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Study of combined radio and optical observations of meteors with the BRAMS and CAMS-BeNeLux networks

Hervé Lamy (1), Michel Anciaux (1), Sylvain Ranvier (1), Stijn Calders (1), Antoine Calegaro (1), Cis Verbeeck (2), Antonio Martinez Picar (2), Carl Johannink (3), and Johan De Keyser (1)

(1) Royal Belgian Institute for Space Aeronomy, Space Physics, BRUSSELS, Belgium (herve.lamy@aeronomie.be), (2) Royal Observatory of Belgium, Brussels, Belgium, (3) Dutch Meteor Society, Schiefestrasse 36, 48599 Gronau, Germany

In this study, optical data of meteors obtained with the CAMS (Camera for All-sky Meteor Surveillance)-BeNeLux network on 4-5 October 2018 and radio observations obtained with the BRAMS (Belgian RAdio Meteor Stations) network are combined in order to obtain an ionization profile along the meteor path.

First, the trajectory, initial speed and deceleration parameters of a given meteor are provided by the CAMS-BeNeLux data. For a given trajectory, the theoretical positions of the specular reflection points for radio waves are computed for each combination of a given BRAMS receiving station and the BRAMS transmitter. Using the speed and deceleration observed for that meteor, the theoretical times of appearance (when the meteor passes the specular reflection points) are computed. The spectrograms obtained from the BRAMS data are then inspected to find the corresponding radio meteor echoes, check that their presence/absence is consistent with the height of the reflection points, and to verify whether they belong to the underdense / overdense regime.

Next, we show how to compute the profile of the meteor echoes (power vs time) from the raw BRAMS data. The starting time of these profiles is much more accurate than in the spectrograms and is compared to the theoretical time of appearances computed before.
The peak power values of the meteor profiles are used to determine the ionization (electron line density) at the various specular reflection points for multi-stations observations. This is done using the McKinley (1961) formula which is valid for underdense meteor echoes. We discuss briefly how to compute the gains of the antennas, the polarization factor, and how the peak power values are transformed from arbitrary units into watts using the signal recorded from a device called the BRAMS calibrator.

Finally we conclude with some discussion on how to extend this study to overdense meteor echoes or those with intermediate electron line densities, and how these results can be combined with an ablation meteor model in order to obtain an estimate of the initial mass of the meteoroid.