Lick Northern Proper Motion Program: NPM1 Catalog

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Documentation for the Computer-Readable Version

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Abstract

The *NPM1 Catalog* provides absolute proper motions, positions, and photographic photometry, measured in the Lick Northern Proper Motion (NPM) program, for some 149,000 stars with $8 \leq B \leq 18$ covering the sky outside the Milky Way north of declination $-23°$. The rms errors of the NPM absolute proper motions are $\sim 0.5\,''\,\mathrm{cent}^{-1}$. The rms position errors average $\sim 0\farcs15$. The rms errors for the photometry average ~ 0.2 mag in B and ~ 0.15 mag in $B - V$.

1 Introduction and Source Reference

A copy of this document should accompany any further distribution of this file.

1.1 Introduction

The Lick Northern Proper Motion (NPM) program is a mammoth photographic survey of the northern sky, whose goal is to measure absolute proper motions on an inertial system defined by some 50,000 faint galaxies for some 300,000 stars over a blue apparent magnitude range from 8 to 18, covering the northern two thirds of the sky. A full description of the NPM program is given by Klemola, Jones, and Hanson (1987).

The NPM survey is based on photographs taken with the Lick 51 cm (20 in) Carnegie double astrograph. There are 1,246 $6° \times 6°$ fields in the NPM survey (from $+90°$ to $-23°$). First-epoch photography began in 1947; second-epoch photography was completed in 1988. Measurements and reductions for proper motions, positions, and photometry in the sky outside the Milky Way began in 1975 and were completed in 1992.

Included in the NPM program are many stars of astrophysical interest, anonymous stars for galactic studies, and a selection of stars from positional catalogs and from other proper motion surveys. The *NPM Catalog* will serve as a data base for studies of stellar kinematics, galactic rotation, luminosity calibrations, and the correction to precession.

The NPM program falls into two parts: Part I covers the 72% of the northern sky lying outside the Milky Way. Here, faint galaxies define the inertial reference frame for absolute proper motions. Part II covers the remaining 28% of the northern sky – the Milky Way.

Part I of the NPM program has now been completed (Klemola, Hanson, and Jones 1993). The resulting catalog (which is denoted *NPM1 Catalog*) contains some 149,000 stars from measures in 899 of the 1,246 NPM fields. Each NPM field was photographed at two epochs between 1947 and 1988. The mean first and second epochs are 1950 and 1977; the average epoch difference is 27 years. The first-epoch plates were taken in the blue only; both blue and yellow plates were taken at the second epoch. A future catalog (*NPM2*) will cover the 347 NPM Milky Way fields upon completion of Part II of the NPM program.

The Southern Hemisphere counterpart of the NPM program is the Yale Southern Proper Motion (SPM) program (van Altena et al. 1986; Lopez, Lee, and van Altena 1986), which uses a 51 cm double astrograph at El Leoncito, Argentina, to cover the sky south of declination $-17°$. Together, the two programs will provide absolute proper motions over the whole sky.

1.2 Source Reference

Klemola, A.R., Hanson, R.B., and Jones, B.F., 1993, "Lick Northern Proper Motion Program. III: The NPM1 Catalog" *AJ* (in preparation)

2 Structure and Content of the NPM1 Catalog

2.1 File Structure

The Lick *NPM1 Catalog* as distributed here is in a single fixed block file. It contains 148,940 records, each 84 bytes long. The catalog is the concatenation of 114 NPM1 zones, each covering $1°$ of declination. The zones are ordered from north to south ($+89°$ through $+00°$, $-00°$ through $-23°$). As in the AGK3 each star is assigned a running number within its zone, in right ascension order. Multiple measures from overlapping fields have been averaged to give one entry (one record) per star.

This information is sufficient for a user to describe the indigenous characteristics of the machine-readable version of the Lick *NPM1 Catalog* to a computer.

2.2 Content

The *NPM1 Catalog* contains some 94,000 stars chosen anonymously for the NPM astrometric reductions and for statistical studies of stellar motions. These anonymous stars lie chiefly in two distinct magnitude ranges: $11 < B < 13$ (25,000 stars) and $14 < B < 17$ (69,000 stars) and comprise by far the largest subset in the *NPM1 Catalog*.

The *NPM1 Catalog* contains some 28,000 positional reference stars, chiefly in the magnitude range $8 < B < 12$. These stars were used to derive equatorial coordinates from the measurements. For the northern sky ($\delta > -2\overset{\circ}{.}5$) the AGK3 was used. For the southern sky ($\delta < -2\overset{\circ}{.}5$) stars from the SAO catalog were selected, using ACRS data for these stars for better accuracy.

The remaining 27,000 stars in NPM1 are chosen from the *Lick Input Catalog of Special Stars* (ICSS), which includes large numbers of stars of all classes gathered by Klemola from the astronomical literature. Specific classes of stars included in the ICSS are listed in Table II of Klemola et al. (1987).

Bytes	Format	Units	Label	Description
1- 8	A8		name	[]!NPM1 star "name"
1	A1		DE-	Sign of declination for this zone (+ or $-$)
2- 3	I2	deg	DEd	[0,89] Declination zone
4- 8	F5.4		znum	Running number in this declination zone
10-11	I2	hour	RAh	[0,24[Right Ascension(B1950) Hours
13-14	I2	min	RAm	[0,60[Right Ascension(B1950) Minutes
16-21	F6.3	s	RAs	[0,60[Right Ascension(B1950) Seconds
23	A1		DE-	[+-] Sign of declination for this star (+ or $-$)
24-25	I2	deg	DEd	[0,89] Declination (B1950) Degrees
27-28	I2	arcmin	DEm	[0,60[Declination (B1950) Arc minutes
30-31	I2	arcsec	DEs	[0,60[Declination (B1950) Arc seconds
35-42	F8.2	arcsec/hyr	pmRA	Absolute proper motion R.A. (in "/century)
43-50	F8.2	arcsec/hyr	pmDE	Absolute proper motion Declination
51-56	F6.2	mag	B	B magnitude from photographic photometry
57-62	F6.2	mag	B_V	$B - V$ color from photographic photometry (= -9.99 if no data)
63-68	F6.2		epoch	Original mean epoch of position (-1900)
69-70	I2		iclass	[1,7] Code for class of star = SUM of 1 if anonymous star (faint or bright) +2 if catalog star (AGK3 or SAO) +4 if other star (*Lick Input Catalog*)
71-72	I2		nfields	Number of NPM fields on which star was measured
74	I1		ips	Discrepancy flag Position (see Table 2)
75	I1		ipm	Discrepancy flag Proper motion (see Table 2)
76	I1		ibv	Discrepancy flag Photometry (see Table 2)
77-83	I7		icatno	AGK3 identification for zones +89 to -01 SAO identification for zones -02 to -23
84	A1		agksgn	AGK catalog identification blank if AGK zone = NPM zone + if AGK zone = NPM zone + 1 $-$ if AGK zone = NPM zone $-$ 1

Table 1: Byte-per-byte description of file: NPM1.dat

Each star's entry begins with its NPM1 "name," containing the NPM1 declination zone and the star's running number within its zone (e.g., +89.0001). Any star in the catalog can then be specified by prefixing "NPM1" to the "name" (e.g., NPM1+89.0001).

Positions are given for equinox B1950 and computed epoch 1950. Each star's entry includes the absolute proper motion ($''$ cent^{-1}) and blue magnitude ($\sim B$). For 97% of the stars the color ($\sim B-V$) is also given. Other data given for each star are the original mean epoch; a stellar class code; the number of NPM fields measured; and discrepancy flags for position, proper motion, and photometry. Finally, as an additional identification the AGK3 (north) or SAO (south) number (if any) is given.

The rms errors of the NPM absolute proper motions are about 0.5 $''$ cent^{-1} in each coordinate. The rms position errors at the catalog epoch 1950 average about $0\overset{''}{.}15$ in each coordinate for declinations from $0°$ to $+70°$. North of $+70°$ and south of the Equator, the right ascension errors increase to $0\overset{''}{.}20$. The rms errors for the NPM photographic photometry average about 0.2 mag in B and 0.15 mag in $B-V$.

2.3 File Format

Table 1 gives a byte-by-byte description of the contents of the data file.

Flags	Position	Proper Motion	Photometry
0	O.K.	O.K.	O.K.
1	R.A.	R.A.	B
2	Dec.	Dec.	$B-V$
3	Both	Both	Both
9	Error	Error	Error
Limits	$0.5''$	$1.5''$ cent^{-1}	0.5 mag

Table 2: NPM Discrepancy Flags

Table 2 gives a description of the discrepancy flags for proper motion, position, and photometry. (NOTE: Error code [9] may appear in the *NPM Catalog*, as any serious errors are identified. These stars will be retained in the catalog, to preserve the numbering system. However, their data should not be used.)

3 Notes to the Catalog

As of August 1993 there are no Notes to the *NPM1 Catalog.* Detailed documentation and an updated description of the NPM reductions and catalog preparation will be published separately (Klemola, Hanson, and Jones 1993). Klemola is collating the full set of cross-identifications for the *NPM1 catalog.* The complete cross-identifications will be sent to the ADC as a separate file. Also, the list of 50,000 NPM1 reference galaxies has been made available as catalog 1200 from the ADC.

4 Acknowledgments

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5 References

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Klemola, A. R., Hanson, R. B., and Jones, B. F. 1993, AJ (in preparation)

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van Altena, W. F., Girard, T., Lopez, C. E., Klemola, A. R., Jones, B. F., and Hanson, R. B. 1986, Highlights Astron. 6, 89