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UNUSUAL SLOW FADING OF STANDSTILL IN AT Cnc

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AT Cnc is a well-established Z Cam-type dwarf nova with clear alternations of dwarf nova-type phase and standstills (see Nogami et al. 1999 for the extensive review on this object). The presence of standstills, in addition to outbursts, is the defining feature of Z Cam stars, and standstills are considered to be equivalent to non-outbursting novalike (NL) variables with thermally stable accretion disks (cf. Osaki 1996 for a review of disk instability in dwarf novae). Standstills in Z Cam stars usually terminate with a sudden fading to quiescence, whose rate of decline is roughly equal to the rate of decline from outbursts.

The recent standstill of AT Cnc began in 2000 November, and has shown peculiar phenomena until now, 2001 May. [N.B. The portion prior to the standstill was not well covered by observations, since the object was only visible in the morning twilight. Several negative estimates with upper limits below 14th magnitudes indicate that the object had not started this standstill before October.] The object has been monitored as a part of VSNET Collaboration (http://www.kusastro.kyoto-u.ac.jp/vsnet/). Visual observations have been made by a number of observers, using the comparison star sequences calibrated in the V band. The typical error of visual estimates is $0^{\mathrm{m}}\!.2$ mag, which will not affect the following discussion. The light curve drawn from these observations is presented in Figure 1. A portion of the long-term light curve of AT Cnc is presented for comparison in Figure 2, which clearly shows the normal outbursting state of this dwarf nova. The remarkable difference between the figures demonstrates how unusual the present behavior is. The long-term light curve covering the 1995–2001 period is also available at

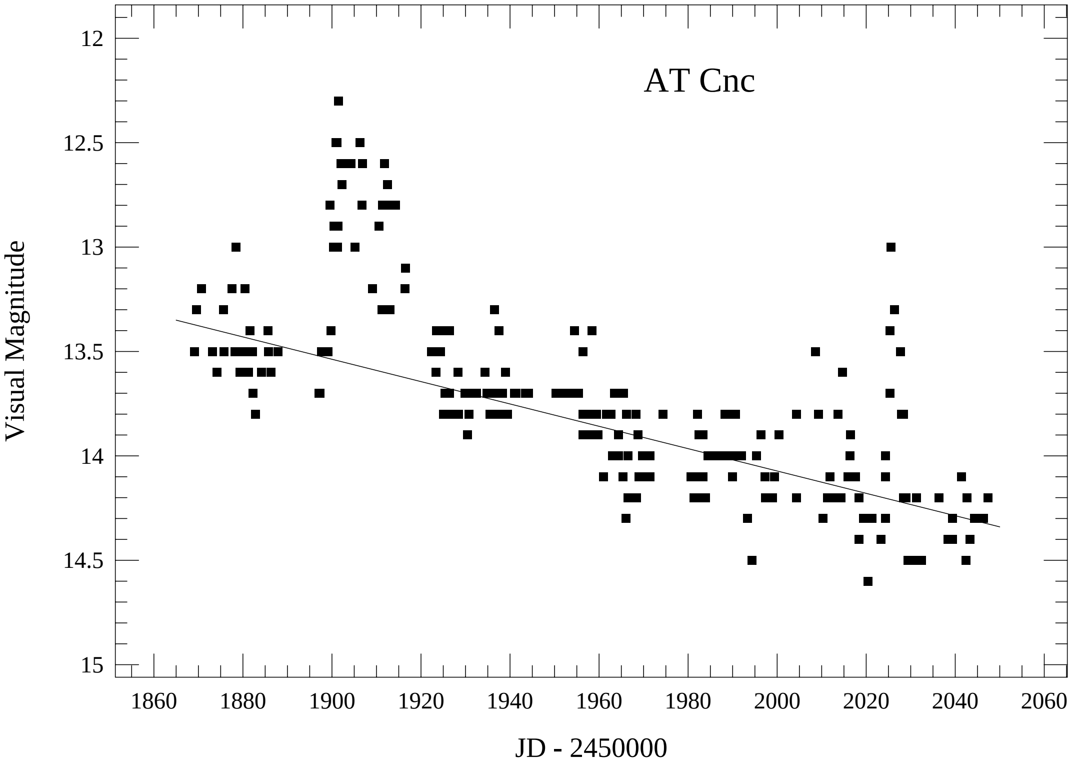

Figure 1. Light curve of AT Cnc. The solid line shows the decline at the rate of 0.0054 mag d^{-1}

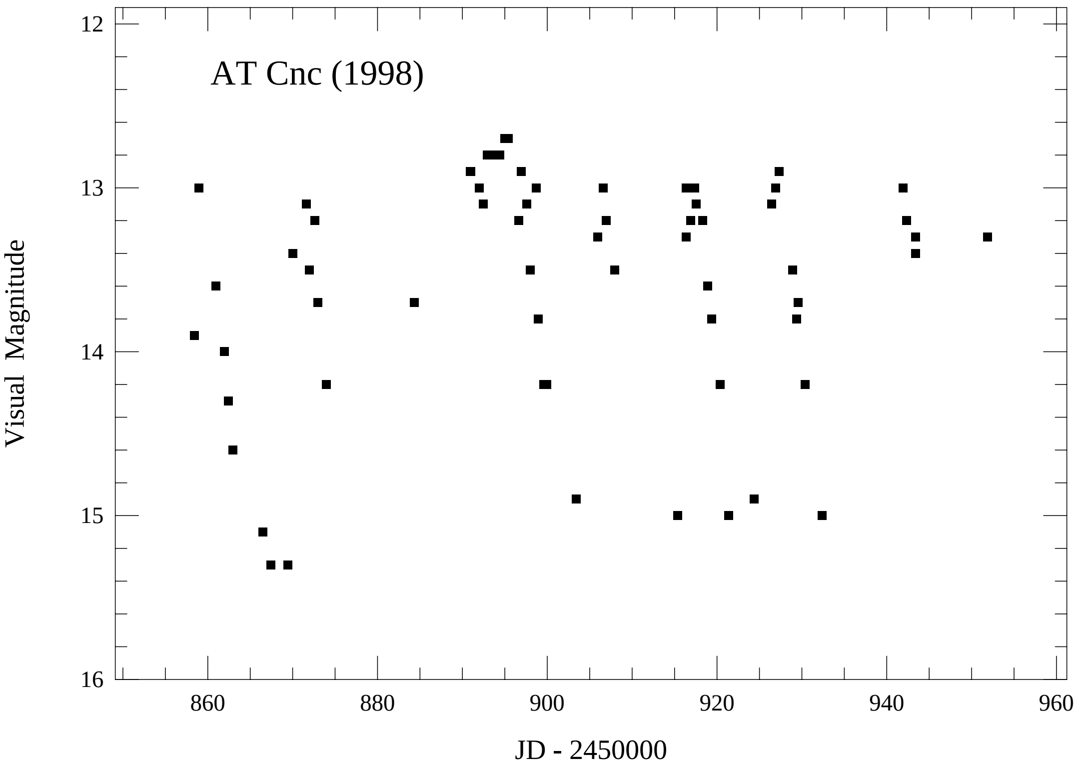

Figure 2. Light curve of AT Cnc in 1998, showing normal outburst cycles

http://www.kusastro.kyoto-u.ac.jp/vsnet/LCs/index/CNCAT.html . The first noticeable event during this standstill occurred in 2000 December (around JD 2451900), an outburst starting from the standstill. Since dwarf nova outbursts are believed to be a consequence of thermal disk instability, which occurs when the mass-transfer rate is below a certain limit, $\dot{M}_{\rm crit}$ (cf. Osaki 1996), such an outburst from the standstill is unexpected if it is triggered by the thermal disk instability. Another small outburst occurred in 2001 April (around JD 2452026), but this may be of different nature, as it was on the slow fading branch on the standstill, as described below.

The other very peculiar feature of this standstill is the slow fading throughout the standstill (except two "outbursts" described above). Such a trend is extremely peculiar among all known Z Cam stars. The rate of decline, measured by linear fitting to the light curve, after removing the two "outbursts", is 0.0054 mag d^{-1}, corresponding to the e-folding time of $\sim$ 200 d, which is totally inconsistent with the usual fading rate (0.3–0.4 mag d^{-1}) of this dwarf nova. This fading rate is more characteristic to slow fadings in VY Scl-type novalike variables (cf. Table 1 of Honeycutt et al. 1994). Together with the similarity of standstills with novalike variables, this similarity of fading rate and pattern suggests that we may be witnessing a VY Scl-type phenomenon (temporary reduction of mass-transfer rate) in a Z Cam star. However, as discussed in Honeycutt et al. (1994) and also in King et al. (1998), the standard disk-instability theory predicts that the system should undergo dwarf nova outbursts as the mass-transfer rate decreases. What has been observed in AT Cnc is the contrary: the "outbursts" are much more infrequent and smaller than in its normally outbursting state.

In VY Scl-type stars, an idea has been proposed to solve the same dilemma (Leach et al. 1999). Leach et al. (1999) could reproduce the VY Scl-type fading, without causing major outbursts, by taking the irradiation by the hot white dwarf into account. One may speculate that the same process may be taking place in the present peculiar standstill of AT Cnc. This is not the only similarity of AT Cnc with VY Scl-type stars. Nogami et al. (1999) discovered an intermittent P Cyg-type absorption feature which they interpreted as winds. Such intermittent winds are more commonly seen in VY Scl-type stars, and are rare in dwarf novae. The best example is BZ Cam (originally discovered by J. R. Thorstensen and presented in Patterson et al. 1996; see also Ringwald and Naylor 1998). The spectroscopic evidence of similarity of AT Cnc to BZ Cam was already addressed by Nogami et al. (1999), and the present observation of standstill may be an additional support to the relation between these seemingly different classes of objects. There may be a common underlying mechanism to produce the observed VY Scl-type or VY Scl-like features, as well as high-speed winds, in AT Cnc and BZ Cam. Since some of VY Scl-type stars are suspected to be steadily burning hydrogen on the surface of their white dwarfs (Greiner et al. 1999), the present anomalous state of AT Cnc would be an attractive target to search for similar phenomenon in a Z Cam-type dwarf nova.

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