

## Very Wide “Visual Double Stars” for the Astrometric Calibration of CCD’s

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**ABSTRACT:** We present first results of a catalogue of standard double stars for the astrometric calibration of CCD’s. The data were taken from photographically determined precise positions and proper motions of stars in the region of radio sources and open clusters. In this report, we give preliminary results of stars in the region of 3C 273 and NGC 1647.

### 1. INTRODUCTION

Telescopes with CCD detectors is equipment well suited for astrometric and photometric observations of double stars. However, there still remain some problems in the astrometric calibration of CCD frames. Photographic astrometric catalogues (e.g., from star clusters) may also be used for the calibration of CCD frames if they contain stars fulfilling the following conditions:

1. There must be at least one very wide pair, with a large distance of the two components but on the other hand small enough to have both of them simultaneously on the CCD chip. (Distance between 50 and 180 arcsec).
2. The positions of the components should be known with an accuracy of a few hundredths of arcsecs; the accuracy of the proper motions must be of the order of  $\pm 0''2/100$  yr, in order to enable future use of the data.
3. The stars must not be too bright ( $m > 10$ ), because of possible overexposure on the CCD, which may affect the accuracy.
4. The magnitude difference of the components should not exceed 3 mag.

We have started to select suitable stars from unpublished catalogues of recent astrometric work in Bonn and give here first examples. There exist two possibilities for the calibration, the first one uses only two stars and takes them as standard double stars. The second employs open clusters in which often more than two stars are in a small field covered by one CCD exposure. In that case a classical calibration with an affine transformation between rectangular coordinates  $(x, y)$  and standard coordinates  $(X, Y)$  from the projected right ascension and declination can be used.

## 2. STANDARD DOUBLE STARS IN TWO FIELDS

We have reduced the data already used in Brosche *et al.* (1991) for the calibration of the future HIPPARCOS system to the PPM catalogue and searched for suitable candidates. Table 1 gives the results for this field. Moreover, we have made a preliminary reduction of 16 plates from a proper motion study of the open cluster NGC 1647 (Geffert *et al.* 1990) and selected also from this catalogue possible candidates. Results from this data are given in Table 2.

The tables give coordinates, proper motions and magnitudes of the stars, from which precise angular separation and position angle for each epoch may be easily calculated. Positions and proper motions are given for equinox 2000 and epoch 1950. Rough values of distance and position angle for epoch 1950 are given in the last two columns. The accuracy of the positions is of the order of  $\pm 0''.04$  while that of the proper motions is  $\pm 0''.2/100\text{yr}$ .

TABLE 1. Astrometric standard stars in the 3C 273 field.

$\alpha_{2000}^a$ ( <sup>h</sup> <sup>m</sup> <sup>s</sup> )	$\delta_{2000}^a$ ( <sup>°</sup> <sup>'</sup> <sup>''</sup> )	$\mu_{\alpha \cdot \cos \delta}^b$	$\mu_{\delta}^b$	$m^c$ (mag)	$\rho^d$ ( <sup>''</sup> )	$\theta^d$ ( <sup>°</sup> )
12 29 06.718	+02 03 08.58	-70	-118	13.2	52	281
12 29 03.312	+02 03 18.43	-367	-104	13.5		
12 28 41.193	+01 48 43.71	39	-122	13.1	107	77
12 28 48.102	+01 49 08.51	-324	-245	13.7		
12 27 45.427	+02 12 49.14	-28	31	12.8	140	357
12 27 44.882	+02 15 08.62	-27	-258	12.9		
12 28 01.238	+01 32 12.13	3	-49	12.7	142	179
12 28 01.488	+01 29 50.56	-2	-199	13.4		

<sup>a</sup> coordinates of the stars for epoch 1950 and equinox 2000

<sup>b</sup> proper motions in right ascension (multiplied by  $\cos \delta$ ) and declination in  $0''.01/100\text{yr}$

<sup>c</sup> magnitude of the component

<sup>d</sup> distance in arcsec and position angle in degrees for epoch 1950 and equinox 2000

## 3. FUTURE WORK

We are planning to extend this work in the near future to about 10 fields distributed over the sky. It would be useful, if observers using our fields for astrometric calibration of CCD chips would tell us their experience with our data.

## 4. ACKNOWLEDGMENTS

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TABLE 2. Astrometric standard stars in the region of NGC 1647 \*

$\alpha_{2000}^a$ ( <sup>h</sup> <sup>m</sup> <sup>s</sup> )	$\delta_{2000}^a$ ( <sup>°</sup> <sup>'</sup> <sup>''</sup> )	$\mu_{\alpha \cdot \cos \delta}^b$	$\mu_{\delta}^b$	$m^c$ (mag)	$\rho^d$ ( <sup>''</sup> )	$\theta^d$ ( <sup>°</sup> )
04 45 14.181	+19 07 57.26	-133	-14	11.6		
04 45 15.368	+19 07 24.04	-123	-13	10.2		
04 45 08.161	+19 08 09.87	-122	-7	9.9		
04 45 55.960	+19 10 51.73	-82	-13	9.0		
04 45 56.455	+19 09 57.90	-109	2	12.1		
04 45 58.120	+19 10 39.30	-111	-9	9.3		
04 45 42.645	+19 06 19.19	-100	1	10.2	49	354
04 45 42.277	+19 07 07.56	-105	-9	10.4		
04 45 54.263	+18 56 59.35	-89	-21	9.5	63	288
04 45 50.062	+18 57 18.19	-89	-15	11.4		

\* Note that the first two fields contain three stars

### 5. REFERENCES

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