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## NGC 1346 broadband polarization returns to its pre-changing-look level

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Post

The radio-quiet active galactic nucleus (AGN) NGC 1346 is known for its optical spectral evolution, that transitioned from a type-1 (broad and narrow emission lines observed in its total flux spectrum) to a type-2 classification (narrow emission lines only) somewhere between 2001 and 2018 (Senarath et al. 2019). The exact moment the source "changed of look" was, unfortunately, not caught by any telescope. In November 23, 2022, 1.83 m Perkins polarimetric measurements revealed that the source was still in a type-2 spectral state, based on its R-band polarization level :  $P_{\text{debiased}} = 2.95\% \pm 0.86\%$  and  $\Theta = 155.6\text{deg} \pm 8.0\text{deg}$  (Perkins Telescope Observatory, Flagstaff, AZ, USA). VLT/FORS2 observations carried out on August 12 and September 4, 2024, discovered that NGC 1346 changed back to its former type-1 classification: broad Balmer lines reappeared in its total flux spectrum and its continuum polarization drastically diminished ( $P_{\text{debiased}} = 0.15\% \pm 0.01\%$  and  $\Theta = 165.7\text{deg} \pm 2.6\text{deg}$  in August, and  $P_{\text{debiased}} = 0.09\% \pm 0.01\%$  and  $\Theta = 175.8\text{deg} \pm 4.1\text{deg}$  in September). Perkins polarimetric measurements on March 25, 2025 confirmed, based on the observed R-band polarization ( $P_{\text{debiased}} = 0.42\% \pm 0.35\%$ ,  $\Theta = 168.1\text{deg} \pm 18.2\text{deg}$ ) that the source stayed in a type-1 state (Marin, Hutsemekers & Jorstad 2025). Here, we report new Perkins polarimetric measurements obtained on September 24 and 25, 2025 in the R-band, showing that NGC 1346's polarization returned to its pre-changing-look level, indicating that the AGN most certainly transitioned back to its type-2 spectral classification. The Perkins telescope used the PRISM camera equipped with a polaroid (POL-HN38) and a R-band filter ( $\lambda_{\text{eff}} = 6407 \text{ Angs}$ ). The polarimetric observations involved four series of Stokes parameters (I, Q, and U measurements). A series consists of four observations of the polaroid at instrumental position angles of  $0\text{deg}$ ,  $90\text{deg}$ ,  $45\text{deg}$ , and  $135\text{deg}$ , with an exposure of 120 seconds at each position angle. The Q and U parameters were averaged over the series to calculate the degree of polarization, P, and position angle of polarization, Theta, and their uncertainties. The images were corrected for bias and flat field. We used field stars to perform both interstellar and instrumental polarization corrections. During the observations, the seeing was 2.5 arcseconds at an airmass of 1.3. The observed R-band magnitude is

14.285 +/- 0.006 on both September 24 and 25. The debiased polarization (following Simmons & Stewart 1985) is 3.72% +/- 0.14% at Theta = 142.5 +/- 1.0deg on September 24, and 3.13% +/- 0.77% at Theta = 120.0deg +/- 6.1deg on September 25. Such high values correspond to the 2022's polarization, when the source was still classified as a type-2. We thus conclude that NGC 1346 has likely undergone another changing-look event that would require swift new spectropolarimetric observation to understand what is the underlying phenomenon at work.

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