

Comparison of Cosmic Radiation Detectors in the Radiation Field at Aviation Altitudes

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Knowledge for Tomorrow

Outline

- ▶ Introduction
- ▶ Destination Areas
- ▶ Space Weather
- ▶ Results
- ▶ Summary



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Background:

- ➔ Participating groups are active in dosimetry aboard aircraft in Europe
- ➔ DLR flight facility provides a unique opportunity for joint measuring flights
- 🌍 **Goal:** Comparison of instruments for comparability of measuring data and quality management



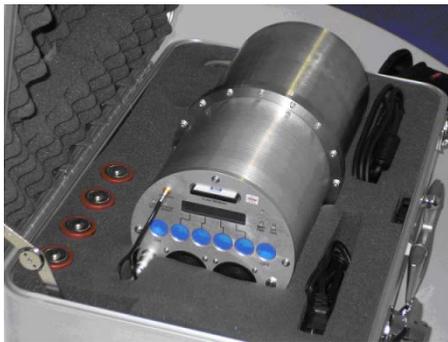
Aircraft

Dassault Falcon 20E / D-CMET



Measuring Equipment

- Tissue equivalent proportional counter (TEPC): HAWK 1 & 2
- Semiconductor detectors: Liulin 4F, 4J, 6C, 6G, 6SM5



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Destination Areas

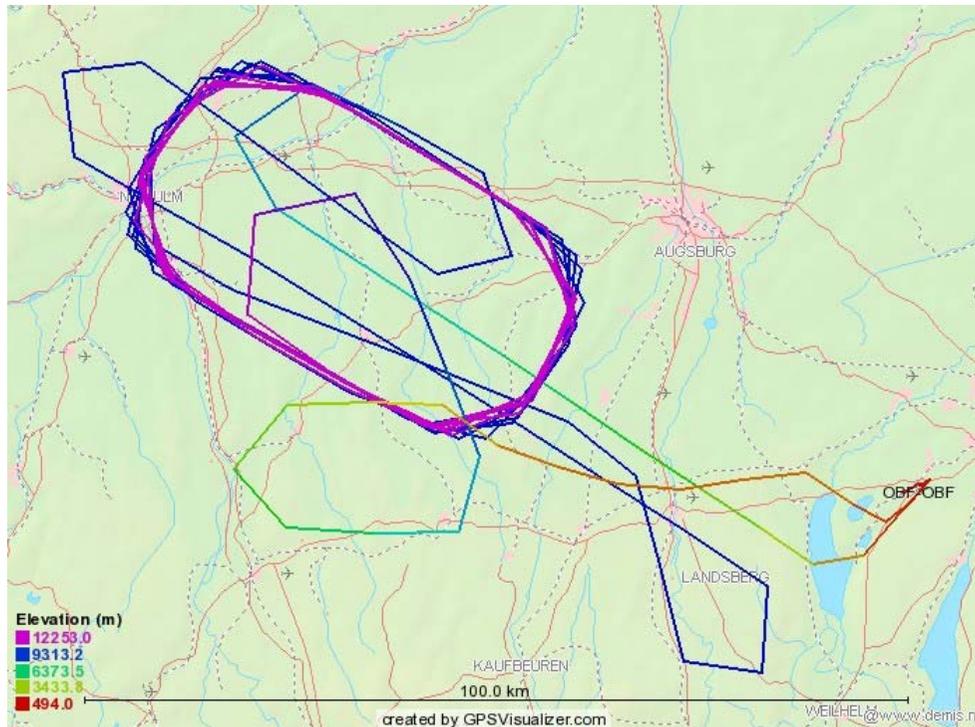
Airspace in south Germany and south Norway

Upper and lower airspace

=> R_c : ≈ 1.3 GV and 4.0 GV @ FL320 and FL400



Destination Area OBF-OBF



- 14 May 2013

- Destination area:

N: 48.13°- 48.52°

E: 9.88°- 10.73°

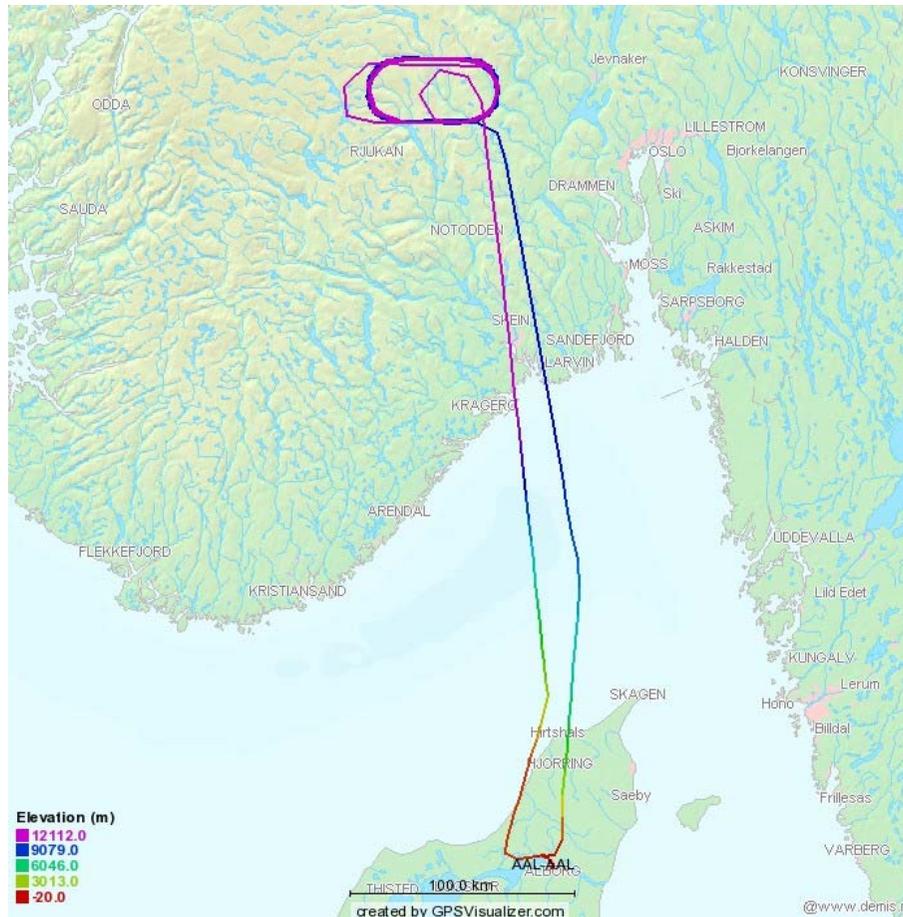
R_C: 3.95 GV - 4.10 GV

- FL320: 1123 UTC – 1236 UTC

- FL400: 1250 UTC – 1351 UTC



Destination Area AAL-AAL



- 15 May 2013

- Destination area:

N: 60.00°- 60.26°

E: 8.32°- 9.51°

R_C: 1.29 GV - 1.33 GV

- FL320: 1119 UTC – 1300 UTC

- FL400: 1324 UTC – 1430 UTC



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Space Weather



Available online at www.sciencedirect.com

SciVerse ScienceDirect

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ADVANCES IN
SPACE
RESEARCH
(a COSPAR publication)

www.elsevier.com/locate/asr

Solar activity
(W-parameter):

$W \approx 66 \ (\Delta \leq 0.4)$

$Kp = 3$

for all flights

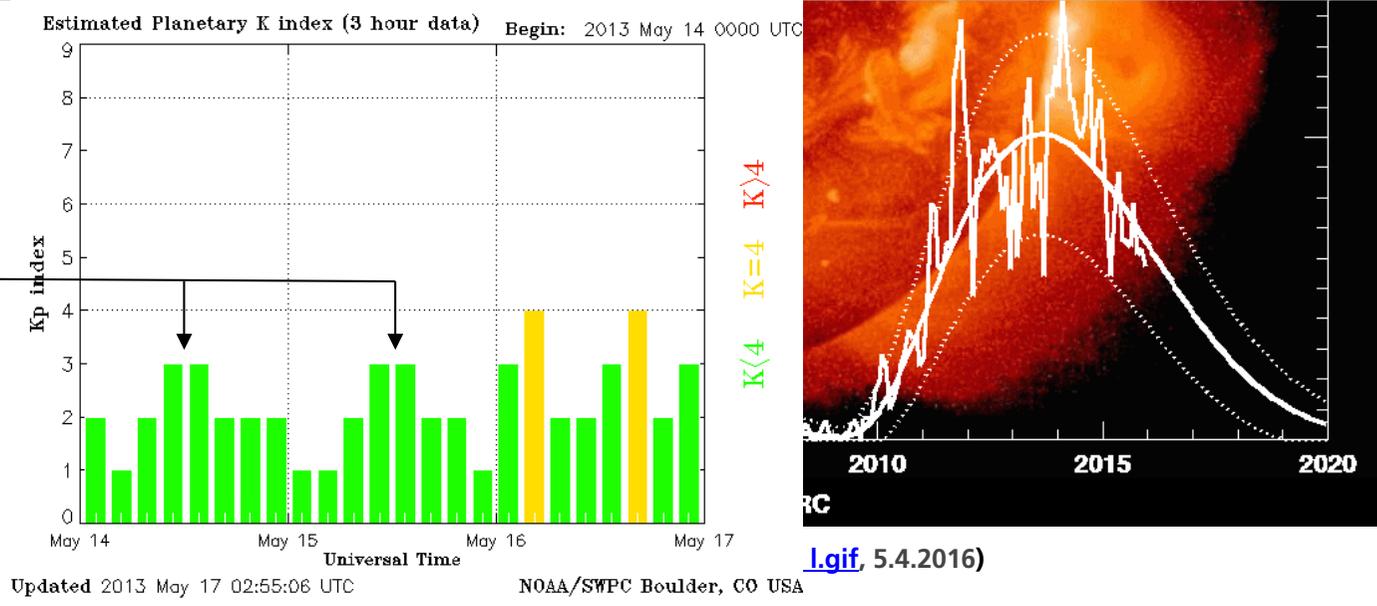
A ready-to-use galactic cosmic ray model

Daniel Matthiä*, Thomas Berger, Alankrita I. Mrigakshi, Günther Reitz

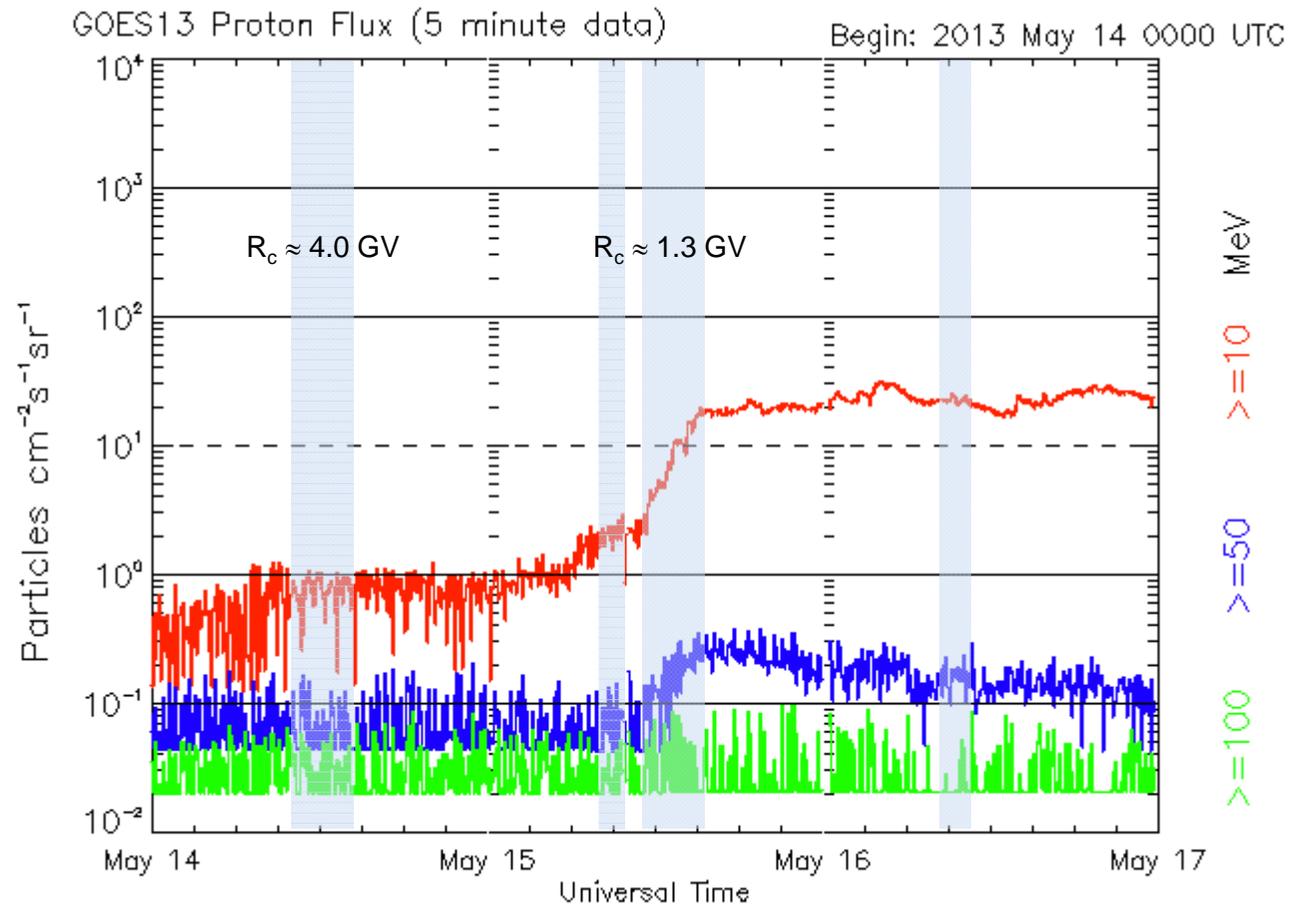
German Aerospace Center, Institute of Aerospace Medicine, Linder Höhe, 51147 Cologne, Germany

Received 15 May 2012; received in revised form 14 September 2012; accepted 16 September 2012

Available online 25 September 2012



Space Weather: GOES-13



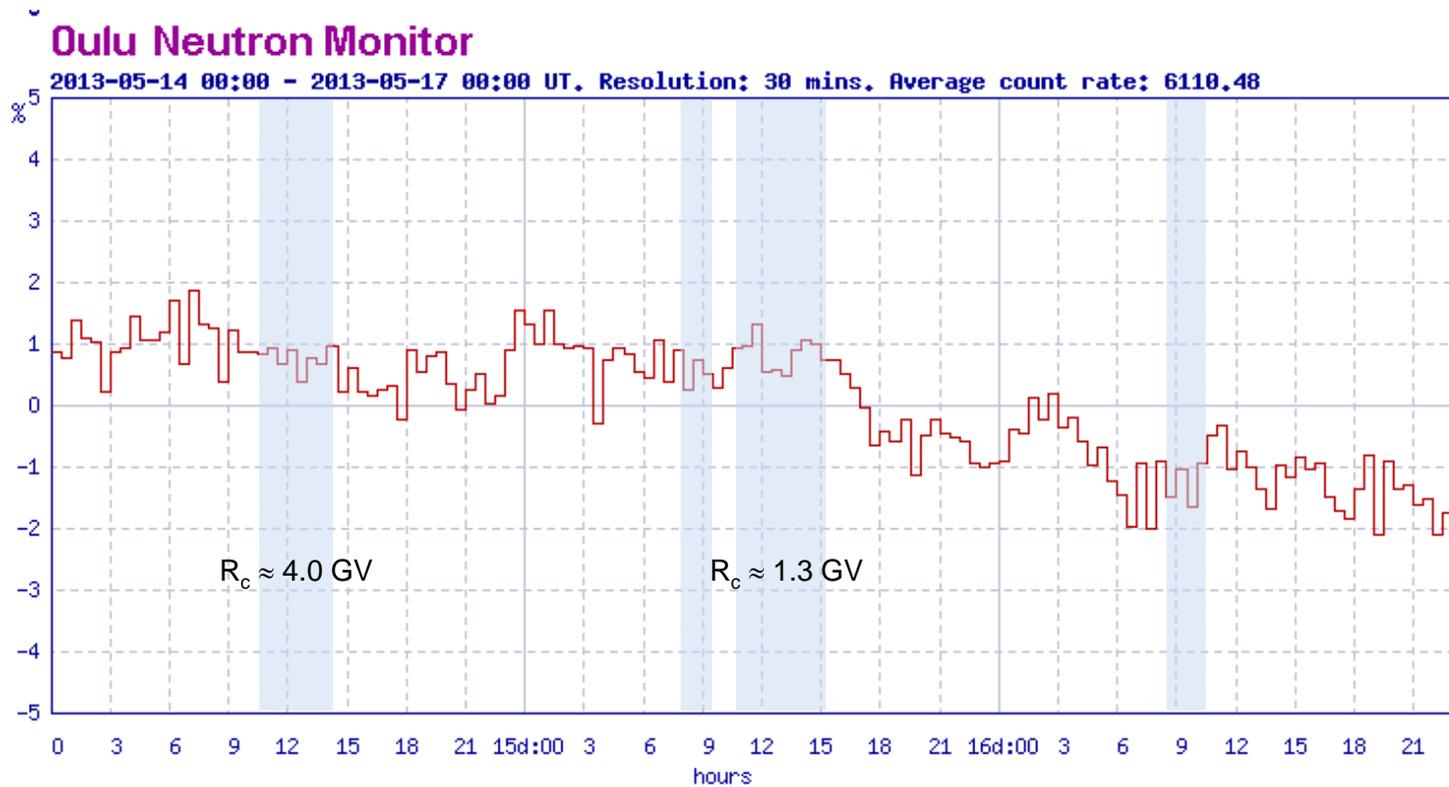
Updated 2013 May 16 23:56:02 UTC

NOAA/SWPC Boulder, CO USA

 measuring flights



Space Weather: Neutron Monitor Oulu



Source: <http://cosmicrays oulu.fi/>

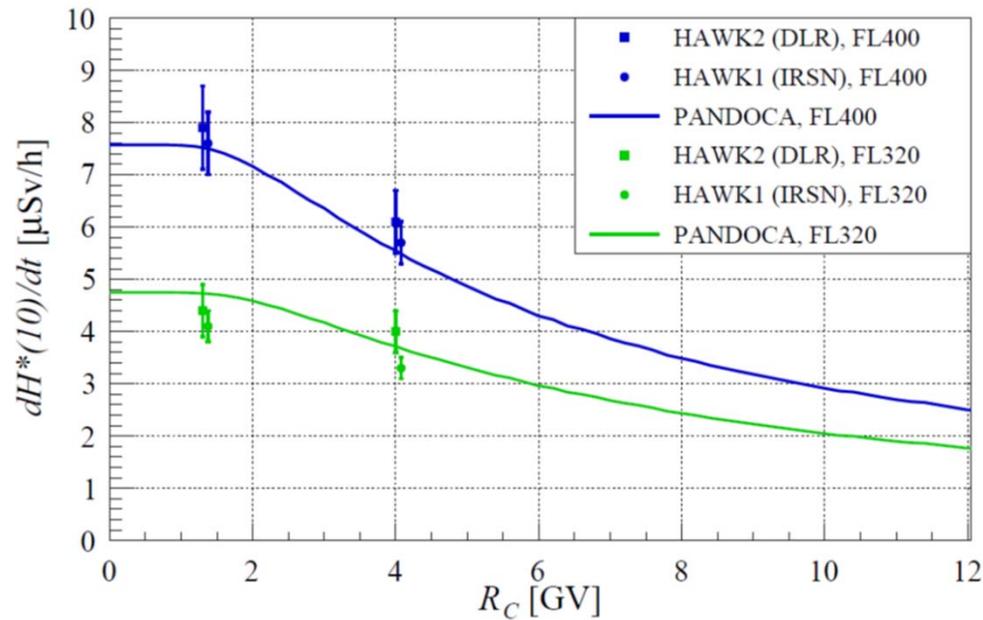


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TEPC: Ambient dose equivalent rate $dH^*(10)/dt$



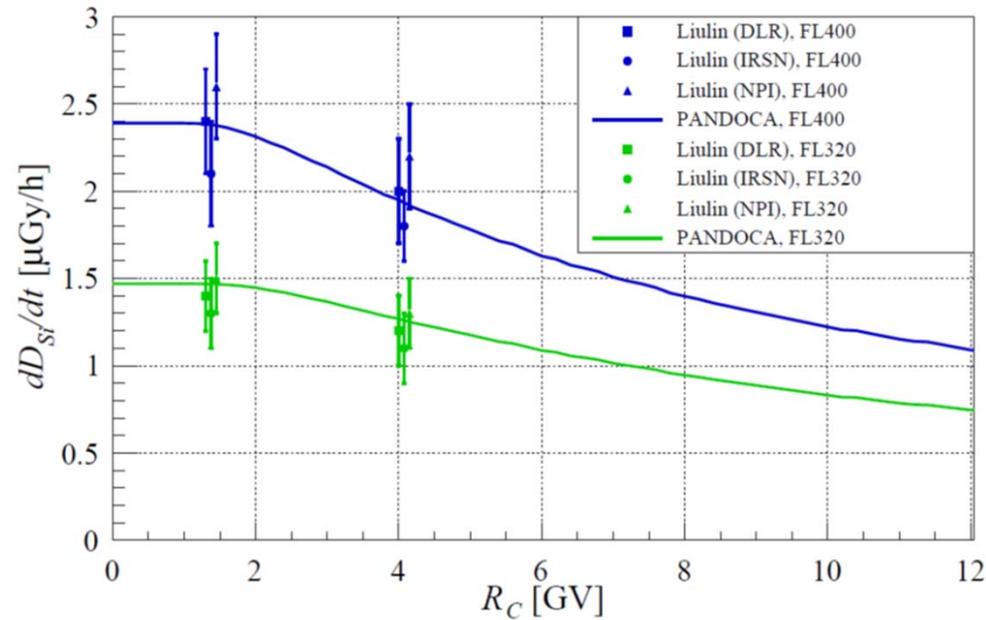
Result:

Deviation is less than 10% on average.

	OBF 320	OBF 400	AAL 320	AAL 400
$\text{HAWK}_{\text{DLR}} / \text{HAWK}_{\text{IRSN}}$	1.21	1.07	1.07	1.04



Liulin 6G: Absorbed dose rate in silicon $dD(\text{Si})/dt$



Result:

Deviation from the mean dose rate is about 9% on average.

	OBF 320	OBF 400	AAL 320	AAL 400
$\text{Liulins}_{\text{DLR}} / \text{Liulins}_{\text{average}}$	1.00	1.00	1.00	1.00
$\text{Liulins}_{\text{NPI}} / \text{Liulins}_{\text{average}}$	1.08	1.10	1.07	1.08
$\text{Liulins}_{\text{IRSN}} / \text{Liulins}_{\text{average}}$	0.92	0.90	0.93	0.88



Dose Rates: Comparison with PANDOCA



Space Weather

RESEARCH ARTICLE

10.1002/2013SW001022

Key Points:

- Numerical model calculating radiation exposure in aviation
- Model validation with experimental data

Numerical calculation of the radiation exposure from galactic cosmic rays at aviation altitudes with the PANDOCA core model

Daniel Matthä¹, Matthias M. Meier¹, and Günther Reitz¹

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Result:

Deviation is less than 10% on average.

	OBF 320	OBF 400	AAL 320	AAL 400
HAWK _{average} / PANDOCA	0.92 (5)	1.05 (5)	0.89 (6)	1.03 (7)
Liulins _{average} / PANDOCA	0.92 (9)	1.05 (11)	0.93 (13)	1.00 (8)



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Summary

- Dose rates were measured in European airspace at four positions for about one hour at each position.
- Space Weather: Stable conditions during the measuring flights ($W \approx 66$, $K_p = 3$). Short-term solar activity did not affect the results.
- HAWK data agree within about 10%.
- Deviation of the Liulin data from the mean dose rate is less than 10% on average.
- PANDOCA model calculations agree with the measured data within about 10% for $H^*(10)$ as well as for the absorbed dose in silicon.



Further Information

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RESEARCH ARTICLE

OPEN ACCESS

CONCORD: comparison of cosmic radiation detectors in the radiation field at aviation altitudes

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