

RADAR OBSERVATIONS OF THE KOSMOS-1408 FRAGMENTATION EVENT

D. Kastinen⁽¹⁾, J. Vierinen⁽²⁾, T. Grydeland⁽³⁾, and J. Kero⁽¹⁾

⁽¹⁾*Swedish Institute of Space Physics, 98128 Kiruna, Sweden*

⁽²⁾*University of Tromsø, The Arctic University of Norway, 9037 Tromsø, Norway*

⁽³⁾*NORCE Norwegian Research Centre, 9019 Tromsø, Norway*

ABSTRACT

On 15 November, 2021, the defunct Kosmos-1408 satellite was destroyed in a so called direct-ascent anti-satellite test by Russia. The debris created from the deliberate demolition poses a danger to infrastructure in space. As such, it is vital to measure and characterize the fragments as soon as possible after the fragmentation event.

We describe the use of the EISCAT UHF radar and the EISCAT Svalbard radars to perform beam-park experiments aimed at observing the cloud of space debris generated. The non-profit EISCAT Scientific Association operate four radar antenna sites to enable research on the ionosphere and the upper atmosphere. However, they have also proven very valuable in performing monostatic measurements of the space debris environment. Such measurements have been used in e.g. the calibration of the ESA MASTER debris model. Using correlation analysis towards a publicly available catalog we identified objects not in the catalog that are likely Kosmos-1408 fragments as well as already known ones.

We also present and apply a technique to estimate the size of objects from monostatic measurements by matching the signal to noise ratio of the detection to the radiation pattern of the radar. With this method we estimate the size distribution of the debris cloud. We also demonstrate how a pair of beam-park observations can be used to perform a crude, yet seemingly reliable, initial orbit determination. However, we did not have the opportunity to perform initial orbit determination on the Kosmos-1408 fragments, instead we validated the procedure using the available catalog.

Finally, we present followup observations conducted ~ 5 months after the fragmentation event and that show a still compact cloud of debris.

Keywords: radar, space debris, Kosmos-1408.

1. DISCUSSION

In order to confirm with the publication guidelines and that the content must not have been published previously in whole or in part, we would like to refer readers to the open-access research paper *Using radar beam-parks to characterize the Kosmos-1408 fragmentation event*¹ published in *Acta Astronautica*, Volume 202, January 2023, Pages 341-359 [KVGK23]. There, we describe in detail the conducted study and the results presented at the 2nd ESA NEO and Debris Detection Conference at ESA/ESOC, Darmstadt, Germany, 24-26 January 2023.

AUTHOR CONTRIBUTIONS

DK: Conceptualization and writing of this study, methodology, software, observations. JV: Software, observations. TG: Software, writing, copyediting. JK: Observations, writing, copyediting.

ACKNOWLEDGMENTS

We gratefully acknowledge the EISCAT staff for their assistance during the experiments and in preparation of data for further analysis. EISCAT is an international association supported by research organizations in China (CRIPR), Finland (SA), Japan (NIPR and ISEE), Norway (NFR), Sweden (VR), and the United Kingdom (UKRI). This work was supported in part by the European Space Agency (ESA) Space Debris Office, under cooperative agreement ESA Contract No. 4000132725/20/D/MRP.

REFERENCES

KVGK23. Daniel Kastinen, Juha Vierinen, Tom Grydeland, and Johan Kero. Using radar beam-parks to characterize the Kosmos-1408 fragmentation event. *Acta Astronautica*, 202:341–359, 2023.

¹<https://doi.org/10.1016/j.actaastro.2022.10.021>