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Interactive comment on "On the efficiency of rocket-borne particle detection in the mesosphere" *by* J. Hedin et al.

Anonymous Referee #2

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This paper presents a much-needed update to the calculation of smoke detector efficiencies first discussed by Horanyi (1999). The inclusion of Brownian motion in the trajectory calculations serves to illustrate the fate of smoke particles that reach a stagnation point inside the detector. Most interesting is the effect of Brownian motion on the particle collection efficiency; Figure 6 shows that the inclusion of Brownian motion in the trajectory calculations severely inhibits particle collection in an unventillated detector.

A few observations concerning the paper content follow: - The trajectories presented in Figure 3 are slightly confusing. If it is assumed that the front grid is at -6.2V and the second grid at +6.2 V, then postitively charged particles entering the detector would naturally be slowed down at the second grid; this is particularly true for smaller parti-

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cles, and would tend to exacerbate the effects of Brownian motion, as seen in the top panel of Figure 3. However, the usual "picture" of Brownian motion for heavy particles with a large kinetic energy (compared to the ambient molecules) is a gradual spreading of the particle beam in position and velocity space, as is commonly presented in statistical mechanics texts. However, the trajectories presented in the lower two panels in Figure 3 show sharp trajectory changes, presumably from single-molecule collisions in the detector, that I would not have expected in the large-particle limit of Equation 6. A more detailed sample trajectory with collision points clearly marked might resolve this apparent inconsistency. - To continue with the above point, although Brownian motion may dominate particle motion at stagnation points in the detector, an applied electric field would tend to decrease this influence; the continuum limit would be some "terminal velocity". Presumably, the weak electric field inside the detector that results in the positive/negative assymetry evident in the top panel of Figure 8 is due to the effective terminal velocity in the detector. This might mean that the electric field configuration can play a greater role in detector efficiency than implied here. More emphasis on the neutral-particle trajectory would result in a clearer picture of the effects of Brownian motion. - Different assumptions about unknown smoke particle properties (particle density, shape, etc.) can also significantly change the effective cross sections calculated in the text. If particles are less dense and aerodynamic effects are larger, mass losses due to heating and sublimation may need to be considered, even for smoke particles. It would be interested to see dependencies on particle properties explored in future work.

In summary, the paper presents results that build upon, but differ significantly from, previous work (Hornayi, 1999). The differences between the continuum and Brownian motion simulations deserve further comment, particularly given the large mass difference between smoke particles and ambient molecules. It should also be noted that the effective cross sections calculated here only partially describe quantities that influence the efficiency of smoke particle collection; the results are presented as a generalization of smoke particle detectors currently in existence, and should not be taken as an

absolute efficiency for smoke particle detection in general.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 1183, 2007.

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