



THE UNIVERSITY OF
CHICAGO

COMPUTATIONAL AND APPLIED MATHEMATICS
STUDENT SEMINAR

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Polychromatic Map-making from Imaging Telescopes
with Asymmetric Beams

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Jones 226, 5747 South Ellis Avenue

ABSTRACT

Data from an imaging telescope with an asymmetric antenna pattern that varies significantly with wavelength can be used to reconstruct images in multiple wavelength bands from a single set of scans. This is potentially particularly valuable for an instrument such as QUBIC, because the QUBIC antenna pattern has multiple peaks with wavelength-dependent positions. We quantify the ability of such an instrument to reconstruct polychromatic maps both analytically and numerically. When the telescope has full-sky coverage, it is convenient to transform to the spherical harmonic basis. Hence we analyze statistical properties of the signal reconstruction as a function of the A_{lm} coefficients of the antenna pattern. When the telescope observes only part of the sky, no such transformation can be made—hence more computation is required in this case. We compare monochromatic and polychromatic map-making to determine the number of wavelength bands that can be accurately reconstructed in a QUBIC-like instrument as a function of angular scale. This formalism can be applied to other instruments whose antenna patterns have features that vary strongly with wavelength.