Quantifying the risk of high-impact space weather events for the power industry

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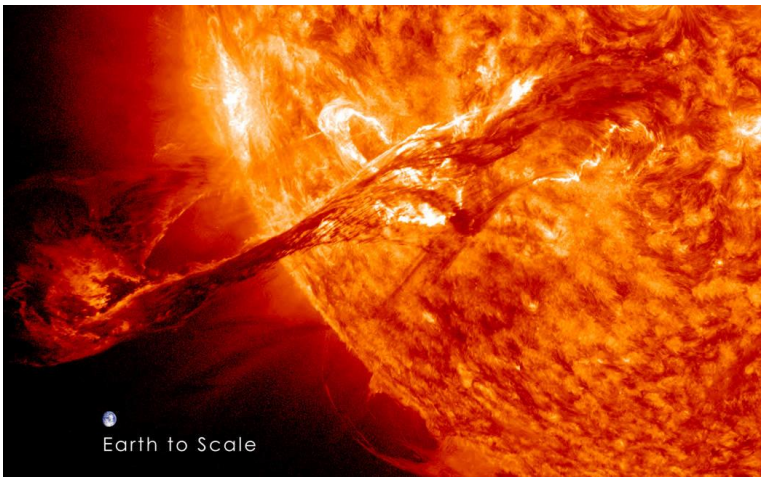
Technological infrastructures, such as power grids and telecommunications networks, are vulnerable to space weather. While most hardware is engineered to be resilient against common, moderate space weather, it can be significantly impacted or even fail during rare, extreme space weather events. Efficiently engineering resilience into critical systems requires accurate estimates of "worst-case" scenarios, such as a "1-in-1000 year solar storm", that the system can be designed to endure in a predictable manner. A common approach is to develop a statistical model for a class of extreme event, for example solar flare occurrence, and to use this model to estimate the maximum event size that will probably be observed in a specified return period.



A coronal mass ejection (CME), approximately a billion metric tons of material moving at around a million km/h, erupts through the solar atmosphere. CMEs drive the most extreme space weather which can damage power grids and space hardware.

Although this general approach can be effective, for space weather there are a number of challenges. Firstly, comprehensive space weather observations only cover the space age, approximately 60 years, with fewer and poorer quality observations spanning back approximately 150 years. Given the solar cycle is approximately 11 years, these data span a relatively short period in terms of space climate. Secondly, many of the data commonly used to assess the severity of space weather events are global metrics, which are often poor indicators of likely impact on local scales. Finally, as space climate changes over centuries, observations made over recent decades become less representative of conditions we should expect in the coming decades. Thus when undertaking statistical analysis of historic data, it is vital that physical constraints on the system, such as energetic arguments about limits on solar flare size, be incorporated.

This project will assess which space weather observations and measures are most appropriate for predicting the

impact of space weather events on UK and global power infrastructure, and will then statistically model these data and the known physical constraints on extreme space weather, providing estimates of storm magnitude return periods.

Training opportunities:
The student will have the opportunity to attend space physics summer schools in the UK and US. The student will undertake an extended placement at EDF Energy (TBC).

Student profile:
This project would suit a student with a strong background in quantitative science (e.g., Maths, Physics or Engineering-related undergraduate degree). Previous experience with computer programming is desirable but not essential. Previous knowledge of solar/heliospheric physics is not required.

Funding particulars:
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