Exploring spatial variations in PSF shape

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Science Image Selection Criteria
(*quadrant based*)

- 2020-01-12 <= night date <= 2020-03-31
- DIQ (median FWHM) <= 3.0 arcsec
- Airmass <= 1.1
- Moon altitude < 30 deg.
- Photometric ZP > 25.5 mag.
- 1000 <= number PSF-fit catalog sources <= 5000 (*g*), 6000 (*r*)
- Number of matching PS1 calibrator stars >= 250
- Exptime = 30 sec.
- Processing quality status flag > 0
- Archive status > 0

- Total number of quadrant images in *g*-filter = 84,972
- Total number of quadrant images in *r*-filter = 71,417

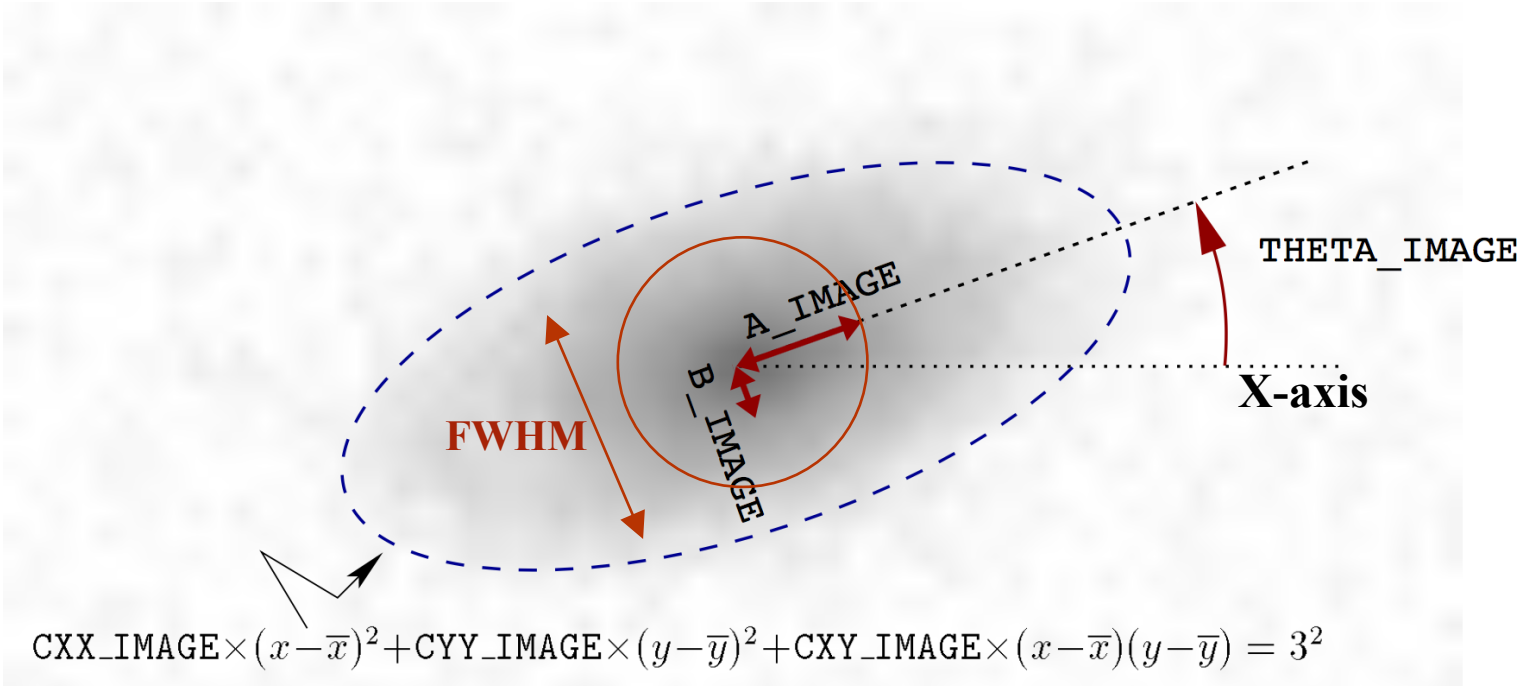
Procedure

- Partitioned each quadrant image into 8 × 8 bins (~ 6.5 × 6.5 arcmin^2 bins).
- Used ZTF sources with mags: 13.5 <= mag <= 18.5.
- Used *raw* archived catalogs with **no corrections** applied to photometry.
- From SExtractor (aperture) catalogs, stored *FWHM* and ellipse fit parameters: *A*, *B*, and *Theta* per source.
- Used only unmasked, uncontaminated ZTF extractions with *flags* = 0.
- Matched to *stellar* sources in PS1 catalog per quadrant partition over 8 × 8 grid therein.
- Computed *Elongation* = *A* / *B* per source.
- Normalized the per source *FWHM*, *Elongation*, *Theta* by their respective frame medians
- Computed the median of normalized *Elongation*, *FWHM*, *Theta* per quadrant partition.
- Stitched all 8 × 8 quads × (8 × 8 partitions per quad) = 64 × 64 bins into mosaic.

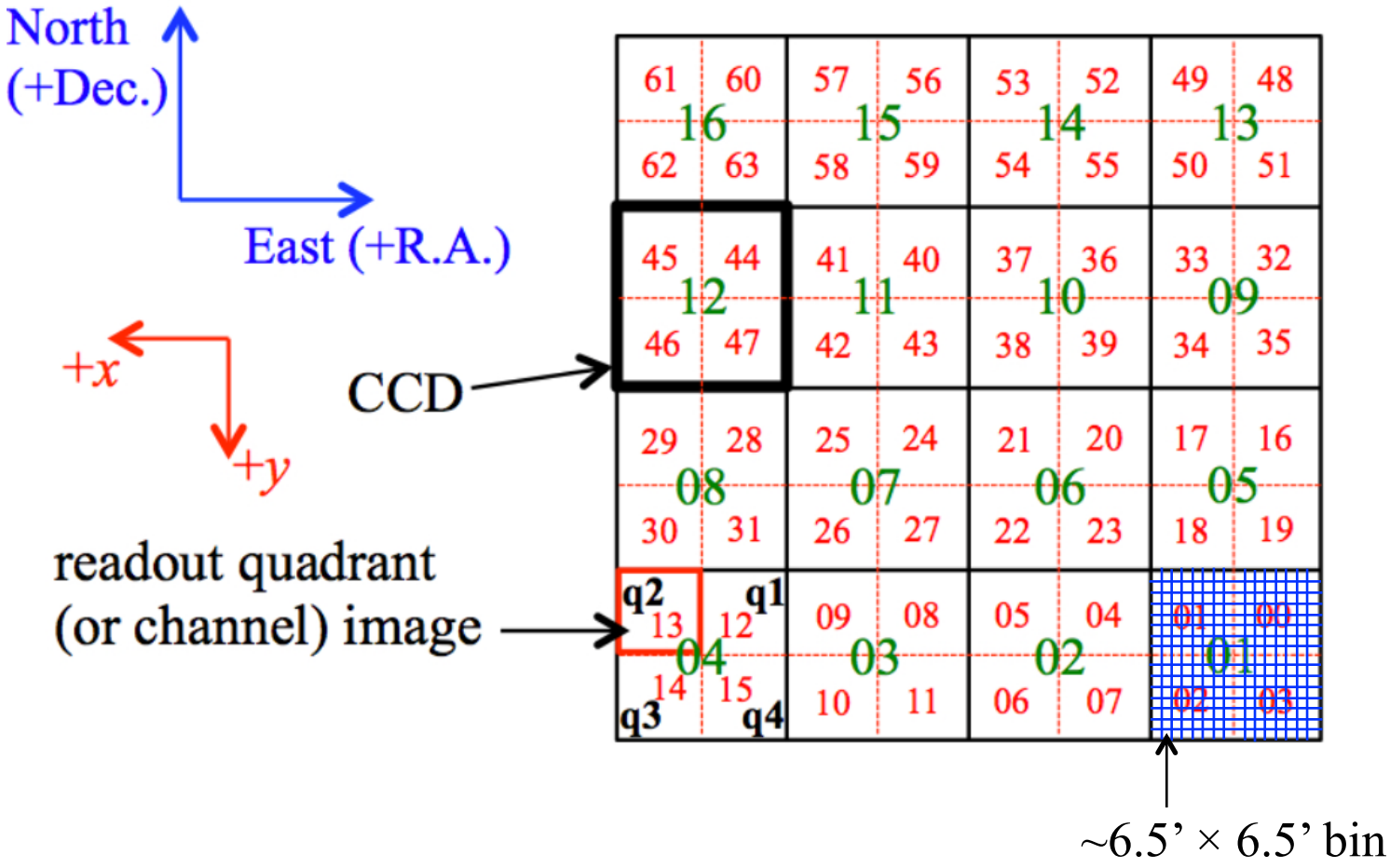
- Resulting number of sources per bin: ~ 6,000 – 20,000

Parameters Extracted per source

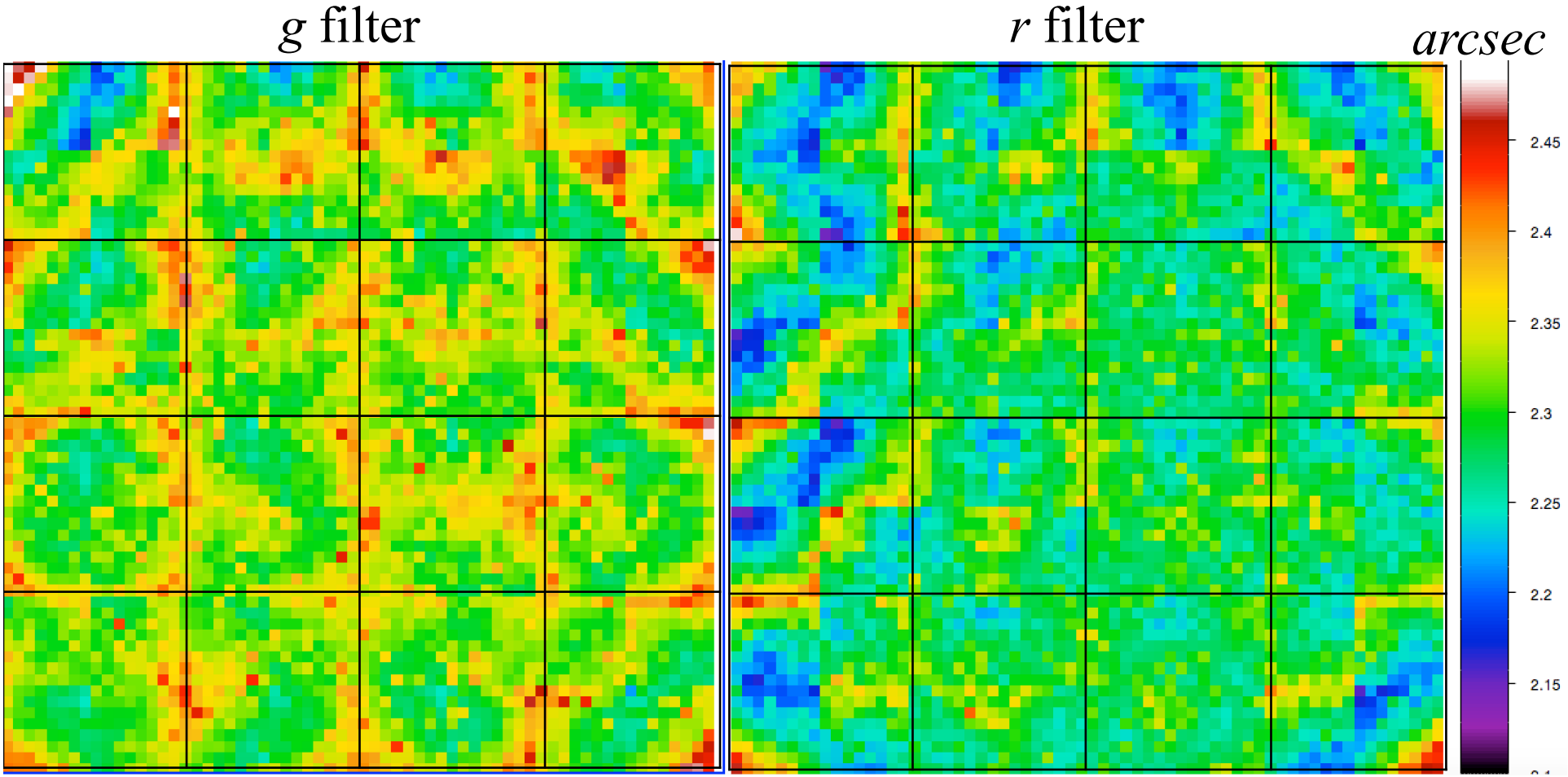
- *FWHM* ~ 2 * sqrt(isophotal area contained within half maximum / π).
- Semi-major axis (*A*): extent of maximum spatial RMS (2nd moment) of light profile.
- Semi-minor axis (*B*): extent of minimum spatial RMS (2nd moment) of light profile.
- *Elongation* = *A* / *B*.
- *Theta* = angle between A and + X-axis (counterclockwise > 0; clockwise < 0).



Assumed CCD / quadrant image layout



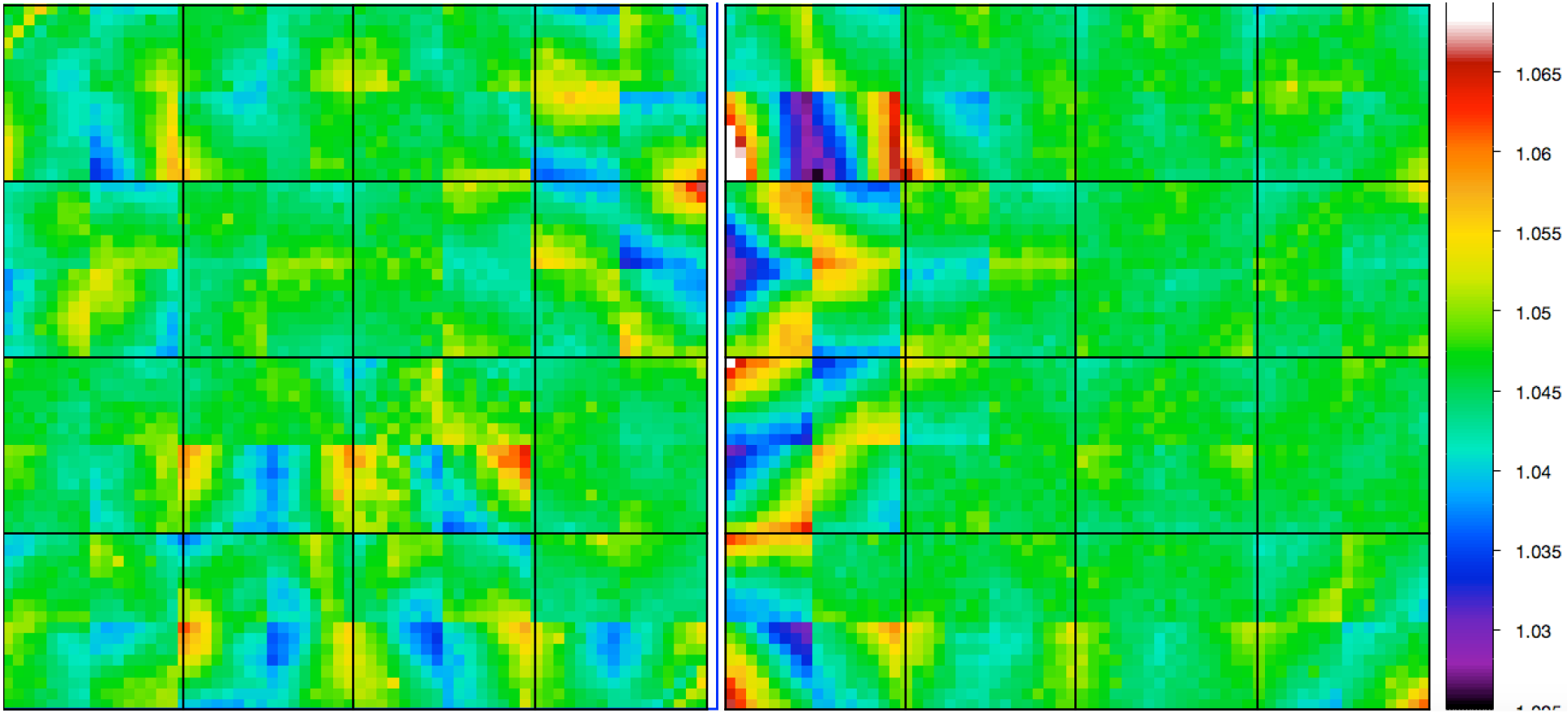
Spatial variation in PSF FWHM (2020 Jan – Mar)



Spatial variation in PSF Elongation (2020 Jan – Mar)

g filter

r filter



Spatial variation in orientation of PSF elongation (2020 Jan – Mar)