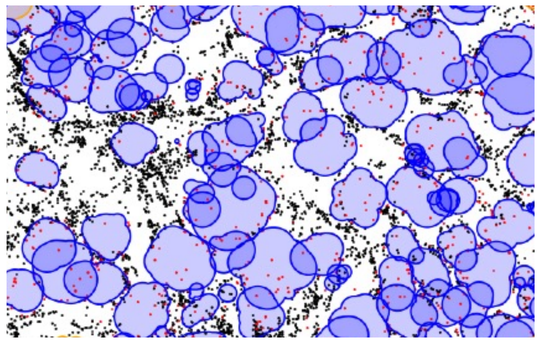
Lonely, Hungry Supermassive Black Holes

Anish S. Aradhey[1,2], Anca Constantin[2], Michael S. Vogeley[3], Kelly A. Douglass[4]

Introduction

What are cosmic voids?

- Testbeds for galaxy nature/nurture



A slice of the Sloan Digital Sky Survey (DR7), the galaxy catalog used for this study. Void regions are shaded blue, while wall galaxies are black. Credit: Douglass et al. 2023

What are active galactic nuclei (AGN)?

- Black holes with an appetite
- Emit variable light across spectrum

Why search for variability?

- Uncover obscured black holes

Methodology

- ~270,000 galaxies ($z \leq 0.11$)
- 12 yr. of NASA NEOWISE data
- Quantify **variation** (σ_{12}) and **coupling** (r) in two bands (W1 & W2)

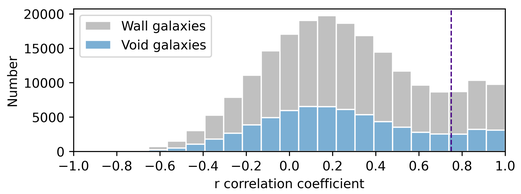


Figure 1. Distributions of the r correlation coefficient between W1 and W2 measurements for void/wall galaxies. We consider objects with r ≥ 0.75 to be variable.

Conclusions

- **Bright** galaxies are slightly more likely to be active in sparse regions
- **Consistent** with past findings

Hundreds of **overlooked** actively-snacking supermassive black holes show **variability.**

Cosmic **environment** has **subtle** effects on supermassive black hole **evolution.**

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

JAMES MADISON UNIVERSITY

[1] University of North Carolina at Chapel Hill
[2] James Madison University
[3] Drexel University [4] University of Rochester

A. A. and A. C. acknowledge support from the National Science Foundation award NSF: AST #1814594.

Results

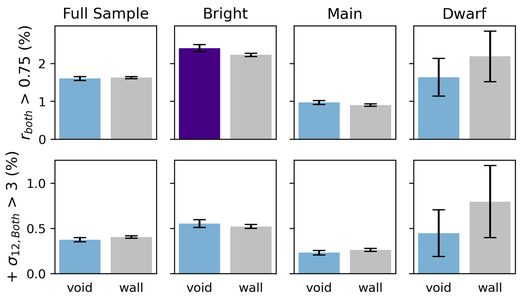


Figure 2. Void and wall variable fractions of each luminosity subsample using simple (top row, just considers r) and more stringent (bottom row, also considers σ_{12}) variability criteria. Purple shows significance.

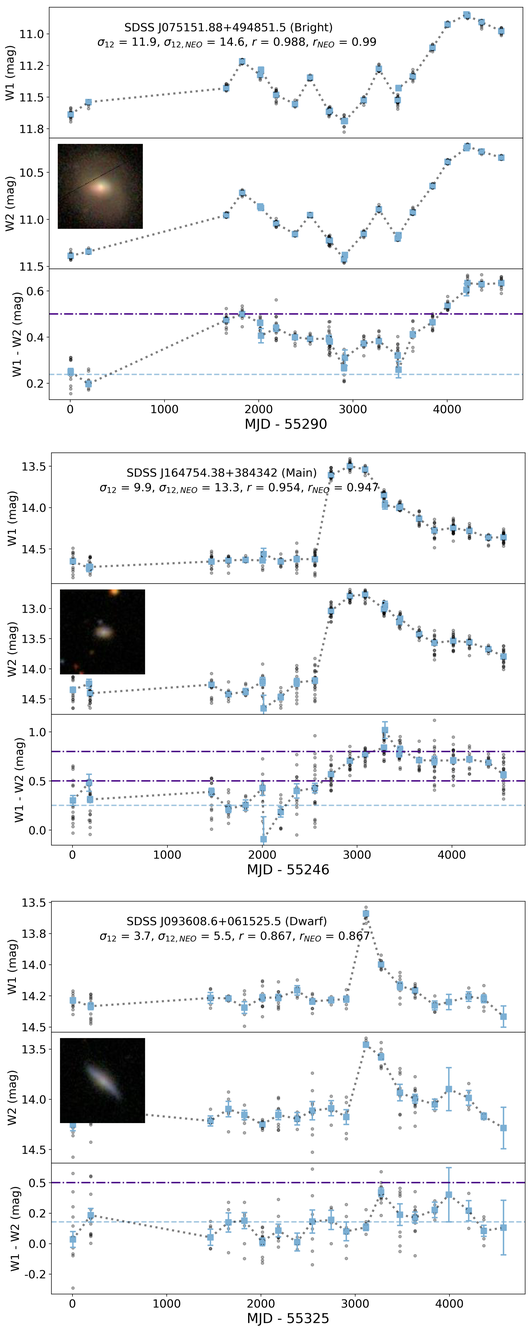


Figure 3. WISE light curves of galaxies not classified as BPT/WISE color AGN. Thumbnails are from the SDSS.