

Confirmation of 109 objects in the New Suspected Variables Catalogue as red long period variables

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Abstract : Colours are derived from online surveys for suspected variables in the NSV having good positions and a red subset of the resultant data is assessed against the NSVS online time series database

Introduction

The electronic combined Catalogue New Suspected Variables (NSV) archived at the Centre de Données astronomiques de Strasbourg (CDS) (Samus *et al* 2004) is used as a source for gaining positions and colour information from the Second United States Naval Observatory CCD Astrographic Catalogue (Zacharias *et al* 2004). In colour index plots of near optical against near infrared magnitudes the red dwarf and giant stars diverge from the normal sequence apparently due to the effect of TiO absorption bands upon the background blackbody continuum flux normally measured by these passbands (see, for example, Bessell and Brett, 1988, figure 2 and the text). Using this colour information a subset of objects likely to be red long period variables can be selected and assessed against the time series data archived at the Northern Sky Variability Survey, NSVS, (Wozniak *et al* 2004) to test to see if the suspects are variable.

In some cases these objects have been identified via automated cross matching of variables published by ASAS3 (see for example Pojmanski 2003) and where those miss objects in their own survey area, in the Northern Sky Variability Survey's Red Variables (Williams *et al* 2004). However, most of these catalogues are not readily available, rarely being in VizieR, and certainly not in SIMBAD, at the CDS. When they are available (eg the recently launched Variable Star Index or VSX, Watson *et al* 2006) their astrometric accuracy is such that automated cross matching of objects with the NSV, itself prone to astrometric error, can be problematic and incorrect, not only missing matches, but sometimes incorrectly matching the wrong NSV object with an ASAS3 or NSVS variable.

It is in this context that this list is presented, as it provides accurate positions and confirmatory light curves together in a medium that will allow SIMBAD linkage to this information for their NSV identities. Although many have been noted as variable by either ASAS3 or NSVS in the past, albeit independent on any certainty of accurate NSV cross matching in those cases, about forty percent of the following seem previously unconfirmed, being fainter objects than those mostly automated variability surveys normally safely deal with.

Methodology

The NSV electronic file as archived at the CDS ftp holdings was crossed against the UCAC2 catalogue using a small two arc seconds search radius in VizieR. From this data positions, UCAC2 red magnitude (Zacharias *et al* 2004) and 2MASS photometry (Skrutskie *et al*) were taken. The UCAC2 is an astrometric, and not a

photometric , catalogue which can have errors of up to ± 0.3 magnitudes on the global level (Zacharias *et al* 2004), but is adequate for this purpose as the colour index it is to be used for, red-J, has a large range thus diluting problems normally caused by such errors.

The derived data consisting of some 5,050 datapoints was used to generate the colour indices red-J and J-Ks. A colour - colour diagram of the resultant data was generated with red-J versus J-Ks as shown in figure 1. As noted in Bessell and Brett (1988) there is a turnoff point for the red giants, which for these colours is completely covered by $J-K_s > 1$ and $red-J > 3$.

Accordingly those objects were selected as likely to be mostly red long period variables, whilst also as the NSVS archive does not extend too far south in any great depth, a lower limit of 0° Declination was used and objects south of this were further removed leading to a subsample of approximately 500 objects, which reduced to approximately 250 candidates after matching to the NSVS.

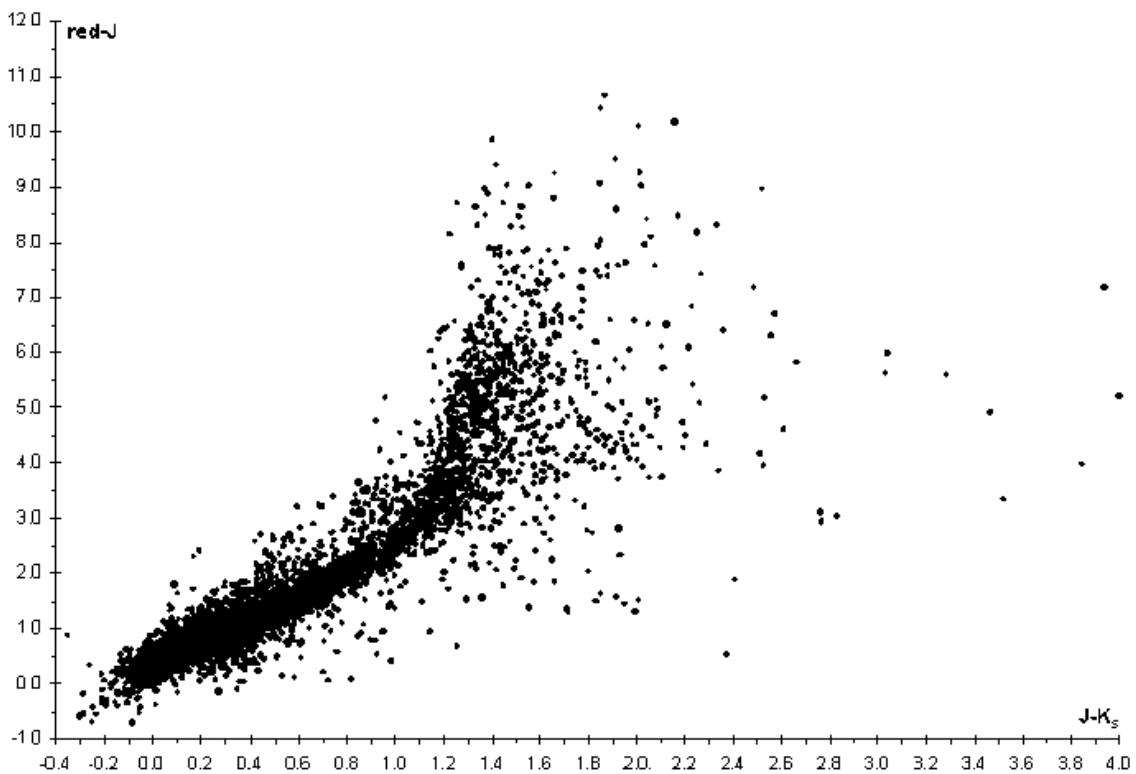


Figure 1 : A plot of the 5050 NSV objects as red-J versus J-Ks

These were then checked, by means of eyeball inspection of graphs derived from data sourced via the NSVS online time series SQL server, in order to assess variability. Any object found to be evidently variable by the inspection of these light curves was thereby confirmed variable. Many were constant, and not a small few were too faint for the NSVS archive to have any data. This resulted in 122 objects, with a further 13 candidates being removed due to being already detected in an earlier paper (Greaves 2006), leaving a total of 109 objects.

Results

On the fly plots of the confirmed objects showing the evidence of their variability where created via perl script. Each object is identified by its NSV number, an accurate J2000 position given, and the plot of the light curve for that object shown, detailing date and NSVS instrumental magnitude (Wozniak *et al* 2004). Vertical bars denote the relative scale of the errors as given by NSVS.

The complete ensemble of an NSV position tallying to good accuracy with the position of an accurate astrometric catalogue, said position itself being able to be used to generate a light curve showing variability for an object at that position (within the confines of NSVS resolution) gives good confidence that the suspected variables are indeed really variable.

One hundred and nine objects are presented here in an appendix immediately following the references. Most of the objects are semiregular variables, with a handful of possible Mira.

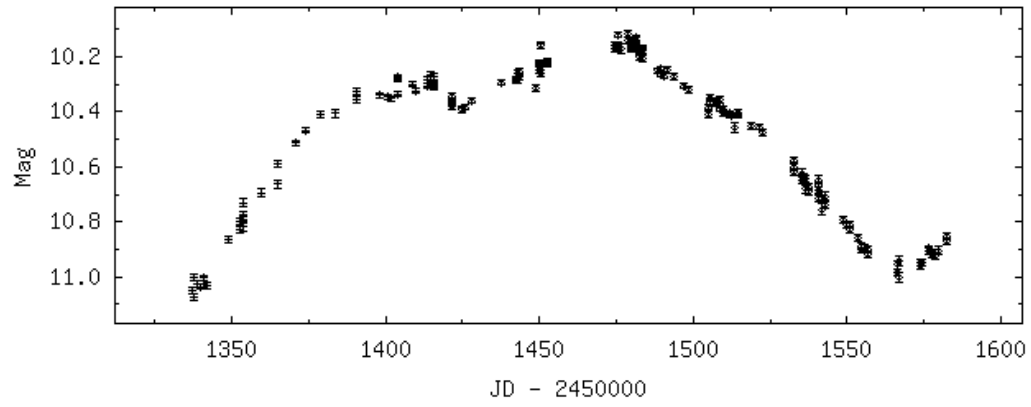
Acknowledgements

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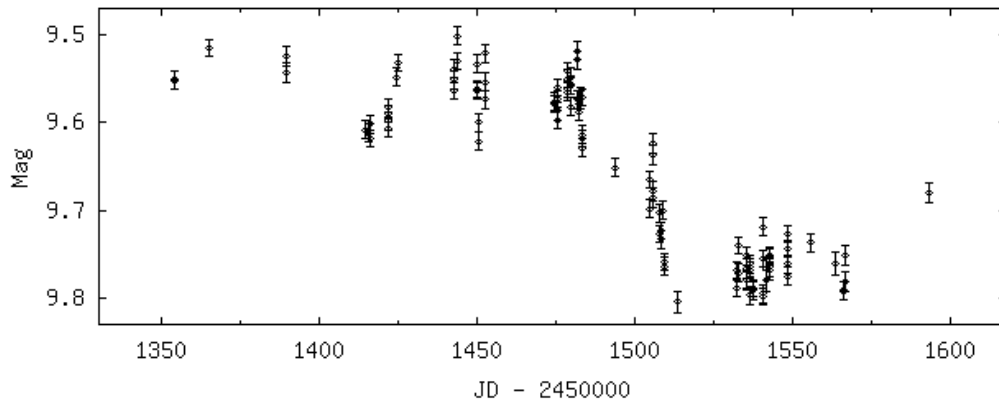
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Zacharias, N., Urban, S. E., Zacharias, M. I., Wycoff, G. L., Hall, D. M., Monet, D. G., Rafferty, T. J., 2004, AJ, 127, 3059

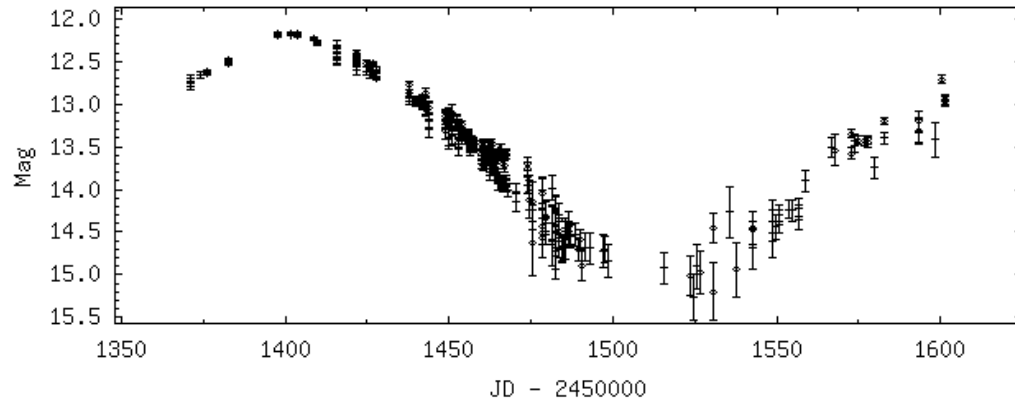
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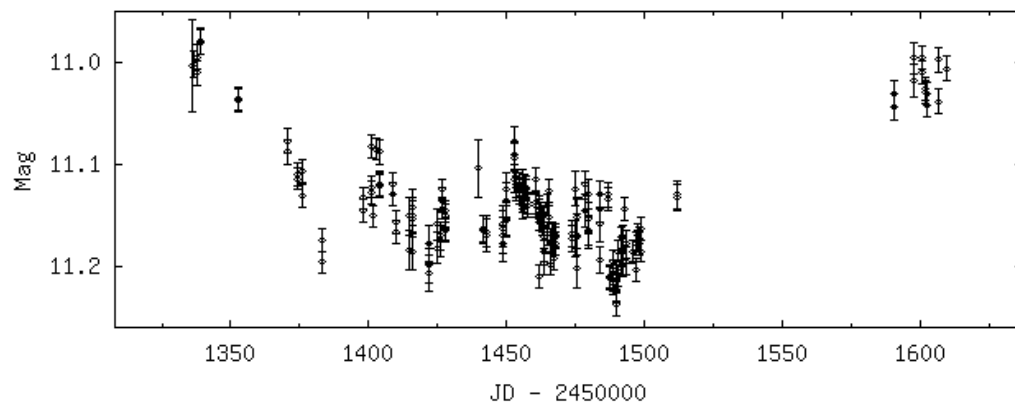
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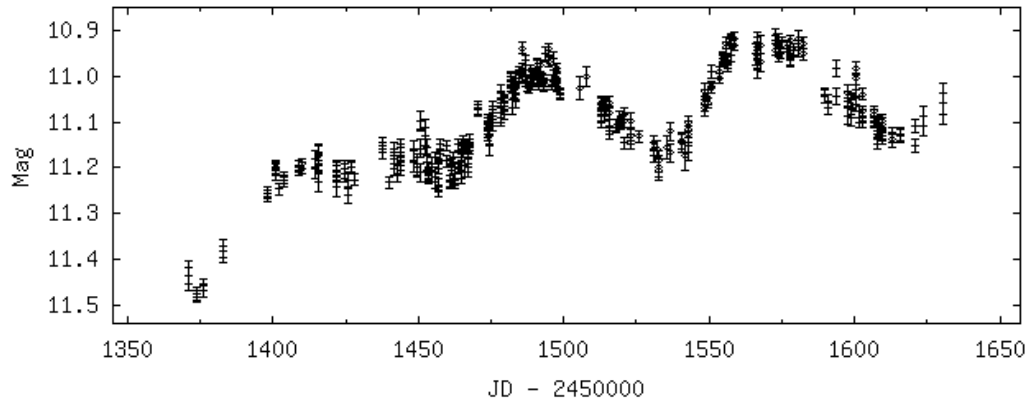
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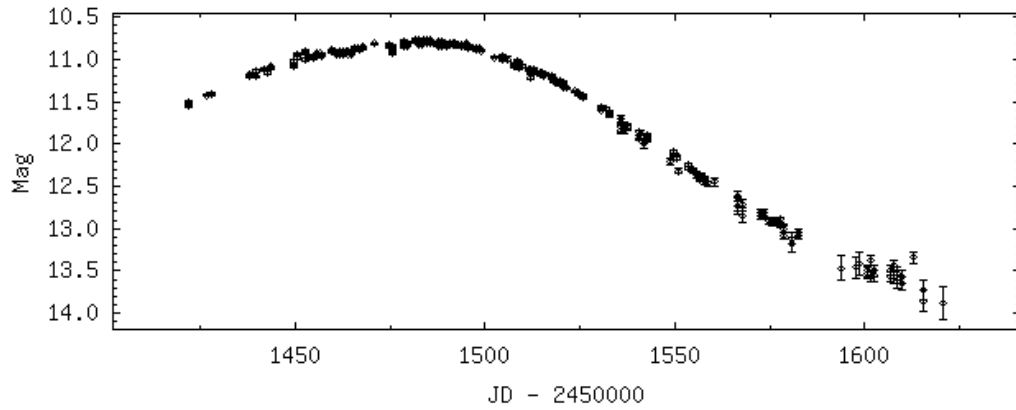
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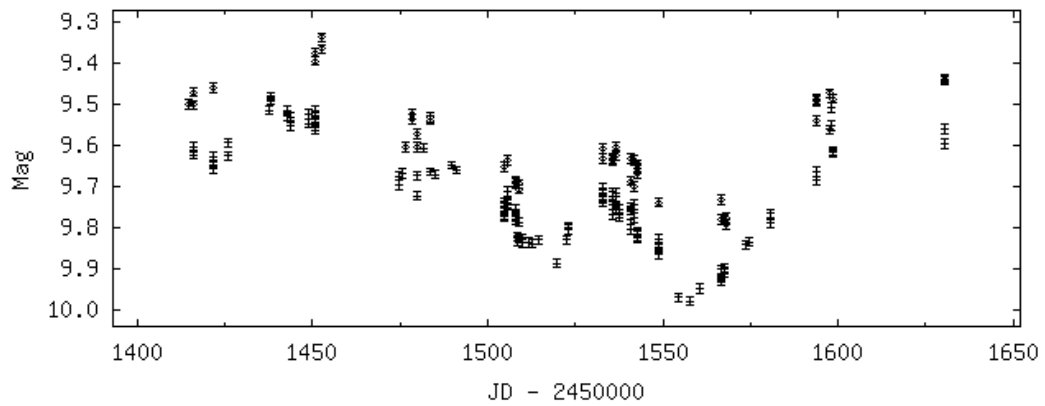
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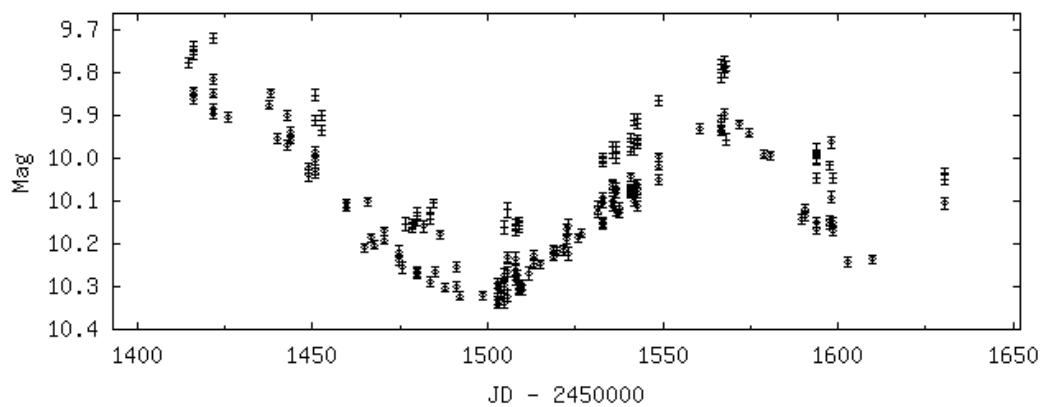
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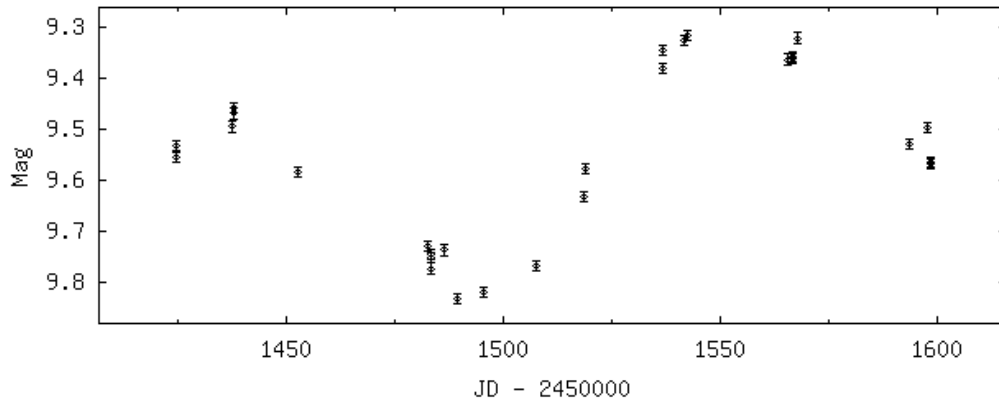
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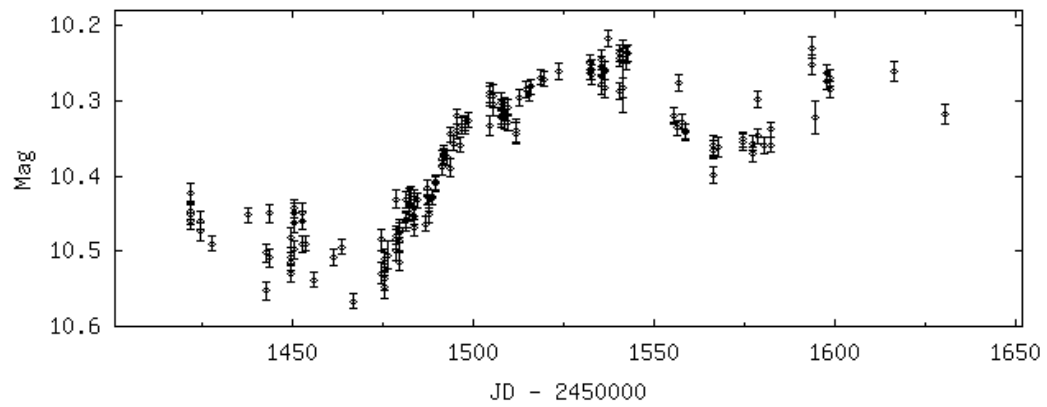
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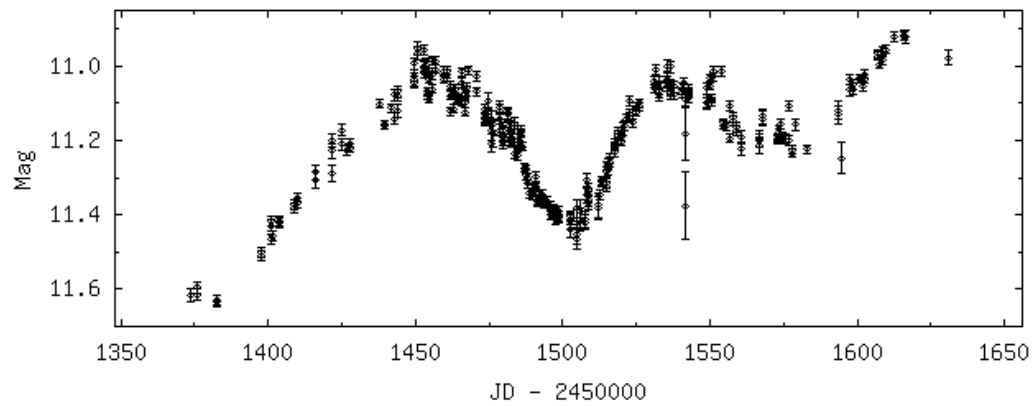
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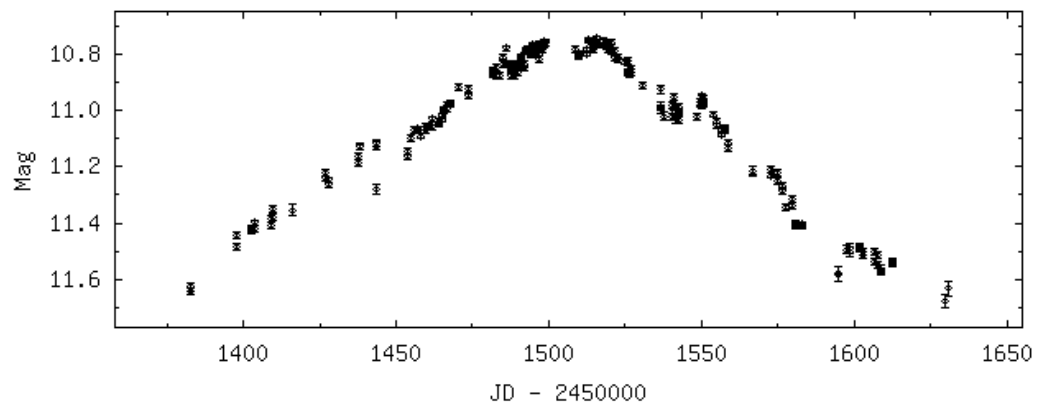
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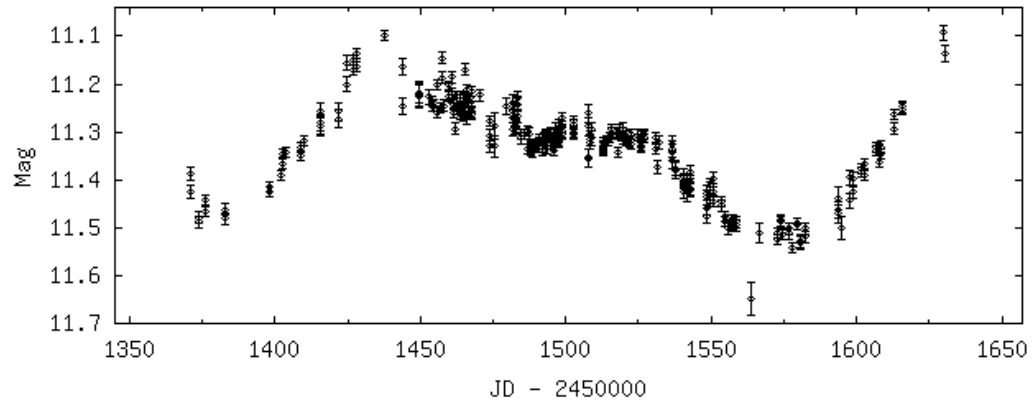
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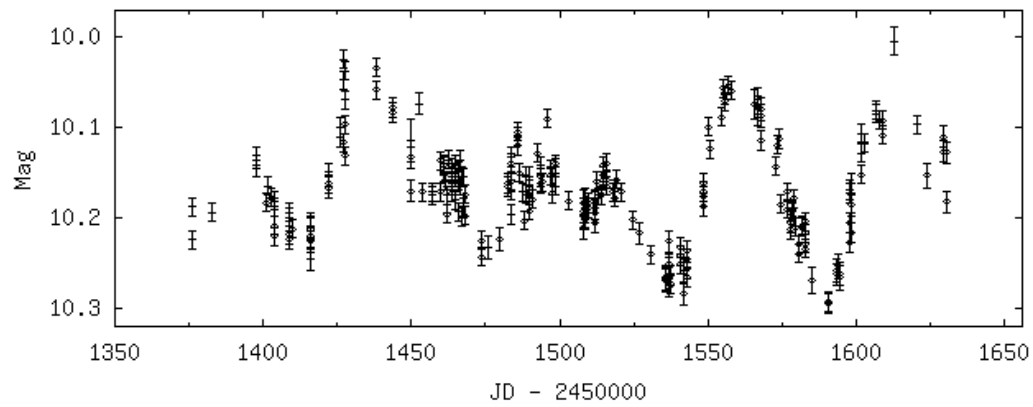
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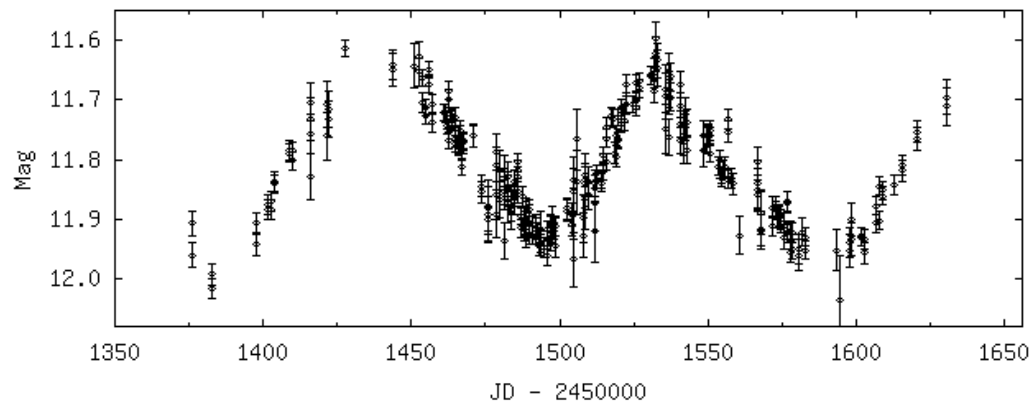
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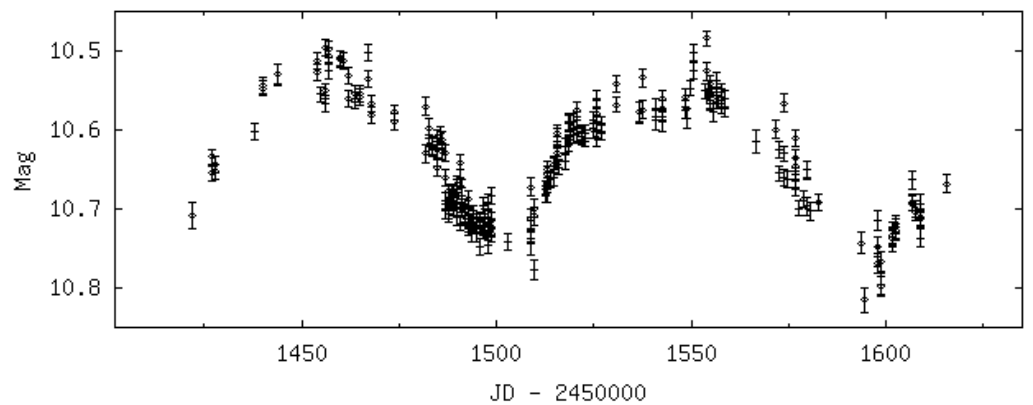
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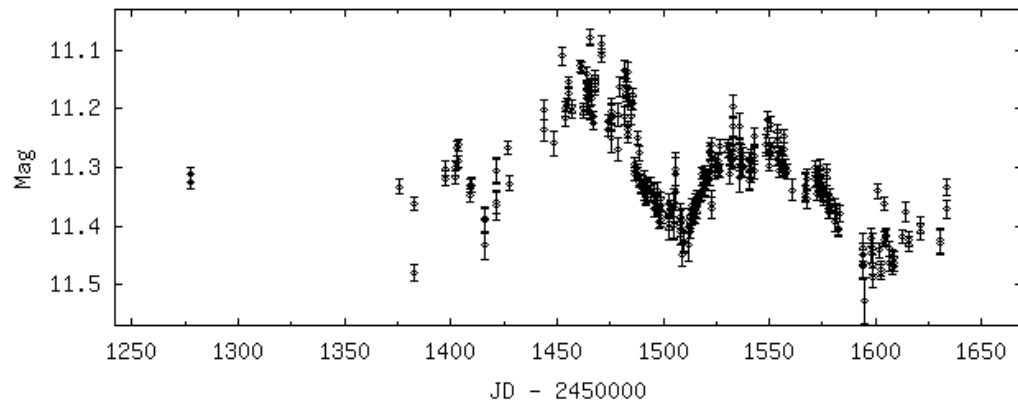
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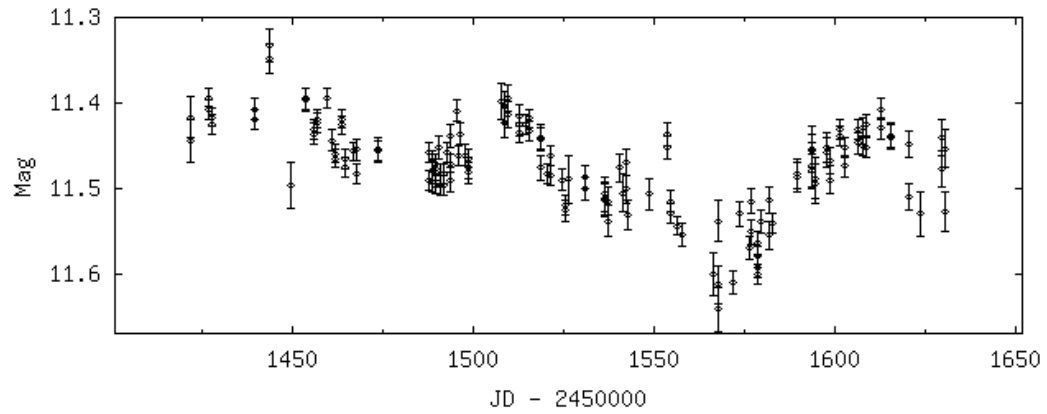
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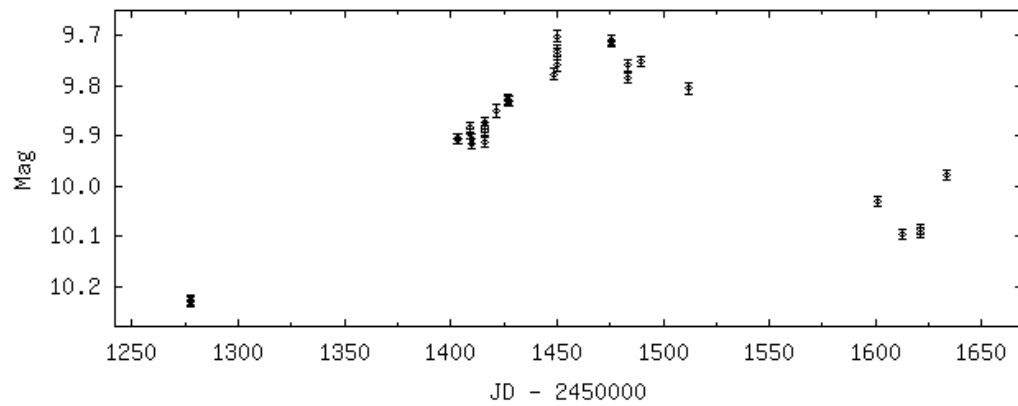
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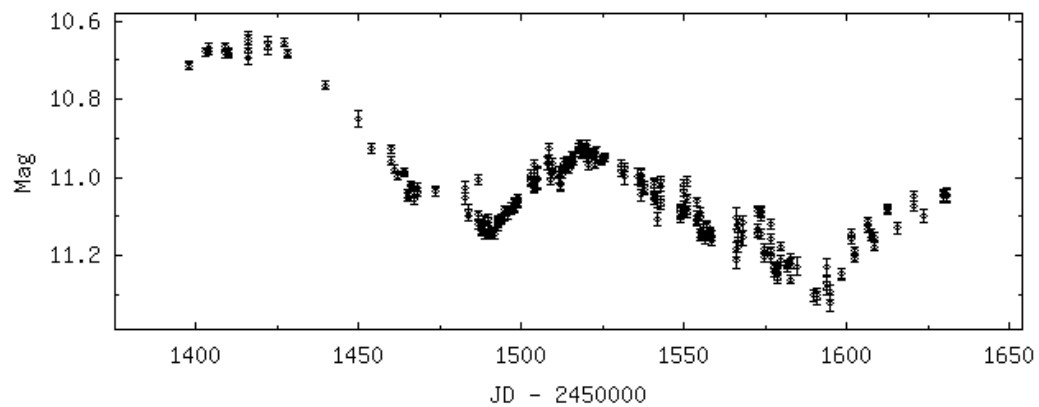
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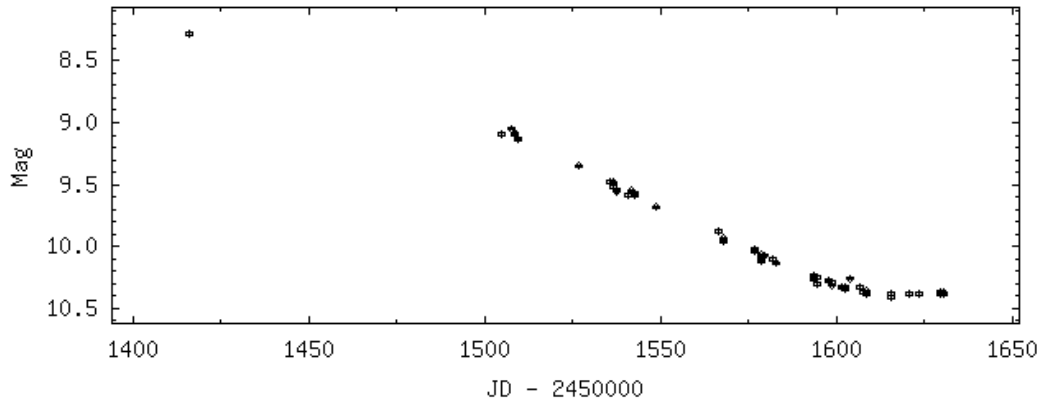
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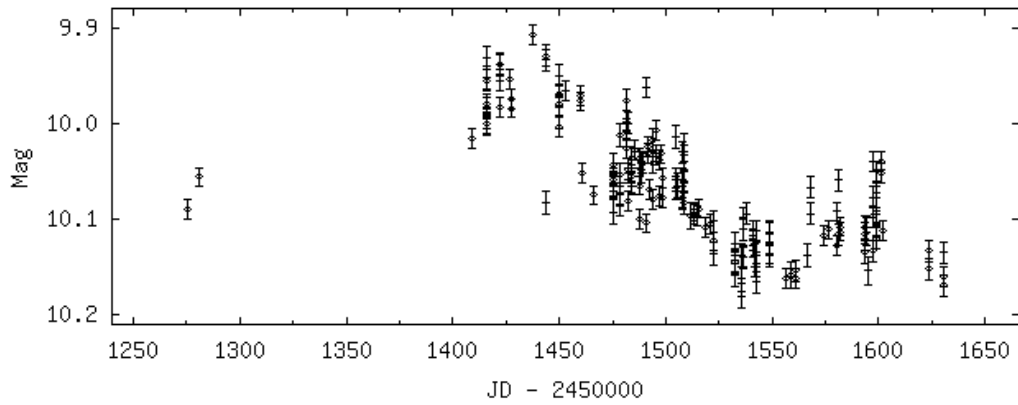
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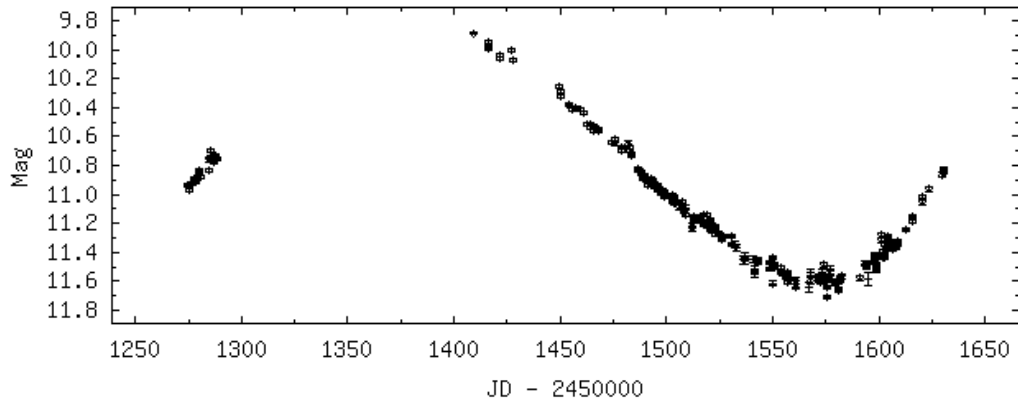
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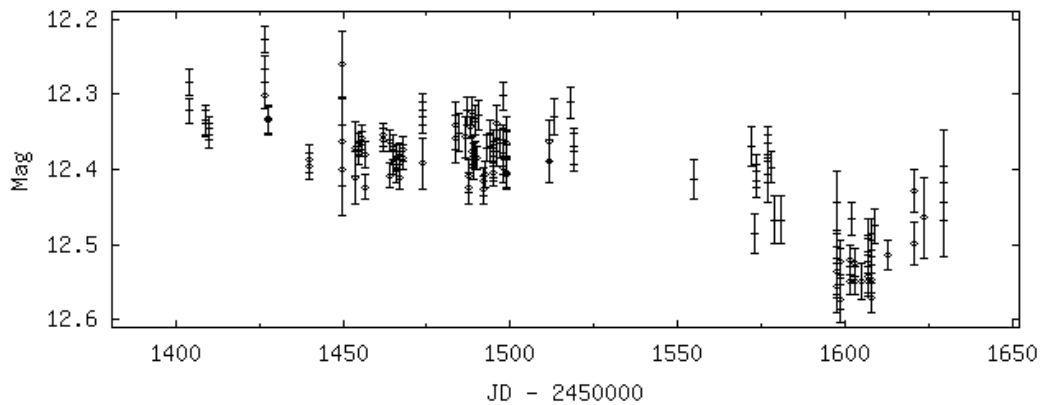
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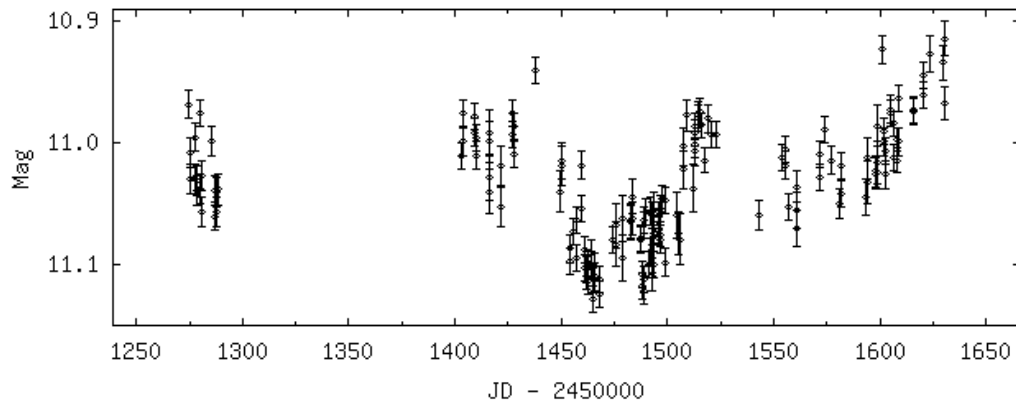
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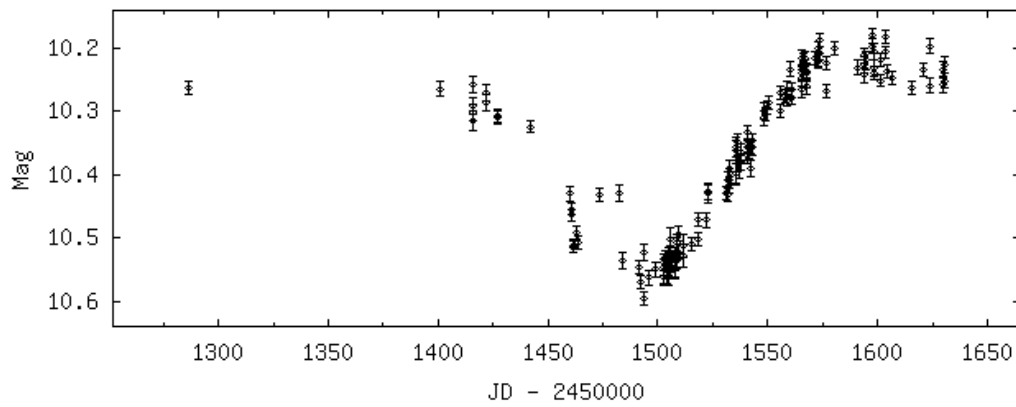
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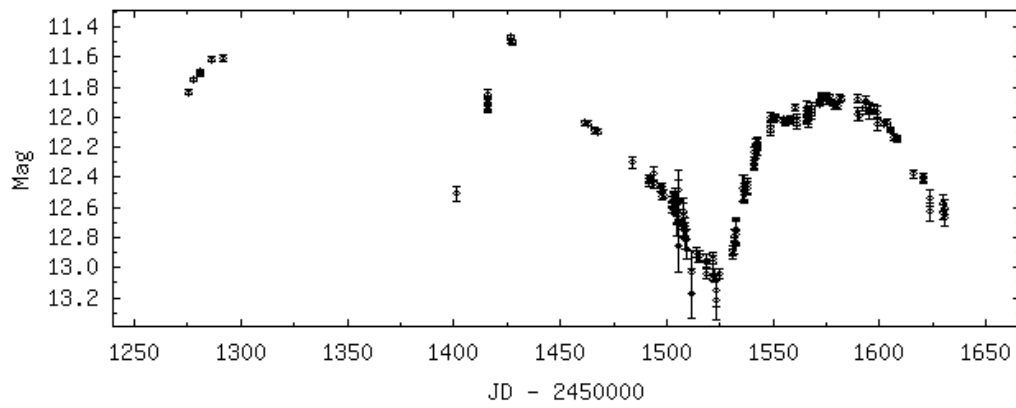
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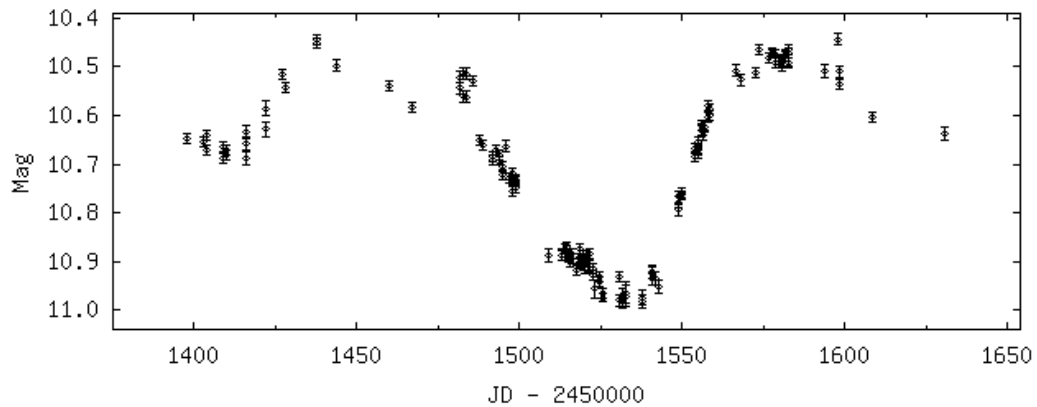
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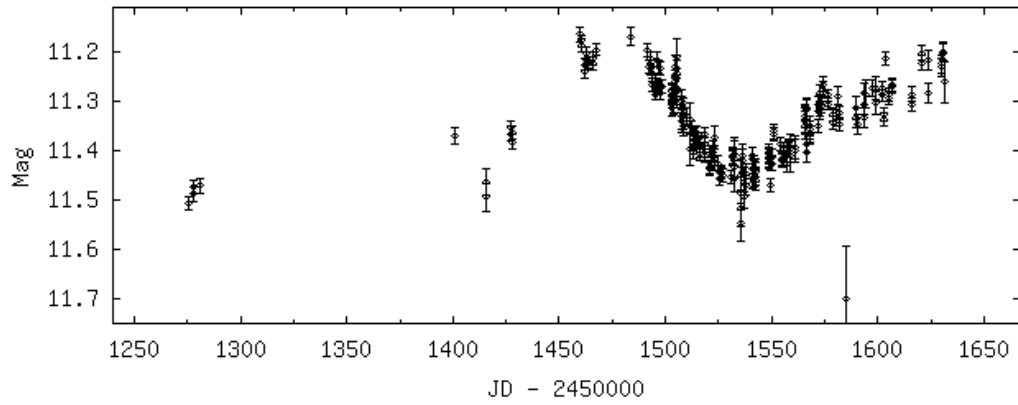
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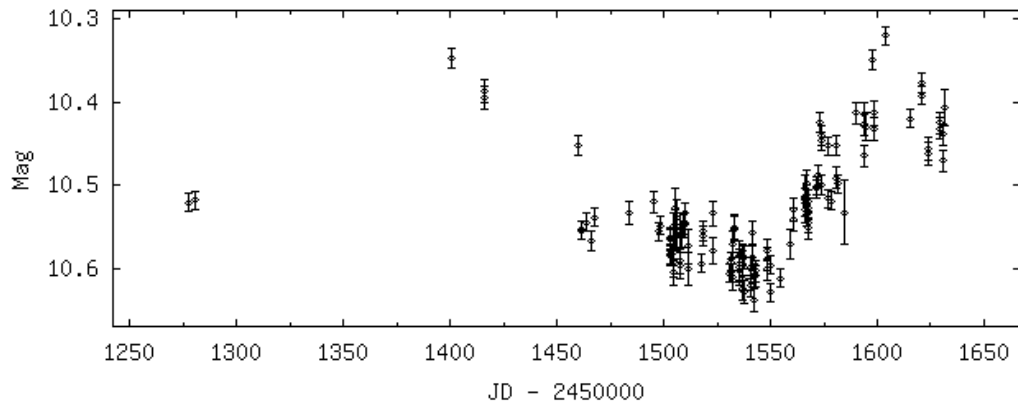
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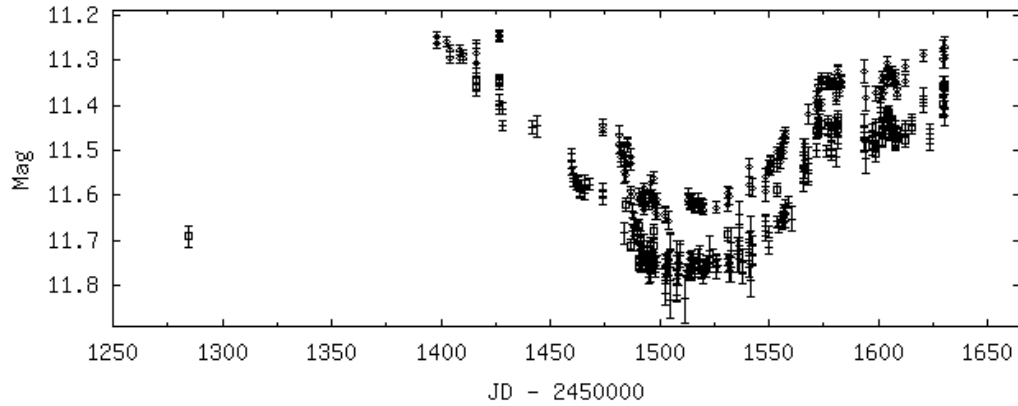
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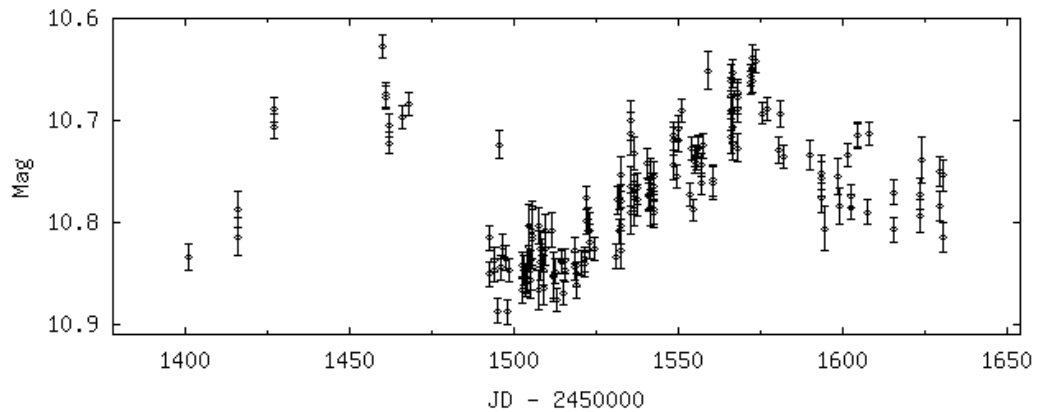
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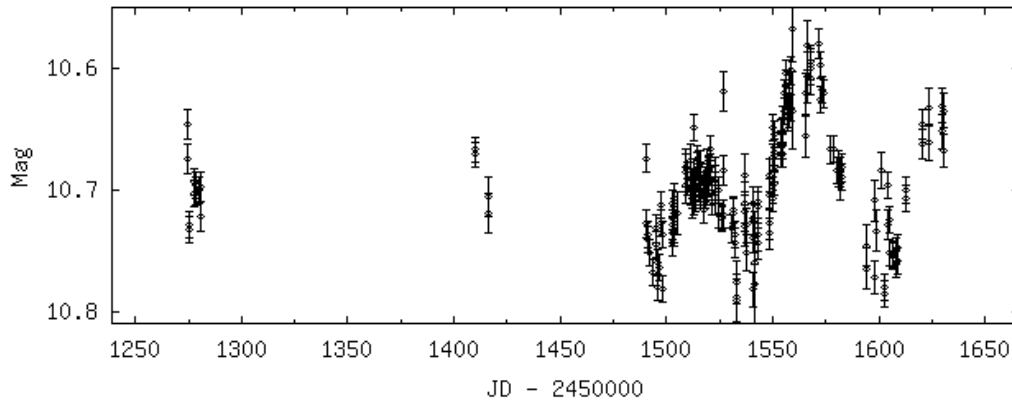
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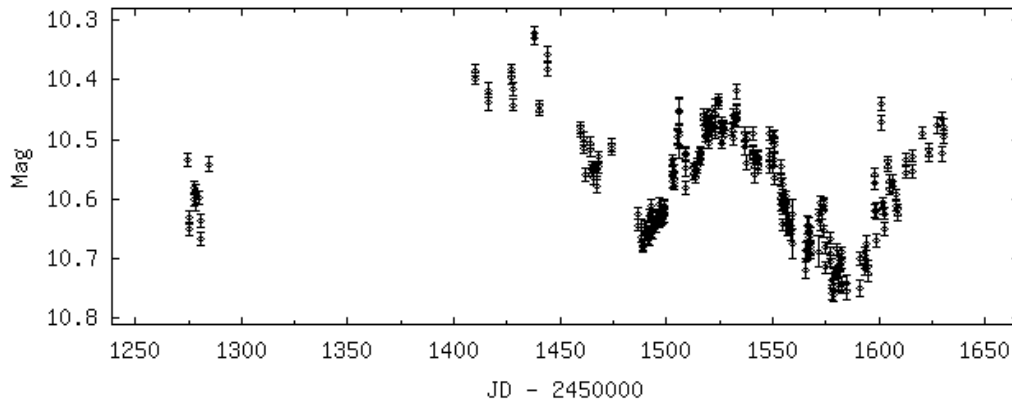
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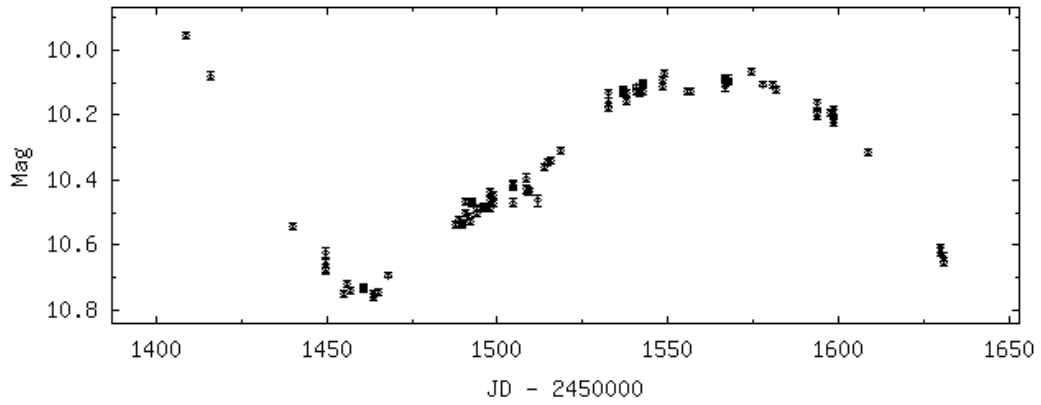
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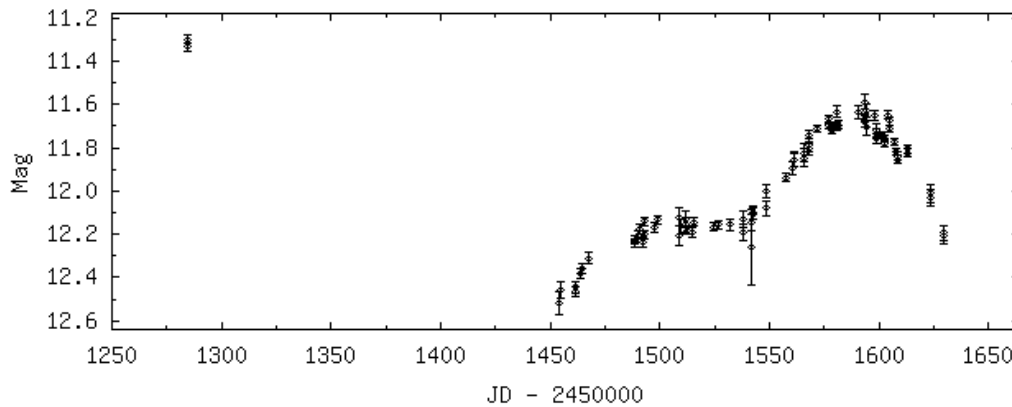
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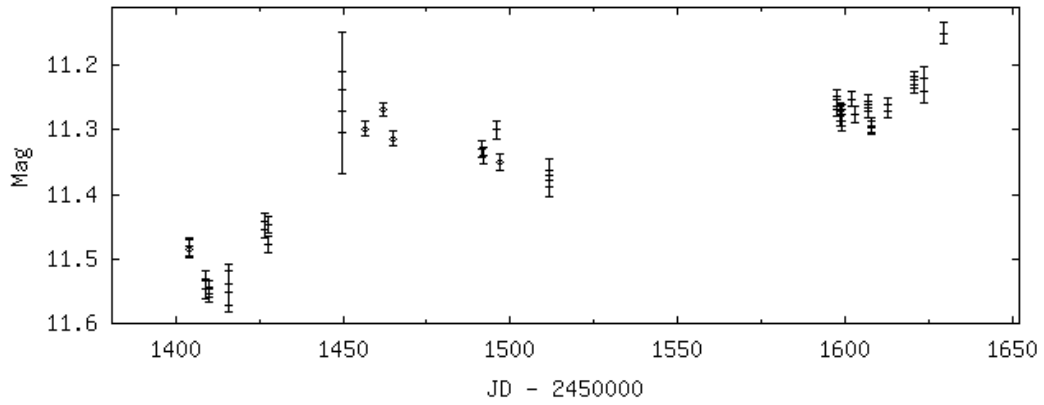
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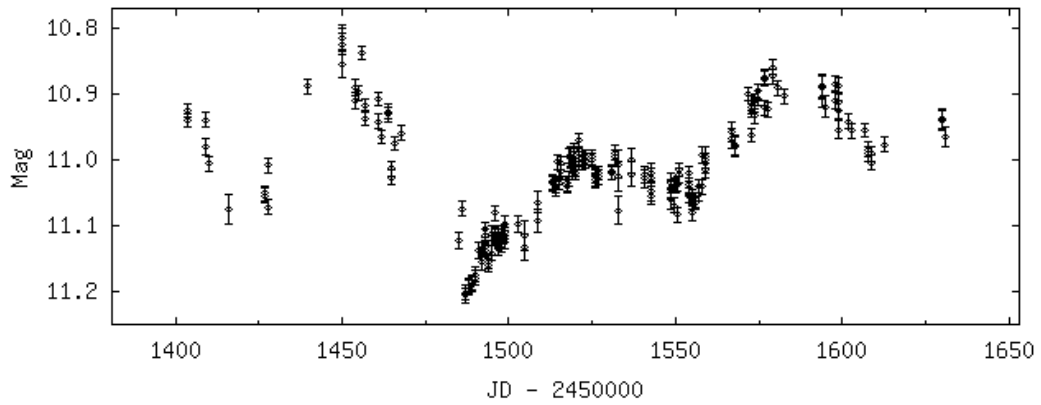
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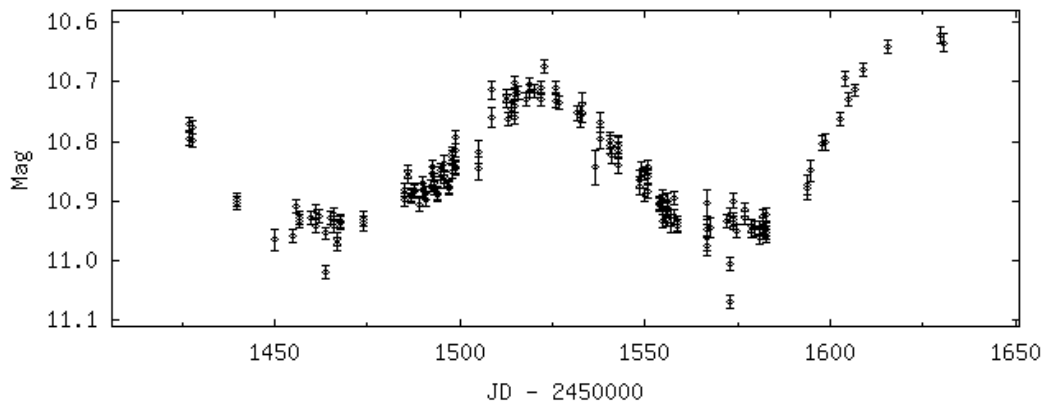
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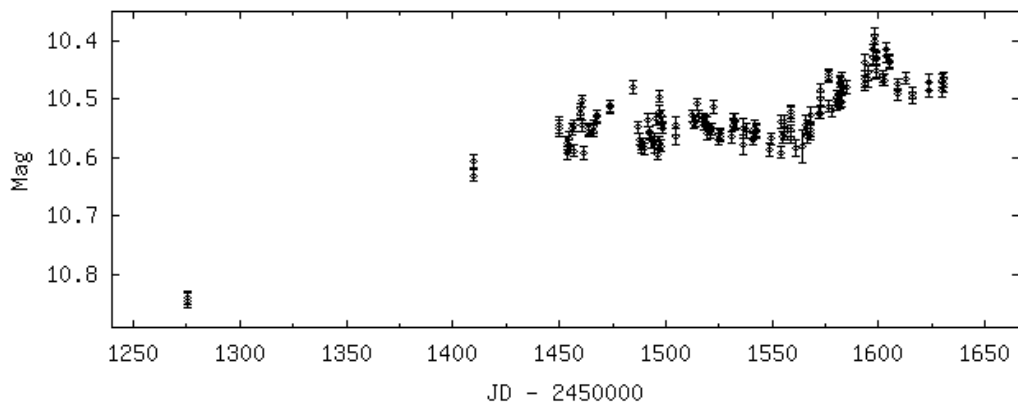
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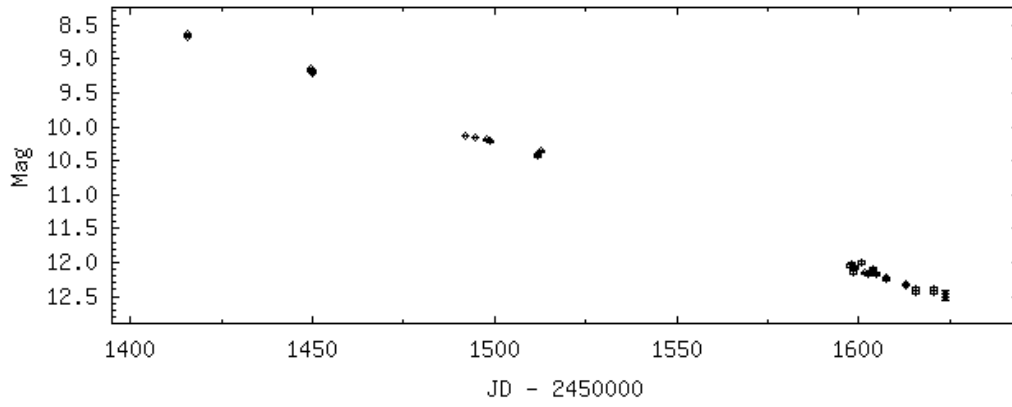
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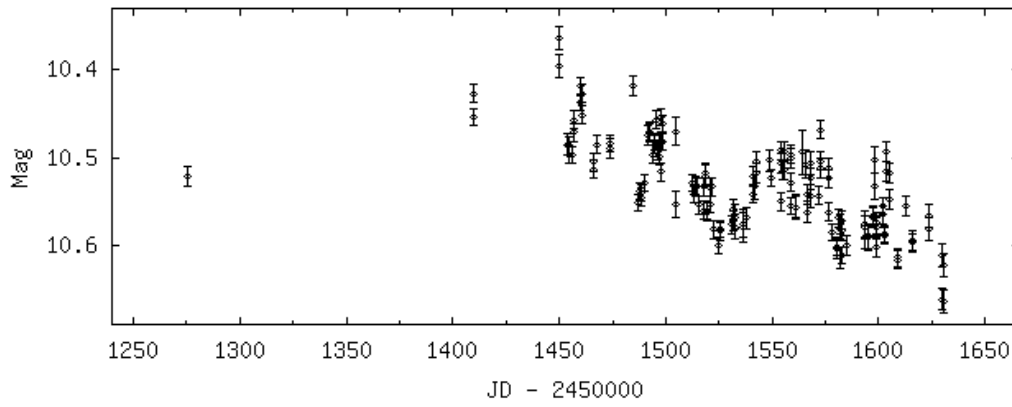
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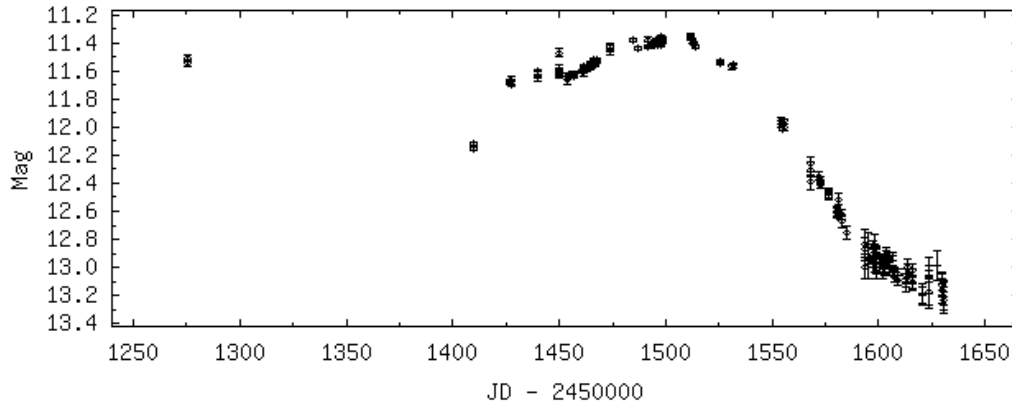
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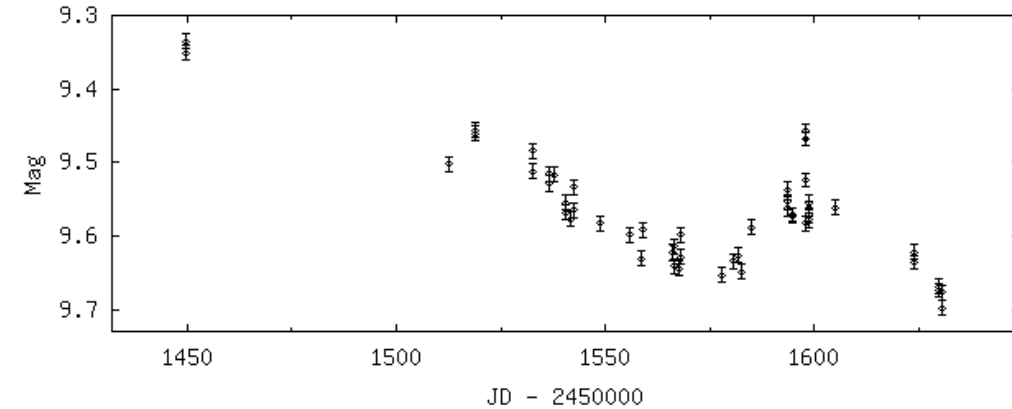
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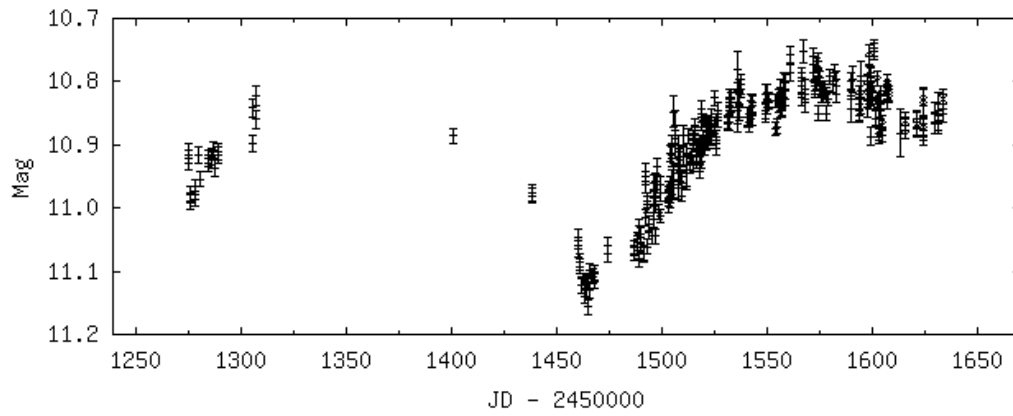
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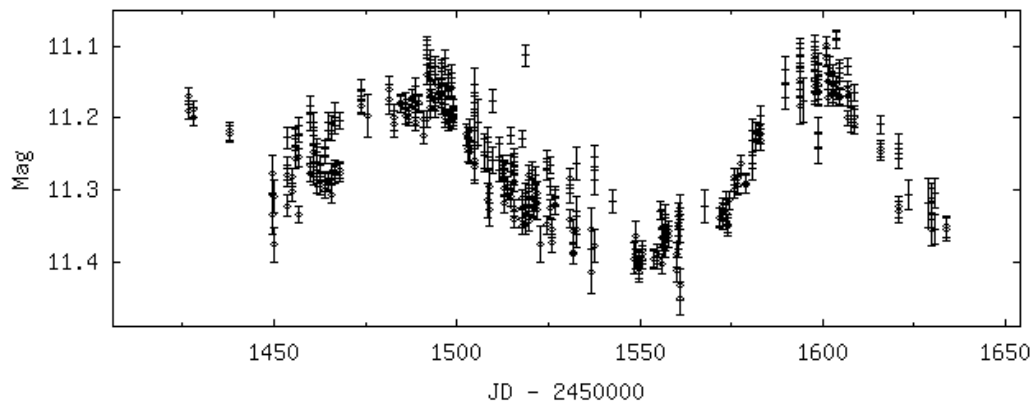
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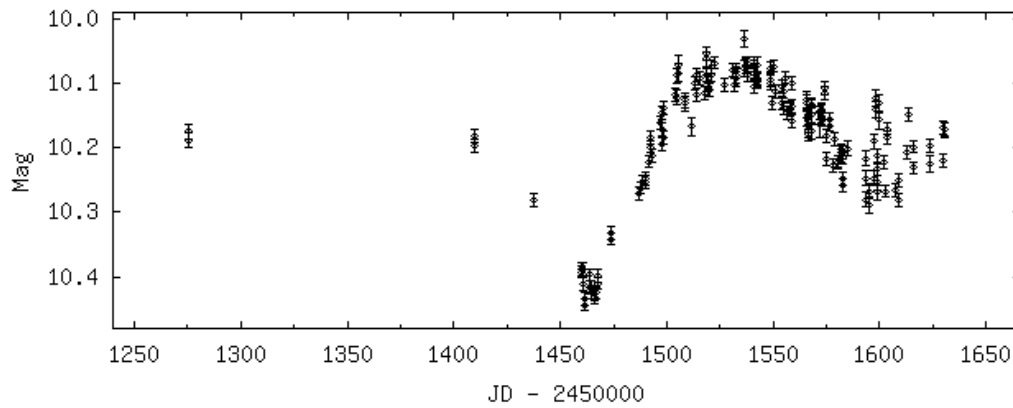
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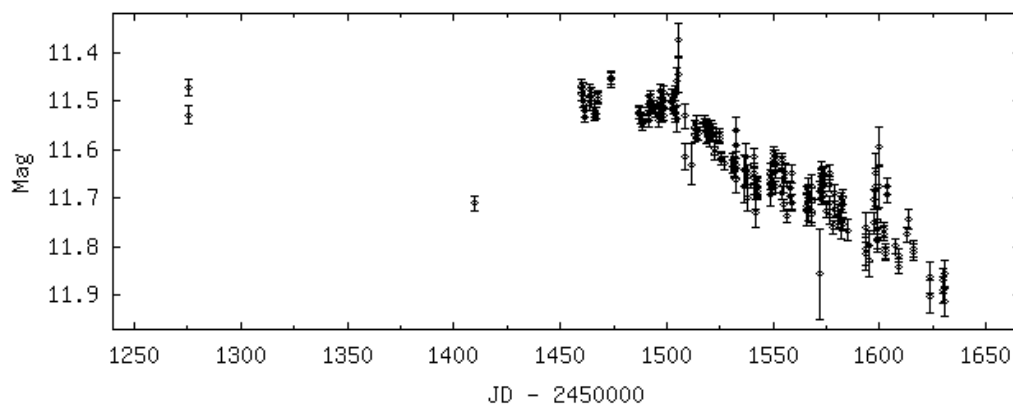
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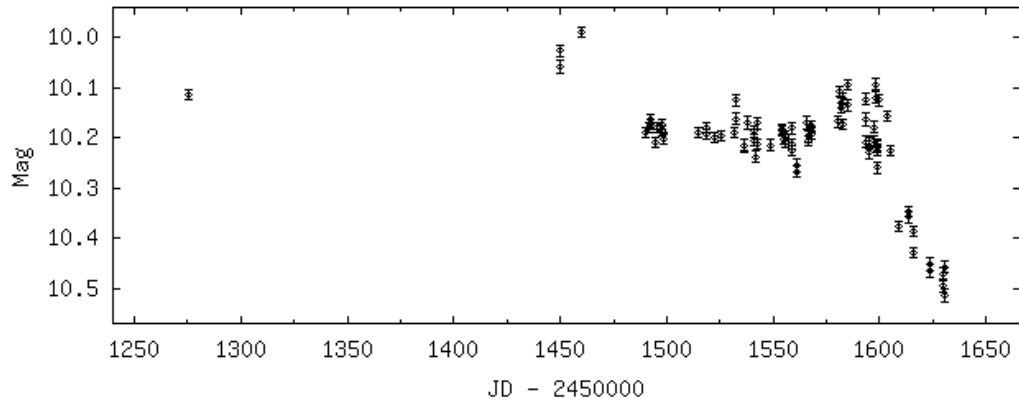
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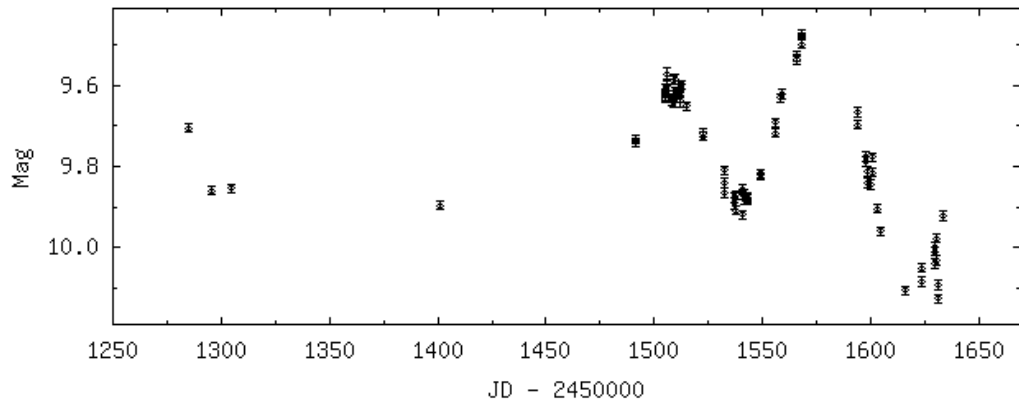
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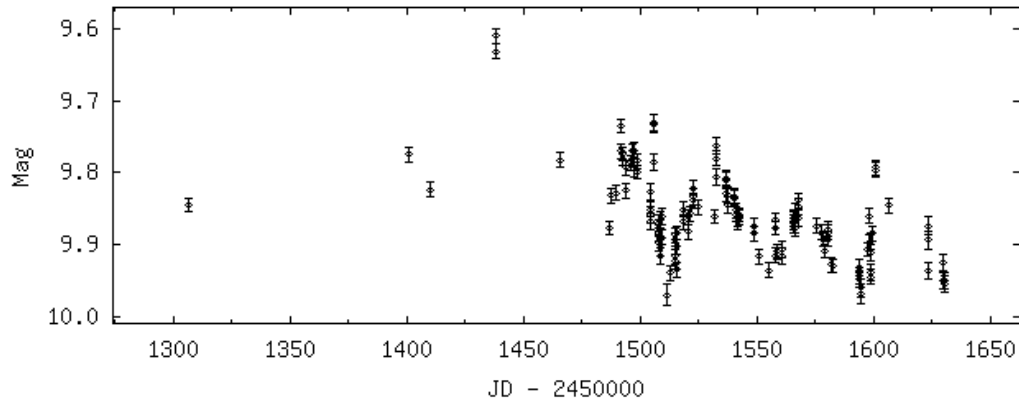
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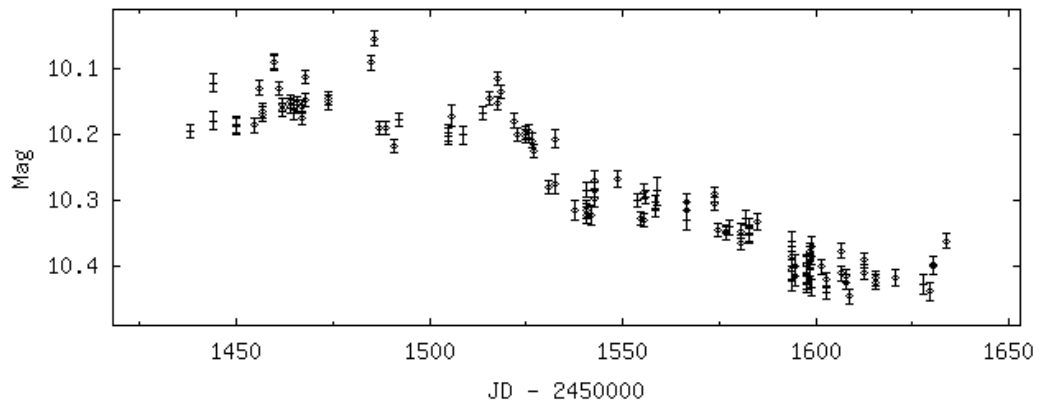
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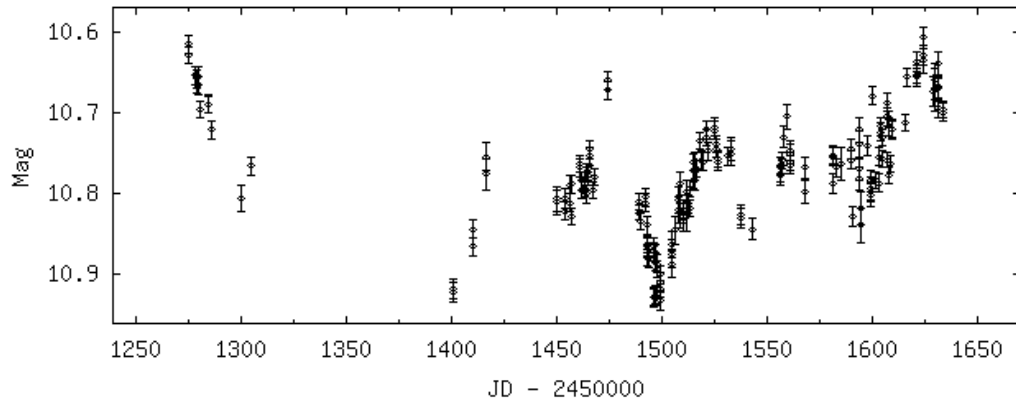
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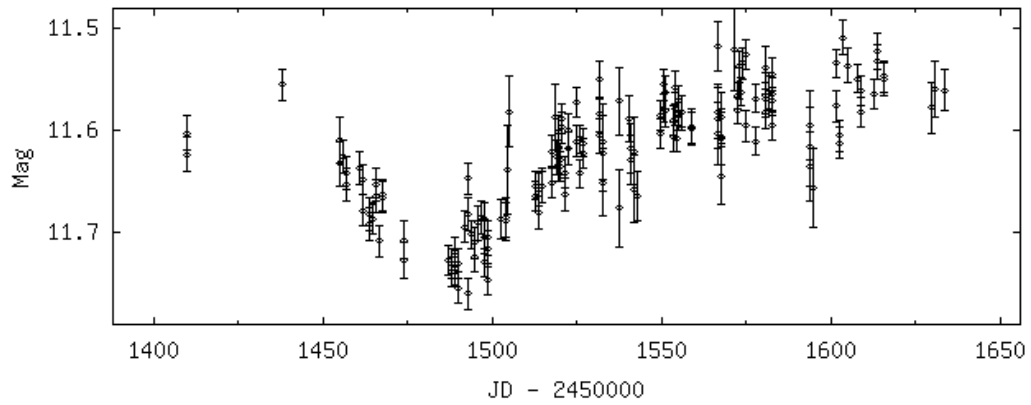
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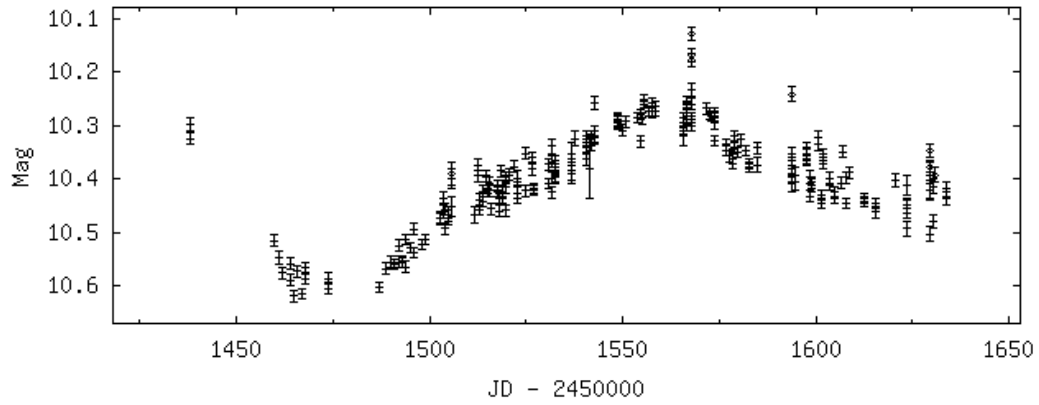
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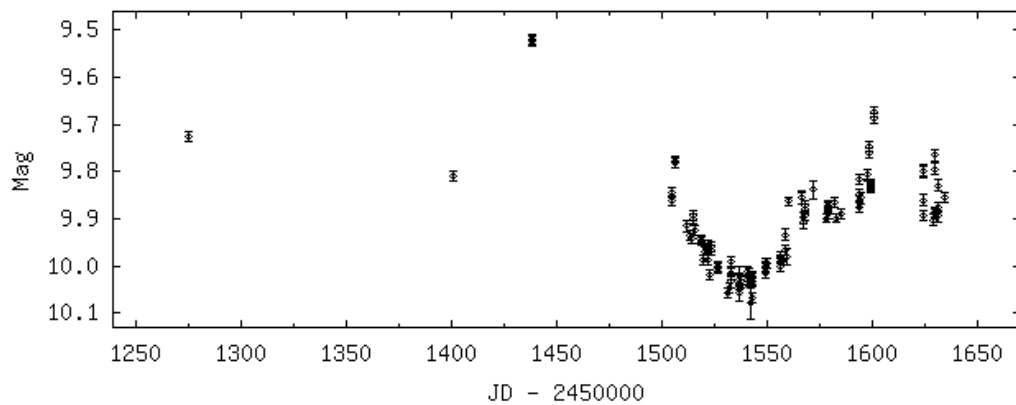
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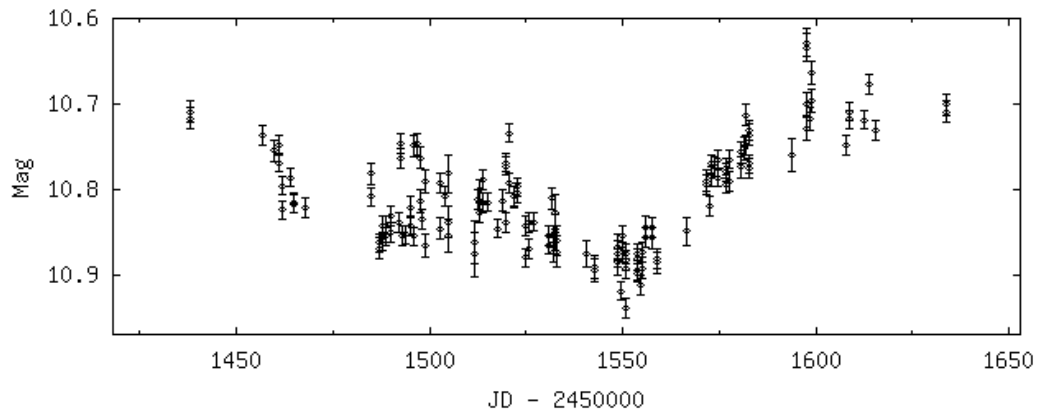
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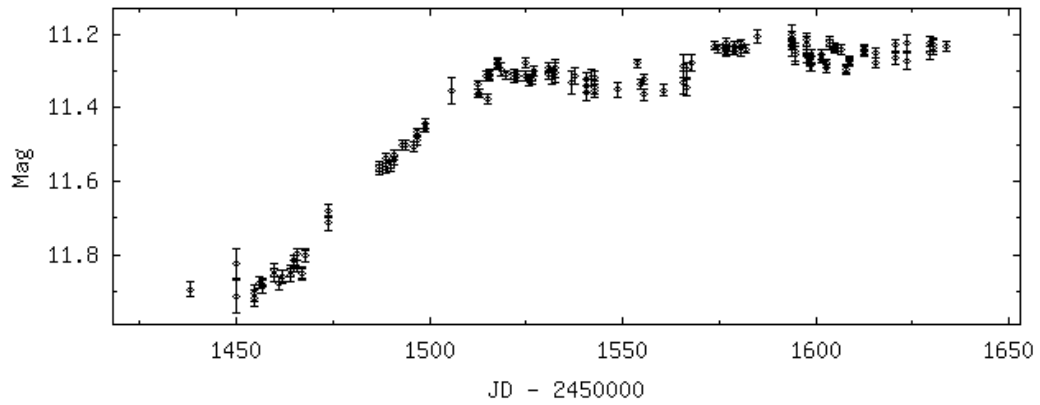
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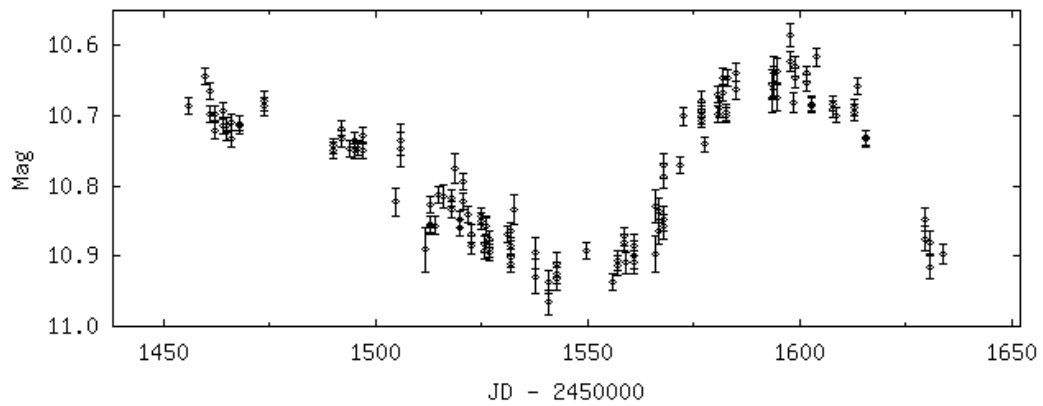
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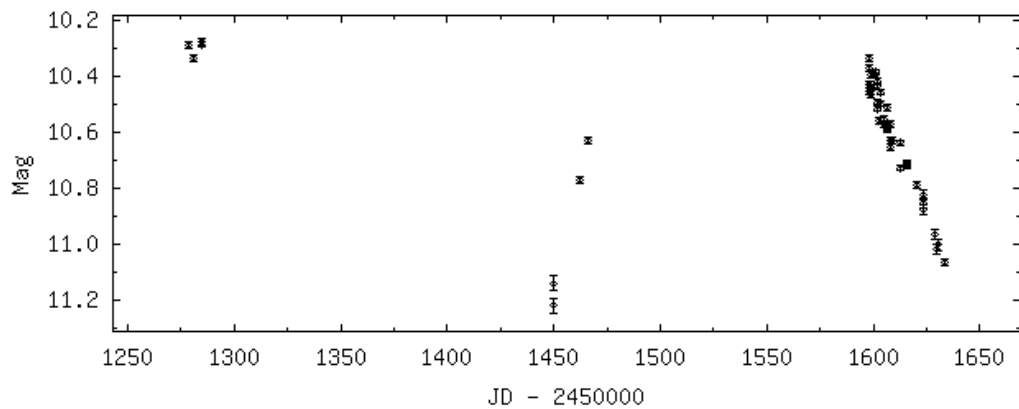
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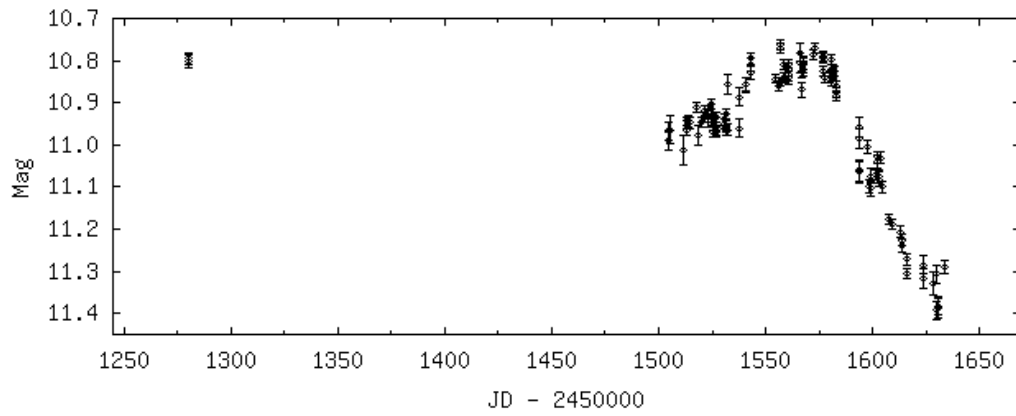
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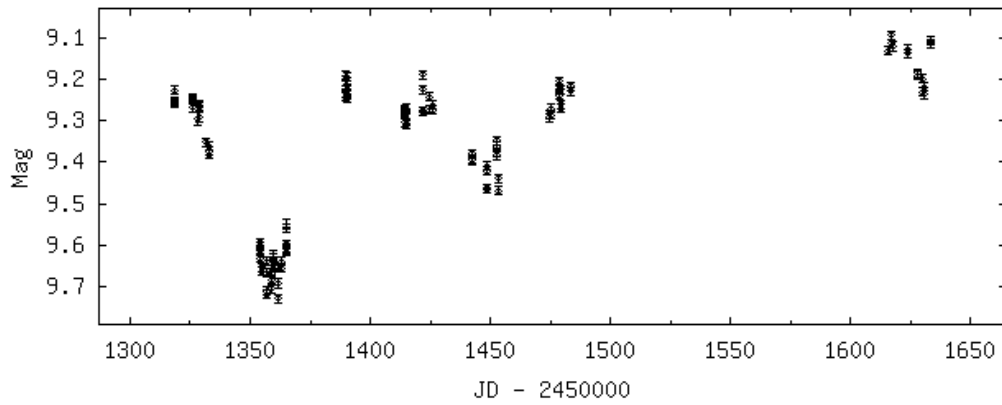
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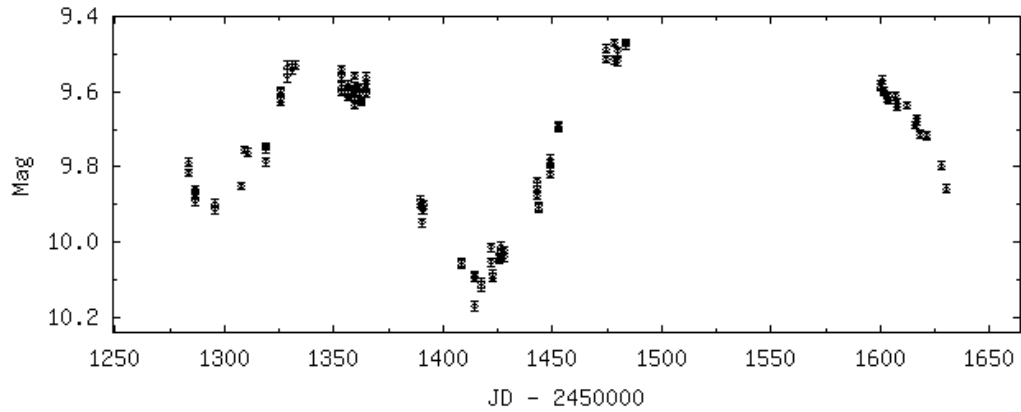
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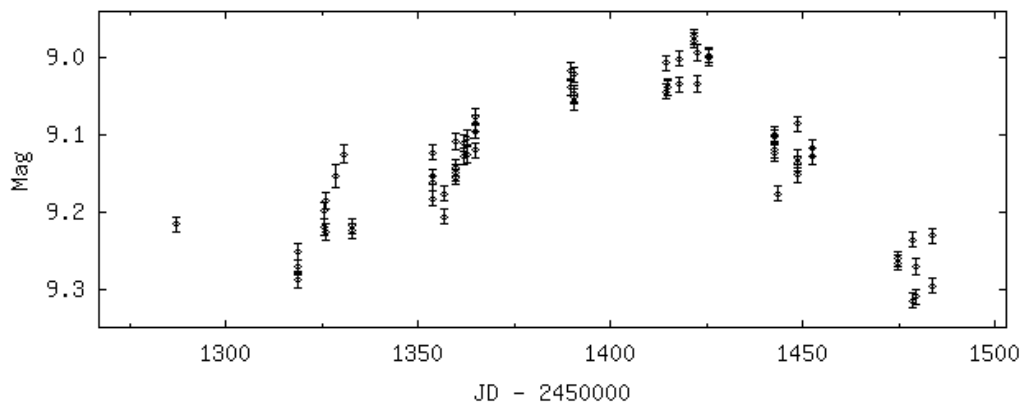
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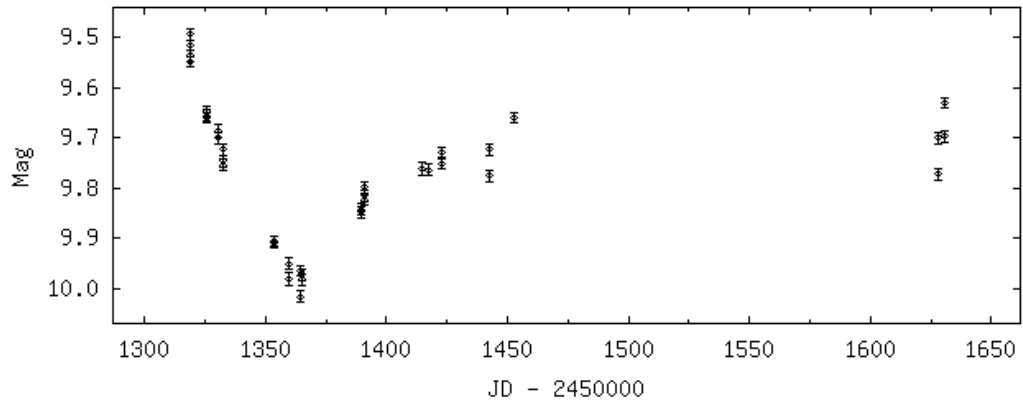
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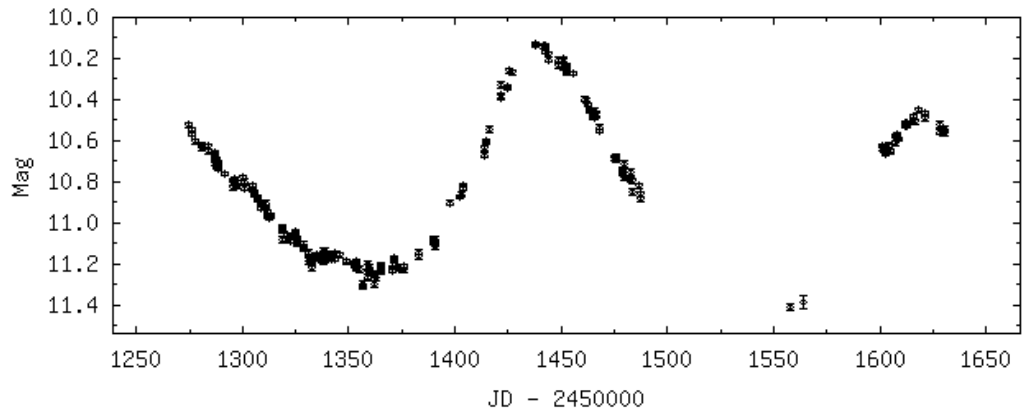
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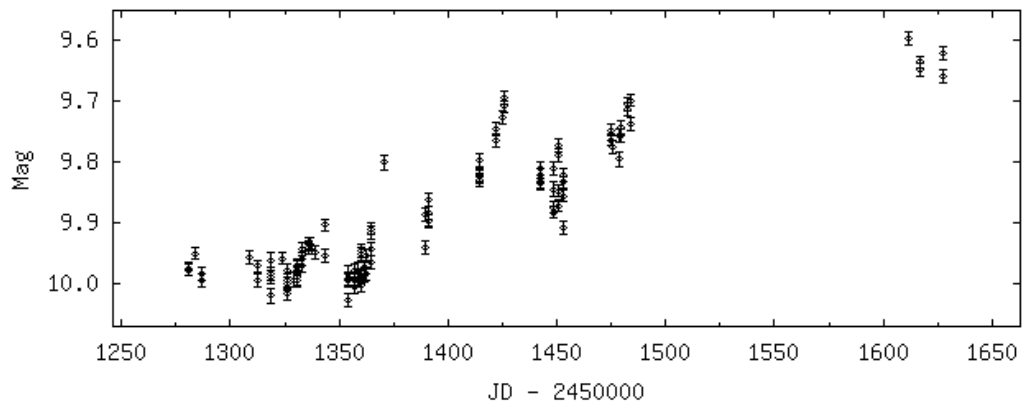
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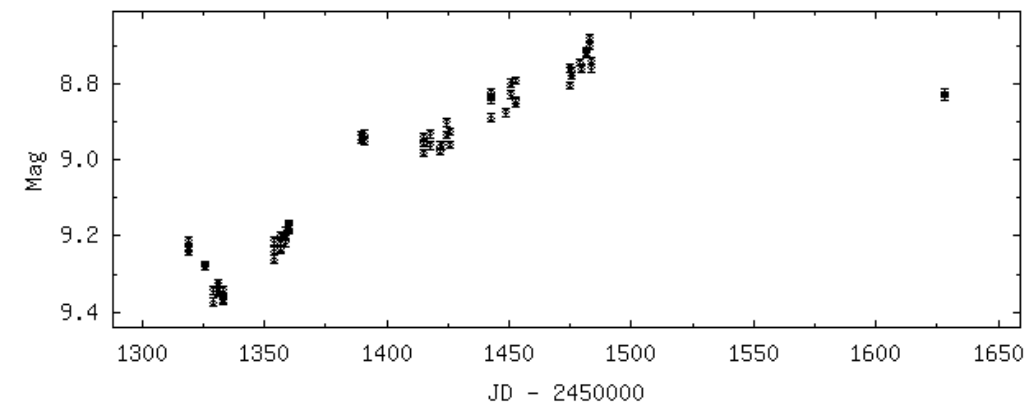
NSV 8224 J2000 17 07 11.9 +36 18 10



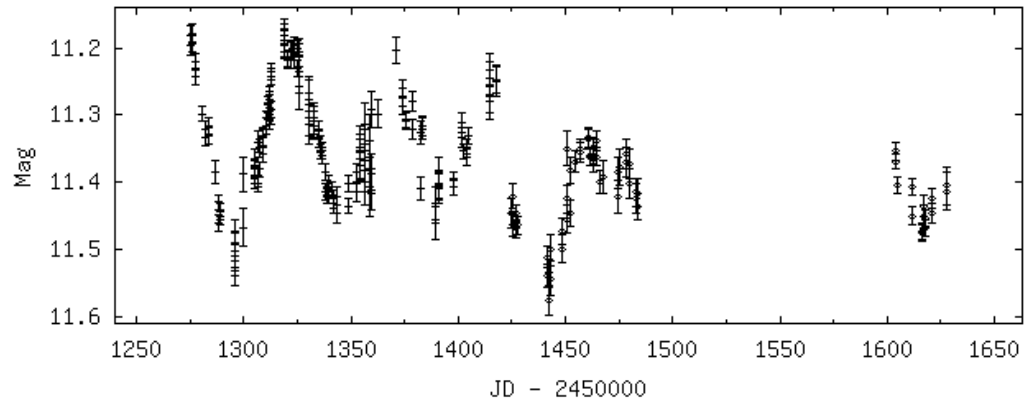
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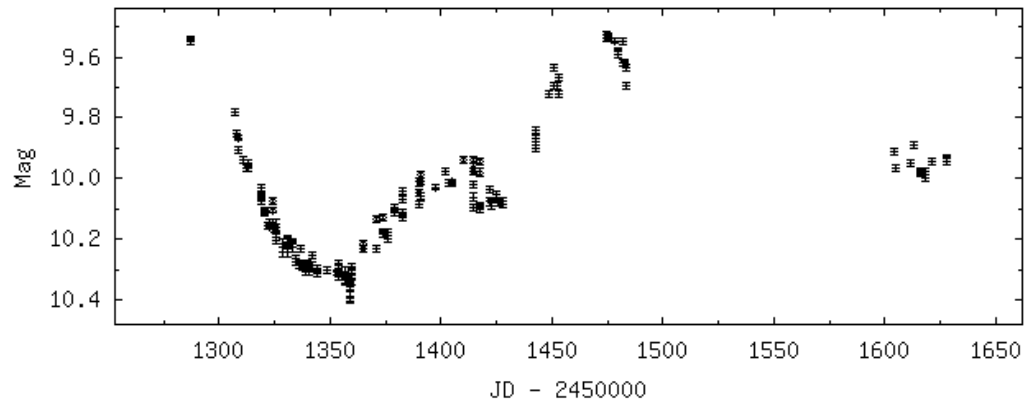
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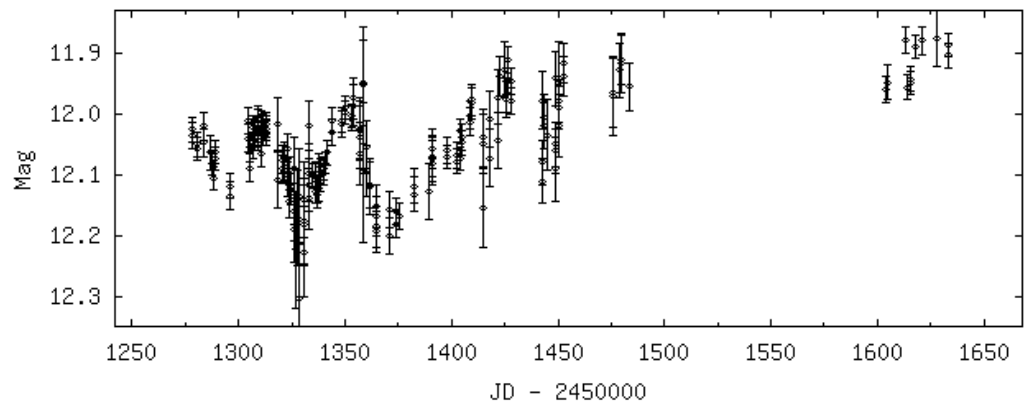
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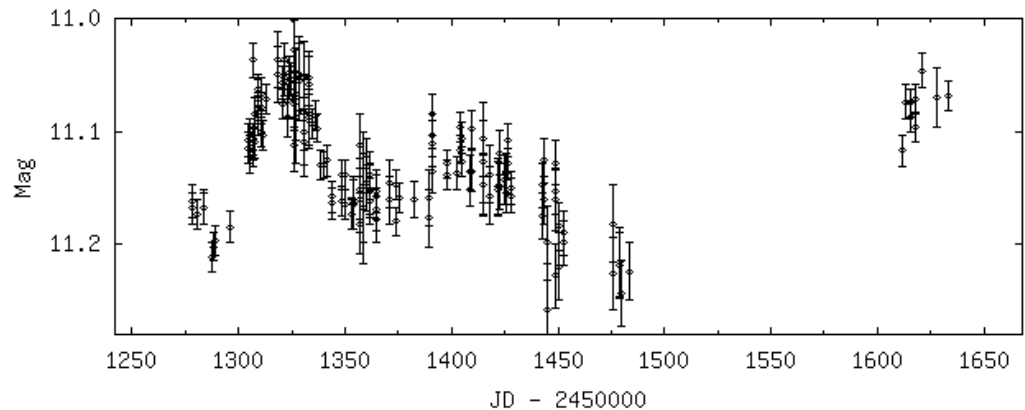
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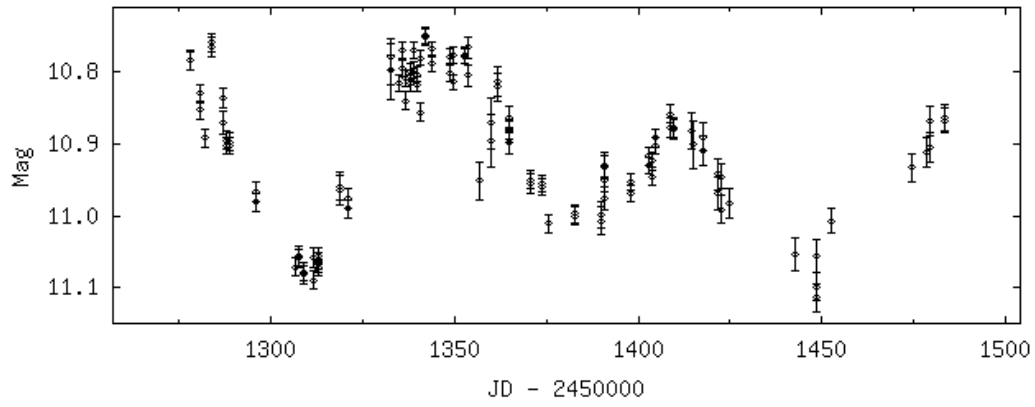
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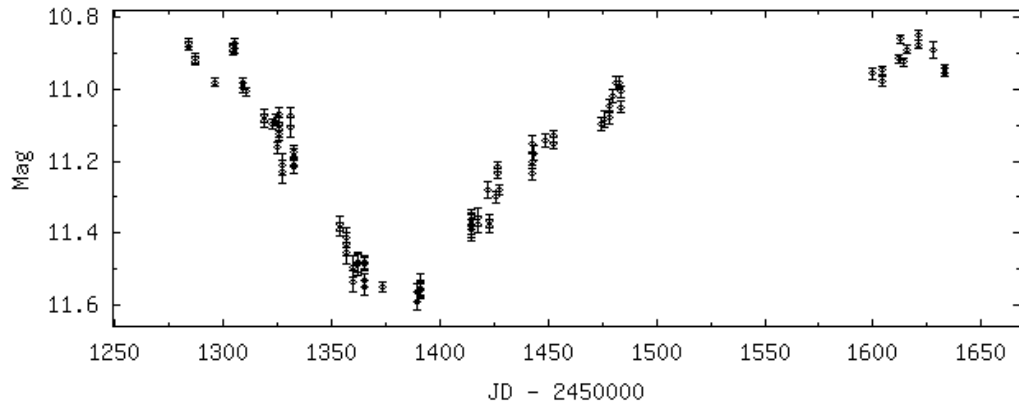
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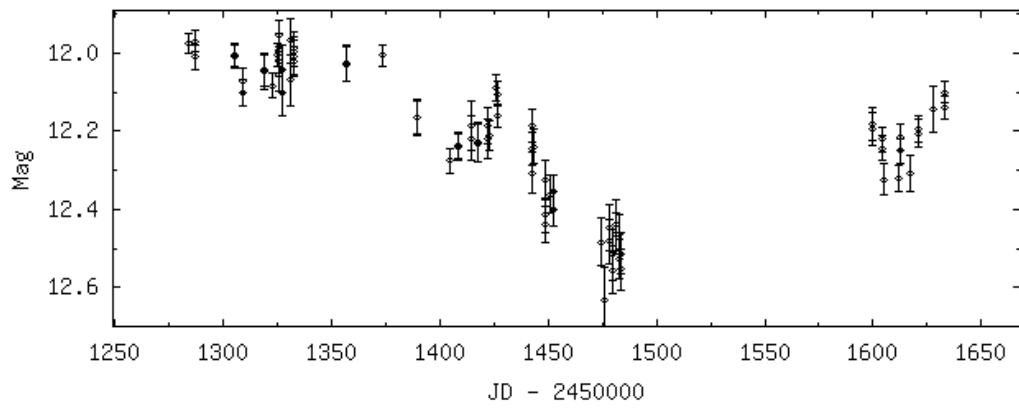
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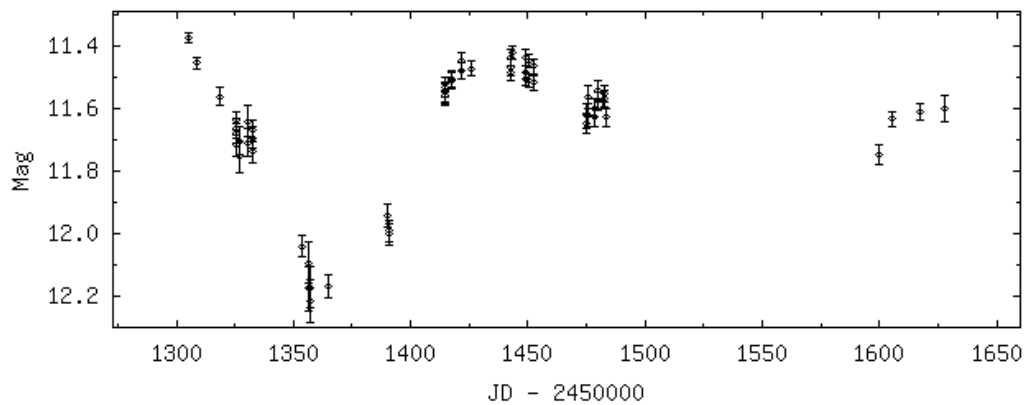
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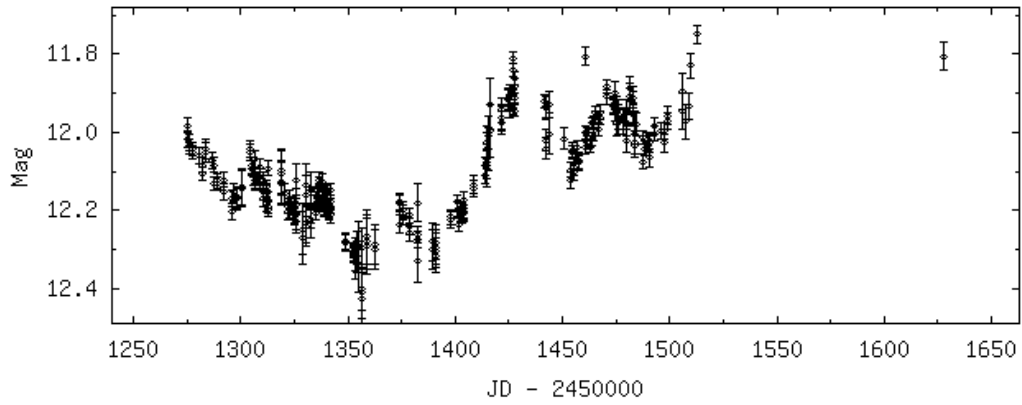
NSV 10439 J2000 18 15 14.0 +04 30 50



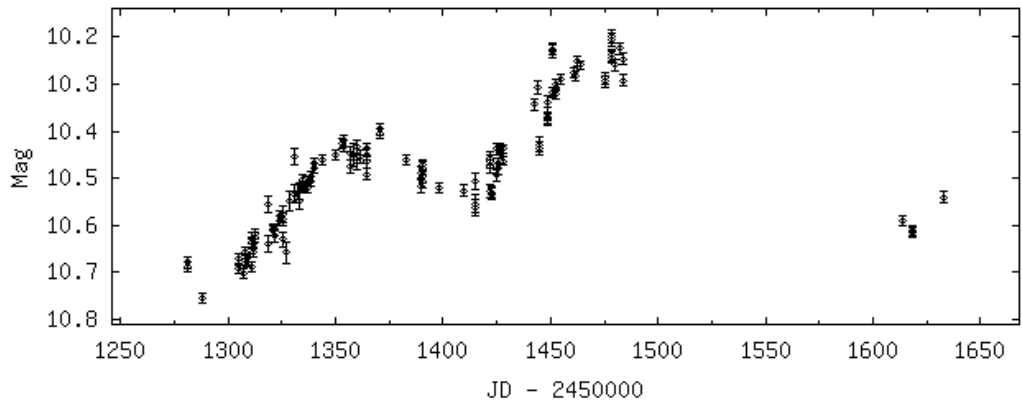
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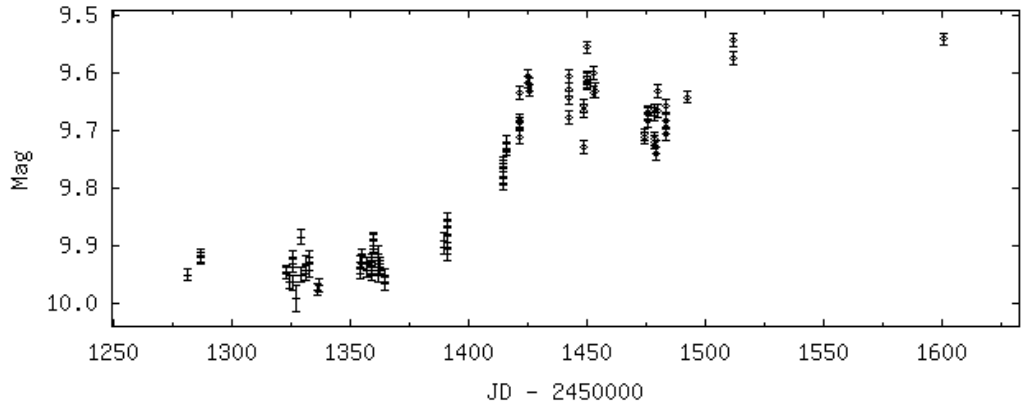
NSV 11363 J2000 18 47 52.8 +38 42 18



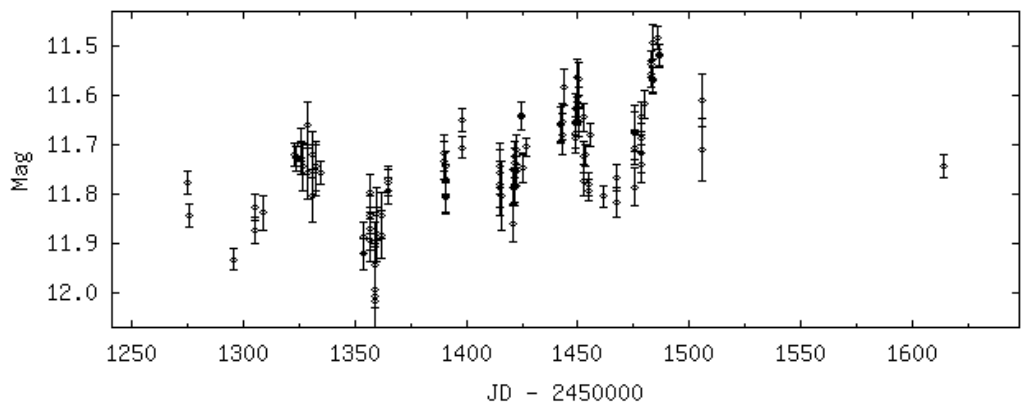
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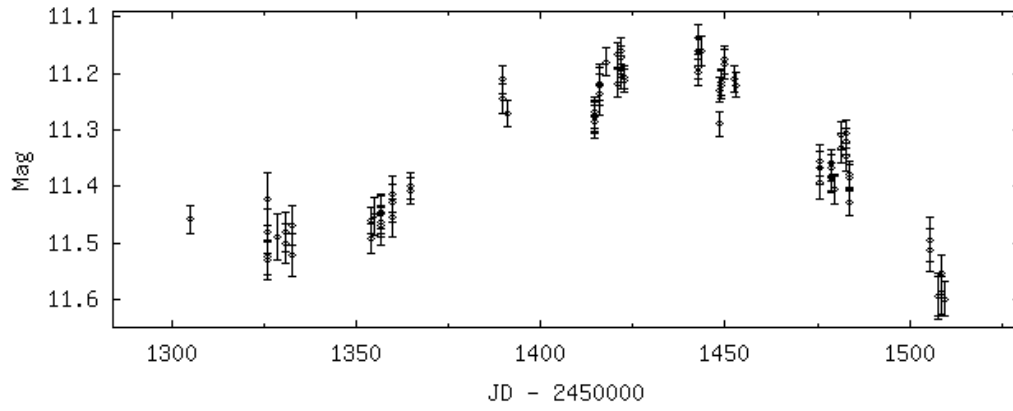
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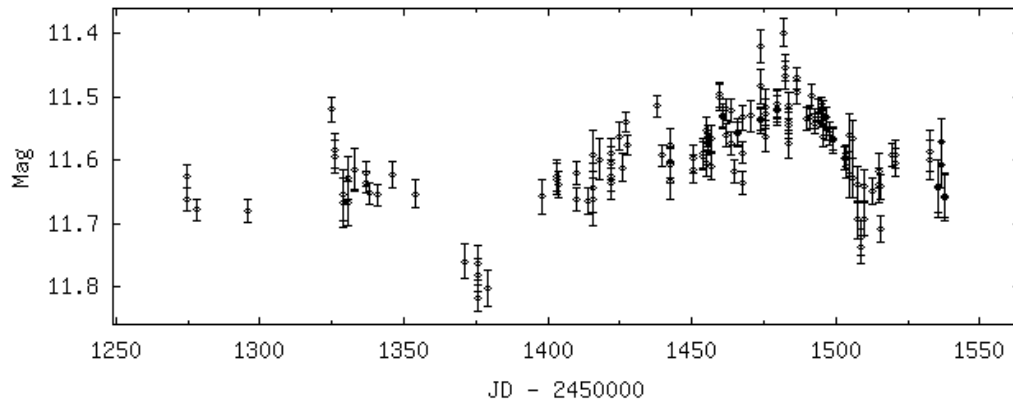
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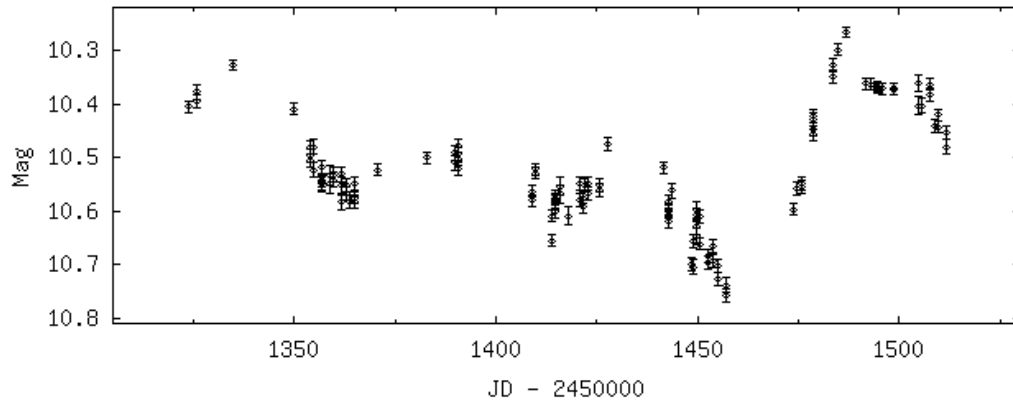
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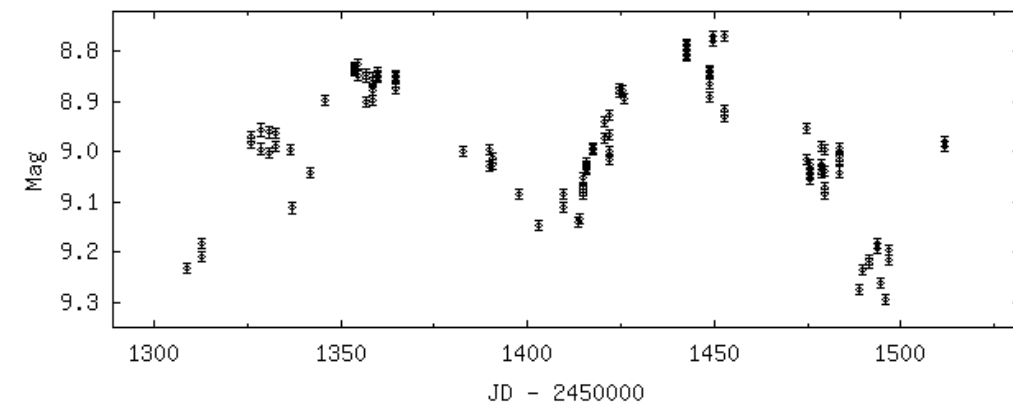
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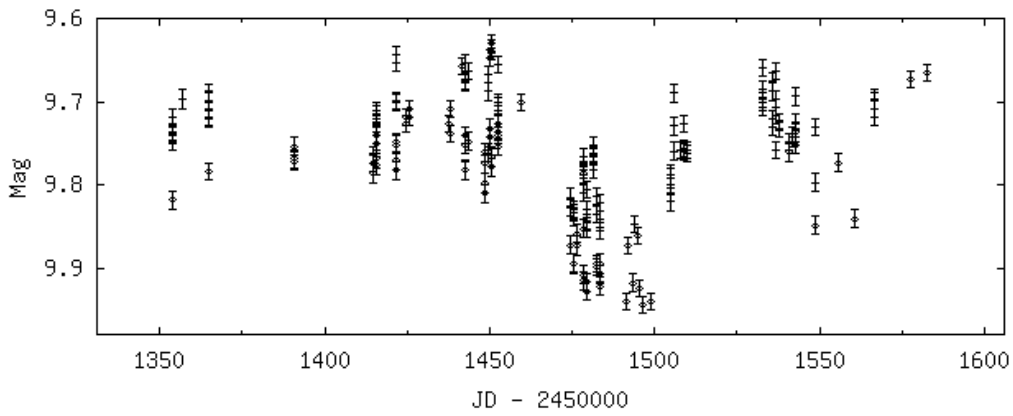
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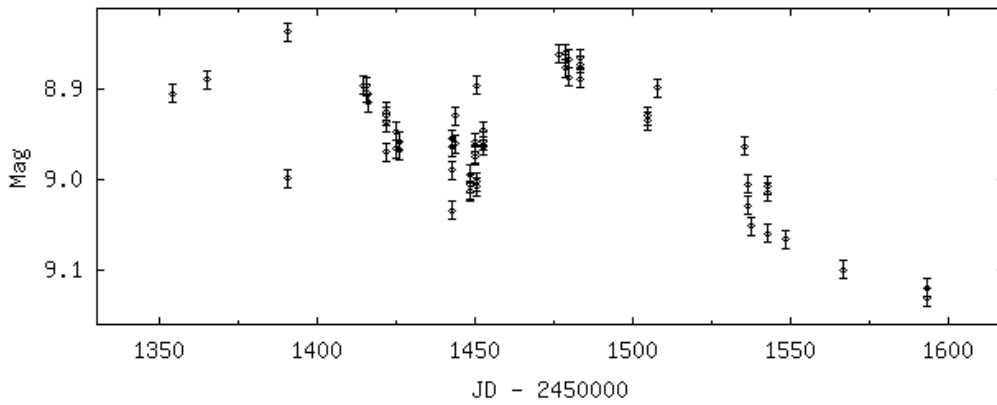
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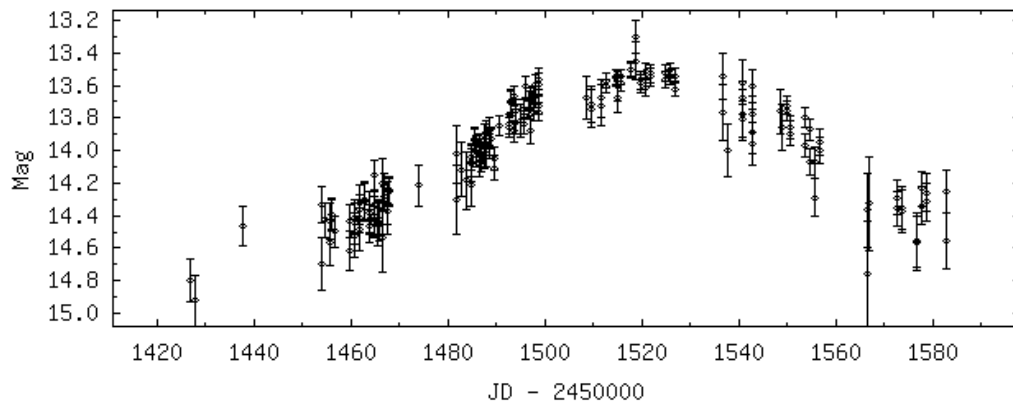
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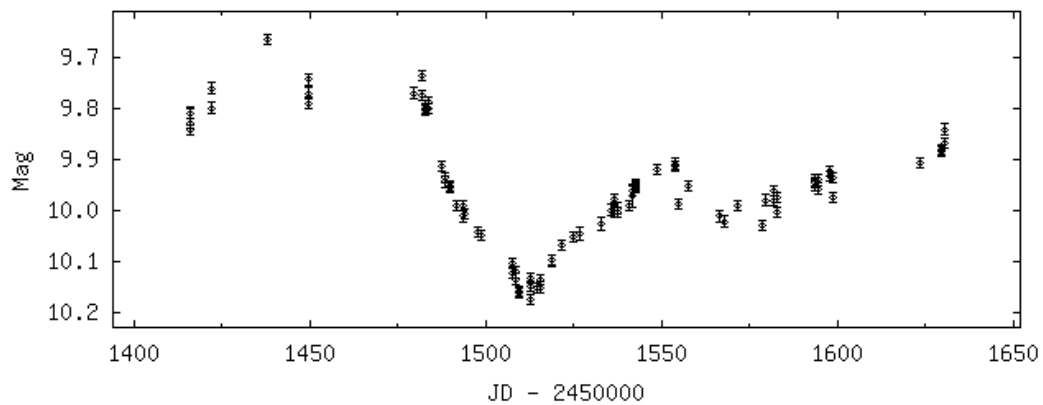
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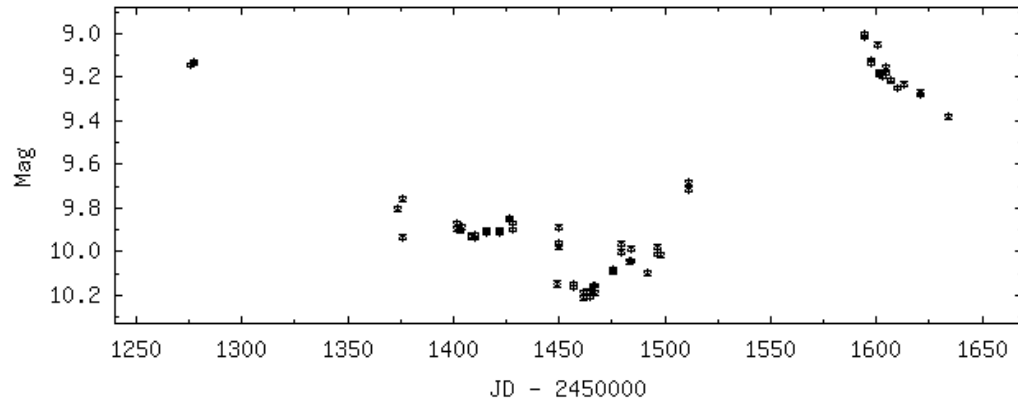
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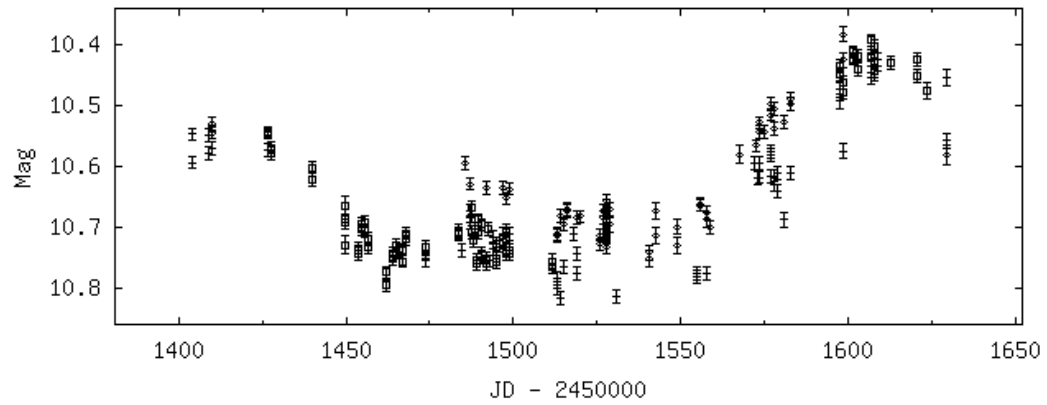
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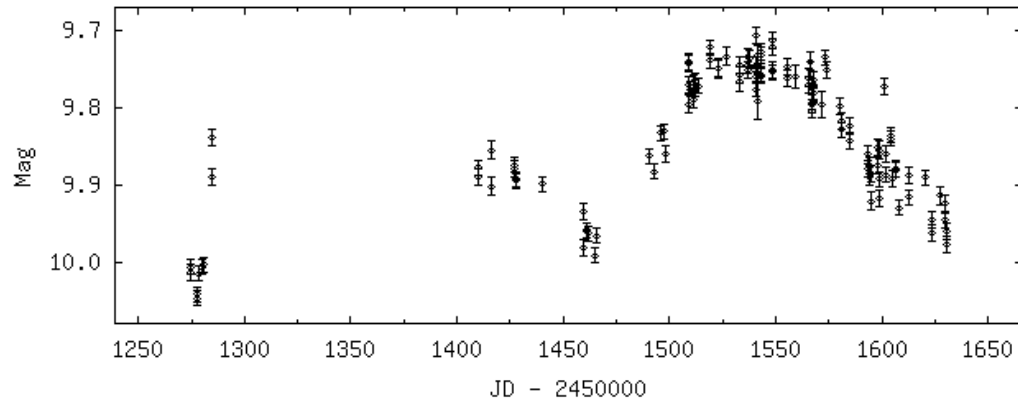
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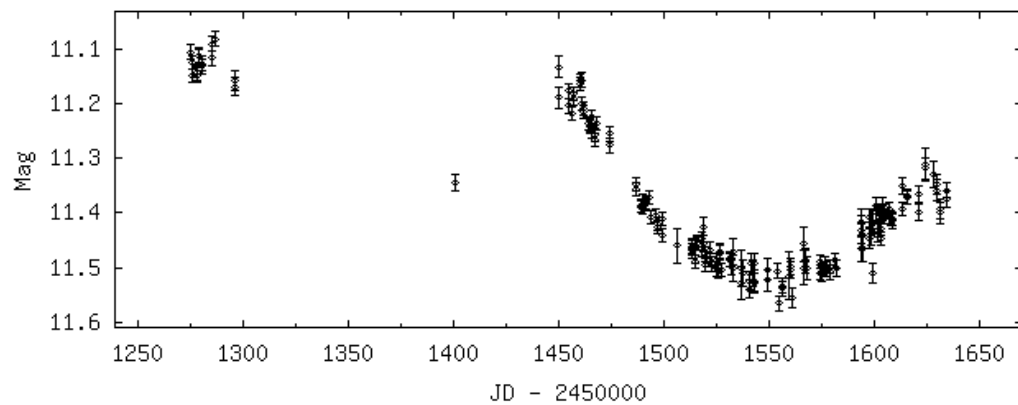
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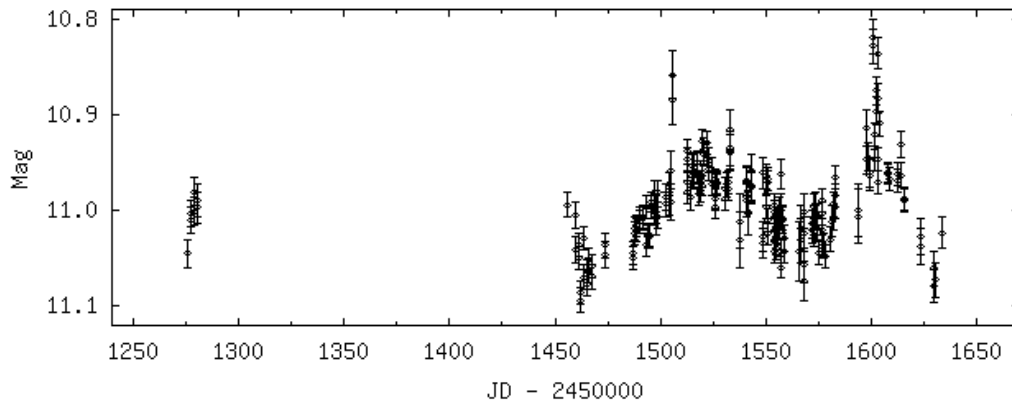
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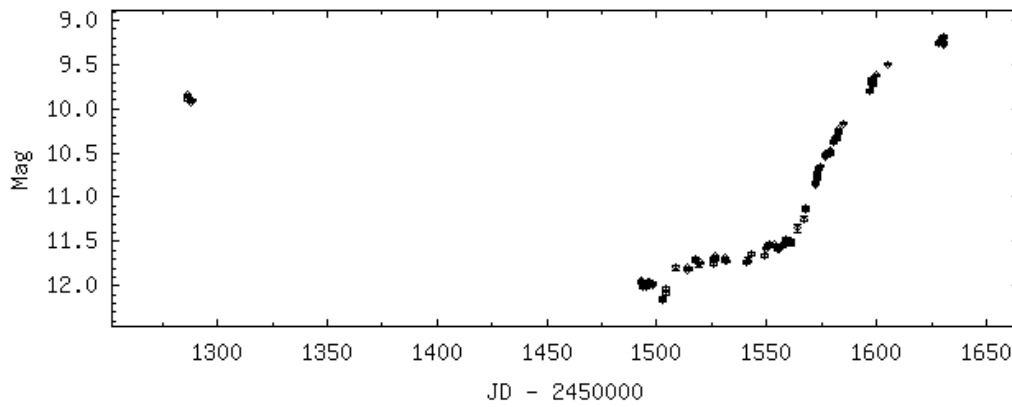
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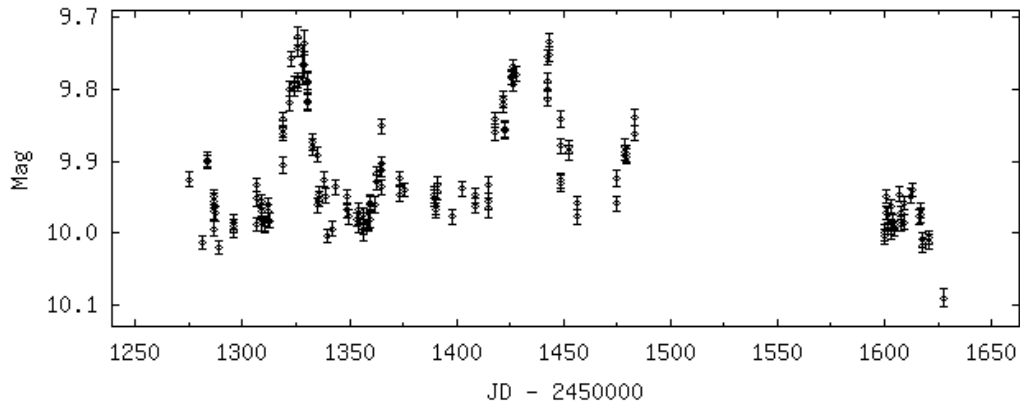
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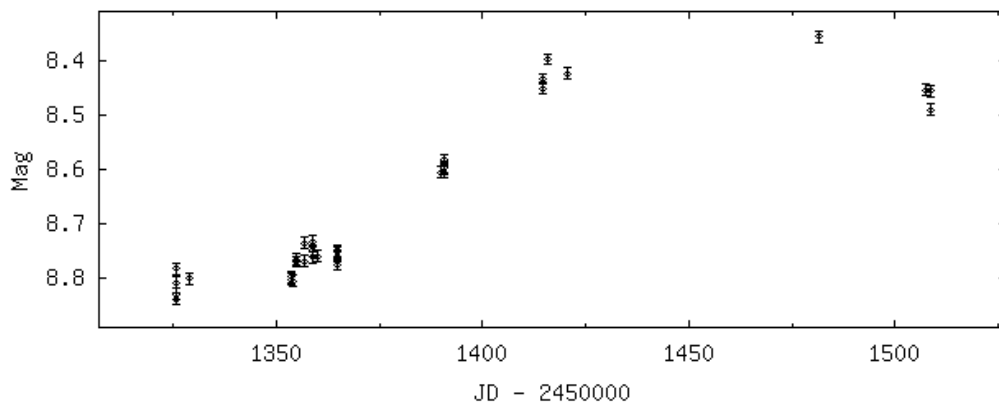
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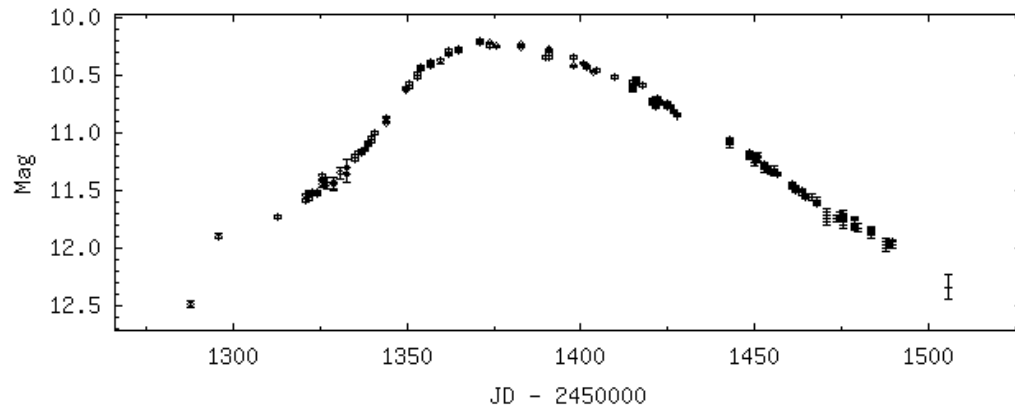
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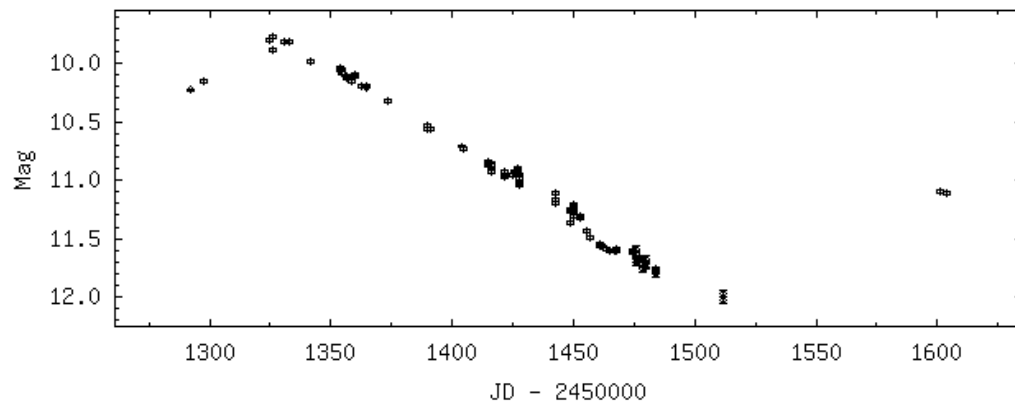
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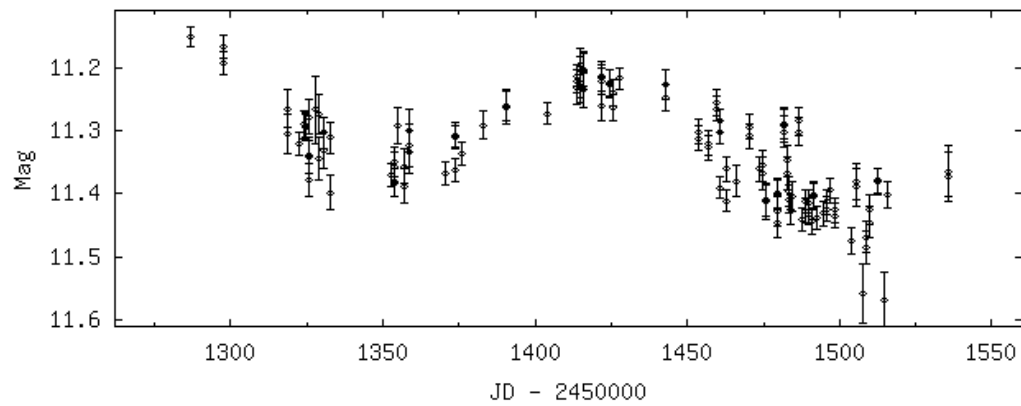
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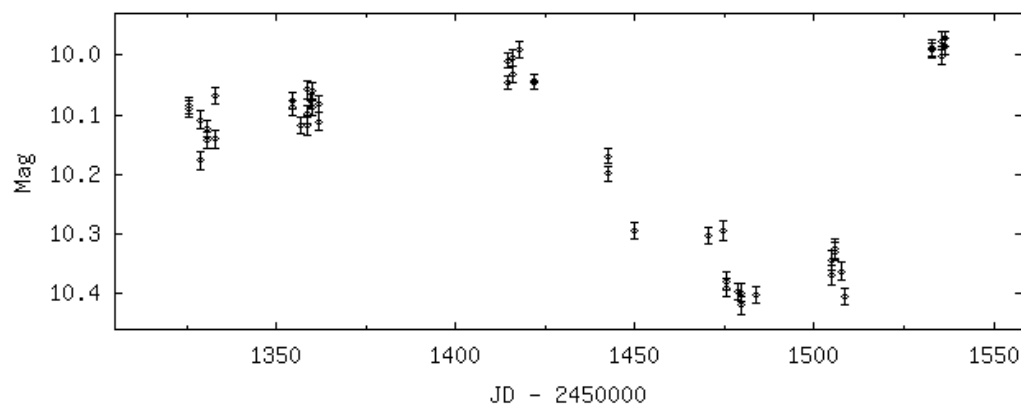
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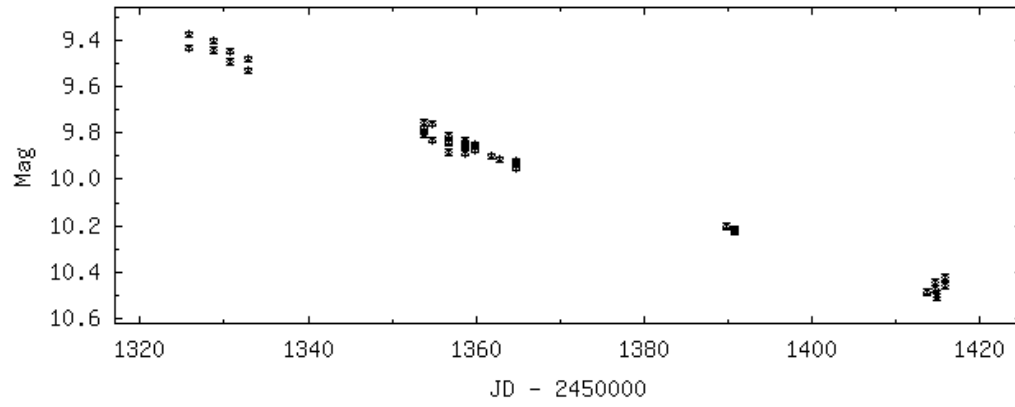
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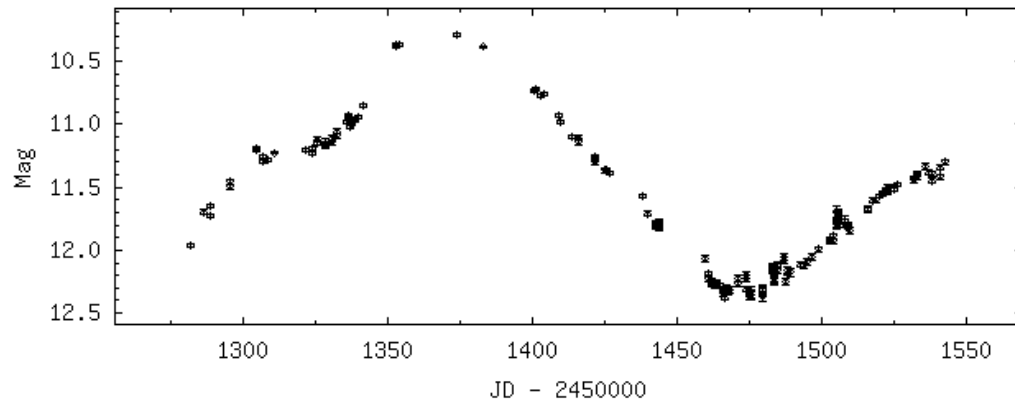
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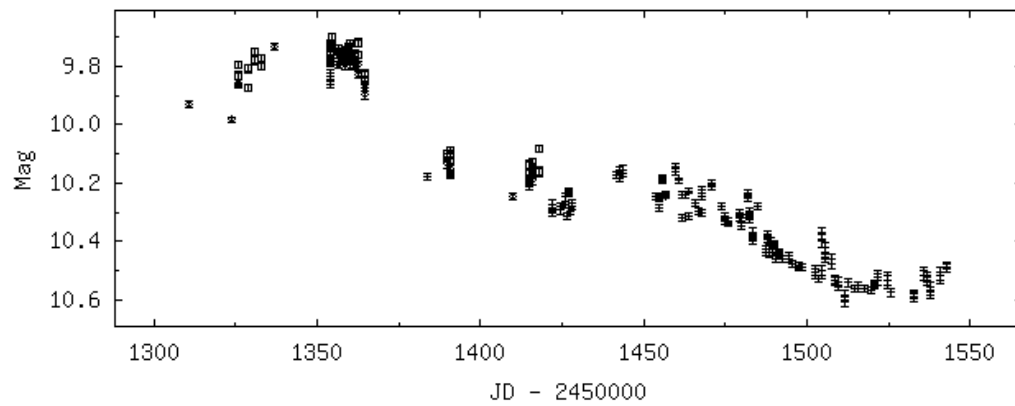
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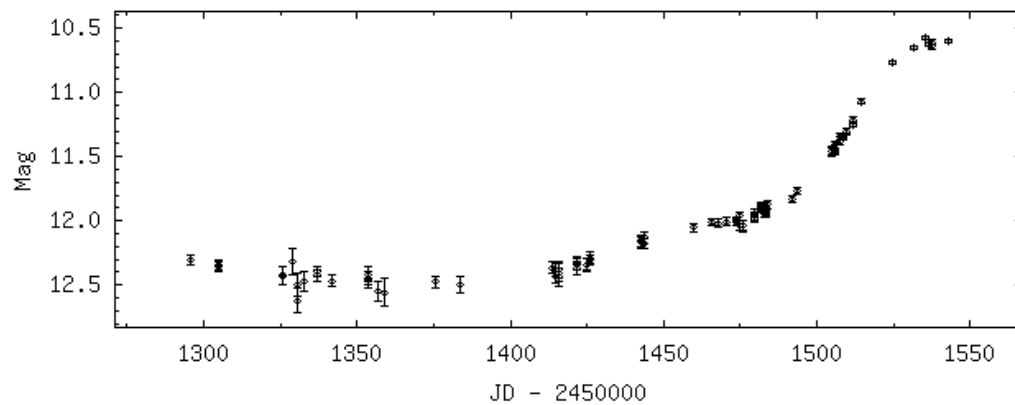
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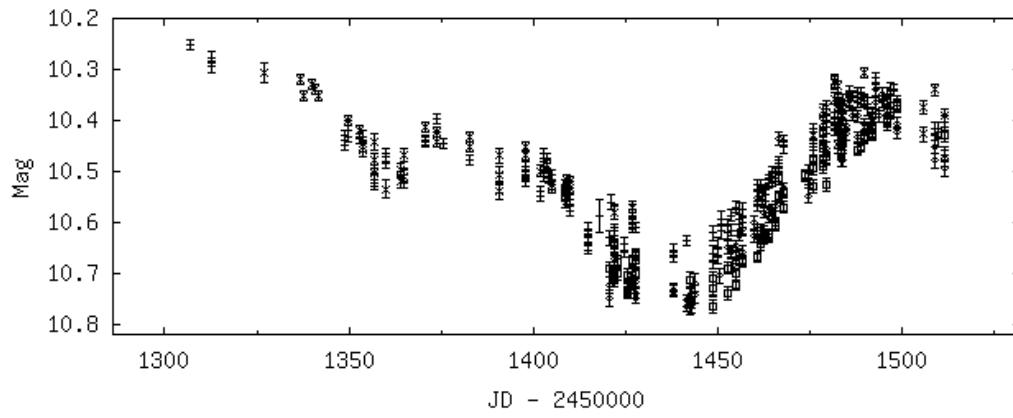
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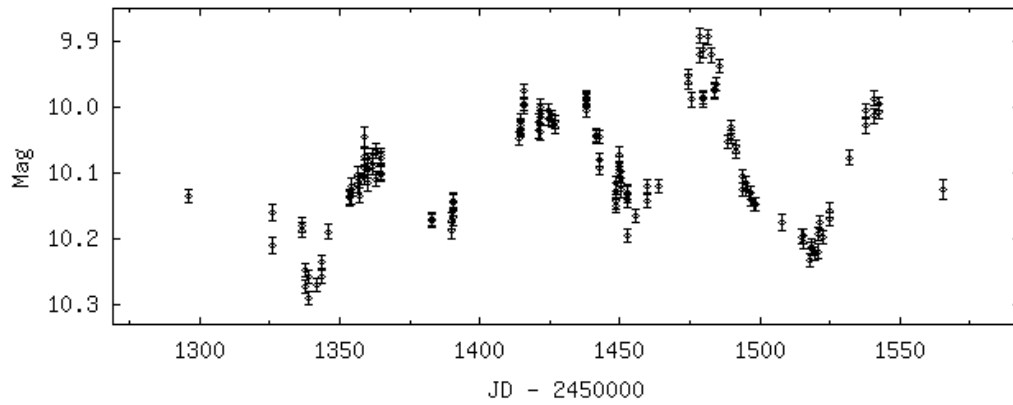
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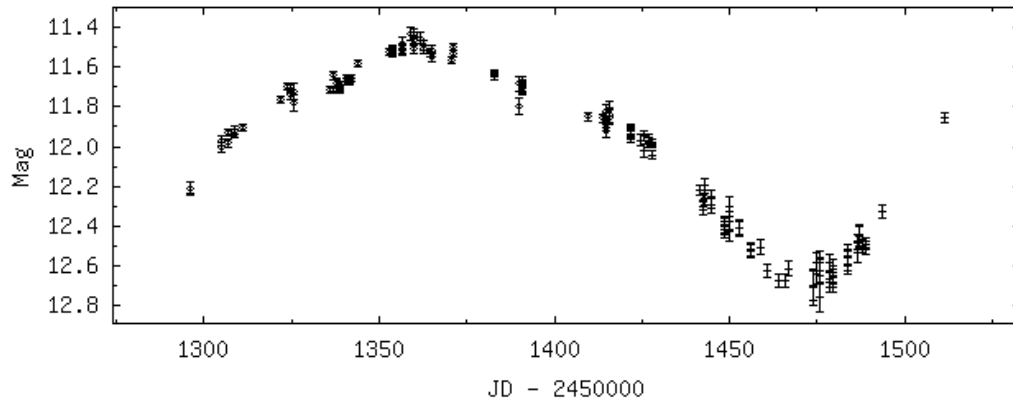
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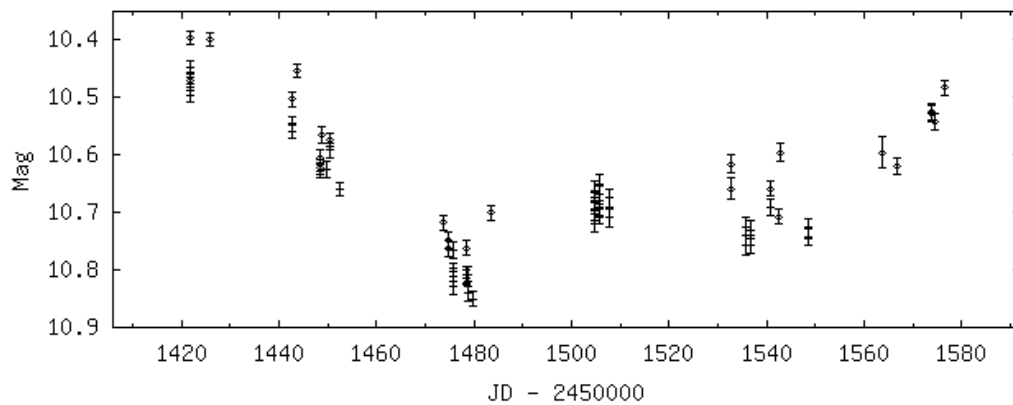
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NSV 25841 J2000 22 09 05.1 +45 30 29



NSV 26077 J2000 23 24 01.8 +46 52 13

