Graphics

From Observation to Publication

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Abstract

This article describes the use of TEX in publishing observations of variable stars observed by Dutch amateur-astronomers. The observations are published in the journal "Variabilia" and in the so-called Reports. In the latter the observations, collected in several years, are published and submitted to the professional astronomer. It includes tables and light-curves: plots of the changing magnitudes of stars versus time. In creating the light-curves, PICTEX is used. In preparing the files for PICTEX, simple TEX-coding is used for manipulating the data.

1 The Data

Each observation is characterized by the observed star, a date, the brightness of the star and a code representing the observer. To avoid calender problems the so-called Julian Date is used. For example the Julian Date of 1961, September 9, my date of birth, is equal to 2437552 .

Each observation is TEX-coded as follows:

```
\obs #1.#2.#3.#4.#5.
```

#1 is the whole part (i.e. integer part) of the Julian Date, #2 its fractional part. #3 is the integer part of the magnitude, #4 its fractional part, and #5 is the observer-code. (The last is not used for plotting.) TEX can calculate with integers so the observing date and magnitude (the apparent brightness of a star) are transformed to integers. In the case of date, simply the integer part of the Julian Date is used. The magnitude is expressed in units of 0.1 so the magnitude is $10 \times$ #3 + #4.

For each star we have a number of observations. The file of observations processed by plain-TEX produces a file suitable for PICTEX. This .plt file contains all the necessary information for a plot: the axes are properly scaled and labeled and contain information about the star. See the example on page 125. Figure 1 shows a typical file ready for TEX.

The macros used to create the .plt file are given below. Part II neglects the fraction of the Julian Date and calculates the magnitude, in units of 0.1. Both are written to a temporary file with the extension .obs. In part II also the minimum and maximum values along the axis are estimated. These values are used in Part III to calculate the proper sizes of the graph. In Part III the final .plt file is created for processing by PICTEX.

```
\input plot.tex
\harvard{000451}
\head{SS Cas}
\type{Mira  HIP}
\obs 47537.4.10.0.CMG.
\obs 47539.4.9.7.FJH.
\obs 47544.3.10.2.CMG.
\obs 47544.3.10.4.BMU.
\obs 47549.4.10.5.BMU.
\obs 47550.4.10.3.CMG.
\obs 47554.4.10.5.NWL.
\obs 47565.3.11.3.CMG.
\obs 47565.3.11.4.BMU.
\obs 47567.3.11.5.FJH.
\obs 47569.3.11.7.BMU.
\obs 47573.3.11.7.CMG.
\obs 47574.4.12.0.BMU.
\obs 47578.3.12.1.CMG.
\obs 47579.3.11.8.FJH.
\obs 47579.3.12.1.BMU.
\obs 47586.4.12.3.BMU.
\obs 47592.3.12.6.CMG.
\obs 47594.3.12.5.FJH.
\endhead
\bye
```

Figure 1: An input-file for TEX to create a file ready for PICTEX.

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%  PART I plot.tex      %%
%%%%%%%%%%%%%%%%%%%%%%%%%%%
\newcount\tempx     \newcount\tempy
\newcount\tempz     \newcount\maxx
\newcount\minx      \newcount\miny
\newcount\maxy      \newcount\numobs
\newwrite\plotfile \newwrite\obsfile
\def\head#1{
 \global\def\plotname{\sternum\ #1}
 \initplot}
\def\endhead{\immediate\closeout\obsfile
 \startplot}
\def\harvard#1{\global\def\sternum{#1}}
\def\type#1{\global\def\typename{#1}}
\def\initplot{
 \immediate\openout\obsfile=\jobname.obs
 \global\minx=99999
 \global\maxx=0
 \global\miny=99999
```

```
 \global\maxy=0
 \global\numobs=0}
\def\pplot#1#2{\tempx=#1
 \tempy=\maxy
 \tempz=#2
 \advance\tempy by-\tempz
 \advance\tempx by-\minx
 \immediate\write\plotfile{\noexpand
  \put {$\noexpand\bullet$} at
   {\the\tempx} {\the\tempy}}}
%%%%%%%%%%%%%%%%%%%%%%%%%%
%%  PART II              %%
%%%%%%%%%%%%%%%%%%%%%%%%%%
\def\obs #1.#2.#3.#4.#5.{
 \message{#5}
 \global\advance\numobs by 1
 \tempx=#1
% estimate min max x
 \ifnum\minx>\tempx \global\minx=\tempx \fi
 \ifnum\maxx<\tempx \global\maxx=\tempx \fi
 \tempy=#3
 \tempz=#4
% calculating magnitude
 \multiply\tempy by 10
 \advance\tempy by\tempz
% estimate min max y
 \ifnum\miny>\tempy \global\miny=\tempy \fi
 \ifnum\maxy<\tempy \global\maxy=\tempy \fi
 \immediate\write\obsfile{\noexpand
  \pplot{\the\tempx}{\the\tempy}}}
%%%%%%%%%%%%%%%%%%%%%%%%%%
%%  PART III             %%
%%%%%%%%%%%%%%%%%%%%%%%%%%
\def\startplot{
% create nice numbers along axis
 \global\divide\minx by 10
 \global\multiply\minx by 10
 \global\divide\maxx by 10
 \global\multiply\maxx by 10
 \global\advance\maxx by 10
 \global\divide\miny by 10
 \global\multiply\miny by 10
 \global\divide\maxy by 10
 \global\multiply\maxy by 10
 \global\advance\maxy by 10
 \global\advance\maxx by-\minx
 \ifnum\numobs>15
% writing pictex commands
  \def\name{\sternum.plt}
  \immediate\openout\plotfile=\name
  \message{\name}
  \immediate\write\plotfile{\noexpand
   \beginpicture}
  \immediate\write\plotfile{\noexpand
   \setcoordinatesystem units <0.35mm,1mm> }
  \tempz=\maxy
  \advance\tempz by-\miny
  \immediate\write\plotfile{\noexpand
   \setplotarea x from 0 to {\the\maxx},
    y from 0 to {\the\tempz}}
  \immediate\write\plotfile{\noexpand
   \plotheading{\plotname\ \typename}}
  \immediate\write\plotfile{\noexpand
   \axis bottom label {JD-{\the\minx}}}
  \immediate\write\plotfile{ticks
   numbered from 0 to {\the\maxx} by 40 / }
  \immediate\write\plotfile{\noexpand
   \axis left label {} }
  \immediate\write\plotfile{ticks
   from 0 to {\the\tempz} by 10 / }
  \tempx=\miny
  \advance\tempx by-10
  \tempz=\maxy
  \loop\ifnum\tempz>\tempx
        \tempy=\maxy
        \advance\tempy by-\tempz
        \immediate\write\plotfile{\noexpand
         \put {\the\tempz} at
          -15 {\the\tempy}}
        \advance\tempz by-10
  \repeat
% find out where to put text
% along y-axis.
  \tempz=\maxy
  \advance\tempz by-\miny
  \divide\tempz by2
  \tempx=\tempz
  \divide\tempx by10
  \tempy=\tempz
  \multiply\tempx by10
  \advance\tempy by-\tempx
  \ifnum\tempy=0
        \advance\tempz by5
  \fi
  \immediate\write\plotfile{\noexpand
   \put {Magn.} at -15 {\the\tempz}}
  \input \jobname.obs
  \immediate\write\plotfile{\noexpand
   \endpicture}
  \immediate\closeout\plotfile
 \fi}
```

2 Macros

In Part I the initialization is done: counters and files are defined. Information about the stars is stored in the tokens `\plotname`, `\sternum` and `\typename`.

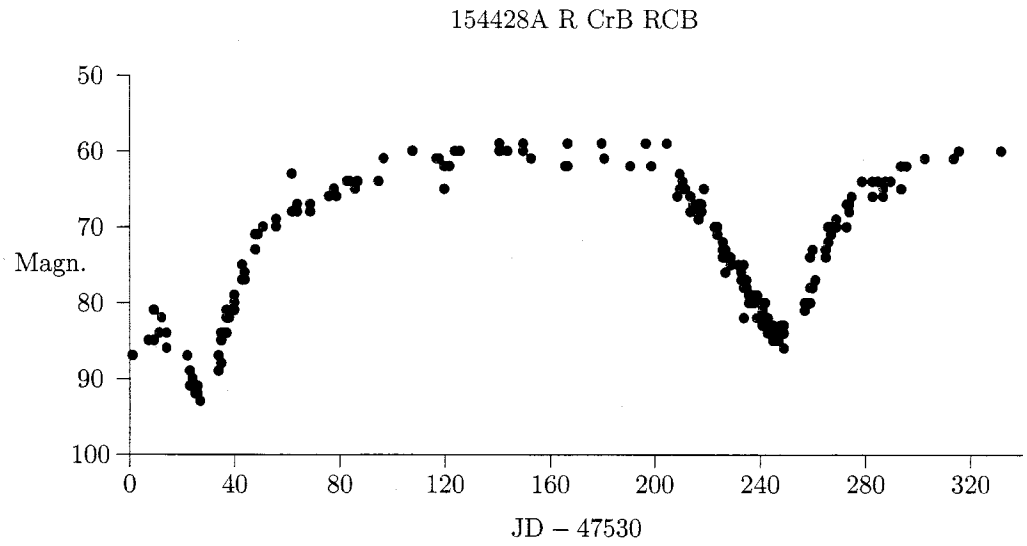

Figure 2: The light-curve of the star R CrB. The decrease in brightness can be seen clearly in this picture. The data are collected by Dutch amateur-astronomers.

Also some initial values for the minimum and maximum values along the axis are set. The macro `\pplot` is used in Part II and executed in Part III. The macro writes the re-scaled X and Y values to the `.plt` file. Again the latter is used with PICTEX to obtain the desired result.

In Part II `\obs` is defined: the magnitude and Julian Date are converted to integers as described above and the maximum and minimum values are estimated according to the simple algorithm:

if $x_i <$ min then min $:= x_i$;

if $x_i >$ max then max $:= x_i$;

Also the number of observations is counted. This number is stored in `\numobs`.

In Part III the final plotting commands are written to the `.plt` file. This part is only executed if the number of observations is bigger than 15. The minima and maxima found in Part II are re-calculated to have nice numbers along the axes. Commands for labels and numbering axes are also written into the file. After setting up the graph the data to be plotted are read from the `.obs` file. This file is created in Part II. Figure 3 shows such a `.plt` file.

```
\beginpicture
\setcoordinatesystem units <0.35mm,1mm>
\setplotarea x from 0 to {340},
 y from 0 to {50}
\plotheading {154428A\ R CrB\ RCB}
\axis bottom label {JD-{47530}}
 ticks numbered from 0 to {340} by 40 /
\axis left label {}
 ticks from 0 to {50} by 10 /
\put {100} at -15 {0}
\put {90} at -15 {10}
\put {80} at -15 {20}
\put {70} at -15 {30}
\put {60} at -15 {40}
\put {50} at -15 {50}
\put {Magn.} at -15 {25}
\put {$\bullet $} at {1} {13}
\put {$\bullet $} at {7} {15}
.
.
.
\endpicture
```

Figure 3: The start of a typical plot-file as created by Part III.

3 Publishing the Data

All the observations of one year are collected in one file with a structure as in Figure 1. This file contains 6000 to 10.000 lines depending on the weather conditions. The file is processed using `plot.tex` and a number of `.plt` files are created. The same file is used to create a multi-column tabular output of the observations; see the example on the next page. These macros are available on request.

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okt – nov – dec 1991

000451 SS Cas
Mira HIP
560.4 13.0 FJH
572.5 13.3 FJH
594.5 12.5 FJH

000928 UW And
Mira
533.4 11.7 FJH
556.3 12.7 FJH
570.5 13.7 FJH

001046 X And
Mira
532.4 10.9 FJH
551.4 9.9 FJH
572.4 9.1 FJH
596.4 9.1 FJH
611.4 9.8 FJH

001726 T And
Mira
557.4 10.6 FJH
572.4 9.5 FJH
596.4 8.2 FJH
614.4 8.5 FJH

001755 T Cas
Mira HIP
596.4 9.0 FJH
614.4 9.1 FJH

001838 R And
Mira HIP
540.5 9.1 FJH
557.3 9.8 FJH
572.4 10.3 FJH
596.3 10.9 FJH
611.4 11.2 FJH

002725 A TU And
Mira HIP
557.4 11.5 FJH

003162 TY Cas
Mira
576.3 13.5 FJH
594.5 11.5 FJH

003179 Y Cep
Mira
551.4 13.0 FJH
570.5 13.6 FJH
590.6 14.0 FJH

004047 U Cas
Mira
540.4 12.7 FJH
550.4 13.0 FJH
557.3 13.7 FJH
572.5 14.2 FJH
596.3 :15.5 FJH

004132 RW And
Mira
533.5 15.3 FJH
596.3 :15.5 FJH

004435 V And
Mira
557.3 14.1 FJH
569.5 14.5 FJH
596.3 14.8 FJH
615.3 14.3 FJH

004533 RR And
Mira
533.5 15.0 FJH
557.3 13.8 FJH
569.5 12.1 FJH
596.4 10.9 FJH
611.4 9.8 FJH

004746 A RV Cas
Mira
533.5 15.5 FJH
557.3 15.0 FJH
601.5 12.6 FJH
611.4 11.7 FJH

004958 W Cas
Mira HIP
556.6 :10.1 KKP

005840 RX And
UGZ
532.42 14.0 FJH
533.48 13.7 FJH
536.43 14.0 FJH
540.44 11.5 FJH
545.38 12.0 FJH
551.34 13.5 FJH
556.35 13.0 FJH
557.32 13.4 FJH
558.37 13.1 FJH
559.38 13.5 FJH
560.35 13.6 FJH
569.46 12.3 FJH
570.35 11.2 FJH
572.39 11.5 FJH
574.43 11.6 FJH
575.34 11.6 FJH
576.33 12.2 FJH
594.44 13.7 FJH
596.35 13.7 FJH
615.28 13.9 FJH

010621 A X Psc
Mira
536.4 14.5 FJH
558.4 13.9 FJH
570.5 13.5 FJH
596.4 12.9 FJH

010937 FO And
UG
533.47 14.9 FJH
536.45 <15.4 FJH
572.46 14.6 FJH
596.34 <15.4 FJH
615.28 14.2 FJH

010940 U And
Mira
540.5 9.6 FJH
557.4 10.2 FJH
569.5 11.1 FJH
594.4 11.9 FJH
614.4 12.3 FJH

011041 A UZ And
Mira
533.5 15.1 FJH
557.3 14.0 FJH
569.5 13.9 FJH
594.4 13.2 FJH
614.4 12.0 FJH

011055 A VZ Cas
Mira
560.4 10.6 FJH
611.4 11.0 FJH

011208 S Psc
Mira
540.5 11.0 FJH
557.5 11.8 FJH
570.5 12.2 FJH
596.3 12.7 FJH

011712 U Psc
Mira
536.4 14.2 FJH
558.4 14.4 FJH
570.5 13.6 FJH
596.3 12.2 FJH

012020 RX Psc
Mira
536.4 :15.1 FJH
596.3 14.5 FJH

012031 TY Psc
UGSU
594.45 12.1 FJH
596.34 12.4 FJH

012502 R Psc
Mira
536.5 13.8 FJH
559.3 13.9 FJH
570.5 13.9 FJH
596.3 13.1 FJH

012746 SX And
Mira
556.4 10.6 FJH
575.3 11.1 FJH
594.5 11.5 FJH
611.4 12.0 FJH

013050 KT Per
UGZ
536.44 12.4 FJH
540.46 14.4 FJH
556.35 12.2 FJH
557.32 11.9 FJH
558.36 11.8 FJH
559.38 11.8 FJH
560.35 12.0 FJH
572.46 14.4 FJH
575.35 12.4 FJH
576.33 12.4 FJH
590.52 11.9 FJH
601.46 11.9 FJH

013238 RU And
SRa
536.5 12.0 FJH
556.4 11.7 FJH
575.3 11.9 FJH

013338 Y And
Mira
532.4 14.2 FJH
540.5 14.0 FJH
551.3 13.2 FJH
569.5 11.3 FJH
594.5 9.9 FJH
611.4 9.2 FJH

013937 AR And
UGSS
532.42 14.2 FJH
533.47 15.3 FJH
556.36 12.5 FJH
557.32 12.8 FJH
558.36 13.5 FJH
559.39 <15.0 FJH
572.36 12.3 FJH
574.43 12.7 FJH
575.36 14.0 FJH
594.45 11.9 FJH
596.32 12.2 FJH
601.46 12.7 FJH

015254 U Per
Mira HIP
533.4 8.3 KKP
536.4 8.5 JOJ
556.3 8.2 JOJ
556.6 8.7 KKP
601.3 9.1 KKP
601.4 8.4 JOJ

015457 V666 Cas
Mira
556.4 11.2 FJH
576.3 11.2 FJH

015912 S Ari
Mira
533.5 13.8 FJH
558.4 14.5 FJH
570.5 14.6 FJH
596.3 :15.2 FJH

020227 Z Tri
Mira
532.5 14.7 FJH
540.5 14.7 FJH
596.3 13.7 FJH

020356 UV Per
UGSS
613.51 12.6 FJH
614.40 12.7 FJH
615.23 12.7 FJH

020657 A TZ Per
UGZ
532.50 12.9 FJH
536.44 13.8 FJH
540.46 14.3 FJH
551.35 12.8 FJH
557.33 13.9 FJH
558.36 14.2 FJH
559.39 14.2 FJH
560.48 13.7 FJH
570.35 13.5 FJH
572.47 13.8 FJH
575.36 13.7 FJH
590.51 13.6 FJH
596.46 13.6 FJH
601.46 12.7 FJH
615.27 13.4 FJH

021024 R Ari
Mira HIP
540.5 12.5 FJH
551.4 12.4 FJH
575.5 10.5 FJH

021143 A W And
Mira HIP
540.4 13.1 FJH
551.3 12.7 FJH
569.5 12.4 FJH
594.5 11.8 FJH
611.4 10.7 FJH

021281 Z Cep
Mira
536.5 14.1 FJH
551.4 13.5 FJH
570.5 11.9 FJH
581.3 11.6 FJH
590.6 11.8 FJH
613.5 12.3 FJH

0214-0 3 Mira
Mira HIP
536.5 4.0 SAQ
536.6 4.0 BMU
596.3 6.1 SAQ

021558 S Per
SRc HIP
556.4 12.0 FJH
557.3 11.8 HIL
576.3 12.2 FJH
594.5 12.2 FJH

0220-0 0 R Cet
Mira HIP
536.5 9.2 SAQ
601.3 8.3 SAQ

022150 RR Per
Mira
540.5 11.5 FJH
556.4 11.7 FJH
575.4 12.2 FJH
590.5 12.7 FJH

022980 RR Cep
Mira
536.5 14.1 FJH
570.5 13.1 FJH
581.3 12.5 FJH
590.6 11.8 FJH
613.5 11.2 FJH