Improved astrometric analysis of Pluto

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Pluto is the main representantive body of the transneptunian objects (TNOs). It presents an atmosphere and a satellite system with 5 known moons (three of them discovered less than 10 years ago). To learn about the physical and dynamical properties of this system, the most efficient method from the ground — in spite of its rarity — are stellar occultations, which showed an evident drift of about 20 milli-arcsecond (mas) in the declination when comparing to the ephemerides [1].

This fact was a great motivation to repeat the reductions and analyses for a large set of our observations. Around 6500 CCD images of Pluto were obtained over 174 nights using 3 telescopes at Pico dos Dias Observatory (OPD/LNA) in Brazil, covering a time span from 1995 to 2013, and another 12 nights in 2007 and 2009 using the ESO/MPG 2.2-m telescope equipped with the Wide Field Imager (WFI). The astrometric positions were reduced using PRAIA (Platform for Reduction of Astronomical Images Automatically) [2] using UCAC4 as the reference catalog. Also, they were corrected for differential chromatic refraction and later the (x, y) center of Pluto was determined from corrections to the measured photocenter, contaminated by Charon. Both corrections were obtained with the original procedures.

The final astrometric positions were then compared to the planetary ephemerides (DE421+plu021) and occultation results. We obtained the mean values of 7 mas and 36 mas for the right ascension and declination, respectively, and the standard deviations of $\sigma_\alpha = 45$ mas and $\sigma_\delta = 49$ mas for the offsets in the sense of "observed minus ephemerides position". Moreover, we obtained the same behavior for the declination as obtained from stellar occultations, with a drift of around 100 mas since 2005.

With the imminent arrival of the New Horizons spacecraft to this system (scheduled for July 2015), new ephemerides may be corrected so that they do not present systematic drifts near the time interval that contains our observational data, allowing the determination of local adjustments to Pluto's orbit.

References: [1] Assafin, M.; Camargo, J. I. B.; Vieira Martins, R.; Andrei, A. H.; Sicardy, B.; Young, L.; da Silva Neto, D. N.; Braga-Ribas, F.: "Precise predictions of stellar occultations by Pluto, Charon, Nix, and Hydra for 2008–2015", A&A 515, A32 (2010). [2] Assafin, M.; Vieira Martins, R.; Camargo, J. I. B.; Andrei, A. H.; da Silva Neto, D. N.; Braga-Ribas, F.: "PRAIA - Platform for Reduction of Astronomical Images Automatically", Gaia follow-up network for the solar system objects : Gaia FUN-SSO workshop proceedings, held at IMCCE -Paris Observatory, France, November 29 - December 1, 2010 / edited by Paolo Tanga, William Thuillot.- ISBN 2-910015-63-7, p. 85–88 (2011).