rate of hot pixel accumulation with solar activity, with a lag of a few months, might suggest a GCR connection. Data from the Alpha Magnetic Spectrometer on ISS might also be a good resource for GCR/high energy flux on-orbit.

Absence of correlation with these variables might be worth mentioning to the reader if already considered. Referring to Section 4.3: -Is there evidence for radiation-induced light emission (e.g., fluorescence, phosphorescence, Cherenkov, electroluminescence) originating from the ACCD cover glass, or other upstream optics/surfaces? This may be an explaining mechanism for the $\sim$50% of transients that were observed to affect more than one pixel simultaneously, assuming the pixels were clustered. -Were any transients clustered? -Can the timescale of the transients be resolved, or do they appear in exactly one range bin? If radiation-induced light emission has been ruled out by the author, some discussion of that fact may still benefit the reader. -Is there evidence for latent damage? That is, do any pixels begin to exhibit damage hours, days, or even weeks after they experience an initial transient?

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