Abstract

Over the last ten years experiments onboard the Solar and Heliospheric Observatory (SOHO) acquired XUV data of the solar corona (from $\sim$ 165 to 1600 Å) which provided us with a comprehensive data set covering all phenomena occurring in this region. Striking new results were obtained from these observations on the morphological and physical properties of small and large-scale static and dynamic coronal features, covering a complete solar activity cycle from its minimum in 1996, through the last maximum on 2001 and its declining phase towards the next minimum expected in 2007.

In this Thesis we present the results we obtained from an analysis of coronal spectroscopic observations acquired with the UltraViolet Coronagraph Spectrometer (UVCS) aboard the SOHO spacecraft. After a brief hystorical introduction on UV coronal observations and a summary of the main properties of coronal plasmas, in the first part of this Thesis we review the most important physical processes which give rise to the observed coronal UV spectrum and illustrate the plasma diagnostic techniques used to derive informations on the thermodynamic state of the emitting plasma. A description of the UVCS instrument – together with an outline of the characteristics of the other SOHO experiments whose data have been analyzed for a better and more thorough interpretation of data – concludes the first part.

In the second part of the Thesis we focus on results from the analysis of four UVCS datasets. In the first work we study the temporal evolution of a streamer complex observed in June 2000 at the time of a SOHO-Ulysses quadrature. We examine in particular two streamers, which were slowly evolving, for which we derive densities, temperatures and elemental abundances: these turned out to be different in different structures. This possibly depends on the streamer "age" at the time observations have been acquired. In spite of the change in abundance values, both streamers have the same FIP (First Ionization Potential) bias (i.e. the same overabundance of low to high FIP elements, with respect to the photospheric value of the ratio). We conclude that the process responsible for the FIP effect is independent of the absolute values of abundances. The Fe/O ratio, which may be considered a proxy for the FIP effect, was also measured *in situ* by the Solar Wind Ion Composition Spectrometer (SWICS) aboard the Ulysses spacecraft, with the aim of comparing coronal and *in situ* values and identify the coronal source of the plasma sampled *in situ*. As we will show, data do not allow us to come to a definite conclusion on this issue.

The second and third work analyse UVCS data from transient phenomena, the Coronal Mass Ejections (CMEs), in their early and late stage of evolution. In particular, our second work concentrates on the UVCS observations of a CME which occurred on 31 January 2000. Purpose of our analysis is to infer the structure of the CME in the early stage of its development and derive physical parameters of plasma in different parts of the CME. These are not well known: measurements of densities, temperatures and other physical parameters may help identify the mechanisms that

lead to the CME phenomena and serve as guidelines for a theoretical model of CMEs. With the support of data from the MAgnetic Doppler Imager (MDI) the active region (AR) where the CME originates is identified and, combining white light data from the Mauna Loa Observatory and UVCS data, we reconstruct the CME configuration. A comparison of the observed structure with that predicted by the Lin & Forbes (2000) CME model shows the two to be quite similar. Plasma densities and temperatures in the expanding CME front and core are also given but their distribution does not fully agree with the Lin & Forbes predictions. A tentative estimate of the mass in different parts of the CME, and of its overall mass, indicates that at the heliocentric distance of our data (1.6 solar radii) the CME has not yet reached its final mass.

In our third work we report on UVCS observations of the coronal restructuring following a CME wich occurred in November 2002 at the time of a SOHO-Ulysses quadrature campaign. These observations cover, with occasional gaps, a time interval of more than 2 days giving us the possibility to study the evolution of the coronal plasma parameters in the CME late stage. The observed UV emission indicates plasma temperatures above 6×10^6 K: a comparison of the site of hot UV plasma with images from the Extreme UV Imaging Telescope (EIT) aboard SOHO shows the high temperature emission to overlie a growing post-flare loop system formed in the aftermath of the CME. This emission most likely originates in a current sheet (CS) overlying the arcade, for which we infer densities and give the temperature vs. time profile. Although this does not represent the first identification of a CS in a CME event, it is the first time that the evolution in time of its physical parameters has been given. Because at the time of the quadrature, Ulysses was directly above the location of the CME its instrumentation intercepted the ejecta. High ionization state Fe was detected by the Ulysses Solar Wind Ion Composition Spectrometer (SWICS) throughout the magnetic cloud associated with the CME: this is the first unambiguous identification of the coronal source of the highly ionized plasma measured *in situ* by Ulysses. Hence, the SOHO-Ulysses data set provided us with the unique opportunity of analyzing a current sheet structure from its lowest coronal levels out to its *in situ* properties. Both the remote and *in situ* observations are compared with predictions of theoretical CME models.

In the fourth and last work of this Thesis we analyzed UVCS observations of a sungrazing comet observed on February 2001; in particular we show how from UV data it is possible to estimate the physical parameters of the coronal plasma encountered by the comet. This gives us the opportunity of illustrating briefly atomic processes which occur at the time of the interaction between the cool cometary and hot coronal plasmas and are usually not discussed when dealing with coronal spectroscopy. We also derived some cometary properties such as the water outgassing rate, the nucleus size and the number density of dust particles in the tail. This comet apparently went through sequential fragmentation events along its path and it is the first time that UVCS identifed two cometary fragments and their size has been evaluated.

A concise description of future work is given at the end of the Thesis.