



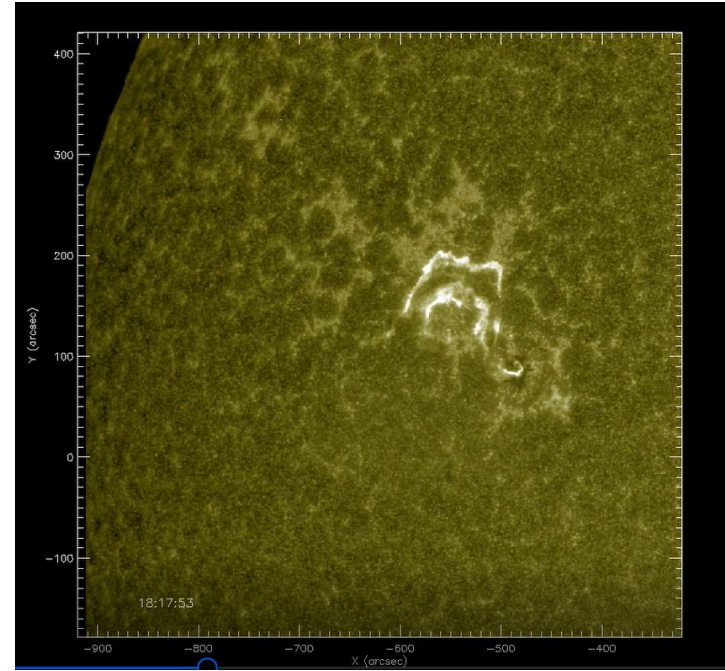
Energy Partition of the Flare-CME Events

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Background

Questions to ask:

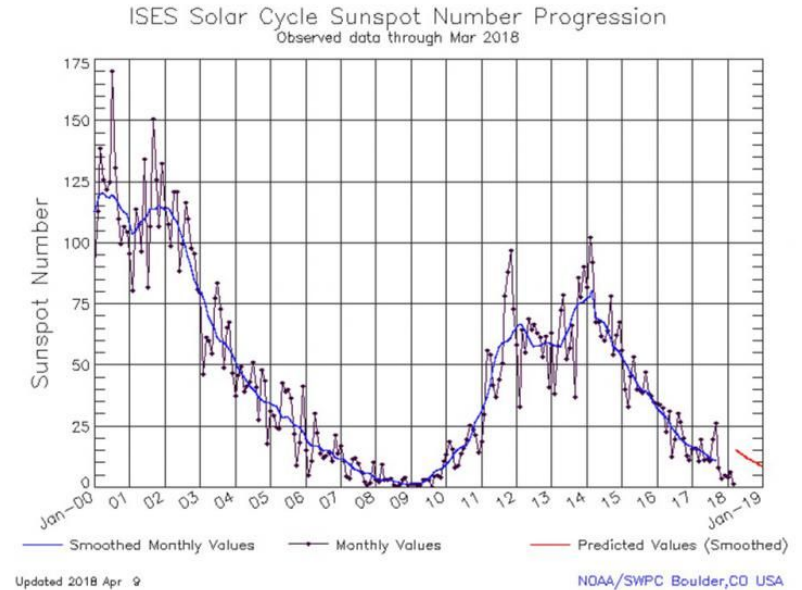
- How much energy is released from the flares?
 - Corona v.s. Transition region
- How much energy is released with the CMEs?
 - Kinetic v.s. Potential
- Can we learn more about the how the magnetic energy is converted into other forms of energy?



Objective

Improving/ Building on previous studies:

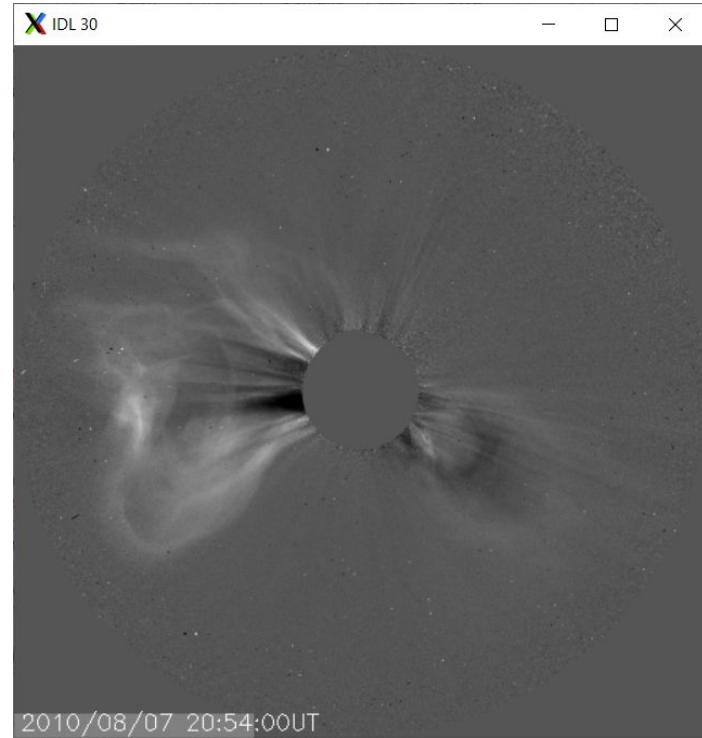
- Estimation of flare energy → improved methods
- Event dates → newer events in solar cycle 24
- Sample size → look at more events





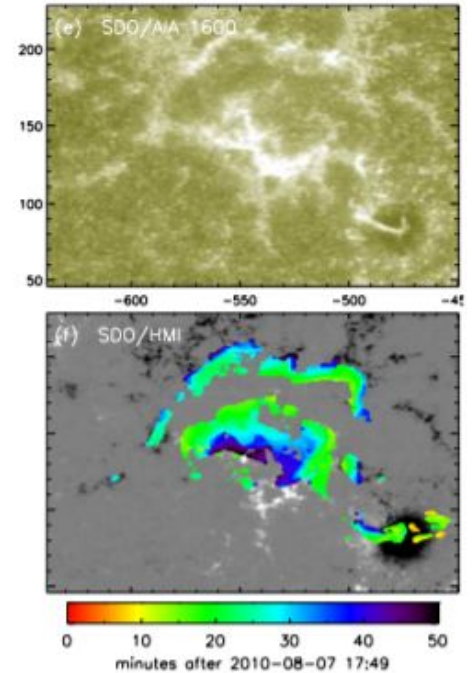
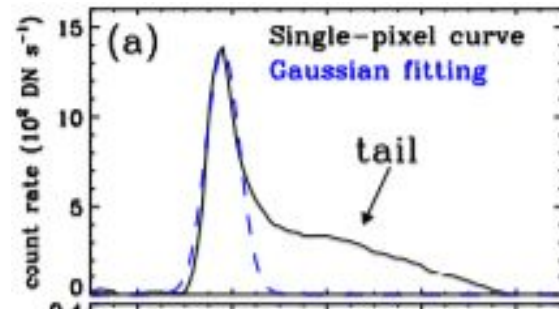
Methods: CME

- Mass Images from STEREO



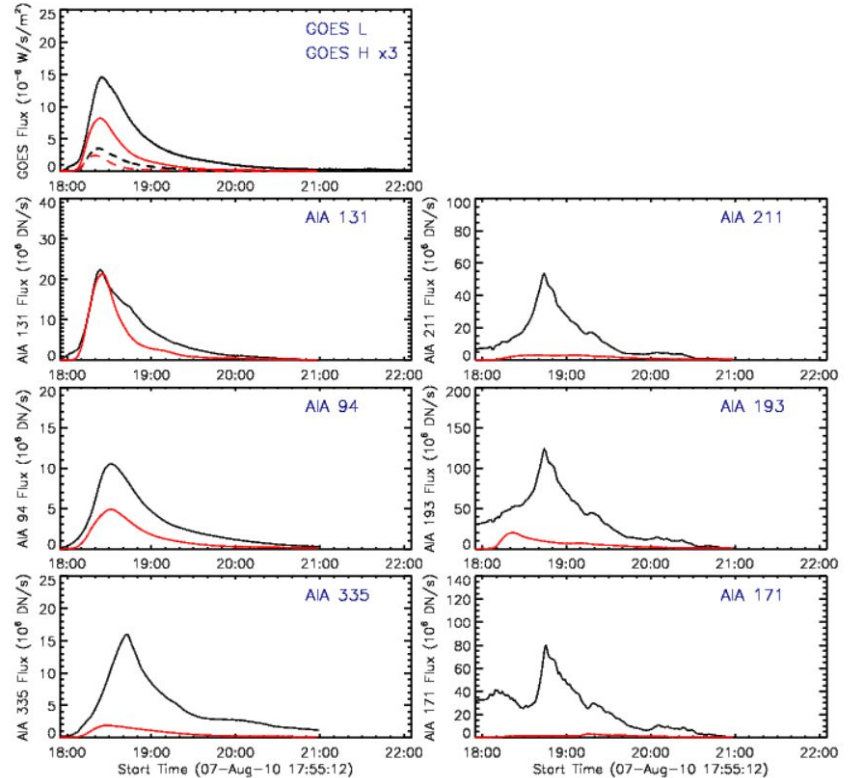
Methods: Flares

- EBTEL (enthalpy-based thermal evolution of loops) Model
- Images from SDO



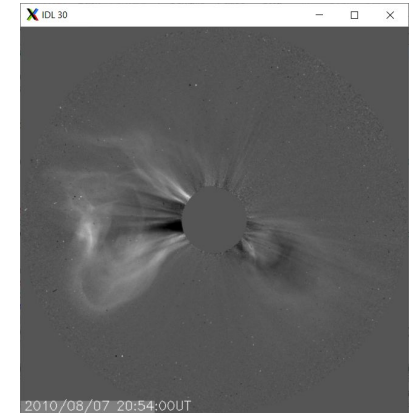
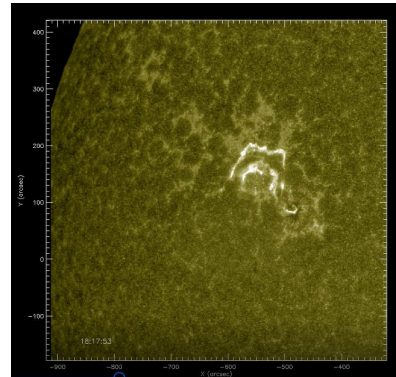
Methods: Flares

- Glambda: Adjusts the slow-heating
- ScI0: Scaling factor for heating rate
- ScI1: Scaling factor for transition region radiation



Methods: Analysis

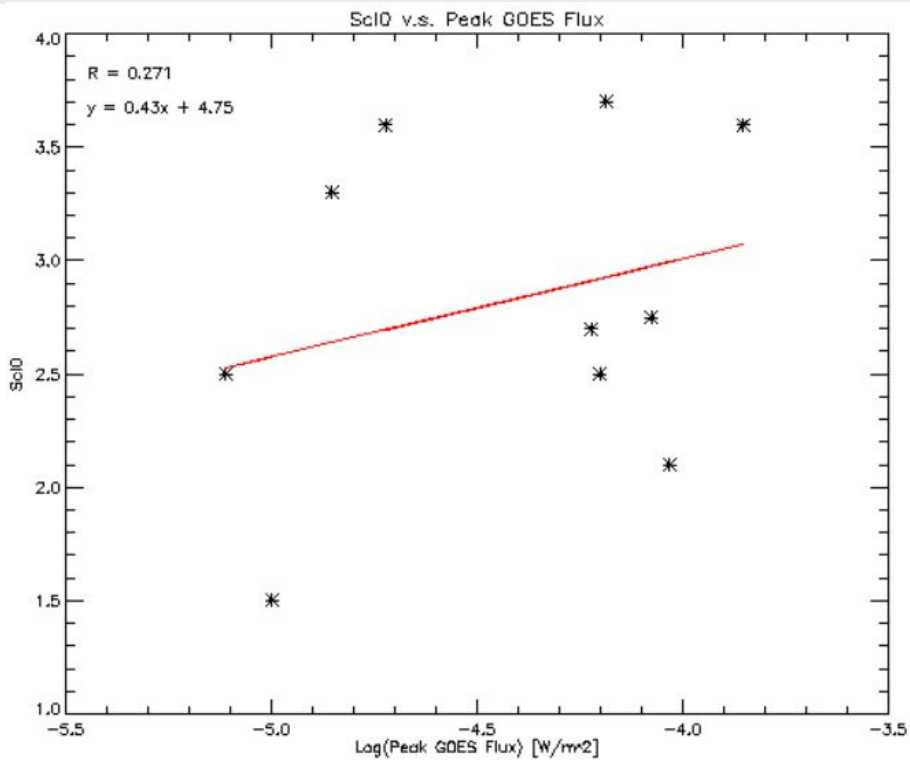
- Analysis of the three parameters
 - Their relation to the GOES flare classes
- Analysis of the energy partition
 - Flare energy v.s. CME energy
 - Radiation from corona v.s. transition region
 - Kinetic energy v.s. Potential energy



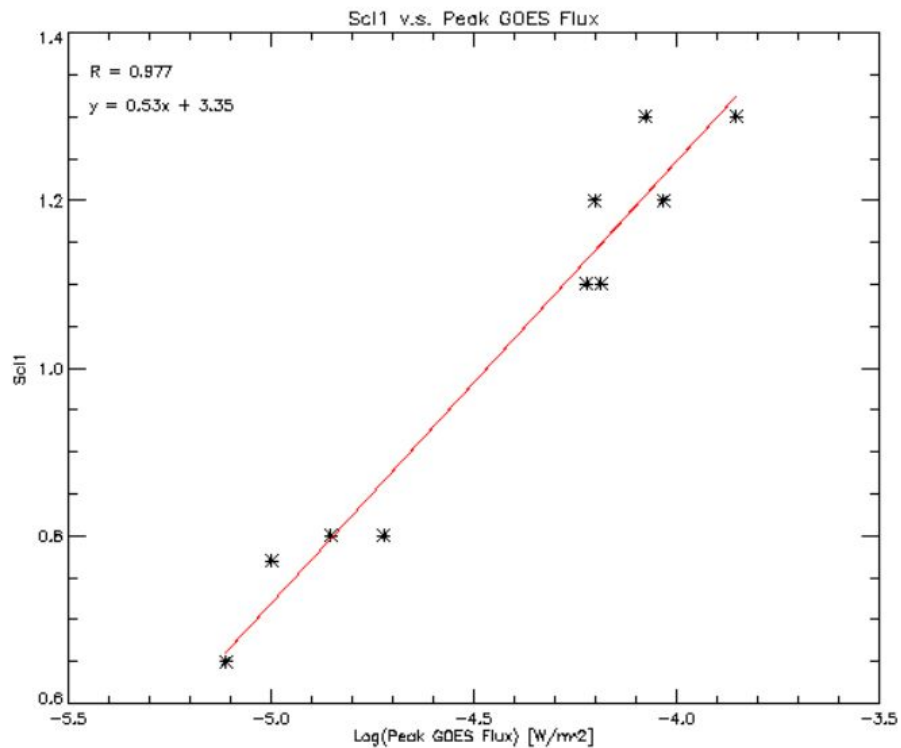


Results

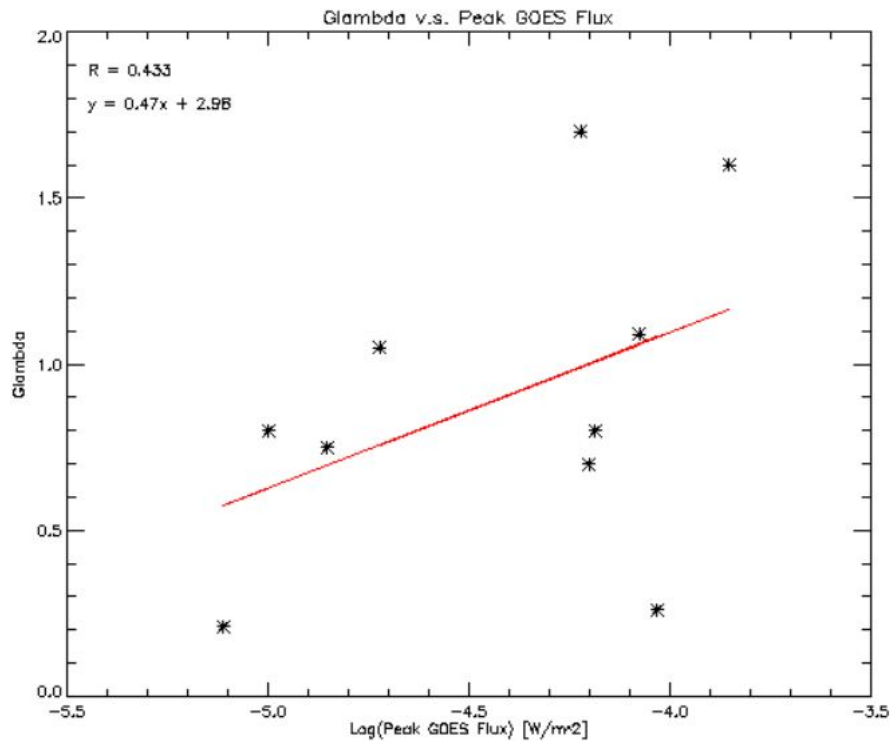
| Event | GOES Class | Glambda | ScI0 | ScI1 | Correlation | Q [ergs] |
|------------|------------|---------|------|------|-------------|-----------------------|
| 2010/08/03 | M1.0 | 0.8 | 1.5 | 0.77 | 0.88 | 8.56×10^{30} |
| 2011/06/21 | C7.7 | 0.21 | 2.5 | 0.65 | 0.80 | 9.03×10^{30} |
| 2011/08/02 | M1.4 | 0.75 | 3.3 | 0.8 | 0.78 | 6.57×10^{30} |
| 2011/08/03 | M6.0 | 1.7 | 2.7 | 1.1 | 0.96 | 2.97×10^{31} |
| 2011/08/04 | M9.3 | 0.26 | 2.1 | 1.2 | 0.96 | 2.02×10^{31} |
| 2012/03/09 | M6.3 | 0.7 | 2.5 | 1.2 | 0.94 | 3.31×10^{31} |
| 2012/03/10 | M8.4 | 1.09 | 2.75 | 1.3 | 0.88 | 6.08×10^{31} |
| 2012/06/14 | M1.9 | 1.05 | 3.6 | 0.8 | 0.85 | 1.19×10^{31} |
| 2012/07/12 | X1.4 | 1.6 | 3.6 | 1.3 | 0.75 | 9.56×10^{31} |
| 2013/04/11 | M6.5 | 0.8 | 3.7 | 1.1 | 0.89 | 2.41×10^{31} |



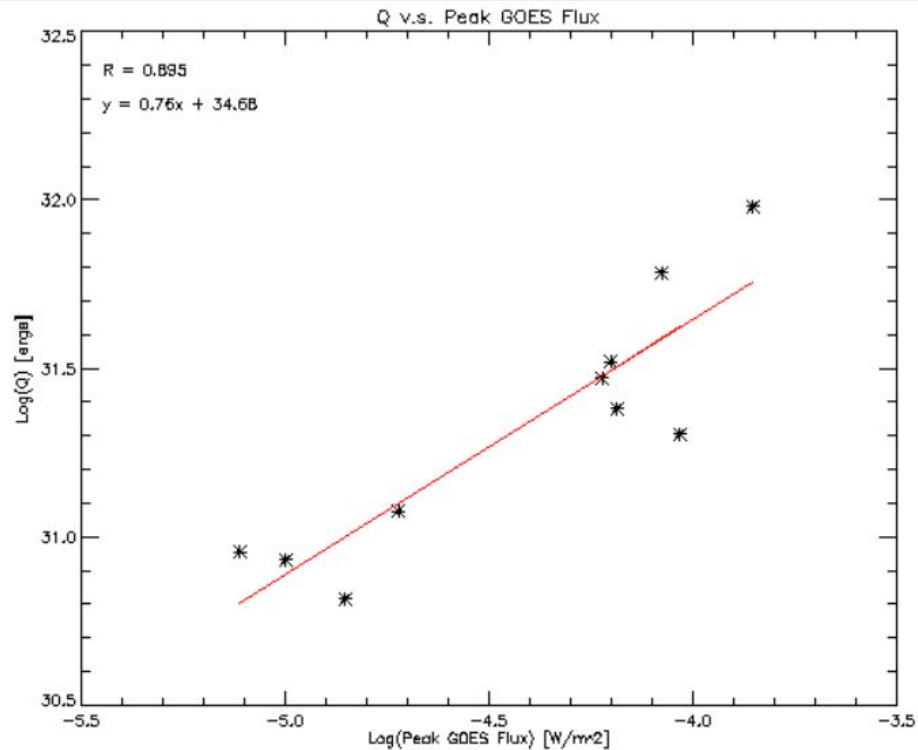
Correlation = 0.271
 Mean = 2.825
 Stdv = 0.723



Correlation = 0.977
 Mean = 1.022
 Stdv = 0.243

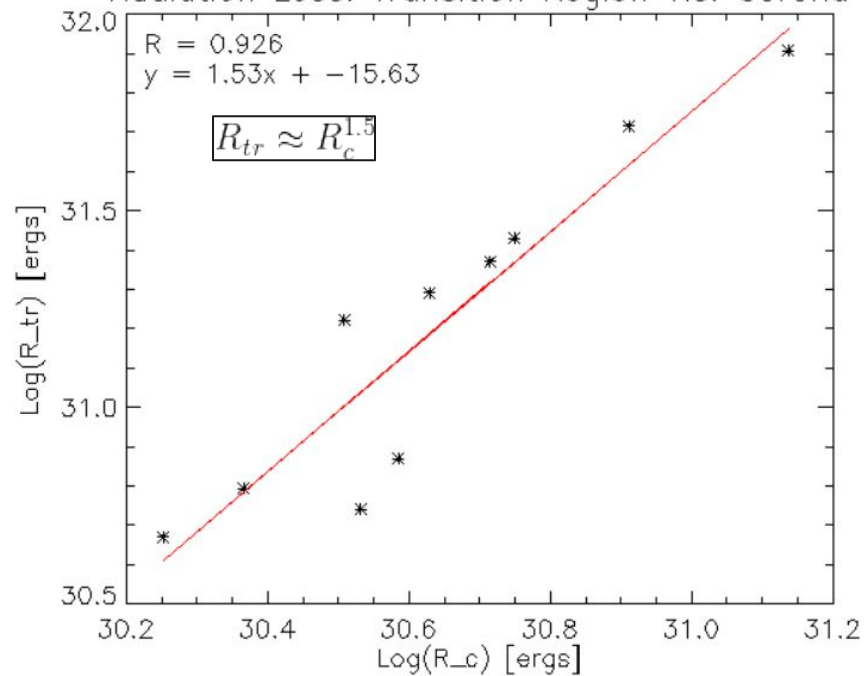


Correlation = 0.433
Mean = 0.896
Stdv = 0.490



Correlation = 0.895
Mean = 3.000E+31
Stdv = 2.823E+31

Radiation Loss: Transition Region v.s. Corona



| | Mean | Standard dev. |
|--------------|------|---------------|
| Q/E_{cme} | 0.77 | 0.67 |
| R_c/R_{tr} | 0.31 | 0.16 |
| E_k/E_p | 4.84 | 9.93 |

Conclusion

Main Findings

- Energy partition for 10 events
- A few strong correlations
- Some quantities having a small range

Future work / Improvements

- Possibly improving the flare estimation with a better method
- Comparing different parameters/ratios with more than just GOES flare class
- Working on more events to increase sample size





Thank you!



Sources

Images:

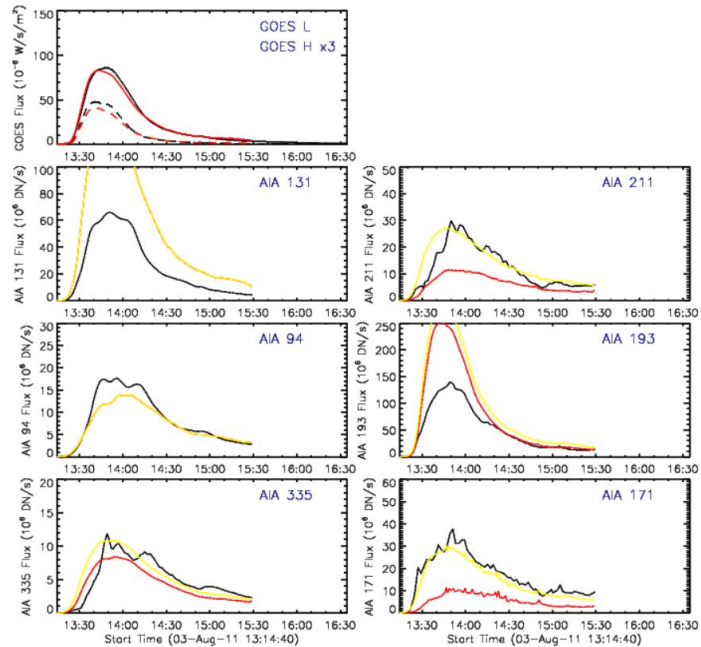
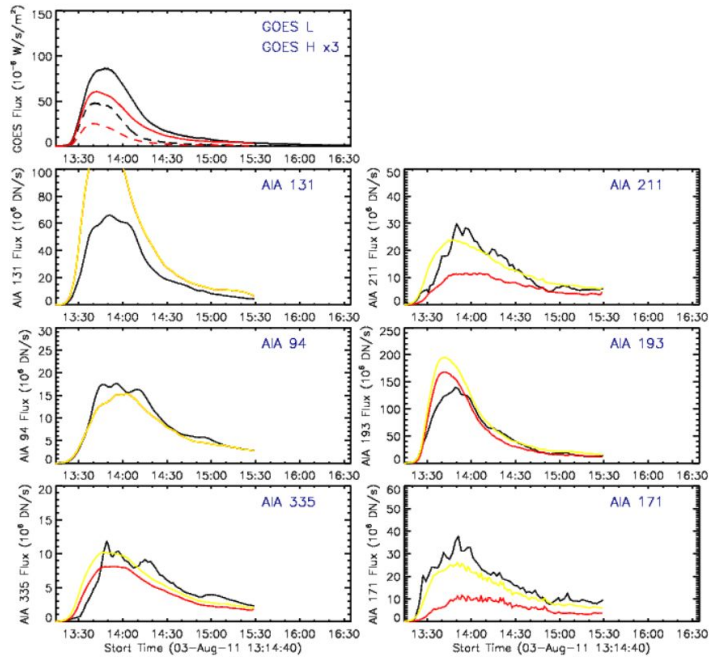
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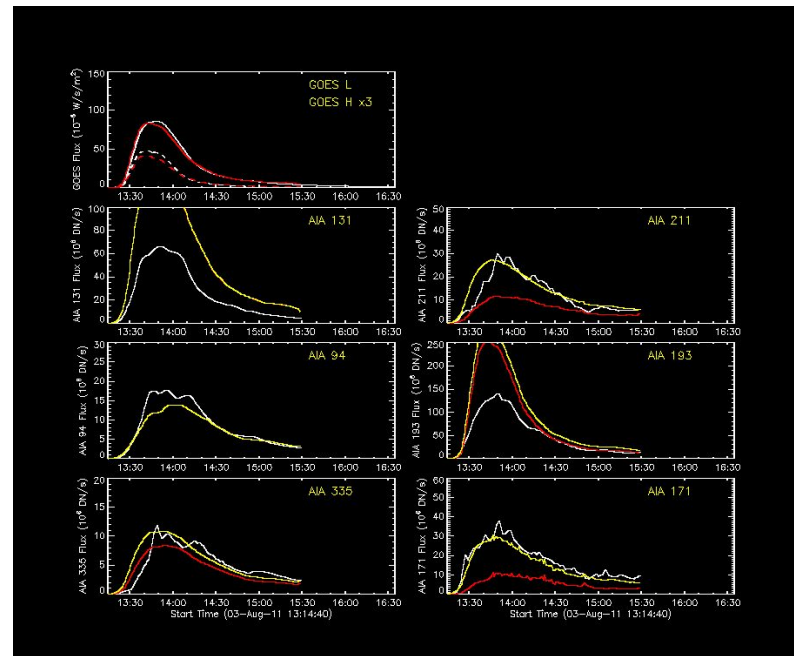
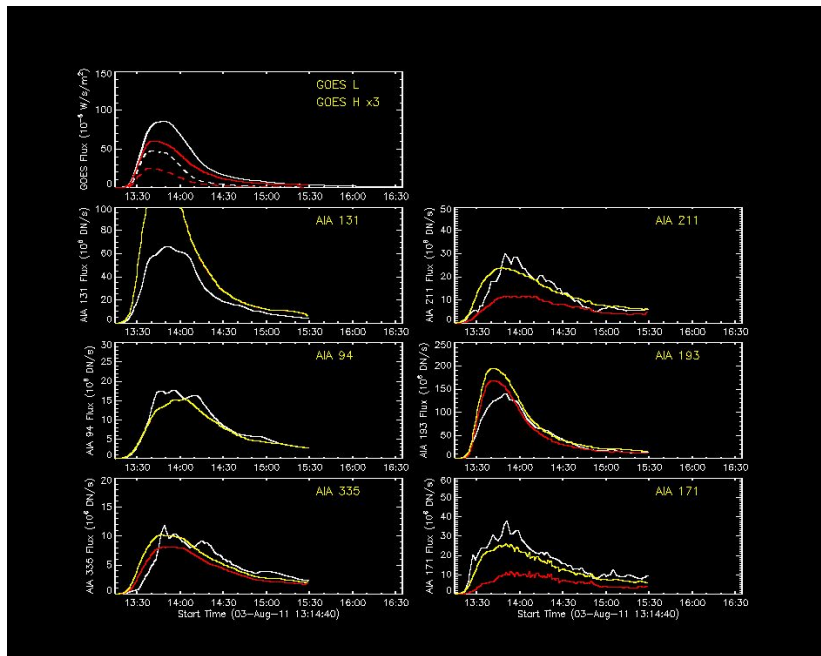
https://www.nasa.gov/mission_pages/stereo/images/index.html

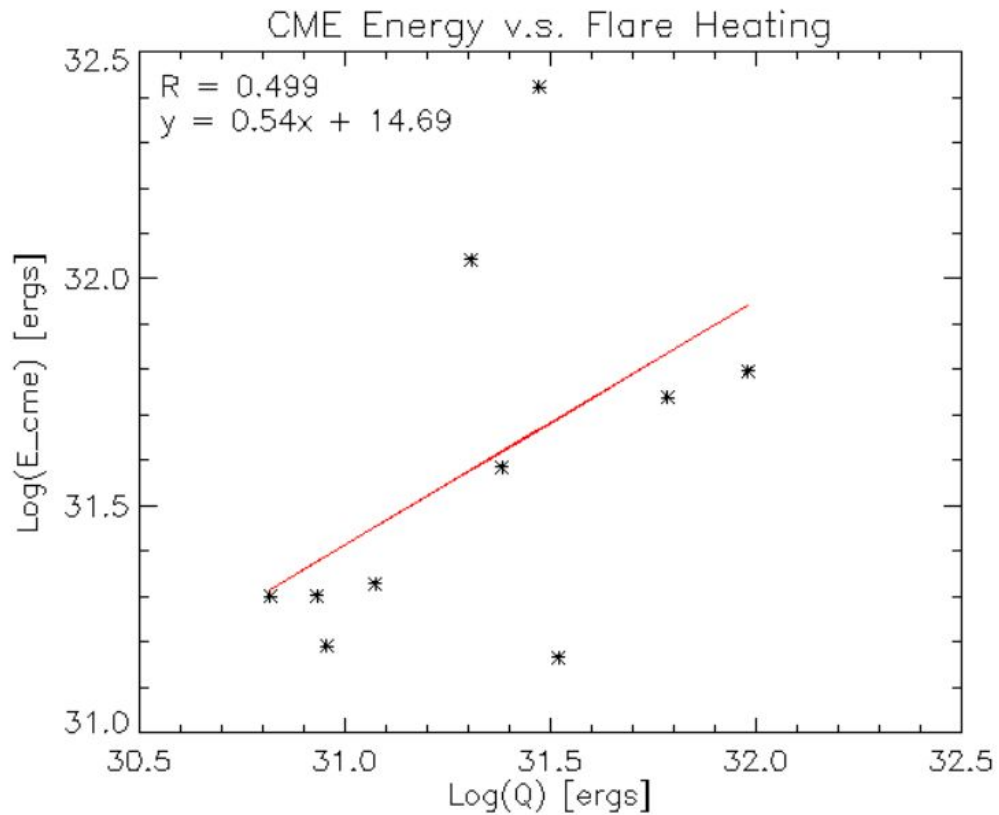
https://www.nasa.gov/mission_pages/sdo/images/index.html

Reference

<https://iopscience.iop.org/article/10.1088/0004-637X/759/1/71/pdf>







Potential Energy v.s. Kinetic Energy of CMEs

