A Planet Around the Dwarf Nova V893 Sco?

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The dwarf nova system V893 Sco shows eclipses, and very accurate groundbased eclipse timing has shown that there is apparently a sinewave in the O-C curve (Bruch 2014). The system has *partial* eclipses of the white dwarf and so is nearly edge-on (*i*=72.5°), the masses of the dwarf nova components are well known (totaling 0.88 ± 0.25 M$_\odot$), the O-C period is 10.19 ± 0.23 years, and the amplitude of the O-C curve is 0.73 ± 0.04 minutes. After considering all possibilities, Bruch concluded that there is a third body orbiting around the dwarf nova binary. The small O-C curve amplitude implies a very small mass, and Bruch calculates that this is a 9.5 Jupiter-mass planet in a 4.5 AU orbit. This is unique and unprecedented, as well as exciting. The vision of a planet orbiting a dwarf nova is very evocative, and the main science question would be how such a planet could form. But I think that the planet hypothesis is not strong, mainly because the O-C curve extends only from 1998 to 2013, so only 1.5 cycles of the sinewave are known.

The orbital period of V893 Sco is 0.075 days. Over the entire duration on Field 2, Kepler will measure 1180 eclipse times. The full eclipse duration is 7 minutes, and this forces us to request the 1-minute cadence. The deep eclipses (1.1 mag deep) will be centered to an accuracy of around one minute (or likely somewhat better) with least-square fits of a parabola to the ~7 magnitudes in eclipse. The amplitude of the apparent sinewave in the O-C curve is 0.73 minutes, with the one-sigma scatter of the 108 groundbased eclipse times being 0.4 minutes. When averaging a hundred K2 times together, I will get a timing accuracy of 0.1 minutes, for a dozen such values. Care will have to be taken to correct to the Solar System's barycenter (as has been done for the groundbased times). With this, the planet hypothesis will receive a severe test as to whether the K2 O-C curve follows the fitted sinewave (both in average value and slope) from the groundbased eclipse times. This alone will either kill or give good confidence to the planet idea.

V893 Sco is typically V=14.0 in quiescence, V=12.0 at the peak of the dwarf nova eruptions, and V=15.1 at the bottom of the eclipses. With the 1-minute cadence, the photometric accuracy will be 0.0016 mag in quiescence and 0.0036 mag in eclipse.

I will soon be making expeditions to the Harvard, to PARI, and to England in search of archival photographic plates with short exposures on which I will seek eclipses. I have long and deep experience in pulling out eclipse timings for cataclysmic variables from archival plates, and I expect that I will be able to get perhaps 40 eclipse times for the last sixty years. The main problem is likely to be keeping cycle count between the epochs. For this, having the incredibly good K2 times will be critical. If my extension of the O-C curve with archival data works, then I will test whether the 1998-2013 sinewave is valid over >6 orbital cycles, and this will either kill the planet idea, or give it good confidence.

Beyond the eclipses, V893 Sco is an interesting dwarf nova in its own right, and *Kepler* has looked at only a handful of these (e.g., Cannizzo et al. 2012). Photometrically, V893 Sco has both quasi-periodic oscillations (QPOs) and dwarf nova oscillations (DNOs) in the optical (Warner et al. 2003). The QPO period is around 350 seconds, again forcing the 1-minute cadence for K2. (The DNO is only seen in eruption, with a period of 25.2 seconds, and will be hard to measure with K2.) I will produce Fourier transforms of the quiescent light curve on an orbit-by-orbit basis (for 1180 orbits total), with the QPO frequency and amplitude then correlated with brightness and eclipse depth for confrontation with the competing models.

Bruch, A. 2014, A&A submitted arXiv:1404.2902.   Cannizzo, J. et al. 2012, ApJ, 747, 117.
Warner, B. et a. 2003, MNRAS, 344, 1193.