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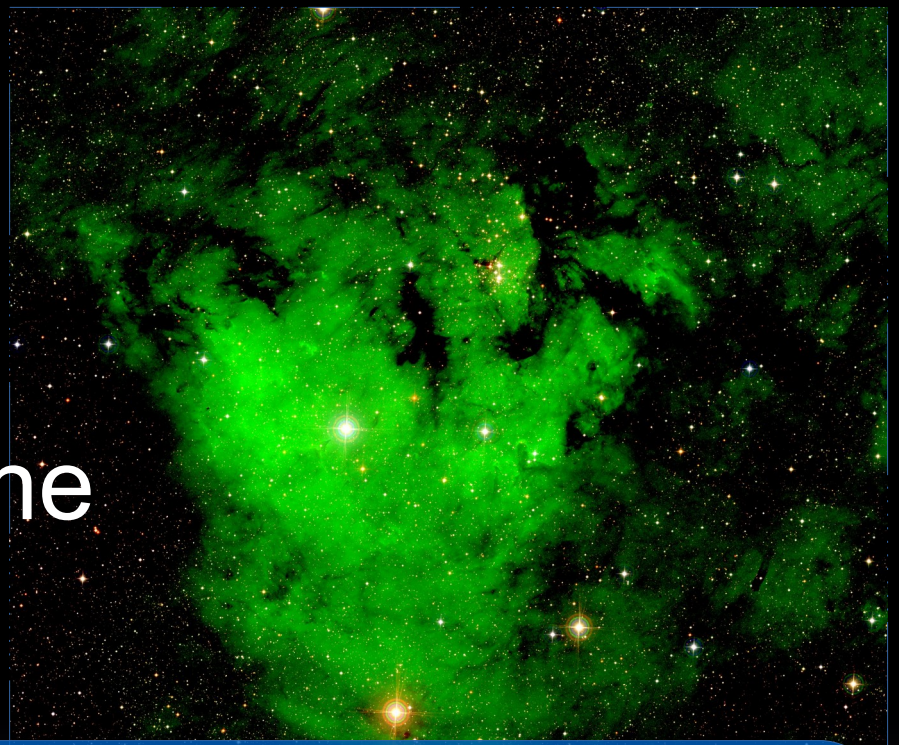
GALANTE: photometric survey of O+B+WR stars in the Galactic Plane

Status and first results



GALANTE is an optical (3000-9000 Å) photometric survey with seven intermediate/narrow filters that has been covering the Galactic Plane since 2016 using the Javalambre JAST/T80. The GALANTE photometric system (defined in Lorenzo et al. 2019) is designed to identify the majority of the early-type massive stars within several kpc of the Sun and derive estimations for stellar parameters (Maíz Apellániz & Sota 2008; Maíz Apellániz et al. 2014). The calibration scheme make use of external 2MASS and Gaia (photometric and astrometric) data. As of mid 2020, 21% of the project observations have been completed, resulting in over 300 1.4°x1.4° astronomical fields. The pipeline is functional and here we focus on our test field, Berkeley 59, showing preliminary results. The collaboration will ultimately provide a 7-filter photometric catalog of stars with a precision of several mili-magnitudes.

GALANTE is a long-term ongoing observational project (2016-2025) contributing to the study of **Galactic star populations**. Specifically, GALANTE associated photometric system is designed to identify **all Galactic O+B+WR** stars with AB magnitudes 6-17 and derive **estimations** for T_{eff}, log (g), metallicity, and amount and type of extinction: **E(4405−4595)** and R_{5495}.

Some characteristics of the survey are:

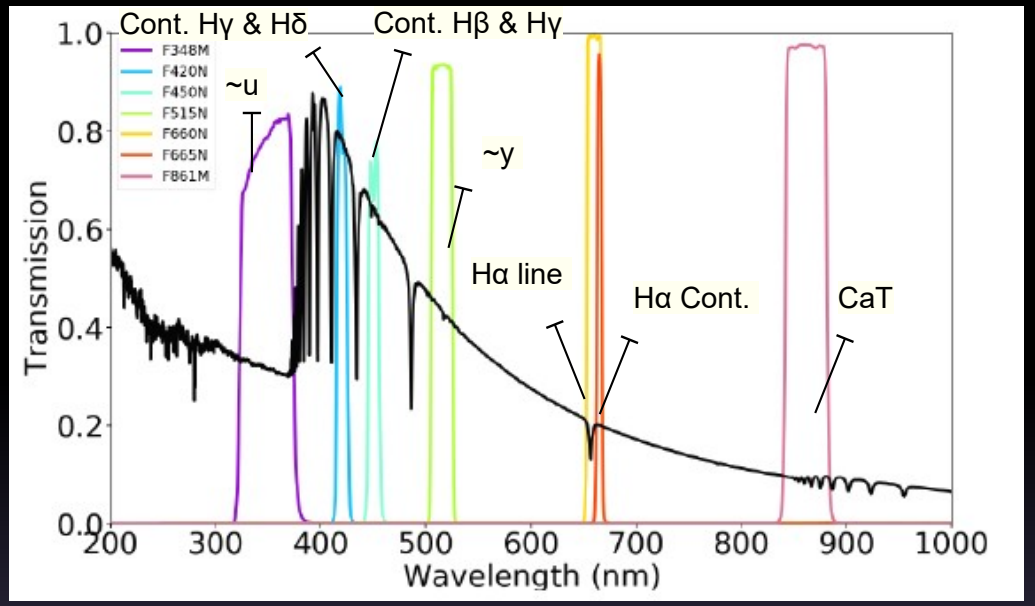
- Galactic Plane coverage + interesting out-of-plane fields: JAST/T80 at OAJ.

- 1.4°x1.4° FOV, 0.55”/px, no gaps.

- Exp. Times: 2 x (0.1s + 1s + 10s + 2 x 50/100 s, at two different airmasses). AB mag 6-17 with S/N > 100.

- Seven Medium and Narrow band filters. Four J-PLUS filters (F348M, F515N, F660N, and F861M) & three developed by the GALANTE team (F420N, F450N, and F665N).

- Photometric and astrometric 2MASS and GaiaDR2 data for the input calibration catalog, and deriving synthetic photometry with CHORIZOS*.



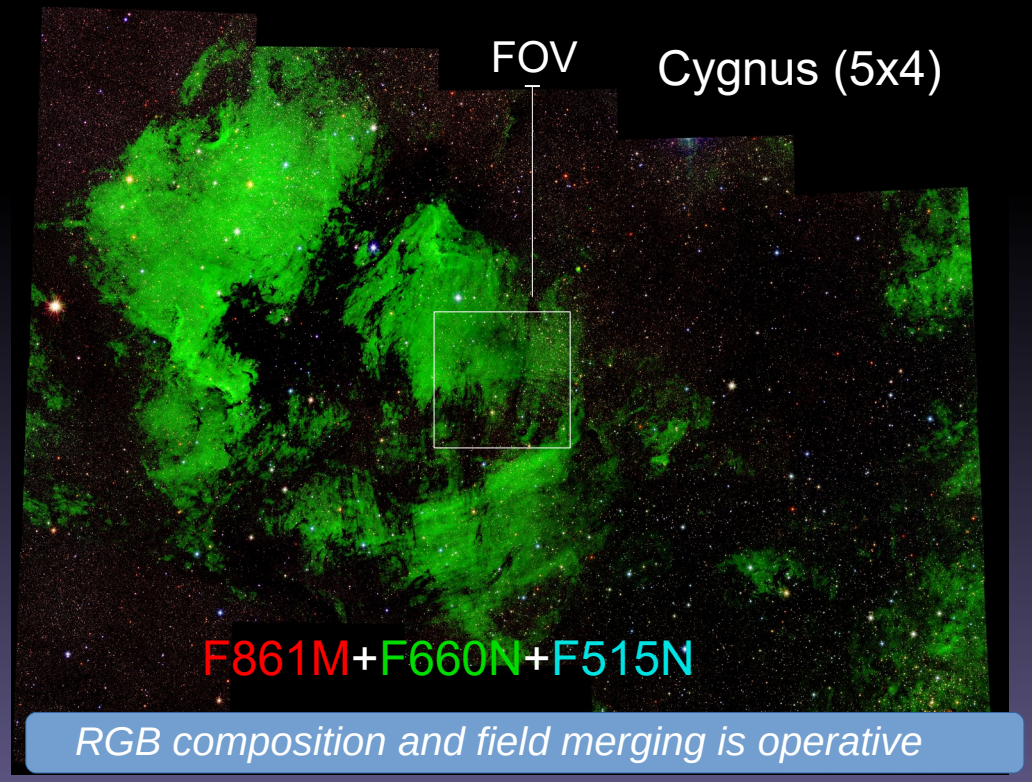
The number, width and effective wavelength of the filters compose an optimal system to accomplish temperature and extinction determination.

**CHORIZOS is a χ2 minimization algorithm for parametrized modelling and characterization of photometry and spectrophotometry (developed by Jesús Maíz Apellániz). The code is written in IDL and is available to the astronomical community.*

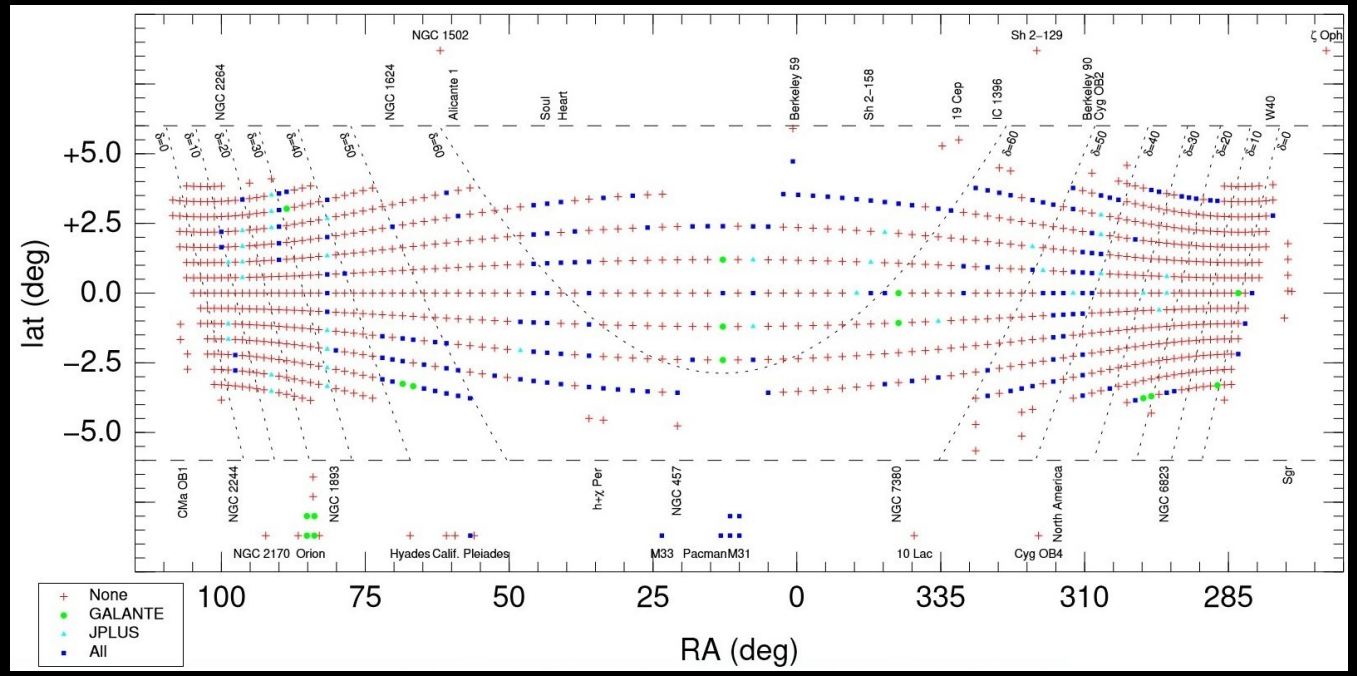
Status update

Post-pipeline functionality

★ **150/1063** Northern fields finished, **90** partially observed (GALANTE or JPLUS filters). ~20% GALANTE North.



RGB composition and field merging is operative



★ After receiving the reduced images from the pipeline, most steps of the calibration are now operative including:

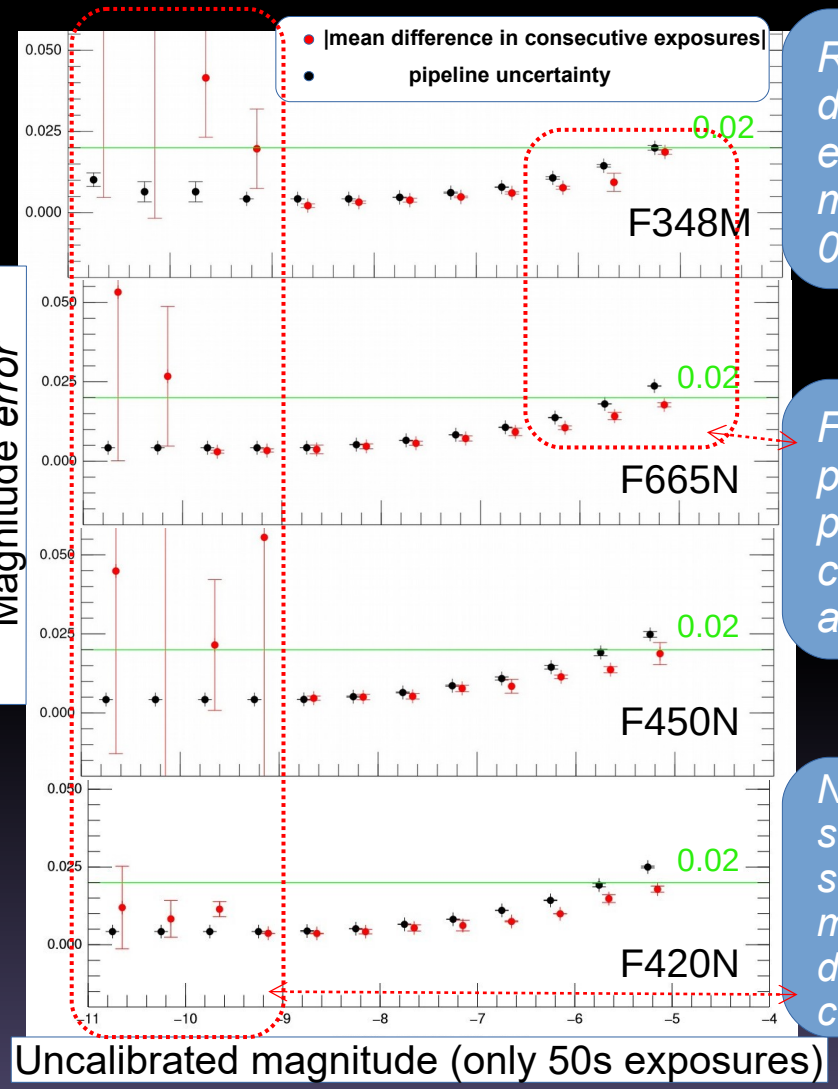
- Astrometric correction
- Background calculation
- Additional moon-flat correction
- **Aperture photometry**
- **Flux calibration**

Test results, calibration, and evaluation of the last two are discussed here.

A first DR0 catalog of the sample field Berkeley 59 is discussed here, and will be soon publicly available

Calibration evaluation

★ Relative calibration (testing aperture photometry)



Reproducibility dominates random error, which median is below 0.02 mag

Fainter stars produce worse photometry, but we compensate with appropriate uncert.

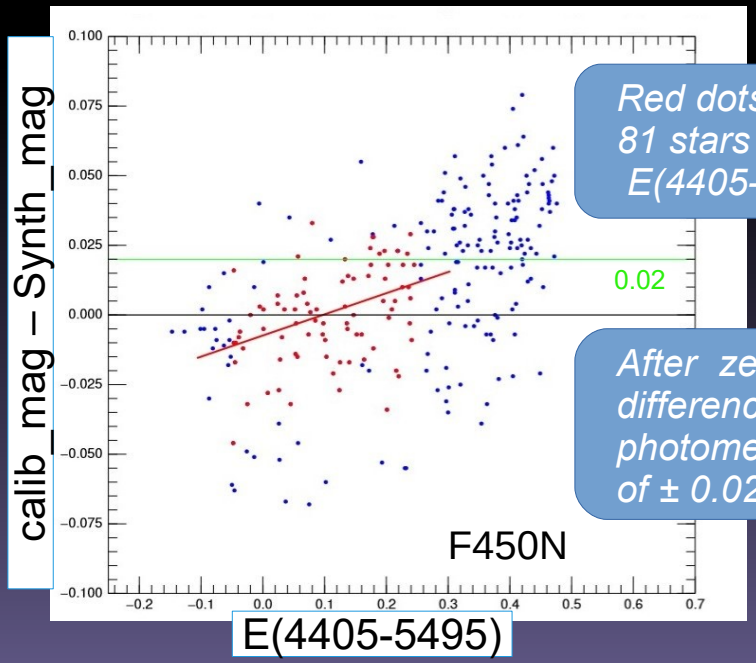
Non-linearity near saturation is clear, stars with uncalibrated mag < -9 are discarded for absolute calibration

Non-consecutive exposures present a similar result, but with higher effects on both ends of the magnitude range

★ Absolute calibration (testing flux calibration)

Steps are:

- Generate **synthetic photometry** of each star with 2MASS+GaiaDR2 data. Estimations for temperature and extinction are inferred in this process.
- Obtain the **combined uncalibrated magnitude** for each star, using all exp. times, and minor diffraction corrections. Uncertainty used as weight.
- Define a **calibration sample** of stars in the field using photometric quality flags, colour cuts, and limiting to low extinction stars. ~100 stars.
- The synthetic photometry of the calibration sample is used as standard values to derive a unique **zero point,** which is applied to the rest of the field sample.

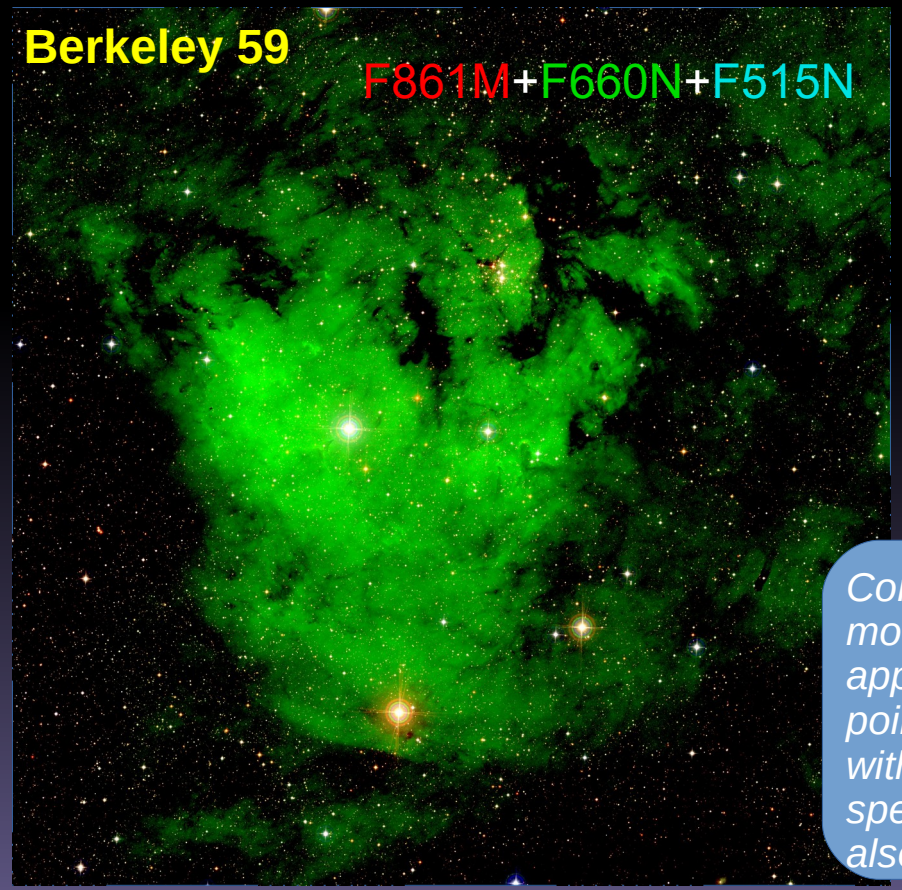


Red dots: Calibration sample 81 stars with extinction E(4405-5495) = [0.0,0.25]

After zero point correction differences with synthetic photometry are of the order of ± 0.02 mag

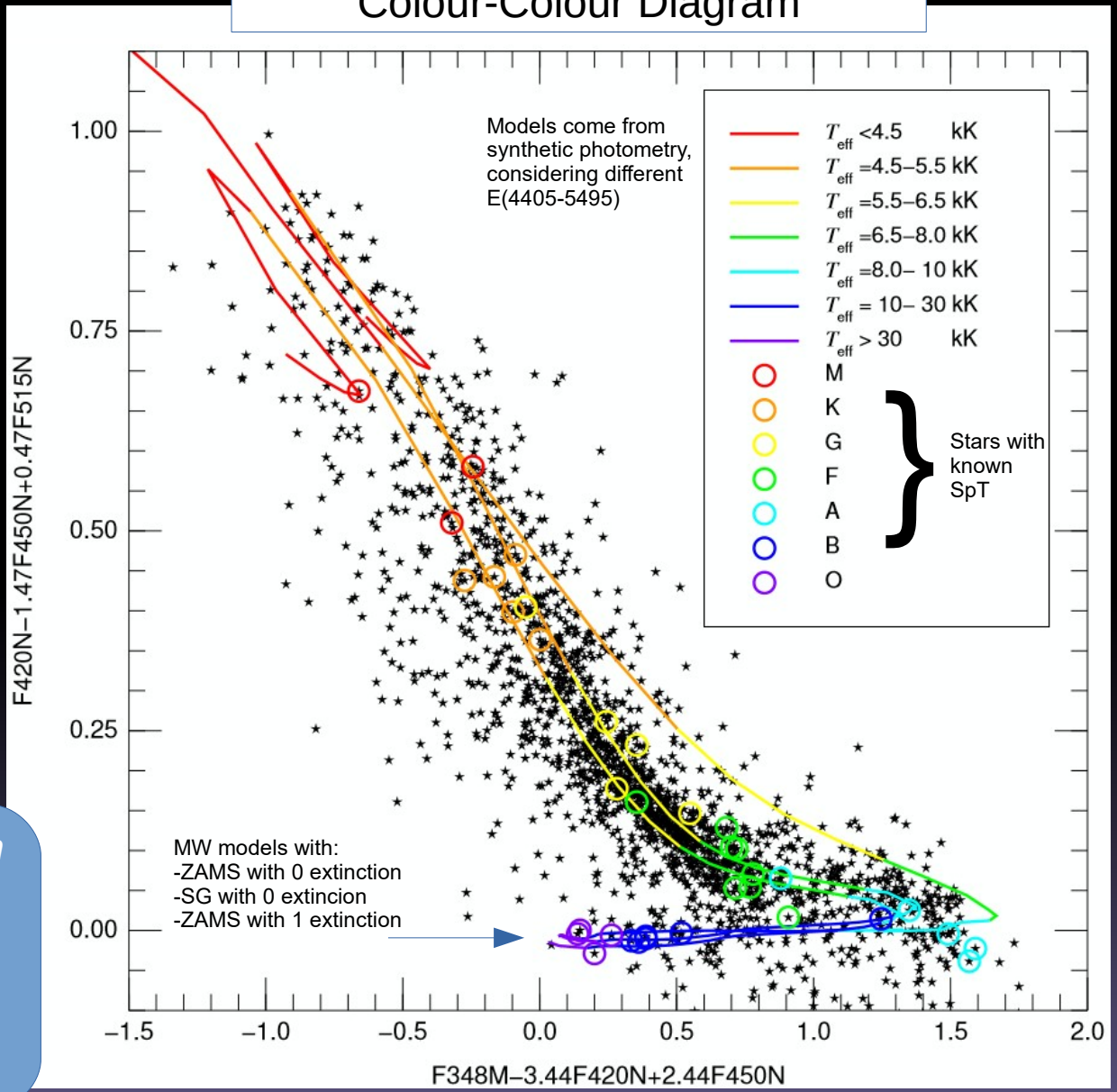
★ **DR0 available:** aperture photometry of one test field Berkeley 59

- Magnitudes and uncertainties for 7 filters + synthetic photometry
- ~78,500 stars considered in the field, >6,000 with results in bluer filters, > 55,000 in redder ones.



Comparison with models: appropriate zero point, and stars with known spectral type also consistent

Colour-Colour Diagram



Post-pipeline steps pending:

- **Extrapolate** the obstacles solved during the reduction procedure of the **test field**
- **PSF** photometry
- **Alternative calibration** strategies: stars in overlapped fields, and spectrophotometry of selected stars in each field

GALANTE will ultimately provide:

- Identification of all OB+WR stars in the Northern Galactic plane down to magnitude 17
- Estimate T_{eff} for that sample
- Measurements of E(4405-5495) and R_{5495} for the OBA sample, by cross-matching with 2MASS

Some additional future objectives include:

- The study of emission-line stars
- The IMF of large-area clusters and associations
- A continuum-subtracted Hα map with subarcseconds pixel resolution
- Gaia cross-calibration and WEAVE source identification
- Generation of a set of standards, accurate photometric optical spectral SEDs to be used as a reference for improving the flux calibration of existing and future empirical stellar libraries