Executive Summary: Observing with MUSTANG-2

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1 Introduction

As more projects have been observed with MUSTANG-2, we have accumulated better quantification of its performance using different scan methods. Our default scan pattern is a Lissajous Daisy (LJD), with which we can vary the scanning radius. We have predominantly worked with scanning radii of $2.5'$ or $3.0'$, but larger scan size are also possible. ($2.0'$ is likely the smallest one could consider.)

Some other scan patterns (not LJD) have also been used, but are not referenced here.

We have performed simulated observations of galaxy clusters with $1.0' < \theta_{500} < 4.0'$ to assess trade-offs between the $2.5'$ and $3.0'$ scans. (For simplicity, θ_{500} can be taken as the radius interior to which nearly all of the signal originates). There is certainly room for MUSTANG-2 to observe structures that are outside this characterization, and the information here may help the proposer formulate an initial assessment of feasibility. The MUSTANG-2 team is happy to entertain all potential science with MUSTANG-2 and can assess the technical feasibility of other projects that fall outside of the regime discussed here.

2 Executive Summary

While noise performance is an essential part of estimating time, we stress that signal filtering should also be given equal consideration. The amount of signal filtering is non-trivial, but it is closely related to the scales of the signal. Figure 1 shows the rather dramatic filtering for very large objects on the sky (the cluster at z=0.1). The filtering improves (diminishes) rapidly, but never becomes negligible. Broadly, how much signal lies beyond (outside) of the instantaneous field of view (FOV) of MUSTANG-2 ($4'$). However, scan size also matters, where larger scans result in less signal filtering. For objects whose signal lies predominantly (e.g. θ_{500} for galaxy clusters) within $3'$, the trade-offs between the $2.5'$ and $3.0'$ scans are minimal. We propose the following guidelines:

- Use the $2.5'$ scan
  - if you are primarily interested in (detecting/quantifying) the peak signal, or
  - if the entire signal (e.g. θ_{500}) falls within $2.0'$.
- otherwise, the $3.0'$ scan should perform equivalently or better.

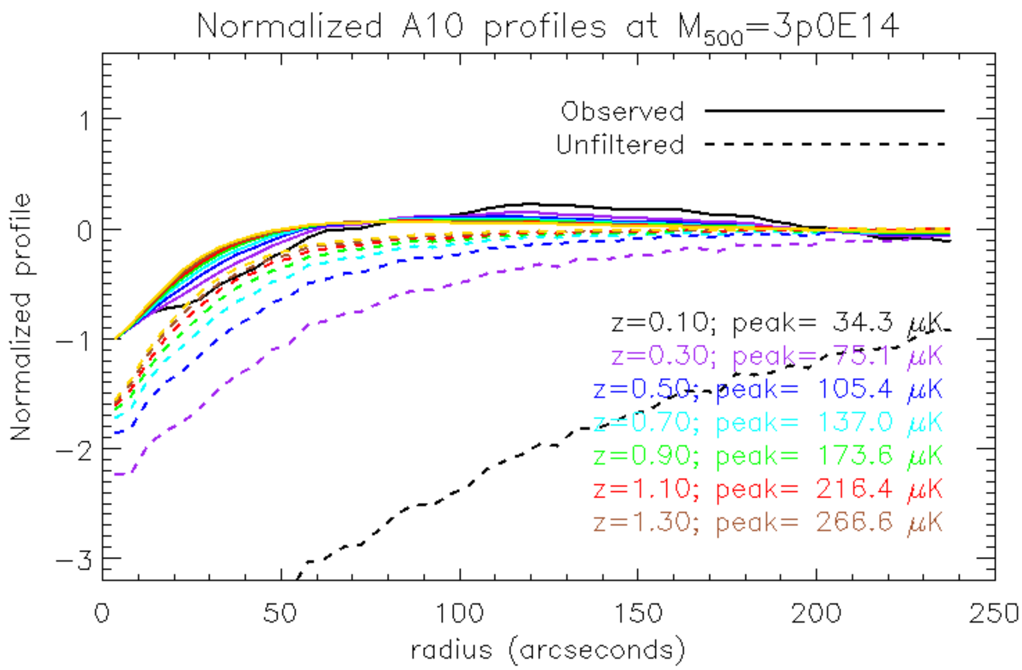

Figure 1: A selection of normalized surface brightness profiles across a range of redshifts for $M_{500} = 3.0 * 10^{14} M_{\odot}$. The dashed lines show the profiles before filtering and the solid lines show the profiles after filtering; both profiles are normalized by the respective peak of the filtered (observed) profiles.

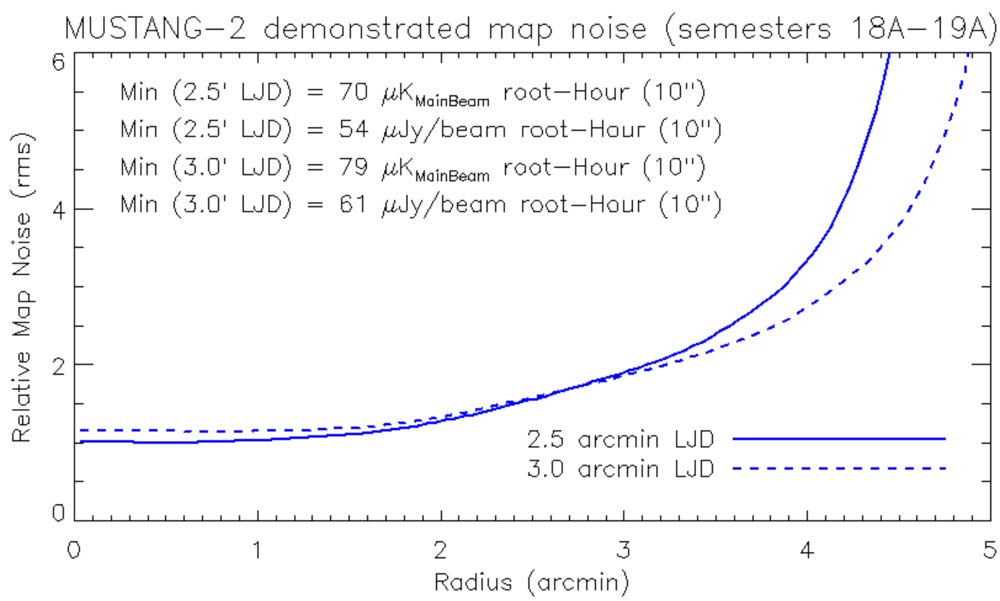

Figure 2: Mapping speed values (in this figure) refer to the RMS within the inner $2'$ of a map smoothed by $10''$. The difference in the central $2'$ is just over 10%, however beyond $3'$, the difference becomes more pronounced.