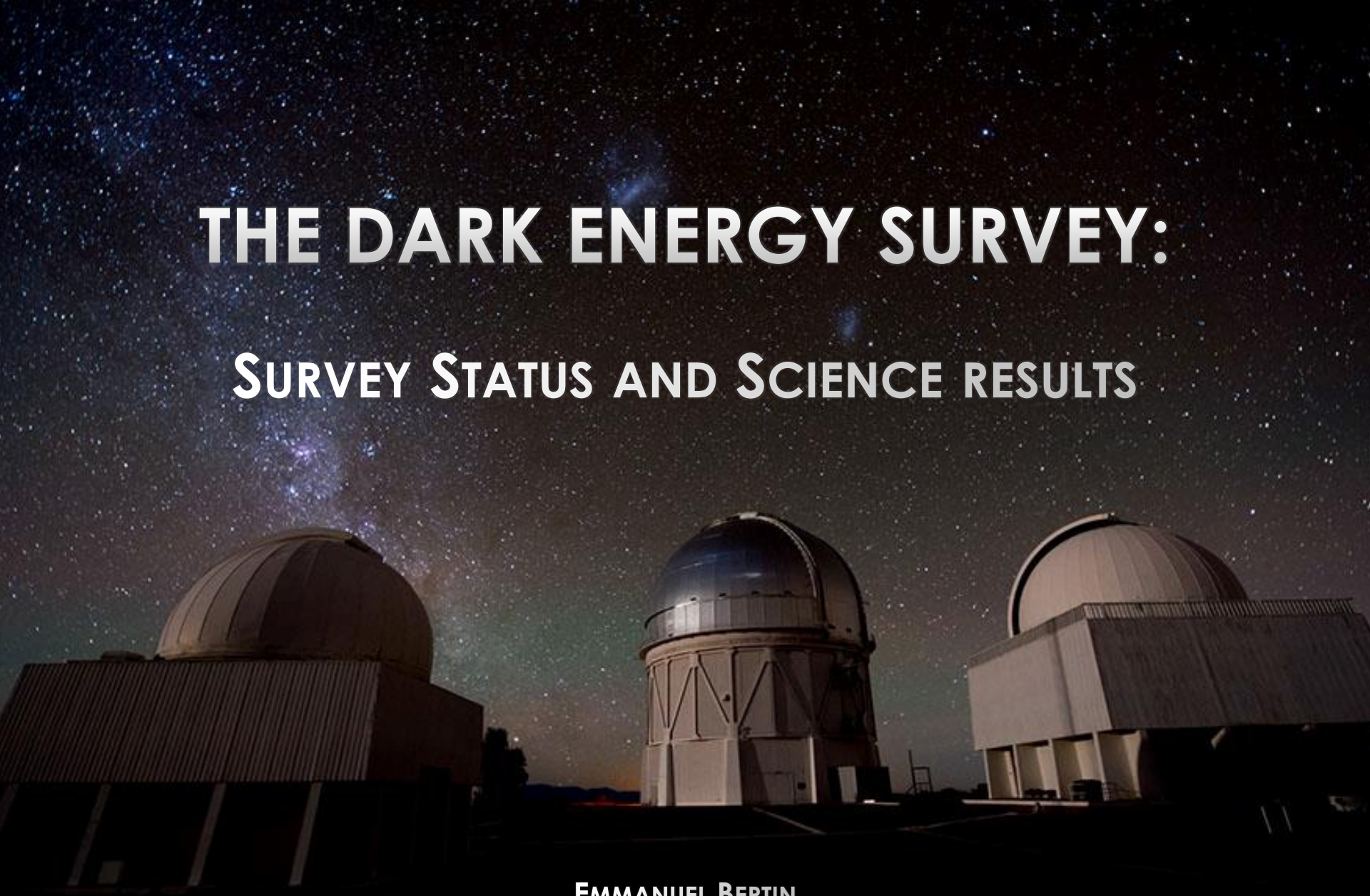
THE DARK ENERGY SURVEY:

SURVEY STATUS AND SCIENCE RESULTS



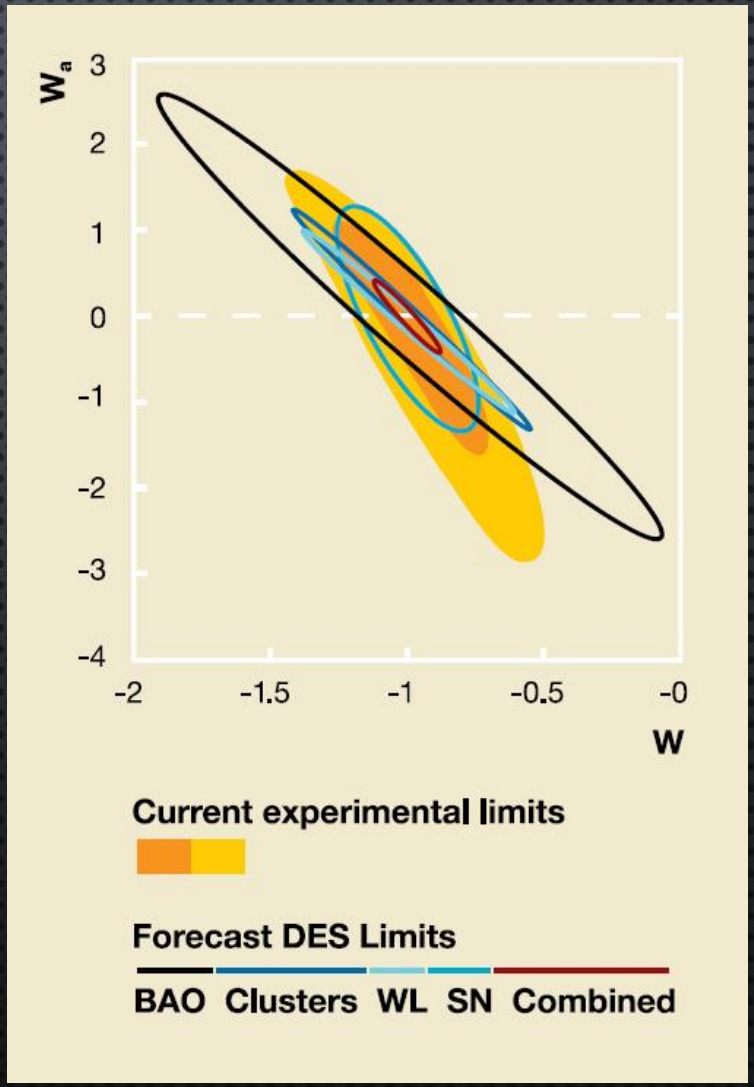
EMMANUEL BERTIN

FOR THE DES COLLABORATION

OVERVIEW

DARK ENERGY SURVEY

- 5000 sq.degree photometric survey of the southern hemisphere in 5 bands (g,r,i,z,Y) down to 24th mag (galaxies, 10σ)
  - 525 nights over 5 years during 5-month seasons
  - Includes the 2500 sq.degree South Pole Telescope SPT-SZ survey footprint
  - 30 sq.degree repeated ~weekly in g,r,i,z (SN fields)
- Survey started Aug 31, 2013.
- Main science drivers: 4 cosmological probes based on distance, geometry and structure growth:
  - Galaxy cluster counts (~100,000) to z~1
  - Gravitational lensing (strong and weak) from 200 million galaxies
  - Baryon acoustic oscillations from 300 millions galaxies to $z \geq 1$
  - 4000 supernova Ia light curves with 0.1<z<1.1



THE COLLABORATION

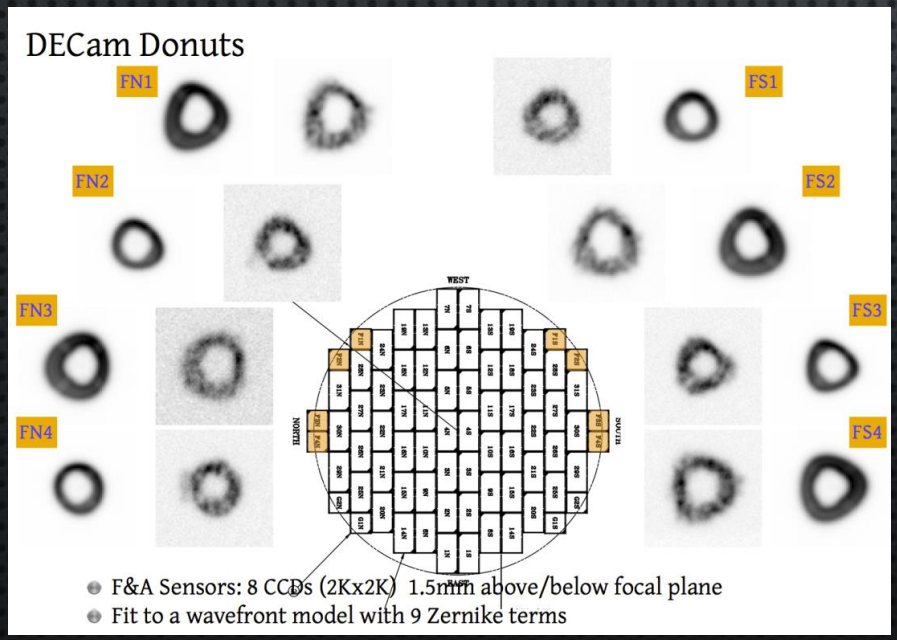
DARK ENERGY SURVEY

- JOSH FRIEMAN, DIRECTOR
- PROJECT INITIATED IN 2004
- 28 INSTITUTIONS, ~400 PARTICIPANTS
- SCIENCE WORKING GROUPS: CLUSTERS, GALAXY EVOLUTION, LARGE SCALE STRUCTURE, MILKY WAY, PHOTOMETRIC REDSHIFTS, QSOS, STRONG LENSING, SUPERNOVAE, THEORY, WEAK LENSING
- FUNDING: DOE, NSF, DFG, CSIC, CNPQ, FAPERJ,FINEP + INSTITUTIONS
- NO FRENCH INSTITUTION INVOLVED
  - BUT A FEW FRENCH INDIVIDUALS INVOLVED AS PHDS, POST-DOCS OR EXTERNAL COLLABORATORS
  - POSSIBILITY TO SUBMIT EXTERNAL COLLABORATOR PROPOSALS

THE INSTRUMENT: DECAM

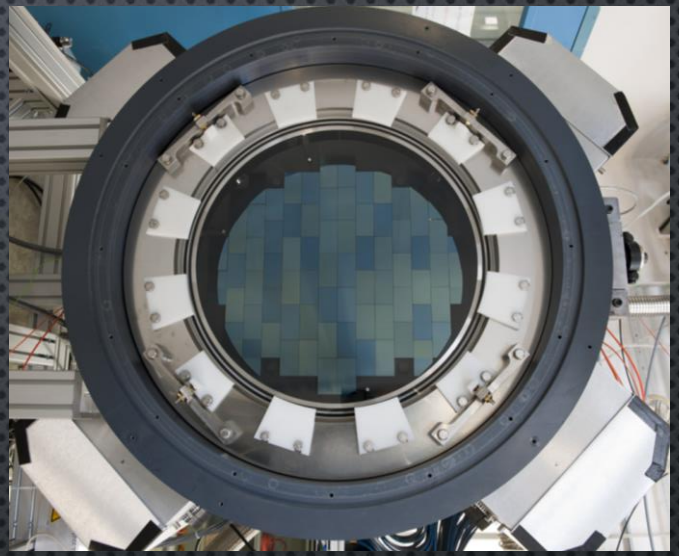
DARK ENERGY SURVEY

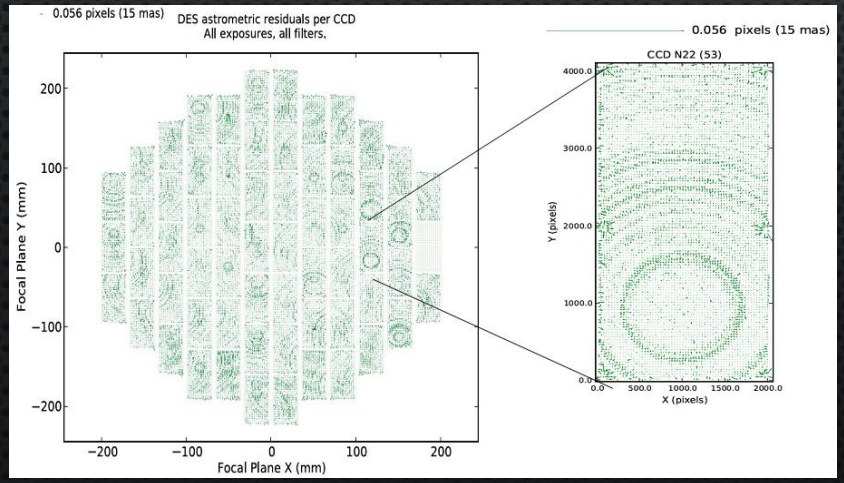
- INSTALLED ON THE BLANCO 4M TELESCOPE AT CTIO. SEEING (I BAND) ~0.9"
- 3-SQ. DEGREE FIELD OF VIEW (2.2 DEGREE DIAMETER).
- HEXAPOD COMPENSATES FLEXURES BASED ON OUT-OF-FOCUS IMAGES



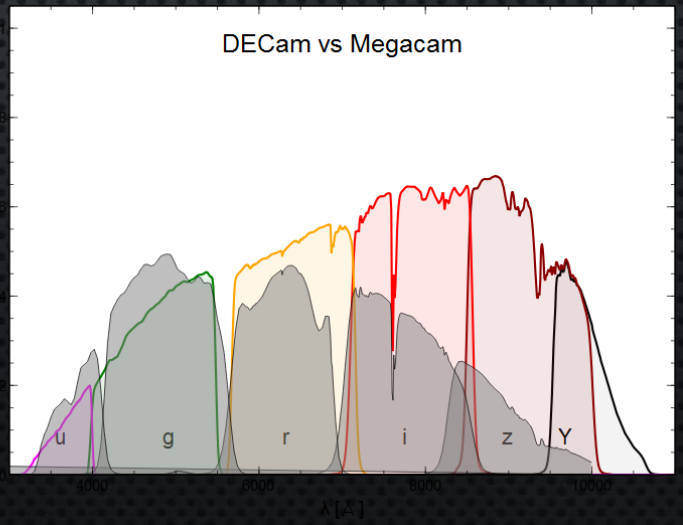
DECAM DETECTORS

- 570 MPIXELS
- THICK, FULLY-DEPLETED CCDS
  - VERY HIGH Q.E IN THE RED
  - VERY LITTLE FRINGING IN I AND Z
  - CARE SHOULD BE TAKEN WITH STRONG LIGHTING (SUPER-SATURATION)
  - SIGNIFICANT DISTORTION OF THE PIXEL GRID DUE TO LATERAL ELECTRIC FIELD VARIATIONS
    - STATIC: RESISTIVITY VARIATIONS ("TREE-RINGS")
    - DYNAMIC: "BRIGHTER-FATTER" EFFECT





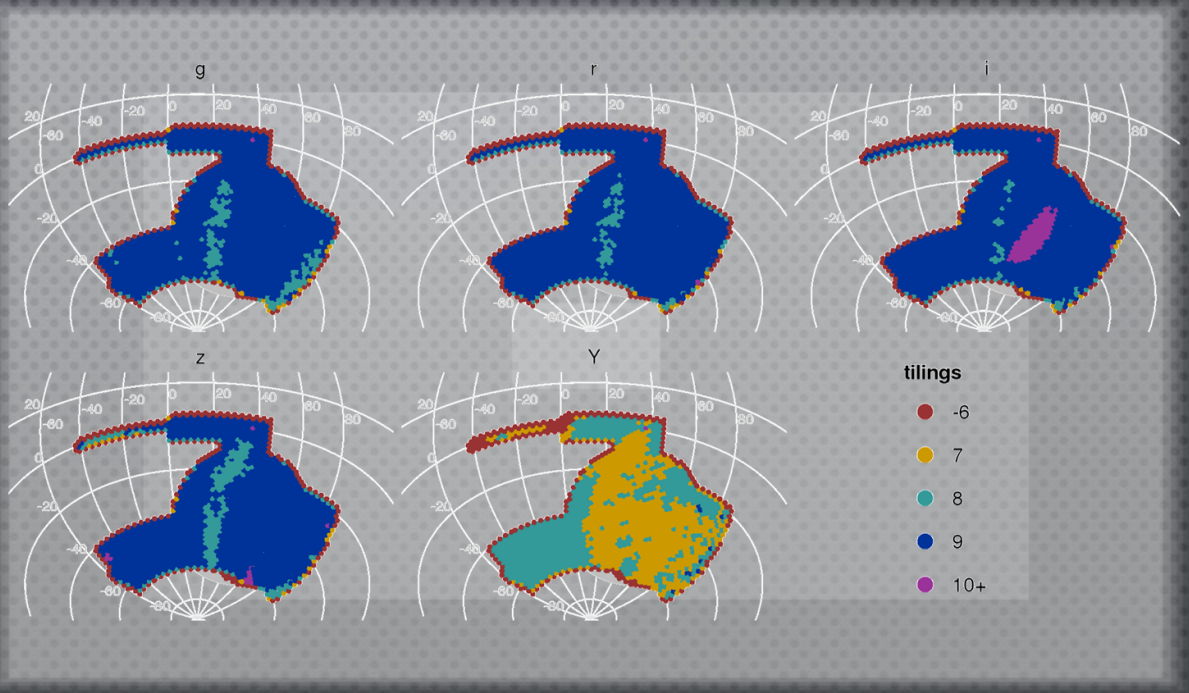
A. Plazas



SURVEY AND OBSERVATION STRATEGY

DARK ENERGY SURVEY

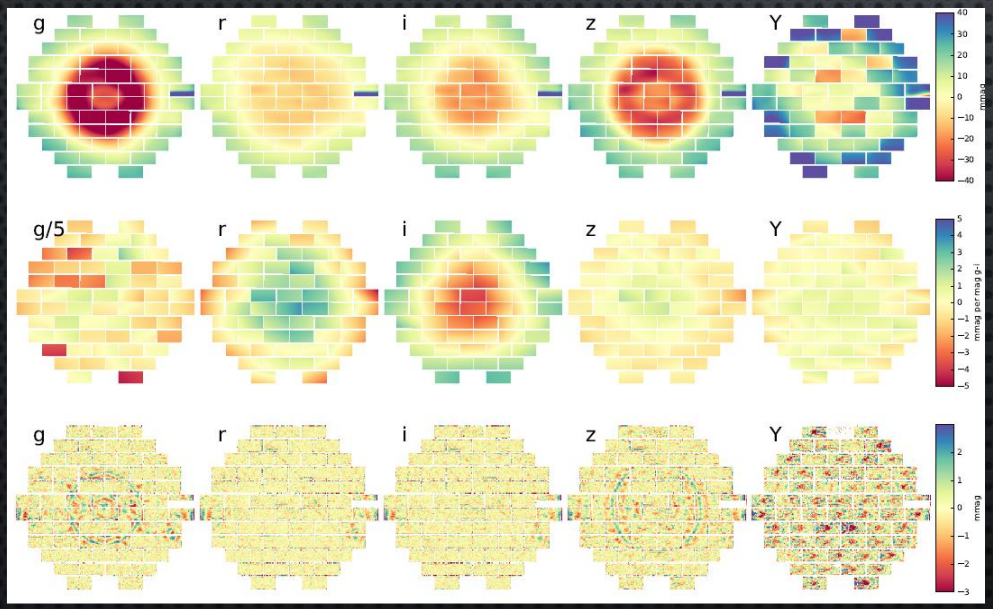
- OBSERVATIONS ARE CARRIED OUT BY DES MEMBERS FROM AUGUST TO FEB
- ~ 90S EXPOSURES
- 12 EPOCHS, ~2 PER SEASON
- SWITCH TO SN FIELDS DEPENDING ON OBSERVING CONDITIONS
- VERY LARGE DITHERS (UP TO 1 DEG) IMPLY
  - MULTI-EPOCH MEASUREMENTS

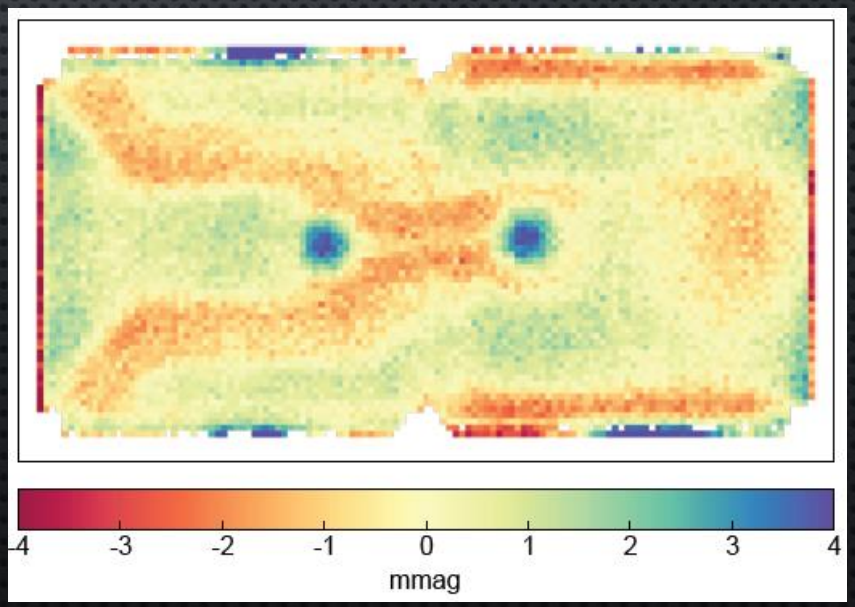


E.Nielsen

INSTRUMENTAL CALIBRATION

- PHOTOMETRIC RESPONSE MODELLED AT THE MILLIMAG LEVEL (PHOTOMETRIC HOMOGENEITY REQUIREMENT: <20 MILLIMAG).
- ASTROMETRIC RESPONSE MODELLED AT THE MAS LEVEL (RELATIVE ASTROMETRY REQUIREMENT: <15 MAS)



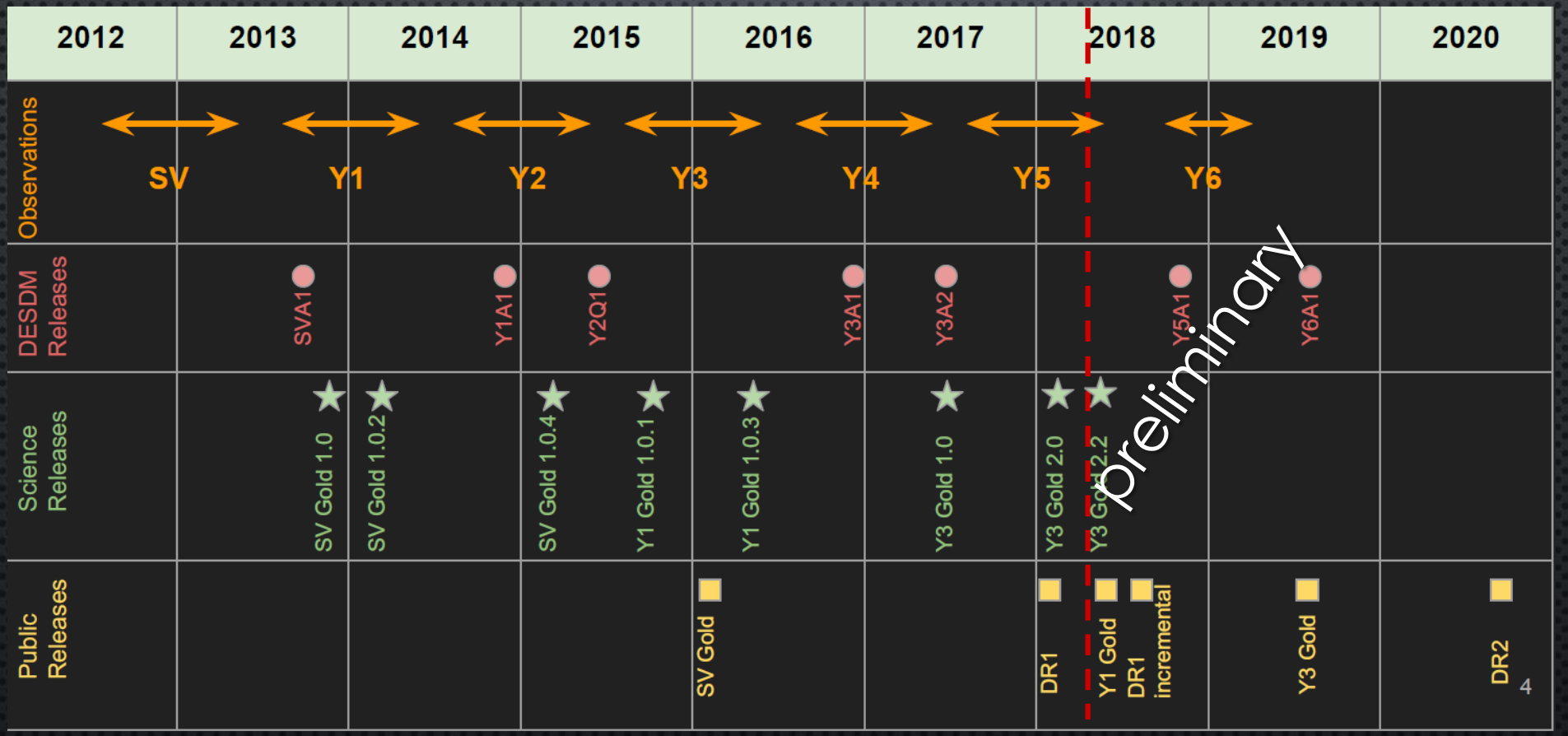


G.Bernstein

DATA

- Science Data throughput ~400GB per clear night
- Data processed at NCSA (U. of Illinois) through the DESDM (data management) system
  - DECam community pipeline operated by NOAO
  - DES data products readily available to the DES community through the DES archive at NCSA
- Yearly / bi-yearly internal data releases to the collaboration
- Raw data proprietary period is 12 months (NOAO standard: 18 months)
  - can be accessed through the NOAO NVO portal

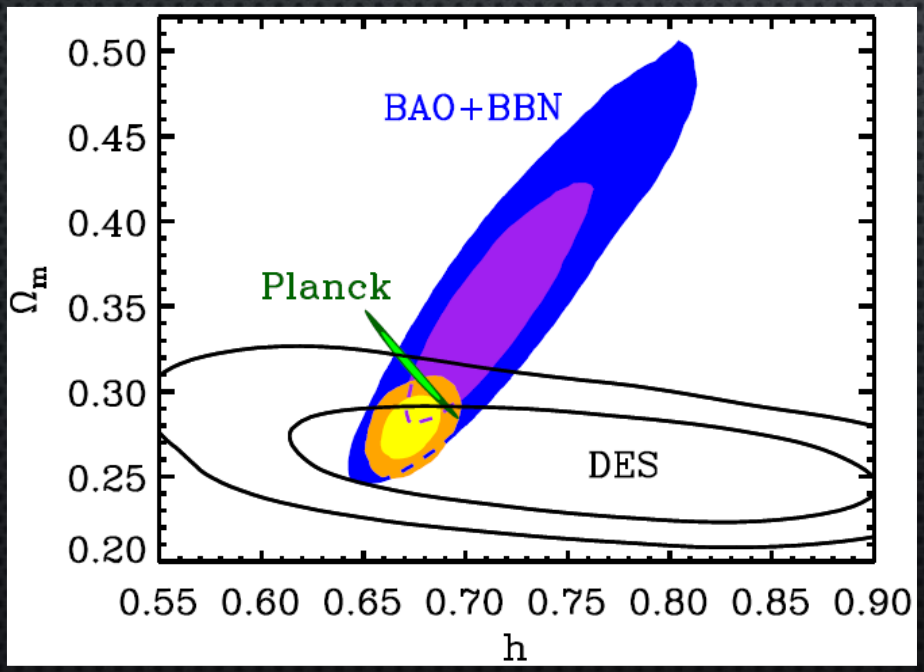
DATA RELEASES

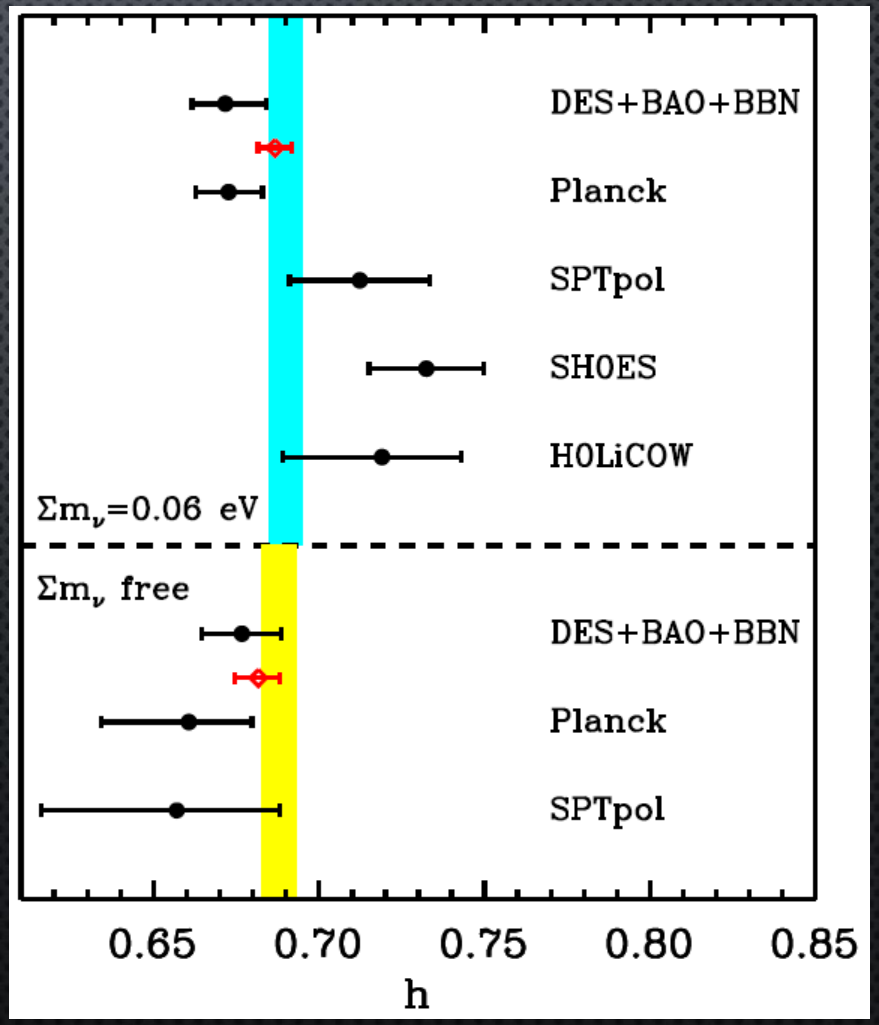


Courtesy of M. Carrasco-Kind

YEAR 1 SCIENCE HIGHLIGHTS

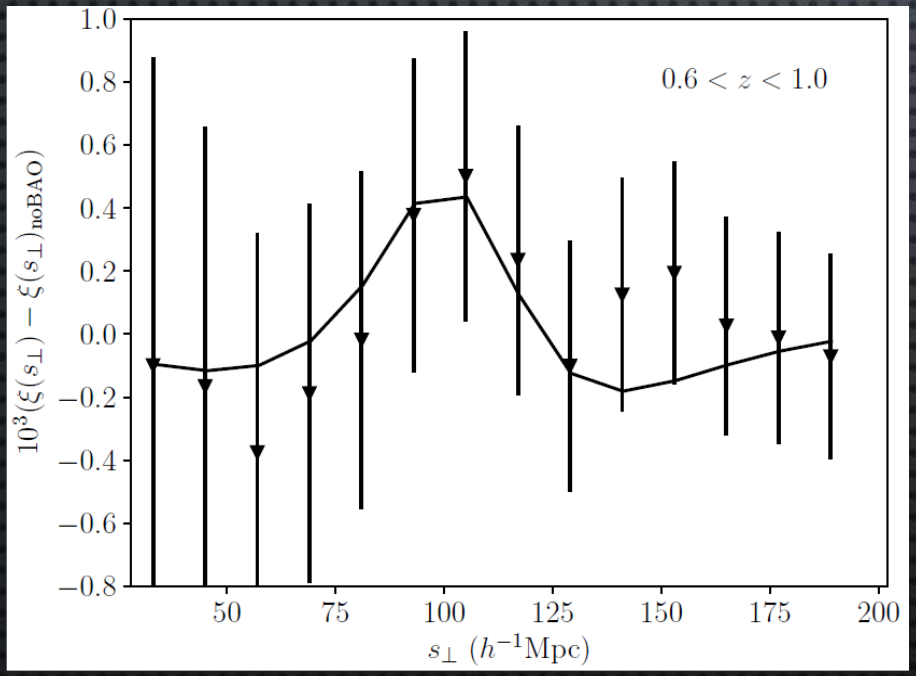
- BAO+BBN CONSTRAINS: H_0 = 67.2+/- 1KM.S^{-1} (ABBOTT ET AL. 2017)

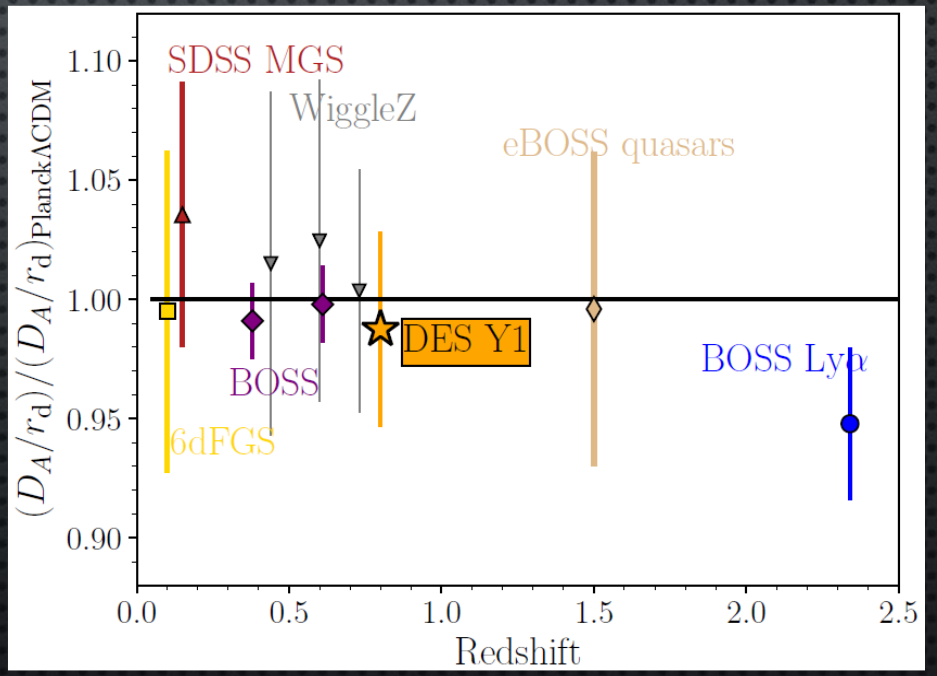




YEAR 1 SCIENCE HIGHLIGHTS

- BAOs (Abbott et al. 2017)

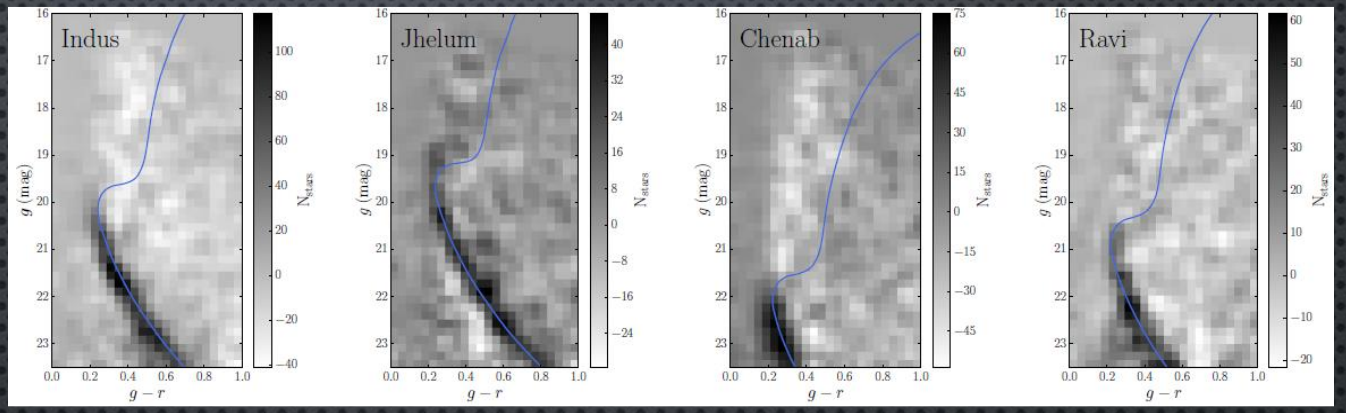


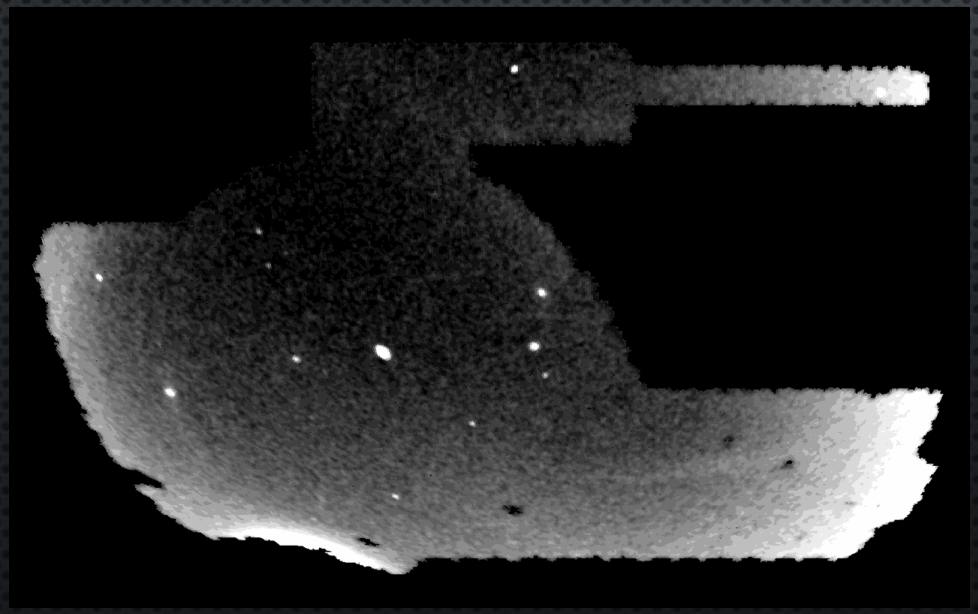


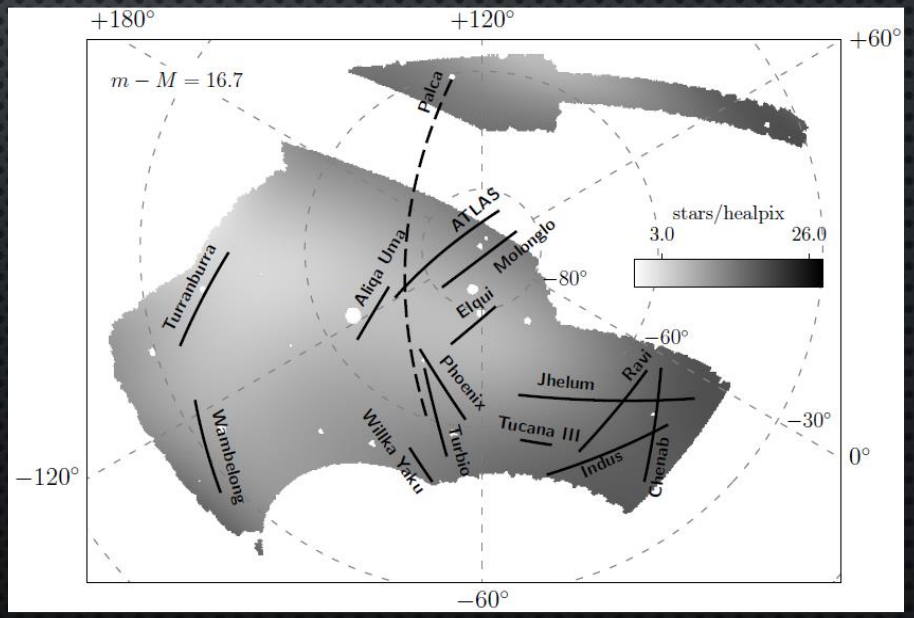
EARLY YEAR 3 RESULTS

DARK ENERGY SURVEY

- STELLAR STREAMS (SHIPP ET AL. 2018)
- 11 NEW STREAMS

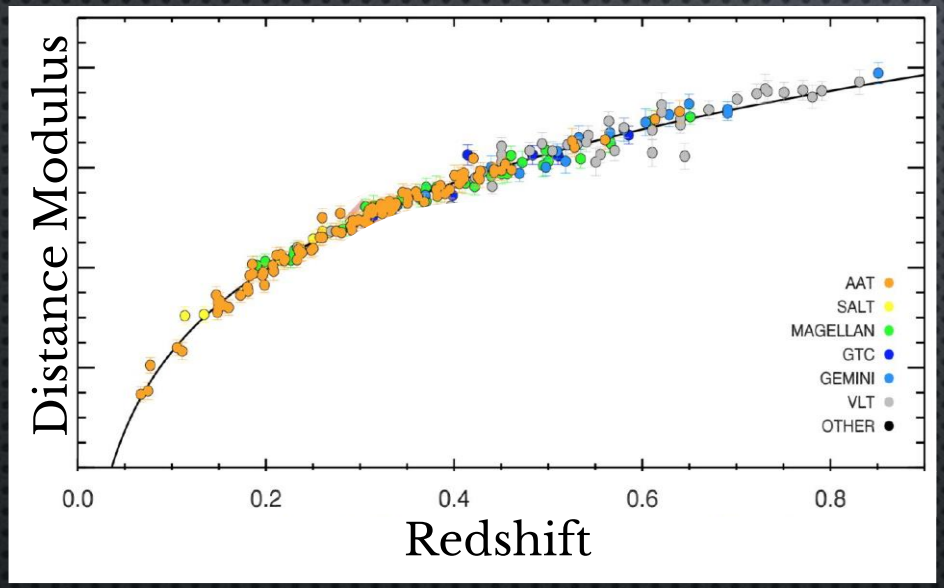


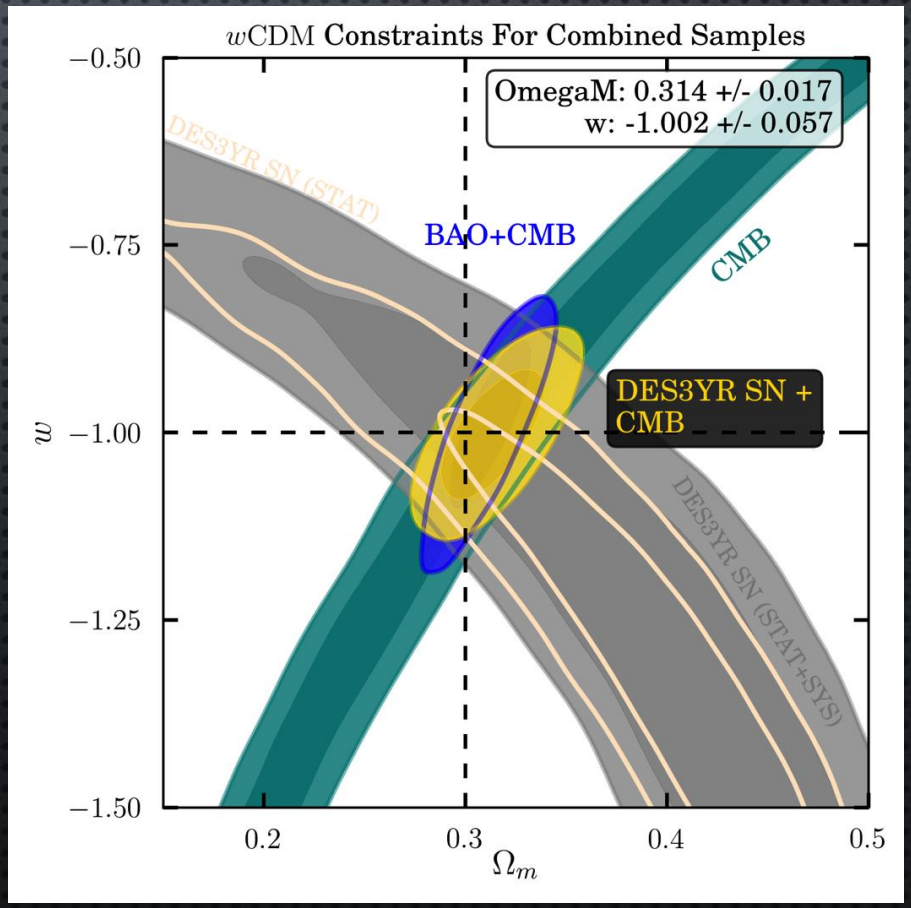




EARLY YEAR 3 RESULTS

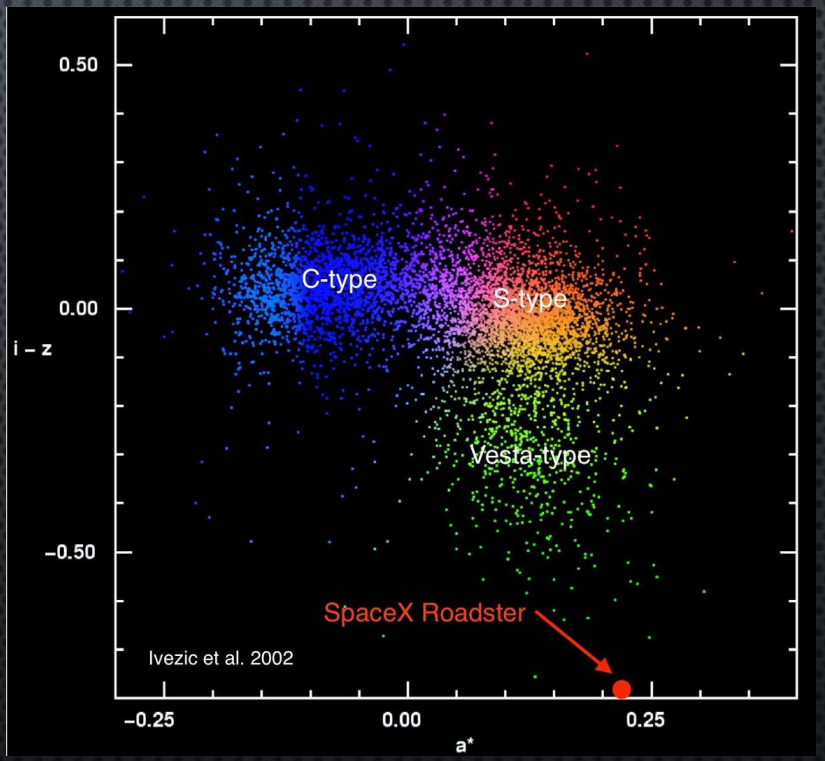
- BROUT ET AL. (AAS 2018)
- PRELIMINARY





TRANSIENT AND MOVING OBJECTS

DARK ENERGY SURVEY



D.Guerdes