Extragalactic Cepheid database

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We present in this paper an exhaustive compilation of all published data of extragalactic Cepheids. We have checked every light curve in order to characterize the different types of Cepheid and detect potential overtone pulsators, or to estimate the quality of the data. This compilation of about 3000 photometric measurements will constitute a very useful tool for astronomers involved for instance in the extragalactic distance scale.

Key words: Database - Cepheids: extragalactic

1. Introduction

It is well known that Cepheid pulsating stars constitute, through the Period-Luminosity (PL) relation, the one primary calibrator for extragalactic distance scale. Photometric data of extragalactic Cepheids are then the raw material of its calibration, and, thus, it is of greater importance to have as much data as possible.

With the aim of computing new distances based on our direct calibration of the PL relation (Lanoix et al. 1999a) while taking into account the PL relation incompleteness bias (Lanoix et al. 1999b) first, and subsequently calibrating secondary distance calibrators such as Tully-Fisher relation, luminosity peak brightness of SNe Ia (Lanoix 1998) or Faber-Jackson relation for globular clusters (Di Nella-Courtois et al. 1999), we have looked for photometric data of extragalactic Cepheids. We found that Madore published in 1985 a compilation of all data available at this time. However, this compilation actually put data from 10 galaxies together, and to our knowledge, no updated version of this paper exists, whereas data from more than 30 galaxies is now available.

We have therefore updated this compilation for our own work while putting quality flags to every light curve, and have now decided to put this useful tool at the astronomical community’s disposal.

2. Data

We collect 3031 photometric measurements of 1061 Cepheids located in 33 galaxies (without including SMC and LMC). Table 1 gives the complete list and the main characteristic of those galaxies according to the LEDA database [http://www-obs.univ-lyon1.fr/leda/home_leda.html]. Our bibliography is as exhaustive as possible, and is complete until November 1998, while new publications are still arriving.

One can note that some old photographic data has been rejected. For instance, concerning NGC 224 (M31), we exclude data from Gaposchkin (1962) and Baade & Swope (1963, 1964) from our base. Moreover, we also exclude measurements of that galaxy taken in very crowded fields, such as part of Welch et al. (1986) ones. However finding charts or light curves may be found in these papers.

Actually, the compilation can be divided into two subclasses: ground based data and Hubble Space Telescope (HST) data. The first class appears very heterogeneous in many aspects (methods, limit magnitudes, bandpasses, time coverage, quality) since it’s made of observations from many different telescopes. Moreover almost all those Cepheids were observed during a single observation campaign too, so that they cannot be compared to any other campaign. On the other hand, the spatial observations of the HST are highly homogeneous and are composed of Cepheids from 17 galaxies at present. However, concerning papers from the HST Key Project group (see Freedman et al. 1994), we have chosen to keep only data from ALLFRAME software package, while two sets of photometry may be available. We have checked every light curve (except for NGC 3368, NGC 4725 and NGC 224) in order to allocate a flag to them, and then to characterize the type of the corresponding Cepheid, or to give an idea of the reliability of its photometry. Table 2 describes the signification of the different flags we use.
Table 1: List of the 33 galaxies of the database

| Name       | PGC/LEDA number | RA 2000 | DEC 2000 | Morph. type | Lum. class code | Total B-magnitude | HST |
|------------|-----------------|---------|----------|-------------|-----------------|-------------------|-----|
| DDO 155    | PGC 44491       | 12.97777| 14.21618 | Irr         | 9.000           | 14.715            | n   |
| DDO 216    | PGC 71538       | 23.47614| 14.74660 | Irr         | 9.000           | 12.789            | n   |
| DDO 50     | PGC 23324       | 8.31831 | 70.71419 | Irr         | 8.279           | 11.092            | n   |
| DDO 69     | PGC 28868       | 9.98995 | 30.74495 | Irr         | 9.000           | 12.956            | n   |
| IC 10      | PGC 01305       | .34016  | 59.29171 | Irr         | 9.000           | 12.197            | n   |
| IC 1613    | PGC 03844       | 1.08172 | 2.13330  | Irr         | 9.230           | 9.933             | n   |
| IC 4182    | PGC 45314       | 13.09704| 37.60582 | Sm          | 8.338           | 12.409            | y   |
| NGC 1365   | PGC 13179       | 3.56016 | -36.13807| SBb         | 1.371           | 10.350            | n   |
| NGC 2090   | PGC 17819       | 5.78309 | -34.25145| Sb          | 3.931           | 11.767            | y   |
| NGC 224    | PGC 02557       | .71232  | 41.26897 | Sb          | 2.000           | 4.170             | n   |
| NGC 2366   | PGC 21102       | 7.48175 | 69.21442 | Irr         | 8.722           | 11.430            | n   |
| NGC 2403   | PGC 21396       | 7.61513 | 65.59957 | SBc         | 5.000           | 8.824             | n   |
| NGC 2541   | PGC 23110       | 8.24451 | 49.06227 | SBc         | 6.696           | 12.043            | y   |
| NGC 300    | PGC 03238       | .91493  | -37.68250| Scd         | 5.969           | 8.785             | n   |
| NGC 3031   | PGC 28630       | 9.92507 | 69.06665 | Sb          | 2.000           | 7.687             | y   |
| NGC 3109   | PGC 29128       | 10.05185| -26.15890| SBm         | 7.924           | 10.347            | n   |
| NGC 3351   | PGC 32007       | 10.73278| 11.70408 | SBb         | 3.000           | 10.382            | y   |
| NGC 3368   | PGC 32192       | 10.77922| 11.82098 | SBab        | 3.000           | 9.916             | y   |
| NGC 3621   | PGC 34554       | 11.30466| -32.81352| SBcd        | 5.849           | 10.077            | y   |
| NGC 4321   | PGC 40153       | 12.38200| 15.82293 | SBbc        | 1.000           | 9.992             | y   |
| NGC 4441   | PGC 40692       | 12.44097| 31.22479 | Sc          | 3.576           | 10.923            | y   |
| NGC 4496A  | PGC 41471       | 12.52771| 3.93111  | SBd         | 5.600           | 12.116            | y   |
| NGC 4536   | PGC 41823       | 12.57414| 2.18848  | SBbc        | 2.824           | 11.012            | y   |
| NGC 4725   | PGC 43451       | 12.84079| 25.50030 | SBab        | 1.689           | 9.955             | y   |
| NGC 5253   | PGC 48334       | 13.66551| -31.64477| S?          | /               | 10.765            | y   |
| NGC 5457   | PGC 50063       | 14.05356| 54.35075 | SBc         | 1.000           | 8.197             | y   |
| NGC 598    | PGC 05818       | 1.56414 | 30.66017 | Sc          | 4.000           | 6.193             | n   |
| NGC 6822   | PGC 63616       | 19.74940| -14.80306| Irr         | 8.493           | 9.322             | n   |
| NGC 7331   | PGC 69327       | 22.61809| 34.41949 | Sbc         | 2.000           | 10.165            | y   |
| NGC 925    | PGC 09332       | 2.45467 | 33.57817 | SBcd        | 4.000           | 10.583            | y   |
| SEXTANS A  | PGC 29653       | 10.18369| -4.71346 | Irr         | 9.704           | 11.745            | n   |
| SEXTANS B  | PGC 28913       | 9.99996 | 5.33256  | Irr         | 8.117           | 11.834            | n   |
| WLM        | PGC 00143       | .93246  | -15.45032| Irr         | 8.258           | 11.113            | n   |

The ground-based measurements are divided up among 11 different bandpasses, from B (440 nm) to K (2200 nm), whereas HST observed only in V and I bands. Table 2 gives the relation between notations and wavelengths.

Our base contains several types of magnitude corresponding to the calculation method that is described in table 4. In some cases the sign “:” may follow magnitudes or periods: it means that these magnitudes are doubtful and that these periods are just estimates or lower bounds of the real values (according to the original authors).

The reference codes and the corresponding authors are given in table 5. They can allow the interested reader to look at the finding charts as well as the light curves.

Finally, the Cepheid names are those chosen by the authors, except in the case of several stars in NGC 224 (Freedman & Madore 1990, field IV) and NGC 3368 (Tanvir 1995), where we obtain data right from their figures and called them FRE -- and TAN --, respectively.

3. Table structure

Data is presented as a table of more than 5000 lines according to the structure described below for each Cepheid:

- First line: Host galaxy, Cepheid name, number of following data lines for that Cepheid
- Second line: pointer = 1, logarithm of the period in days, light curve flag
- Next lines: pointer = 2, magnitude, type, band, reference

This database is available as an ASCII table on request by sending an e-mail to Lanoix@obs.univ-lyon1.fr.
Extragalactic Cepheid database

Table 2: Bandpasses

| Band | \( \lambda_{\text{eff}} \) | Band | \( \lambda_{\text{eff}} \) |
|------|----------------|------|----------------|
| B    | 440            | IV   | 1050           |
| V    | 550            | J    | 1250           |
| r    | 650            | H    | 1650           |
| R    | 700            | K    | 2200           |
| i    | 820            | g    | 500            |
| I    | 900            |      |                |

Table 3: Description of light curves flags

| Flag | Light curve description |
|------|-------------------------|
| N    | Normal                  |
| S    | Symmetrical (but high amplitude) |
| B    | Bumpy                   |
| B+   | Scattered or very bumpy |
| O    | Overtone                |
| O-   | Low amplitude (but asymmetrical or with high period) |
| P    | Peculiar                |
| /    | No curve                |

Table 6: Extract of the ASCII file for the Cepheid V1 of galaxy IC1613.

----------------------------------------
IC1613 V1 9
1 .748 N
2 21.36 mea B Fr88a
2 20.79 mea V Fr88a
2 20.36 mea R Fr88a
2 20.14 mea I Fr88a
2 20.50 max B Sa88a
2 22.03 min B Sa88a
2 21.27 ave B Sa88a
2 21.39 mea B Sa88a
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Table 4: Magnitudes description

| Flag | Description                        |
|------|------------------------------------|
| mea  | Intensity averaged (based on curve area) |
| max  | Maximum                            |
| min  | Minimum                            |
| ave  | Average of minimum and maximum     |
| /    | Single measurement                 |

Table 5: References

| Reference code | Corresponding authors | Reference code | Corresponding authors |
|----------------|-----------------------|----------------|-----------------------|
| Ala83          | Mc Alary et al. 1983  | Mad87          | Madore et al. 1987    |
| Ala84          | Mc Alary et al. 1984  | McA84          | Mc Alary & Madore 1984|
| Aly95          | Alves & Cook 1995     | Mou87          | Mould 1987            |
| Car90          | Carlson & Sandage 1990| Mus98          | Musella et al. 1997   |
| Cap92          | Capaccioli et al. 1992| Pio94          | Piotto et al. 1994    |
| Chr87          | Christian & Schommer 1987| Phe98      | Phelps et al. 1998    |
| Coo86          | Cook & Aaronson 1986  | Raw97          | Rawson et al. 1997    |
| Fer96          | Ferrarese et al. 1996 | Sah94          | Saha et al. 1994      |
| Fer98          | Ferrarese et al. 1998 | Sah95          | Saha et al. 1995      |
| Fr88a          | Freedman 1988         | Sa85a          | Sandage & Carlson 1985a|
| Fr88b          | Freedman & Madore 1988| Sa85b          | Sandage & Carlson 1985b|
| Fre90          | Freedman & Madore 1990| Sa88a          | Sandage 1988          |
| Fre91          | Freedman et al. 1991  | Sa88b          | Sandage & Carlson 1988|
| Fre92          | Freedman et al. 1992  | Sh96a          | Saha et al. 1996a     |
| Fre94          | Freedman et al. 1994  | Sh96b          | Saha et al. 1996b     |
| Gal96          | Gallart et al. 1996   | Sh96c          | Saha et al. 1996c     |
| Gib98          | Gibson et al. 1998    | Sii96          | Silbermann et al. 1996|
| Gra97          | Graham et al. 1997    | Sii98          | Silbermann et al. 1998|
| Hoe90          | Hoessel et al. 1990   | Tam68          | Tanman & Sandage 1968 |
| Hoe94          | Hoessel et al. 1994   | Tan95          | Tanvir et al. 1995    |
| Hoe98          | Hoessel et al. 1998   | To95a          | Tolstoy et al. 1995a  |
| Hug98          | Hughes et al. 1998    | To95b          | Tolstoy et al. 1995b  |
| Kay67          | Kayser 1967           | Tur98          | Turner et al. 1998    |
| Ke96           | Kelson et al. 1996    | Vis89          | Visvanathan 1989      |
| Kin87          | Kinman et al. 1987    | Wa88           | Walker 1988           |
| Mad85          | Madore et al. 1985    | Wel86          | Welch et al. 1986     |

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