High-contrast imaging (HCI) is a key technique to directly image and characterize exoplanets. It requires both high angular resolution and strong stellar flux suppression. To achieve this, adaptive optics (AO) systems are combined with coronagraphs. One important limitation in HCI is the temporal error (servo lag) of the AO system, which reduces spatial resolution and leads to a loss of about one magnitude in contrast.

In the focal plane, this error produces a structure called the wind-driven halo (WDH), observed as asymmetrical wings of light oriented along the direction of the dominant wind layer, with an intensity depending on atmospheric conditions. Several approaches could mitigate this effect, including increasing the AO loop frequency, applying predictive control, or reducing the halo with image post-processing. However, a detailed understanding of the origin of this phenomenon is required to optimize these approaches.

To address this, we analyzed 10 years of VLT/SPHERE-IRDIS archival data to characterize the WDH. We then performed correlations with meteorological and AO telemetry data. We found a higher occurrence rate of the WDH than previously reported, and a clear correlation between high-altitude, high-velocity wind layers (jet stream) and with the loss of contrast in HCI images.