Applying Forward Model Photometry to ZTF

Leveraging External Catalogs to Maximize Science Output

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Outline

- Description of additional available catalogs
- Benefits of forward model photometry
- Possible implementations of such an approach

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Available Catalogs

- PTF/iPTF, Gaia, Pan-STARRS1, Galex, WISE/NEOWISE, SDSS, DECaLS, etc.
- Improved photometry, astrometry, higher resolution, infrared and ultraviolet information, historical light curve comparisons, star-galaxy comparisons, stellar completeness, and so on
- Leveraging that information appropriately is difficult
    - ***Forward model photometry is the most natural way to integrate information from different surveys at different wavelengths***

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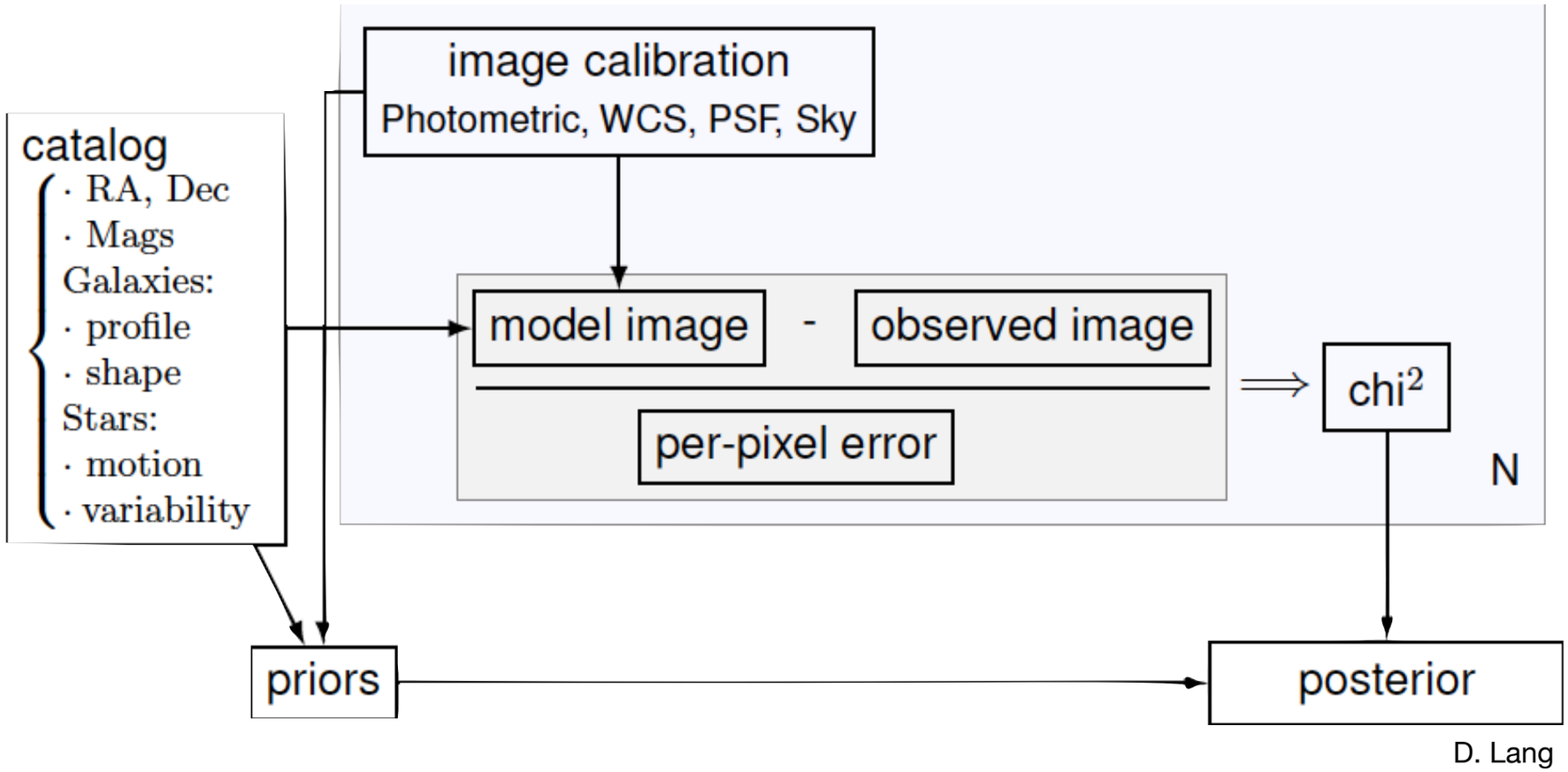
Tractor: Forward Model Photometry

- Assume heuristic calibration info about the image

  (e.g. PSF model) that can be parametrized to fit the sources

- Seek maximum likelihood parameters of the model



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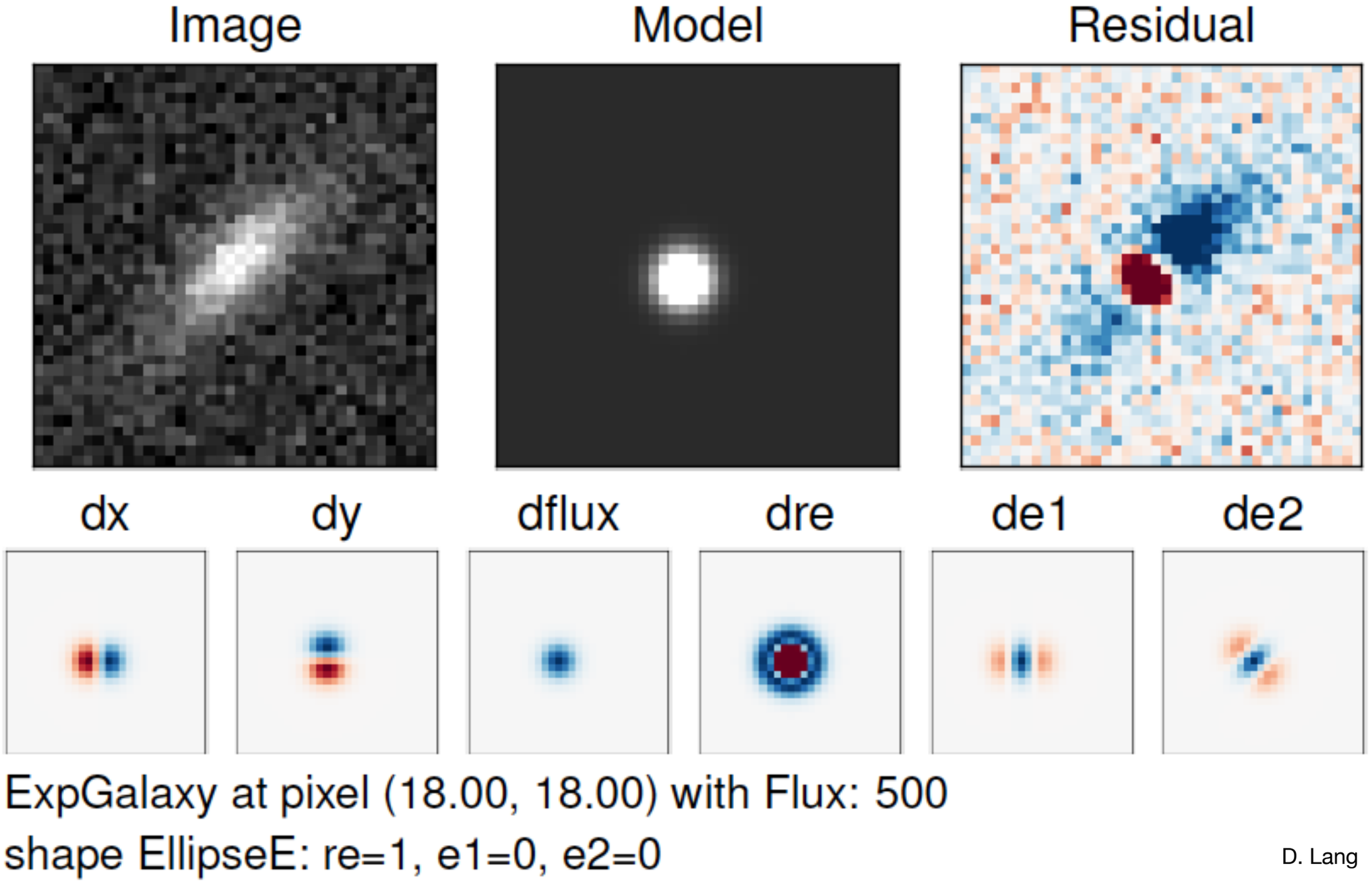

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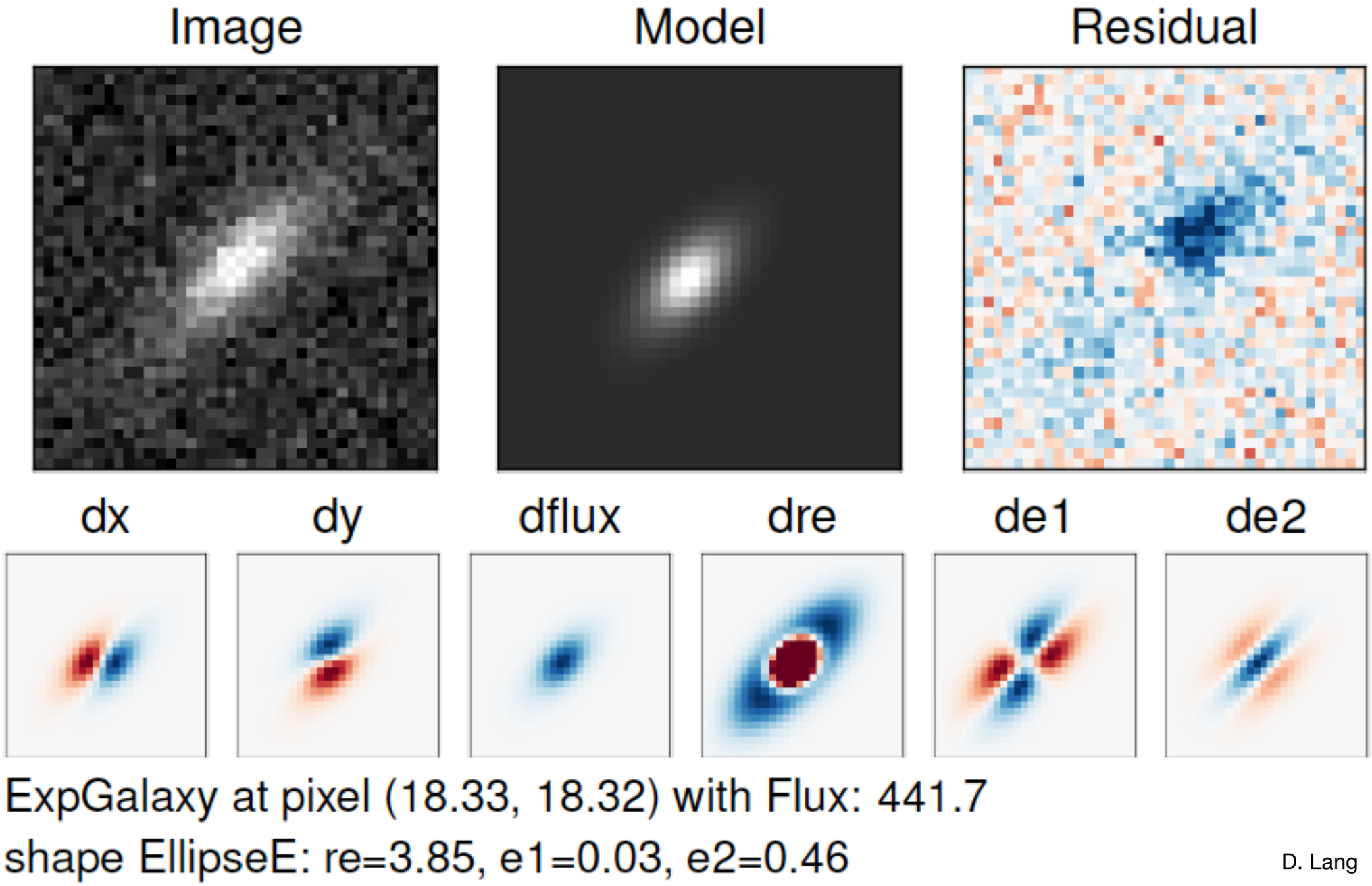

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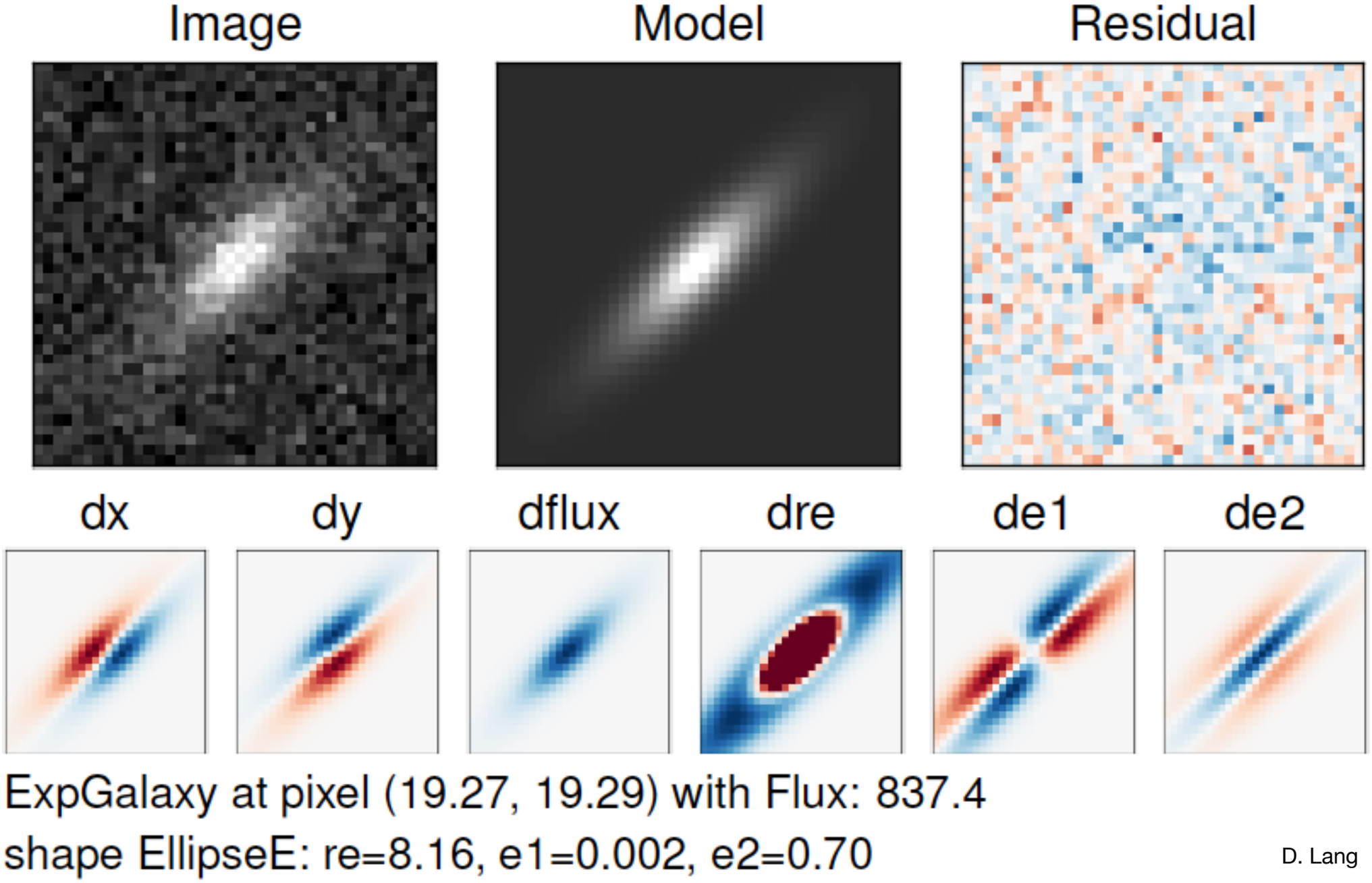

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Tractor: Forward Model Photometry

- Handles multiple exposures, multiple bands, on multiple instruments
- Handles masked pixels and bleed trails easily
- Avoids deblending
- Possible to go back and re-fit calibration parameters
- Easy to add priors to external information
- Possible to use physical models
- Possible to do forced photometry using the model
    - Observed offset from a precise galaxy model can be an indication of TDE, strong lensing event, SN

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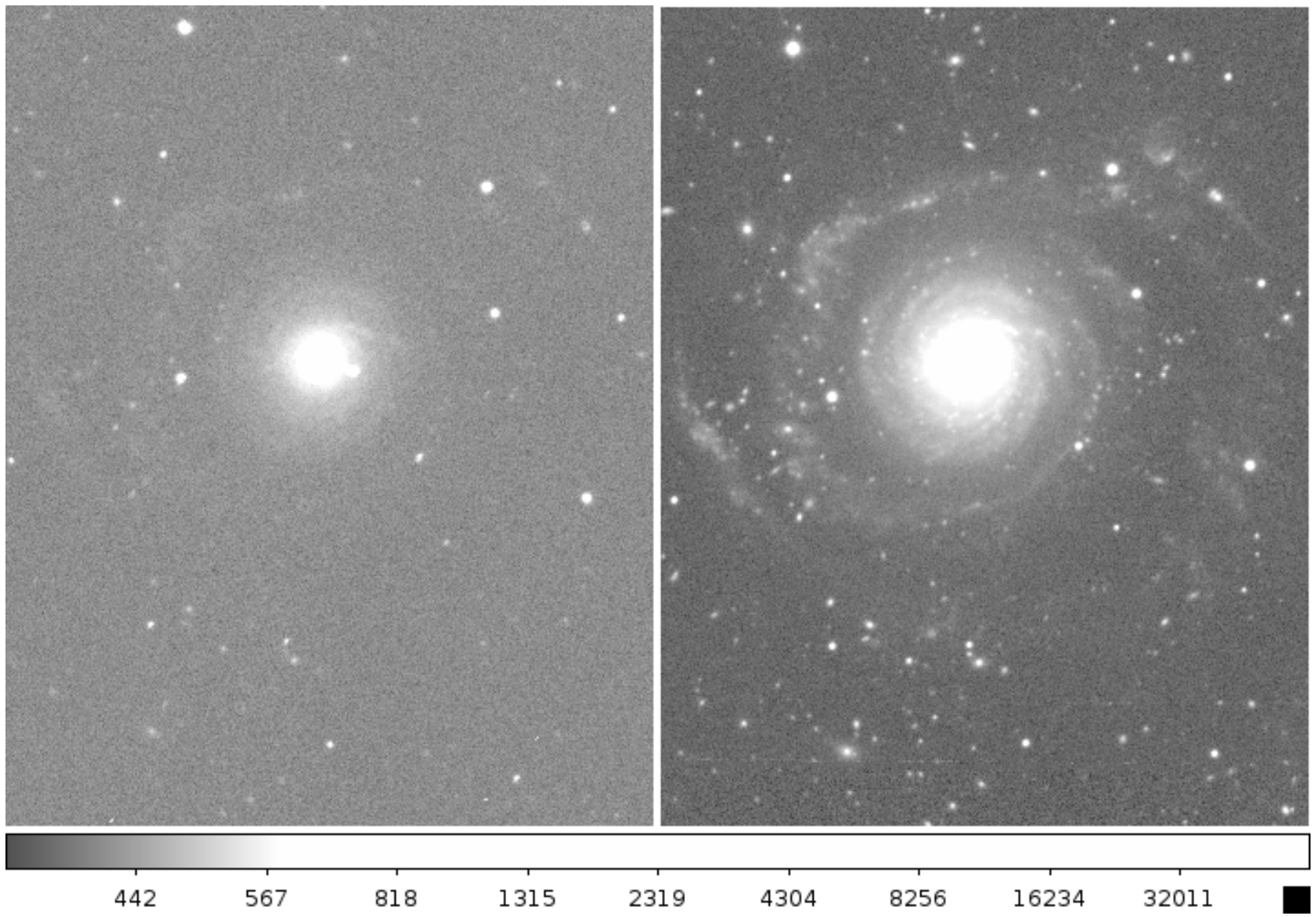
The Legacy Survey

ZTF

DECaLS



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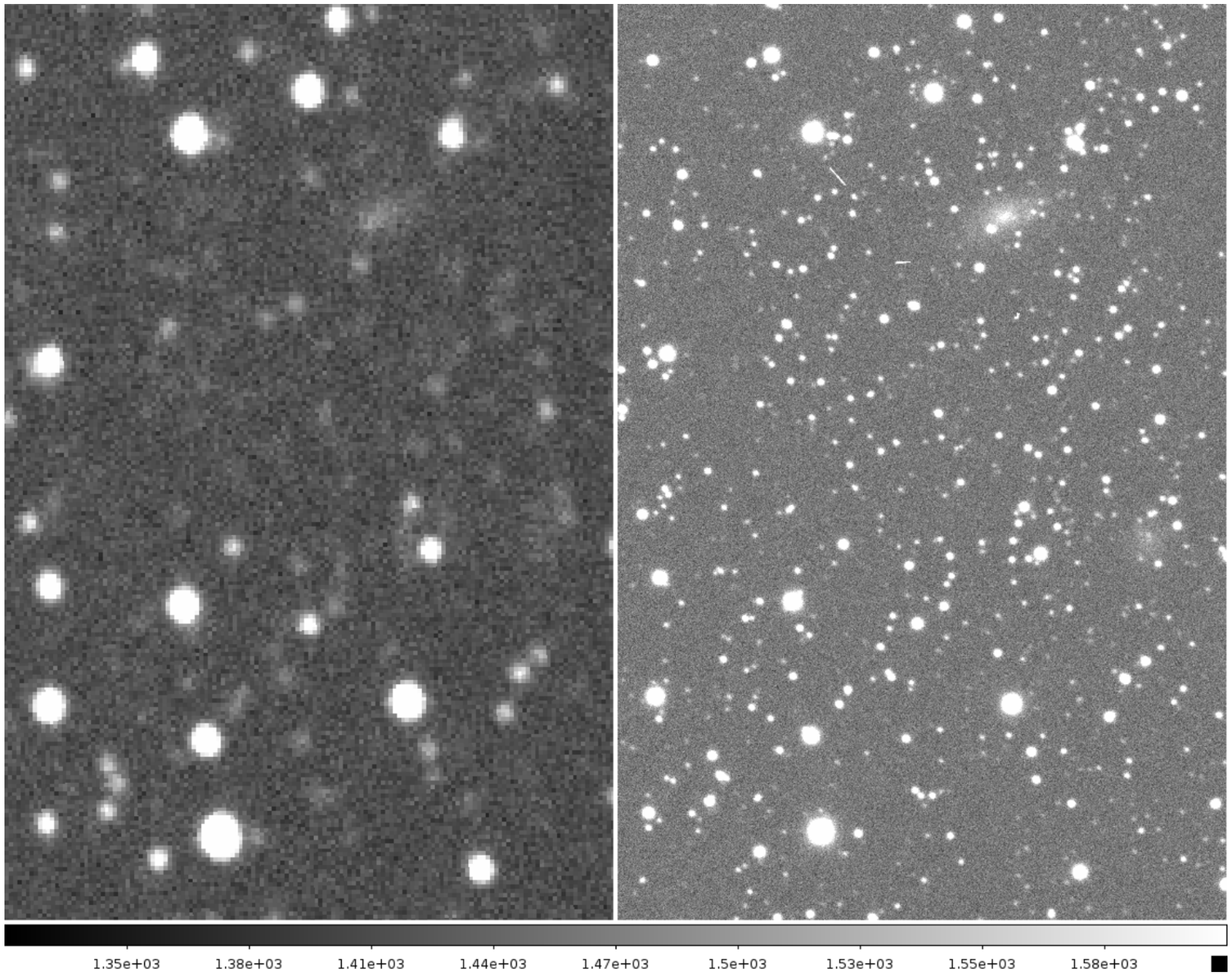

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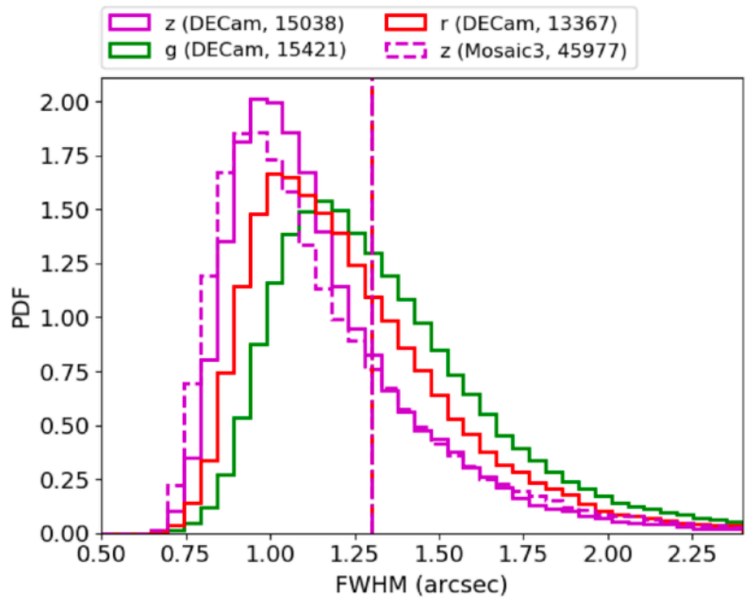
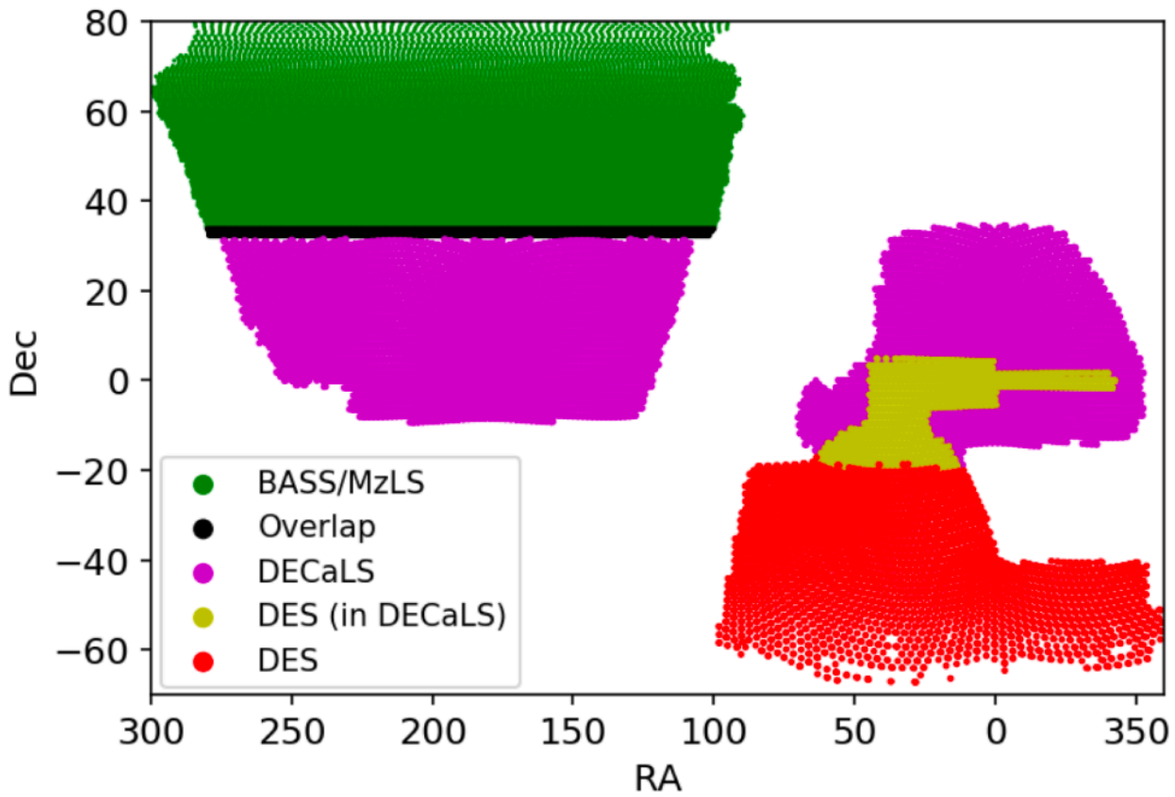
The Legacy Survey

- DESI target selection campaign has imaged 14,000 deg^2
  - 1-2 magnitudes deeper than SDSS
- Already implemented into the Tractor model dataset
- Entirely public



K. J. Burleigh et. al. in



K. J. Burleigh et. al. in prep

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Cross-Matched Catalogs

- Basic querying and cross matching (at a scale larger than photometric calibration) could be in the IPAC pipeline
- Straightforward to implement given a concise set of catalogs and deliverables advantageous to the community
- Need to make sure we build in some probabilities (i.e. star (20%), qso (70%), galaxy (10%))
- See Maayane Soumagnac's talk in just a moment

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A Discussion of the Power of this Tool

- Could live at the Marshall level, could be a TOO tool, basic querying and cross matching could be in the IPAC pipeline, could exist in AMPEL
- Could base a model on DECaLS data and then apply it to incoming ZTF data (i.e. forced photometry with fixed model)
  - Cadence of such photometry would be science dependent
- Could generate a model based on everything we want on-the-fly (including WISE, NeoWISE, etc.)

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