

# Project Outline

Ding Yuan (0859821)

Supervisor: Prof. V. Nakariakov

**Thesis Title:** Waves in Solar and Stellar Coronae

## Project Outline:

Based upon modern ground-based and space-borne observational facilities, waves and oscillations in the solar coronae are well resolved in visible light, EUV, X-ray and radio waves. The interpretation of the observed phenomena is well developed in terms of MHD wave theory. The combination of observational results and theory provide us with a ground for MHD corona seismology, which is applied in estimation of coronal magnetic field, transport coefficient etc.

The project is designed to analyze EUV, X-ray and microwave data, with special focus on wave and oscillation processes, to apply MHD and kinetic theory in interpretation of observed phenomena and in plasma diagnostics. Application of the solar plasma diagnostic techniques to the analysis of coronae of sun-like stars and M-dwarfs is planned.

## Introductory Reading List:

- [1] Nakariakov V.M., Verwichte E., "Coronal Waves and Oscillations", Living Rev. Solar Phys. 2 (2005) 3. <http://www.livingreviews.org/lrsp-2005-3> (cited on <2009-10-23>)
- [2] Inglis, A.R., Nakariakov, V.M., A multi-periodic oscillatory event in a solar flare. Astronomy and Astrophysics **493** (2009) 259-266
- [3] Nakariakov, V.M., Melnikov, V.F. Quasi-Periodic Pulsations in Solar Flares Space, Science Reviews **55** (2009)
- [4] Scargle, J.D. Studies in astronomical time series analysis. II - Statistical aspects of spectral analysis of unevenly spaced data, Astrophysical Journal **263** (1982) 835-853
- [5] Torrence, C., Compo, G.P. A Practical Guide to Wavelet Analysis Bulletin of the American Meteorological Society **79** (1998) 61-78

## Initial Task:

### ● Oct.-Dec.:

1. To get familiar with the current research in solar coronal waves and oscillations.
2. To understand the objective and challenges of MHD coronal seismology.
3. To acquire practical experience in IDL programming, wavelet and periodogram analyses.
4. To apply the data analysis package in IDL (<http://atoc.colorado.edu/research/wavelets/>) and periodogram.pro and filtsig.pro to synthetic data with white and red noise and of variable cadence time.

### ● Jan.-Mar.:

1. To get familiar with data pre-processing and pre-analysis techniques.
2. To apply the techniques mentioned above to real data analysis.
3. To attend the RAS discussion meeting in March.

## **Six months Milestones:**

1. To acquire skills in data analysis and interpretation.
2. To get familiar with the key issues of coronal waves and oscillation.
3. To apply the techniques mentioned above and have some results ready to present in the discussion meeting in March.

## **Taught Modules:**

- MM0: Essential Graduate Math
- MM1: Time Series Analysis
- Online course (Belfast): Introduction to Plasma Physics
- CY901: High Performance Scientific Computing
- PL1: Waves in laboratory and astrophysical plasma
- Core Algorithms in High Performance Scientific Computing
- PX420: Solar Magnetohydrodynamics
- PX392: Plasma Electrodynamics