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Pre-main sequence star Proper Motion Catalogue*,**,***

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Abstract. We measured the proper motions of 1250 pre-main sequence (PMS) stars and of 104 PMS candidates spread over all-sky major star-forming regions. This work is the continuation of a previous effort where we obtained proper motions for 213 PMS stars located in the major southern star-forming regions. These stars are now included in this present work with refined astrometry. The major upgrade presented here is the extension of proper motion measurements to other northern and southern star-forming regions including the well-studied Orion and Taurus-Auriga regions for objects as faint as $V \leq 16.5$. We improve the precision of the proper motions which benefited from the inclusion of new observational material. In the PMS proper motion catalogue presented here, we provide for each star the mean position and proper motion as well as important photometric information when available. We provide also the most common identifier. The rms of proper motions vary from 2 to 5 mas/yr depending on the available sources of ancient positions and depending also on the embedding and binarity of the source. With this work, we present the first all-sky catalogue of proper motions of PMS stars.

Key words. astrometry – stars: kinematics – stars: pre-main sequence – galaxy: open clusters and associations: general

1. Introduction

The kinematic studies of young stars, including PMS stars, are fundamental in order to discuss their formation mechanism and their membership properties. Proper motions allow the detection of structures as moving groups and associations to which these stars belong.

The main scenarios to explain the mechanisms of star formation like sequential star formation (Blaauw 1964, 1991), the Gould Belt model (Olano & Pöppel 1987) and star formation by impact of high-velocity clouds (Lépine & Duvert 1994), are based on the kinematics of young stars. In this context the knowledge of the proper motions of young stars is essential.

The available astrometric catalogues as HIPPARCOS (ESA 1997), Tycho-2 (Høg et al. 2000) or UCAC2 (Zacharias et al. 2004) provide proper motions of variable precision for a large number of stars including several PMS stars. Due to the magnitude limit of HIPPARCOS and TYCHO-2 catalogues, for the faintest of these stars, the only proper motions available in the literature are those of UCAC2 catalogue. Unfortunately, for these faint objects, these proper motions are usually of poor quality, based on a two point solution.

Some local efforts were also made by authors to produce proper motions to investigate the kinematics of selected samples of young stars in restricted areas (as done for example by Hartmann et al. 1991; Relke 1998; Terranegra 1999). However, most PMS stars remain unmeasured or poorly measured in terms of proper motion.

A specific problem of measuring proper motions of PMS stars is that these objects often present an embedded aspect and have close companions. In this context a dedicated work on these objects is necessary to derive more reliable proper motions.

This work is the continuation of attempt started in 1999 to measure proper motions over the entire sky of PMS stars already identified in the literature. In a first paper (Teixeira et al. 2000), we presented the results of the determination of the proper motions of 213 PMS stars located in the major southern star-forming regions (Chamaeleon, Lupus, Upper Scorpius – Ophiuchius and Corona Australis). In this present work, we extended our effort to all star-forming regions where astrometric material was available. We included some new sources of

* Full Table 6 is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/438/769

** Based on observations performed at the Bordeaux automated meridian circle, at the Valinhos automated meridian circle, at the ESO Danish 1.5 m telescope and at the OHP 120 cm telescope. Based on measurements made with MAMA automatic measuring machine.

*** This work made use of The Digitized Sky Survey and 2MASS images for visual inspection of our sources. This work made use of the Vizier/Simbad CDS database.

positions: 2MASS All-Sky Catalog of Point Sources (Cutri et al. 2003), UCAC2 catalogue and original observations from the CCD meridian circles of Bordeaux and Valinhos Observatories (Viateau et al. 1999). All positions used here to calculate the proper motions were referenced to the ICRF (Ma et al. 1998) as defined by the HIPPARCOS and Tycho-2 catalogues.

2. Data

Our list of known PMS stars made as exhaustive as possible is based on: Schawartz (1977, 1984), Marraco & Rydgren (1981), Herbig & Bell (1988), Harris et al. (1988), Ichikawa & Nishida (1989), Feigelson & Kriss (1989), Gregorio-Hetem et al. (1992), Gauvin & Strom (1992), Wilking et al. (1992), Feigelson et al. (1993), Hartigan (1993), Thé et al. (1994), Alcalá (1994, 1995), Casanova et al. (1995), Torres et al. (1995), Brandner et al. (1996), Krautter et al. (1997), Walter et al. (1997), Covino et al. (1997), Frink et al. (1997), Magazzu et al. (1997), Wichmann et al. (1996, 1997), van den Ancker et al. (1997, 1998), Malfait et al. (1998), Martín et al. (1998), Preibisch et al. (1998), Cambresy et al. (1998), Li & Hu (1998), Terranegra et al. (1999), Bertout et al. (1999), Magnier et al. (1999), Neuhäuser et al. (1995, 2000), Li et al. (2000), Bontemps et al. (2001), Gómez et al. (2001, 2003), Luhman et al. (2003), Viera et al. (2003).

From these papers, we determined an input list of 1637 PMS stars.

Present day positions are easy to find or produce for bright or faint objects but ancient astrometric positions are usually available for bright stars only. As the precision of the proper motions results directly from the time basis, the proper motions of faint objects are always of poorer quality than those of bright objects.

For the current epoch we used various sources of positions. We started an observational campaign of all our targets with the CCD meridian circles of Bordeaux ($\phi = 44°50', \lambda = 00°32'$) and Valinhos ($\phi = -23°00', \lambda = 46°58'$) (Viateau et al. 1999). We also used recent positions from the upgraded catalogues UCAC2 and 2MASS.

From these sources we could extract positions for most of our PMS targets. Some observations from OHP 120 cm and ESO D1.5 m performed from 2000 to 2002 were also included in this work.

For the intermediate and first epochs we could rely on positions from AC2000.2 (Urban et al. 1998), "Carte du Ciel" plates from Bordeaux, USNO-A2.0 (Monet et al. 1998), HIPPARCOS (ESA 1997) and Tycho-2 catalogues, SERC-J and POSS I and POSS II Schmidt plates digitized with the MAMA measuring machine installed at the Centre d'Analyse des Images at the Paris Observatory (Berger 1991).

AC2000.2 and "Carte du Ciel" measurements provide ancient positions (mean epoch ~1910) for objects brighter than $V \leq 13-14$. For fainter objects our first epoch source of position comes from USNOA2.0, POSS I, SERC-J and POSS II plates remeasured with the MAMA measuring machine.

2.1. CCD meridian observations

The CCD meridian positions were obtained with the Bordeaux meridian circle (Réquième et al. 1997; Viateau et al. 1999) and also with the Valinhos CCD meridian circle (Dominici et al. 1999; Teixeira et al. 2000).

Both instruments are very similar and their magnitude limit is about $V = 16.0$. Their astrometric and photometric observational precisions depend on the magnitude and in the best interval ($9.0 \leq V \leq 14.0$) are about 50 mas in both coordinates and 0.05 in magnitude. The CCD meridian observations are carried out with a filter GG495+BG38 (bandpass from 5200 to 6800 Å). This system is not far from the Johnson one as explained in Dominici et al. (1999).

The observational procedure (TDI mode) produces an observed strip of an arbitrary length in right ascension and of 28′ or 14′ in declination for Bordeaux and Valinhos meridian circles respectively. Usually, the length in right ascension provides at least 30 Tycho-2 stars in the strip, used as reference stars. The meridian positions considered here result from a minimum of 3 observations (in most cases 6 observations).

For the reduction of these observations we take advantage of the fact that the same field (strip) is observed more than 3 times and we apply a global technique as developed in Benevides-Soares et al. (1992) and Teixeira et al. (1992).

A more detailed description of the observation procedure with these instruments and of the data treatment and reduction can be found in Viateau et al. (1999) and Dominici et al. (1999).

We included in the observational campaign of both instruments our input list of 1637 objects from which 558 could be observed at least six times with a mean precision of 50 mas.

2.2. Plate material

For this project 94 Schmidt plates copies have been digitized and analyzed with the MAMA measuring machine which provides currently the most accurate measurements. Its repeatability is about 0.4 μm. 29 of them were POSS I $6.3° \times 6.3°$ Schmidt plate copies (epoch = 1950–1960), 37 were POSS II $6.3° \times 6.3°$ Schmidt plate copies (epoch = 1980–1985), 25 were SERC-J $6.5° \times 6.5°$ Schmidt plate copies (epoch = 1970–1980) and 3 were ESO(R) plate copies.

For each plate, a catalog of (x, y), flux and area was produced for about 100 000 objects. Each plate was astrometrically reduced from (x, y) to (α, δ) with reference stars from the TYCHO-2 catalogue (Hög et al. 2000). The mean residual of the plate reductions was about 0.25″ in both coordinates. The Schmidt plate and meridian strip distribution is given in Fig. 1 with the PMS stars of our input list. Moreover, measurements from 10 plates from the Bordeaux Carte du Ciel archive were used in this work.

2.3. Published data

For about 40% of our targets we could find positions in the AC2000.2 catalogue. The epochs of AC2000.2 positions range from 1881 to 1950 with a mean of about 1907. The AC2000.2 provides a large time base for proper motion calculation and so

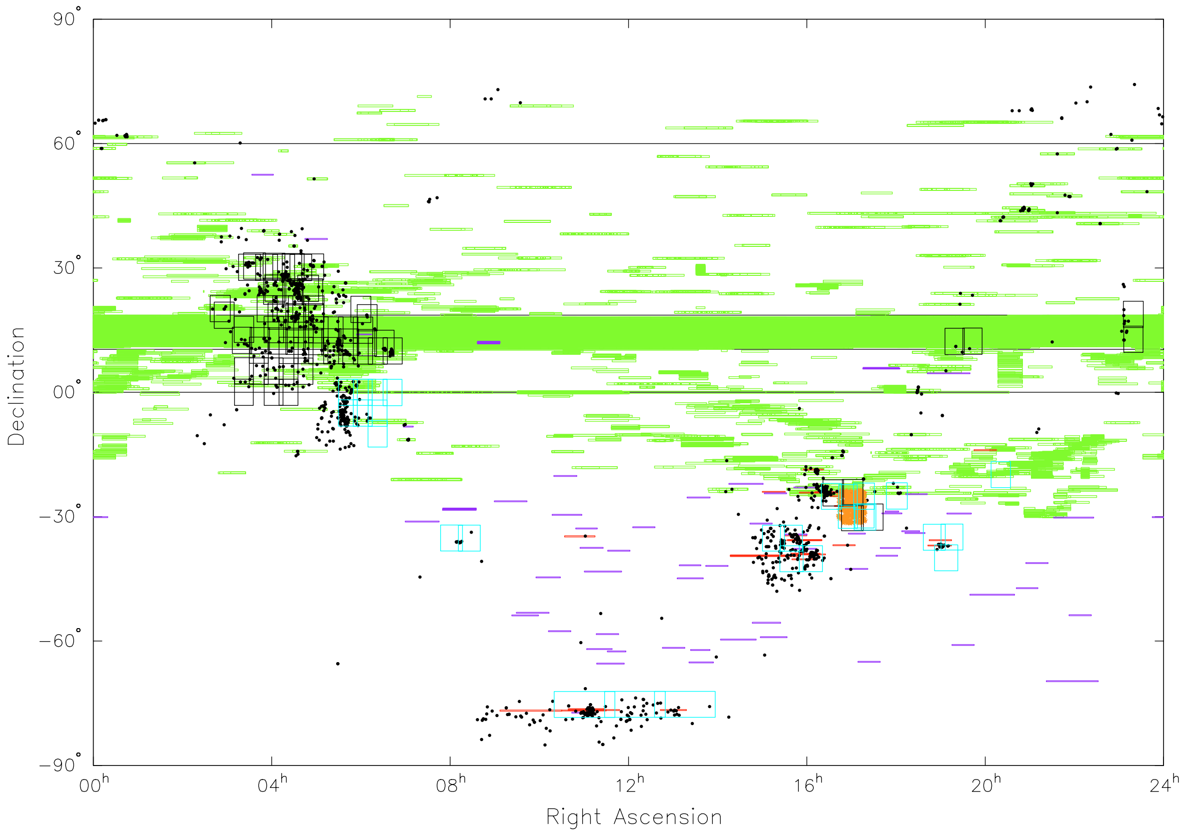

Fig. 1. Survey area. Squares = Schmidt plates (Black = POSS plates, Blue = SERC-J), Strips = meridian fields. Dots are the PMS stars from our catalogue.

ensures excellent precision. This catalogue contains more than 4.5 millions stars brighter than $V \sim 12.0$. Their positions are given for the epoch of observation allowing us to work with a time base at worst greater than 50 years. Frequently it reaches 80–100 years and it can even exceed 100 years.

For the brightest stars we could take advantage of the extremely accurate HIPPARCOS and Tycho-2 positions. In the case of Tycho-2 we worked with the observed positions.

For several stars we could use positions from the Southern Hemisphere Catalogue of Bordeaux (SHCB hereinafter) that was part of the HIPPARCOS Input Catalogue (Rousseau et al. 1997). These positions were derived from ESO Schmidt plates with a mean epoch = 1978.

For the fainter stars we benefited from the positions from catalogue such as USNO-A2.0, that gives positions for more than 0.5 billion stars ($R \sim 20$). In spite of the lower precision of the USNO-A2.0 positions compared to other recent catalogues and some imperfections as pointed out by Assafin et al. (2001), this catalogue is very important in providing first epoch positions for many faint stars. Its position epochs range from 1950 to 1984. Care has been taken to exclude USNO-A2.0 positions when Schmidt POSS I or SERC-J plate positions were used, since these plates were used for the realization of the USNO-A2.0.

For 72% of objects we could use UCAC2 positions. UCAC2 gives positions for about 48 million stars ($R \leq 16$) with positional errors ranging from 20 to 70 mas at the epoch of the catalogue position. UCAC2 also provides proper motions of variable quality that will be compared with ours in the discussion.

Another catalogue that has been an important source of recent positions is 2MASS. This catalogue gives positions for about 0.5 billion stars with positional errors around 70 mas for $J \leq 17$ and very important photometric information such as the J, H and K_s magnitudes. This photometric information was included in our final catalogue. We benefited from the 2MASS positions for nearly all our stars.

3. Proper motions

The proper motions and mean position determination was carried out by a weighted least square fit as presented in Teixeira et al. (2000).

The weights were calculated in the usual way as $1/\sigma^2$ where the σ were taken as the mean precision given by the authors or roughly estimated by us for each source of positions. The values of σ used in the calculation of the weights are given in Table 1.

In this table, we also give the contribution of each position source to the proper motion determination, i.e., the number of stars for which we have taken position in the corresponding catalogue. In the last column we give the mean epoch of each catalogue.

The use of astrometric material from these sources allowed us to determine reliable proper motions and mean positions for 1346 stars from our input list of 1637 targets.

Table 1. Precisions of the various sources of positions used to derive the weights for the least square adjustment and number of stars.

Source	σ(mas)	Nstars	Mean Epoch
Carte du Ciel	200	20	1909–1950
AC2000.2	200	572	1892–1950
Schmidt plates	300	854	1950–1997
USNO-A2.0	250	956	1950–1984
SHCB	300	66	1974–1978
Tycho-2	60	379	1991.2
HIPPARCOS	1	104	1991.2
UCAC2	100	980	1954–2002
2MASS	200	1324	1997–2001
Bordeaux meridian	60	577	1996–2004
Valinhos meridian	60	47	1997–1999

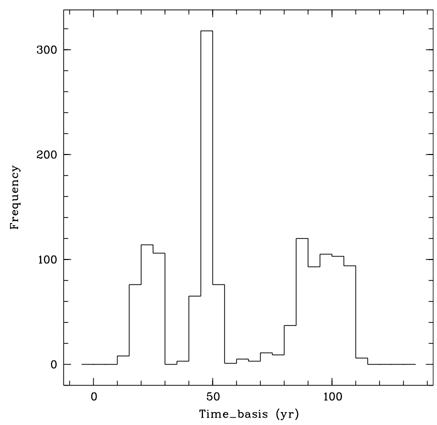

Fig. 2. Distribution of time base for proper motion calculation.

The number of stars in the catalogue is smaller than the number of targets in our input list because we could not find positions with a time base ≥10 years (usually for the faint objects). Another few stars were eliminated due insedure identification, especially in crowed fields when the original position was extracted from the ROSAT catalogue (Voges 1999; Voges 2000) which gives positional errors from 6 to 30″.

Since various combinations of source positions were used for the proper motion determination and that the AC2000.2 catalogue is limited to the brightest stars, a dependence of the quality of the proper motions on the magnitude is clearly observed.

In most cases the time base was larger than 30 years reaching in many cases more than 100 years. The histogram of the distribution of the time basis is shown in Fig. 2. About 300 proper motions (~20%) were measured with a time basis from 10 to 30 years, about 500 (~35%) with time basis between 30 and 60 years, more than 400 (~30%) between 60 and 100 years and nearly 200 (~15%) with time basis greater than 100 years.

Figure 3 gives the distribution of the number of position sources used to derive our proper motions.

We see from Fig. 3 that most (~90%) proper motions were determined with at least 4 points.

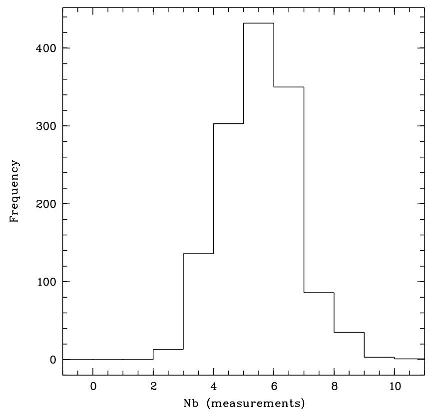

Fig. 3. Number of points used for the proper motion determinations.

There are two possible levels of misidentification of our input targets in the available data: misidentification between the various data for one source which generally leads to an erroneous proper motion with a large error and misidentification of the input target in the whole data (especially in crowded fields when the target position comes from the ROSAT catalogue). In this case the derived proper motion can be of good quality but does not refer to the targeted PMS objects. In this work, we have solutions usually derived from 4 points and therefore problems of misidentification in the various data sets are rare; moreover, all stars were checked in detail to eliminate possible remaining misidentifications.

In some cases, the identification of the input target in the data lead to several possibilities (especially in crowded zones). Sometimes we removed the object from the final catalogue as it was impossible to decide between the competitors; in other cases we used the photometric information to select the most probable candidate.

In the case of very close binaries, in the material used, the separation of the components sometimes could not be performed. When the proper motion appeared representative of the motion of the pair, we added to the identifier the mention AB, as for HBC 507 (LkHα313, $05^h47^m13.93^s$ +00°00′17.70″) and HBC 508 (LkHα312 $05^h47^m14.0^s$ +00°00′15.9″) which becomes LkHα312 AB).

4. Internal precision

The internal precision (formal errors) of our positions and proper motions reflect the weights attributed to each source position and their epochs and therefore are dependent on the various possible combinations between the catalogues.

As expected the best precision concerns stars present in AC2000.2 or in Carte du Ciel plates, mainly due to the very large time base as well as when extremely accurate catalogues such as HIPPARCOS, Tycho-2 or UCAC2 are used in the proper motion determination.

The average internal positional precision is $\sigma_{\alpha,\delta}$ = 40 mas for 80% of stars, reaching 180 mas for the poorer determinations. For proper motions, the internal precision is σ_μ = 2 mas/yr for 60% of the cases and is as poor as 9 mas/yr for the poorer determinations. In these few extreme

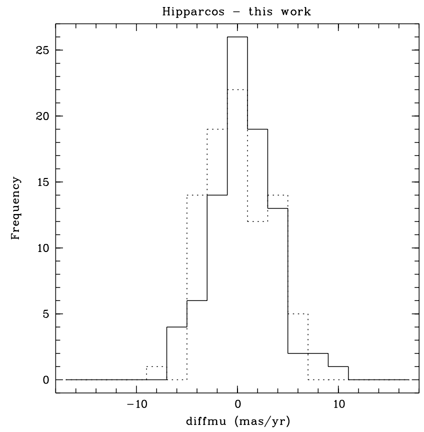

Fig. 4. Distribution of the differences in proper motion between HIPPARCOS and our proper motions. Solid line corresponds to $\Delta\mu_\alpha \cos(\delta)$ and dashed line corresponds to $\Delta\mu_\delta$.

cases the proper motion given in our catalogue (based on two or three sources of positions) should be taken as indicative. Nevertheless in each case, a visual inspection of the material was performed and only the stars for which we had convincing data for proper motion have been kept in our catalogue.

5. Comparison with other catalogues

To estimate the consistency of our proper motions, we compared them with those from astrometric catalogues such as HIPPARCOS, Tycho-2 and UCAC2. Our proper motions were derived from data that were also used in the determination of the proper motions of these catalogues. As a consequence, the proper motions are not independent but correlated. The heaviest correlations concern Tycho-2 stars and UCAC2 bright stars for which we have in common AC2000.2 positions and Tycho-2 observed positions or AC2000.2 positions and UCAC2 observed positions. The comparison of our proper motions with those catalogues will allow us to check the coherence of our results and to point out the problematic cases for which an explanation is required.

5.1. Comparison with HIPPARCOS

The HIPPARCOS proper motions are the best available proper motions but this catalogue concerns only stars brighter than $V \sim 10$ mag. So, this comparison is very limited in magnitude and concerns the stars for which we could in general find a first epoch position in the AC2000.2 catalogue and for which our proper motion errors are low.

Figure 4 shows the histogram of the proper motion differences in the sense this work minus HIPPARCOS for the 103 common stars.

In this comparison, after a 3σ elimination, we obtain a mean difference in $\mu_\alpha \cos\delta$ and μ_δ of +0.1 and –0.3 mas/yr with a standard deviation of 3.1 and 3.0 mas/yr.

We see that for most of the comparison stars the agreement is very good. A few points, eliminated at the 3-sigma level, are discrepant with large differences; they will be discussed in the next section. We give these large differences in Table 2.

5.1.1. Discrepant points

For stars AB Dor AB, HD 176269 and CD-36 10569 we see an excellent agreement between our and Tycho-2 values. HIPPARCOS treats stars AB Dor AB as a single star but the 2MASS image reveals a faint companion with a separation of 6″. HIPPARCOS errors on this proper motion are lower than 1 mas/yr and we cannot decide on the observed discrepancy.

Even being relatively bright, star HD 176269 has proper motion errors in the HIPPARCOS catalogue higher than the HIPPARCOS standard of 16.1 and 7.9 mas/yr. It is part of a multiple system. We believe that the observed discrepancies come from HIPPARCOS measurement of the photocenter of the system.

For star CD-36 10569 HIPPARCOS gives a flag of "suspected non-single". We believe that this is the cause of the observed discrepancies between our catalogue and Hipparcos.

Our proper motions for stars RX J0336.0+0846 and DF Tau are different from HIPPARCOS and UCAC2 ones and the HIPPARCOS values are different from the UCAC2 ones. The HIPPARCOS errors for these stars are small and it is difficult to explain the origin of these differences. However, we note that the HIPPARCOS magnitudes, 12.45 and 11.96, for these stars are close to the detection limit of the satellite. Moreover RX J0336.0+0846 is part of a binary system with a separation of 18″.

For star HIP 85755 the very bright magnitude of this object is probably the origin of errors of meausrements in our catalogue.

5.2. Comparison with Tycho-2

The comparison of our proper motions with Tycho-2 ones is based on 339 stars. This comparison is given in Fig. 5.

We notice in this figure a very good agreement between our proper motions and those of Tycho-2 and no systematic tendencies. The mean difference in both coordinates is +0.1 and –0.3 mas/yr with a standard deviation of 1.2 and 1.1 mas/yr after a 3σ elimination. This comparison concerns stars with $V < 11.5$. These dispersions are smaller than in the comparison with HIPPARCOS because our proper motions are more correlated to those of Tycho-2.

5.2.1. Discrepant points

When we compare our catalogue with Tycho-2, 20 objects are eliminated in the 3-sigma elimination process. From these, only 4 objects present proper motion differences that cannot be explained by the formal errors of the catalogues ($\Delta_\mu \geq 2.5\sqrt{\sigma^2_{\text{this work}} + \sigma^2_{\text{Tycho-2}}}$). We give these 4 discrepant values in Table 3.

The larger difference in proper motion concerns RX J0546.1+1232. The UCAC2 proper motion of this object is in good agreement with ours and the magnitude of this star is at the limit of the Tycho-2 catalogue ($V = 12.3$). This suggests that the discrepancies may come from Tycho-2 measurements.

Table 2. Discrepant proper motions with respect to HIPPARCOS sorted by decreasing differences. Column (1) gives the usual identifier, Col. (2) the HIPPARCOS H_p magnitude (close to V), Cols. (3) and (4) give the J2000 coordinates and Cols. (5)–(12) give respectively $\mu_\alpha \cos\delta$ and μ_δ from our catalogue, from HIPPARCOS, Tycho-2 and UCAC2.

Ident	V	α (h m s)	δ (° ′ ″)	This work (mas/yr)	HIPPARCOS (mas/yr)	Tycho2 (mas/yr)	UCAC2 (mas/yr)
AB DorAB	6.88	05 28 44.783	–65 26 56.17	+50 +139	+32 +151	+49 +138	
HD 176269	6.73	19 01 03.251	–37 03 39.06	+7 –30	–5 –19	+8 –29	
RX J0336.0+0846	12.45	03 36 00.328	+08 45 36.49	+13 +17	+26 +24		+20 +36
DF Tau	11.96	04 27 02.786	+25 42 22.56	+2 –22	+14 –26		+9 –15
CD-36 10569	11.00	15 59 49.531	–36 28 27.53	–28 –45	–16 –49	–29 –46	–28 –46
Hip 85755	4.78	17 31 24.951	–23 57 45.29	–1 –36	+5 –26	+3 –26	

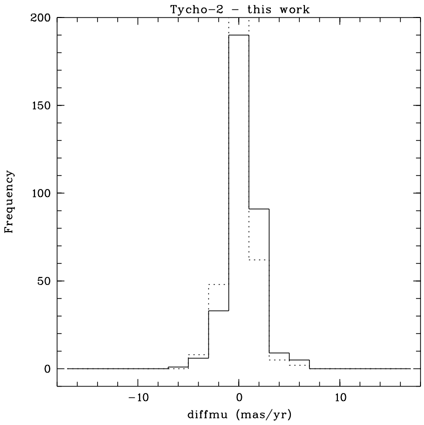

Fig. 5. Distribution of the differences in proper motion between Tycho-2 and our proper motions. Solid line corresponds to $\Delta\mu_\alpha \cos(\delta)$ and dashed line corresponds to $\Delta\mu_\delta$.

For HD 137727 the three catalogues do not agree, although our proper motion in declination is clearly above the two other values. The ACT (Urban 1998) proper motion (22, 58 mas/yr) is close to our determination. We cannot explain this discrepancy.

For star RX J1039.5-7538S (part of a binary system) there is a large discrepancy with Tycho-2. The components of this binary system are well separated (more than 6″) and we use 6 points in the proper motion determination. We are unable to explain the observed discrepancies.

For BD-10 4662 AB, we give the proper motion of the photo-center of the binary system but this is probably also the case for Tycho-2 and UCAC2. The observed discrepancies probably result from its binarity but it is not possible to attribute these differences to one of the compared catalogues. One component of this system is a flare star (FK Ser) inducing a shift of the photo-center of the binary system between epochs.

5.3. Comparison with UCAC2

To test the coherence of our results for the fainter objects, we compared our catalogue with UCAC2 (952 common objects). We show this comparison in Fig. 6.

We obtain for the comparison with UCAC2 a mean difference of –1.2 and –0.6 mas/yr and a standard deviation of 4.3 and 4.2 mas/yr in both coordinates after a 3σ elimination process (855 points). These values are greater than those obtained from the comparison with Tycho-2. This larger dispersion comes from the fact that here we compare the fainter stars for which our proper motions and those of UCAC2 are less accurate and also that there is less material in common between both catalogues and therefore the correlation of proper motions is smaller.

5.3.1. Discrepant points

When we compare our catalogue with UCAC2, 97 stars are eliminate by the 3-sigma elimination process. The differences range from 13 to 78 mas/yr. From these, only 21 present differences larger than 2.5 $\sqrt{\sigma^2_{\text{this work}} + \sigma^2_{\text{ucac}}}$. We give these 21 discrepant values in Table 4.

For most of these large differences (90 of the 97 large differences and 16 of the 21 discrepant values), UCAC2 has determined proper motion solutions with 2 points while our determination was never based on less than 4 points (except for RX J1243.6-7834 and B62-Hα2 for which we used 3 points only) and each fit has been studied individually and images from Digital Sky Survey and from 2MASS in each case have been analyzed. For this reason we believe that a large part of the discrepancy may come from the small number of data points used in the UCAC2 solution. In several cases our proper motion also has large formal errors and it may be that both determinations (ours and UCAC2) are not reliable for these objects.

5.4. Conclusion on the errors of our catalogue

We summarize in Table 5 the quantities corresponding to the comparison of our proper motions with HIPPARCOS, Tycho-2 and UCAC2 after a 3σ elimination.

From the various comparisons reasonable estimates of our random errors on proper motions are $\sigma_\mu \sim$ 2–5 mas/yr depending on the magnitude.

We present in Figs. 7 and 8 the differences in proper motion, respectively in right ascension and declination between our catalogue and HIPPARCOS, Tycho-2 and UCAC2 as a function of the 2MASS K magnitude.

One notices a good accordance between our proper motions and the various catalogues. A systematic effect in the

Table 3. Discrepant proper motion with Tycho-2 ordered by decreasing differences. Column (1) gives the usual identifier, Col. (2) the V magnitude from Tycho-2, Cols. (3)–(8) give respectively $\mu_\alpha \cos\delta$ and μ_δ from our catalogue, from HIPPARCOS, from Tycho-2 and from UCAC2.

Ident	V	α	δ	This work	HIPPARCOS	Tycho2	UCAC2
		(h m s)	(° ′ ″)	(mas/yr)	(mas/yr)	(mas/yr)	(mas/yr)
RX J0546.1+1232	12.34	+5 46 +4.033	+ 12 32 47.57	–4 –7		+10 –8	–2 –8
HD 137727	9.65	15 28 44.018	–31 17 38.39	+22 +60	+24 +40	+20 +48	
RX J1039.5-7538S	9.74	10 39 31.717	–75 37 56.50	+3 +20		+7 +10	+6 +14
BD-10 4662 AB	10.75	18 20 22.757	–10 11 12.82	–1 –38		+9 –33	–1 –24

Table 4. Discrepant proper motions with UCAC2. Columns give: (1) usual identifier, (2) UCAC2 magnitude, (3) number of points used in this work to derive the proper motions, (4)–(7) give respectively $\mu_\alpha \cos\delta$ and μ_δ from our catalogue and from UCAC2. $\mu_\alpha*$ stands for $\mu_{\alpha\cos\delta}$.

Ident	UCACmag	Nb mes	α	δ	This work	UCAC2
			(h m s)	(° ′ ″)	(mas/yr)	(mas/yr)
LkHα 312 AB	13.94	5	05 47 13.938	+00 00 16.61	–26 +7	+50 –9
Haro 6-37 AB	12.77	6	04 46 58.998	+17 02 38.39	+0 –14	–19 –57
Sz 130	13.83	4	16 00 31.027	–41 43 36.99	+31 +8	–2 –24
PDS 145	13.45	4	16 14 20.921	–19 06 04.90	–13 –26	–1 +17
RX J1514.0-4629B	14.02	4	15 13 59.826	–46 29 54.12	+29 +18	–7 –5
L1642-1	14.81	5	04 35 02.299	–14 13 40.56	+6 +16	–2 –25
S2	11.95	5	13 57 57.814	–63 50 14.46	+25 –32	–10 –9
PHα 15	13.28	6	08 08 46.815	–36 07 52.40	+9 –30	–7 +9
RX J0844.5-7846	14.62	5	08 44 31.986	–78 46 31.29	–56 +30	–17 +15
Sz 119	14.11	4	16 09 57.064	–38 59 47.67	–37 –62	–11 –31
CW Cha	15.19	5	11 12 30.908	–76 44 23.86	+12 –30	+7 +9
RX J1243.6-7834	16.22	3	12 43 36.732	–78 34 07.79	–49 +24	–40 –12
Ha 3	12.44	5	19 02 33.057	–36 58 20.83	+28 –28	–9 –30
RX J0400.1+0818N	9.41	7	04 00 09.523	+08 18 18.97	+16 –9	+35 +21
PDS 82AB	12.05	4	16 15 34.571	–22 42 42.39	–26 –16	–26 –51
FS Tau	12.58	6	04 22 02.163	+26 57 30.96	+4 –18	+31 –39
PDS 64	14.07	5	12 57 11.770	–76 40 11.46	+6 –26	–26 –14
1RXS J050808.7+242714	15.63	6	05 08 08.202	+24 27 15.27	–31 –26	–59 –46
FV Tau	15.26	6	04 26 53.502	+26 06 54.06	–7 –27	+25 –20
PDS 65	12.96	5	13 02 13.564	–76 37 57.78	–66 +23	–40 +4
B62-Hα2	15.57	3	17 16 11.728	–20 57 54.37	+20 –29	–9 –21

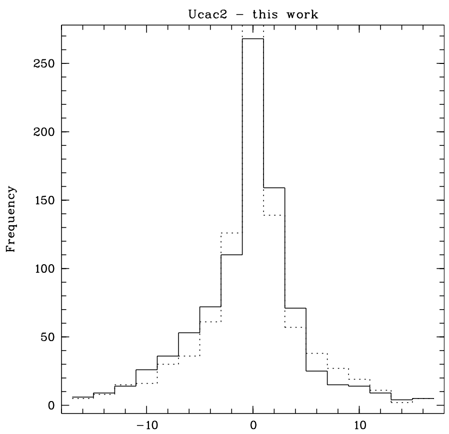

Fig. 6. Distribution of the differences in proper motion between UCAC2 and our proper motions. Solid line corresponds to $\Delta\mu_\alpha \cos(\delta)$ and dashed line corresponds to $\Delta\mu_\delta$.

Table 5. Characteristics of the comparison "*catalogues* minus this work" after a 3-σ elimination. $\mu_\alpha*$ stands for $\mu_\alpha \cos\delta$. Nb is the number of comparison stars.

	Nb	$\langle\Delta\mu_\alpha*\rangle$	$\langle\Delta\mu_\delta\rangle$	$\sigma_{\Delta\mu\alpha*}$	$\sigma_{\Delta\mu\delta}$
HIPPARCOS	87	+0.1	–0.3	3.1	3.0
Tycho-2	313	+0.1	–0.3	1.2	1.1
UCAC2	855	–1.2	–0.6	4.3	4.2

differences of proper motions in right ascension between our catalogue and UCAC2 appears in Fig. 7. This effect, if real, could be attributed to UCAC2 proper motions since no effect of this type is detected in the other comparisons.

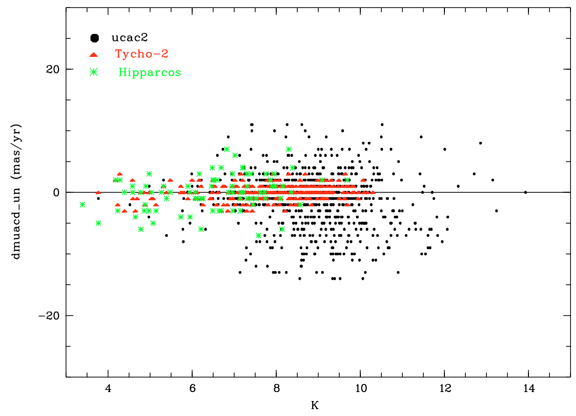

Fig. 7. Distribution of the differences in proper motion in right ascension between the catalogues HIPPARCOS, Tycho-2 and UCAC2 and our catalogue as a function of the 2MASS K_s magnitude.

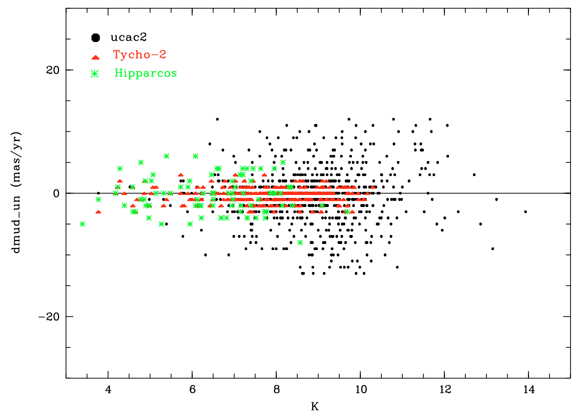

Fig. 8. Distribution of the differences in proper motion in declination between the catalogues HIPPARCOS, Tycho-2 and UCAC2 and our catalogue as a function of the 2MASS K magnitude.

6. PMS star proper motion catalogue

We give in Table 6 an extract of our catalogue (available only in electronic form at the CDS). Stars are sorted by right ascension. We also give some other important information such as the most common identifiers, V magnitudes from CCD meridian circles (Bordeaux & Valinhos), J, H, K_s magnitudes from 2MASS and classification.

Figure 9 shows the K_s magnitude distribution of our catalogue. The limiting magnitude is about $K_s = 15.5$ with a mean magnitude of $K_s = 9$.

In Fig. 10 we can see the sky distribution of the PMS stars that compose our catalogue.

A few of the faintest targets could only be identified on Schmidt plates or in the USNO-A2.0 and 2MASS catalogues, and their proper motions given in our catalogue should be understood as tentative, although each one has been verified (positions and image) individually.

Several objects studied here presented a slightly embedded aspect in the DSS images. Only those for which the quality of the fit was satisfactory were kept in this catalogue.

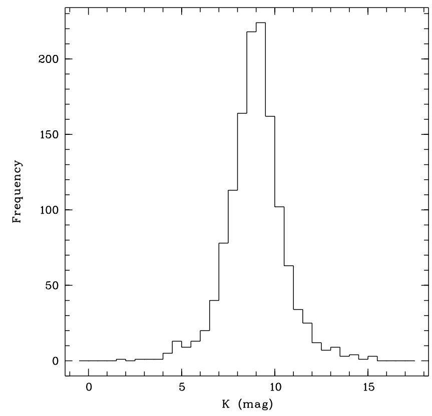

Fig. 9. Distribution of the 2MASS K_s magnitude of our catalogue (available for 99% of the stars).

7. Conclusion

We constructed a PMS Star Proper Motion Catalogue with positions and proper motions for 1250 pre-main sequence (PMS), 104 PMS candidates (including 29 unclassified X-ray active sources), from original and literature astrometric data. These stars are distributed on the whole sky in the most studied star-forming regions.

We have made the first proper motion determination for 30% of our catalogue. UCAC2 gives proper motions for 980 objects present in our catalogue but 35% derived from 2 points only. The re-measurement of these proper motions was absolutely required.

The comparison of our proper motions with the HIPPARCOS, Tycho-2 and UCAC2 ones allowed us to check the consistency of our results and to point out problematic cases.

The comparison with other proper motion sources shows that our catalogue can significantly contribute to clear up possible disagreements between proper motion values for some stars.

The proper motions determined here are reliable material to study the kinematics of moving groups and associations of PMS stars over the sky.

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Table 6. Extract of our catalogue giving: (1) most usual identifier, (2) HBC number, (3)–(8) (α, δ) (ICRS) at epoch t_0, (9) formal error on positions, (10) and (11) Proper motions ($\mu_{\alpha*}$ stands for μ_α cos(δ)), (12) formal error on proper motions, (13) number of points used for the proper motion determination, (14) and (15) l and b galactic coordinates at epoch t_0, (16) and (17) Proper motions in galactic coordinates (μ_{l*} for $\mu_l \cos(b)$), (18) Central epoch for positions, (19) Bordeaux or Valinhos CCD meridian V magnitude, (20) UCAC2 magnitude, (21)–(23) J, H, K (2MASS), (24) classification as given by CDS or found in the literature: T = T Tauri (CTT or WTT), A = HAeBe, Y = YSO, W = WTT, P = PMS, X = X-ray active source (Li 2000, Table 2), O = Post T Tauri, L = Emission Line from HBC catalogue, Tc = T Tauri candidate, Wc = WTTs candidate. Ac = HAeBe candidate, Yc = YSOs candidate, Pc = PMS candidate.

Ident	HBC	α [h m s]			δ [° ′ ″]			$\sigma_{\alpha,\delta}$ [mas]	$\mu_{\alpha*}$ [mas/yr]	μ_δ	σ_μ	Nb	l [°]	b	μ_{l*} [mas/yr]	μ_b	t_0 [yr]	V	UC$_{mag}$	J	H	K	class
G-G 405	209	6	39	40.783	8	58	53.18	39	–5	–5	2	6	203.604	1.497	2	–6	1995.8	12.8	12.1	10.4	9.7	9.2	T
KV Mon	208	6	39	41.466	9	46	19.66	40	4	–16	6	5	202.902	1.861	16	–4	1999.2	14.7	14.1	12.6	11.9	11.7	T
VSB 2	531	6	39	41.573	9	34	40.54	40	3	–14	6	5	203.075	1.773	14	–4	1999.2	13.3	12.8	11.8	11.4	11.3	L
LHα 5	532	6	40	11.128	9	38	6.01	54	–3	–3	5	4	203.080	1.907	1	–4	1997.1	.0	15.6	12.9	12.1	11.6	T
KY Mon	533	6	40	24.157	9	34	12.61	54	6	–11	5	4	203.162	1.925	12	0	1997.1	.0	16.1	13.5	12.5	11.8	T
LL Mon	210	6	40	25.883	9	50	57.75	139	–3	–10	7	3	202.917	2.059	7	–7	1983.0	.0	.0	13.9	13.1	12.6	T
PT Mon	211	6	40	32.008	9	49	35.65	139	1	–9	7	3	202.948	2.071	9	–3	1983.0	.0	.0	13.8	13.0	12.6	T
W68	534	6	40	37.491	9	54	57.94	52	–1	–3	2	5	202.879	2.131	2	–2	1991.2	.0	11.4	10.5	10.2	10.1	L
LM Mon	212	6	40	39.125	9	50	58.89	55	–20	3	6	4	202.941	2.107	–12	–17	1999.2	15.6	.0	12.3	11.3	10.5	T
NX Mon	216	6	40	41.143	9	33	57.90	40	9	–23	6	5	203.197	1.985	24	–2	1999.6	15.4	15.8	13.1	12.3	11.4	T
LP Mon	214	6	40	41.327	9	51	2.50	55	15	–22	6	4	202.944	2.116	26	4	1998.5	15.4	.0	12.8	12.0	11.7	T
V629 Mon	215	6	40	41.361	9	54	13.89	40	0	–3	5	5	202.897	2.140	3	–2	1998.8	13.4	13.2	11.6	10.9	10.4	T
W84	217	6	40	42.183	9	33	37.49	39	–1	–3	2	6	203.204	1.986	3	–2	1995.3	11.8	11.7	10.8	10.3	9.8	L
V590 Mon	219	6	40	44.638	9	48	2.21	40	0	–5	2	5	202.995	2.105	4	–2	1995.8	12.7	12.6	11.4	10.4	9.3	A
LR Mon	220	6	40	47.490	9	49	29.06	55	8	–9	6	4	202.979	2.126	12	3	1998.8	14.0	.0	11.5	10.7	10.0	T
LT Mon	221	6	40	49.890	9	36	49.49	40	5	–10	5	5	203.171	2.039	11	0	1998.8	15.1	14.4	12.4	11.6	11.2	T
W108	222	6	40	51.186	9	44	46.19	40	–5	–1	2	6	203.056	2.104	–2	–5	1995.2	11.9	11.7	10.7	10.2	9.7	L
V419 Mon	223	6	40	53.638	9	33	24.74	40	4	–13	5	5	203.229	2.026	13	–3	1998.9	14.6	14.2	12.4	11.7	11.3	T
W121	535	6	40	56.503	9	54	10.43	40	2	1	2	5	202.926	2.195	0	2	1996.7	12.3	12.0	10.8	10.3	10.2	T
LU Mon	225	6	40	56.798	9	37	48.94	40	2	–15	5	5	203.170	2.071	14	–6	1998.8	15.0	14.5	12.2	11.5	11.3	T
IO Mon	226	6	40	58.836	9	30	57.39	40	0	–10	5	5	203.275	2.027	9	–5	1998.8	13.8	13.1	11.7	10.9	10.5	T
W134	536	6	40	59.343	9	55	20.20	54	–1	–2	2	4	202.915	2.214	2	–2	1993.5	.0	12.0	10.6	10.1	9.7	L
IP Mon	227	6	41	.981	9	32	44.54	41	1	–10	5	5	203.253	2.048	10	–4	1999.0	13.4	12.8	10.6	9.7	9.2	T
LW Mon	537	6	41	3.376	9	40	44.99	54	–1	–14	5	4	203.139	2.118	12	–7	1997.1	.0	15.2	12.9	12.2	12.1	T
W154	538	6	41	3.501	9	31	18.45	39	0	–6	2	6	203.279	2.046	5	–2	1995.8	12.7	12.4	11.4	11.0	10.9	L
LY Mon	228	6	41	4.287	9	24	52.40	146	6	–22	7	3	203.376	2.000	23	–4	1986.2	.0	.0	12.7	11.9	11.5	T

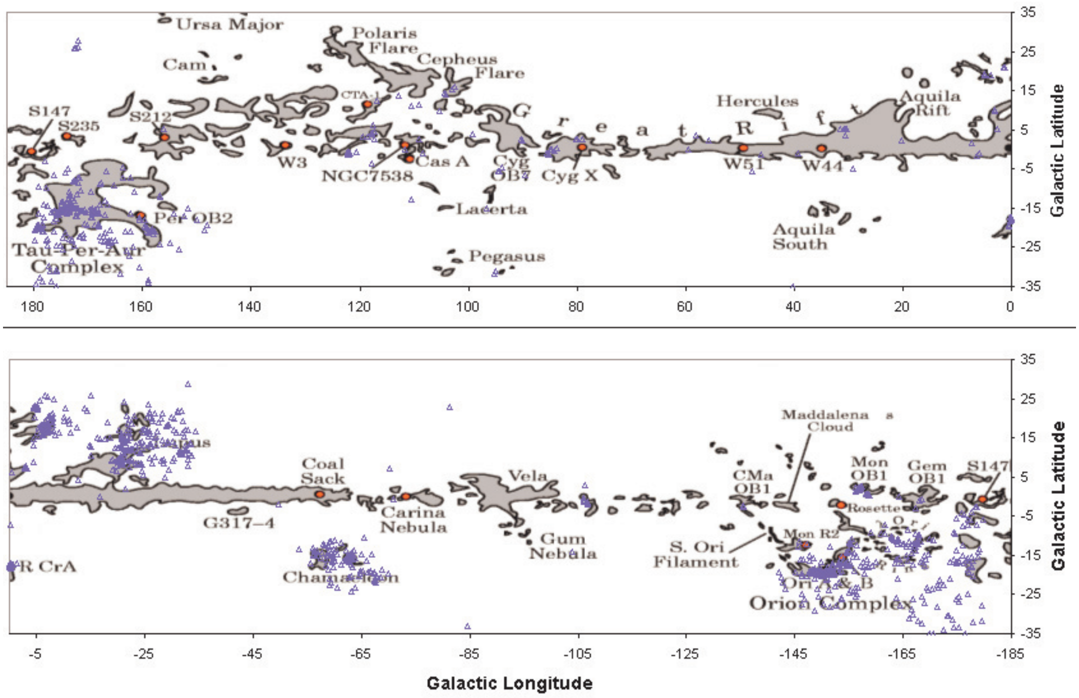

Fig. 10. PMS stars distribution in the sky over CO map (Dame et al. 2001).

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