Coherent transition radiation from the geomagnetically-induced current in cosmic-ray air showers:

<u>Implications for the anomalous events</u> <u>observed by ANITA</u>

Krijn D. de Vries and Steven Prohira



U The Ohio State University







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Figure from H. Schoorlemmer ; K.D. de Vries





Figure from H. Schoorlemmer ; K.D. de Vries



RADIO EMISSION FROM AIR SHOWERS POLARIZATION VS POLARITY









RADIO EMISSION FROM AIR SHOWERS

SOURCE AND GEOMETRY











BALLOON BASED RADIO NEUTRINO OBSERVATORY AND COSMIC RAY DETECTOR



Fig from S. Prohira







 note-polarity <u>flips</u> on reflection

Fig from S. Prohira

















THE ANOMALOUS EVENTS: LETS INVESTIGATE MORE CLOSELY



So what about transition radiation?



RADIO EMISSION FROM AIR SHOWERS FROM CHERENKOV EFFECTS TO TRANSITION RADIATION









RADIO EMISSION FROM AIR SHOWERS FROM CHERENKOV EFFECTS TO TRANSITION RADIATION



 $\frac{1}{D} = \frac{1}{L} \frac{dz}{d(ct)}$



Transition radiation is not limited to the net excess charge crossing a dielectric boundary, but applies equally well to the net transverse air shower current!!!!

CTR-GM



CTR-GM

IMPLICATIONS FOR THE ANOMALOUS EVENTS OBSERVED BY ANITA





CTR-GM

IMPLICATIONS FOR THEANOMALOUS EVENTS OBSERVED BY ANITA







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CONCLUSIONS

Coherent transition radiation is not limited to a net excess charge, but applies equally well to a net current.

Coherent transition radiation is expected to be significant for CR air showers hitting Earth at large elevations 2-3 km, with zenith angles < ~70 degrees.

The two anomalous events detected by ANITA fulfill all properties for coherent transition radiation to be significant and <u>relies on event</u> <u>properties in which the two `anomalous events' are outliers.</u>

CTR-GM is able to provide a polarity flip and as such forms a completely natural, standard model, explanation for the ANITA `anomalous events'.











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THE ELECTRON BEAM SUDDEN APPEARANCE

GOOD MATCH BETWEEN SIMULATIONS AND DATA

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Coherent radio emission from the electron beam sudden appearance

Krijn D. de Vries,^{1,*} Michael DuVernois,² Masaki Fukushima,³ Romain Gaïor,^{4,5,§} Kael Hanson,² Daisuke Ikeda,^{3,6,‡}
Yusuke Inome,^{7,3} Aya Ishihara,⁴ Takao Kuwabara,⁴ Keiichi Mase,^{4,†} John N. Matthews,⁸ Thomas Meures,²
Pavel Motloch,⁹ Izumi S. Ohta,⁷ Aongus O'Murchadha,² Florian Partous,¹ Matthew Relich,⁴
Hiroyuki Sagawa,³ Tatsunobu Shibata,¹⁰ Bokkyun Shin,¹¹ Gordon Thomson,⁸ Shunsuke Ueyama,⁴
Nick van Eijndhoven,¹ Tokonatsu Yamamoto,^{7,3,4} and Shigeru Yoshida⁴
¹Vriie Universiteit Brussel, Dienst FLEM. IIHE, Pleinlaan 2, 1050, Brussel, Belgium





