Proposed SOHO Joint Observing Program

ELEMENTAL ABUNDANCES IN THE TRANSITION REGION AND CORONA

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Progress:

Draft Scheme

Discussion at SPWG

Detailed Plan Minor Revision

Objective: To measure elemental abundances in the transition region, corona and solar wind.

Scientific Case: The elemental abundances in the solar wind are observed to vary and to differ from photospheric abundances. The cause of the these variations is not understood, but there is a correlation between abundance and the ionization potential of the neutral atom (First Ionization Potential). Low FIP elements include Si, Mg and Fe, while high FIP elements include He, N, O and Ne. Those elements having a low FIP are generally enhanced by factors of 2-3 with respect to high FIP elements at coronal temperatures, but not in the transition region. Definitive observations are badly needed for the temperature at which the FIP effect appears, for the strength of the FIP effect in various coronal structures, and for the absolute sense of the effect – whether low FIP elements are enhanced relative to H or high FIP elements are depleted in the corona. The abundance of helium is an especially important question, because of its variability in the solar wind and because its abundance is large enough to affect the overall dynamics of the wind.

In order to extract elemental abundances from observations of one or a few ions, one must know the ionization state of the element. Thus questions of electron temperature and ionization equilibrium implicit in any attempt to derive abundances. We therefore expect that UVCS would make a T_e measurement immediately before or after the abundance observation, but for this description we simply assume that by measuring as many ions as possible for each element we can reduce the uncertainty in the total abundance of the element. It will also be important to determine the coronal density irregularity in order to compare collisionally excited lines with radiatively excited ones. The measurements should extend at least to the ionization freezing-in height for the elements observed (2-3 solar radii) for comparison with *in situ* measurements.

Observables

- Wind (CELIAS)

  Abundances of He, N,O,Ne,Mg,Si and Fe relative to H

- Extended corona (UVCS, LASCO)

  Emission line intensities of H, He, N, O, Ne, Mg, Si, S, Ca and Fe
  Electron density
  Electron temperature for determination of ionization state

- Transition Region and Inner Corona (CDS, SUMER, EIT)

  Lines of several ionization states of each element to cover the temperature range 10^5 - 2×10^6 K. Several lines of each of a few ions to determine electron temperature and possible departures from ionization equilibrium.

Targets:	CH, AR, Streamers, QS
Ground Based:	white light coronagraphs, coronal forbidden line spectra

Proposed UVCS Observations

The UVCS observations will be fairly long integrations at several heights in the corona with 1.2' spatial resolution. The Lyα channel will observe Lyα, N V, S X] and [Fe XII], and possibly [Mg VII], [Fe XIII], and Ne IX. The O VI channel will observe at 3 grating positions to get Lyβ, He II, O VI, Ne VII, Mg X, Al XI, Si XI], Si XII and Ca X, and perhaps Ne VI, Na VII, [Si VII], [Si VIII], [Si IX], S VI, S XI, S XIII, Ar VII, [Ar XII], K IX, Ca VIII, [Ca XIII] and [Ca XIV]. The WLC will observe the polarized light in the 4500-6000 Å band. A T_e measurement would probably precede or follow this JOP.

UVCS

Initial instantaneous F.O.V.	40' x 14" at 1.5 $R_\odot$
	$\parallel$ to the limb
	centered at the target latitude
Pixel	14" x 70" Ly α channel
	28" x 70" OVI channel
Spectral resolution	0.28 Å, Ly α channel
	0.36 Å, OVI channel
Dwell time	3 times 20 min
F.O.V. stepped by	0.5 $R_\odot$
	up to 3 $R_\odot$
Total time	4 h