Radio variability of AGN in the VAST Phase I pilot survey

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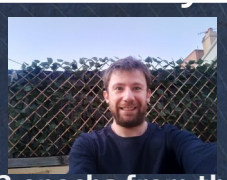

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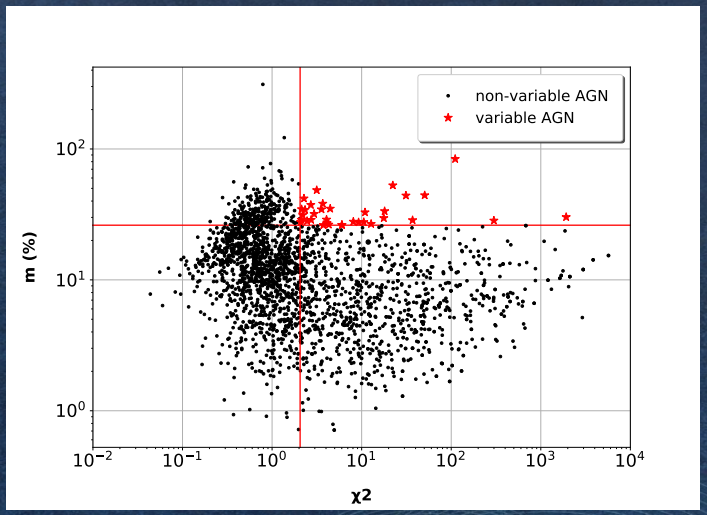
We present a study of AGN using 12 epochs from the Australian Square Kilometre Array Array Pathfinder Survey for Variables and Slow Transients (VAST-P1) Phase I Pilot Survey and the Rapid ASKAP Continuum Survey (RACS). We searched for radio detections of AGN within 15 arcsec of the reported position in the Veron catalogue, the Wide-Field Infrared Survey Explorer (*WISE*) Blazar-like Radio-Loud Sources catalogue and the kernel density estimation (KDE)-selected BL Lac candidates catalogue. We found 33 variable AGN showing variability on timescale of months with modulation indices between 26% and 83% . We conclude this variability is likely due to scintillation.

Selection of variable AGN



$$m = \frac{1}{\bar{I}}\sqrt{\frac{N}{N-1}(\overline{I^2} - \bar{I}^2)},$$

$$\chi^2 = \frac{N}{N-1}\left(\overline{wI^2} - \frac{\overline{wI}^2}{\bar{w}}\right),$$

Variables having at least:

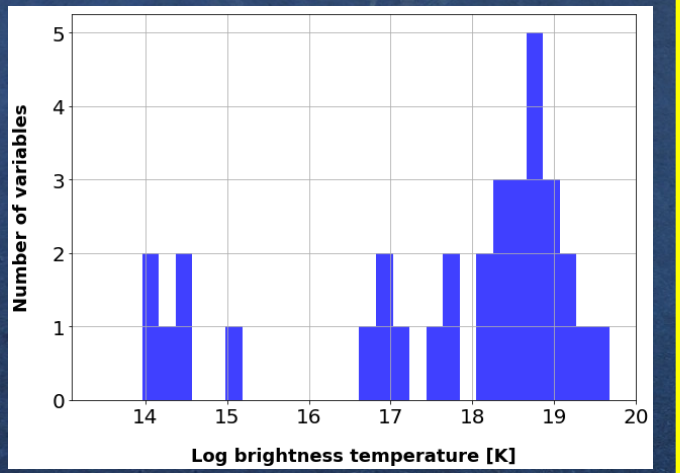
Modulation index m = 26%

χ^2 = 2.06

Scintillation causing radio-variability

$$T_b > 10^{12}\ K$$

The values of brightness temperature are Larger than 10^12 K even considering Doppler boosting effect.



Distribution of brightness temperatures of the variable AGN. The high values suggest that the radio variability is due to scintillation.

Variables for each AGN class

BL Lacs and QSOs have the largest percentage of variable sources. We found 33 variables over a total number of 3667 AGN. Hence, 0.9% of sample is variable.

Sources	Ratio	%
Seyfert galaxies	5/750	0.67%
BL Lacs	7/373	1.88%
QSOs	21/1771	1.19%
Total	33/3664	0.9%

Scintillation Model

We compared the values of modulation index we estimated with our data with the values of modulation index predicted by a scintillation model based on H alpha maps of the Milky Way. The plot on the right shows modulation index vs. timescale for the variable AGN. The timescale was estimated by the scintillation model. We have observed modulation index values(colored triangles) and predicted by the model (black triangles).