

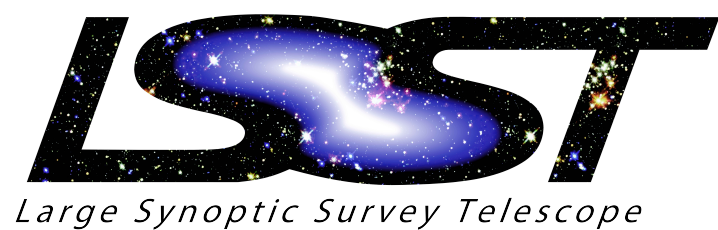
Testing FGCM on DES with Gaia DR2



Eli Rykoff

LSST/DESC Calibration Workshop

24 May, 2018

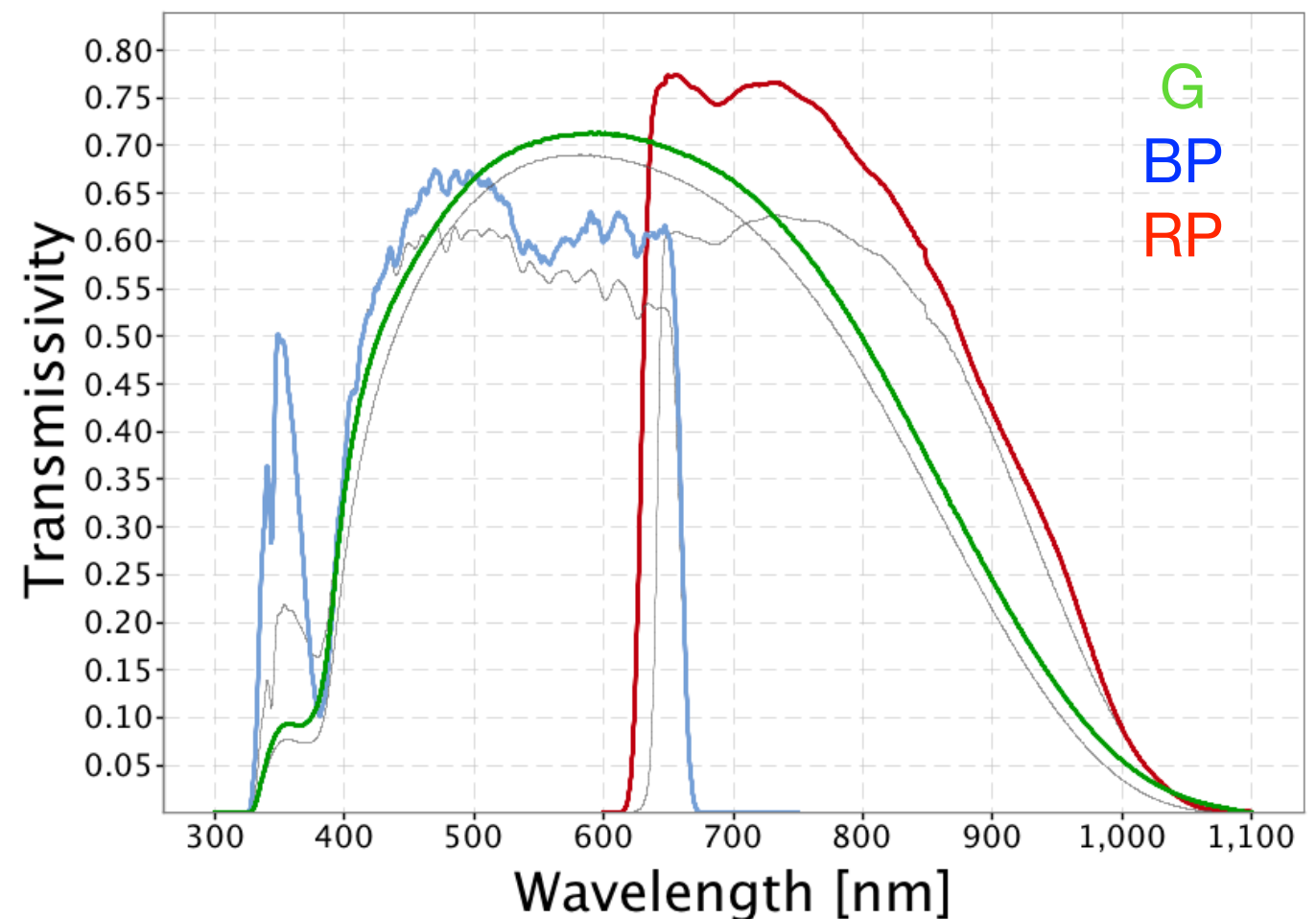


Introduction

- These slides are to assess the uniformity of DES Y4 FGCM calibration and Gaia DR2
- The FGCM calibration is updated and overhauled from that of the Burke, Rykoff++2017 paper
 - Plus and extra year of DES data
- These data have not been published yet, and all plots are **preliminary**
 - I expect there to be additional updates as well after feedback at this workshop

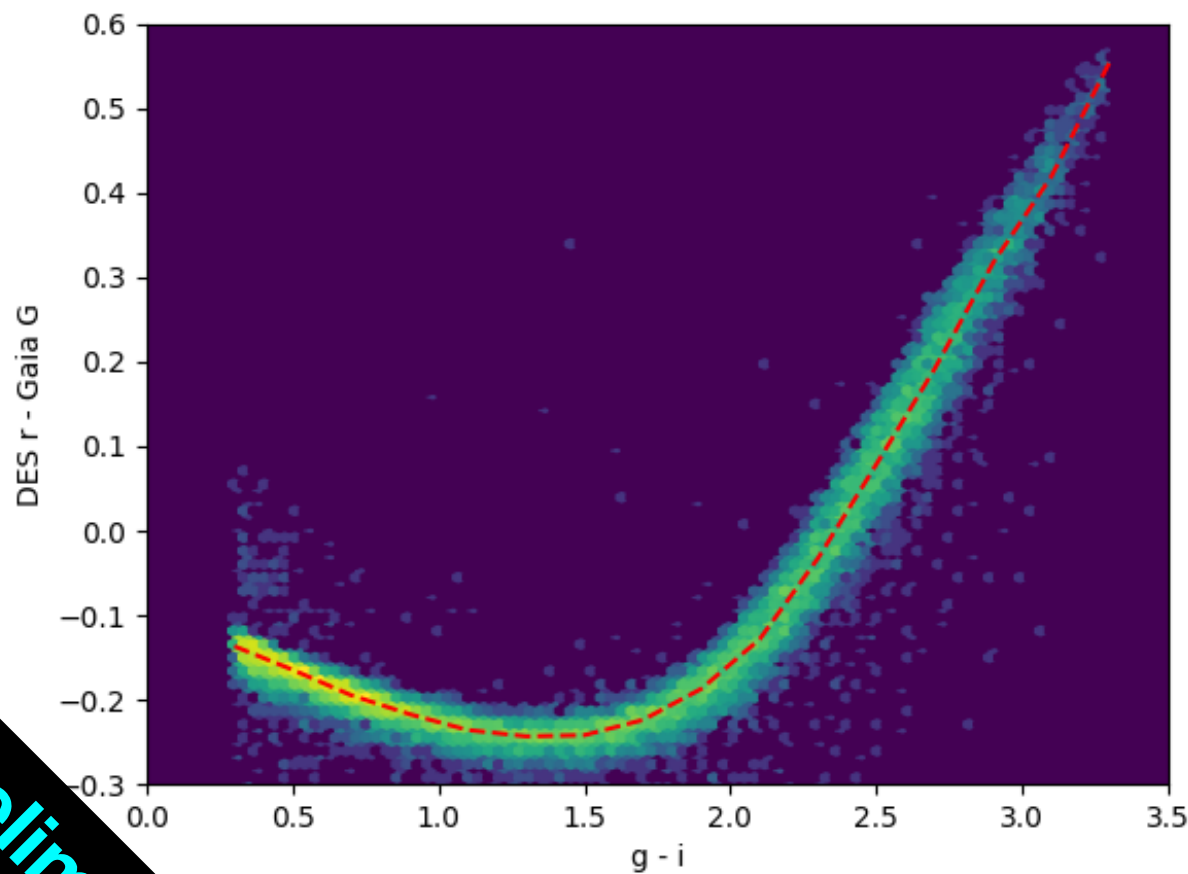
Gaia DR2

- Gaia DR2 was released on April 25th, 2018
- Contains “lots of stars”, well measured, awesome astrometry, etc, etc.
- Contains updated Gaia G-band photometry, plus first BP and RP integrated fluxes

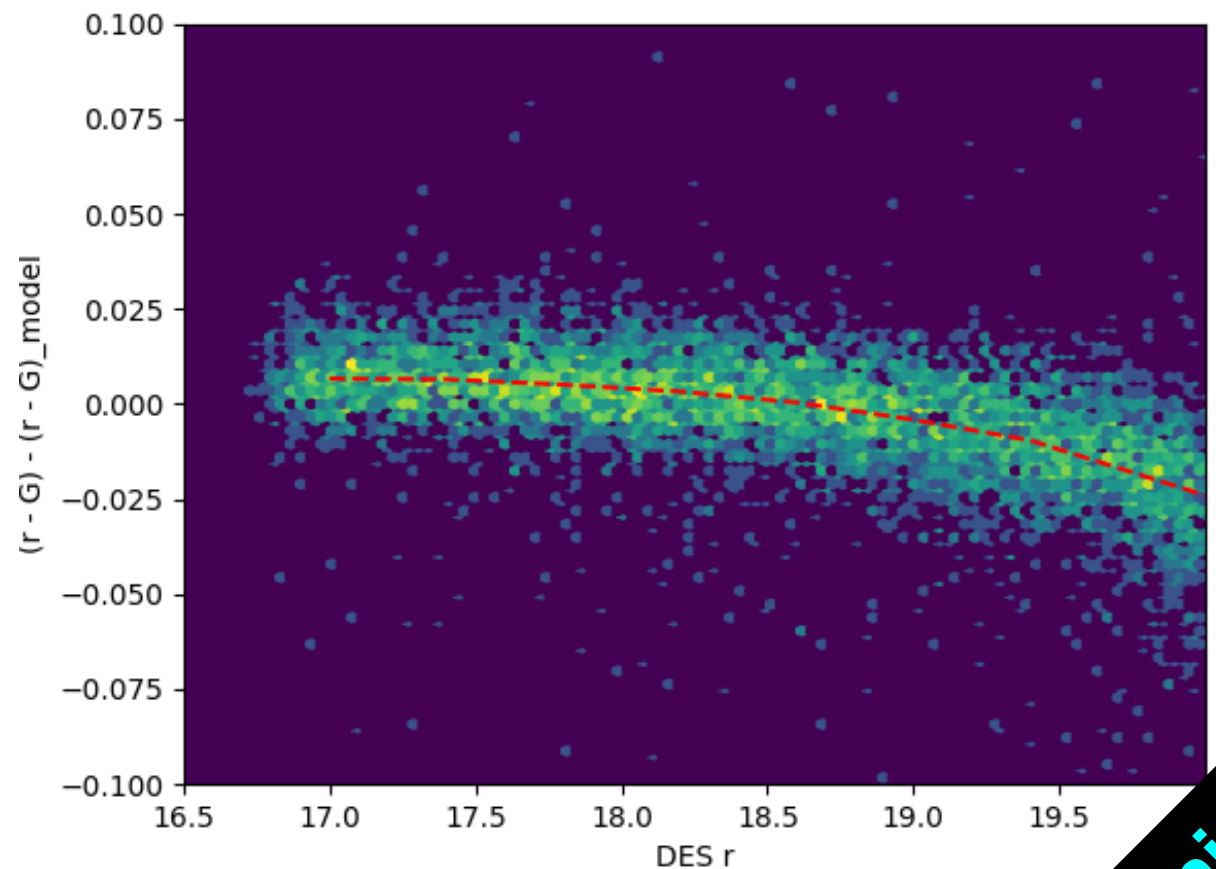


Cross-Calibration

- Use DES SN fields with >50 DES observations for Gaia/DES cross-calibration
- Small residual with magnitude in $r - G$ comparison



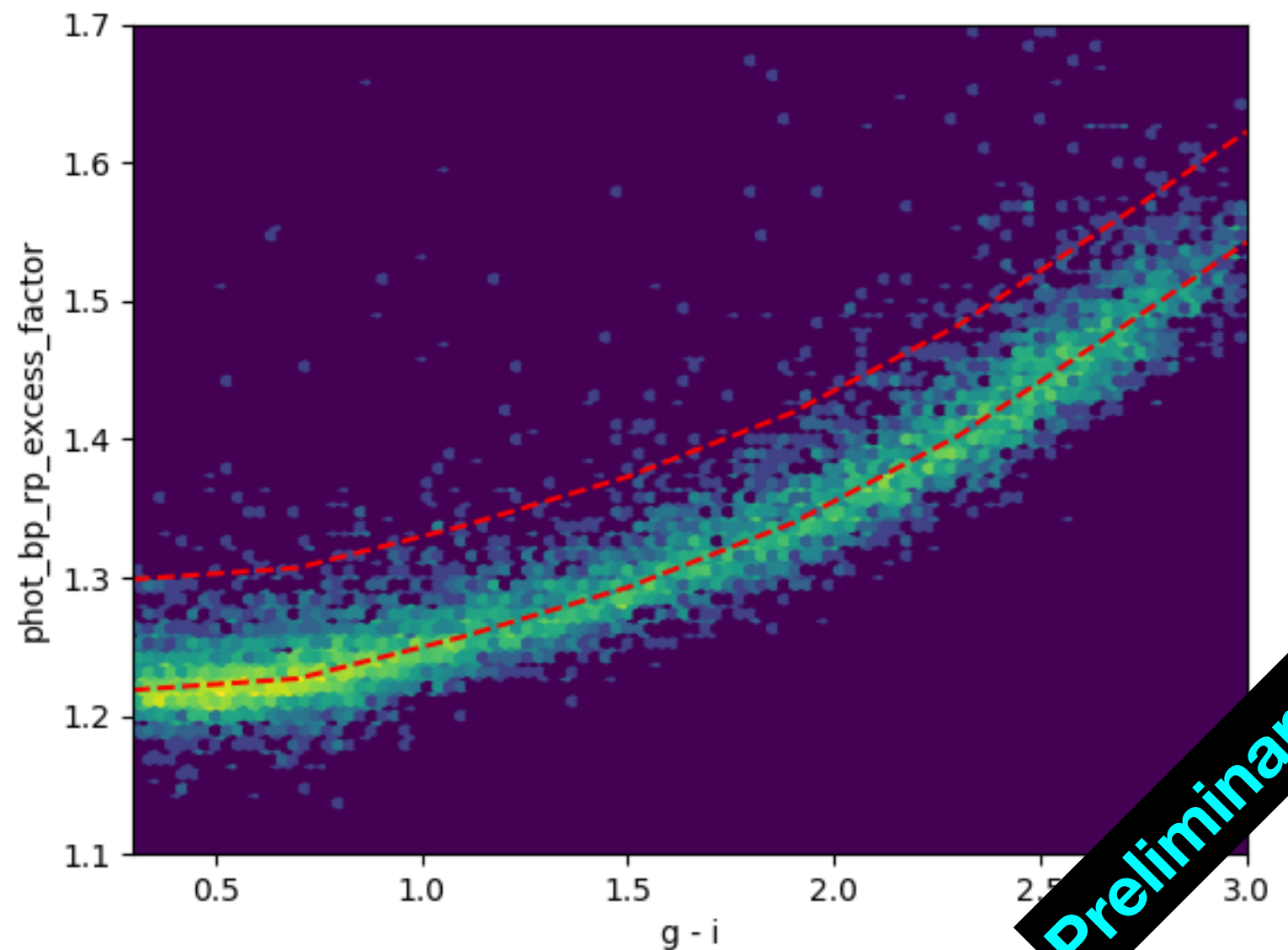
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BP/RP Cross-Calibration

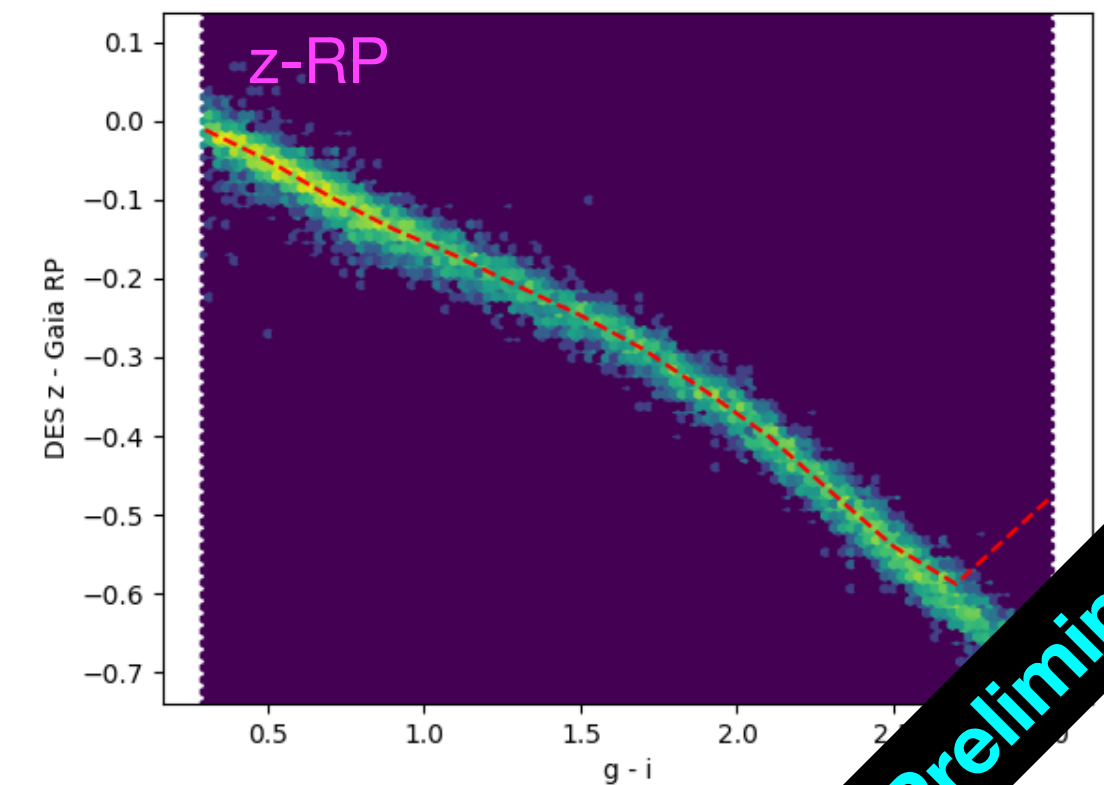
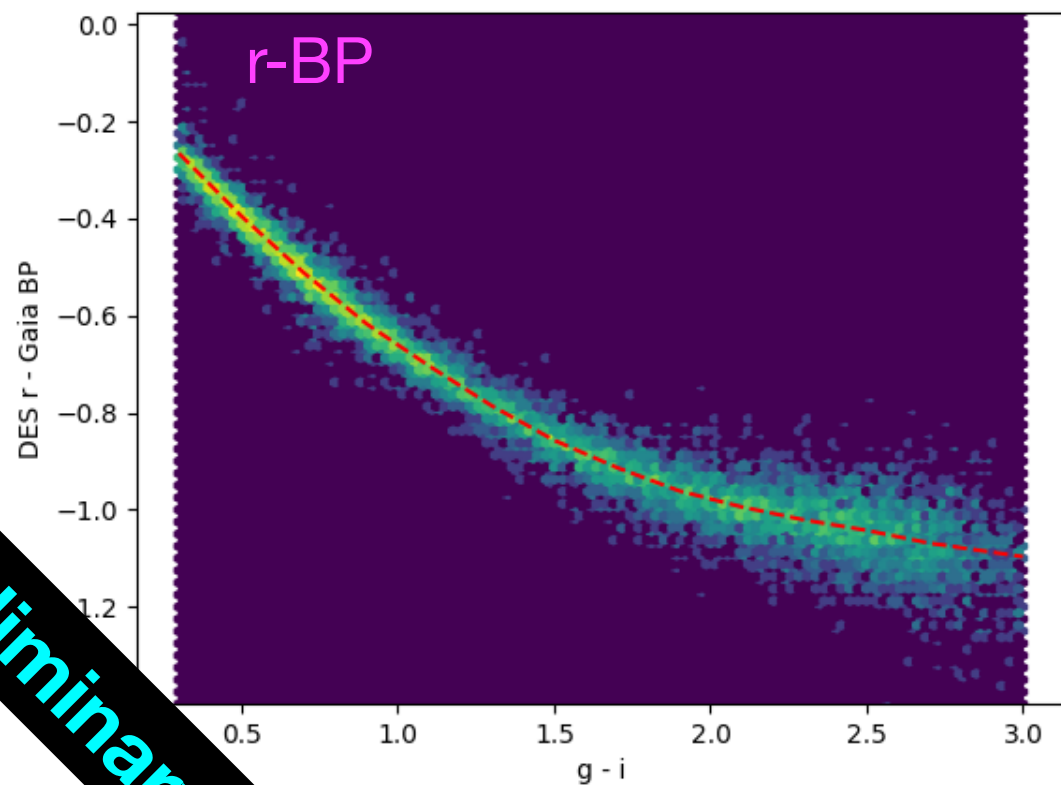
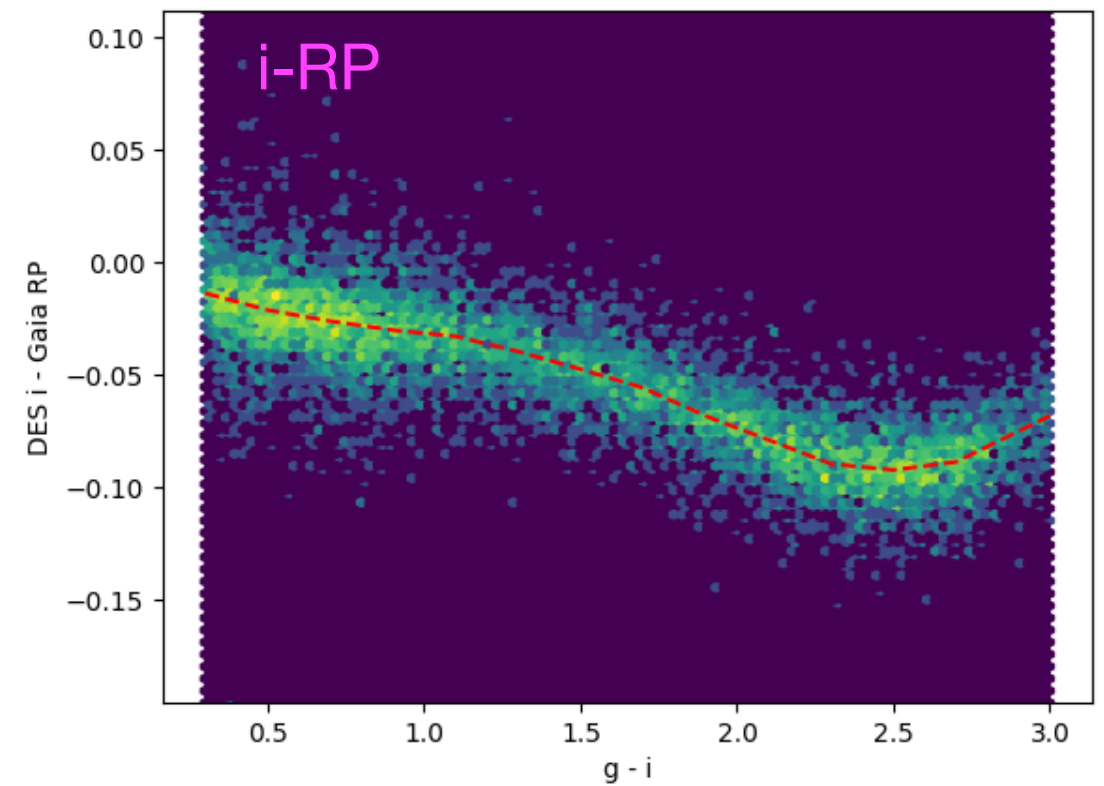
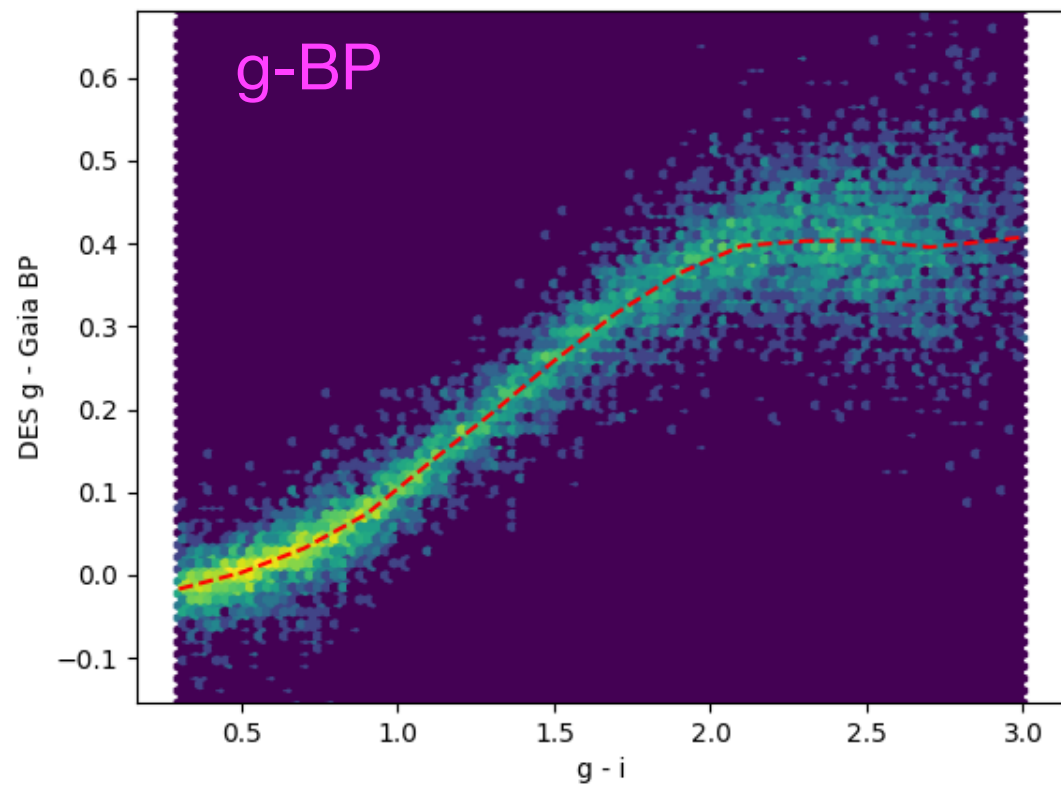
- Cut out stars with large “flux excess”
- Limit to stars with good BP & RP
 - $G < 19$; $s/n > 10$ in each; at least 5 Gaia transits
- Top line shows arbitrary cut on flux excess
 - Excluding these stars makes a noticeable improvement in comparisons



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Cross-Calibration



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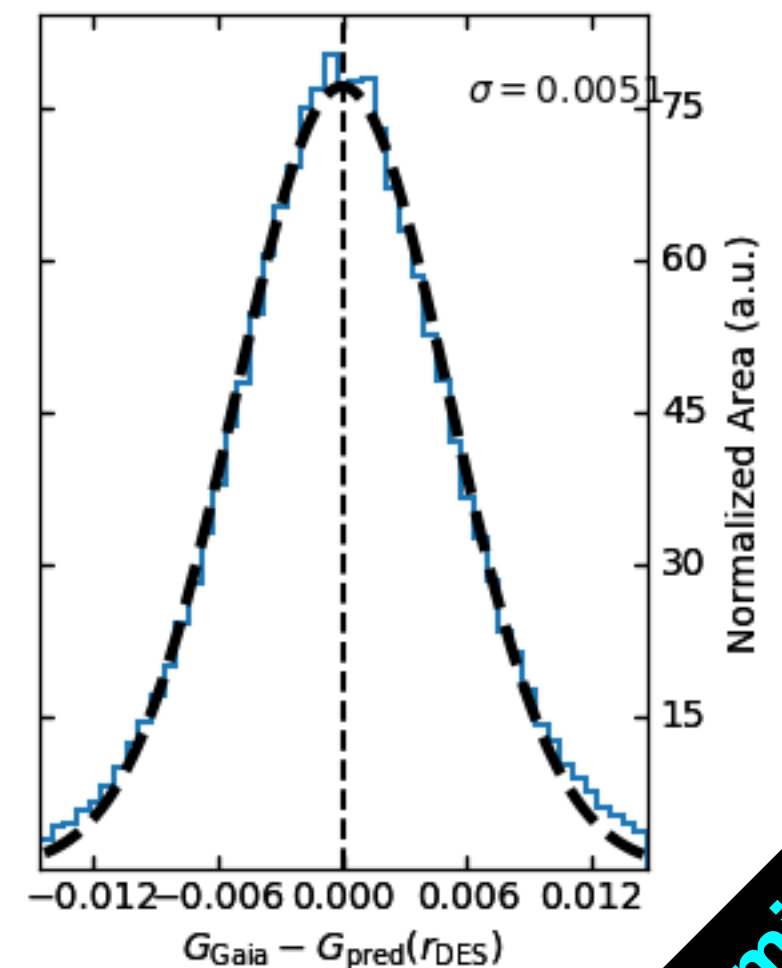
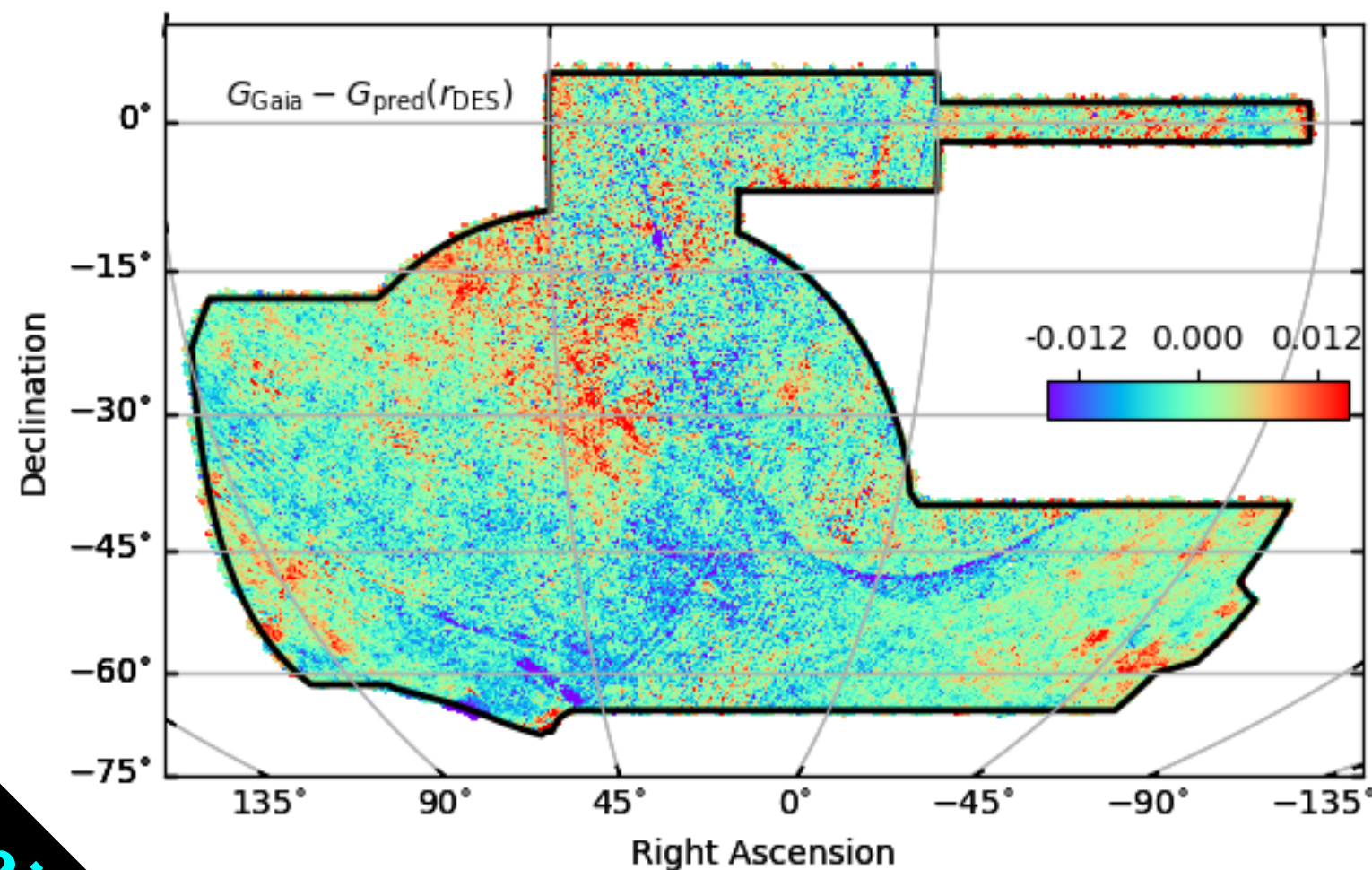
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Making Maps

- Use stars that are at least 10σ in both the DES band and G/BP/RP as appropriate
 - Minimum of 5 Gaia transits
 - $r_{\text{DES}} < 20$; $G < 19$ for BP/RP comparisons
 - $0.5 < g_{\text{DES}} - i_{\text{DES}} < 1.5$
- Bin stars with healpix pixels $n_{\text{side}}=256$ or 128
 - Compute median offset (after offsets) in each pixel
- Make maps!

DES r-band and Gaia DR1

- Offset map ($G - r$) for Gaia DR1 (not ideal selection)
- Uniform with RMS of 5.1 mmag

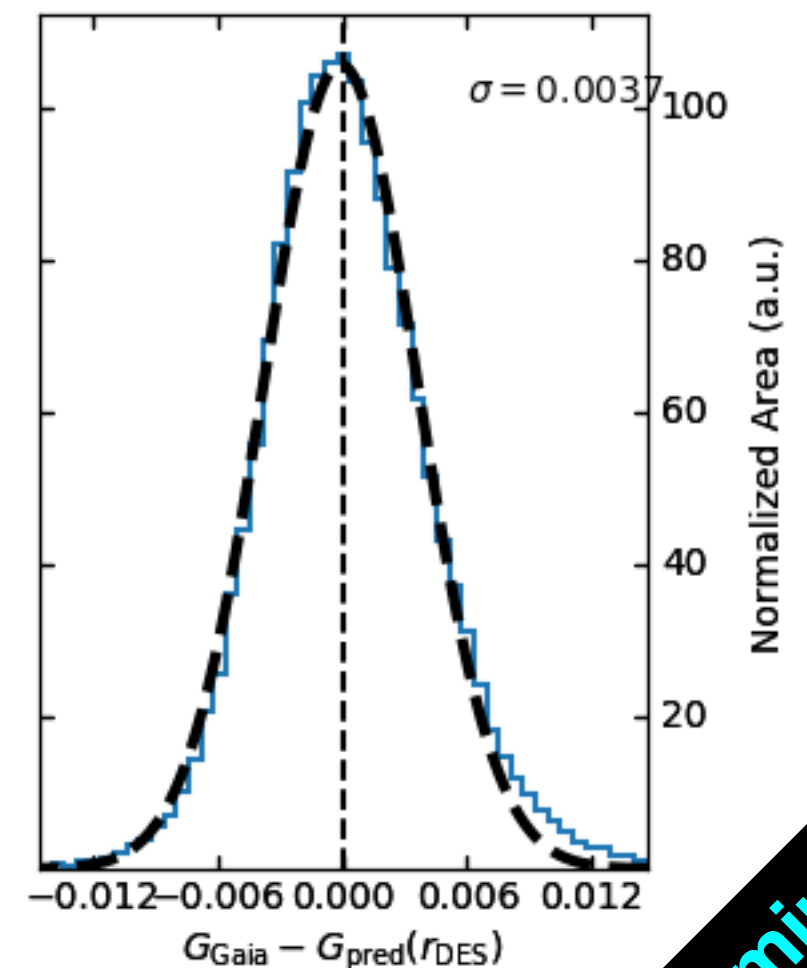
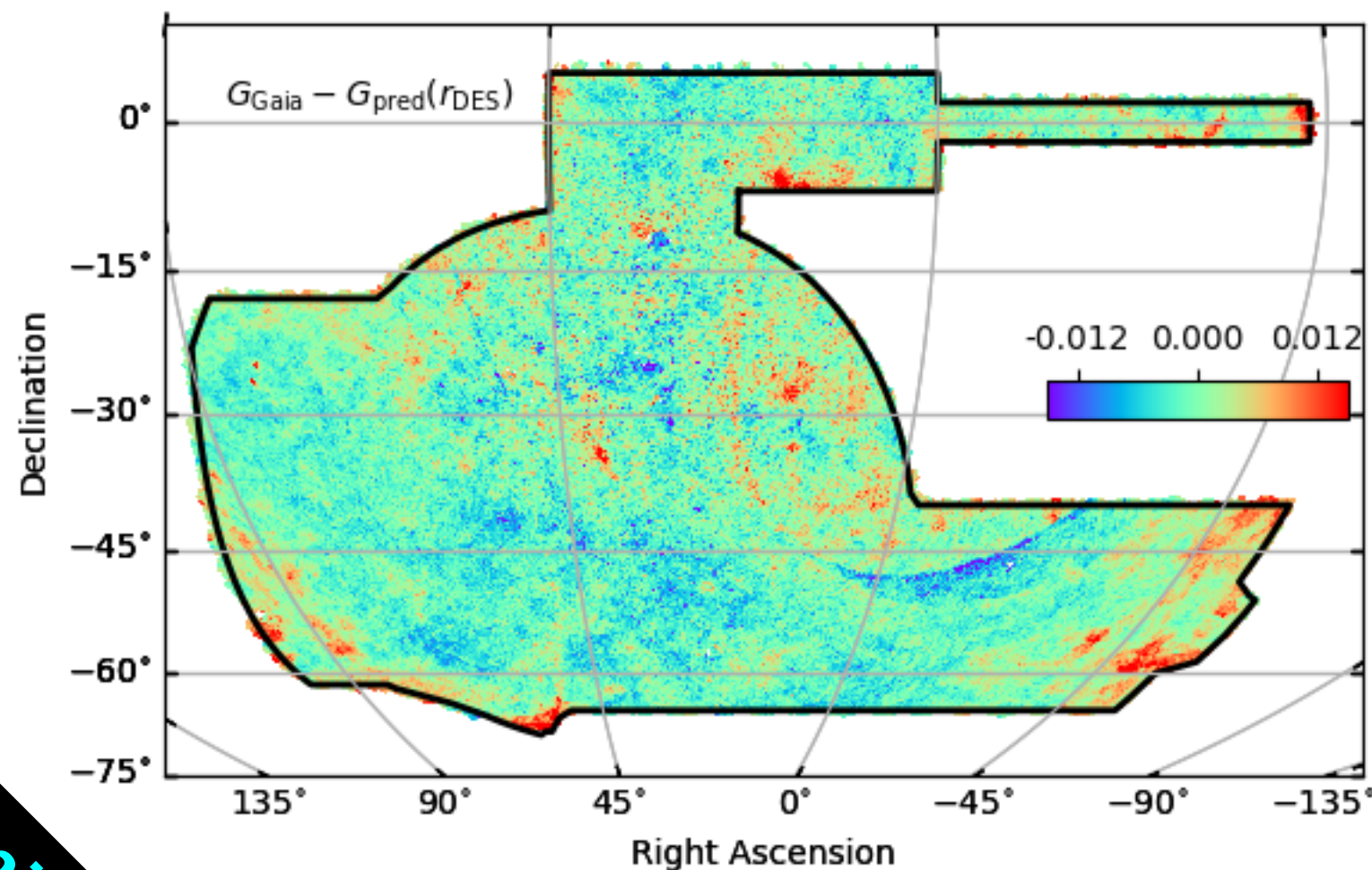


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DES r-band and Gaia DR2

- Offset map ($G - r$) for Gaia DR2, $n_{\text{side}}=256$
- Uniform with RMS of 3.7 mmag

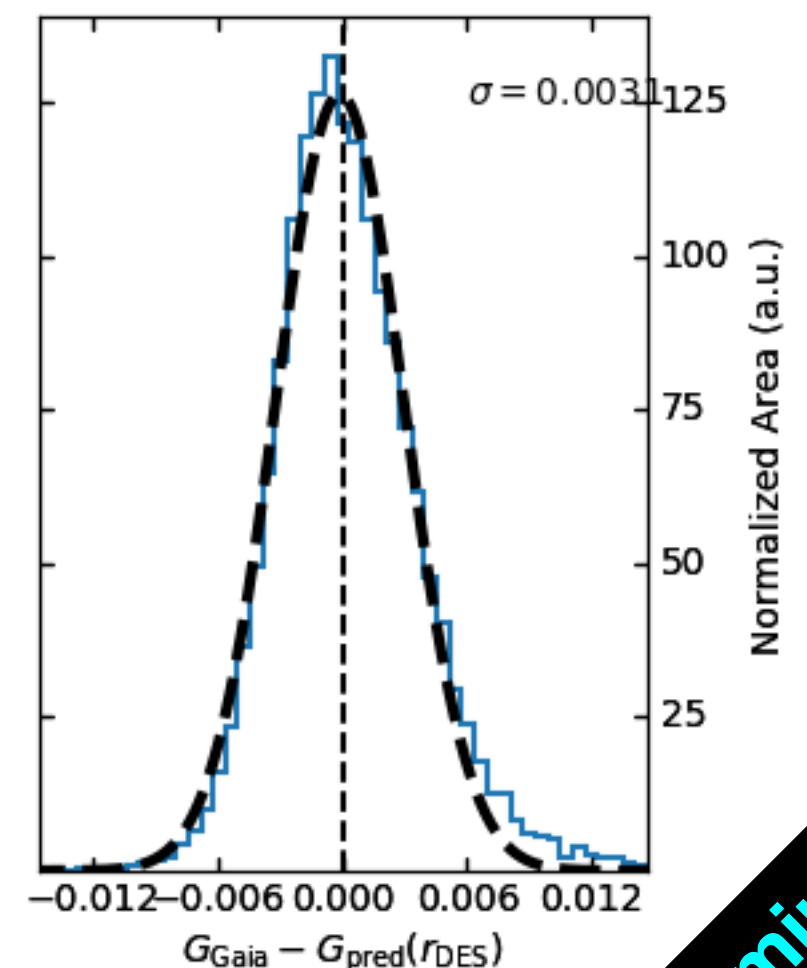
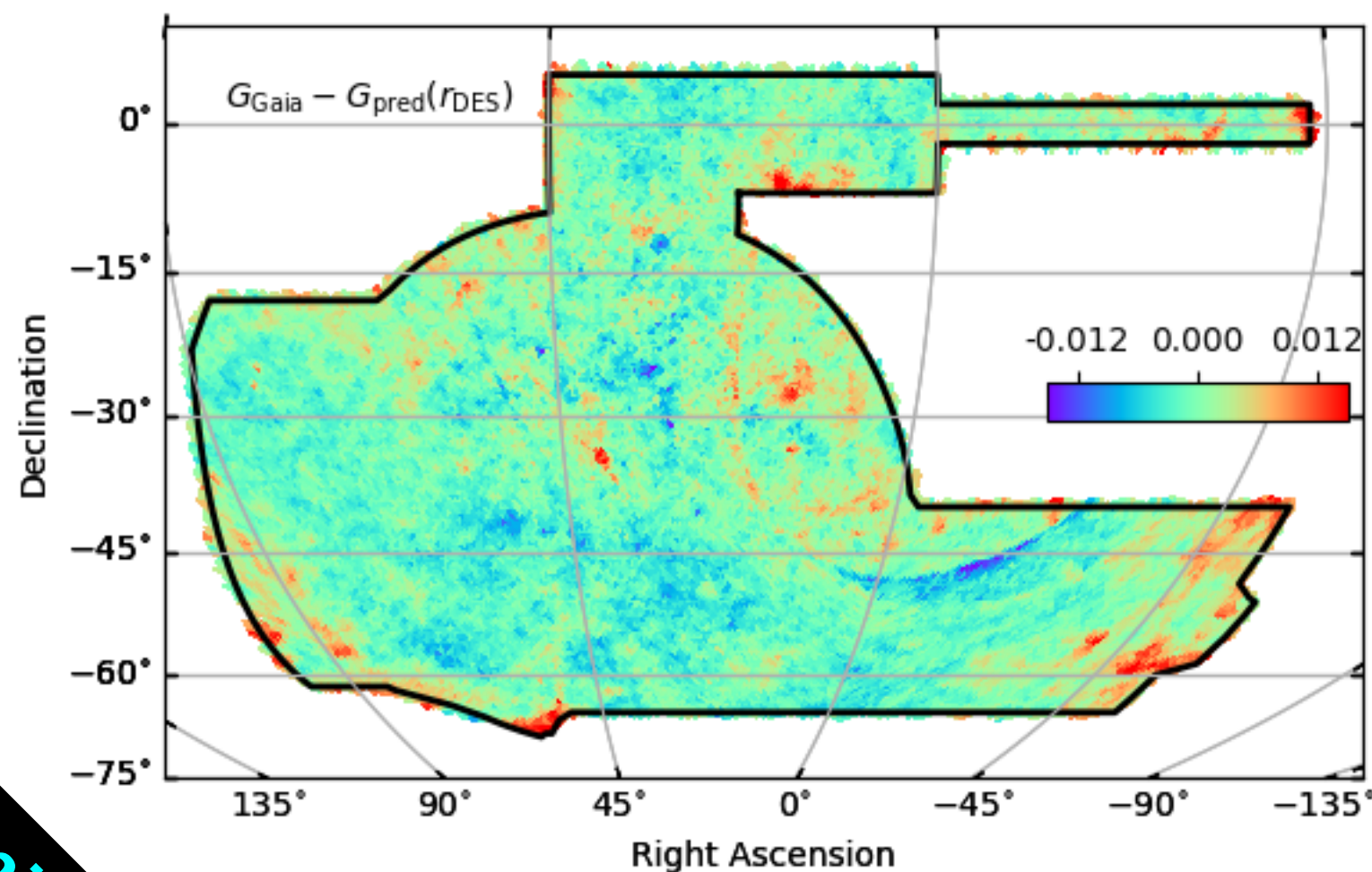


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DES r-band and Gaia DR2

- Offset map ($G - r$) for Gaia DR2, $n_{\text{side}}=128$
- Uniform with RMS of 3.1 mmag
- Noise in comparison or high-frequency modes?
 - Note that DR1 “cat scratches” more visible at 256

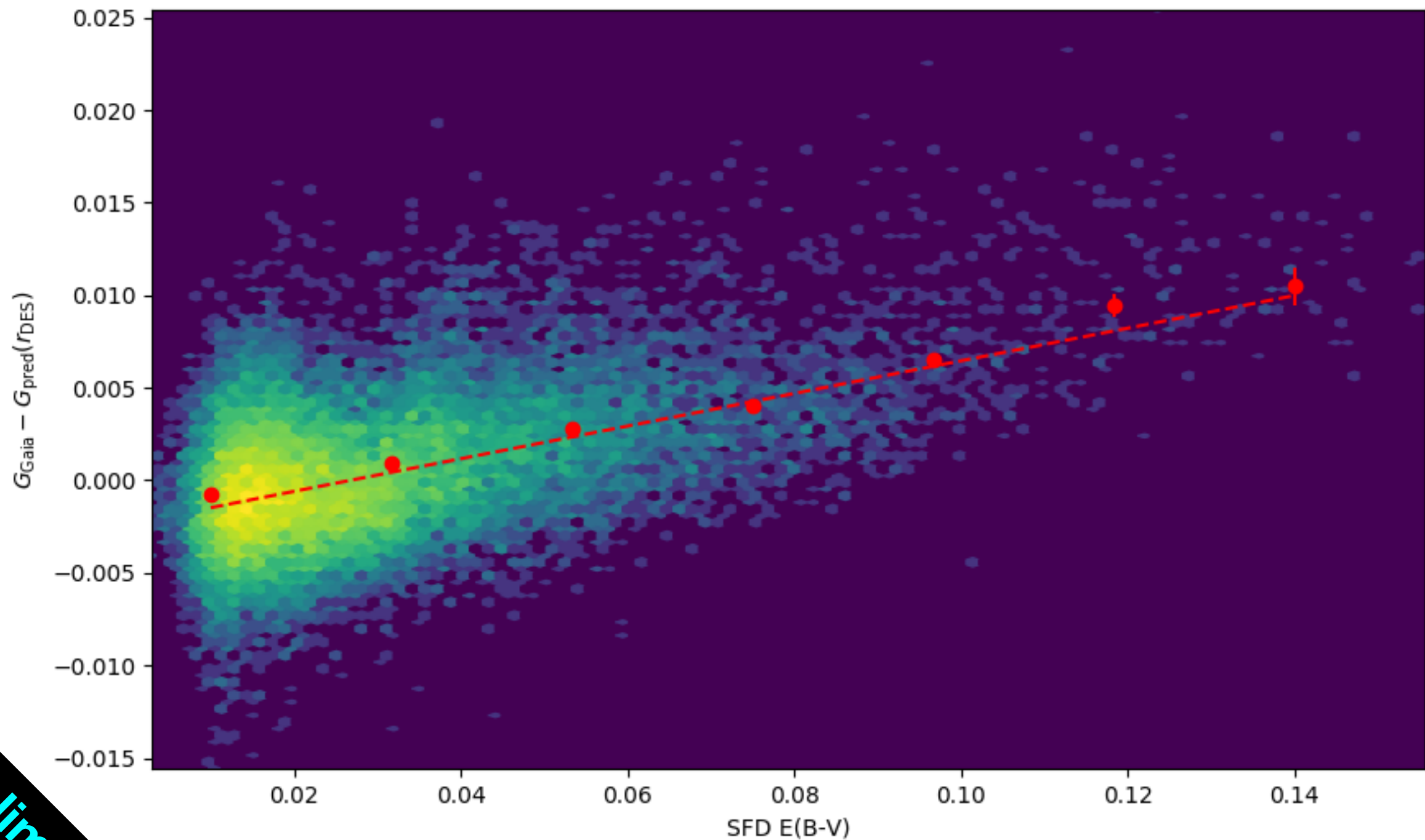


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Residuals And Reddening

- Offset is correlated with SFD98 $E(B-V)$

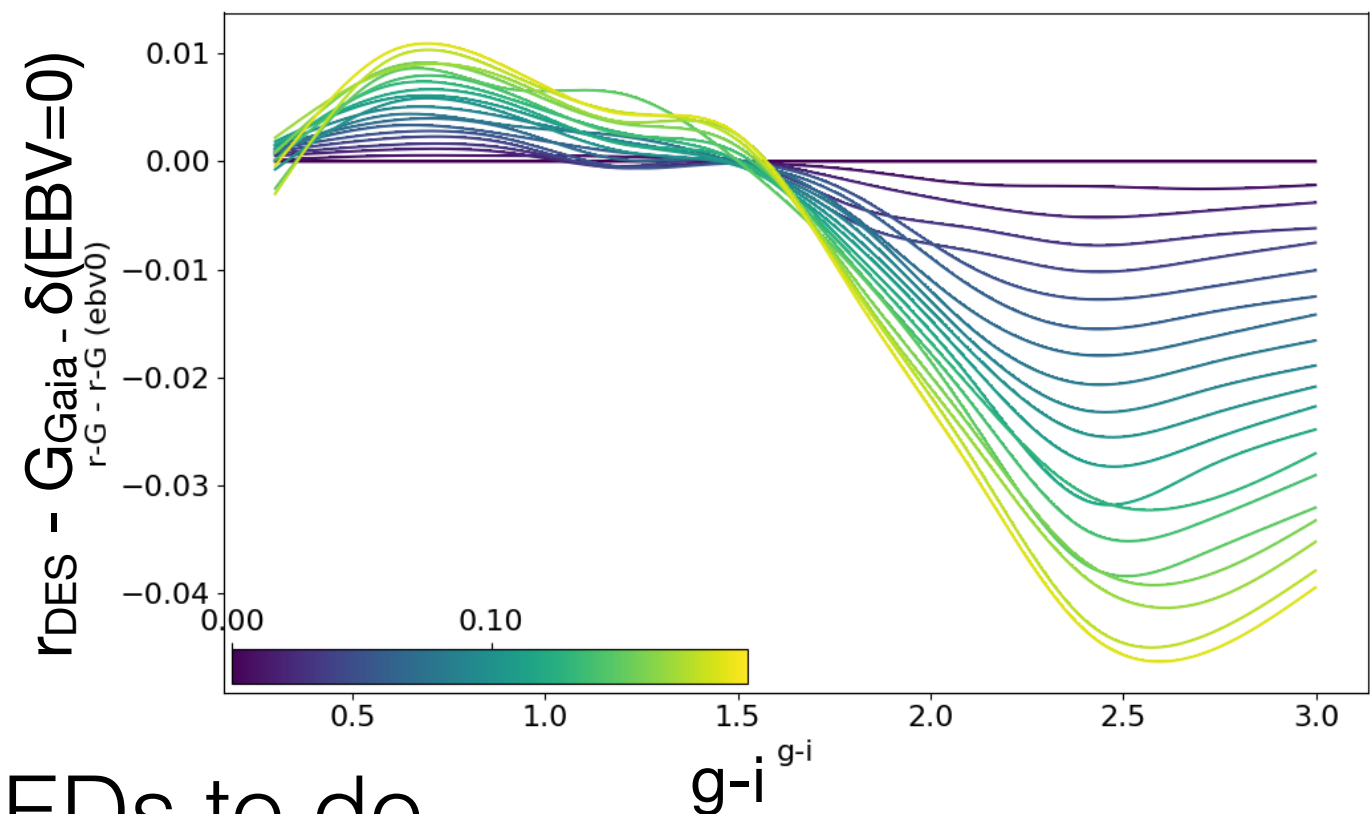
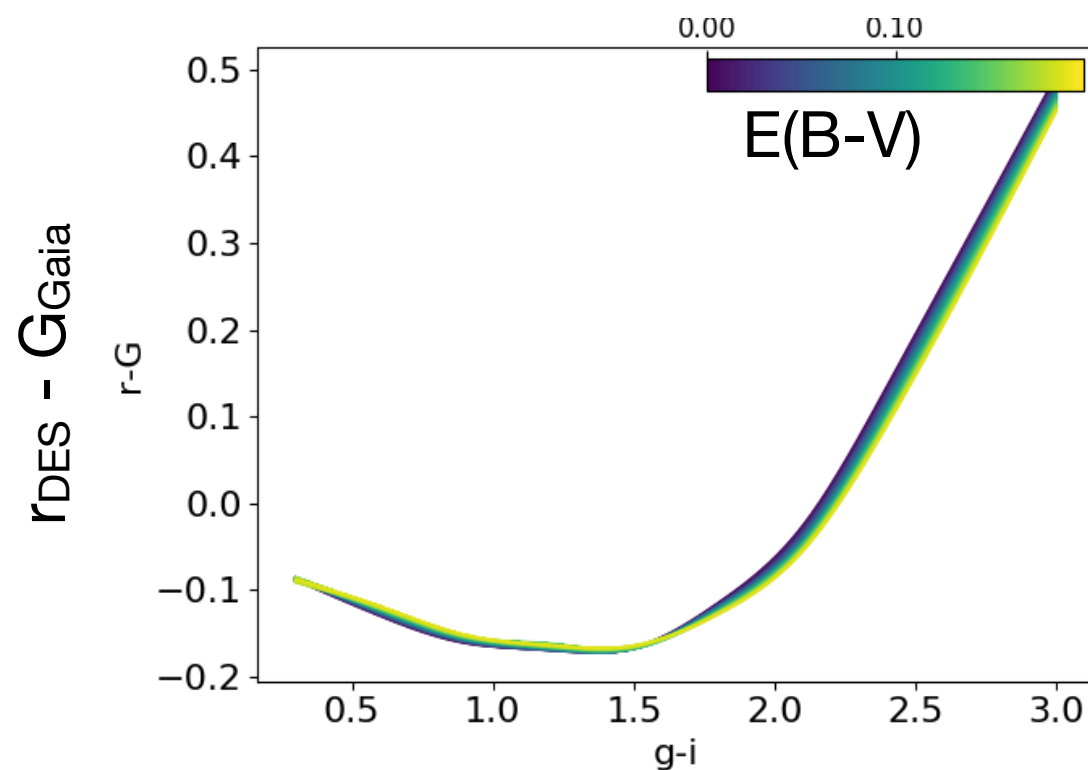


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Why the $E(B-V)$ Correlation?

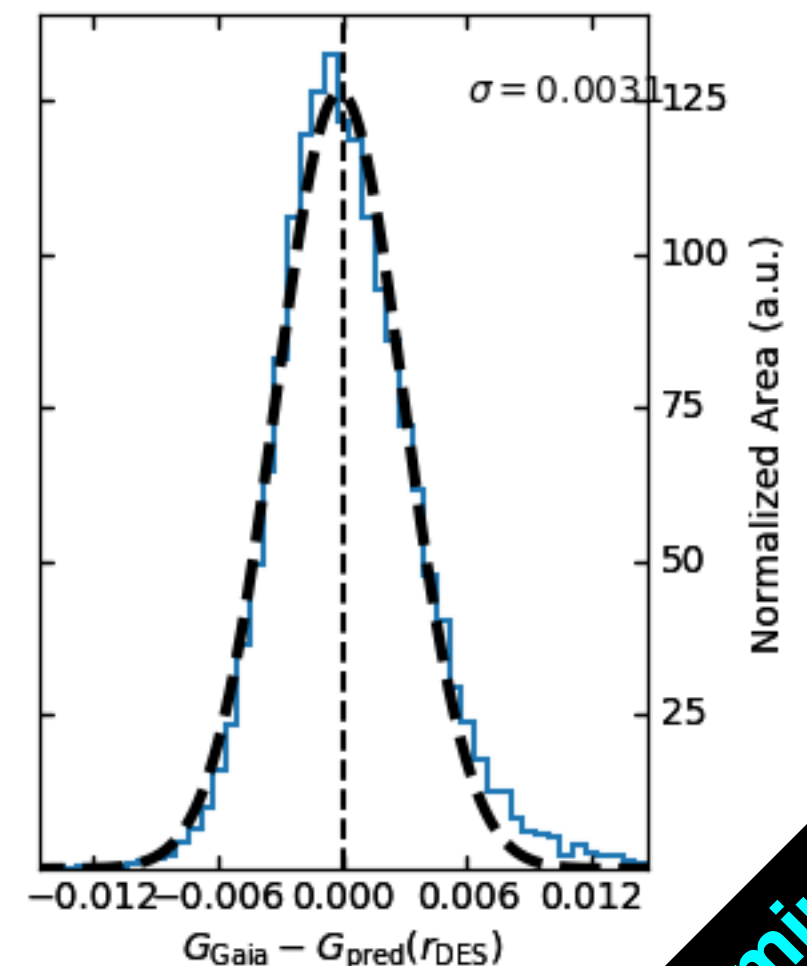
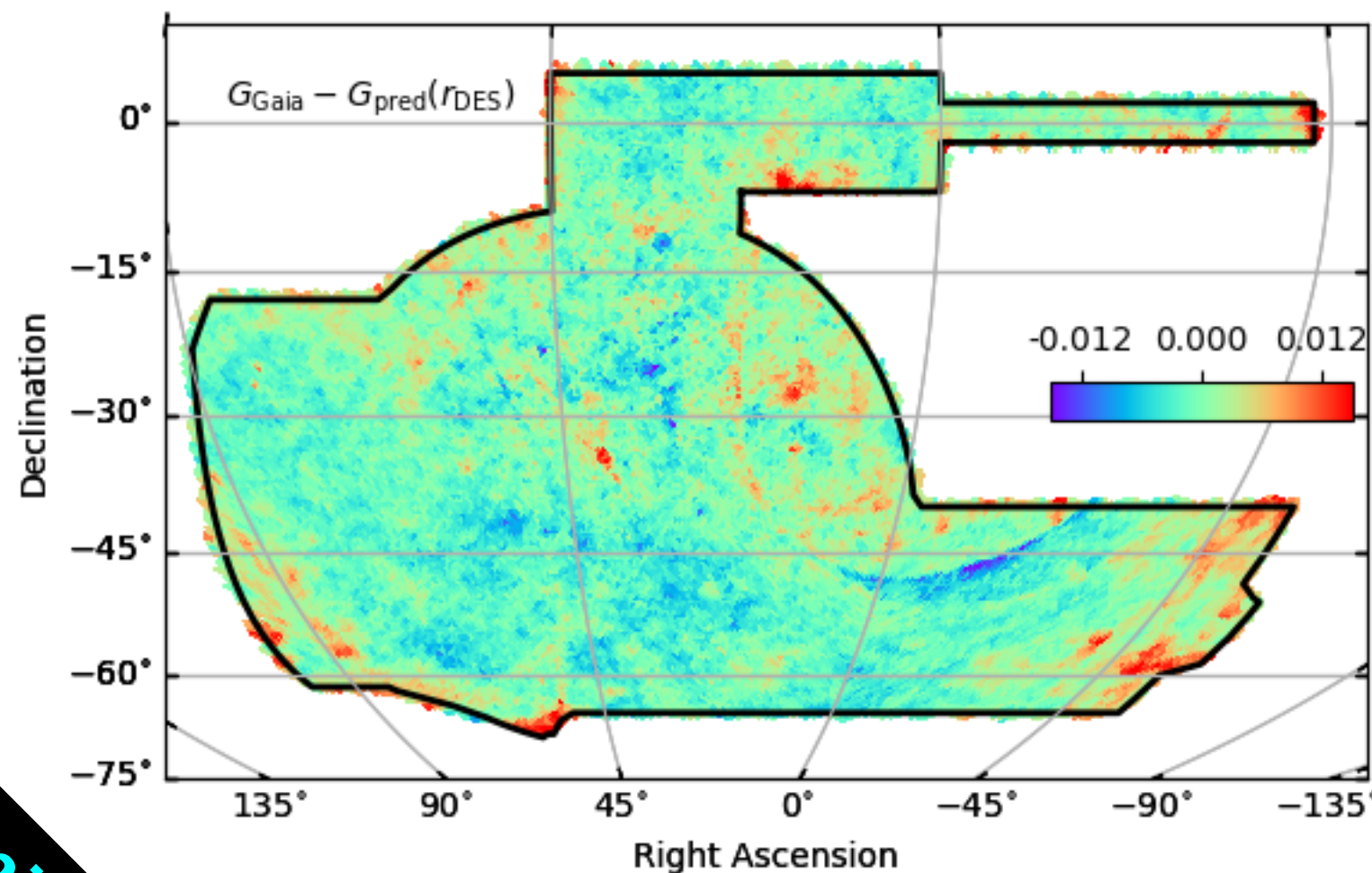
- Color transformation is SED-dependent and therefore reddening dependent!
- Depends on band and color range...but reddening shifts the transformation in strange ways



- You must know actual SEDs to do proper flux transfer

DES r-band and Gaia DR2

- Offset map ($G - r$) for Gaia DR2, $n_{\text{side}}=128$
- Uniform with RMS of 3.1 mmag
- Noise in comparison or high-frequency modes?
 - Note that DR1 “cat scratches” more visible at 256

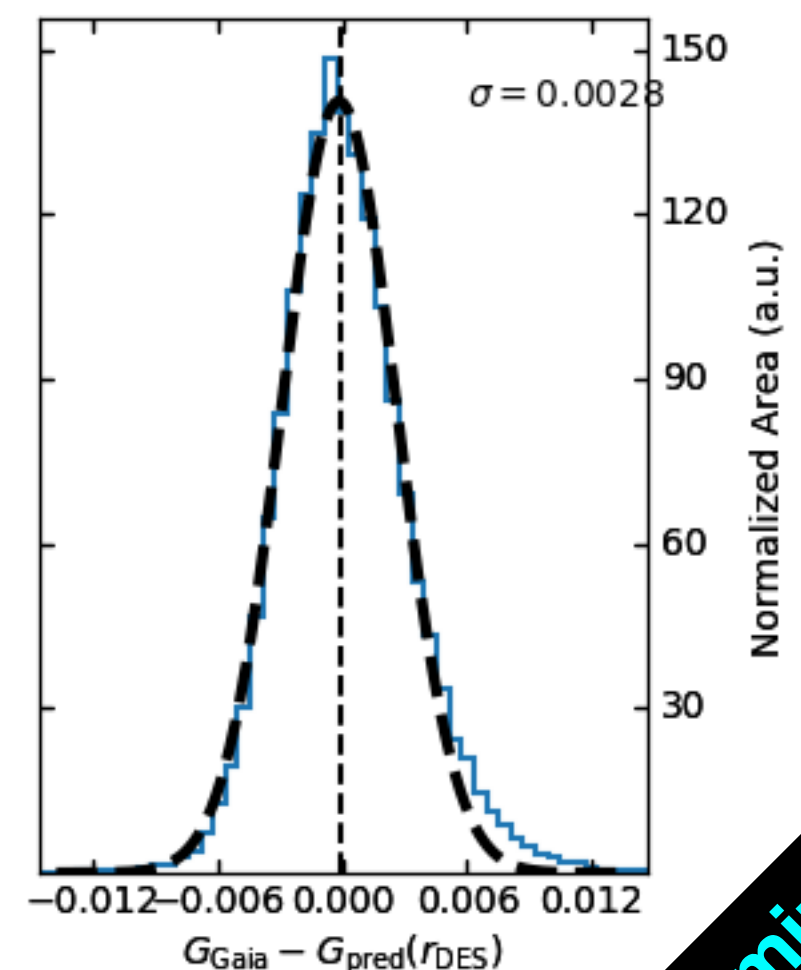
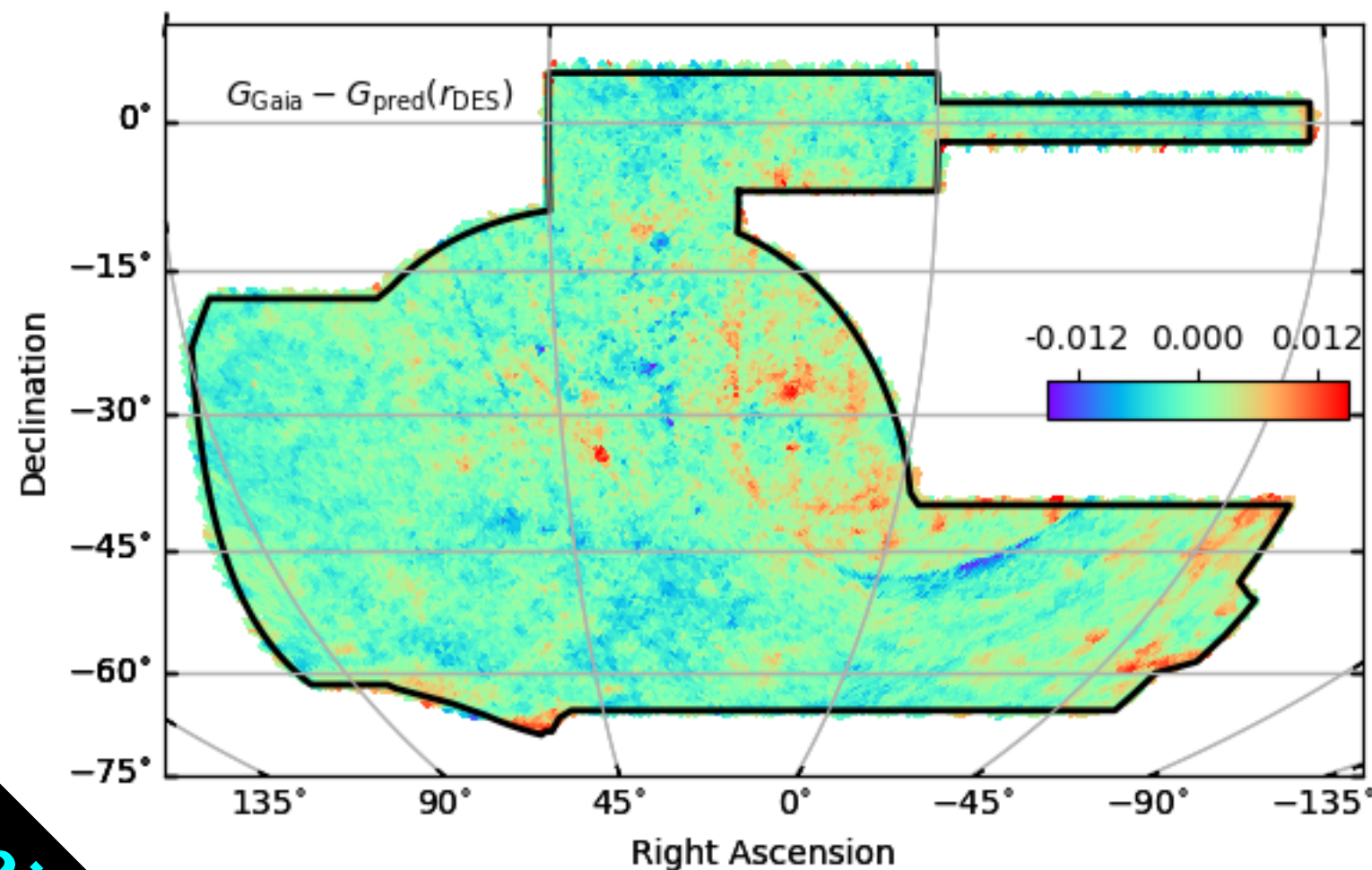


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DES r-band and Gaia DR2

- Offset map ($G - r$) for Gaia DR2, $n_{\text{side}}=128$
- Add in a simple empirical reddening correction
- Uniform with RMS of 2.8 mmag
 - Some residuals still remain...metallicity?

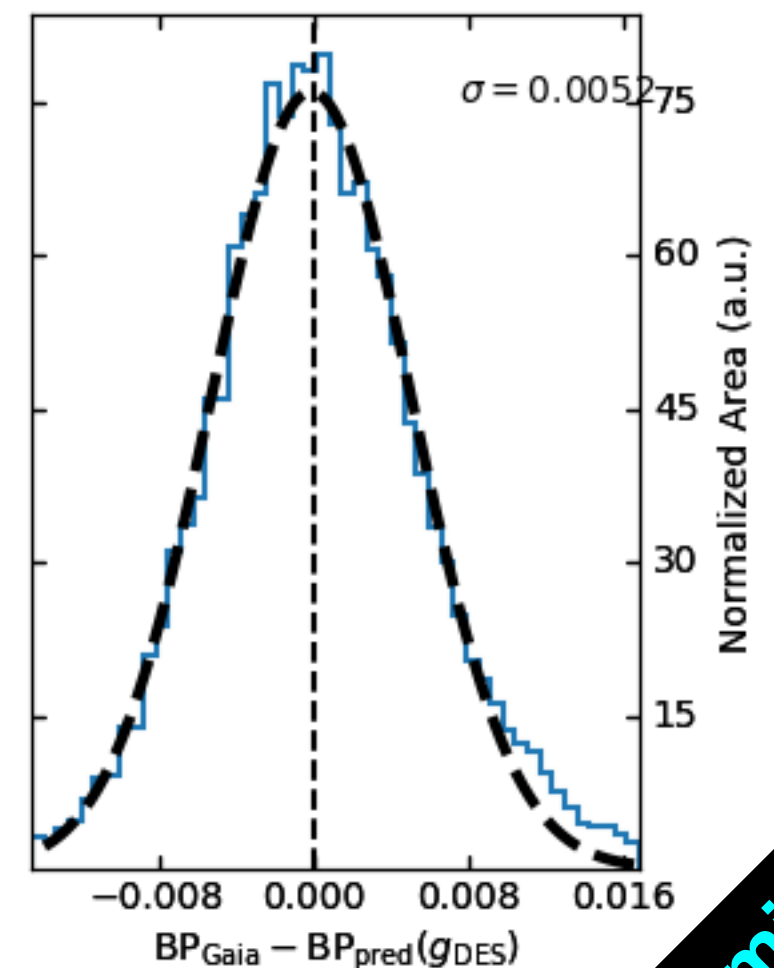
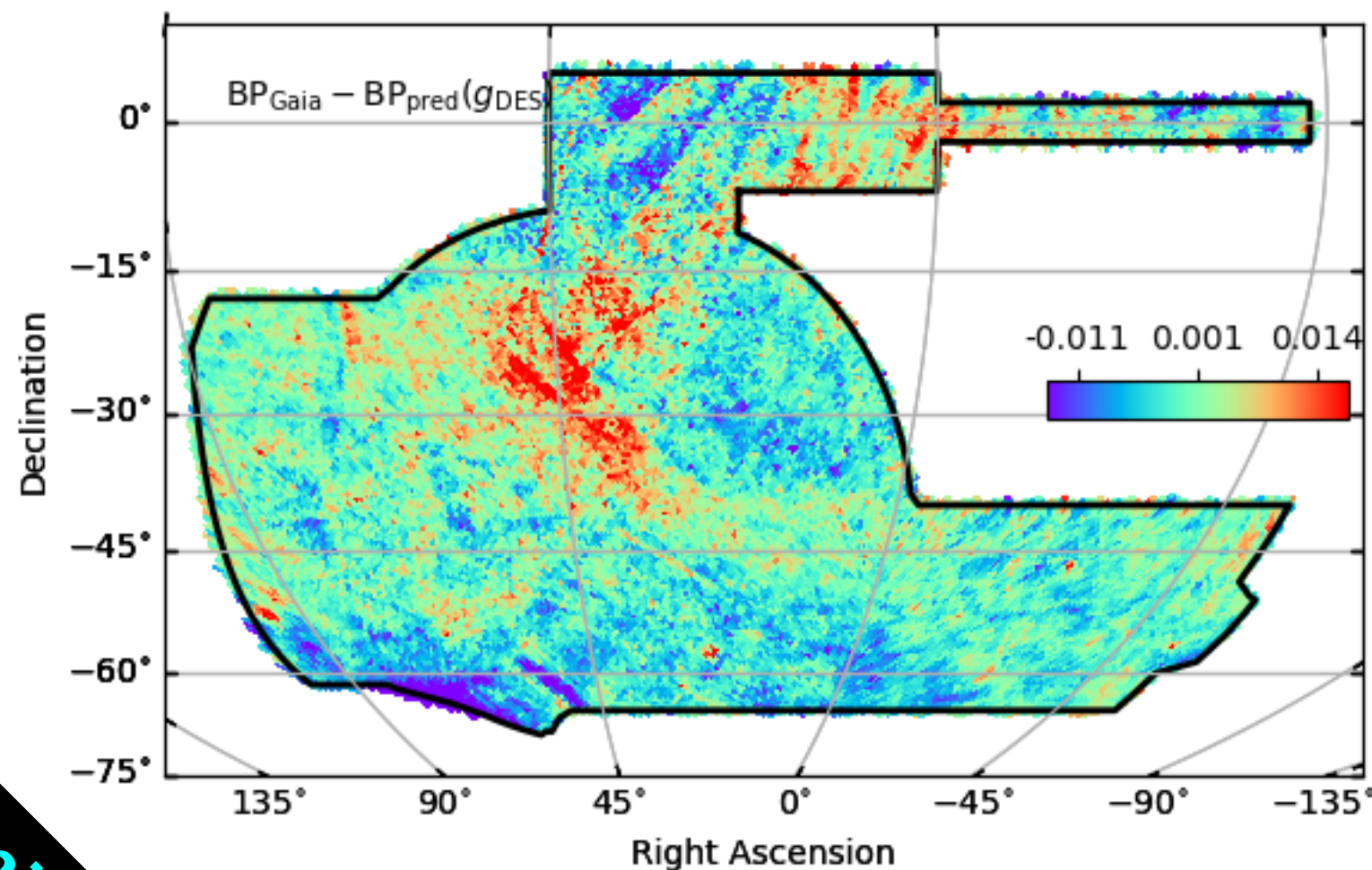


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DES g-band and Gaia BP

- Offset map ($G_{BP} - g$), $n_{side}=128$
- Uniform with RMS of 5.2 mmag
 - Features with Gaia scans (see DR1 comparison)

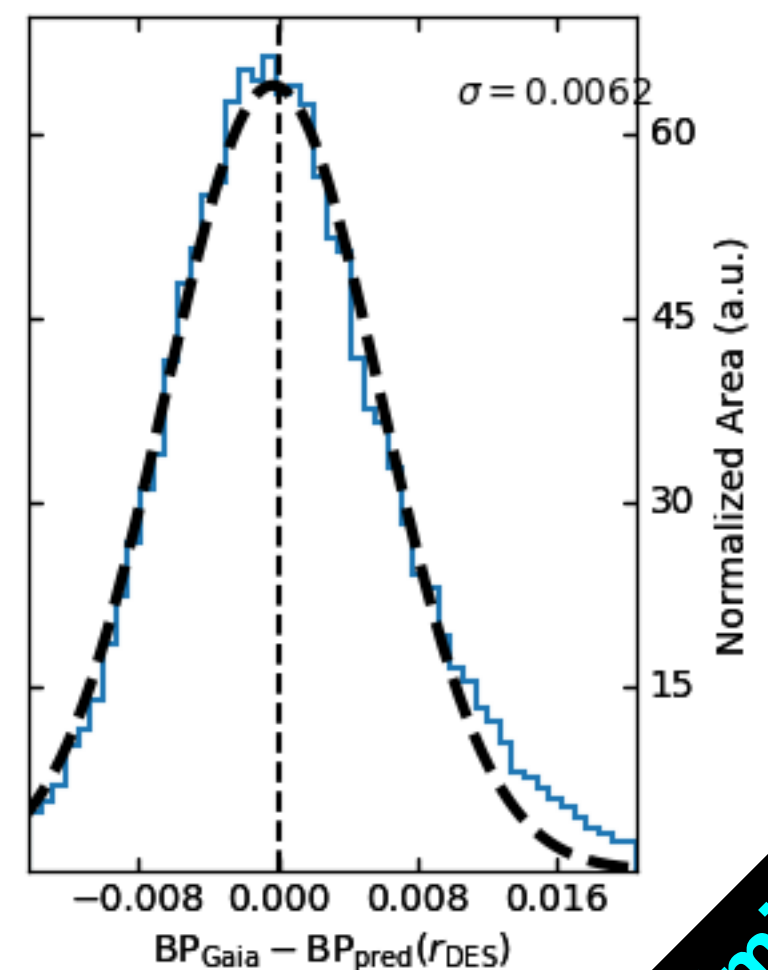
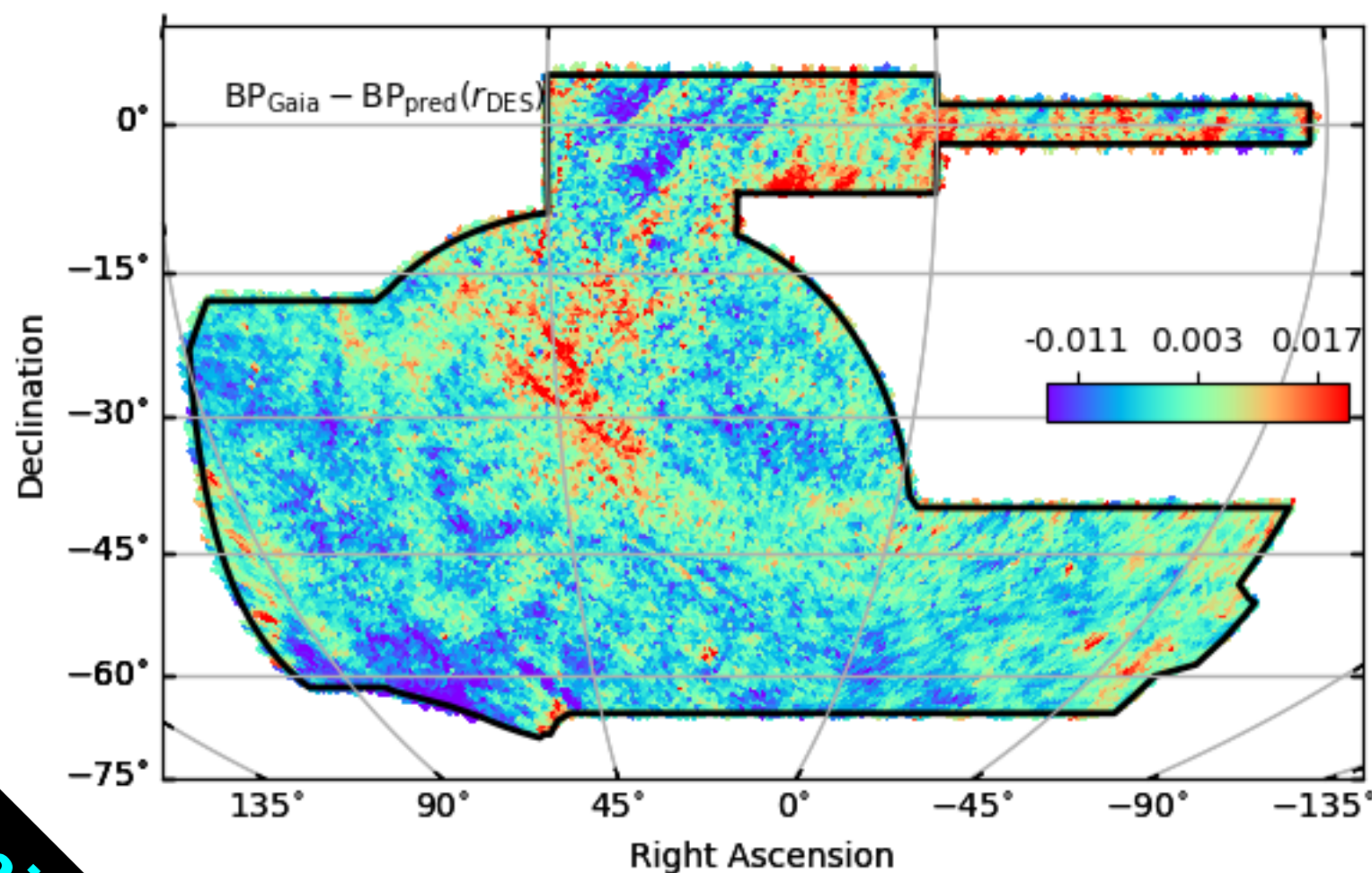


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DES r-band and Gaia BP

- Offset map ($G_{BP} - r$), $n_{side}=128$
- Uniform with RMS of 6.2 mmag
 - Worse than $G - r$ comparison, issues with BP presumably

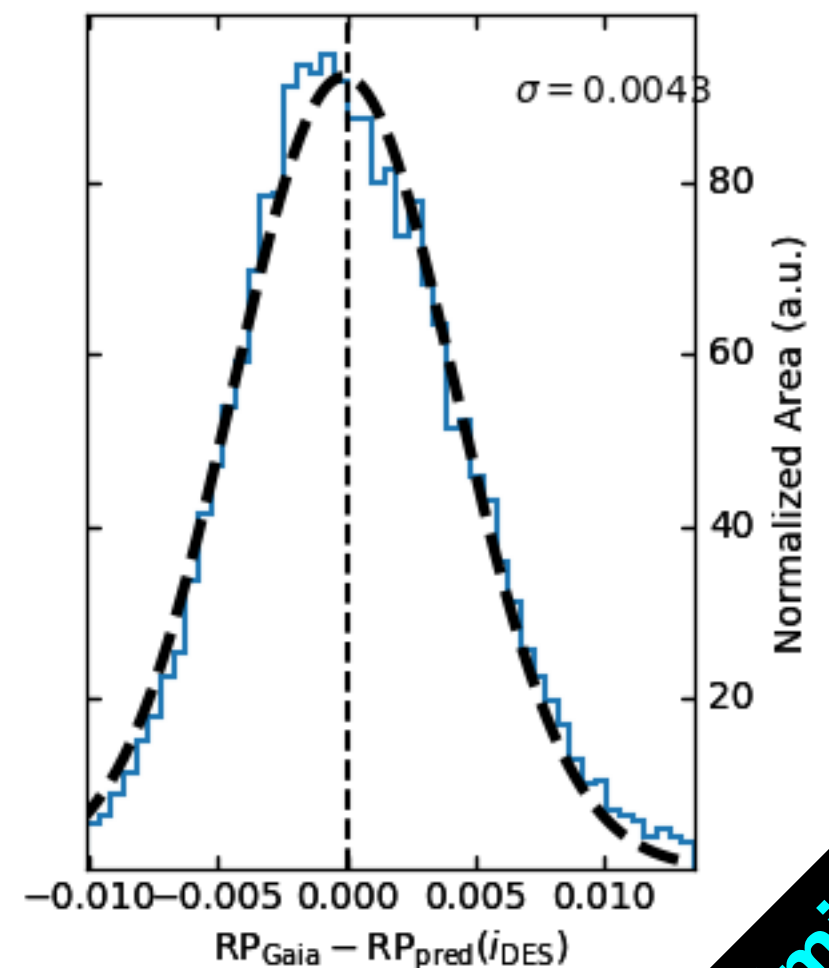
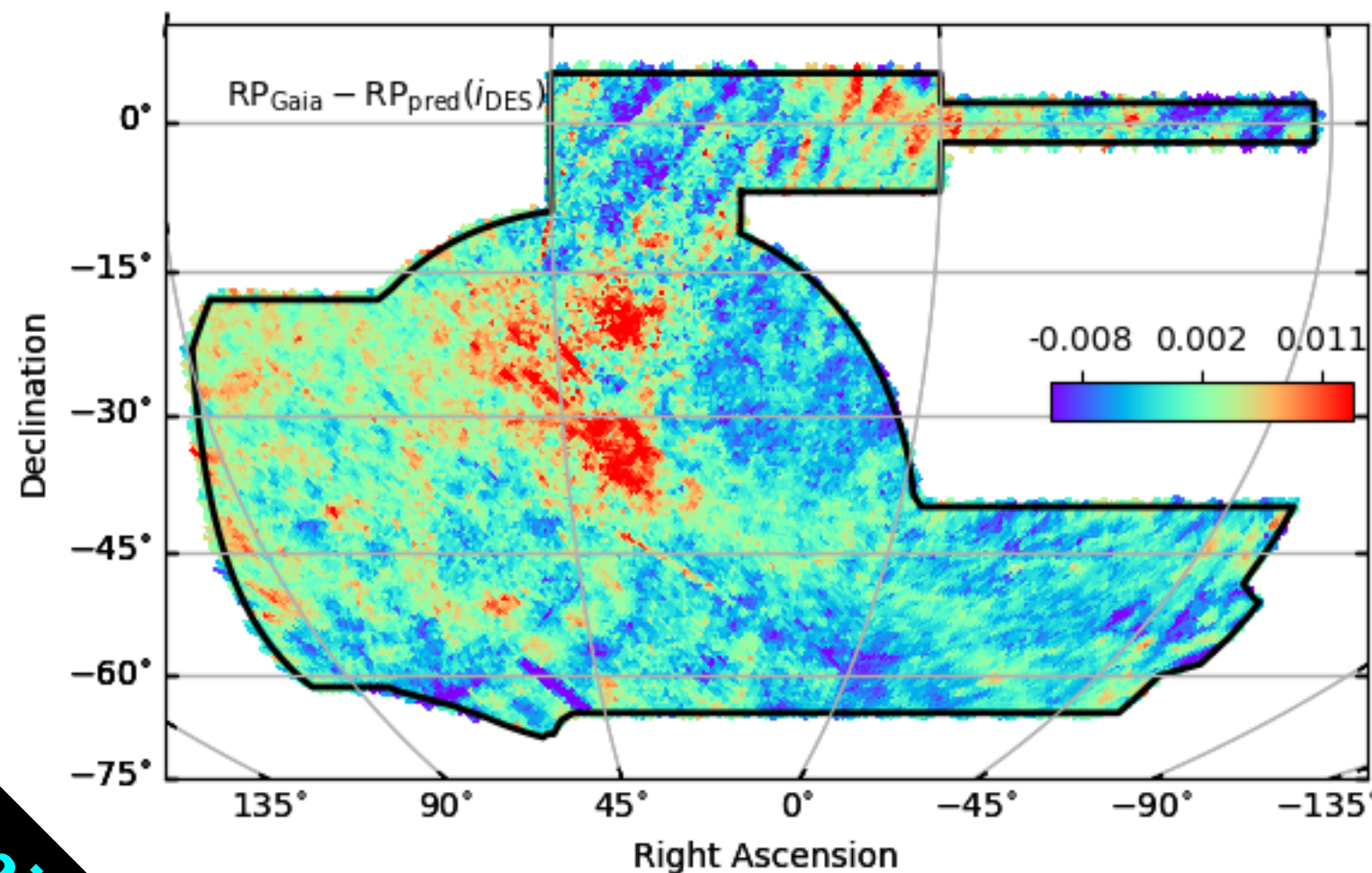


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DES i-band and Gaia RP

- Offset map ($G_{\text{RP}} - i$), $n_{\text{side}}=128$
- Uniform with RMS of 4.3 mmag
 - Overall very good
 - Features with Gaia scans (see DR1 comparison)

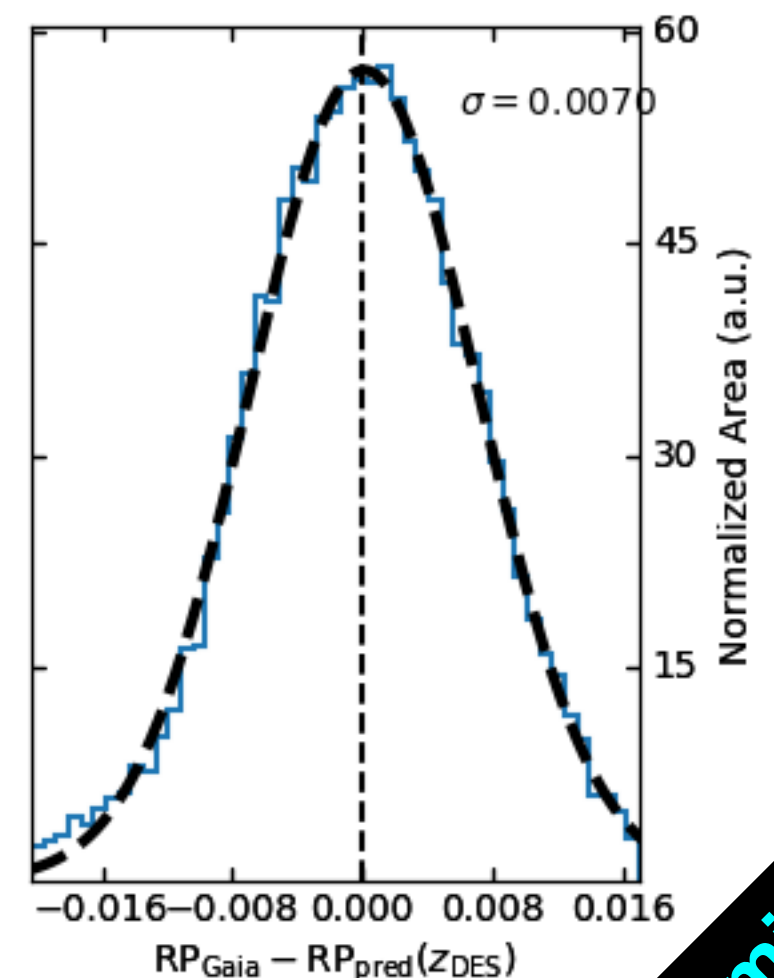
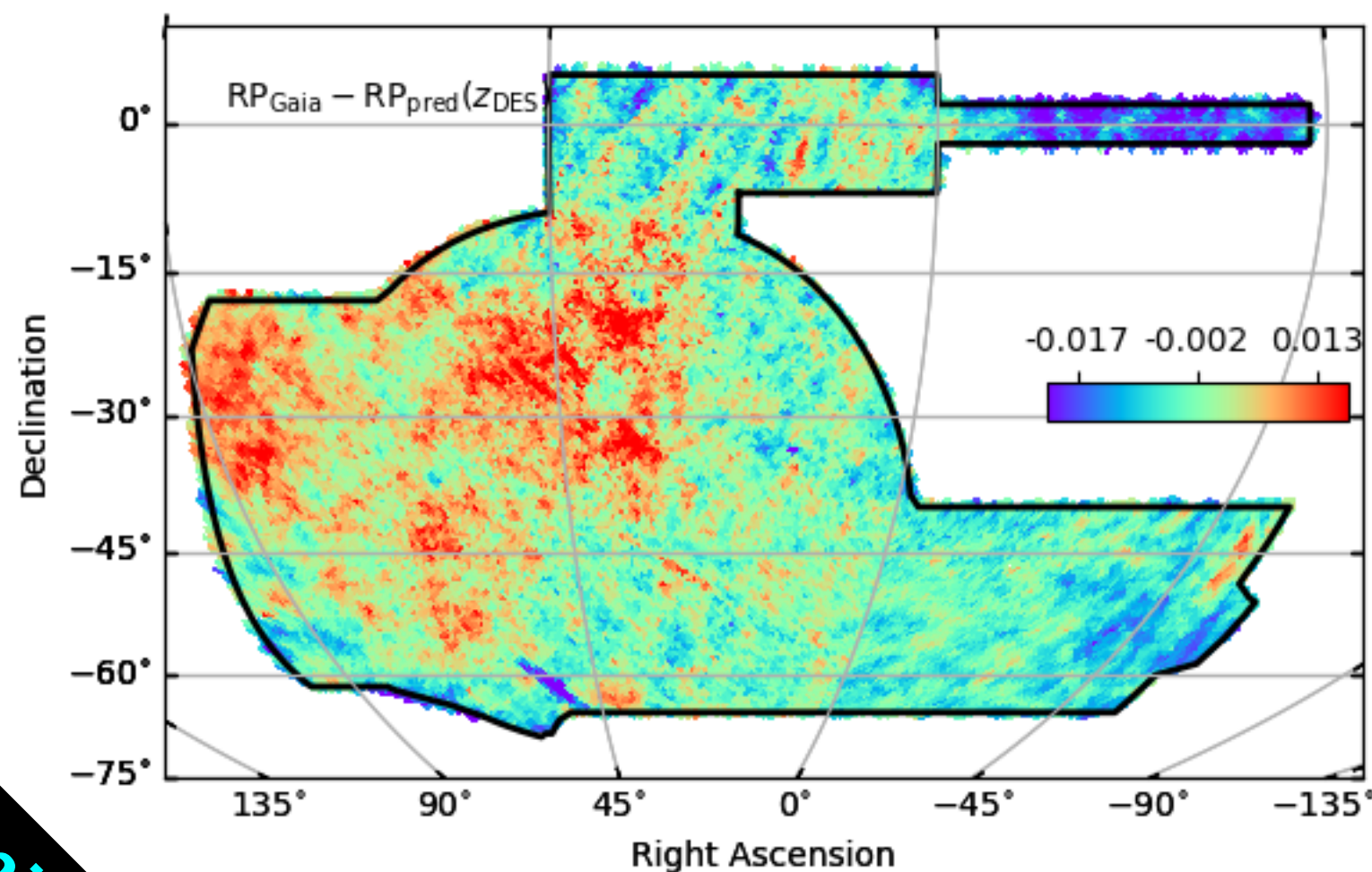


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DES z-band and Gaia RP

- Offset map ($G_{RP} - z$), $n_{side}=128$
- Uniform with RMS of 7.0 mmag
 - Features from both DES and Gaia
 - PWV modeling in DES still not ideal

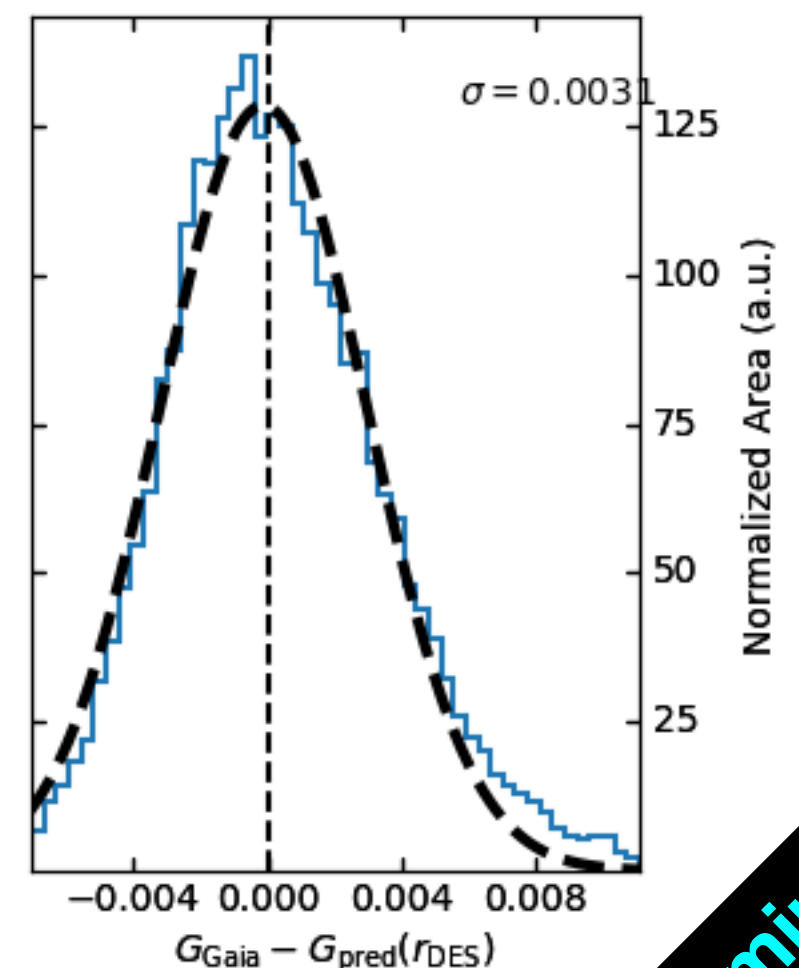
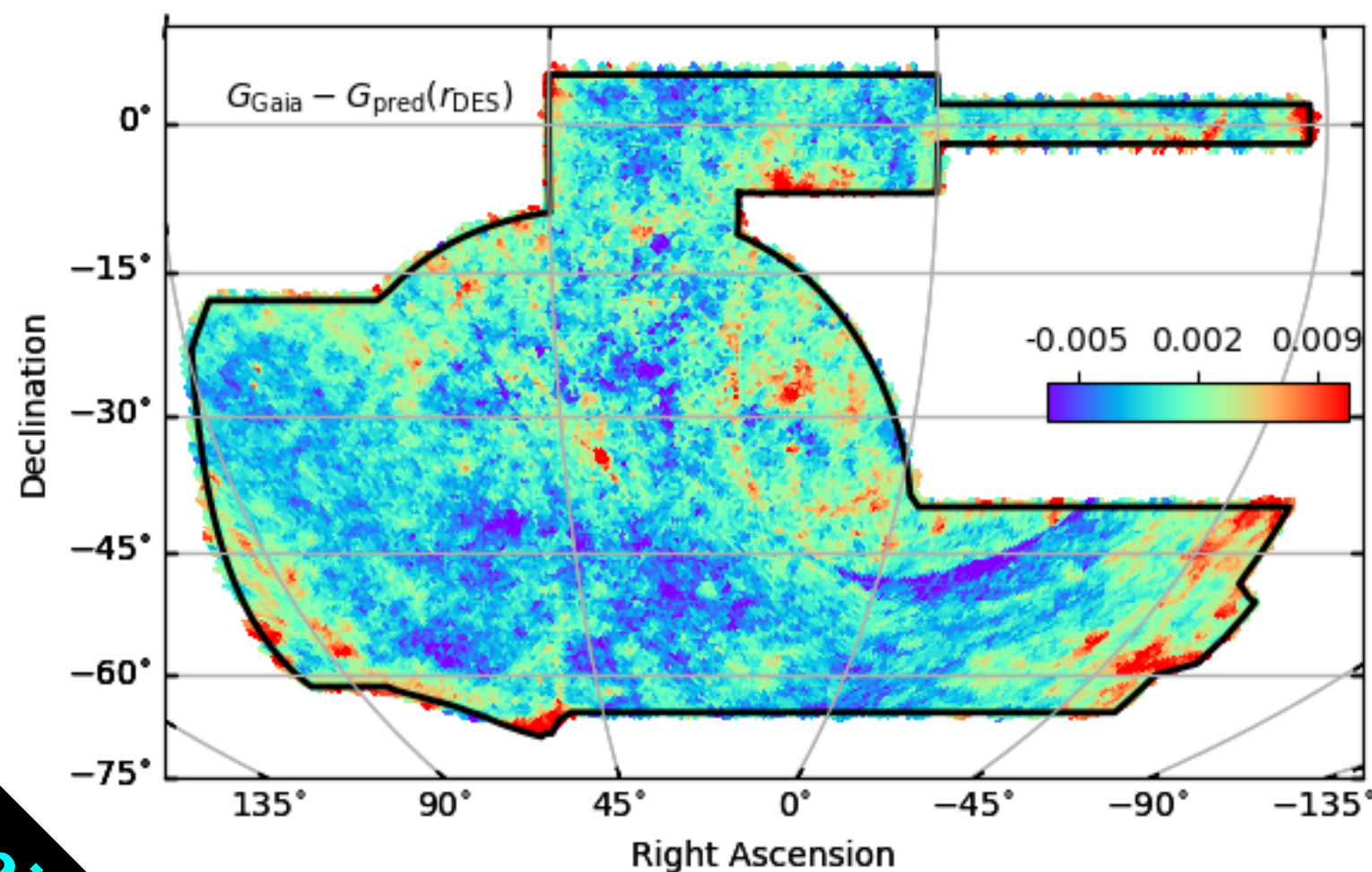


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DES r-band and Gaia DR2

- Offset map ($G - r$) for Gaia DR2, $n_{\text{side}}=128$
- Uniform with RMS of 3.1 mmag
- Narrower scale in to show structure
 - Cat scratches still there at low level



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Issues

- What are the plans for BP and RP calibration going forward?
- Will BP/RP have sufficient density for well-modeled sources for LSST?
- We need the spectrophotometry (SEDs) or end up with reddening/metallicity dependent offsets (bad)