

Euclid Space Mission



***Framework
for
Joint Photometric Validation
of
External Imaging Surveys***

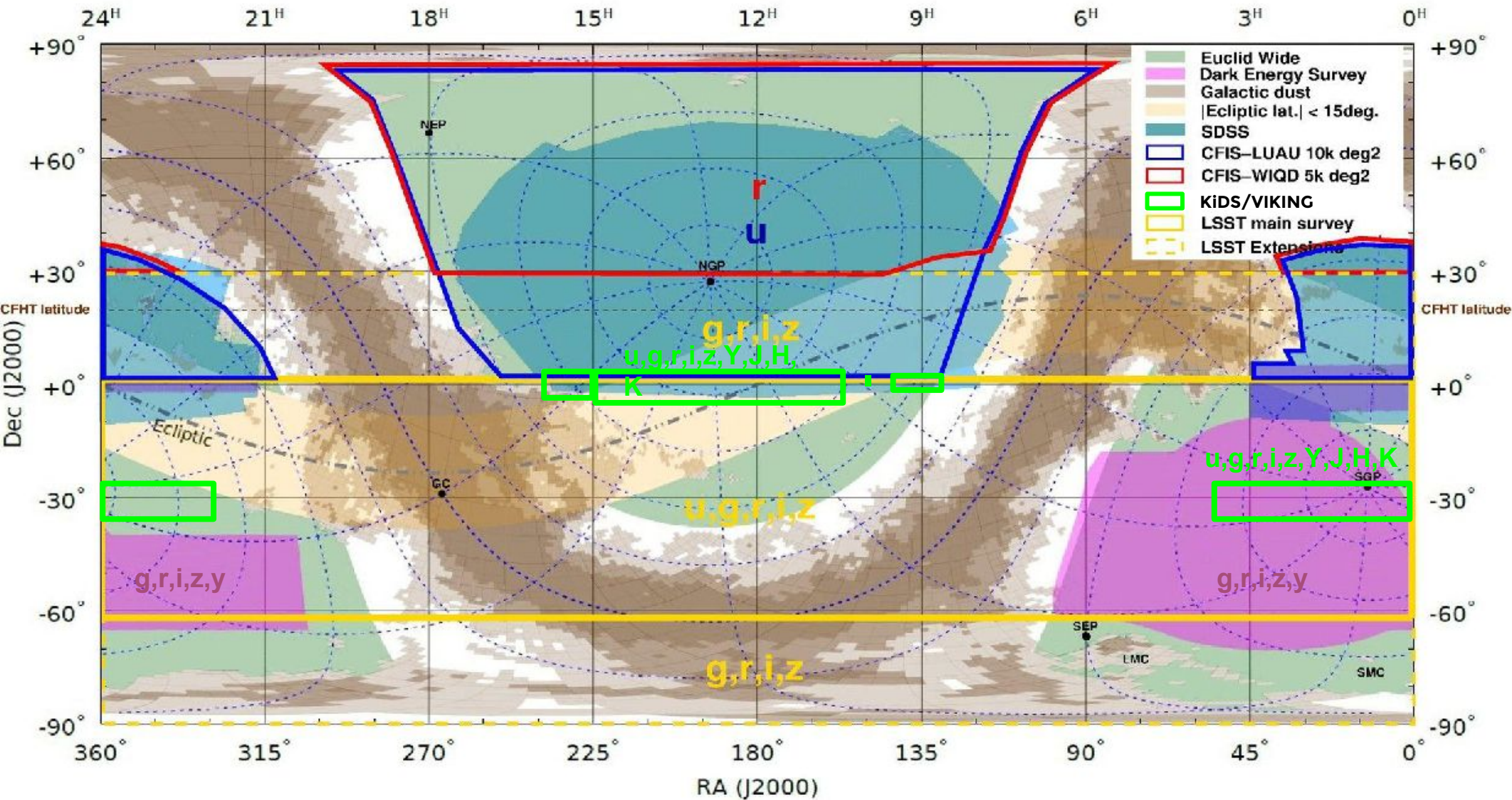
**Gijs Verdoes Kleijn
EXT**

**Kapteyn Astronomical Institute
Groningen, NL**

- **Intro**
- **Idea**
- **Application**
 - **Validation**
 - **Re-calibration**
- **Concluding proposal**

- **Deliver imaging for our ensemble of EXT surveys**
 - **good:**
 - **1% single-filter homogeneity over survey**
 - **0.2% color homogeneity over Euclid FoV**
 - **easy for user**
 - **Identical definition of images, PSF maps and flag maps**

External ground-based imaging



- *Diversity*
- *Connectedness*

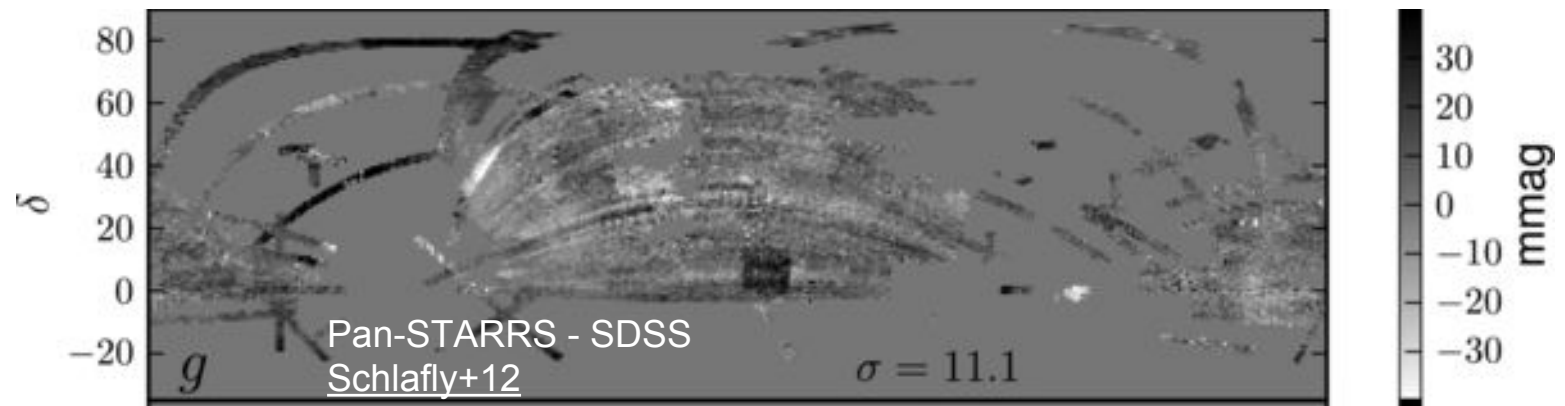
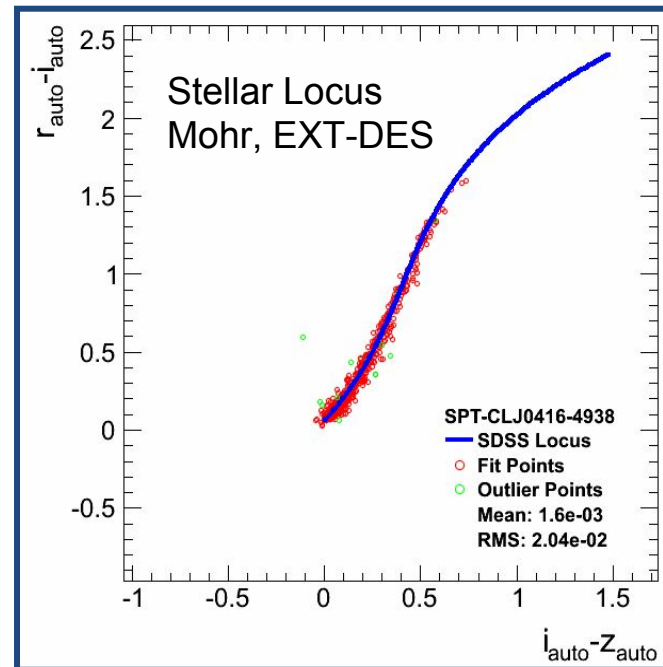
Euclid – status – today

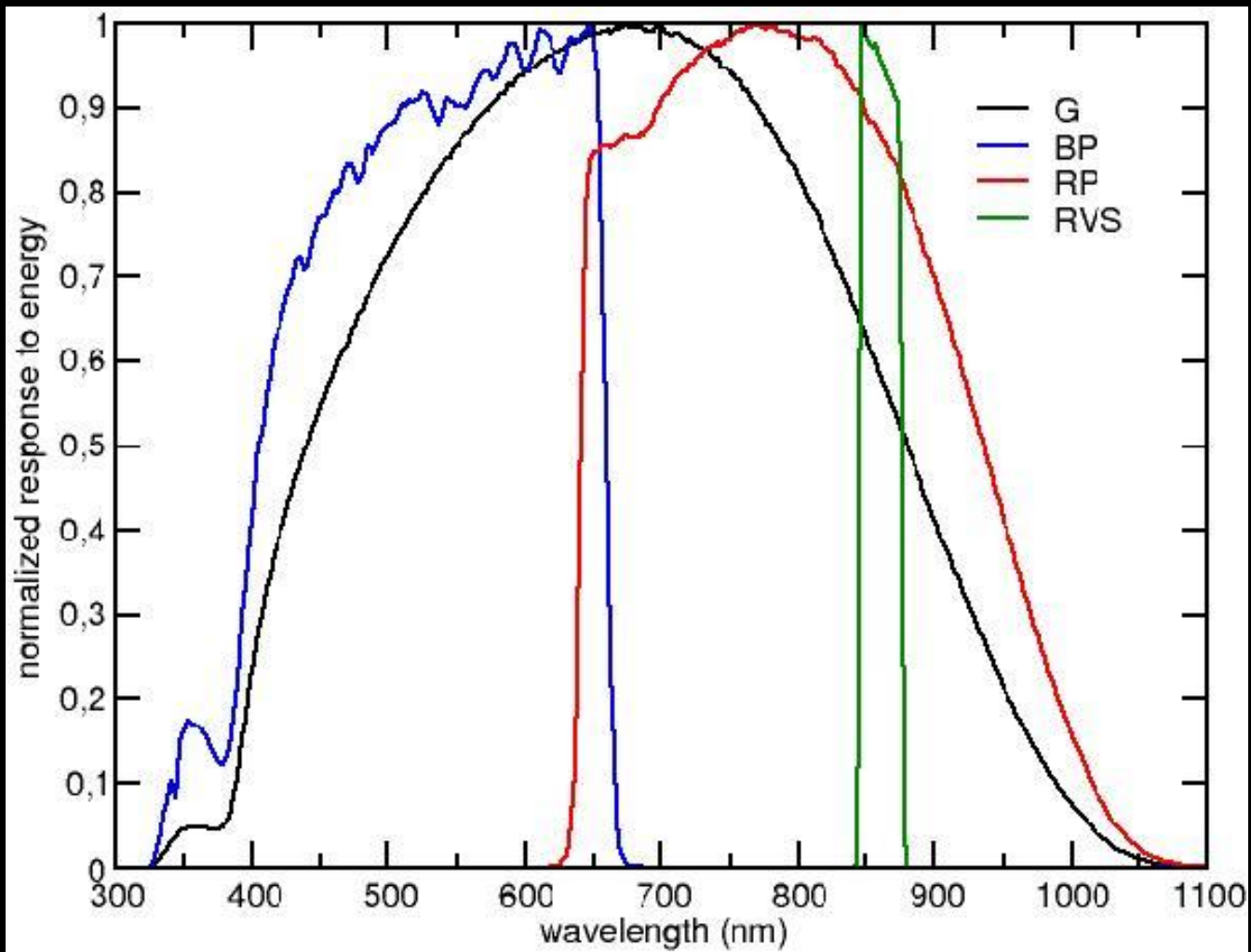
Aug 2016 status, credits Cuillandre/Mohr/Dwelly

- 1. heterogeneity: ~6 surveys & observatories**
 - 2. continuous aggregation, more than a decade**
 - 3. recurrent updates of external calibrators**
-
- **EXT-North: single filters from 3 different observatories**
 - **Join data for validation (stellar locus)**
 - **EXT-South: DES, KiDS precursors for LSST**
 - **Develop generic algorithms & software**

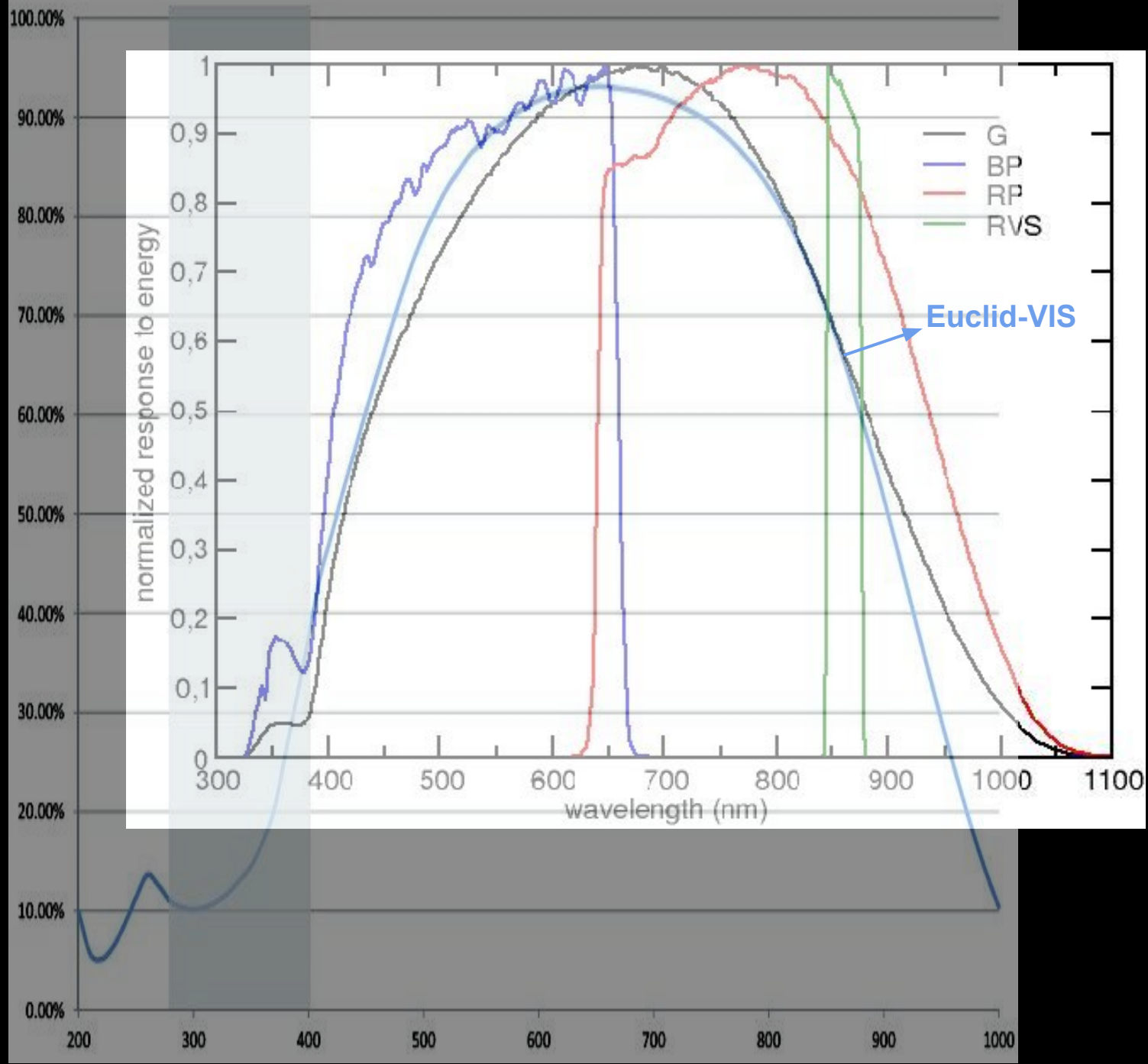
starID, [dateobs,filterID], [(x,y),ADU, (ra,dec),mag]

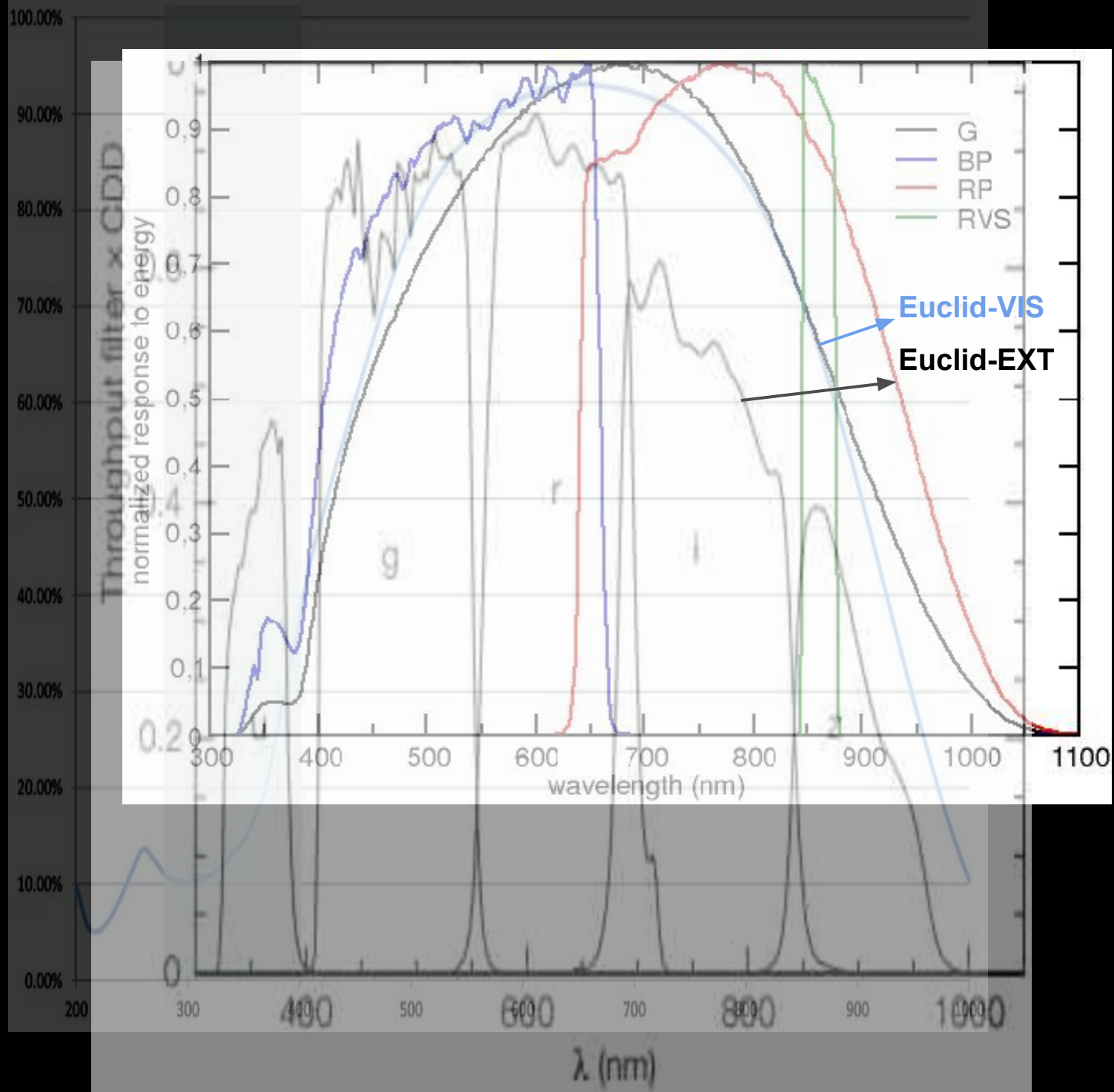
[Axelrod+14](#),
[Bolton+10](#)
[Bramich+12](#)
[Cuillandre+12](#)
[DECaLS](#)
[De Jong+, 15](#)
[Desai, Mohr +12](#)
[High+09](#)
[Ivezic+04](#)
[Kuijken+08, 15](#)
[Lang, 15](#)
[Magnier+06](#)
[Magnier+13](#)
[Padmanabhan+08](#)
[Pier+03](#)
[Regnault+15](#)
[Schlafly+10](#)
[Schlafly+12](#)



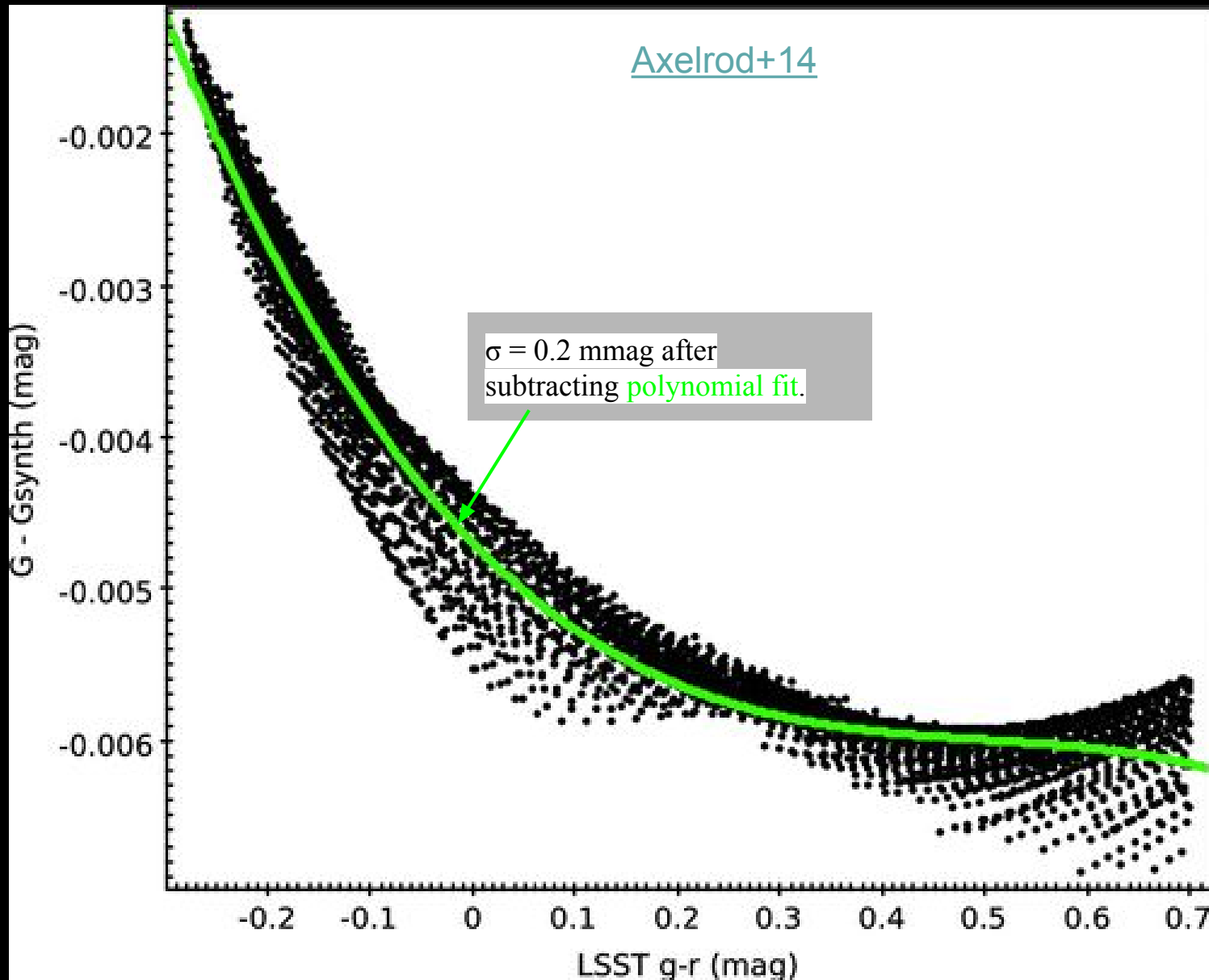


CCD273 BI





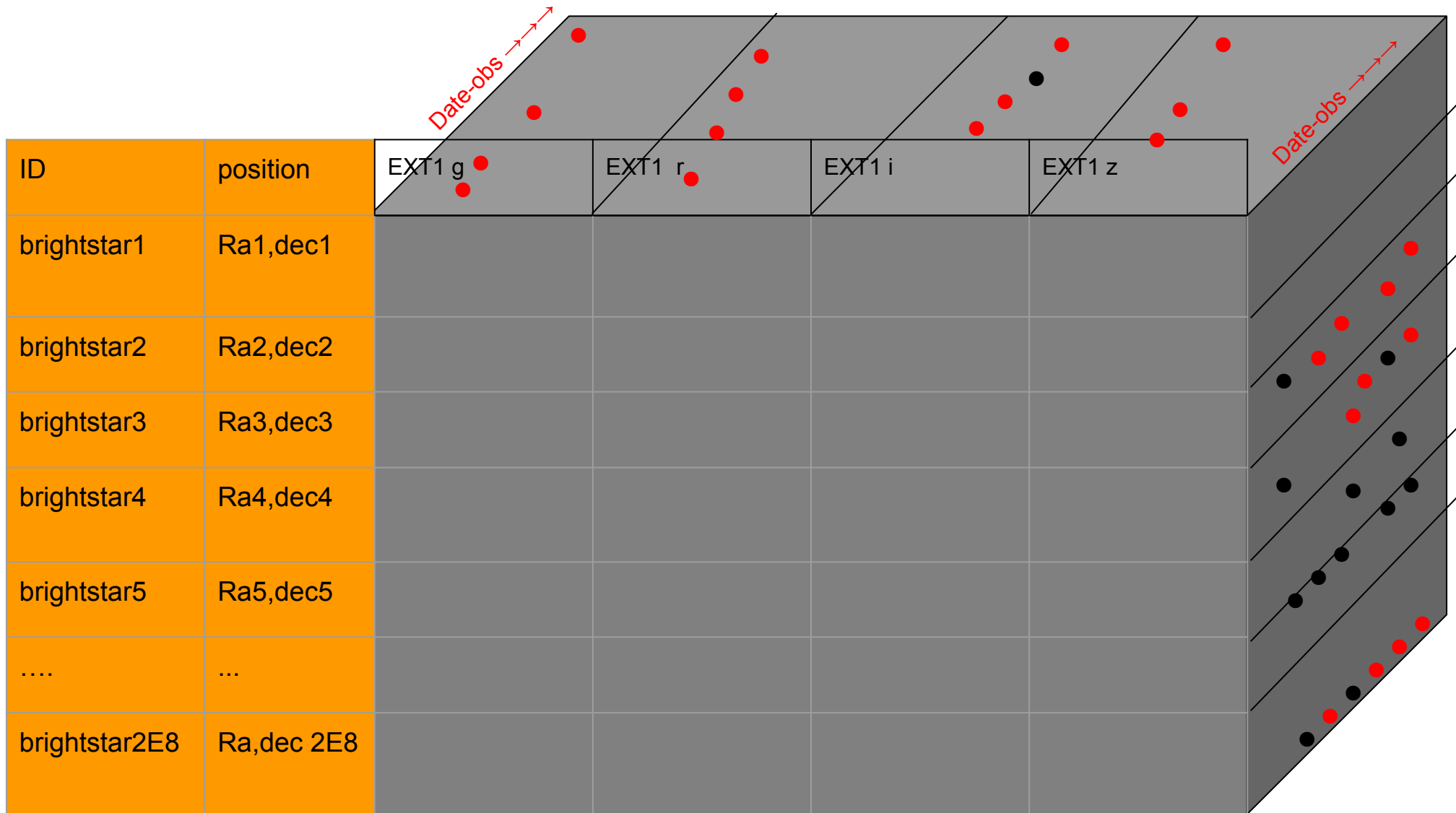
Gaia G / Euclid VIS as validator of 0.2%



ID	position	mag
brightstar1	Ra1,dec1	G1
brightstar2	Ra2,dec2	G2
brightstar3	Ra3,dec3	G3
brightstar4	Ra4,dec4	G4
brightstar5	Ra5,dec5	G5
....
brightstar2E8	Ra,dec 2E8	G2E8

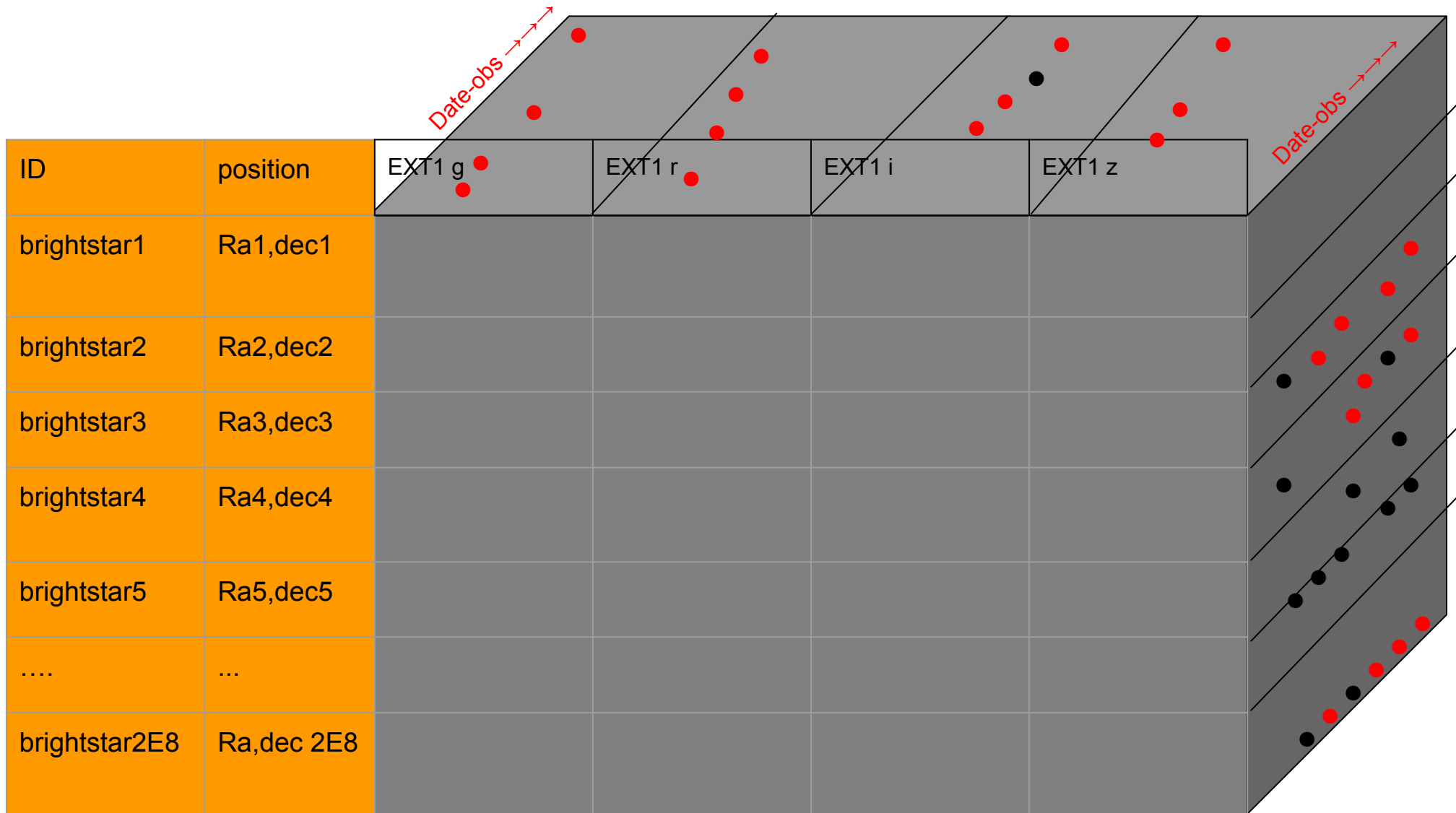
	average	b=20deg
Gaia star density (#/arcmin²)	~3.3	~6.9

Start with Gaia Star Catalog



● = {ADU, mag,(x,y),(ra,dec) and their errors} for given brightstar and dateobs

EXT Stellar Table for relative photometry /uebercal



● = {ADU, mag,(x,y),(ra,dec) and their errors} for given brightstar and dateobs

EXT Stellar Table for absolute calibration (and updates)



Date-obs →

ID	position	EXT1 g	EXT1 r	EXT1 i	EXT1 z	Gaia BP/RP
brightstar1	Ra1,dec1					
brightstar2	Ra2,dec2					
brightstar3	Ra3,dec3					
brightstar4	Ra4,dec4					
brightstar5	Ra5,dec5					
....	...					
brightstar2E8	Ra,dec 2E8					

● = {ADU, mag,(x,y),(ra,dec) and their errors} for given brightstar and dateobs

EXT Stellar Table for validation



Date-obs →

ID	position	EXT1 g	EXT1 r	EXT1 i	EXT1 z	Gaia-G, VIS
brightstar1	Ra1,dec1					
brightstar2	Ra2,dec2					
brightstar3	Ra3,dec3					
brightstar4	Ra4,dec4					
brightstar5	Ra5,dec5					
....	...					
brightstar2E8	Ra,dec 2E8					

● = {ADU, mag,(x,y),(ra,dec) and their errors} for given brightstar and dateobs

EXT Stellar Table for validation, 2



Date-obs →

ID	position	EXT1 g	EXT1 r	EXT1 i	EXT1 z	Gaia-G, PS., DECaLS
brightstar1	Ra1,dec1					
brightstar2	Ra2,dec2					
brightstar3	Ra3,dec3					
brightstar4	Ra4,dec4					
brightstar5	Ra5,dec5					
....	...					
brightstar2E8	Ra,dec 2E8					

● = {ADU, mag,(x,y),(ra,dec) and their errors} for given brightstar and dateobs

Validation handshake with MER



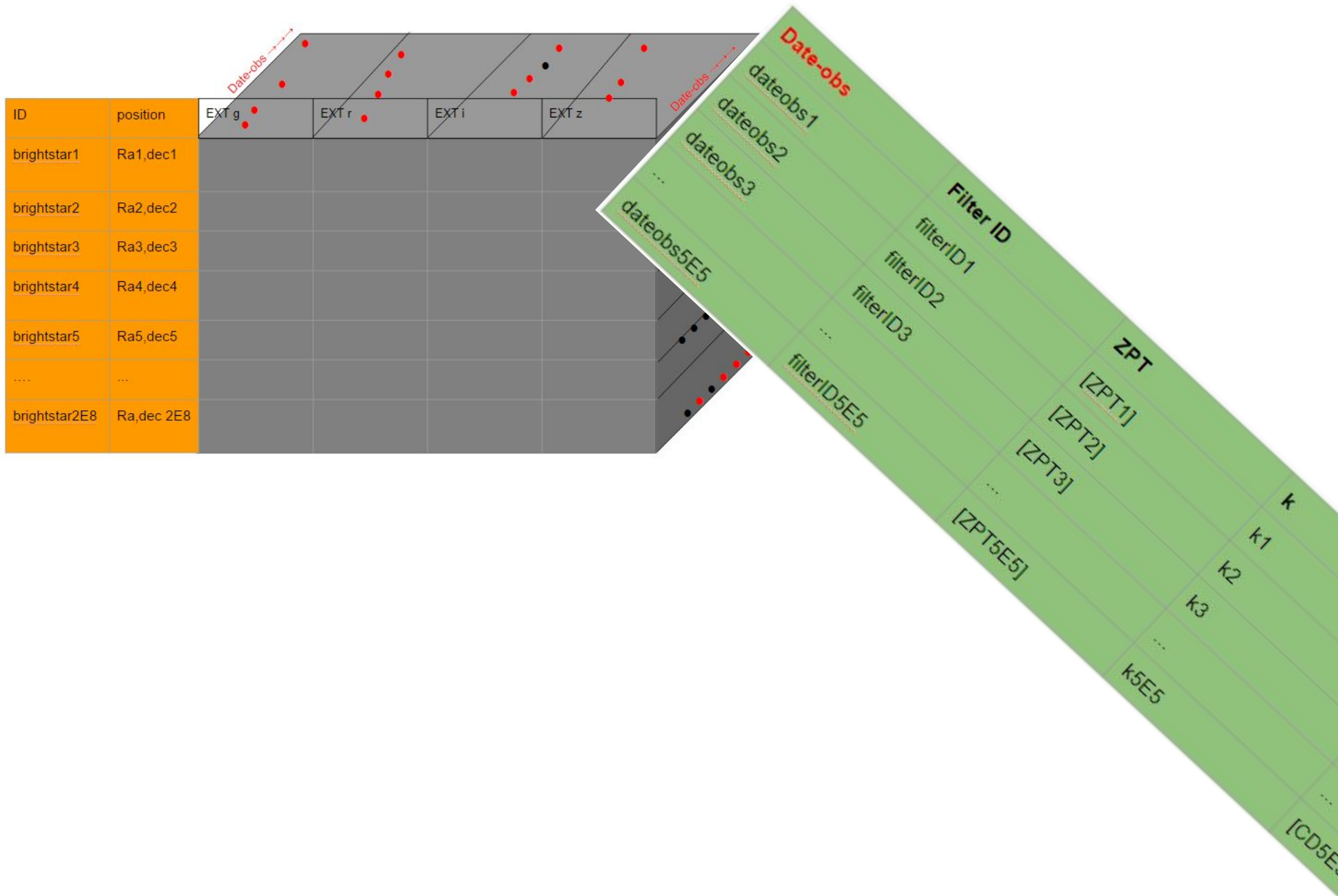
ID	position	EXT1 g	EXT1 r	EXT1 i	EXT1 z	VIS
brightstar1	Ra1,dec1	mag, dmag, ra,dec dradec	mag, dmag, ra,dec, dradec	mag, dmag, ra,dec, dradec	mag, dmag, ra,dec, dradec	
brightstar2	Ra2,dec2					
brightstar3	Ra3,dec3					
brightstar4	Ra4,dec4					
brightstar5	Ra5,dec5					
....	...					
brightstar2E8	Ra,dec 2E8					

Calibration Parameters Table: initial



Date-obs	Filter ID	ZPT	k	CD, PV
dateobs1	filterID1	[ZPT1]	k1	[CD1, PV1]
dateobs2	filterID2	[ZPT2]	k2	[CD2, PV2]
dateobs3	filterID3	[ZPT3]	k3	[CD3, PV3]
...
dateobs 5E5	filterID5E5	[ZPT5E5]	k5E5	[CD5E5, PV5E5]

EXT Stellar Table for intra-survey re-calibration



Date-obs	Filter ID	ZPT	K, C0	CD, PV
dateobs1	filterID1	[ZPT1(x,y)]	K1, C1(x,y)	[CD1, PV1](x,y)
dateobs2	filterID2	[ZPT2(x,y)]	K2, C2(x,y)	[CD2, PV2](x,y)
dateobs3	filterID3	[ZPT3(x,y)]	k3,C5E5(x,y)	[CD3, PV3](x,y)
...
dateobs5E5	filterID5E5	[ZPT5E5(x,y)]	k5E5,C0(x,y)	[CD5E5, PV5E5](x,y)

Date-obs	Filter ID	ZPT	k	CD, PV
dateobs1	filterID1	[ZPT1]	k1	[CD1, PV1]
dateobs2	filterID2	[ZPT2]	k2	[CD2, PV2]
dateobs3	filterID3	[ZPT3]	k3	[CD3, PV3]
...
dateobs5E5	filterID5E5	[ZPT5E5]	k5E5	[CD5E5, PV5E5]

Proposal

- build together EXT Stellar Table
 - Populate it with single-epoch measurements from each EXT survey
- Workhorse
 - for relative photometry (uebercal)
 - for absolute photometry (adding external catalogs)
 - for validations (internal, MER handshake, external)

Collateral benefits

- software re-use (and consistency) across surveys
- Straightforward to deal with new data, new instruments
- Continuous validation (also using survey overlaps)
- EXT re-calibration becomes table operation¹
- Re-delivery to MER of calibration params table (for same single-epoch pixels)
- Exploitation for Legacy science

¹ not all types calibration error

FIN