Comment on acp-2021-417
Anonymous Referee #1

Referee comment on "Surface charge of environmental and radioactive airborne particles" by Gyoung Gug Jang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-417-RC1, 2021

The fate of airborne particles may be influenced by the charge, these particles carry. Charge in this context means on the one hand the net charge an ensemble of particles carries and on the other hand the (positive or negative) charge, the individual particles carry.

In this manuscript the charging state of several types of particles, including radioactive uranium isotopes is investigated using an electrodynamic balance.

This is an important topic; however, I have several concerns with the approach, presented here.

The charge, airborne particles carry after being in the atmosphere for some time, is mainly influenced by attachment of ions of both polarities. After long enough time a Boltzmann equilibrium is established (the time depends on the ion concentration). In this manuscript the charge of freshly suspended particles is investigated, this is the charge they achieve by the dispersion process. Any later changes are not even mentioned. So, these results do not reflect the charge of airborne particles.

For the uranium particles the charge, acquired directly by the decay process is discussed. However, the emitted radiation (α or β) will ionize the surrounding gas. The bipolar ions created thereby will attach to the particles and determine the particle charge. As one emitted a or b can produce a high number of ions this process is much more efficient than the direct charging, where (as shown in the manuscript) days a needed to achieve a high charging level. On average, this process will lead to a net charge close to zero, meaning that the concentration of negative and positive charges is equal. In this case there is no net driving force, acting on the particles. Should the charge distribution be unsymmetric, i.e., a net charge exists, this leads to a space charge which acts as driving force. Therefore, it would be important, to investigate both polarities in the experiment. In the
manuscript no information of polarity is given.

These aspects have to be considered to get relevant information on the importance of particle charge.

Minor remarks:

The particle used are at least in part agglomerates and have shapes far from being spherical. Determining the surface/volume by assuming spherical particles therefore is problematic, this should at least be mentioned.

How is the tapped density for SiO$_2$ particle determined? (table1)

The great discrepancy between calculated and observed size of the SiO$_2$ particles (table1) is probably because observed are primary particles and calculated agglomerates, this should be discussed.