

# RESEARCH LOG - WEEK 5

THOMAS HOWSON

## 1. PREFT

Following the selection of suitable loops last week, the process of modelling individual loops began. Professor Longcope's PREFT (Post Reconnection Evolution of a Flux Tube) code was utilised for this task. Essentially the code takes input parameters that reflect the initial state of the coronal loop being modelled and calculates how the loop is expected to develop. The parameters used as code inputs are shown in the table below.

Input Parameter	Value
Energy Injected into Loop	$1.0 \times 10^{11} \text{ergcm}^{-2}$
Reconnection Angle	$110^\circ$
Maximum Initial Temperature	$4 \times 10^6 \text{K}$
Minimum Initial Temperature (Chromosphere)	$1 \times 10^4 \text{K}$
Magnetic Field Strength	25G
Final Loop Length	$60 \times 10^6 \text{m}$

Initially the code transfers the required energy into the loop structure before monitoring how an idealised loop would evolve. At each time step (equal to one second by default), the code determines the pressure, velocity, temperature and density of the modelled loop. The program is allowed to run for 1800s which approximately corresponds to the duration of the flare being investigated. This will allow for a comparison to be made between the observed loop and the expected appearance of a loop according to the PREFT code. Ultimately, theoretical lightcurves will be plotted, primarily using the modelled temperature (but also the predicted values of the other parameters), and will be compared to those associated with the observed data. In this way, the effectiveness of the model and the nature of the flare can be considered.

Unfortunately, the programs terminated erroneously after the loop had been simulated for around 330s. The result of a bug was that one of the parameters being

modelled would become very large and so too big for the computer to handle. Physical properties becoming arbitrarily large is usually a cause for concern due to a likely violation of the conservation of finitely valued quantities such as energy and mass. However, this issue was resolved and by the end of the week, the code was running as planned.

## 2. MIDTERM PRESENTATIONS

Friday afternoon saw the REU students giving a 20 minute presentation on the research completed so far. Preparations for this inevitably consumed a fair amount of time and so the quantity of research completed was certainly less than in previous weeks. Despite the prospect of a talk to the solar group looming like a menacing thundercloud, the time spent ensuring the presentation had a sound scientific foundation was definitely worthwhile. Previously, it had been easy to forget that all the loop tracing and image alignment was important for investigating hypotheses about solar flares and it was useful to once again bring these theories into consideration. This author found it difficult to introduce basic concepts to world-leading experts in the full knowledge that any science discussed was immediately obvious to the majority of the audience. Nevertheless the presentation provided an excellent opportunity to talk to an audience whose understanding of the subject varied greatly from that of long-established professors to undergraduates with just a few weeks' experience in the field. The session also offered a valuable opportunity to learn about the work that the other REU students have been undertaking. A link to the final presentation will be provided on this website in due course.

## 3. LECTURES AND SEMINARS

This week saw the invasion of speakers from Scotland and in particular the University of St Andrews. Bozeman certainly is a long way to travel to listen to lecturers from St Andrews but it was certainly nice to see some familiar faces. Dr Duncan Mackay delivered a seminar on applications of non-linear force-free magnetic fields to solar phenomena and in particular how the modelling of such fields can be used to consider the loci and orientation (chirality) of solar filaments. Professor Priest, on the other hand, delivered the first two of four lectures on magnetohydrodynamics. After a brief history of St Andrews had been explored, he described how Maxwell's equations are coupled with equations of fluid dynamics to produce the MHD equations. With the help of many amazing observations of the sun (including his own photographs of a total solar eclipse), he described how these equations are used in the modelling solar features.