# Calibration of DES data using Gaia spectra

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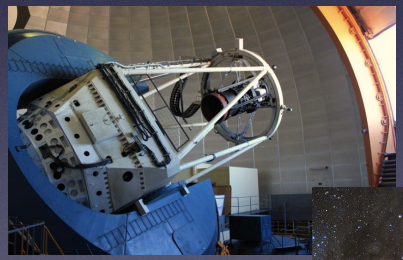
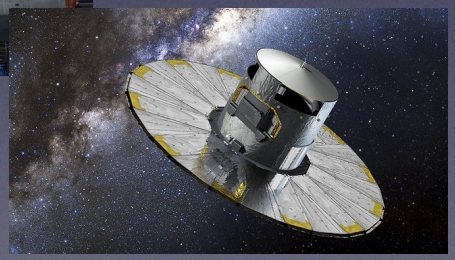
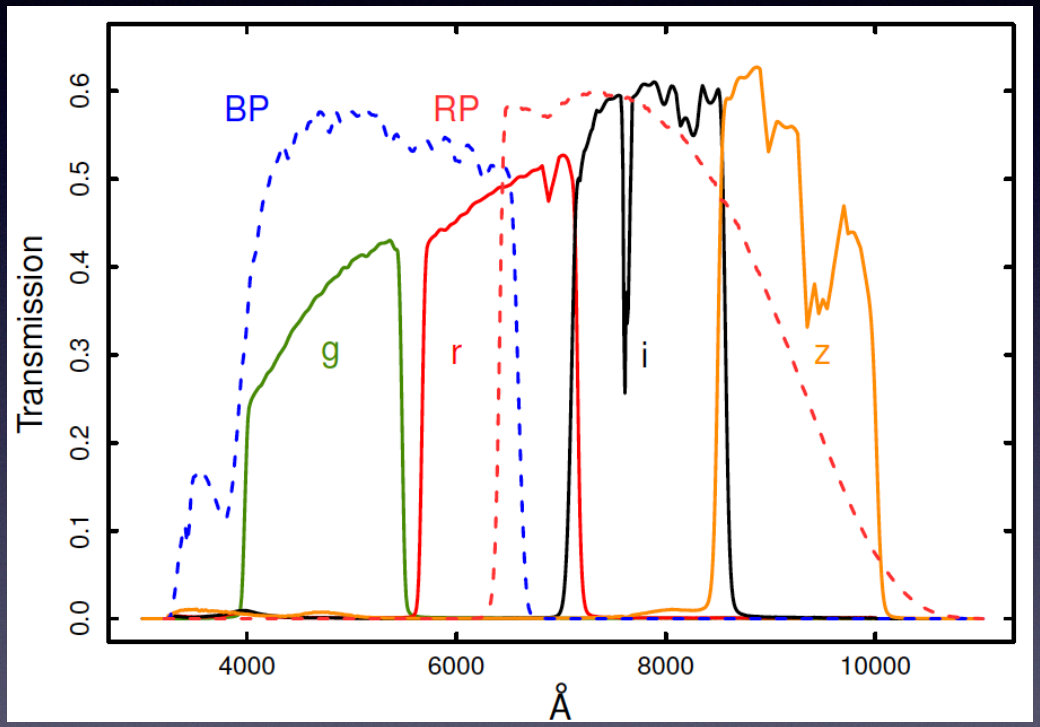
# DES and Gaia filter overlap

- External data shall be provided in order to limit bias in colors for PSF modeling less than 0.2% on scales used to model the PSF.

- Question: Can we use Gaia data for photometric Calibration of DES data to fulfil the above requirement?







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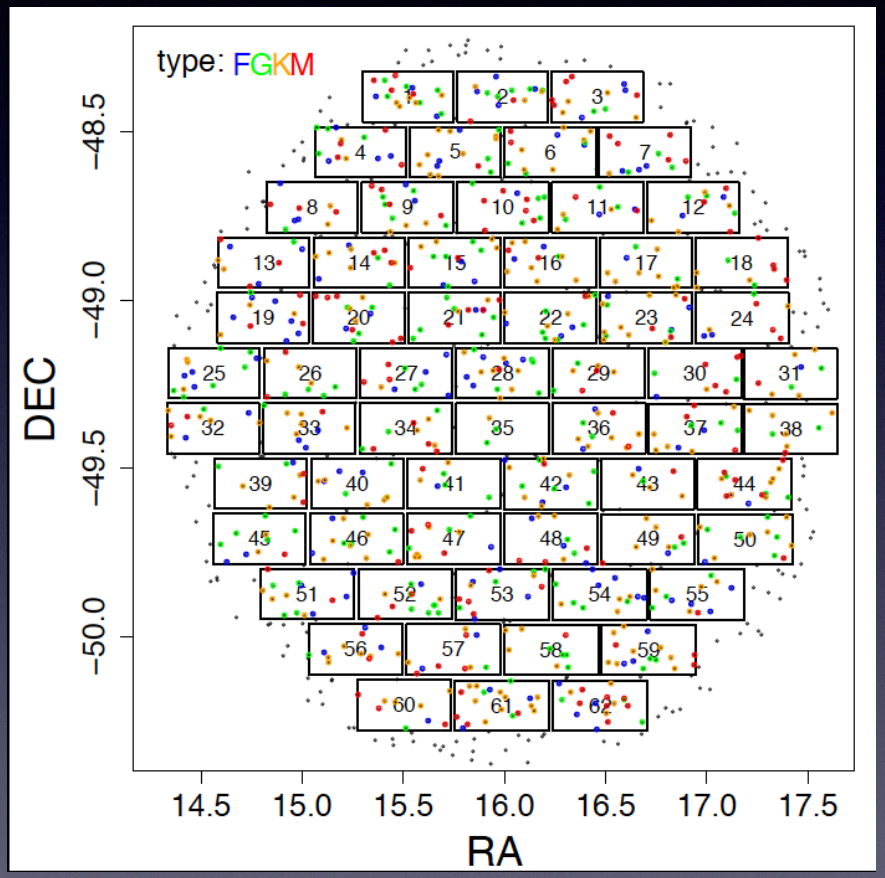
# DES photometric calibration

- ~ 10 exposures cover each point of footprint.
- At low density regions 800 Gaia stars are observed down to g=20 per each exposure (~13 per each CCD)
- The zeropoints at CCD level can be determined with uncertainty of ~0.7% using 10 Gaia stars.



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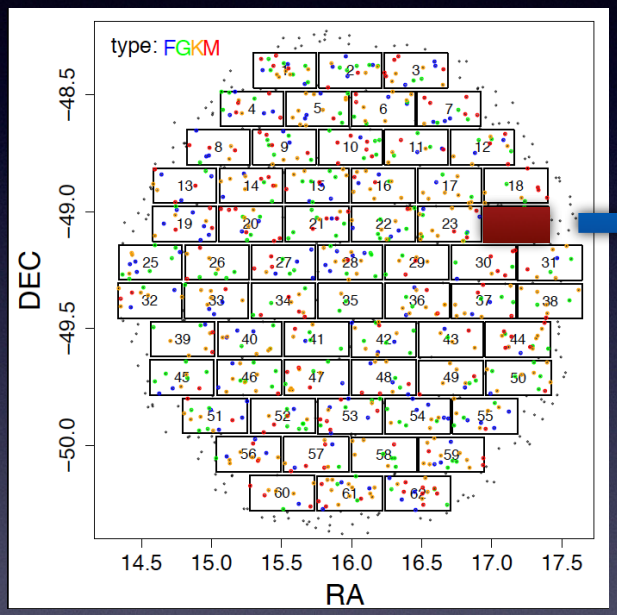
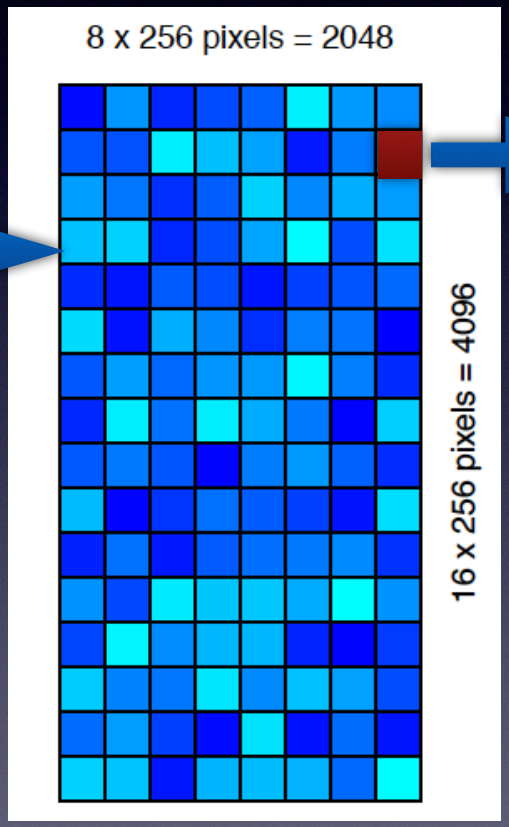
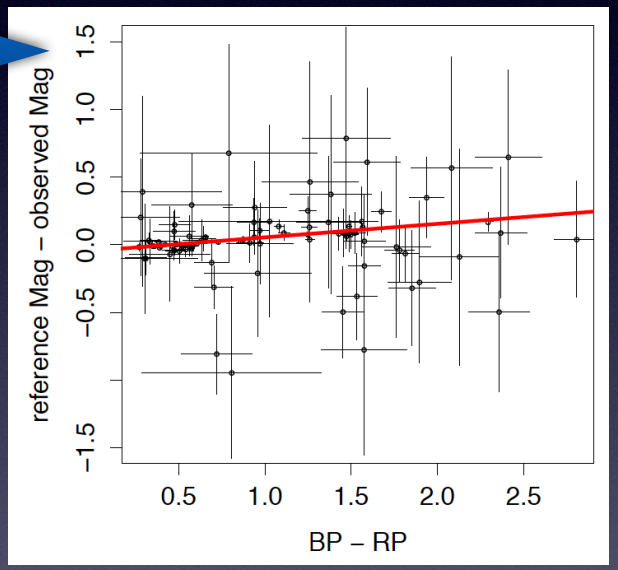
# calibration in 256x256 pixels scale



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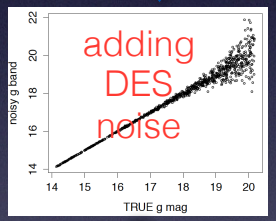
# simulation of Star catalog

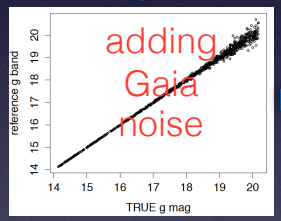
DES and Gaia filters + pickles (1998) SEDs for G,K,F,M stellar type + stellar population synthesis of Galaxy (Robin et al. 2003)

DES **true** magnitudes

Gaia **true** magnitudes

Gaia **observed** magnitudes




DES **reference** magnitudes

recovery of systematic: slope? intercept?

***systematics = slope* (BP-RP) +intercept***

DES **observed** magnitudes



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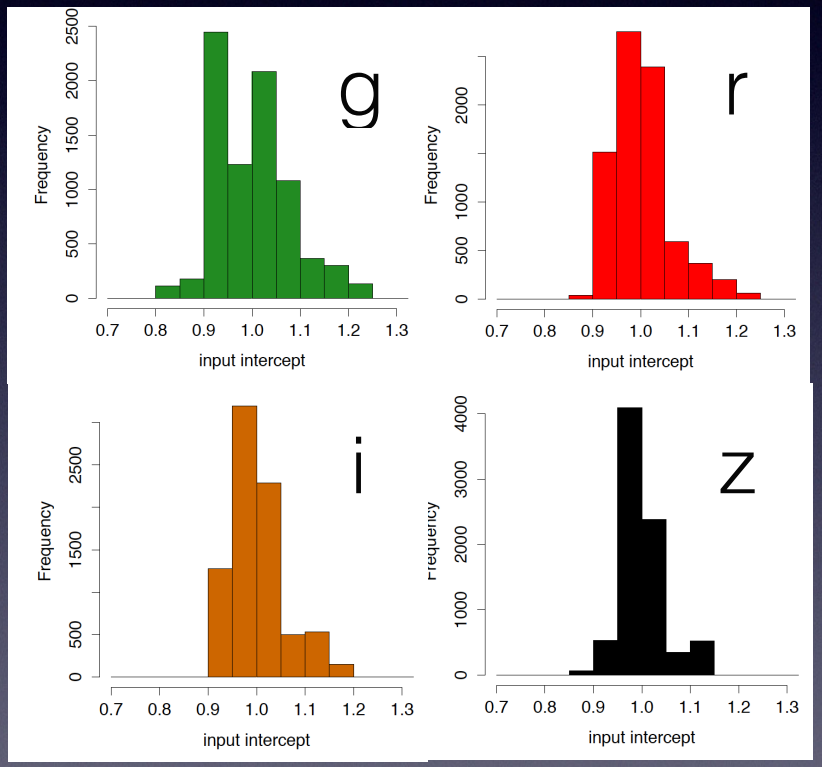
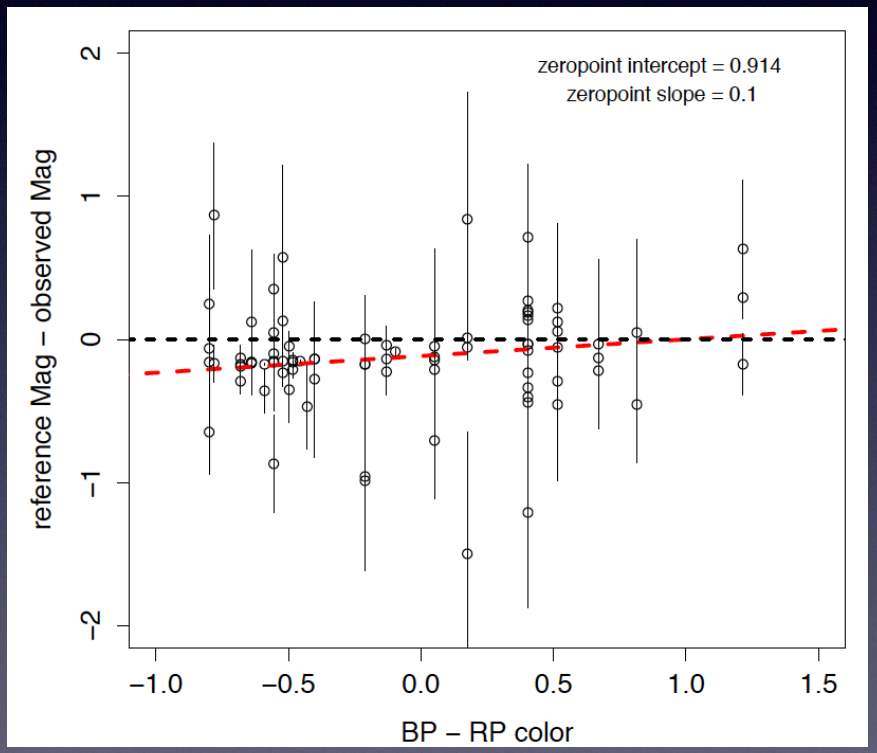
# systematics for each galaxy

## input intercepts




## applying the input systematics: random intercept & fixed slope = 0.1



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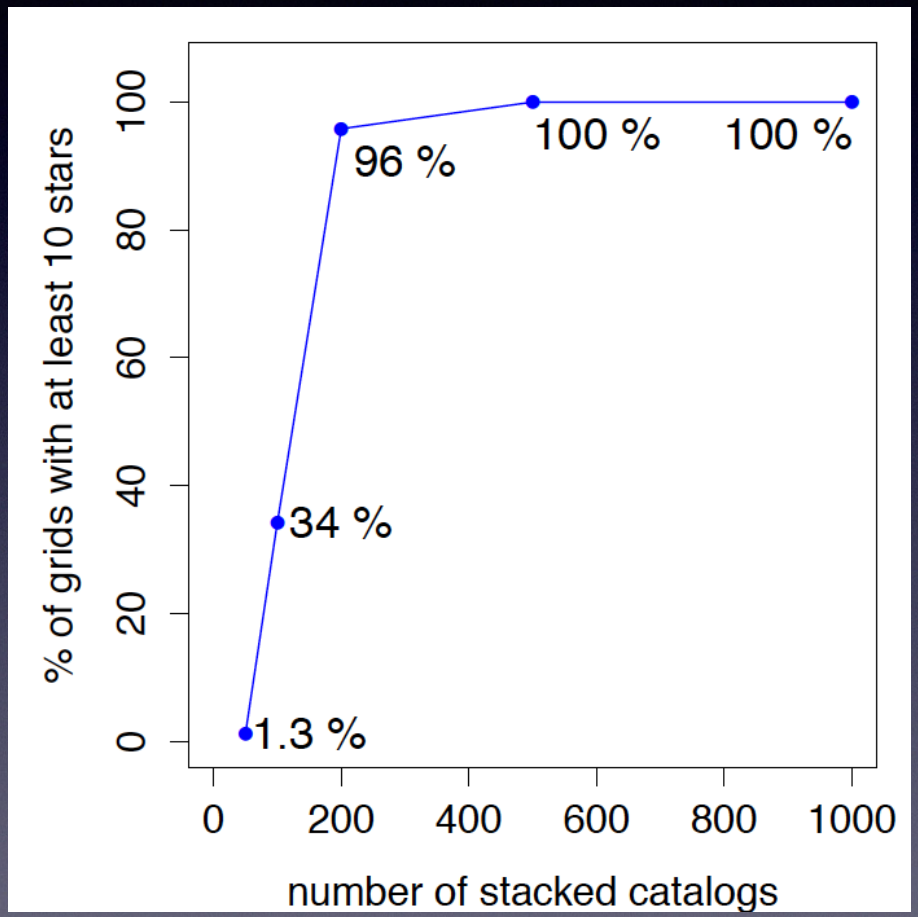
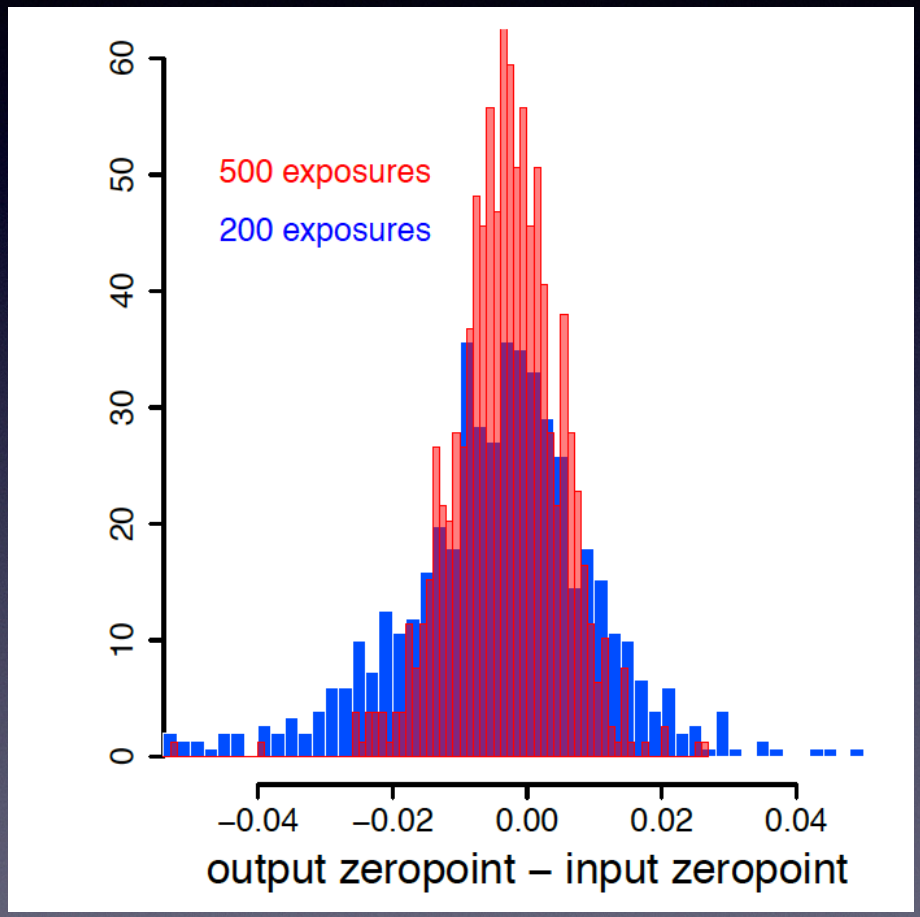
# stacking the exposures

Fraction of the chunks with more than 10 stars




more accuracy with more stacked catalogs



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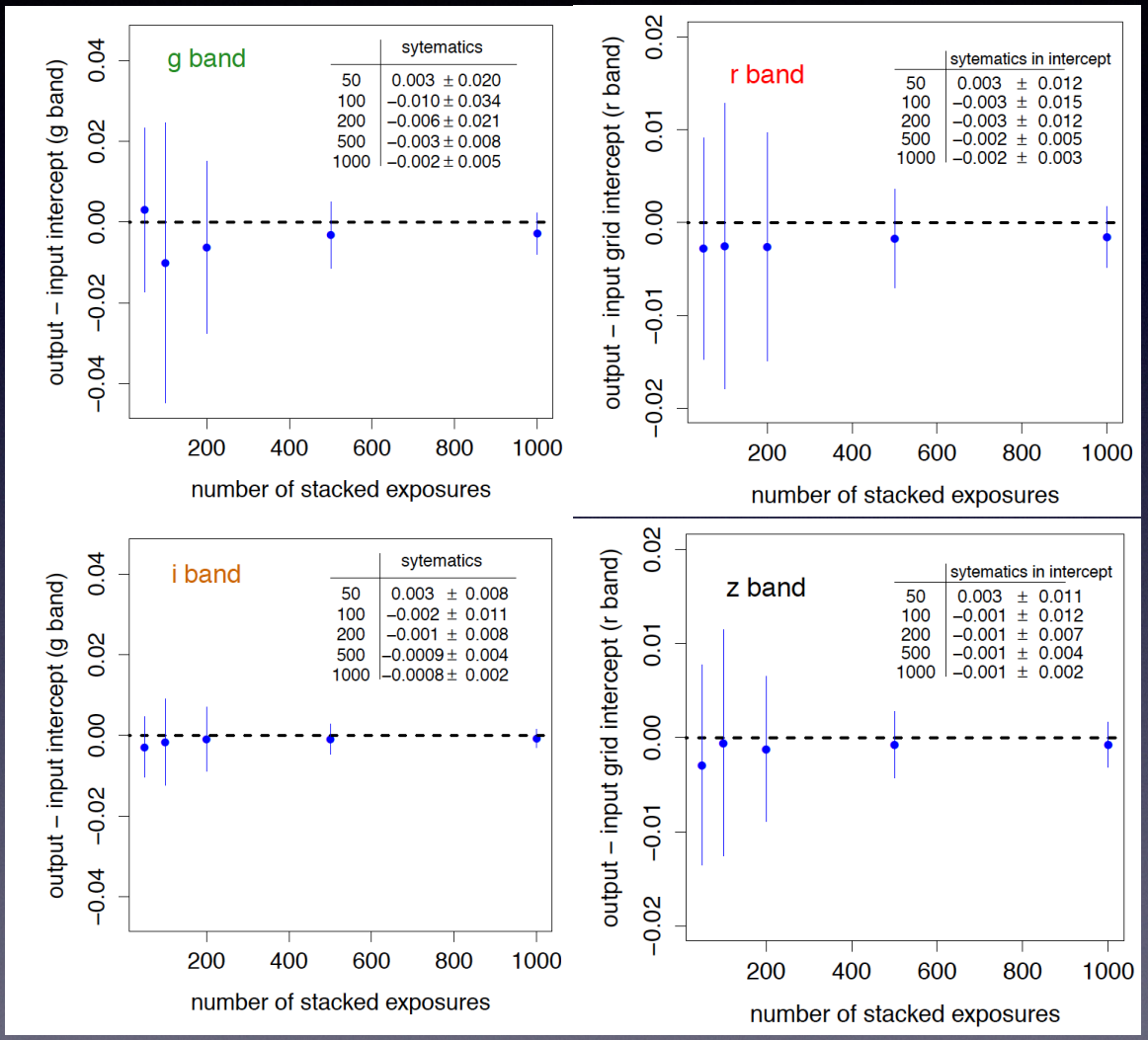
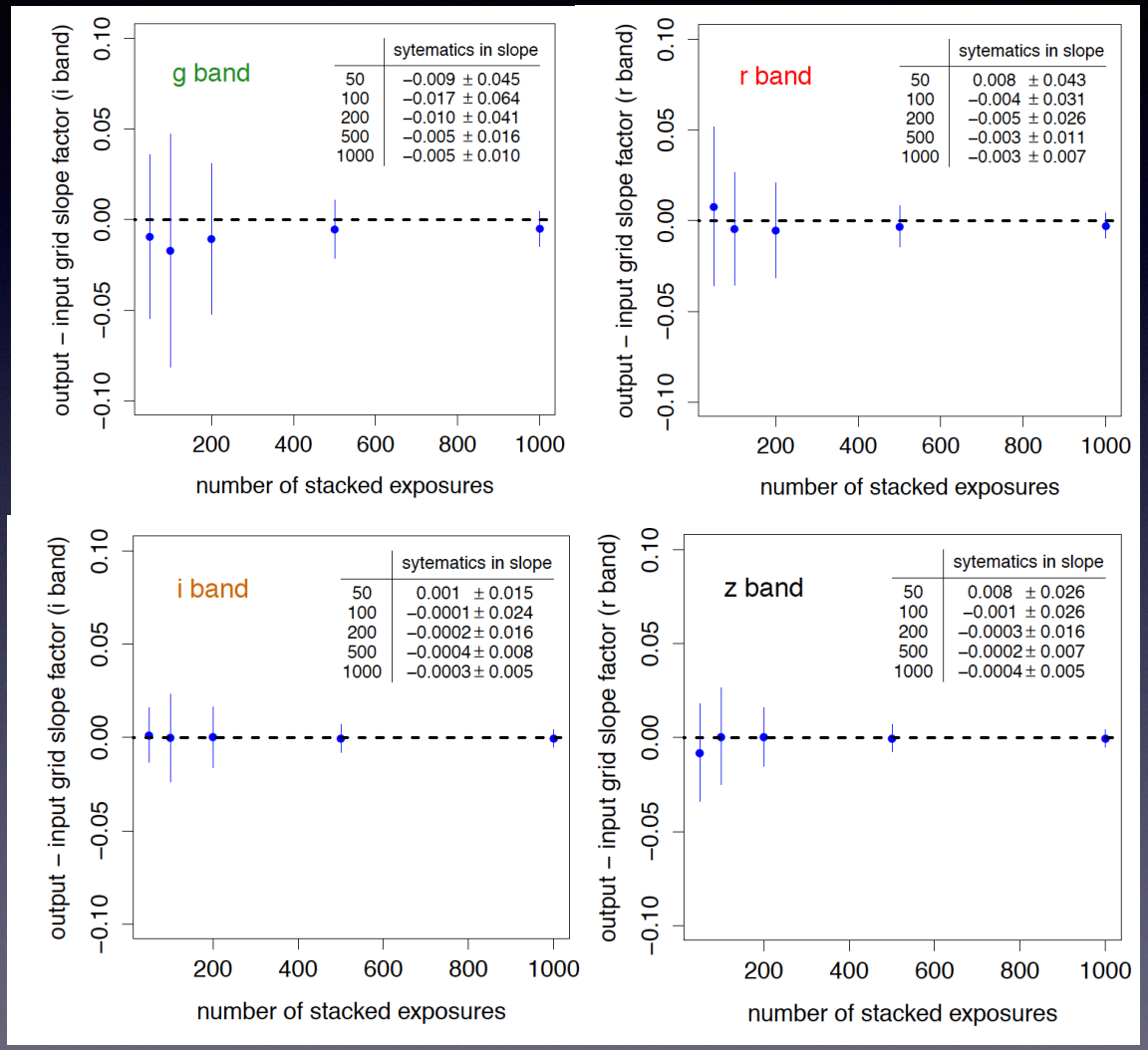
# accuracy in intercept recovery



# accuracy in slope recovery

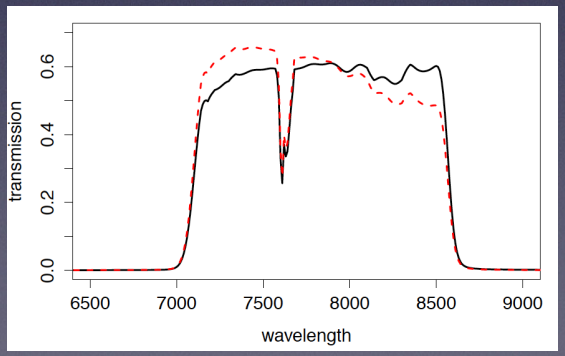


# summary of results
# based on 500 stacked exposures

- We simulated the procedure of calibration of DES data using Gaia low resolution spectrum.
- The density of the stars in the sky provided by a model for stellar population synthesis of the Galaxy.
- The magnitudes are generated using Pickles SEDs and Lepahre package for G,K,M,F types (and difference sub-types).
- Empirically determined noise was induced to the DES magnitudes. A model based on magnitudes and colors generated the Gaia bands error.
- By stacking the single exposures catalogs, we increased the accuracy in systematics measurement.
- The i and z bands can easily fulfil the <0.2% systematics in in PSF modelling, while the g and r band are only close to this threshold.

| filter | systematics in intercept (%) | systematics from slope (%) for one mag. change in color |
|---|---|---|
| g | 0.3 | 0.5 |
| r | 0.2 | 0.3 |
| i | 0.1 | 0.04 |
| z | 0.1 | 0.02 |

- next step: deriving the effective transmission functions



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