The Dark Energy Survey

recent results and looking ahead

Chihway Chang
(KICP Fellow)
for the DES collaboration

Our Current Understanding of the Cosmic History

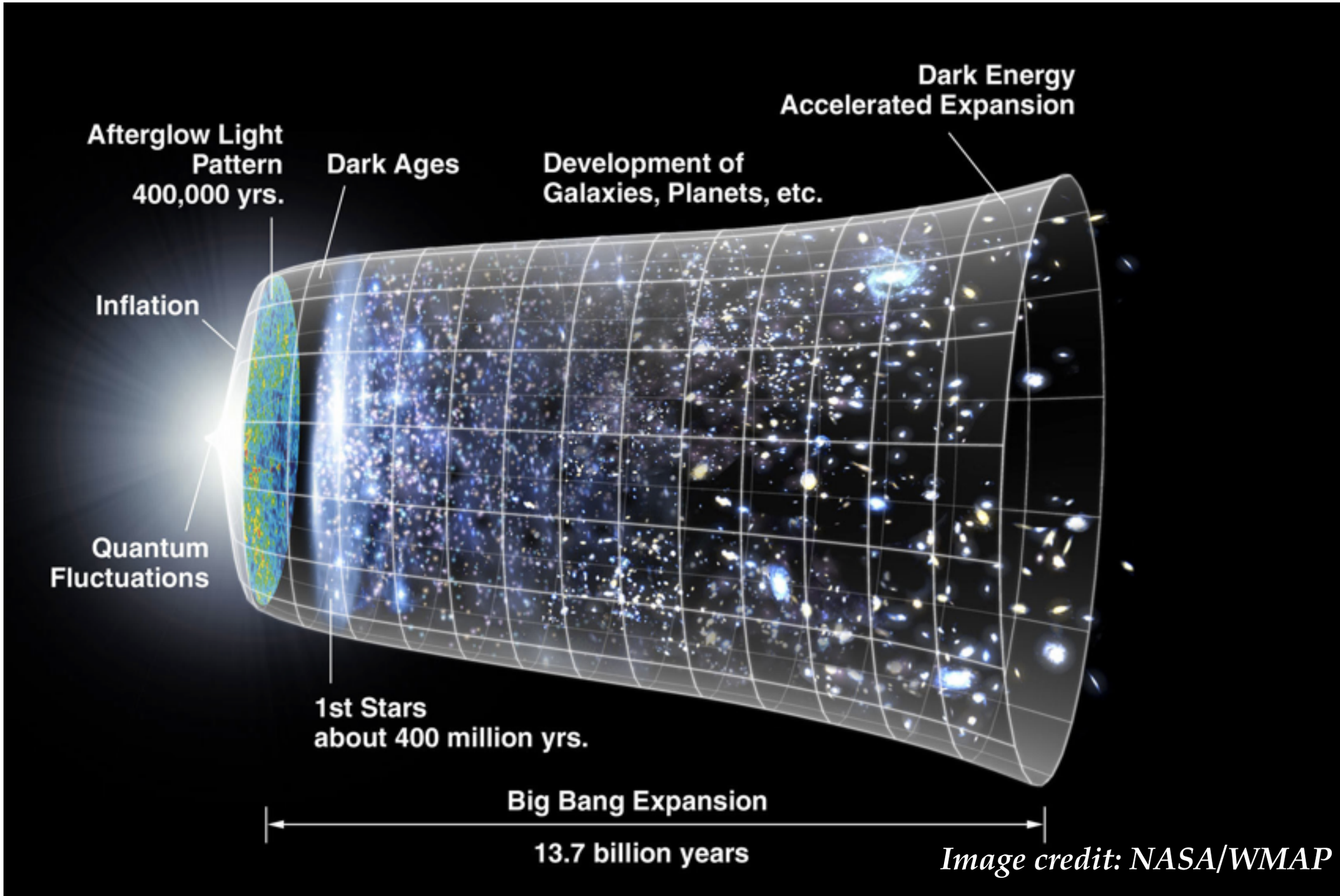

Image credit: NASA/WMAP

Our Current Understanding of the Standard Cosmology

radiation matter curvature dark energy

$$\frac{H^2}{H_0^2} = \frac{\Omega_{r,0}}{a^4} + \frac{\Omega_{m,0}}{a^3} + \frac{\Omega_{k,0}}{a^2} + \frac{\Omega_{\Lambda,0}}{a^{3(1+w)}}$$

dark energy equation of state

$$w = w_0 + (1-a)w_a$$

Our Current Understanding of the Standard Cosmology

radiation matter curvature dark energy

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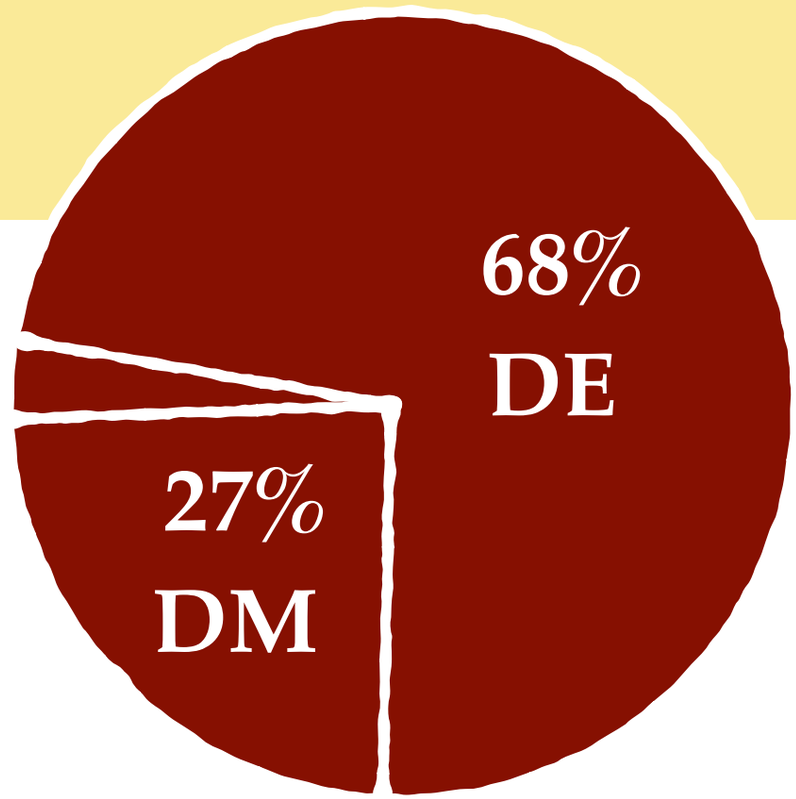
dark energy equation of state

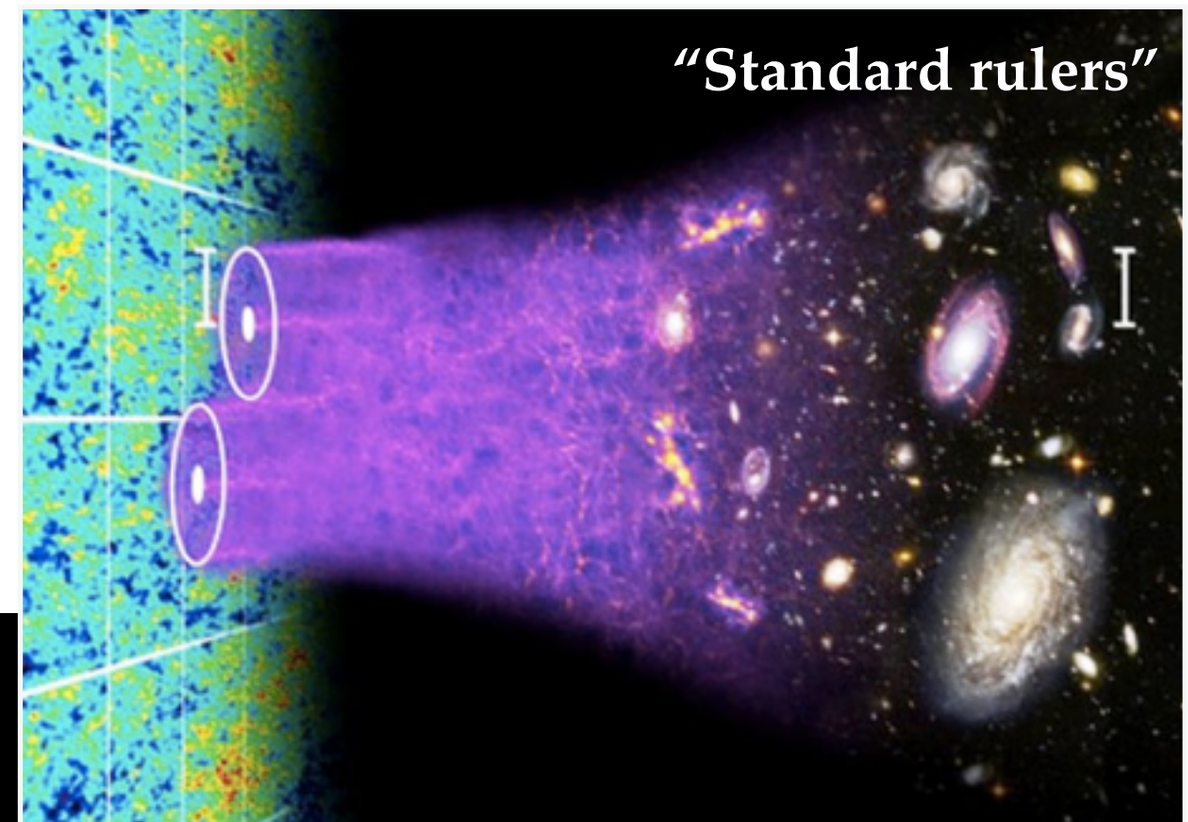
$$w = w_0 + (1-a)w_a$$

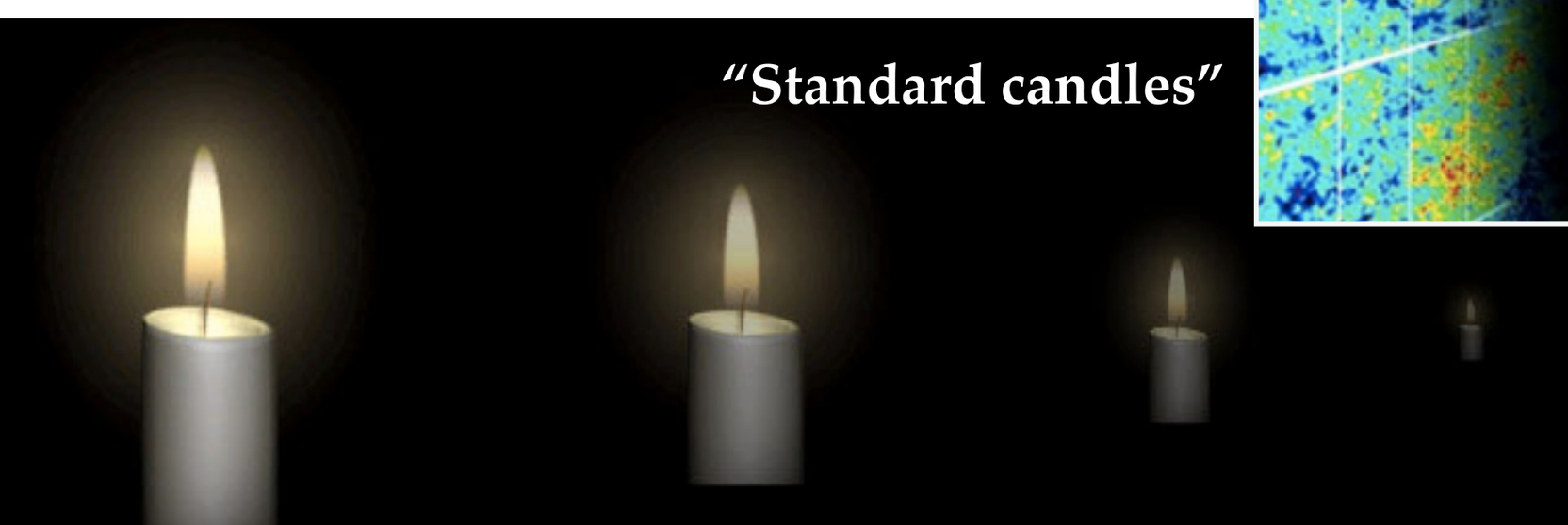
5% normal matter



The Dark Energy Survey

- **Fitting as much DE probes as possible into one experiment:**
  - **Baryon Acoustic Oscillation**
  - **Supernovae Type Ia**
  - Large-scale Structure
  - Weak Lensing
  - Galaxy Clusters





Geometry tests

The Dark Energy Survey

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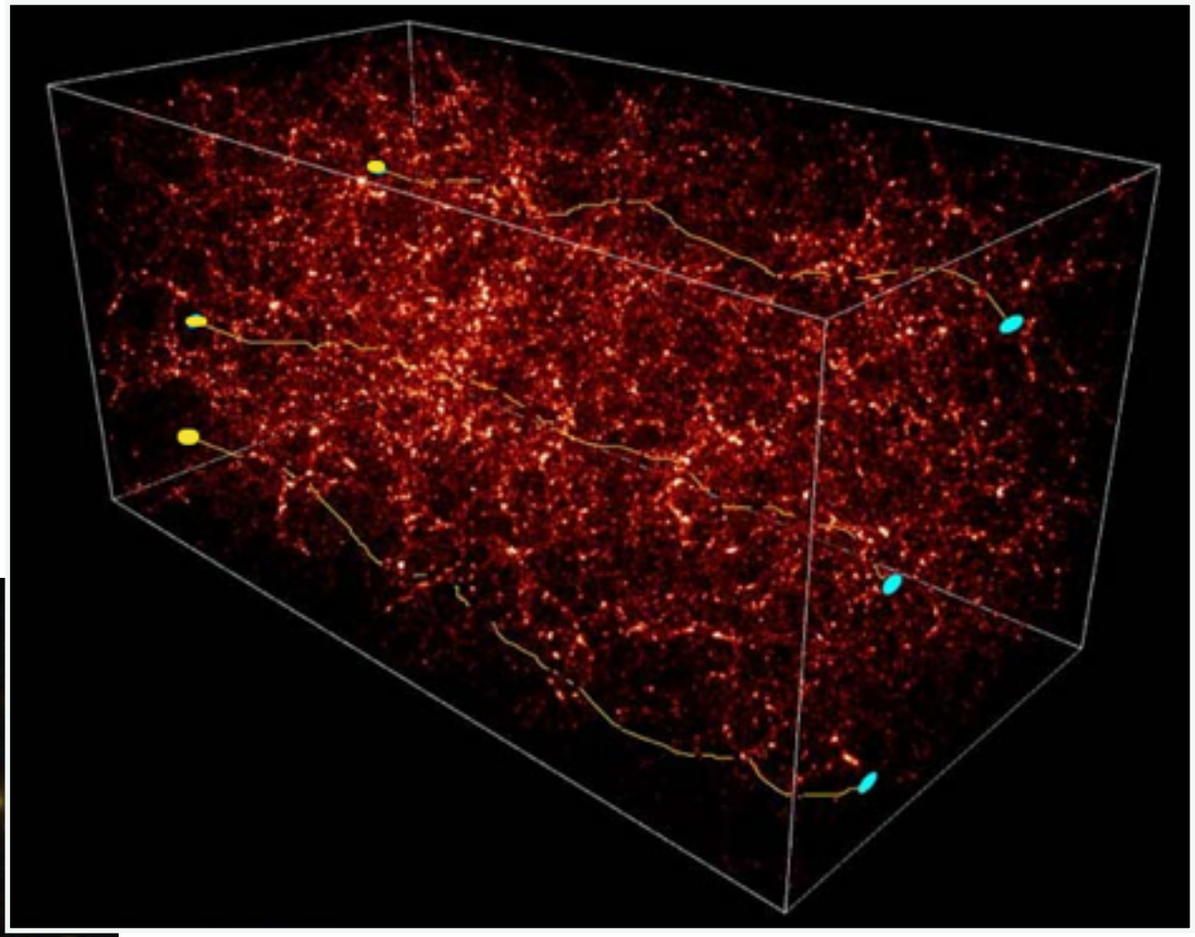
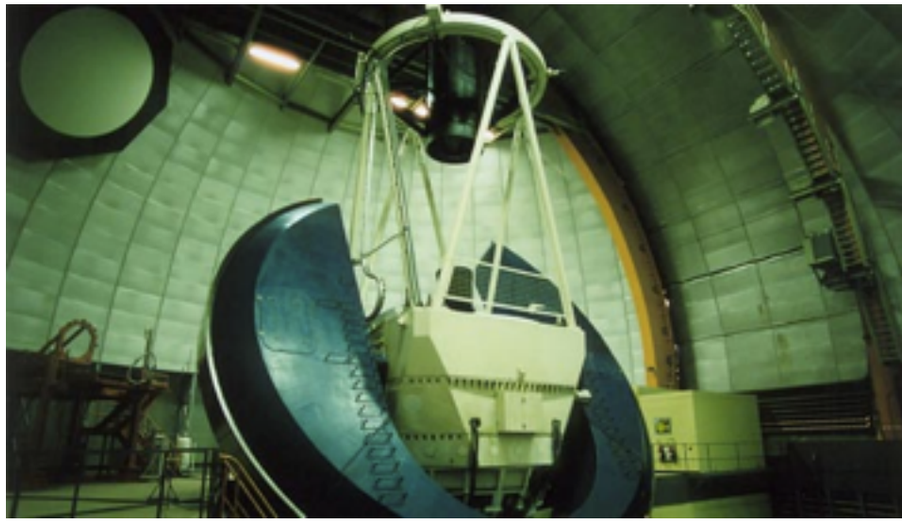
  - Supernovae Type Ia
  - **Large-scale Structure**
  - **Weak Lensing**
  - **Galaxy Clusters**

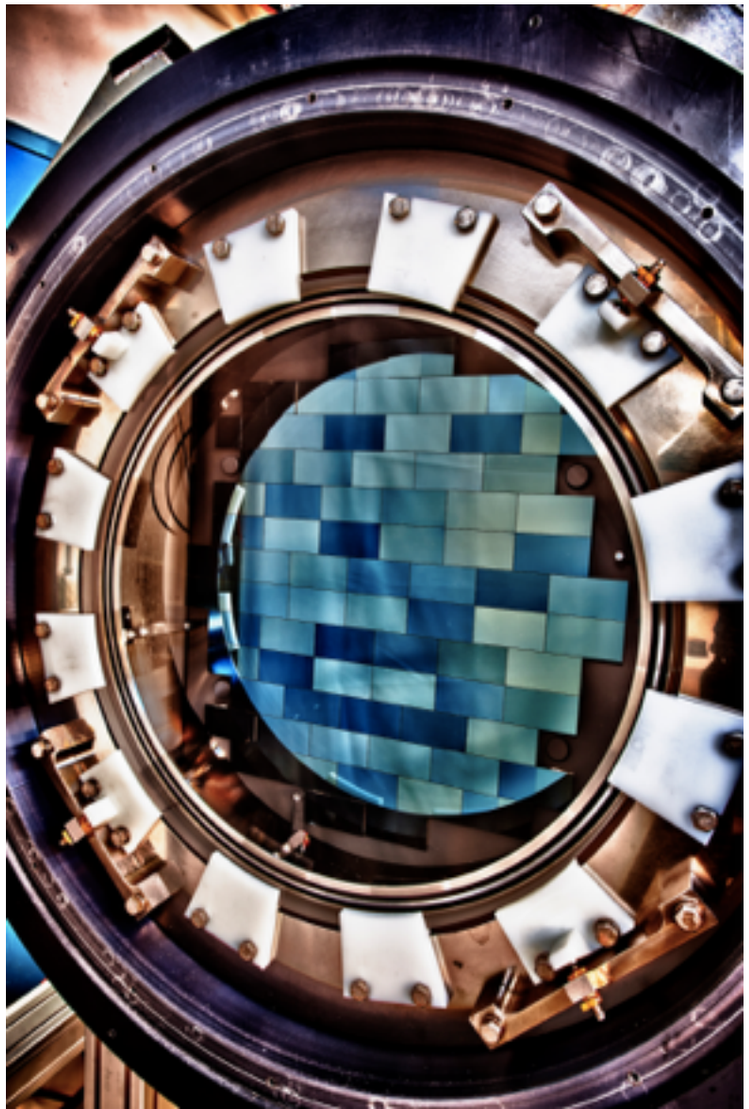


Structure growth tests

The Dark Energy Survey

Image credit: DES





DES is an ongoing imaging survey using the **Dark Energy Camera** on the Blanco telescope
5 filter bands (*grizY*), 3 sq. deg FOV

5 years (2013-2018), **5000 sq. degrees, i~24**

~250 sq. deg Science Verification (SV)
~1500 sq. deg Year 1
~5000 sq. deg Year 3+

$$\frac{\sigma(w_0)}{w_0} \sim 5\% \qquad \sigma(w_a) \sim 30\%$$

The Dark Energy Survey

2016 DES Collaboration Meeting @ Cambridge

over 500 scientists from 30 institutions in 7 countries

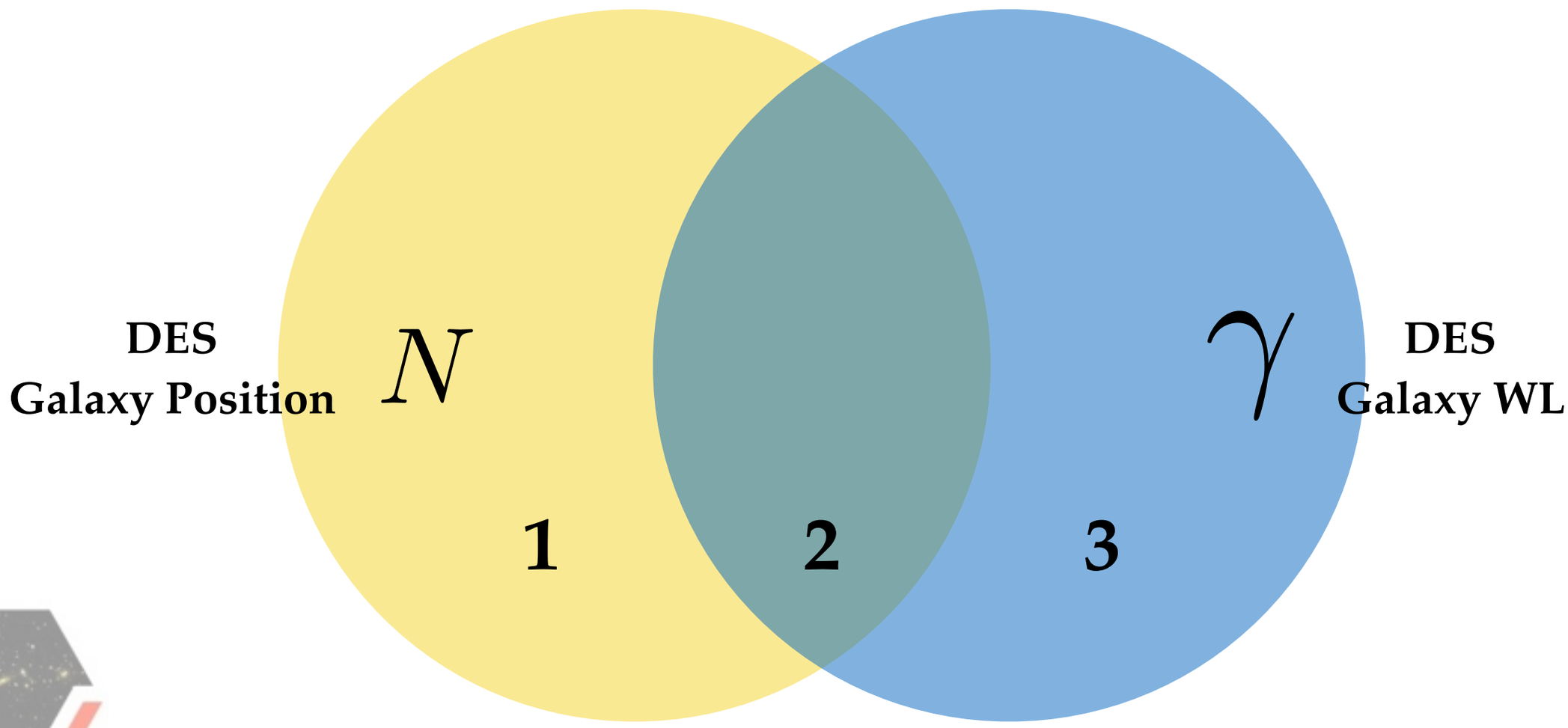
~100 papers submitted / published

Y1 Cosmology: Probe Combination

Position, Flux, Shape

Large-scale Structure
Weak Lensing

Y1 Cosmology: 3x2pt



Y1 Cosmology: 5(6)x2pt

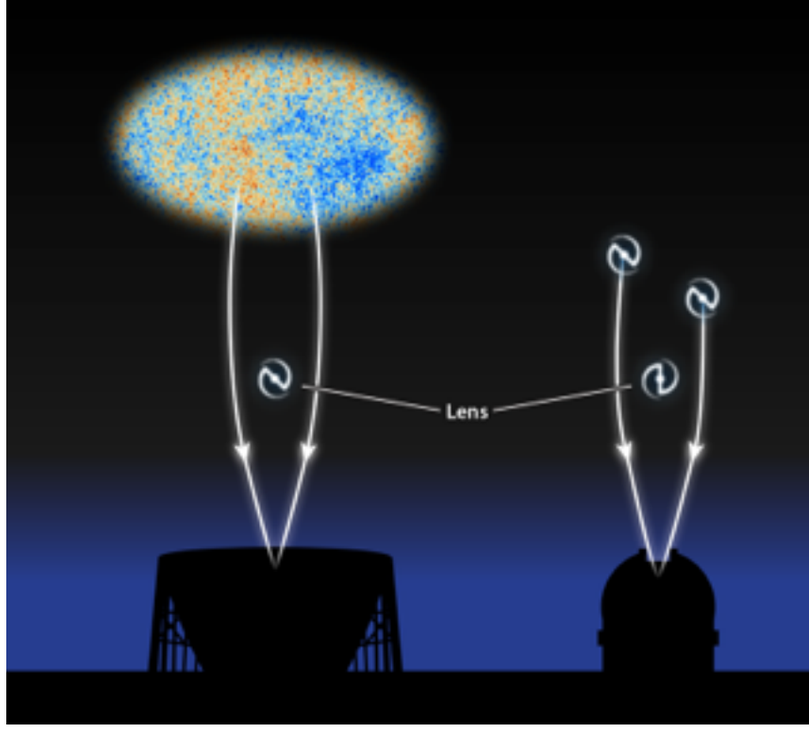
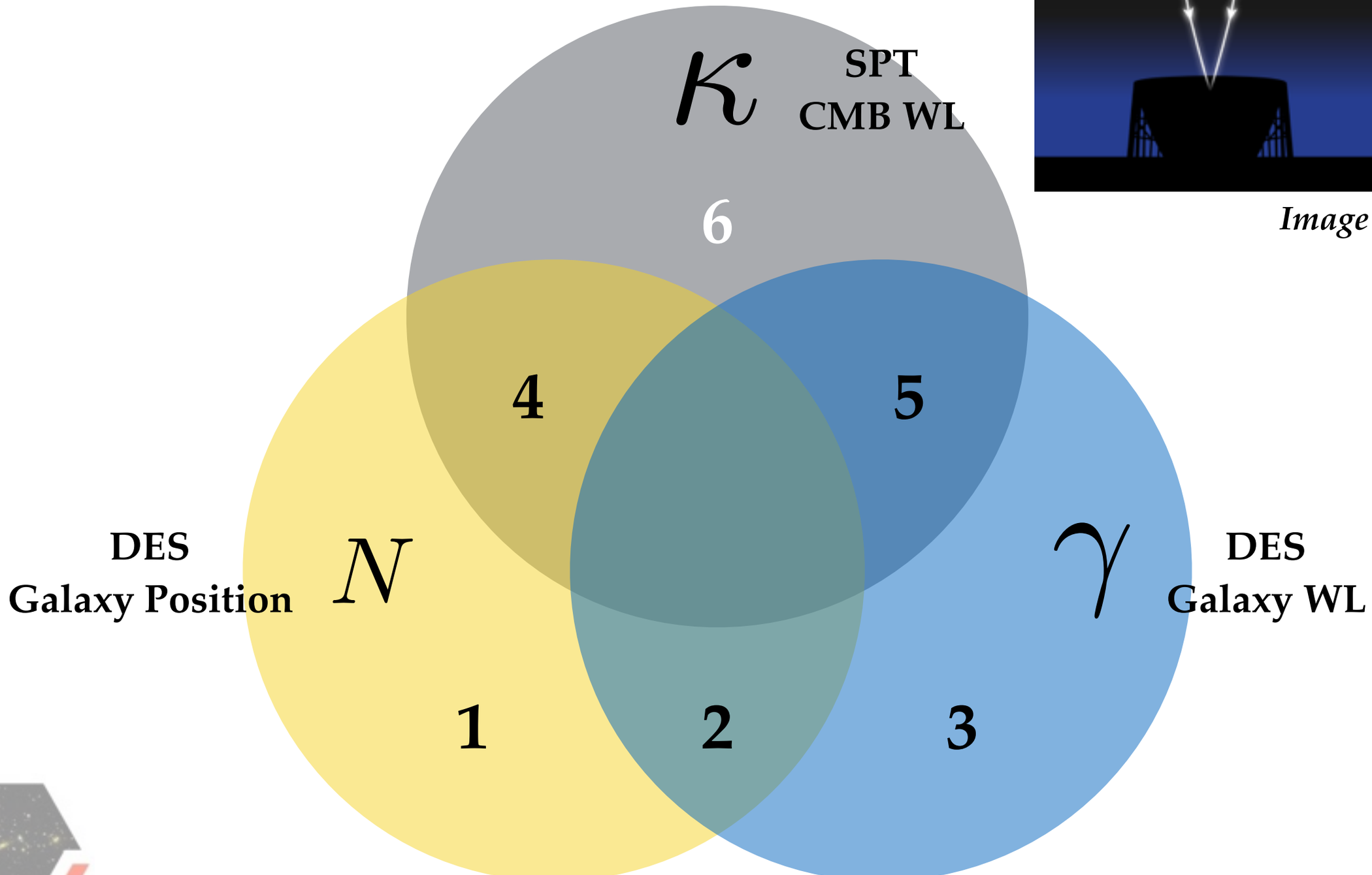
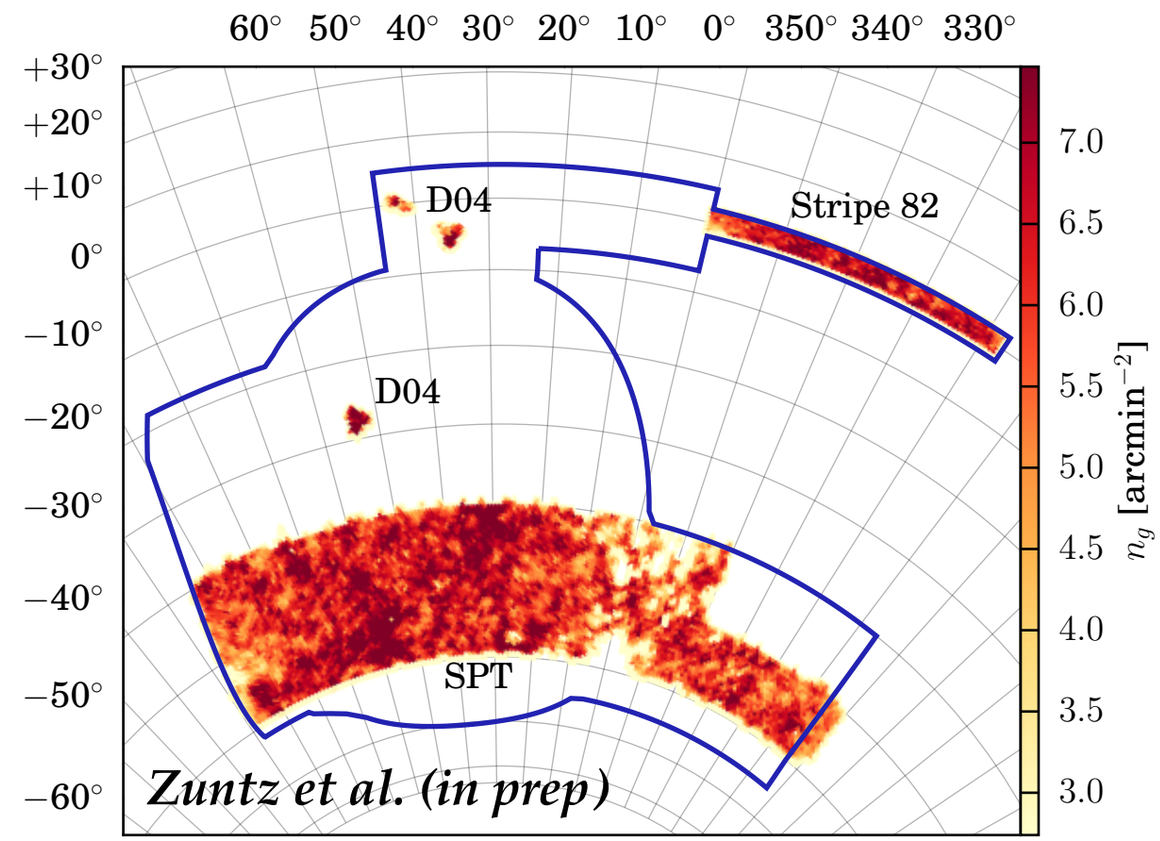


Image credit: APS

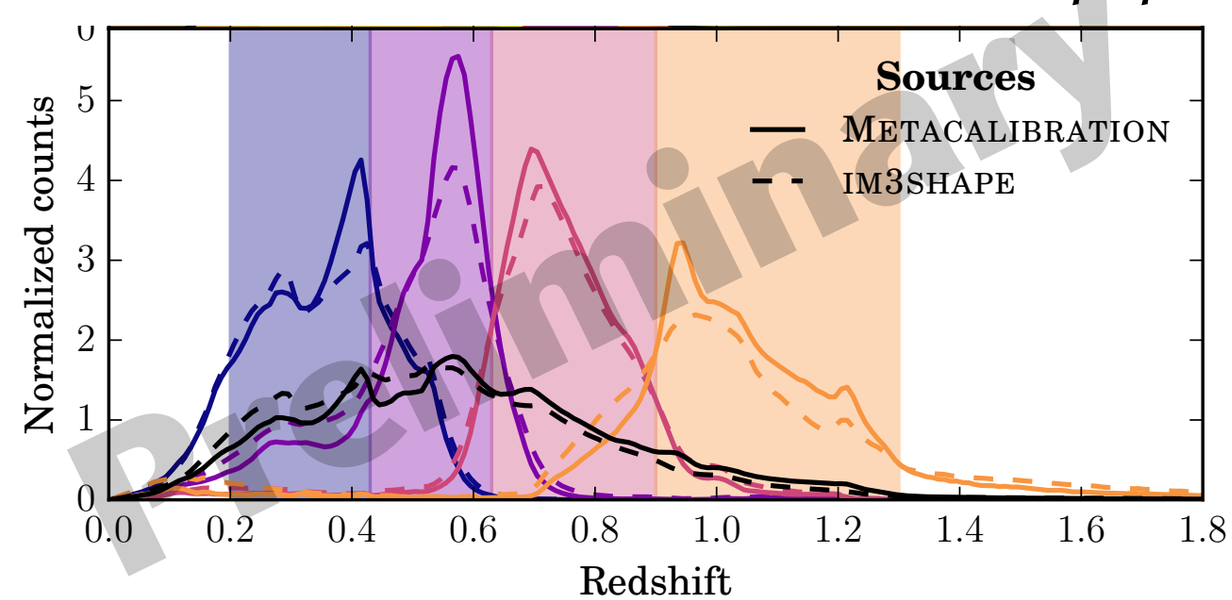


Catalogs to Science

- **Base** (Drlica-Wagner et al., in prep)
- **Photo-z** (Hoyle et al., in prep)
- **Shear** (Zuntz et al., in prep)
  - **MetaCalibration** (Sheldon & Huff 2017)
    - 34.8 M galaxies
  - **Im3shape** (Zuntz et al. 2013)
    - 21.9 M galaxies



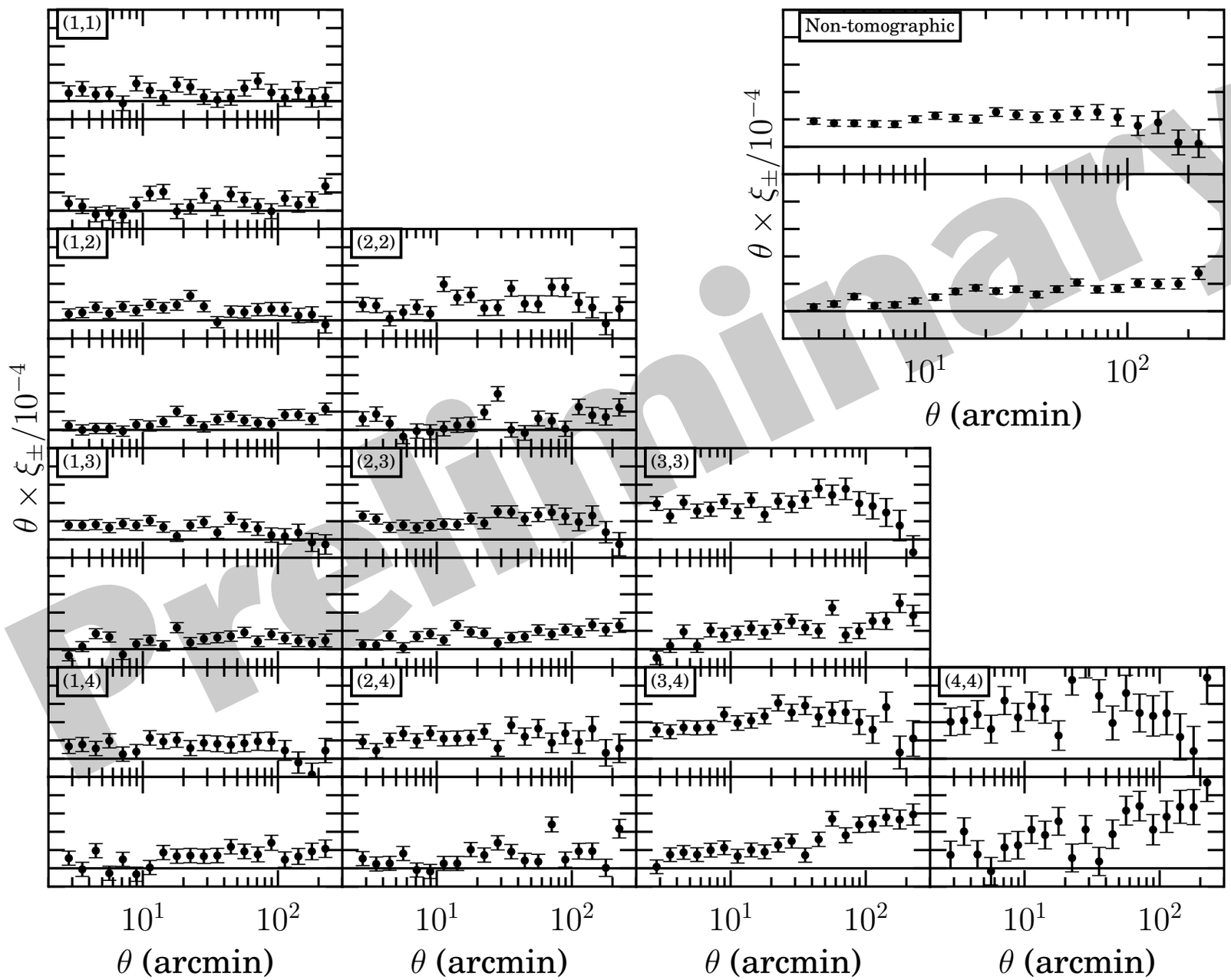
Prat, Sanchez et al. (in prep)



Cosmic Shear ($\gamma\gamma$)

Troxel et al. (in prep)

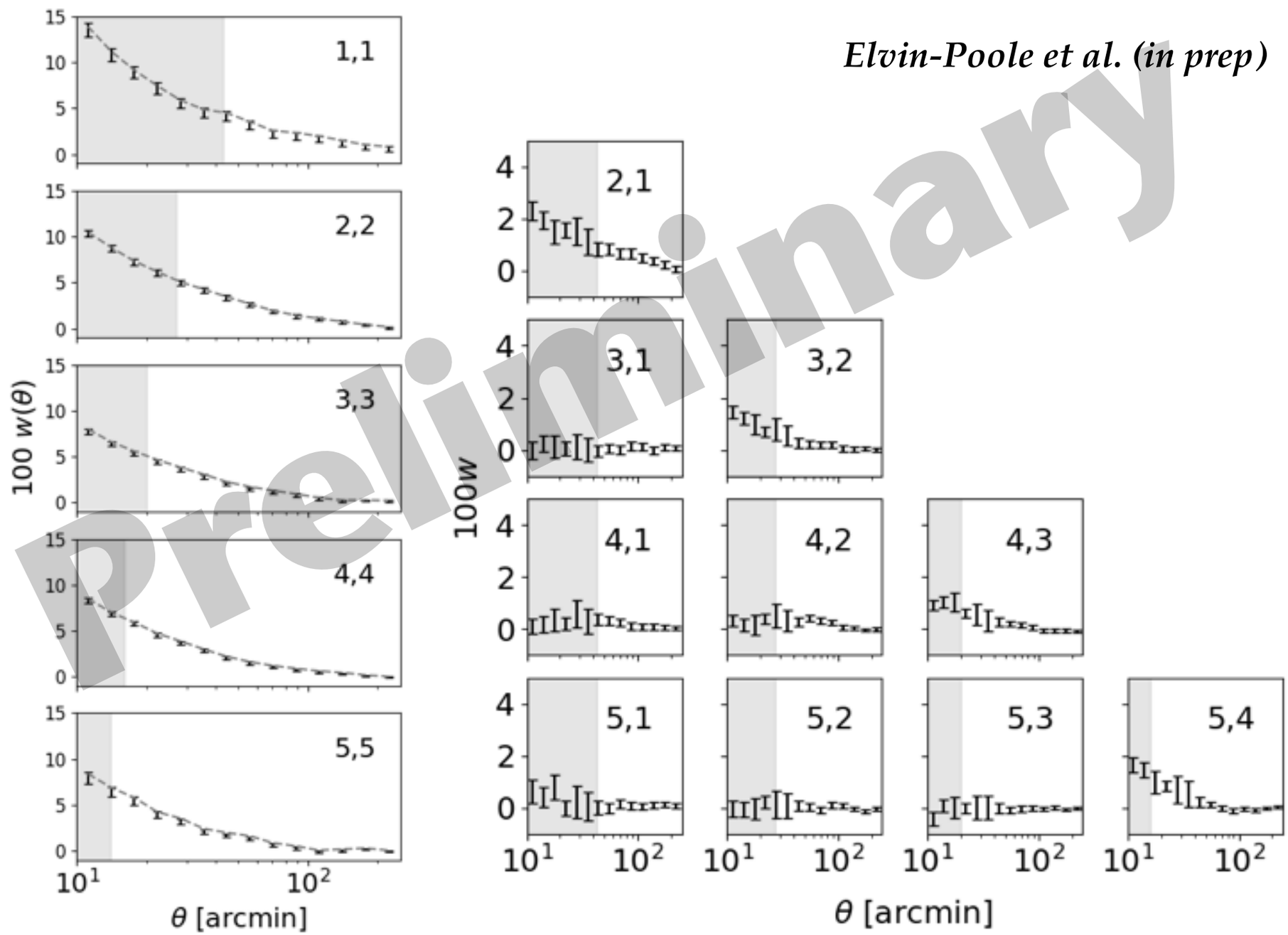
MetaCalibration



Galaxy Clustering (NN)

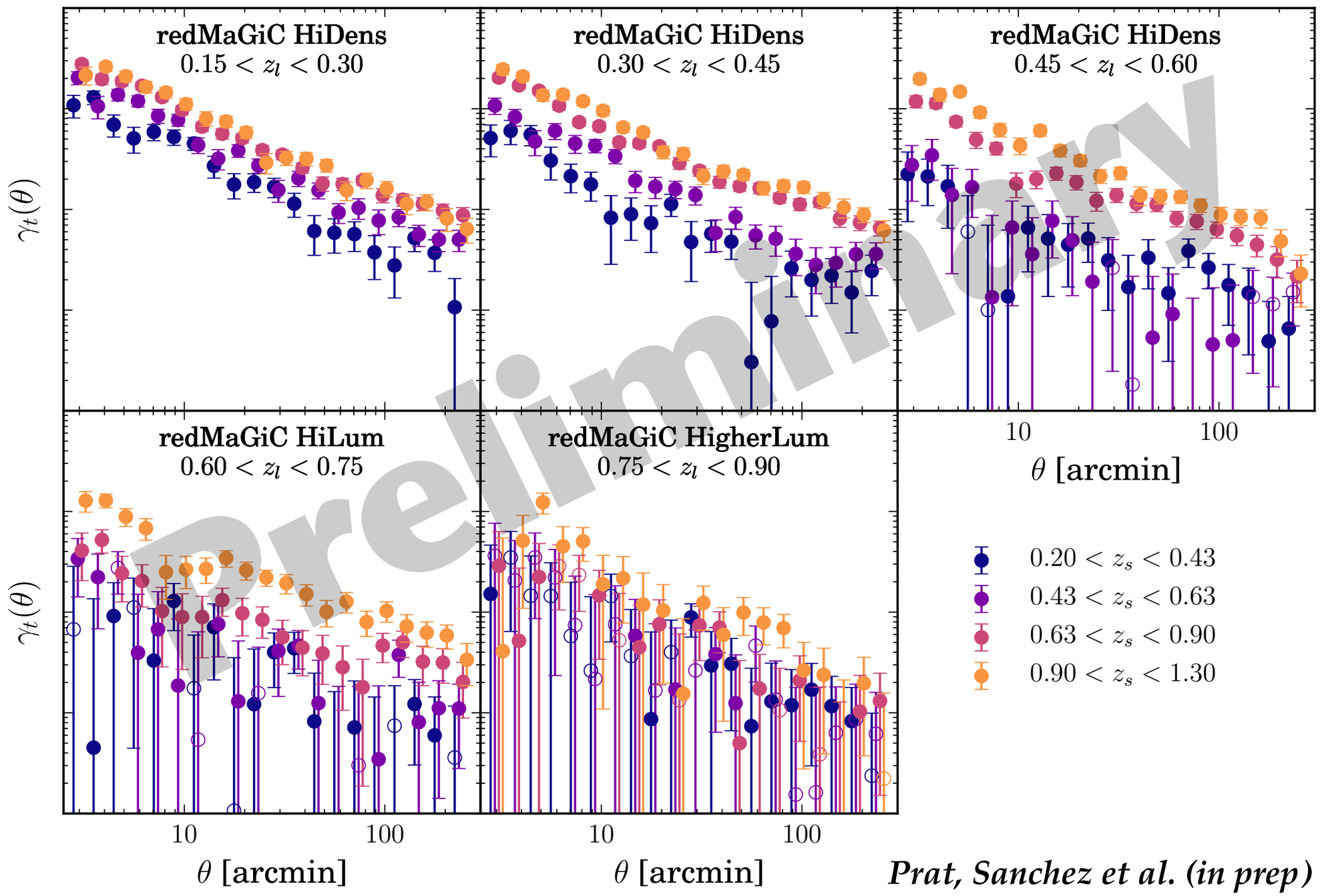
Elvin-Poole et al. (in prep)

RedMagic LRG



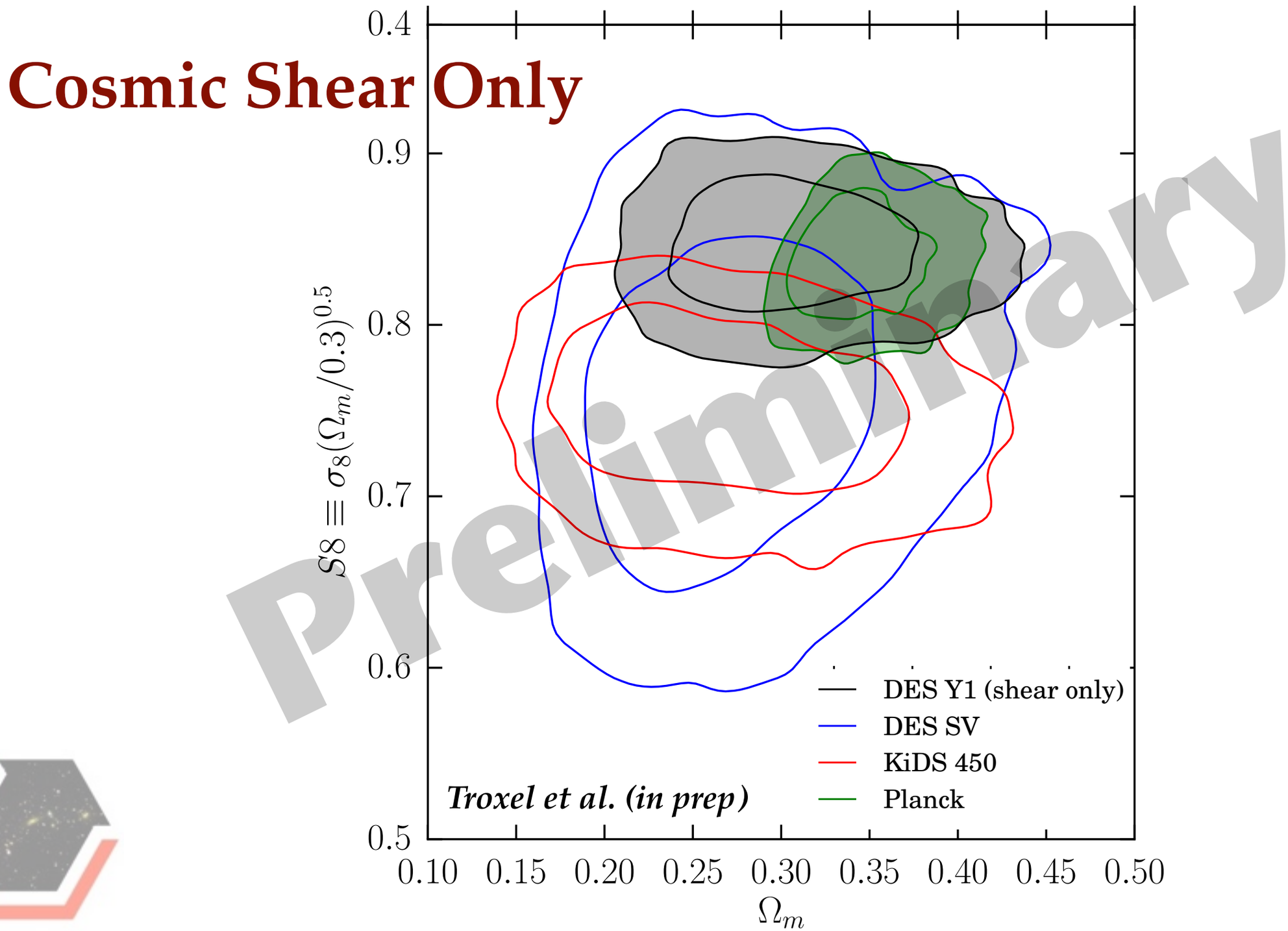
Galaxy-Galaxy Lensing ($N\gamma$)

MetaCalibration



Prat, Sanchez et al. (in prep)

Y1 (Blinded) Cosmology



Non-DE Science: Dwarfs, Gravitational Wave etc.

Dwarfs galaxies — the smallest and most DM-dominated galaxies

Image credit: Alex Drlica-Wagner

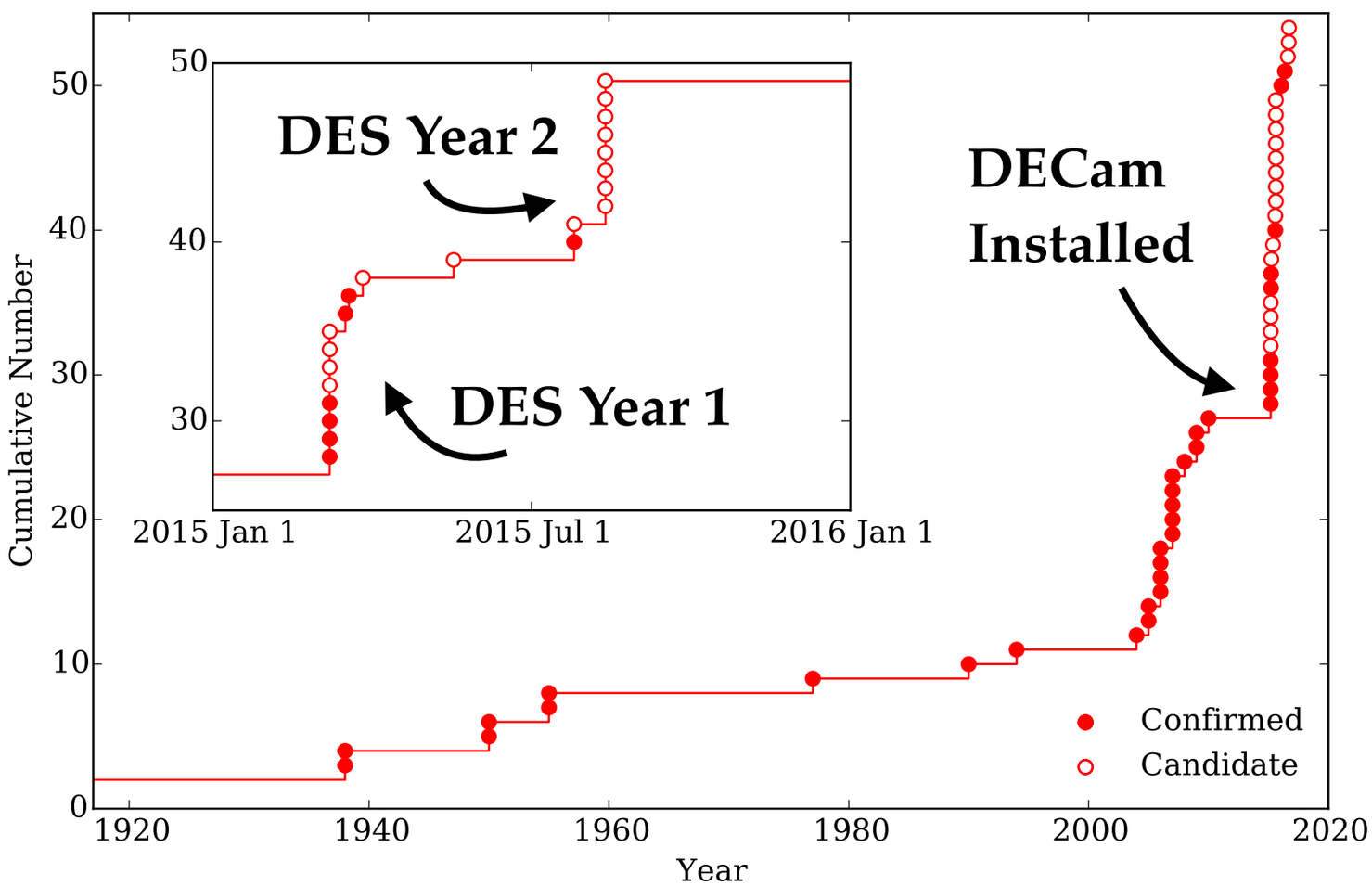
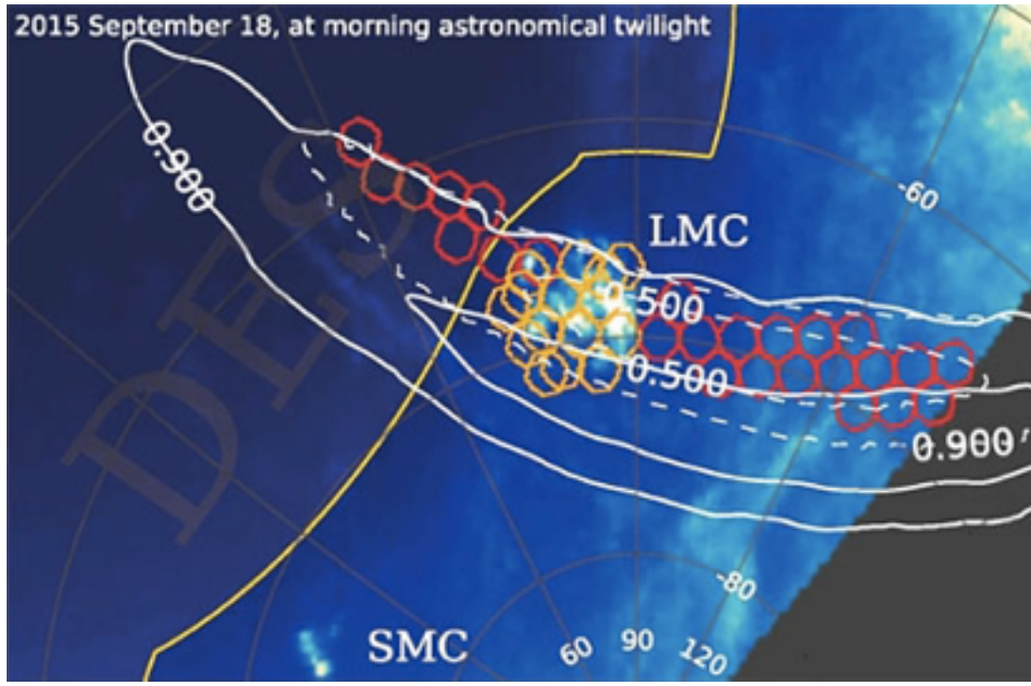


Image credit: Marcelle Soares-Santos



Looking for the optical follow-up on LIGO gravitational wave sources


Thanks!