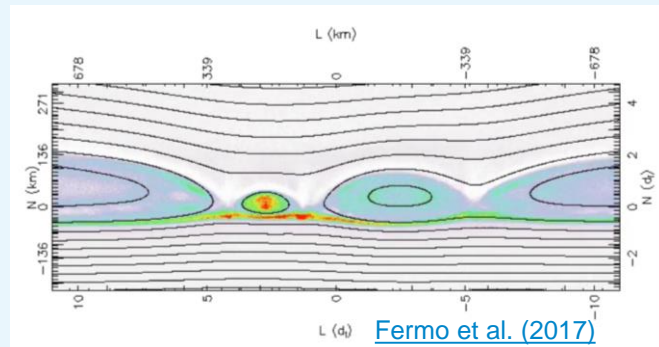


# Survey of Magnetopause Electron Diffusion Region (EDR) associated Flux Ropes

Sadie Robertson<sup>1</sup>, Jonathan Eastwood<sup>1</sup>, Julia Stawarz<sup>1</sup>  
<sup>1</sup>Imperial College London

## Flux ropes...



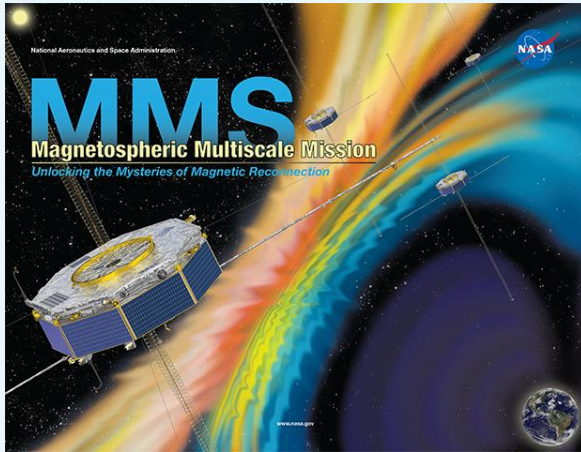
- Twisted, helical magnetic field structures
- Formed via magnetic reconnection
- Observed throughout the solar system, in the solar corona, solar wind and planetary magnetospheres
- Thought to play a role in particle acceleration and energy transfer for magnetic reconnection

## ...and magnetic reconnection

We are investigating the link between magnetic reconnection and flux ropes, with the aim of answering the following questions:

- Are flux rope properties influenced by the ongoing reconnection?
- Are flux ropes observed near the EDR recently formed?
- Do these flux ropes represent a distinct subset of flux ropes?

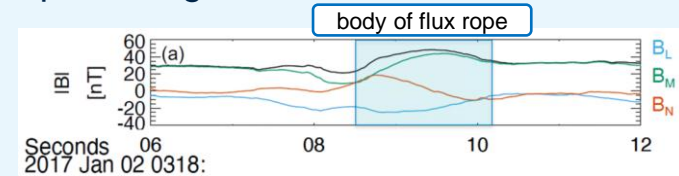
## Magnetospheric Multiscale (MMS) mission



- 4 spacecraft NASA mission investigating magnetic reconnection in the Earth's magnetosphere
- Measures the thermal electron and ion 3D distributions at 30 msec and 150 msec time resolution, respectively, and at spacecraft separations down to a few kilometres
- Allows us to probe electron-scale dynamics
- Multiple reported encounters with the magnetopause Electron Diffusion Regions (EDR)

## Magnetopause flux rope survey

- Flux ropes are identified by a peak in the magnetic field strength and a corresponding bipolar signature in the magnetopause component normal to the magnetopause e.g.

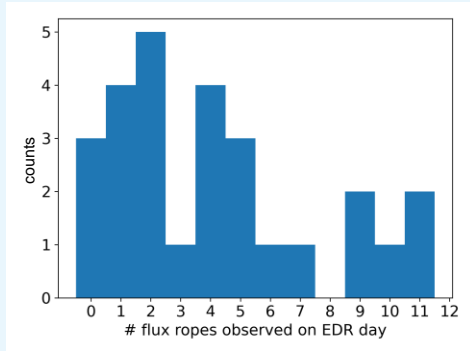


- We surveyed all burst mode data plots on days where EDR encounters were reported by [Webster et al. \(2017\)](#)
- Identified ~100 flux ropes
- Found evidence for electron trapping in magnetic mirror structures on the edge of flux ropes (see [Robertson et al., 2021](#))

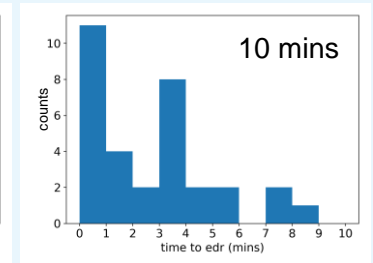
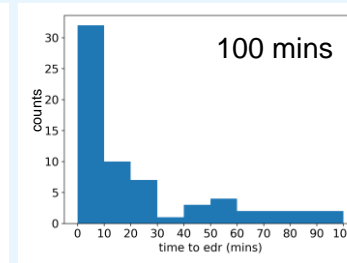
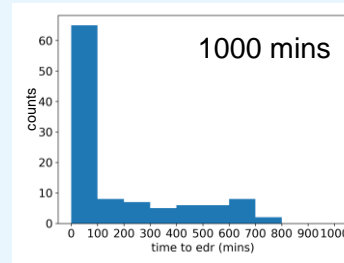
*Currently refining flux rope identification process. Burst plots used originally were of varying timespans. Now using uniform 1-minute resolution plots to ensure standardisation of selection process. As such results presented here are preliminary.*

## Flux rope EDR distributions

- Identified ~100 flux ropes, with between 0-11 flux ropes observed on each day

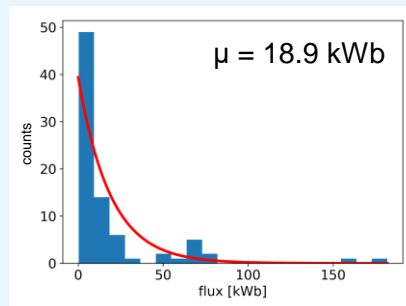
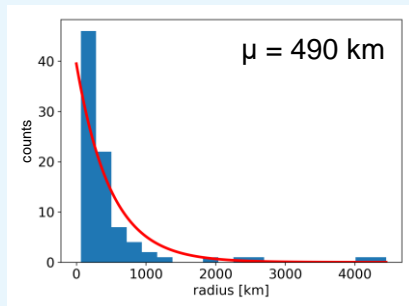


- Flux ropes are more likely to be observed close to the EDR*

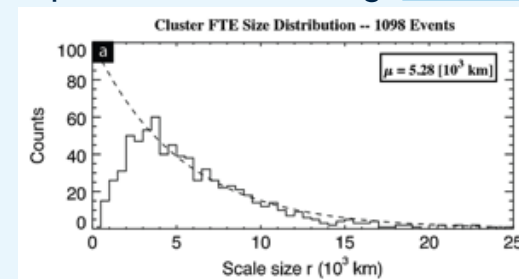


## Flux rope properties

- We find flux ropes to be smaller in size and have smaller flux content than previous studies*



- Here, we have fitted tail exponential distributions to compare with previous studies e.g. [Fermo et al. \(2017\)](#)



- As our distribution peaks at smaller scales, we plan to investigate whether distributions may be better represented by a power law at small scales

## Flux ropes observed within 20 minutes of EDR encounter

- 2 groups of flux ropes compared:
  - WEB: all flux ropes observed on the same day as Webster EDR encounters
  - EDR: flux ropes observed within 20-minute window of EDR encounters
- We find distributions of flux rope parameters to be similar between the two groups
- Kolmogorov-Smirnov tests suggest distributions come from the same underlying distribution
- *Flux ropes observed within 20 minutes of the EDR observation are not observed to have distinct properties – could suggest that small-scale flux ropes do not significantly evolve once they are created near the EDR*

