

Review Report for the manuscript "Thermospheric shock waves and lensing of light in the Barium Release, Optical and Radio rocket experiment", by Leyser et al.

General Comments:

Manuscript presents Barium Release, Optical and Radio rocket (BROR) experiment carried out over Esrange near Kiruna, Sweden. As an active and rare experiment, this study has high scientific merit, warrants publication and I am strongly in favour of its publication. However, major concern is poor organization of this submission and is not as per *Annales Geophysicae* format/guidelines. Owing to this manuscript, in its present form, is difficult to follow in terms of logical sequencing and readability. Overall, my recommendation is "Major Revision"; however, the below-mentioned major shortcomings need to be addressed.

Restructuring and reorganization of the manuscript should be done (as suggested below) to improve overall readability and logical flow:

1. Introduction Section:

Significance of barium-release experiments to study the mesosphere-lower thermosphere and ionosphere. Why? A brief overview of previous reports, and their limitations. Following latest works are missing and should be included.

- a. Fletcher, A. C., Crabtree, C., Ganguli, G., Siefring, C., Soto-Chavez, A. R., & Netwall, C. (2023). Rocket-released neutral clouds in the ionosphere: Formation, evolution, and detection. *Journal of Geophysical Research: Space Physics*, 128, e2022JA031039. <https://doi.org/10.1029/2022JA031039>
- b. Zhu, X., Hu, Y., Zhao, Z., Ni, B., & Zhang, Y. (2020). Ionospheric disturbance caused by artificial plasma clouds under different release conditions. *Earth, Planets and Space*, 72(1), 183. <https://doi.org/10.1186/s40623-020-01317-9>

Scientific objectives/Motivation of the BROR experiment, brief introduction about thermospheric shock, etc..

2. An overview of BROR experiment

Section should include location, launch date, time and duration of flight, payload(s), rocket trajectory, information on release characteristics, and location of optical cameras/details of other ground-based experiments, brief information of solar elevation, solar activity and geomagnetic conditions, etc.. Figure 01 is reasonable; however, should be preceded by a map showing Rocket trajectory. Release characteristics can be furnished in tabular format.

3. Methodology

3.1 Derivation of the speed of shock waves

3.2 Derivation of the radius of copper droplet

For each measurement, a typical example (showing best results) should be presented.

4. Observations and results

In this section, sub-sections devoted to each release should be presented individually covering shock waves observations and different measurements. Wherever possible, imaging observations should also be presented, and comparison with earlier measurements should be performed.

5. Discussion

Please highlight key observations, and dynamics/electrodynamics involved.

6. Summary and Conclusions

Summarize BROR experiment, key findings, limitations, etc.

“Data Availability” should be corrected to clearly mention if data used in this study is publicly available or restricted or mention contact (subject to Annales Geophysicae policy).