RESEARCH LOG - WEEK 3

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1. Introduction to the Complete Data Set

This week saw the absence of both of this author's supervisors as Dr Dana Longcope and Dr Jiong Qiu were both away at meetings. However, such were the problems experienced with IDL this week, this author was certainly not short of work to undertake. The complete data set that will be studied was only properly examined for the first time at the beginning of this week. The data consists of a series of snapshots obtained by the Atmospheric Imaging Assembly (AIA) with each series showing Ultraviolet or Extreme Ultraviolet light of different wavelengths. The wavelengths for which data is available are 94, 131, 171 (the wavelength for which loops were initially traced), 193, 211, 335 and 1600Å. These wavelengths correspond to the emission lines of ionized elements present in the solar plasma. Each wavelength of electromagnetic radiation is emitted by ions associated with a different temperature and so examining the entire data set allows the temperature of solar plasma to be monitored during the evolution of a flare event. The table below lists the source of each wavelength and the plasma temperatures that produce these spectral lines.

Wavelength Å	Source	Characteristic Temperature K
94	Fe XVIII	6.3×10^6
131	Fe VIII, XX, XXIII	$4\times10^5, 10^7, 1.6\times10^7$
171	Fe IX	6.3×10^5
193	Fe XII, XXIV	$1.2\times10^6, 2\times10^7$
211	Fe XIV	2×10^6
335	Fe XVI	2.5×10^6
1600	C IV (+ continuum)	$10^5, 5000$

2. Image Alignment

Since the sun rotates, as time progresses solar structures move across the surface of the sun and so the series of snapshots in question will show interesting features traversing from one side of the image to the other. In order for effective analysis of the coronal loops to be undertaken, this phenomenon must be considered. Therefore,

each of the images had to be shifted by an amount dependent on the time elapsed between an initial reference time and the moment the image was captured. This ensured that within each wavelength, stable solar structures did not shift throughout the series of images. However, since each wavelength is detected by an instrument in a slightly different position, images corresponding to one wavelength are not necessarily aligned with those corresponding to a different wavelength. This was solved by using the 'setpts' command to compare the coordinates of identical features on reference images. The difference between coordinates was then calculated and this was used to shift the images by the required quantity. The suitability of each image shift was then examined and in many cases the process was repeated in order to produce a better alignment.

3. Fun with .Fits Files

Once this author was content with the alignment of the shifted images, the computer intensive process of making maps for each of the wavelengths began. This proved to be an arduous process not only because the creation of each map took a while but because every time the required code was implemented, the low-memory /tmp directory would quickly become overwhelmed by the quantity of data. Some time passed before it was realised that this was the cause of error messages being returned and once this issue was identified a remedy was quickly implemented. It was found to be easiest to generate a map for each wavelength separately, before deleting the .fits files from the /tmp directory. Once this process had been completed for each wavelegnth, a code called 'read_loops_intensity' was implemented. This code was designed to determine whether the loops previously observed in the 171Å images were present at other wavelengths. The results have not yet been evaluated and so there will be more to follow in subsequent weeks.

4. Lectures and Seminars

Possibly due to the absence of three professors from the Physics deparment this week, only one lecture was given and no seminar took place. The talk given by Dr Charles Kankelborg explored the existence of the solar atmosphere and how it is observed. The topics discussed were certainly relevent to this author's work as the spectral emission lines produced in the solar corona were considered. The matter of the coronal heating problem was alluded to and an explanation for the reasonably solid outline that the sun posseses was delivered. Videos of the sun filmed using various wavelengths were presented and it was interesting to see how different features are visible in some frequencies of electromagnetic radiation but are completely absent in others.