

VLA Calibrator Search Tool for GMRT Users

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(Jan 12, 2022)

Introduction: While planning the GMRT time-domain as well as interferometric observations, the VLA calibrator list (ref. here) is extensively used to identify suitable calibrators (primarily phase-calibrators). To aid the user in this calibrator identification process, the first version of the web-based VLA Calibrator Search tool for GMRT users was developed around 2014 (ref NGK). It was a basic tool which facilitated a cone search for VLA calibrators with the user-specified central position and radius of the cone. Despite having just one search criteria, the tool has helped many users.

New search criteria provisions: Recently, feedback was received from some GMRT users that the tool can be much more useful and less time consuming, especially when the user has to find out multiple calibrators, if additional options to further filter out the search output are provided. Following a discussion, it was decided to provide options to search based on frequency bands, above a given flux density limit, for different VLA configurations, as well as for specified limits on UVMin and UVMMax.

Search Criteria and Logic: The list of all VLA Calibrators (1865 in total), downloaded in the text format, is used as the input for the search tool. The search runs through the sequence of options in the following hierarchy.

1. Frequency Bands - Relevant to GMRT, there are two options available, “90cm” and “20cm”. One can choose either one of these bands or both of these together.
2. Flux Density Lower Limit (Jy) - If specified, calibrators having flux densities above or equal to this limit are selected.
3. Array Configurations: If specified, calibrator parameters for only this VLA configuration are considered. The GMRT central square roughly corresponds to VLA configuration D.
4. Calibrator Code - The calibrator codes P, S, W or X can be chosen. If the array configuration above is not selected, then a calibrator is selected as long as it has the specified code for any of the configurations.

5. Maximum UVMin - Calibrators with UVMin either below or equal to this specified limit, as well as the calibrators which do not have any UVMin in the original VLA calibrator list, are selected.
6. Minimum UVMax - Calibrators with UVMax either above or equal to this specified limit, as well as the calibrators which do not have any UVMax in the original VLA calibrator list, are selected.
7. Radius - This is the maximum angular distance from the target source. To reduce the computing time, this filter is applied only after the calibrators are already shortlisted using all of the above mentioned filters. Here the calibrators having angular distance equal to or below the specified value are selected.

As a last step, all the calibrators that follow all the specified criteria are arranged in the ascending order of the angular distance from the target source and displayed at the UI.

A useful tip: *For sources in the declination range +5 to +22 degrees, around the source transit times the GMRT antennas need to switch between two Alt-Az tracking paths (inner and outer) to continue tracking. This switch is unavoidable, and sometimes it could add an extra time of 10-15 minutes to the overheads. To minimize this overhead, the users are encouraged to keep both calibrators and targets on the same side of declination 19.1 degrees, whenever possible.*

General recommendations on how to choose calibrators in different bands and for different antenna-configurations

Choosing calibrators for GMRT band-4 (550 - 850 MHz): *VLA Calibrator manual does not list flux density and other characteristics at 50cm. In that case, users should look at the properties of calibrators at least in two bands to decide the suitability. If information is available at 90cm and 20cm, that can be used to extrapolate to 50cm. If information is not available at 90cm, the information at 20cm and one more band higher than 20cm should be looked at. If the source flux is rising towards low frequencies and if the calibrator is PPPP or SSSS or combination of P and S at 20cm without UV limits or sufficiently large UV limits to meet the requirement at 20cm, that calibrator can be selected for band-4.*

Choosing calibrators for GMRT band-2 (125 - 250 MHz): *For GMRT band-2, calibrators qualified for 90cm mostly will work.*

Choosing calibrators for GMRT Central-Square and Full-array configurations: The spatial extent of GMRT Central Square is comparable to the VLA's D configuration, and hence, the calibrators suitable for VLA's D configuration can be used with the central square antennae of GMRT. The extent of GMRT's full-array lies between those of the B and A configurations of VLA, and hence, the calibrators suitable for those configurations can be used with GMRT's full-array.

References:

List of VLA Calibrators : <https://science.nrao.edu/facilities/vla/observing/callist>