How space storms miscue train signals

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A new modeling analysis shows how space weather could turn U.K. train signals green when they are supposed to be red, and vice versa. Credit: Geof Sheppard, CC BY-SA 4.0

In July 1982, train signals in Sweden misfired and erroneously turned red. The culprit, believe it or not, was a space storm that started 150 million kilometers (93 million miles) away.

Explosive events on the sun can disrupt Earth's magnetic field. They

send massive amounts of magnetized solar material hurtling toward Earth. A space storm, or geomagnetic storm, occurs when this material perturbs our planet's magnetic field. This perturbation can induce electrical currents at Earth's surface that can disrupt power lines, pipelines, train tracks, and more.

Train track disruptions are particularly troublesome because space storms can interfere with detection systems that prevent collisions. Railways detect trains using electrical currents and send stop signals to others to avoid crashes. But when Earth's magnetic field is disrupted, they might send false signals to stop or go, affecting operations and potentially endangering the freight and passengers on board.

C. J. Patterson and colleagues developed a model to test how strong a geomagnetic storm is required to be to disrupt railways and how often that might occur. The model, which simulates how space storms affect electrical signals, is based on two real-life U.K. railway lines with different orientations and geography. The findings are published in the journal *Space Weather*.

They found that along both modeled lines, a space storm strong enough to disrupt a railway signal occurs about once every 30 years. More extreme storms—expected to occur once every 100 years—disrupted nearly all signals along both lines.

These findings can help scientists and regulators assess how vulnerable trains are to cosmic geomagnetic disruptions and spread awareness among operators.

More information: C. J. Patterson et al, Modeling the Impact of Geomagnetically Induced Currents on Electrified Railway Signaling Systems in the United Kingdom, *Space Weather* (2023). DOI: 10.1029/2022SW003385