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Long-term spectroscopic survey of T Tauri stars in the Taurus-Auriga star-forming region

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Abstract. Long-term spectroscopic monitoring of 22 T Tauri stars located in the Taurus-Auriga star-forming region (SFR) is presented. The medium and high-dispersion spectra were obtained at the Stará Lesná (SLO), Skalnaté Pleso (SPO) and Tautenburg observatory (TLS) during 2015–2018. The broadening function technique was used to determine the radial and projected rotational velocities of the stars and to study multiplicity of objects. The analysis was also focused on the determination of atmospheric parameters such as $\log g$, $T_{\rm eff}$ and [Fe/H]. The nature of the objects was assessed by measuring the equivalent with of the H_α and Li I 6708 lines. Their membership was checked using the *Gaia* DR2 parallaxes and estimated model distances.

Key words: Stars: Variables – Stars: T Tauri – Stars: Pre-main sequence

1. Observation and data reduction

We have found many bona fide T Tauri stars (originally designated as members of the nearest known SFR Taurus-Auriga) in the literature without much information and/or contradicting physical parameters. We have focused only on objects classified as weak-line T Tauri stars. We have hand-picked stars with $V < 11$ mag because of our observation limit. Altogether 168 spectra have been obtained with medium and high-dispersion spectrographs:

(i) At SLO with a 60 cm, $f/12.5$ Zeiss Cassegrain telescope equipped with a fiber-fed échelle spectrograph eShel (see Pribulla et al., 2015) with 4150–7600 Å spectral range, and $R = 11\,000$. ThAr calibration unit provides about $100\,{\rm m\,s^{-1}}$ accuracy in radial-velocity.

(ii) At SPO with a 1.3 m, $f/8.36$ Nasmyth-Cassegrain telescope equipped with a fiber-fed échelle spectrograph similar to the MUSICOS design (see Baudrand & Bohm, 1992). The spectral range of the instrument is 4250–7375 Å, and $R = 38\,000$.

(iii) At TLS with the 2 m Alfred Jensch telescope and a $f/46$ Coudé échelle spectrograph. These spectra cover 4510–7610 Å with $R = 31\,500$.

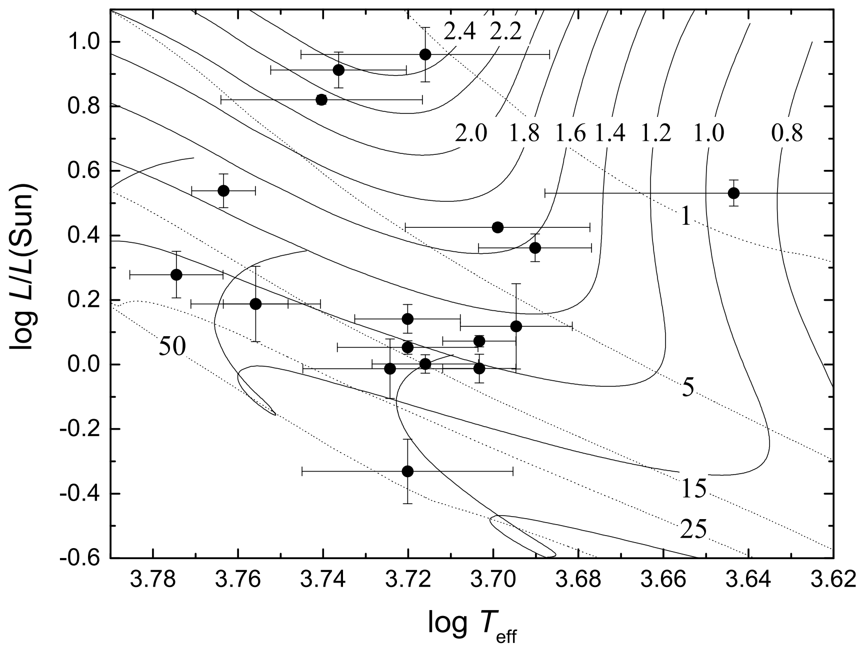

Figure 1. Positions of our targets in the HR diagram with evolutionary tracks from 2.4 to 0.8 $M_\odot$ (solid curves) and isochrones from 1 to 50 Myr (dotted curves). The evolutionary tracks/isochrones for the solar metallicity from the Pisa Stellar Models by Tognelli et al. (2011) are shown.

The raw data from SLO and SPO were reduced using `IRAF` package tasks, Linux shell scripts and `FORTRAN` programs as described in Pribulla et al. (2015). Data were reduced with standard dark and flat-field frames. Bad pixels were cleaned using a bad pixel mask, cosmic hits were removed using the program of Pych (2004). Order positions were defined by fitting Chebyshev polynomials to the tungsten-lamp and blue LED spectrum. In the following step, scattered light was modelled and subtracted. Aperture spectra were then extracted for both the object and the ThAr lamp and then the resulting spectra were wavelength calibrated. Spectra obtained at TLS were also reduced under the `IRAF` environment (e.g. Guenther et al., 2009).

2. Evolution stage

The $ubvy\beta$ photometry data taken from Paunzen (2015) were used as input for the `TempLogG TNG` software (Kaiser, 2006) with different calibrations to derive the temperature $T_{\rm eff}$, [Fe/H] and $\log g$. We have calculated luminosity from the *Gaia* DR2 parallax (Lindegren et al., 2018) and the reddening from Meištas & Straižys (1981); Chavarría-K et al. (2000); Grankin (2013); Herczeg & Hillenbrand (2014). The de-reddening method was based on the Strömgren-Crawford *ubvyβ* photometric system (Crawford, 1975; Schuster & Nissen, 1989). To deduce the age of stars, we used the evolutionary tracks (Figure 1) for solar metallicity from the Pisa Stellar Models (PSM) by Tognelli et al. (2011). We have found that all stars in our sample are younger than 70 Myr. This is close or inclusive to the 10–100 Myr interval for the post T Tauri stars defined by Jensen (2001). The errors, mainly due to the effective temperature, translated into the uncertainty in the mass are of about $\pm 0.2\,M_\odot$. We have measured the equivalent widths (EW) of H_α and Li I 6708 lines using the `IRAF` package. Radial velocities $v \sin i$ were extracted using the broadening function technique (see Rucinski, 1992). We list the results in Table 1. The spectral type of targets was adopted from the available literature.

Table 1. Results of modelling for different targets. Negative values of EW denote emission. Formal errors are given only if several sources/determinations were available. Further details are given in the text.

Star	Age [Myr]	[Fe/H] [dex]	$T_{\rm eff}$ [K]	$\log g$ (cgs)	Sp. type	EW H_α [mÅ]	EW Li [mÅ]	$v \sin i$ [km s^{-1}]
HD 285281	1-8	−0.111	4800(600)	4.4(5)	K1		423	80
V1298 Tau	7-12	+0.010	5170(150)	4.57(28)	K1	254	376	31
HD 284135		−0.555	5700(230)	4.1(4)	G3	824	193	74
HD 284149	15-25	−0.650	6070(170)	4.16(21)	G1	720	169	30
HD 281691	8-18	+0.191	5160(210)	4.61(26)	G8	145	342	25
HD 284266	15-30	−0.134	5850(230)	4.4(4)	K0	408	239	34
HD 284503	10-20	−0.232	5430(260)	4.2(4)	G8	125	274	44
HD 284496	12-20	−0.230	5430(100)	4.2(7)	K0	297	288	28
HD 285840	20-70		5640(40)	4.45	K1		214	25
HD 285957	3-13	+0.059	4940(260)	4.79(25)	K1	155	411	28
HD 283798	17-21	+0.595	5760(130)	4.7(4)	G7	380	243	29
HD 283782	<3	+0.082	4900(700)	4.72(29)	K1	−3937	237	77
HD 30171	2-4	−0.353	5390(260)	4.0(5)	G5	706	273	112
HD 31281	8-12	−0.558	5500(400)	4.0(5)	G1	970	167	83
HD 286179	10-35	−0.153	5800(300)	4.6(4)	G3	1316		22
HD 286178			4490(90)	4.6	K1	211	166	46
HD 283447	2-4		4050(50)	4.7	K3	−1397	500	47
HD 283572	2-5		5340(60)	4.5	G5	899	274	82
HD 285778	8-15	−0.352	5300(250)	4.0(5)	K1	510	269	21
HD 283518	<2		3770	4.8	K3		517	74

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