ESTIMATOR BASED ITERATIVE DATA REDUCTION FOR LARGE FORMAT SUBMILLIMETER ARRAYS - THE VIEW OF THE WORLD THROUGH SHARC-2

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The arrival of a new generation of large format bolometer detector arrays in submillimeter astronomy has brought with it new possibilities as well as new challenges in the field of data reduction. A key aspect of successful data reduction at submillimeter wavelengths is the proper rejection of the rapidly varying and bright atmospheric emission that often dwarfs the typical astronomical signal by several orders of magnitude in power. The large number of pixels, now available in new instruments like SHARC-2, all simultaneously collecting information on the atmospheric background, enable novel approaches of sky subtraction without the traditional differencing via position-switch or chop, thus promising to overcome a range of problems associated with chopped images.

The elimination of differencing, however, makes one more exposed to other sources of slowly varying signals in the data stream, such as instrumental drifts, and require instrumental stability on longer time-scales, lower 1/f detector noise properties, as well as a more in-depth understanding of the instrument itself. However, the experience of SHARC-2 has demonstrated that the right combination of carefully chosen observing modes together with an iterative data reduction approach, modeling all relevant signals via a series of maximum-likelihood estimators, can achieve images with unprecedented clarity and fidelity.

While its relative simplicity cannot match singular value decomposition (SVD) algorithms in rigour, the estimator based approach can readily deal with model non-linearities, like those arising from internal detector gain fitting, while the sequential solving of the various models provides more intuitive insight into the workings of the data reduction and allows for easier fine tuning for any particular data set. Meanwhile, the processing time requirement of an estimator based reduction algorithm is relatively modest and is expected to scale linearly with the size of the incoming data stream, making it an attractive choice for future instruments boasting ever larger pixel counts and/or increased sampling rates.

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