PART I: General Description

Abstract

Background information is presented on the T Tauri stars observed with the IUE until the end of 1994. The log of observations and the UV spectrum are provided for all the objects as well as the FES light curves until November 1992. This information is completed with basic data on the individual sources.

1 Introduction

T Tauri Stars (TTS) are low mass (M$\leq 1 M_\odot$) pre-main sequence (PMS) stars. They are often classified into two main sub-classes: classical TTS (CTTS) and weak line TTS (WTTS). This classification is based on the strength of the Hα line (W(Hα) $\geq$ 10 Å for CTTS and W(Hα) $\leq$ 10 Å for WTTS) that was taken primitively as a good tracer of their magnetic activity (and youth).

The IUE has been contemporary to the rapid development of research on star formation and this shows up in the science carried out with it. The first projects were devoted to study the magnetic activity of the TTS and the role that Alfvén waves may play in the acceleration of their very energetic winds (Giampapa et al 1981, Penston & Lago 1983, Calvet et al, 1985). In addition the emission line fluxes were converted into emission measures to model and analyze the structure of the atmosphere (Jordan et al 1982, Brown et al 1984). The increasing evidence of the presence of disks around the TTSs (Snell et al 1980, Jancovicks et al 1983, Rydgren et al 1985, Bastien 1987, Beckwith et al 1990) as well as the realization that gravitational energy (accretion) is the most likely source for driving the outflows (Lada 1987, Cabrit et al 1990) led to analyze the UV excess of the TTS with respect to main sequence stars as generated in the accretion process (Bertout et al 1988, Simon et al 1990, Gómez de Castro and Fernández 1996). Moreover, the discovery by Ortolani and D'Odorico (1980) of UV emission from Herbig-Haro (HH) objects also made clear that the interaction of the collimated TTS jets with the surrounding medium is also susceptible to be studied with IUE. Therefore there are several different physical processes associated with star formation that can be and have been studied by means of the IUE data presented in this Guide. The following is a brief description of the UV spectrum of the TTS and a summary of the main findings on the TTS physics obtained from IUE data.

1.1 The UV spectrum of the TTS

The UV spectrum of the TTS has a weak continuum and several strong emission lines. The continuum is significantly stronger than the observed in main sequence stars of similar spectral types (G to M); this excess represents the short wavelength tail of the veiling continuum detected at optical wavelengths (Herbig, 1962; Hartigan et al 1990). The underlying photosphere is barely detected; only in warm (G-type) WTTS is the photospheric absorption spectrum observed. The UV continuum excess is significantly larger in the CTTS than in the WTTS (see e.g. Imhoff & Appenzeller, 1989). Simple models of hydrogen free-free and free-bound emission added either to black bodies or to the spectra of standard stars reproduce reasonably well the data (Calvet et al 1984; Lago et al 1984; Herbig and Goodrich 1986; Bertout et al 1988; Simon et al 1990). The fits yield electronic temperatures of $1 - 5 \times 10^4$ K that are chrosmospheric-like. Two different mechanisms have been proposed to generate this hot plasma. The UV continuum could be originating either in dense chromospheres (Kuhi, 1966; Calvet et al 1984) or in the release of the gravitational binding energy from the infalling material (Bertout et al 1988; Simon et al 1990).

The most prominent lines in the spectrum are those of Mg II at 2800 Å. The surface fluxes are typically 10^7 - 10^8 erg cm^{-2} s^{-1}, approximately 50 times larger than those from the Sun. They are among the highest seen in late-type stars including those of RS CVn binaries. High resolution profiles of the lines have been obtained only for 17 sources: BP Tau, RY Tau, T Tau, DF Tau, DG Tau, GM Aur, SU Aur, RW Aur, CO Ori, GW Ori, FU Ori, TW Hya, LKHa 332, RU Lup, AK Sco, S CR A and DI Cep (Appenzeller et al 1981,Jordan et al 1982, Penston & Lago 1983, Brown et al 1984, Giampapa & Imhoff 1985, Gómez de Castro & Fernández 1996). They can be generically described as broad, asymmetric emission lines with typical full widths at 10 % intensity of few hundreds km/s. A major narrow absorption feature is detected overimposed to the emission, probably of interstellar origin. Redshifted absorption components have been eventually detected in some sources (see e.g. Gómez de Castro & Franqueira 1997). The broad blueward shifted absorption component characteristic of mass-loss has been detected in few CTTSs. The lines are variable and optically thick in most sources.

Fe II lines corresponding to the multiplets: UV 2,3,35,36 (2330-2410Å); UV 32,62,63 (2700-2750 Å); UV 60,78 (2900-3000 Å) are also observed in several sources (Gahm et al 1979, Imhoff & Giampapa 1980, Appenzeller et al 1980, Brown et al 1984, Gómez de Castro & Fernández 1996). The Fe II lines are individually weaker than the Mg II, C II or Si II lines but are so numerous that altogether they become a significant coolant of the PMS stars atmospheres (see e.g. Jordan, 1988). Weaker emission features in the long wavelength range (2000 - 3200 Å) are the C II] and Si II] blend at 2330 Å, the Fe II lines at 2507 Å due to the fluorescence by Ly α and the Al II 2670 Å resonance line.

The short wavelength range (1200 – 2000 Å) is dominated by emission lines such as those typically found in the chromospheres and transition regions of cool giants. The strongest lines are those of C IV(UV1), O I(1303 Å) and Si II(UV1). Also lines of He II(1640 Å), Lyα, N V(UV1), Si IV(UV1), Si III](1892 Å), C III](1908 Å), and CII (UV1) as well as of molecular hydrogen have been found (Gahm et al 1979,Appenzeller & Wolf 1979, Appenzeller et al 1980, Imhoff & Giampapa 1980, Brown et al 1981, Penston & Lago, 1982, Brown et al 1984, Lago et al 1985, Simon et al 1990, Lemmens et al 1992, Gómez de Castro & Fernández, 1996, Gómez de Castro & Franqueira, 1997). The surface fluxes of these lines are typically 10^6-10^7 erg cm^{-2} s^{-1}, approximately 3 orders of magnitude larger than the observed in the Sun (Imhoff & Giampapa 1980, Lemmens et al 1992, Gómez de Castro & Fernández, 1996). The TTSs, in general, deviate from active stars in the flux-flux relations. They have an excess of emission from low ionization with respect to high ionization species when compared with other active stars.

1.2 TTSs physics studied with IUE data:

There are three main physical processes associated with the TTS that have been studied with IUE. These are: magnetic activity, accretion and outflow.

Magnetic activity

The youth of the TTSs as well as their rapid rotation rates (e.g. Vogel & Kuhi 1981, Hartmann et al 1986) as compared with late type main sequence stars have been used to study the relevance of the dynamo effect and remnant primordial magnetic fields to the generation of nonradiative heating of the stellar atmosphere and the driving of stellar winds.

The emission-line fluxes have been used to derive emission measures and model the structure of the upper atmosphere (Jordan et al 1982; Brown et al 1984;Lago et al 1985). Brown et al (1984) found evidence in T Tau for a two-component density structure although the geometry involved was uncertain.

The TTS chromospheres produce strong Ca II and Mg II emission lines. The Mg II surface fluxes have been estimated for a number of TTS (Giampapa et al., 1981; Calvet et al., 1985). These surface fluxes are around $10^7 - 10^8$ erg cm^{-2}, roughly 50 times larger than for the Sun. The ratio of Ca II to Mg II emission in the WTTS is consistent with a normal chromosphere, and seems to be an extrapolation from the dwarf stars to higher activity levels. However, the Mg II k-line seems to arise in a extended region in the CTTSs, probably associated with the Hα emission region (Calvet et al 1985). In fact, extended Mg II emission has been found in at least 2 CTTS: T Tau (Brown et al 1984) and CW Tau.

The correlations between the fluxes of lines formed in the chromosphere, transition region and corona (henceforth flux-flux correlations) and between these fluxes and the stellar rotation period (flux-period correlations) have been used to obtain a better understanding of the mechanisms responsible for the presence of activity. The TTSs extend these relations as defined by other cool stars towards larger flux densities typically by a factor of ~ 40. They deviate slightly from the flux-flux relations derived from the rest of the active stars: F, G, K dwarfs, dMe stars, RS CVn and even the WTTSs (Lemmens et al 1992; Gómez de Castro & Fernández 1996). Moreover, the scatter of the data points about the mean flux-flux relations for the TTSs is slightly larger than for these other active stars although this is probably related with the uncertainties in the conversion to surface flux densities (Lemmens et al 1992).

Among the overactive stars the CTTS form a special class: they are overactive in the chromospheric and transition region emissions but not so in X-rays (see e.g. Lago et al 1985). Bouvier (1990) reports evidence for an inverse correlation between x-ray surface flux and rotational period in a sample of 21 TTS (including both CTTS and WTTS) and proposes that this is caused by a solar-type magnetic dynamo; rotation is the primary parameter governing the level of magnetic dynamo activity in cool stars. However a comparison of the TTS with other active stars shows that the CTTS exhibit radiative losses in the lines that are up to 100 times larger than those measured in cool dwarfs and evolved binaries. This suggests that other effects are producing an anomalous enhancement of the radiative loses in the UV. Radiation from accretion disks is suggested as the main source.

The UV continuum and line emission of TTS are variable. The variations have been found to be periodic-like in some objects (Gómez de Castro and Fernández 1996, Gómez de Castro & Franqueira, 1997) but there are also rapid variations (in time scales of few hours) likely associated with the well known flaring activity of the TTS (see e.g. Montmerle et al 1993 for a review). A good example is the flare that occurred to BP Tau in February 1992. This flare lasted for few hours and was reported by Gullbring et al (1996) from a UBVRI monitoring campaign. The event was also detected with IUE as a fast increase in the Si II, Mg II and UV continuum fluxes (Gómez de Castro & Franqueira 1997). The event could be peculiar in the sense that the optical light curves are very different than the observed in flare stars (it was cool with T=7000-8000 K and had light curves with similar rise and fall times). Gullbring et al (1996) suggested that it was produced as a result of inhomogeneous accretion.

Accretion

The mechanism involved in the acceleration of the TTS winds is still unknown, but seems to be related with the presence of accretion disks around the TTS (e.g. Cabrit et al., 1990, Hartigan et al 1995). There are many indications of the presence of disks around TTS (Bastien,1987; Jankovics, Appenzeller and Krautter, 1983; Edwards et al., 1987; Beckwith et al., 1990). Disks around the TTS are accreting mass onto the star. However the details of this process are not known. For many years it has been assumed that the material from the viscous disk accretes steadily onto the star through the boundary layer between the disk and the star (Bertout et al 1988). This boundary layer is expected to be the responsible of the UV excess of the TTS with respect to main sequence stars of the same spectral types. Accretion rates of $\sim 3\ (10^{-7}$ - $10^{-9})$ $M_\odot$ yr^{-1} are able to reproduce reasonably well the spectra of the TTS from the UV to the mid-infrared. FU Orionis variables have been also explained by accretion from protostellar disks (Kenyon et al 1989, Hartmann et al 1989). However there are some properties that cannot be accounted by this simple boundary-layer model.

Some T Tauri Stars (TTS) have periodic photometric variability. The periods inferred are 2 - 10 days in agreement with those expected for rotational modulation. The periodicity has been explained as due to the presence of spots on the stellar surface. The analogy is normally made with the RS CVn systems and, in fact, the properties of many TTS can be explained in a similar way, i.e., by the presence of *dark spots* generated by an enhanced solar-like activity. However there are some objects whose properties cannot be explained by this mechanism. Some TTS have *much stronger* variations in the U than in the R or I bands, and in these cases the variability is best modelled by *hot spots* on the stellar surface. The detection of hot spots on the stellar surface of some CTTS has increased the suspicion that the infall material could be chanelled by strong dipolar fields on the stellar surface (Simon et al 1990, Koenigl 1991, Lamzin et al 1996). Some theoretical models have been developed in the last years mainly addressing the implications of magnetically channelled accretion in the spin-down of PMS stars and the generation of mass outflows (Tout and Pringle, 1992; Cameron and Campbell 1993; Pearson and King 1995).

Key observational tests, however, have not been carried out until recently. If the material falls onto the stellar surface channelled by the field lines, the UV flux (the accretion flux) variation should be correlated with the optical variability. The correlation between the optical and the UV variability was first studied for BP Tau (Simon et al. 1990) and

RU Lup (Giovannelli et al. 1990). A study of the correlation between optical and UV continuum variability has been also carried out for the TTS in Taurus using the IUE Archive Data. However these correlations could be just due to the well known flaring activity of the TTS (e.g. Joy 1945, Montmerle et al 1993) or to accretion instabilities. In general, the rotational period has not been well tracked. For instance, RU Lup was observed just 8 times in 5 years, and BP Tau has a photometric period around 7 days (Vrba et al. 1986) but only a half of it was well monitored in the 1200 -2000 Å range where the most prominent resonance lines are observed (Simon et al, 1990).

The presence of hot spots has been reported without ambiguity only for 11 CTTSs: DN Tau, GI Tau, GK Tau and BP Tau (Vrba et al 1986), DF Tau (Bouvier and Bertout 1989), DE Tau, DG Tau, IP Tau, GM Aur and TAP 57NW (Bouvier et al 1993) and DI Cep. Nine of these have been observed at least once with the International Ultraviolet Explorer (IUE) but only two have been properly monitored in the wavelength range between 1200Å and 2000 Å: DI Cep (Gómez de Castro & Fernández, 1996) and BP Tau (Gómez de Castro & Franqueira, 1997).

The UV monitoring of DI Cep showed that the light curves are similar in all the lines (O I, C IV, Si IV and Si II) suggesting that there is a broad range of temperatures in the hot spot (from 10^4 to 10^5 K). Variations in the spot properties during several years lead to the conclusion that rather than dealing with a strong dipolar field the material is channelled by a variable loop structure that could cause inhomogeneous accretion events.

The variations of the UV spectrum of BP Tau during 2 rotation periods show that lines that can be excited by recombination processes, such as those from O I and He II have periodic-like light curves, whereas lines that are only collisionally excited do not follow a periodic-like trend (Gómez de Castro & Franqueira 1997). These results agree with the expectations of the magnetically channelled accretion models. The kinetic energy released in the accretion shocks is expected to heat the gas to temperatures of $\sim 10^6$ K that henceforth produces ionizing radiation. The UV (Balmer) continuuum and the O I and He II lines are direct outputs of the recombination process. However, the C IV, Si II and Mg II lines are collisionally excited not only in the shock region, but also in inhomogeneous accretion events and in the active (and flaring) magnetosphere and therefore their light curves are expected to be blurred by these irregular processes.

Mass outflows from PMS stars

PMS stars are characterized by very high mass-loss rates of $10^{-6} - 10^{-8}$ $M_\odot$/year. Outflows are detected over a wide range of scales from the parsec size of the molecular outflows and the optical jets to the some tens of AU scales where the optical forbidden lines or the P-Cygni profiles observed in Hα and NaD lines are formed. P-Cygni profiles are also observed in the Mg II lines of few CTTS. The terminal velocity of the wind inferred is of few hundreds of km/s. The low level continuum as well as the presence of some metallic lines makes difficult to determine the terminal velocities accurately. The comparison with the high signal-to-noise ratio profiles obtained with the Hubble Space Telescope of some of these sources suggests that some of them may have broad emission wings (see e.g. Gómez de Castro & Franqueira 1997). In some stars the absortion component is filled in with emission (see e.g. RW Aur in Imhoff & Appenzeller 1989).

There are few TTSs that are bright enough at short wavelengths to be observed in high dispersion. Penston and Lago (1982) analyzed the widths of the C IV, Si III] and C III] lines in RU Lup finding widths of $\sim$ 170 km/s. These lines are formed at much higher temperature than the Mg II lines that are however broader.

The comparison between the Ca II and Mg II line fluxes in the nearly simultaneous observations carried out by Calvet et al (1985) suggests that the Mg II lines are formed in an extended region probably associated with the wind, in contrast with the Ca II lines that form closer to the surface. In fact, extended Mg II emission has been detected in the line by line images of some sources like T Tau or CW Tau. In the last years, high resolution imaging and long slit spectroscopy of some CTTS in optical bands (Solf 1989, Gomez de Castro 1993) have shown the presence of small scale (arcsec scale) jets unresolved in previous observations.

Finally, the HH nebulosities produced by the interaction between the TTSs outflows and the environmental medium, have also been detected with IUE. The detection of HH objects with IUE by Ortolani & D'Odorico (1980) was a surprise. Their spectrum is characterized by the presence of strong emission lines that depend on the characteristics of the object. Low-excitation objects emission is dominated by the Lyman band of the H_2. High excitation objects show C IV, C III, CII] and Mg II emission. The line emission is variable. There is also a far UV continuum centered at 1500 Angstroms that is usually interpreted as collisionally enhanced two-photon emission of hydrogen (Dopita et al 1982) although this interpretation seems quite uncertain.

2 Background information on ULDA spectra of TTS

The Herbig and Bell (1988) Catalogue (HBC) contains 742 PMS stars and is the most complete and up-to-date compilation of young stars. All the stars in this catalogue that have been observed with IUE are included in our catalogue. All the sources classified in the Data Base as TTS (class 58) are in the HBC catalogue. A complete list can be found at the end of this introductory section, together with some general information as the 1950.0 ecuatorial coordinates, the V apparent magnitude, the spectral type and the number of low dispersion spectra obtained with IUE in the LWP, LWR and SWP cameras.

In order to faccilitate work with this catalogue we provide for each source a list of general information on physical properties and the spectral energy distribution. This is followed by a list of details on the available IUE observations and some basic data derived from them. This information is completed with two figures: the mean spectrum of the star and the light curve as derived from FES measurements.

1. A list of general information:

Name This is homogeneous object identification as established in the IUE Data Bank (Barylak, 1991). Also the variable star name is provided.

Other identifications The HBC entry number as well as other conventional designations provided in the HBC.

Type Indicates to which group the star belongs. The classification has been taken after the HBC. The abreviations are: CTTS, WTTS, SUAur and FUOri. CTTS holds for Classical TTSs, WTTS for weak line TTSs, SUAur for stars like SU Aur (type late F to K, weak emission in H_α and Ca II, very broad absorption lines (vsini $>$ 50 km/s) and relatively high luminosity) and FUOri for TTS which exhibit large increase in optical brightness, typically 5 mag. or more (see Hartmann 1991 for more details).

Spectral type After HBC.

Photometric data UBVRI values have been extracted from the HBC. Therefore the data are not homogeneous and include Johnsons-Cousin, Johnson (marked with *) and Instrumental (marked with *i) photometry. The conversion factors are given in Rydgren & Vrba (1983). These data have been complemented with published values when they are more complete than the quoted in the HBC (the reference is indicated in the tables). JHKL photometric data have been extracted from Vrba et al (1986) for the stars in Taurus and from the Catalog of Infrared Observations for the rest (Gezari et al 1993).

IRAS fluxes Most of them have been taken from Weaver & Jones (1992). The flags a, b and c hold for the estimated errors, δF: a ($\delta F \leq 10\%$), b ($10\ \% \leq \delta F \leq 25\ \%$) and c ($\delta F \geq 25\ \%$). For the rest of the sources the reference from which the IRAS fluxes have been taken is indicated in the table.

Activity parameters These are photometric period, amplitude of the brightness variations in the V band and rotational velocity as in the HBC completed with the results of the last monitoring campaigns. Einstein and ROSAT X-rays fluxes are also provided when available. The references are indicated in the tables.

Wind parameters These are: the H_α and [O I] equivalent widths and the association with HH objects. W(Hα) has been taken from the HBC. The references from which the W([OI]) values have been taken are indicated in the tables. The information about the association with optical jets and HH objects has been obtained from the "General Catalogue of Herbig-Haro objects" (Reipurth 1994).

Binarity characteristics of the system (double, triple...) and the separation between the components. For the TTS that are known to be spectroscopic binaries the period is indicated. Also TTS whose binarity has been searched for and not found are indicated. The references are indicated in the tables. The size of the IUE aperture is $\sim$ 22$\times$9.5 arcsec. and the spatial resolution of IUE is between $3.5''$ and $5''$ depending on the wavelength and the camera used. This implies that the UV spectrum of most of the binaries observed with IUE corresponds to the whole system, and henceforth is dominated by the brightest component.

2. A list with IUE observations

   The log of the IUE observations is provided. For each observation we indicate, the camera and image number, the dispersion, the date of observation, the integration time and the quality given by the observer according to standard codes adopted for the description of the IUE images. The Fine Error Sensor (FES) magnitude is provided in the last column.

   The FES gives estimates of the visual magnitude with RMS errors of 0.08 mag (Holm and Rice 1981). The FES measurements have been converted into magnitudes using Stickland's (1980) and Perez's (1991) calibration. They have been corrected from colour effects, the sensitivity degradation of the cameras (Fireman and Imhoff 1989) and the change of the FES reference point after January 1990 in GSFC and after July 1990 in VILSPA. There are few stars for which we have not information about the B-V colour and henceforth no magnitude has been computed; in these cases the FES magnitude is marked with an asterisk.

3. A list with basic data derived from the IUE observations.

   A table with the mean fluxes of the most prominent UV lines (Mg II, Si II, He II, C IV, Si IV and O I) and the mean continuum flux in two windows of 50 Å centered at 1855 Å and 2900 Å that have been proved to be well suited for measuring the continuum level (Gómez de Castro & Fernández 1996, Gómez de Catsro et al 1997). The Mg II line fluxes of few sources are affected by the presence of a nearby reseau mark used for the geometric calibration of the cameras; these uncertain fluxes are marked with an **R**.

4. Figures.

   The first figure is a plot with the mean UV spectrum of the stars. The mean spectrum has been computed as a mean of all the *unsaturated* spectra; the bad pixels are marked with asterisks in the figure. The second figure is the FES light curve and it is only represented for stars with 20 or more IUE observations.

Table 1: No. of stars observed in the star forming regions best studied with IUE

Region	CTTS	WTTS	SUAur	FUOri	No type
Taurus	24	10	2		
Orion	6		2	1	8
Chamaleon	9				1
Lupus	13				2
Oph-Sco	11				4

Table 2: No. of spectra obtained for the star forming regions best studied with IUE

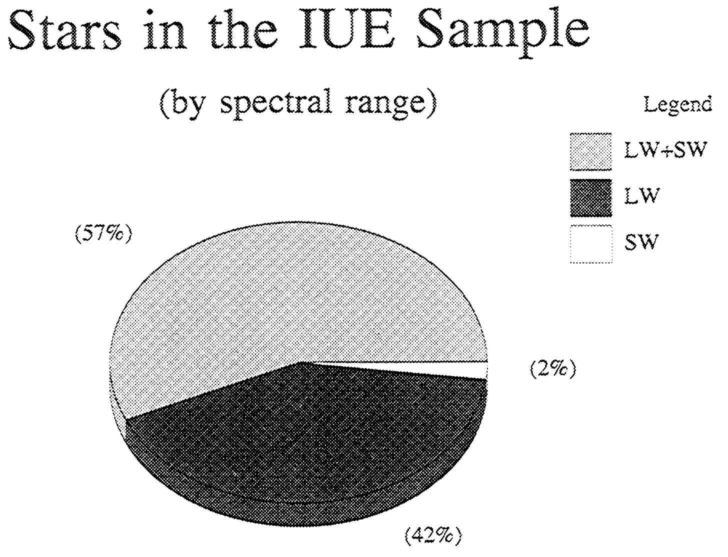
Region	CTTS		WTTS		SUAur		FUOri		No type	
	LW	SW	LW	SW	LW	SW	LW	SW	LW	SW
Taurus	396	82	34	9	45	11				
Orion	17	5			5	0	18	3	13	9
Chamaleon	28	10							2	1
Lupus	59	33							1	1
Oph-Sco	27	10							4	0

2.1 Statistics

There are 132 TTS observed with IUE but 21 of them have IUE spectra with no scientific value; these are: V819 Tau (HBC 378), DI Tau (HBC 39), HBC 392, HBC 393, HL Tau (HBC 49), HN Tau (HBC 60), DQ Tau (HBC 72), RY Ori (HBC 436), HBC 483, NX Mon (HBC 216), LX Mon (HBC 229), MO Mon (HBC 238), HBC 620, HBC 622, HBC 631, DoAr 21 (HBC 637), HBC 641, V346 Nor (HBC 646), HBC 678, AS 353B (HBC 685) and V1057 Cyg (HBC 300). There are also 5 TTS observed in the Orion region whose spectra are dominated by the bright nebular contribution (scattered light from a young cluster of early type stars). These are: KM Ori (HBC 122), LL Ori (HBC 126), V356 Ori (HBC 129), MT Ori (HBC 458) and AN Ori (HBC 150). Most of the remaining 106 sources are classical TTS: there are 70 CTTS, 10 WTTS, 4 SUAur and 1 FUOri. There are also 24 stars that have not been asigned any type in the HBC.

The best studied star formation region is Taurus where 36 TTS have been observed (CTTS:24, WTTS:10, SUAur:2). Then Orion (19 TTS; CTTS:6, SUAur:2, FUOri:1). Other regions where a significant amount of TTS have been observed are Lupus (15 TTS; CTTS:13 and 2 without asigned type), Ophiuchus-Scorpio (15 TTS; CTTS:11 and 4 without asigned type) and Chamaleon (10 TTS; CTTS: 9 and 1 without asigned type).

Most of the stars have been only observed in the long wavelength range (LWP-LWR cameras) since the emissivity of the TTS in the short wavelength range (SWP camera) is very low. 60 TTS have been observed in both spectral ranges, 44 have been observed only with the LWP-LWR cameras and 2 have been observed only with the SWP. Most of



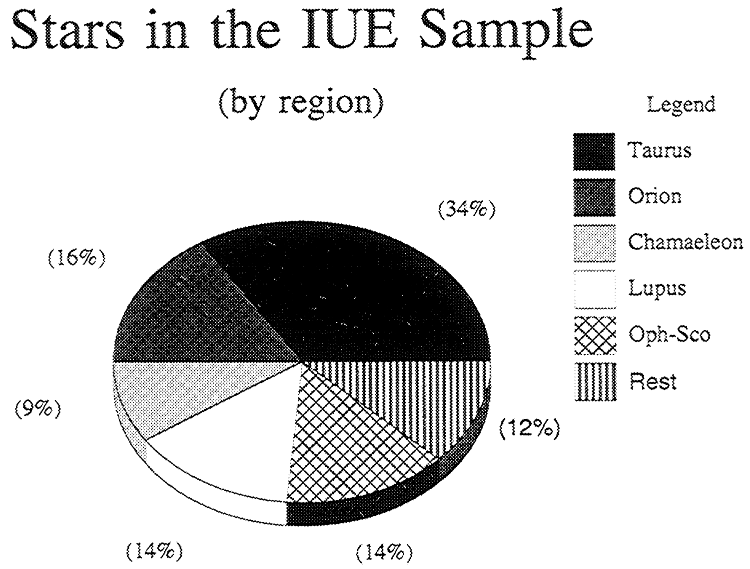


Figure 1: Characteristics of the IUE sample of TTS. **Top**: Fraction of stars observed per spectral range; **Bottom**: Fraction of stars observed per star forming region.

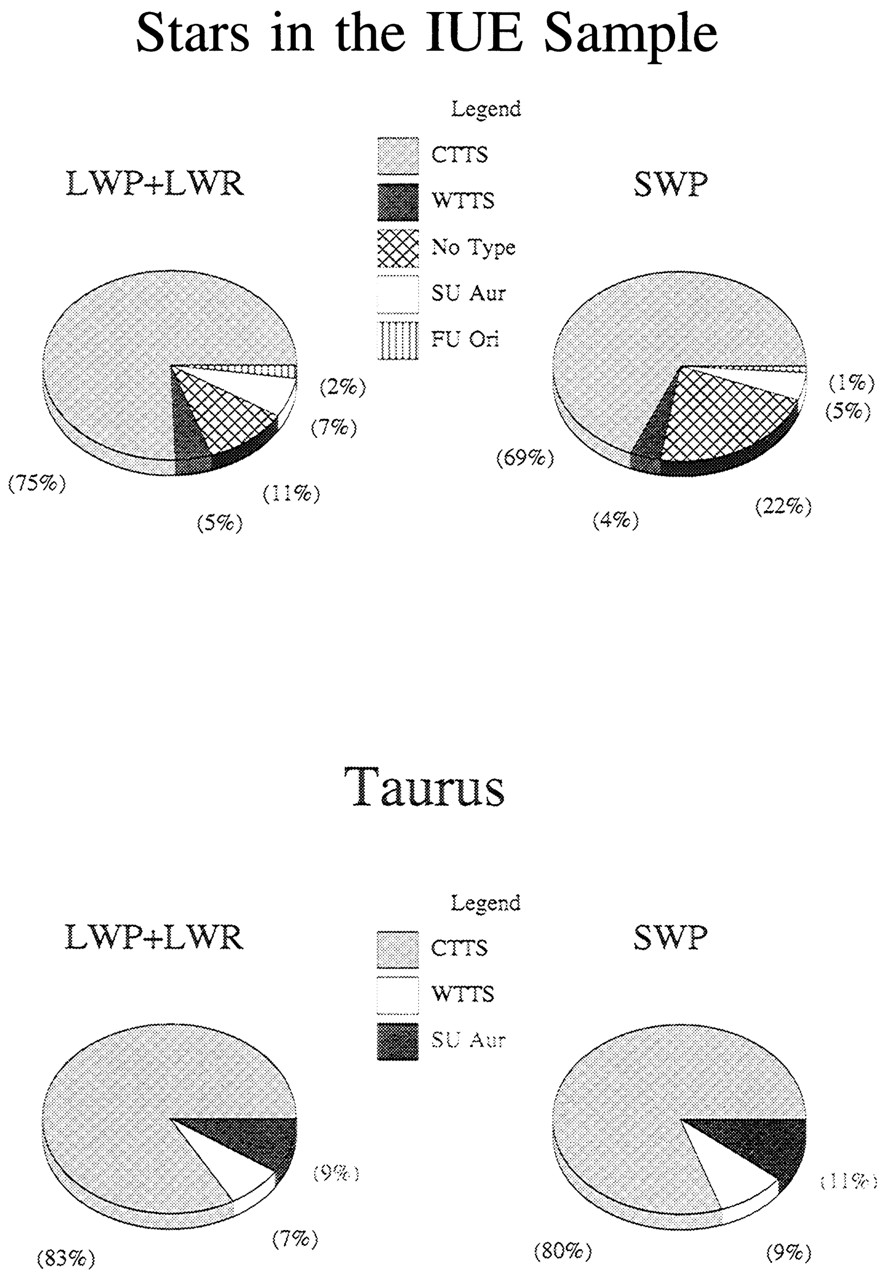


Figure 2: Characteristics of the IUE sample of TTS. **Top**: Distribution of stars per spectral range and type for the whole IUE sample; **Bottom**: Same as above for the Taurus star forming region.

the SWP spectra have very low Signal-to Noise ratio; in fact, there are only 20 TTS with good (S/N $\geq$ 10) spectra in the SWP range. These statistics are summarized in Figs. 1 and 2 and Tables 1 and 2.

3 List of TTS observed with IUE

HBC	Star	RA(1950.0)			Dec(1950.0)			V	Spectral	Type	LW		SWP
no.		h	m	s	°	’	”		type		P	R	
10	LkHa 264	2	53	46.92	+19	53	33.8	12.46	K5 V	CTTS	3		3
367	V773 Tau	4	11	07.29	+28	04	41.2	10.62	K3 V	WTTS	6		1
23	FM Tau	4	11	07.82	+28	05	18.8	14.22	M0	CTTS	1		
25	CW Tau	4	11	11.34	+28	03	27.2	12.36	K3 V	CTTS	5		
29	V410 Tau	4	15	24.83	+28	20	01.7	10.82	K3 V	WTTS	9	2	4
376		4	15	59.1	+17	16	01	12.28	K7	WTTS	1		
32	BP Tau	4	16	08.61	+28	59	15.3	12.09	K7 V	CTTS	49	16	16
378	V819 Tau	4	16	19.92	+28	19	02.6	13.24	K7 V	WTTS	1		
33	DE Tau	4	18	49.84	+27	48	05.2	13.00	M2:V	CTTS	5	3	3
34	RY Tau	4	18	50.85	+28	19	35.0	10.01	K1 IV,V	CTTS	87	6	14
380	HD 283572	4	18	52.52	+28	11	06.6	9.04	G5 IV	SUAur	3	8	3
35	T Tau	4	19	04.21	+19	25	05.4	9.90	K0 IV,V	CTTS	16	20	11
36	DF Tau	4	23	59.63	+25	35	41.7	11.49	M0,1 V	CTTS	19	7	6
37	DG Tau	4	24	01.01	+25	59	35.5	12.01	M ?	CTTS	2	20	3
388		4	24	17.2	+17	44	03	10.34	K1	WTTS	2		1
39	DI Tau	4	26	38.00	+26	26	20.1	12.86	M0 V	WTTS	1	1	
43	UX Tau A	4	27	09.96	+18	07	21.0	10.69	K2 V	WTTS	6		1
45	DK Tau	4	27	40.48	+25	54	59.0	11.70	K7 V	CTTS	4		1
392		4	28	34.5	+17	00	02	12.53	K5	WTTS	1		
393		4	28	40.22	+18	01	41.3		K2 III:				1
49	HL Tau	4	28	44.42	+18	07	36.2	14.57	K7,M2?	CTTS	1		1
397	L1551-51	4	29	15.57	+17	51	02.6	12.06	K7	WTTS	1		
399	V827 Tau	4	29	20.39	+18	13	54.7	12.18	K7,M0	WTTS	1	1	
400	V826 Tau	4	29	22.03	+17	55	18.6	12.11	K7,M0	WTTS		1	
54	GG Tau	4	29	37.06	+17	25	22.3	12.24	K7 V	CTTS	6		
52	UZ Tau e	4	29	39.26	+25	46	13.4	12.86	M1,3:V	CTTS	1		
55	GH Tau	4	30	04.79	+24	03	18.3	12.95	M2,3 V	CTTS	1		
404	V807 Tau	4	30	05.2	+24	03	39		K7 V	CTTS	2		
405	V830 Tau	4	30	08.26	+24	27	26.7	12.21	K7,M0 V	WTTS	2	1	1
56	GI Tau	4	30	32.33	+24	15	03.1	13.01	K6 V	CTTS	1		1
57	GK Tau	4	30	32.76	+24	14	52.4	12.14	K7 V	CTTS	2		1
58	DL Tau	4	30	36.02	+25	14	24.0	13.05	K7 V	CTTS	4	2	1
60	HN Tau	4	30	45.67	+17	45	38.2	13.70	K5	CTTS		2	
63	AA Tau	4	31	53.45	+24	22	44.1	12.37	K7 V	CTTS	3	3	1
65	DN Tau	4	32	25.68	+24	08	52.3	12.36	M0 V	CTTS	14	5	
72	DQ Tau	4	43	59.99	+16	54	40.1	13.16	M0,1 V	CTTS	1		
73	Haro 6-37	4	44	05.90	+16	57	19.2	13.55	K6	CTTS	1		
74	DR Tau	4	44	13.20	+16	53	23.8	11.17		CTTS	32	8	11
75	DS Tau	4	44	39.07	+29	19	56.2	11.90	K5 V	CTTS	5		1
76	UY Aur	4	48	35.71	+30	42	13.6	12.37	K7 V	CTTS	3		
77	GM Aur	4	51	59.76	+30	17	14.7	12.03	K3 V	CTTS	3	4	3
426	LkCa 19	4	52	25.90	+30	13	10.8	10.85	K0 V	WTTS	1		1
79	SU Aur	4	52	47.84	+30	29	19.4	8.93	G2 III	SUAur	19	15	8
80	RW Aur	5	04	37.69	+30	20	13.9	10.12	K1:	CTTS	15	21	9
84	CO Ori	5	24	51.22	+11	23	12.3	9.83	F8:e V	SUAur	1	3	
85	GW Ori	5	26	20.78	+11	49	52.8	9.80	G5	CTTS	1	12	3
86	V649 Ori	5	26	36.32	+11	49	38.1	12.01	G8 III,V	CTTS		1	
434	Rst 137B	5	28	35.82	-65	29	18.8	13	M3,4		4		1
435	AB Dor	5	28	35.82	-65	29	18.8	6.83	K0,2		28	17	30
436	RY Ori	5	29	39.57	-2	51	55.6		F8:pe		1		1
443	HD 245059	5	31	49.26	+10	05	10.9	9.82	K3 V:		1		1
113	V1044 Ori	5	31	49.28	-5	38	43.6	11.50	G5 IV,V	CTTS		1	1
114	EZ Ori	5	31	50.76	-5	06	45.7	11.60	G0:n	SUAur	1		
116	IU Ori	5	32	08	-5	43	36		K2III			1	1
122	KM Ori	5	32	28.48	-5	25	07.9	11.55	K1		2		1
126	LL Ori	5	32	38.18	-5	27	13.5	11.66	K2,3	CTTS	1	1	1
129	V356 Ori	5	32	41.68	-5	31	53.0	13.10	K3				1
132	P1817	5	32	46.93	-4	46	36.8	11.13	K2		1		
458	MT Ori	5	32	50.42	-5	24	38.7	12.01	K3,4		6		1
471	NV Ori	5	33	04.06	-5	35	01.2	9.91	F4,8III,V		1	1	1
144	V360 Ori	5	33	04.17	-5	11	20.2	12.61	K6	CTTS		1	

HBC no.	Star	RA(1950.0)			Dec(1950.0)			V	Spectral type	Type	LW		SWP
		h	m	s	°	’	”				P	R	
150	AN Ori	5	33	14.56	-5	30	04.2	11.32	K0,1 IV			1	1
482	BN Ori	5	33	47.65	+6	48	13.0	9.64	F2,3ea		5		5
483		5	33	55.55	-6	47	25.1	17.7	G8:	WTTS			4
167	P2441	5	34	22.70	-4	27	26.9	10.76	G5:			1	1
487	P2494	5	34	42.93	-6	08	01.6	10.74	K0 IV		1		
181	DL Ori	5	39	01.10	-8	07	20.7	13.07	K1	CTTS		1	
500	NGC 2023/c	5	39	05.4	-2	18	13	17.69	G,K	CTTS			1
186	FU Ori	5	42	37.97	+9	03	02.5	9.24	G: I,Il	FUOri	7	11	3
515	+1g 1156	5	51	27.6	+1	39	43	9.93	K2:n		1		
216	NX Mon	6	37	56.27	+9	36	48.9	15.63	cont	CTTS		2	1
217	W84	6	37	57.32	+9	36	28.7	11.95	F8,G0e			1	
222	Wl08	6	38	06.11	+9	47	38.1	11.97	F9:e			1	
229	LX Mon	6	38	20.62	+9	51	10.2	15.33	K7	CTTS		1	
238	MO Mon	6	38	46.4	+9	29	53	13.54	K2	CTTS		1	
565	SY Cha	10	55	18.5	-76	55	35	13.03	M0:	CTTS	2		
567	TW Cha	10	57	47.2	-77	06	34	13.08	M0:	CTTS	1		
244	Sz 6	10	57	50.8	-76	45	33	11.24	K2	CTTS	5		3
568	TW Hya	10	59	30.08	-34	26	07.4	10.94	K7 V	CTTS	9	3	5
569	CS Cha	11	01	7.8	-77	17	25	11.63	K5:	CTTS	4		1
570	CT Cha	11	02	43.6	-76	11	06	12.36	K7:	CTTS	1		
245	LHa 332-17	11	05	57.5	-77	21	50	10.68	G2 V	CTTS	4		1
575	VW Cha	11	06	38.1	-77	26	12	12.51	K2	CTTS	3		1
578	VZ Cha	11	07	51.9	-76	07	02	12.75	K6	CTTS	1		1
588	Sz 41	11	10	50.2	-76	20	45	11.60	K0		2		1
247	CV Cha	11	10	53.8	-76	28	01	10.96	G8 V	CTTS	2	5	2
597	Sz 65	15	36	16.3	-34	36	54	12.74	K7,M0	CTTS	2		
248	Sz 68	15	42	01.4	-34	08	08	10.31	K2 V	CTTS	4		1
249	GW Lup	15	43	32.8	-34	21	19	13.83	M1.5	CTTS	1		
250	GQ Lup	15	45	58.3	-35	29	58	11.40	K7 V	CTTS		1	1
603	Sz 77	15	48	32.4	-35	47	47	12.50	M0	CTTS	2		
605	Sz 82	15	52	51.1	-37	47	24	11.89	M0	CTTS	3		
251	RU Lup	15	53	24.3	-37	40	35	10.52	K	CTTS	25	11	25
606	Sz 126	15	53	57.6	-42	31	28	14.10	K,M		1		
608	He 3-1126	15	55	38.9	-22	48	46	10.5	G5		1		1
609	Sz 129	15	55	51.0	-41	48	38	13.02	K7,M0	CTTS	1		
252	RY Lup	15	56	05.0	-40	13	36	10.41	K0,1 V	CTTS		2	2
253	EX Lup	15	59	42.6	-40	10	09	13.13	M0:V	CTTS		1	2
612	HO Lup	16	03	39.4	-38	54	19	12.93	M1	CTTS	1		1
615	Sz 96	16	04	51.1	-39	00	37	14.06	M1.5	CTTS	1		
616	HK Lup	16	05	00.9	-38	56	44	12.88	K7,M0	CTTS	4		1
617	Sz 102	16	05	08.3	-38	55	16	16.3	K?				1
620	Sz 108	16	05	21.2	-38	58	24	13.14	M0.5		1		
622	Sz 111	16	05	32.3	-39	29	50	14.5	M0.5	CTTS	2		
631	Sz 124	16	08	31.6	-38	54	34	13.83	M0		1		
254	As 205	16	08	37.70	-18	30	42.6	12.39	K5 V	CTTS		1	1
633	Wa Oph/2	16	09	05.0	-18	59	12	11.65	K1 IV	CTTS	1		
634	Wa Oph/3	16	09	46.37	-18	51	49.2	10.78	K0 IV	CTTS	1		1
256	Haro 1-1	16	18	31.24	-26	05	24.0	13.34	K5,7		1		
636	ROX 3	16	22	47.0	-24	44	11		M0		1		
259	SR 4	16	22	54.87	-24	14	01.5	12.89	K6,7	CTTS	1		
637	DoAr 21	16	23	01.67	-24	16	50.3	13.95	G,K		1		
641	ROX 20 B	16	24	13.0	-24	44	58		M		1		
263	SR 12	16	24	17.68	-24	34	59.7	13.27	M1,2		1		
264	SR 9	16	24	38.88	-24	15	23.3	11.38	K5,7	CTTS	2		1
265	SR 10	16	24	54.05	-24	19	38.4	14.01	M1.5	CTTS	1		
266	V853 Oph	16	25	43.67	-24	21	42.2	13.52	M1.5	CTTS	2		
268	Haro 1-16	16	28	31.74	-24	21	10.0	12.59	K2,3	CTTS	1		
646	V346 Nor	16	28	56.8	-44	49	08	16.3	F8eqIII	FUOri		1	1
647	DoAr 51	16	29	09.77	-24	33	56.4	13.59	M0:		1		
270	V1121 Oph	16	46	25.24	-14	16	56.5	11.48	K5	CTTS		3	1
271	AK Sco	16	51	23.12	-36	48	28.6	8.82	F5e V	CTTS	10	2	3
656	AS 216	16	57	27.83	-27	33	43.9		K2 V	CTTS	2		3

HBC no.	Star	RA(1950.0)			Dec(1950.0)			V	Spectral type	Type	LW		SWP
		h	m	s	°	’	”				P	R	
662	V4046 Sgr	18	10	53.69	-32	48	26.8	10.40	K5,6n V		5	2	8
664	FK Ser	18	17	37.02	-10	12	35.1		K7p V	CTTS	1	2	2
286	S CrA	18	57	46.1	-37	01	37	11.12	K6:	CTTS		2	1
676	Wa CrA/1	18	58	12.4	-37	05	13	11.24	K0,2 IV	CTTS	1		
678	Wa CrA/2	18	58	39.0	-37	11	42	10.45	G8 IV:	CTTS	1		1
685	AS 353B	19	18	09.45	+10	56	09.1	14.6	M0	CTTS			1
300	V1057 Cyg	20	57	06.24	+44	03	46.4		A-Ge	FUOri	1	1	
302	V1331 Cyg	20	59	32.21	+50	09	55.5	11.87	cont	CTTS		3	
315	DI Cep	22	54	08.18	+58	23	59.5	11.31	G8 V:	CTTS	1	3	11

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