Photometric Properties of the RR Lyrae Star SS Piscium

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Abstract

Standard candles are useful tools in astronomy. These are objects whose intrinsic luminosity can be determined from observable properties. RR Lyrae stars are standard candles due to a relation between luminosity and brightness variation. We present V-band photometric observations of the RR Lyrae star SS Piscium. We have constructed a magnitude light curve from three observing nights. From the period of variation and a Fourier series fit to this light curve, we can determine the star's iron abundance and absolute magnitude. From the latter, we determine its distance.

Observations

Observed on three nights: 10/28, 11/4, 11/6

Equipment
- 14in Meade LXF2000-ACF telescope
- SBIG STL-1001E CCD camera
- V-band CCD filter
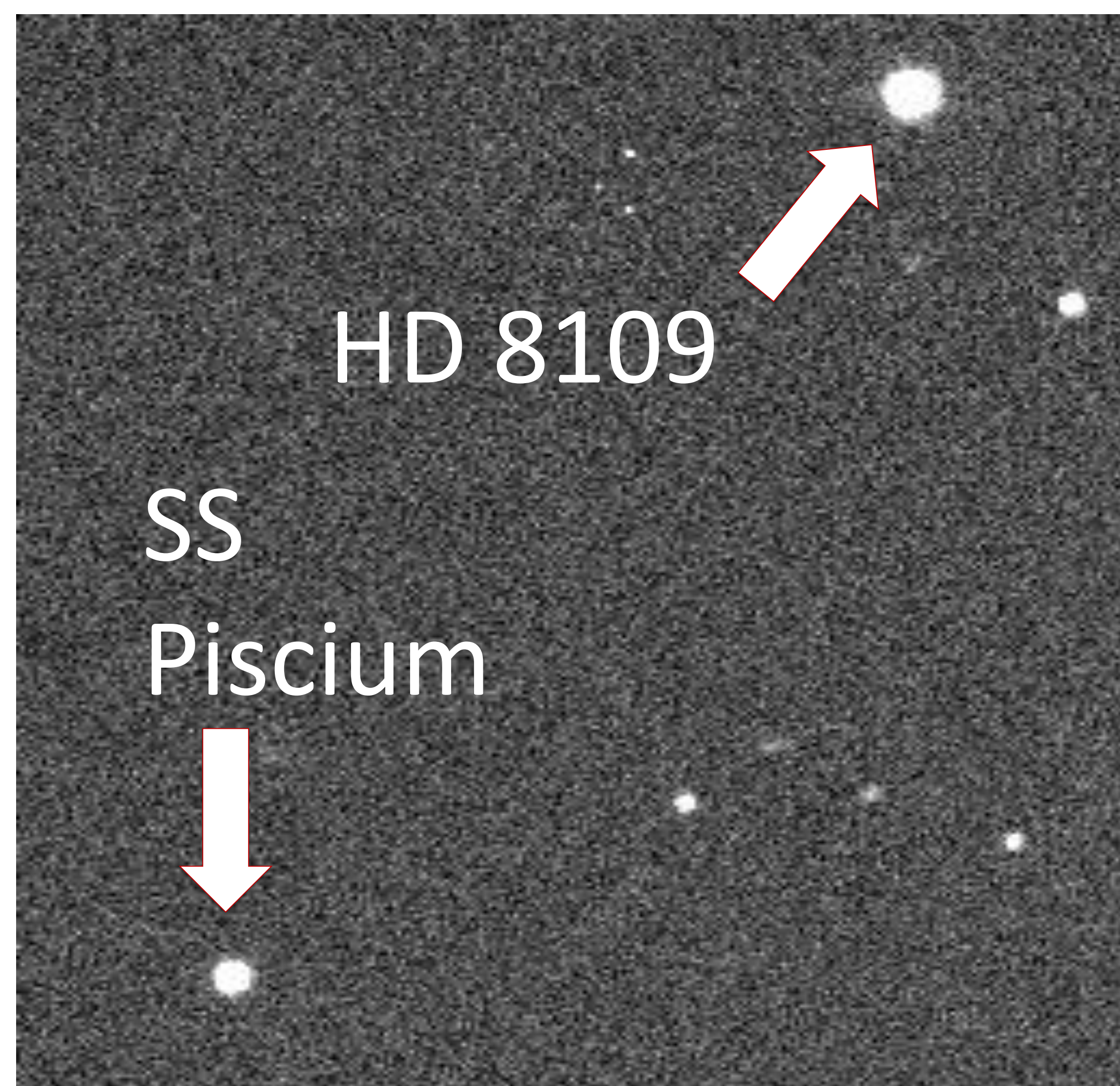
HD 8109

SS Piscium

Analysis Steps

- The star HD 8109 was used as a magnitude calibrator
- The magnitude of SS Piscium is calculated as

$$m_{SS\,Psc} = m_{HD\,8109} - 2.5\,\log_{10}\left(\frac{f_{SS\,Psc}}{f_{HD\,8109}}\right)$$

- Each night's data is combined into a continuous magnitude light curve
- We fit a Fourier series [1] to the combined curve

$$m_V(t) = a_0 + \sum_{n \geq 1} a_n \cos(2\pi n x + \varphi_n)$$

where

$$x \equiv \frac{1}{T}\left(t - t_{brightness\,maximum}\right)$$

- The variation period (T) and the Fourier parameters (a_n, φ_n) give the star's iron abundance [2]

$$[Fe/H] = 52.466\,T^2 - 30.075\,T + 0.131\,\varphi_{3-1}^2 + 0.982\,\varphi_{3-1} - 4.198\,\varphi_{3-1}T + 2.424$$

and its absolute visual magnitude [3]

$$M_V = -0.961T - 0.044\,\varphi_{2-1} + 4.447\,a_4 + 1.061$$
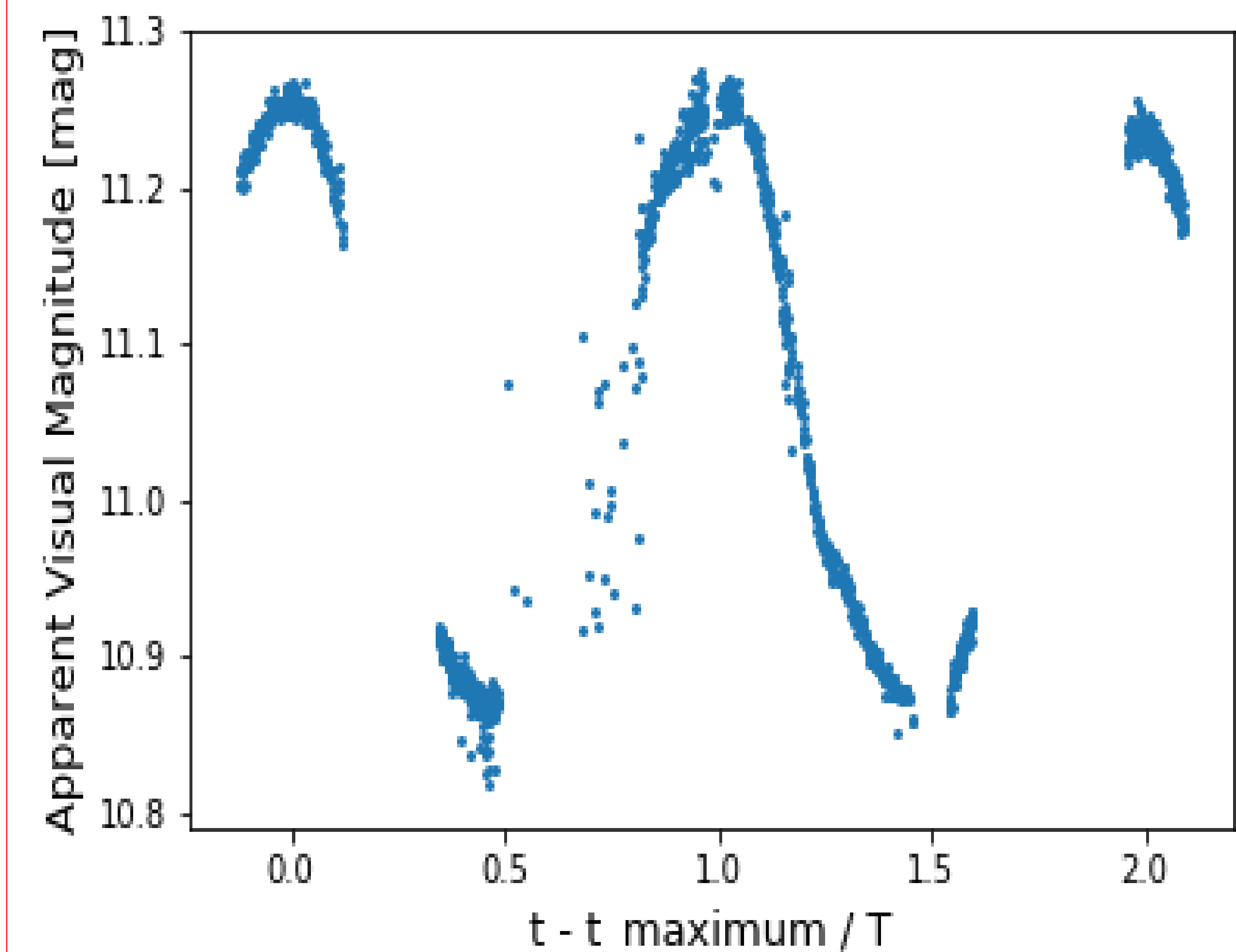
- The heliocentric distance to the star is

$$d = 10^{\frac{1}{5}(\langle m_V \rangle - M_V + 5)}\,[pc]$$

References

[1] arXiv:1210.7886 [astro-ph.GA]

[2] Morgan, S., et al. 2007 MNRAS, 374, 1421

[3] Kovács, G. 1998, MmSAI 69,49

Results

The resulting light curve of SS Piscium

Measurements
- Variation period
    T = 0.292 ± 0.002 day
- Apparent V-magnitude
    m_V = 11.09 ± 0.15 mag
- Absolute magnitude
    M_V = 1.13 ± 0.01 mag
- Iron Abundance
    [Fe/H] = -0.896 ± 0.181 [Fe/H]$_\odot$
- Heliocentric Distance
    d = 984.7 ± 70.3 pc