ESSO (EUV Solar Spectroscopic Observatory)

A magnifying glass to unlock the mysteries of energy transport on the Sun

Mission Overview

ESSO is a sophisticated "magnifying glass" to quantitatively understand the physical mechanisms of energy and mass transport in the hot, magnetized plasma of the solar atmosphere. Energy and mass transport from interiors to coronae (high beta to low beta plasma) is a generic problem in astrophysics, (stars, accretion disks, and galactic coronae) that can only be studied in detail on the Sun. ESSO will provide for the first time the comprehensive, high cadence observations required to trace this rapidly varying flow of energy through the solar atmosphere, and will be the first solar physics mission to achieve sub-arcsecond resolution in the transition region and corona with both spectroscopy and imaging over a continuous temperature range from 10,000 K to 10 million K.

Relevance to NASA Science Themes and Other Missions:

ESSO forms an essential complement to the Living-With-A-Star initiative by exploring the physics of small scales processes involved in the drivers of space weather. While SDO will reveal the conditions under which space weather is generated, ESSO will answer how and why these processes happen.

ESSO also provides synergy with Solar-B by producing high resolution observations of the upper solar atmosphere comparable to the photospheric observations of Solar-B, and a quantitative understanding of the field-plasma coupling in the "magnetic transition region", inaccessible to Solar-B.

Science Goals and Objectives

ESSO will address the following broad scientific questions:

- *What is the interaction and connectivity of structures across layers in the solar atmosphere?*
- *What are the physical processes of mass flow and energy release in the solar atmosphere?*
- *What is the nature, role and cause of wave energy in the solar atmosphere?*

These questions are directly related to two of the primary Quests in NASA's Sun-Earth Connection (SEC) theme, and augments several campaigns in the SEC Roadmap.

Science Payload

UV Imaging Spectrograph (UVS):
Rapid scanning spectrograph with three simultaneous passbands covering a temperature range extending from the low chromosphere (10,000 K) to the flaring corona (10 million K).

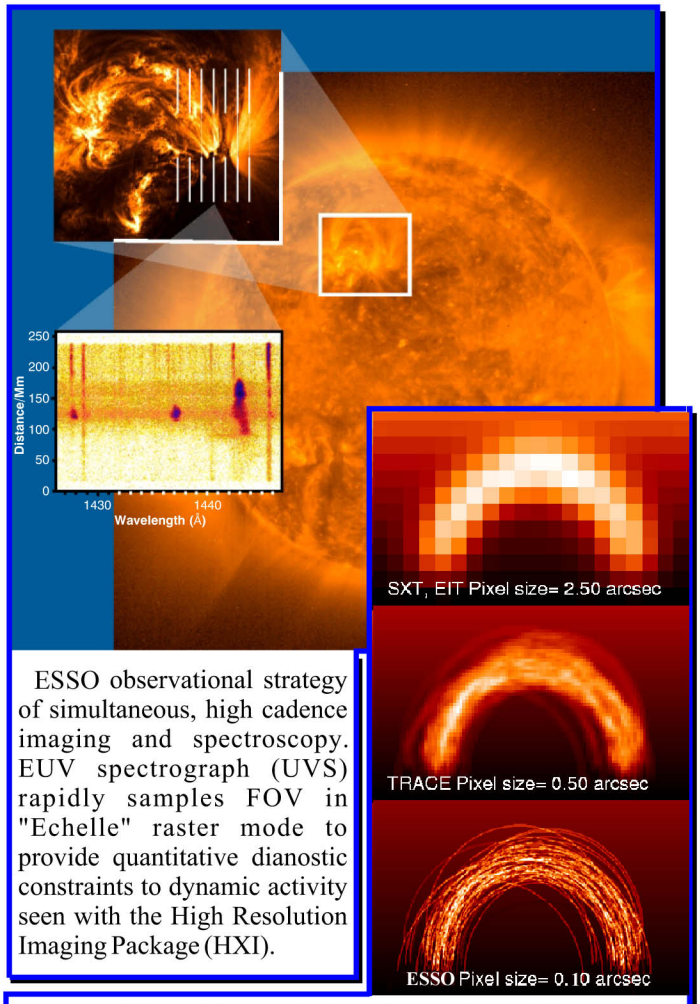
Spatial resolution:	0.1 arcsec pixels
Spectral resolution:	20,000
FOV:	6.8 x 6.8 arcmin^2
Wavelength range:	
Detector A:	510-575 Å (1020-1150 Å)
Detector B:	580-645 Å (1160-1290 Å)
Detector C:	720-785 Å (1440-1570 Å)

Slit Jaw Camera (SJC):
Broad passband UV imager to provide low chromospheric imaging and co-alignment between UVS, HXI and other S/C and GBOs.

Spatial resolution:	0.1 arcsec pixels
Spectral resolution:	15
FOV:	6.8 x 6.8 arcmin
Wavelength passband:	1500-1600 Å

High Resolution Imaging Package (HXI):
Three multi-layer telescopes to provide simultaneous, high time cadence imaging in 3 EUV passbands centered on 3 strong emission lines formed at different heights in the solar atmosphere.

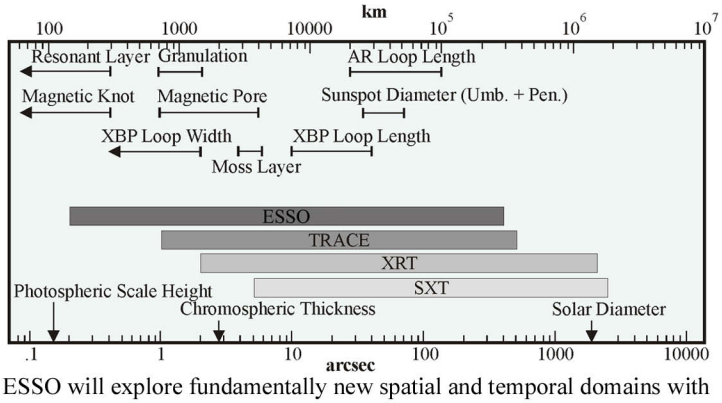
Spatial resolution:	0.1 arcsec pixels
Spectral resolution:	15-30
FOV:	6.8 x 6.8 arcmin^2
Wavelength passbands:	
HXI1:	402 Å (Ne VI formed at 400,000 K)
HXI2:	193 Å (Fe XII and Fe XXIV, formed at 1.5 MK and 20MK)
HXI3:	335 Å (Fe XVI formed at 2.5 MK)



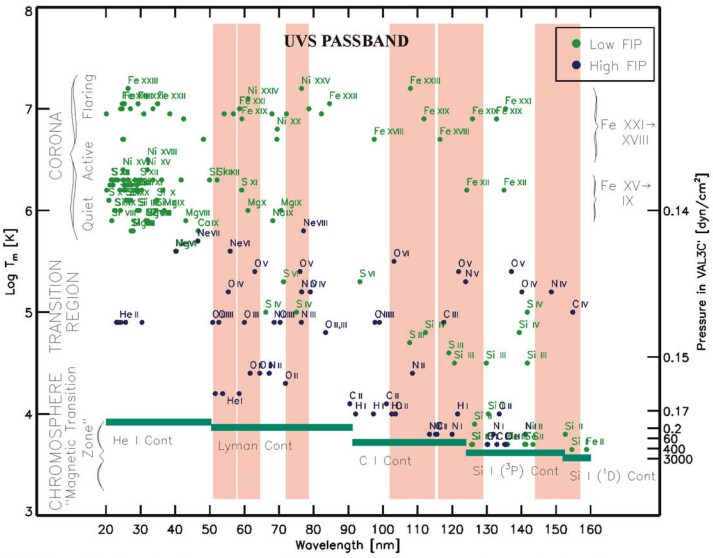
ESSO observational strategy of simultaneous, high cadence imaging and spectroscopy. EUV spectrograph (UVS) rapidly samples FOV in "Echelle" raster mode to provide quantitative dianostic constraints to dynamic activity seen with the High Resolution Imaging Package (HXI).

ESSO will provide quantitative observations with spatial and temporal resolution down to the length and time scales of the photospheric drivers of coronal phenomena.

ESSO (EUV Solar Spectroscopic Observatory) is a near-term, technologically-ready, high resolution imaging and spectroscopic mission to complement SDO, Solar-B and STEREO in the time-frame before 2010

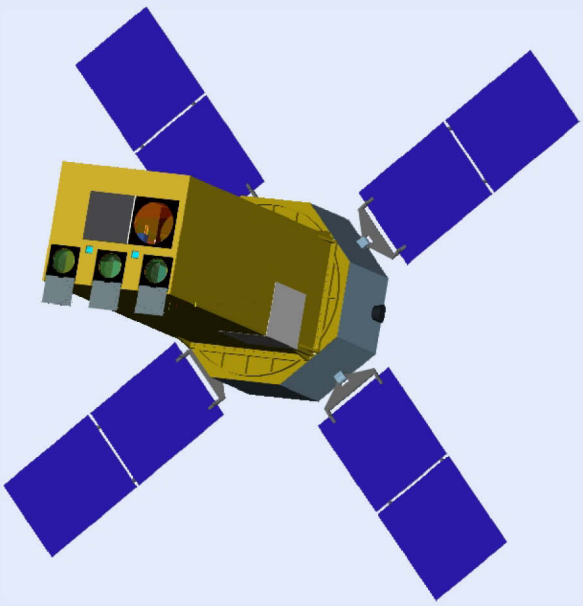


ESSO will explore fundamentally new spatial and temporal domains with more than an order of magnitude improvement over previous missions



ESSO will for the first time observe simultaneously emission lines and continua formed at ALL heights in the solar atmosphere, from the low chromosphere to the flaring corona

ESSO OBSERVATORY



Mission Summary

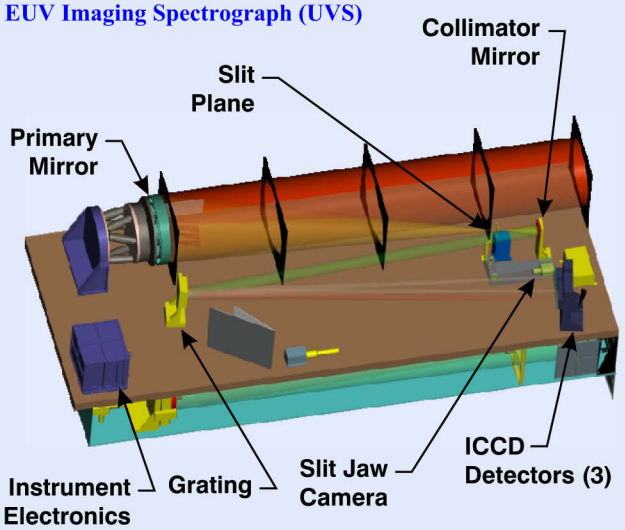
Launch Date:	March, 2007
Launch Vehicle:	Taurus 2210 w/ 92 in. fairing
Orbit:	600 km Sun-synchronous, 98° inclination
Mission Lifetime:	2 years (nominal), 5 years (extended)

S/C Characteristics

Design Heritage:	85% of subsystems are exact duplicates of flight-proven hardware
Redundancy:	All major electronics (CPU, telecom system components, reaction wheels)
Attitude Control:	3-axis stabilized 1.5 arcsec/sec (3 sigma) jitter control
Downlink:	X-band (100 Mbps)

Mass, Power & Telemetry Margins	
Spacecraft mass (mature)	270.9 kg (20.4% reserve)
Payload mass (mature)	240.4 kg (26.5% reserve)
Total Observatory mass	511.3 kg (23.2% margin)
Spacecraft power (mature)	180.9 W (25.0% reserve)
Payload power (mature)	293.8 W (25.0% reserve)
Total Observatory power	474.6 W (35.9% margin)
Total Mission Data Rate	65.5 Gbytes/day
Telemetry Downlink Rate	100 Mbps
Required Downlink Time	5240 sec
Nominal Contact time	6300 sec
Mission Downlink Margin	20%

EUV Imaging Spectrograph (UVS)



High Resolution EUV Imager (HXI)