

TAKE-HOME MESSAGE

Even when the nucleus is obscured, optical RMS variability retains measurable links to the hidden AGN power and the integrated kinematic state of the narrow-line region.

SCIENTIFIC QUESTION

Can long-term optical variability in Type 2 AGNs trace the hidden nucleus and its NLR?

DATA & METHOD

412 Type 2 AGNs

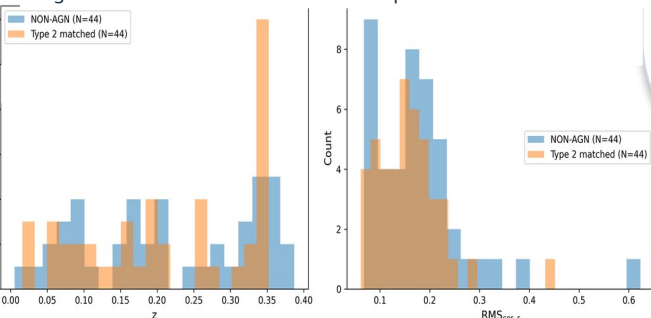
SDSS Stripe 82 multi-epoch ugriz photometry
+ ALPACA emission-line measurements

Noise-corrected RMS vs. line luminosity, EW, and velocity dispersion (Spearman; 3 σ clipping).

$$\text{RMS}_{\text{cor}} = \sqrt{\max(\text{RMS}^2 \text{PSF} - \langle \sigma_{\text{err}} \rangle^2, 0)}$$

CONTROL SAMPLE

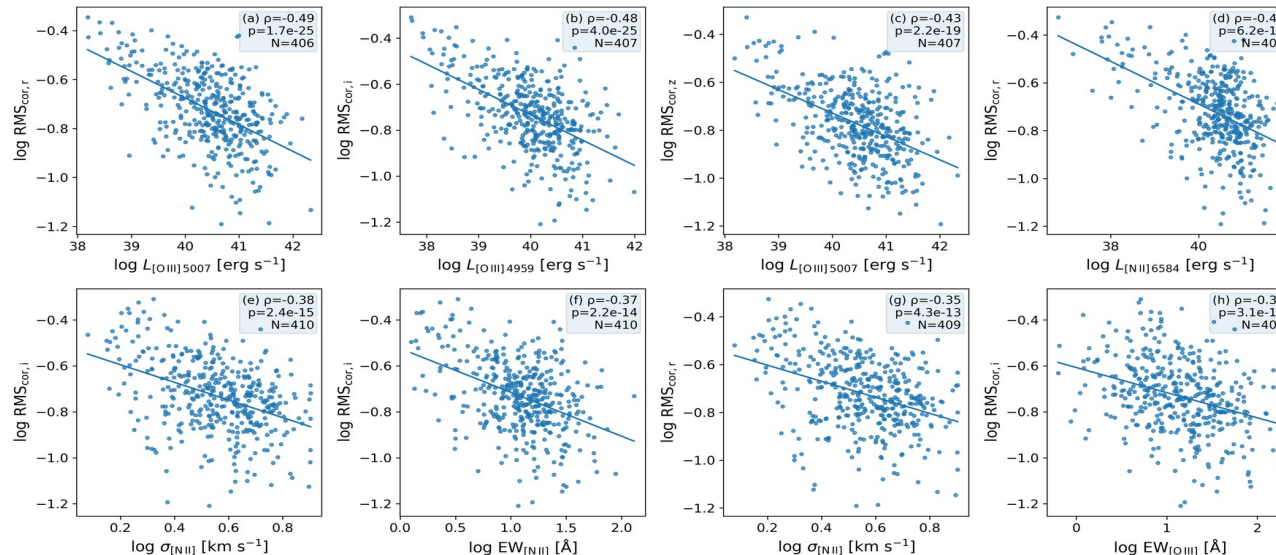
44 inactive/star-forming galaxies matched in redshift and mean r magnitude. RMS distributions remain comparable.



Type 2 AGNs show a broader, more coherent set of variability-spectral correlations; host and measurement effects do not fully explain the signal.

MAIN RESULT

More variable Type 2 AGNs have lower line luminosities, smaller EWs, and smaller velocity dispersions.



Representative correlations; strongest trends occur in r, i, and z. [O III] $\lambda 5007$ luminosity reaches $\rho = -0.49$ ($p = 1.7 \times 10^{-25}$).

LINE LUMINOSITY
 ρ down to -0.49

EQUIVALENT WIDTH
 ρ down to -0.37

VELOCITY DISPERSION
 ρ down to -0.38

CONCLUSION

Optical RMS variability provides a complementary population-level probe of the hidden accretion state in obscured AGNs, linking continuum variability to long-term ionising output and the integrated state of the NLR.

PHYSICAL INTERPRETATION

- Long-term ionising output**
The NLR responds over much longer timescales than Stripe 82 variability; narrow-line luminosity records persistent AGN power.
- Continuum-driven EW**
Narrow-line flux stays nearly constant while the observed continuum changes, producing the RMS-EW anti-correlation.
- Secondary kinematic link**
Partial-rank tests indicate that the RMS- σ trend mainly reflects shared dependence on AGN power.

ROBUSTNESS

Signed excess variance Δ reproduces the luminosity trend in g, r, i, and z, with no luminosity-dependent truncation

