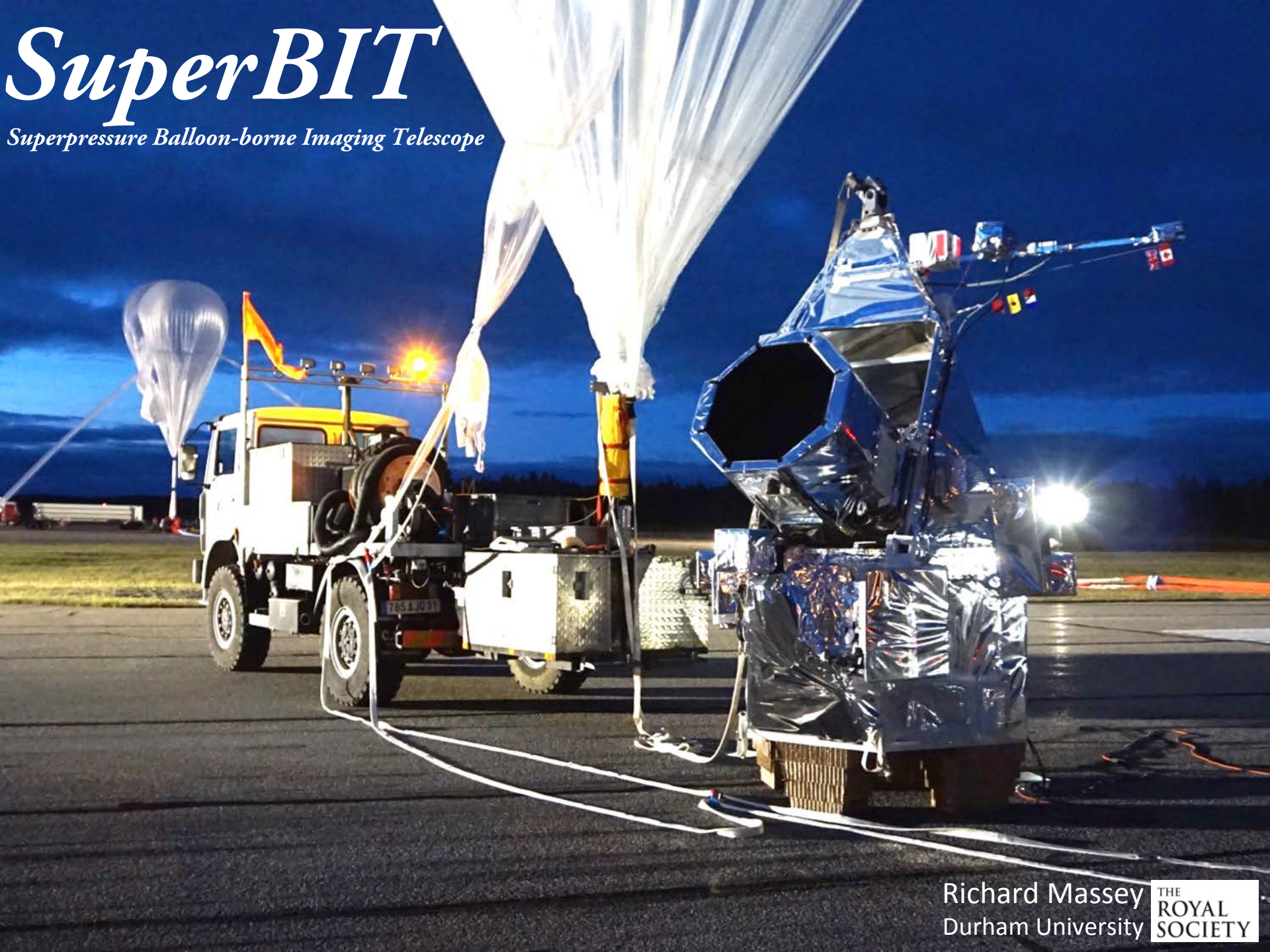


SuperBIT

Superpressure Balloon-borne Imaging Telescope



Richard Massey
Durham University

THE
ROYAL
SOCIETY

SuperBIT

Superpressure Balloon-borne Imaging Telescope

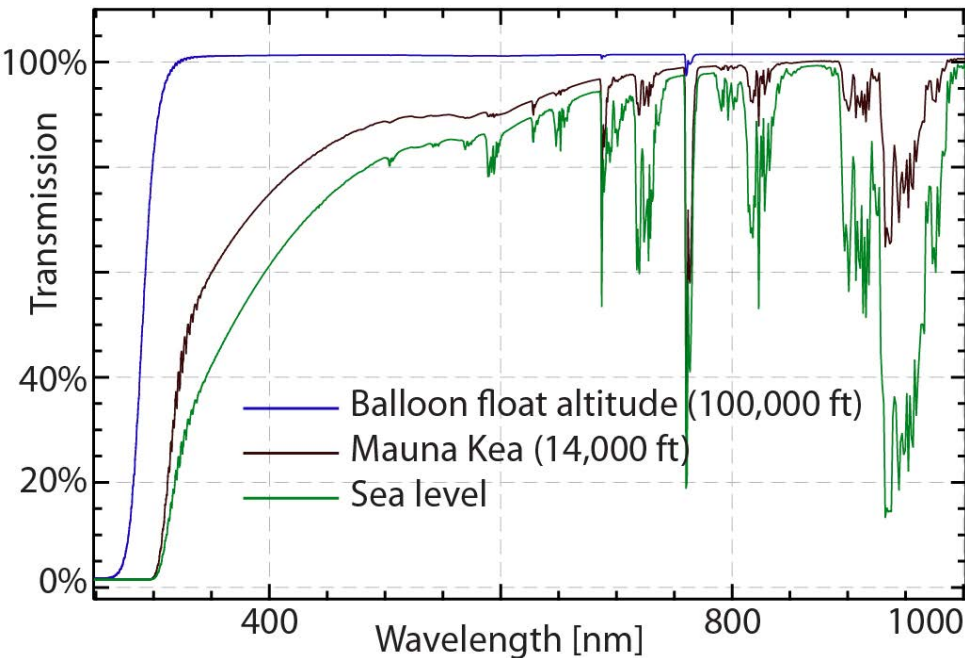


UNIVERSITY OF
TORONTO



Durham
University

Wide-field, space-quality optical & UV imaging from above the Earth's atmosphere

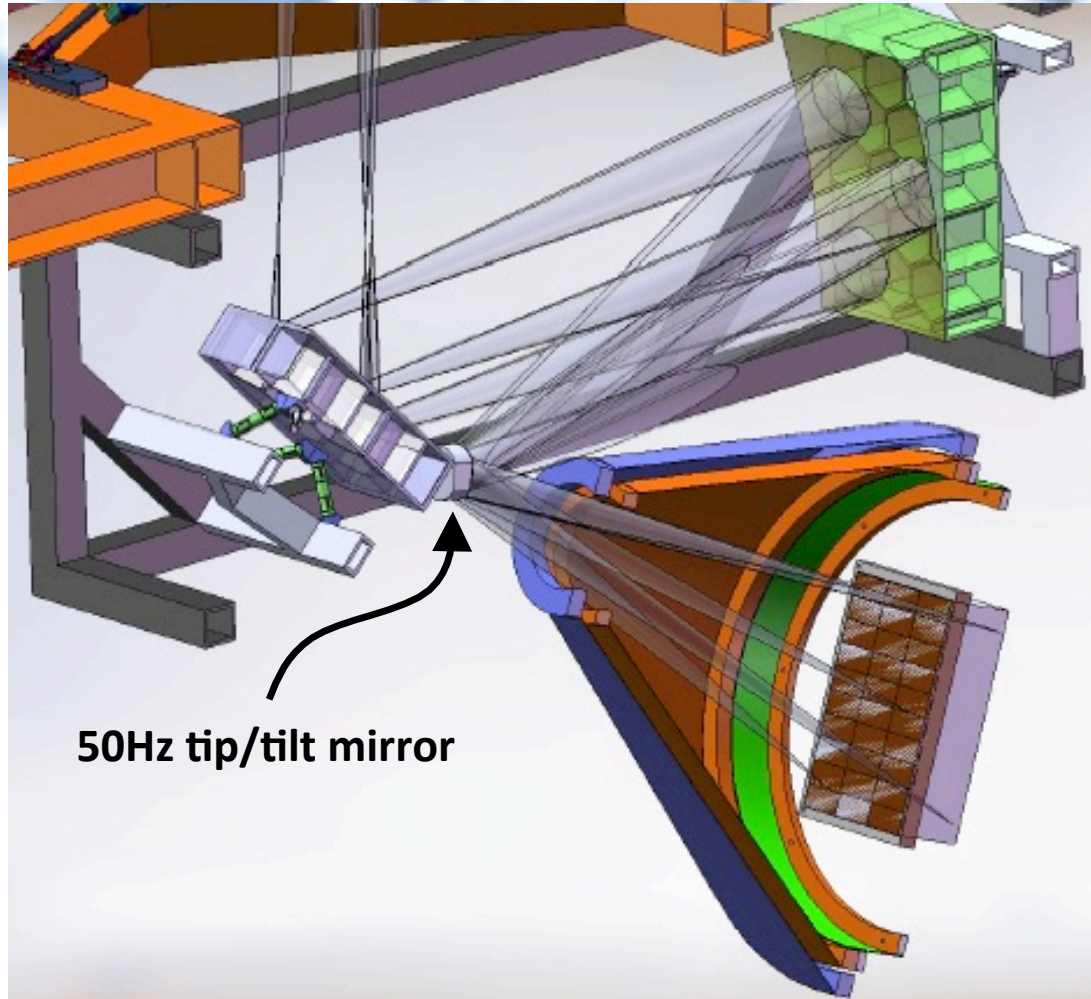
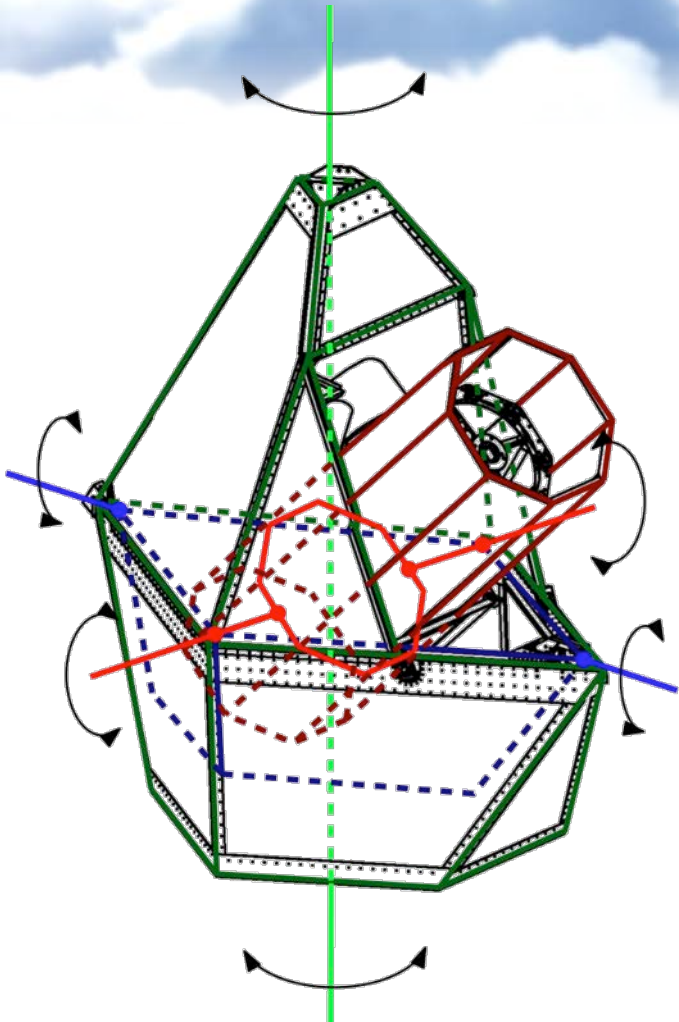


SuperBIT

Superpressure Balloon-borne Imaging Telescope

Three steps to diffraction-limited imaging:

- Passive damping of gondola → 1' rms stability
- Gyros on 3dof nested gimbals → 1" rms
- Guide star + tip/tilt mirror in optics → 0.1" rms



SuperBIT

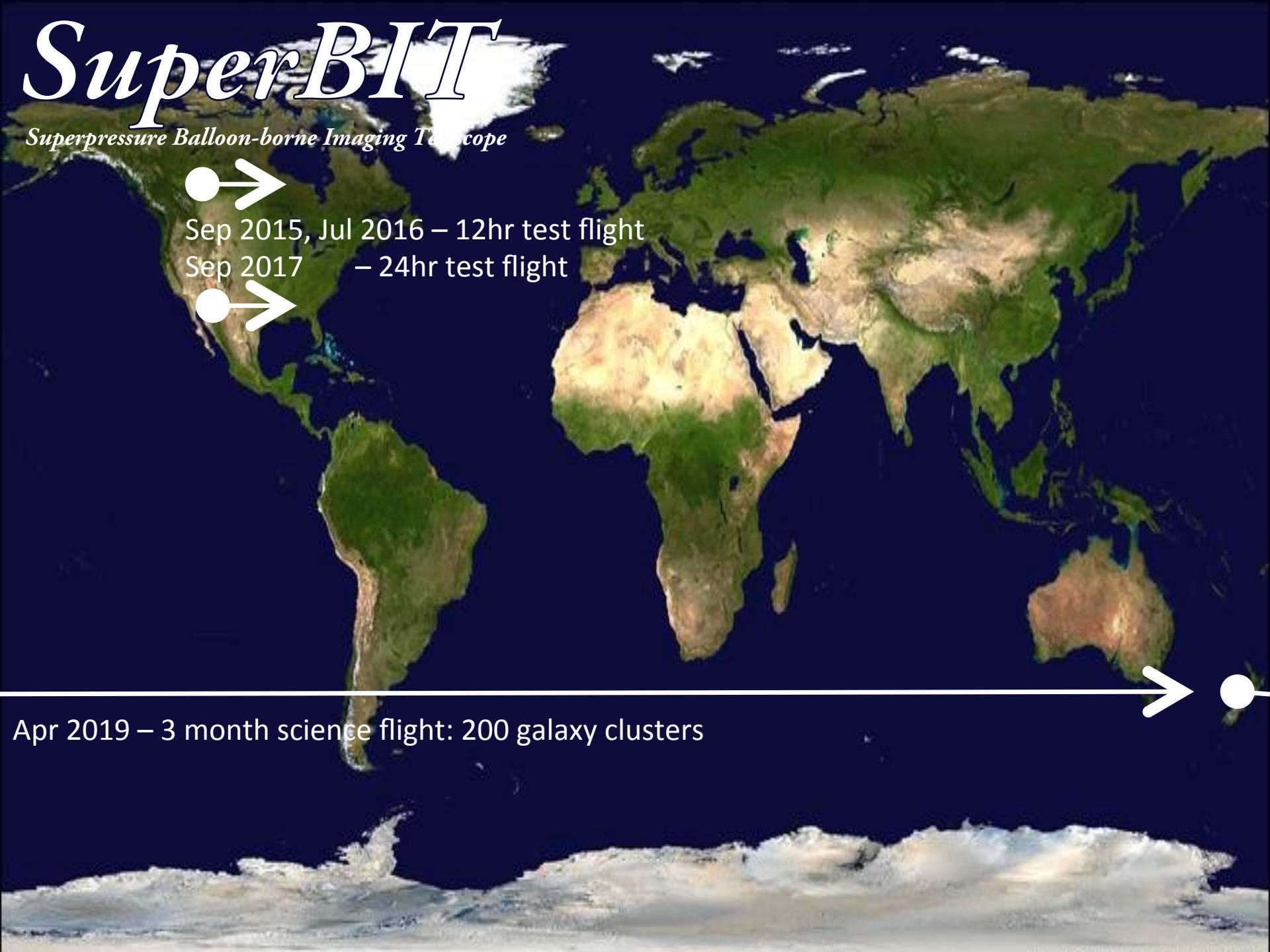
Superpressure Balloon-borne Imaging Telescope



Sep 2015, Jul 2016 – 12hr test flight
Sep 2017 – 24hr test flight



Apr 2019 – 3 month science flight: 200 galaxy clusters



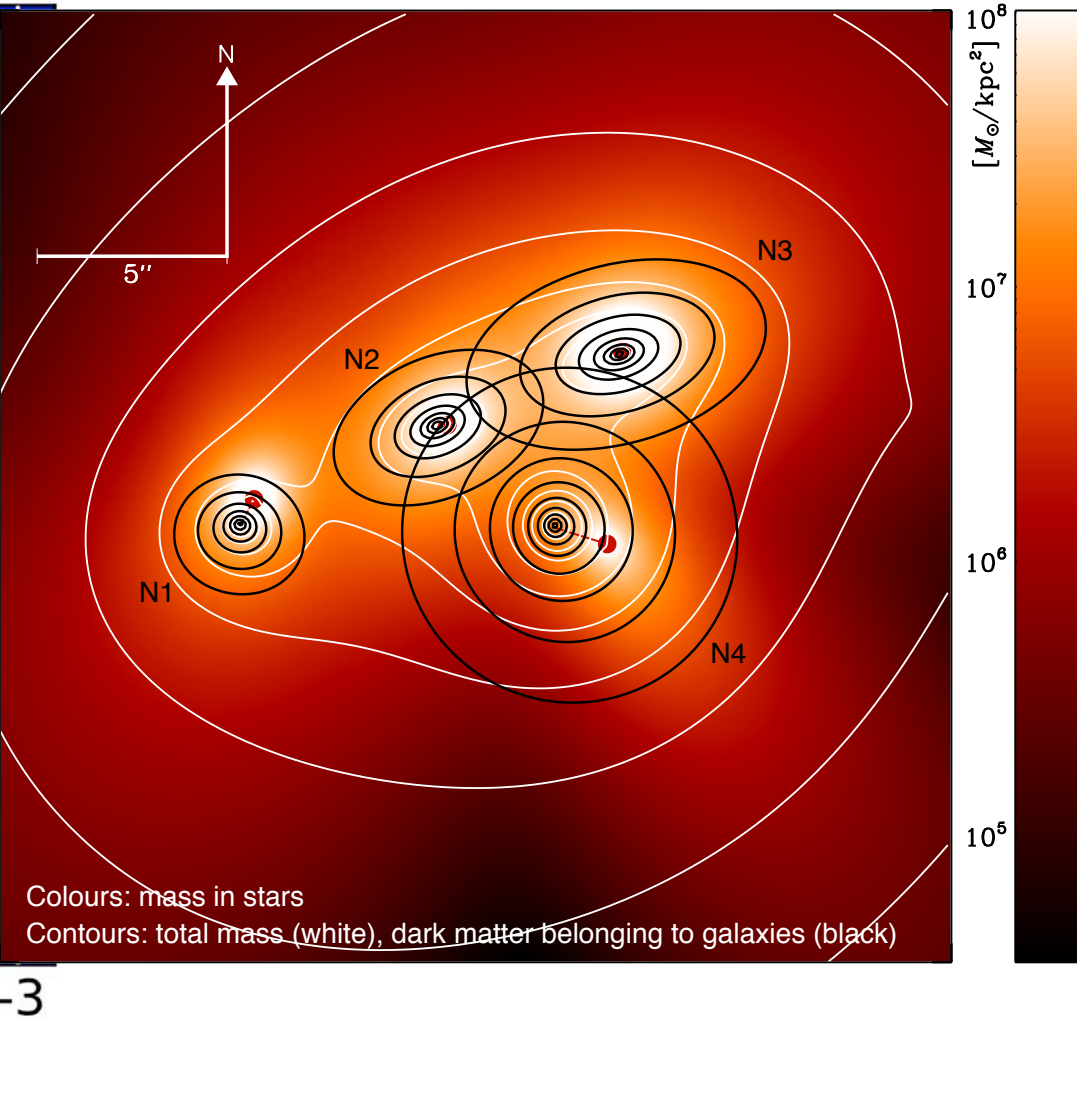
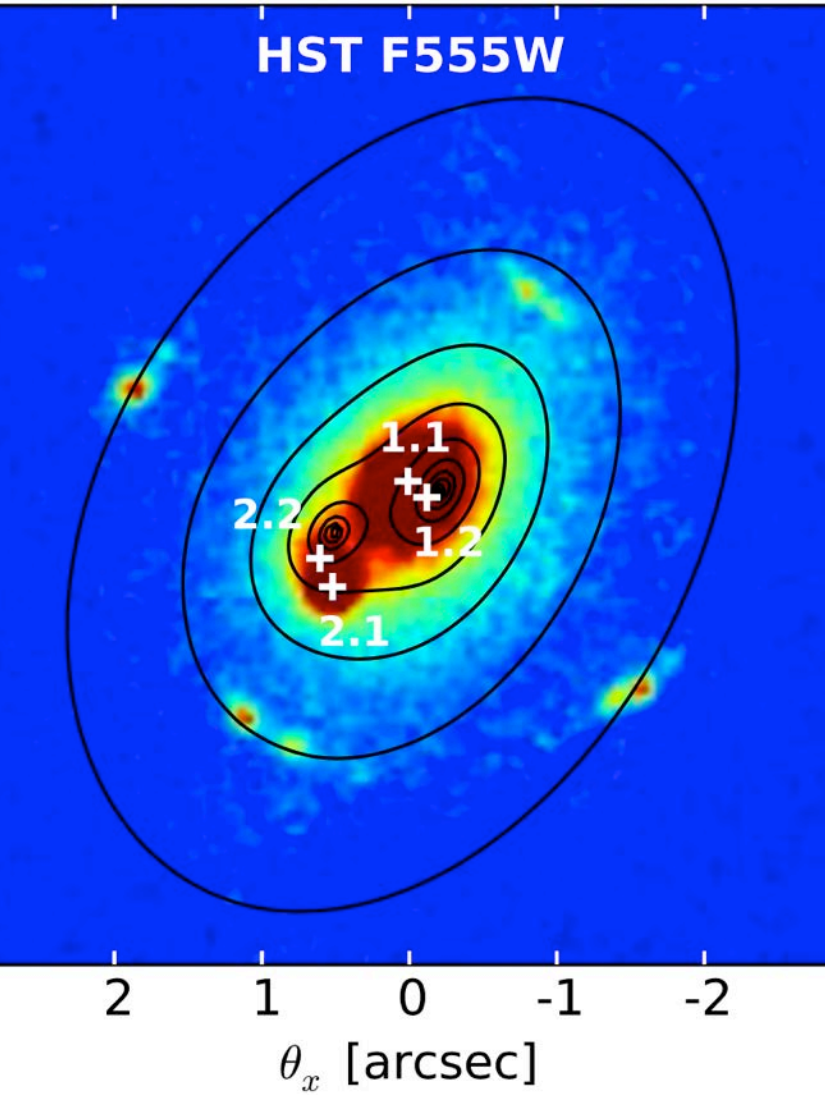
Offsets in individual galaxies

SDSS J1011+0143

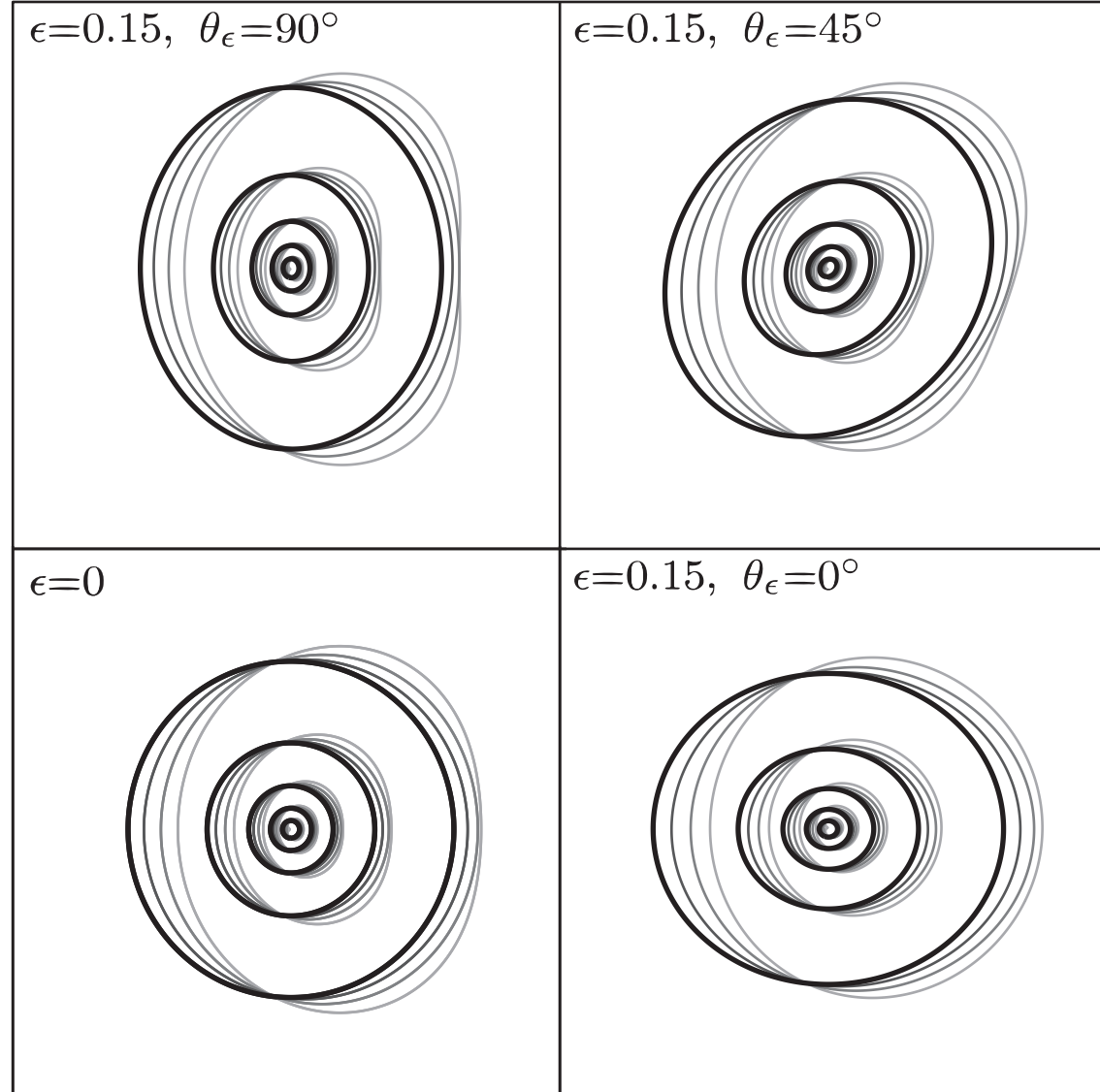
Abell 3827

Shu et al. (2016), ApJ 820, 43

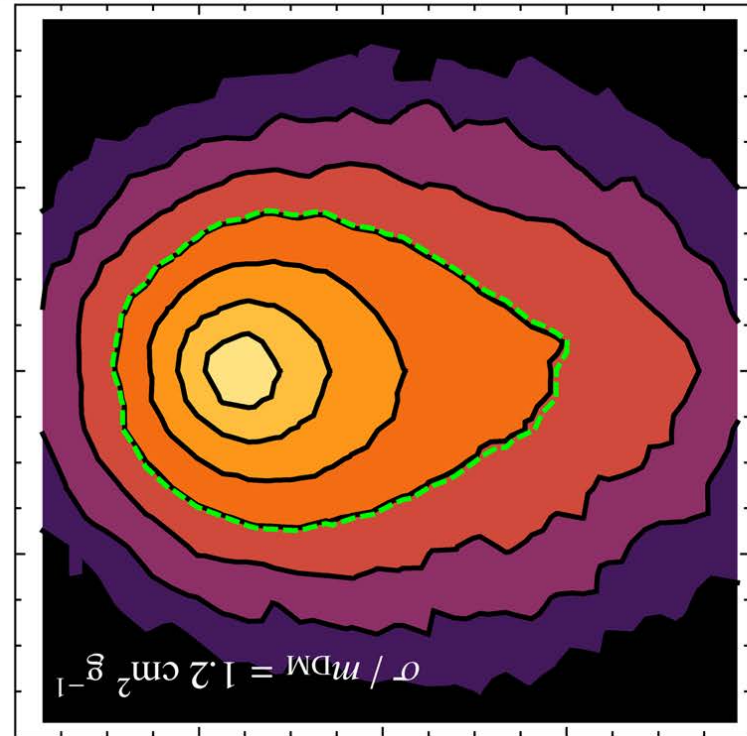
Williams & Saha (2011), MNRAS 415, 0448
Massey et al. (2015), MNRAS 449, 3393
Taylor et al. (2017), MNRAS 468, 5004



New ways to parameterise skewness

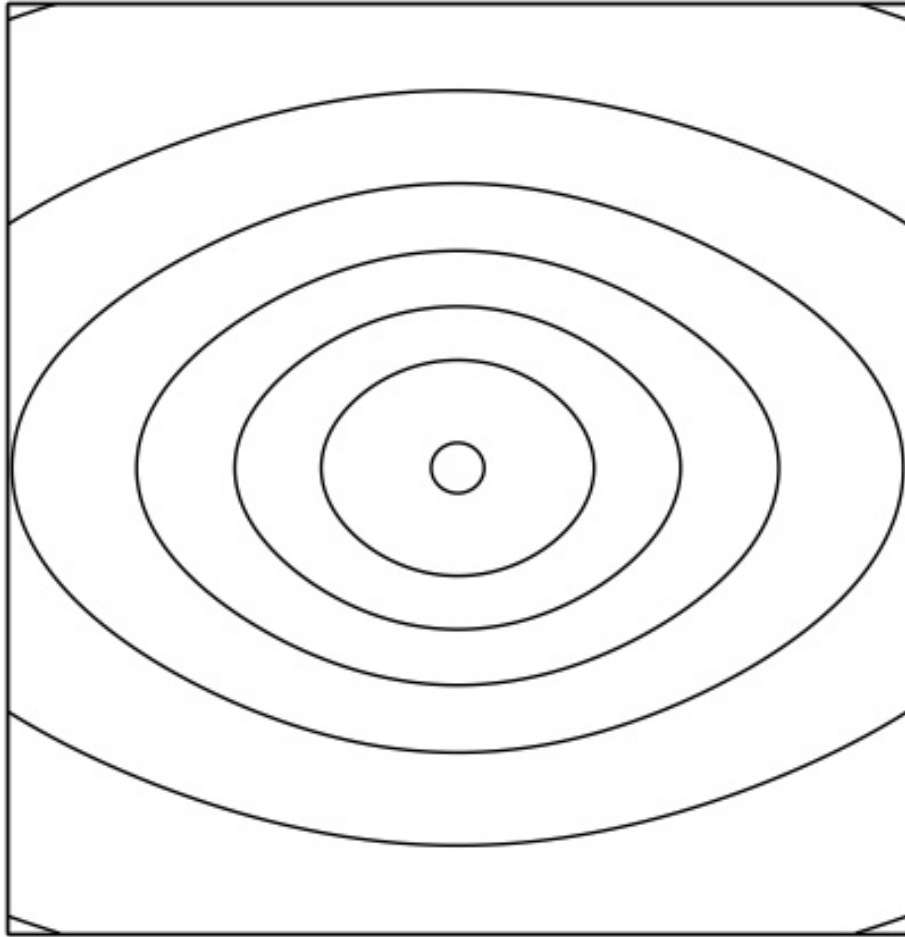


Taylor et al. (2017), MNRAS 468, 5004



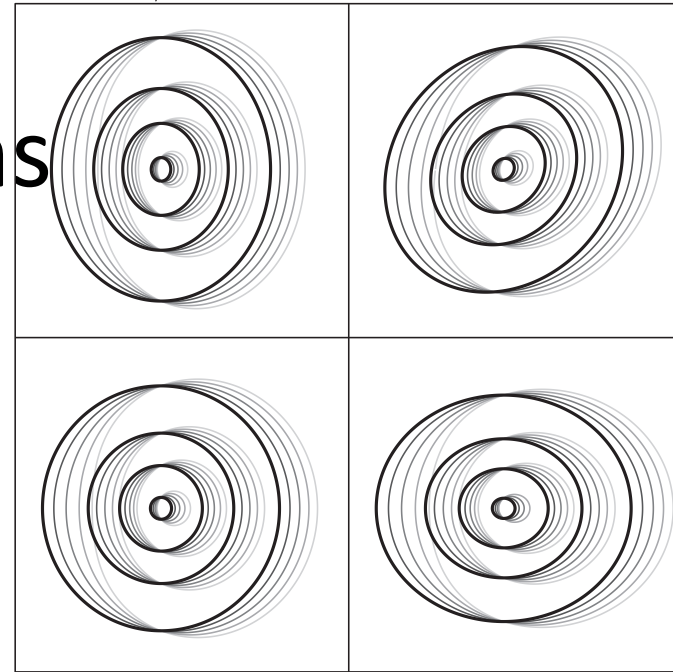
Kahlhoefer et al. (2014), MNRAS 437, 2865

New ways to parameterise non-trivial mass distributions

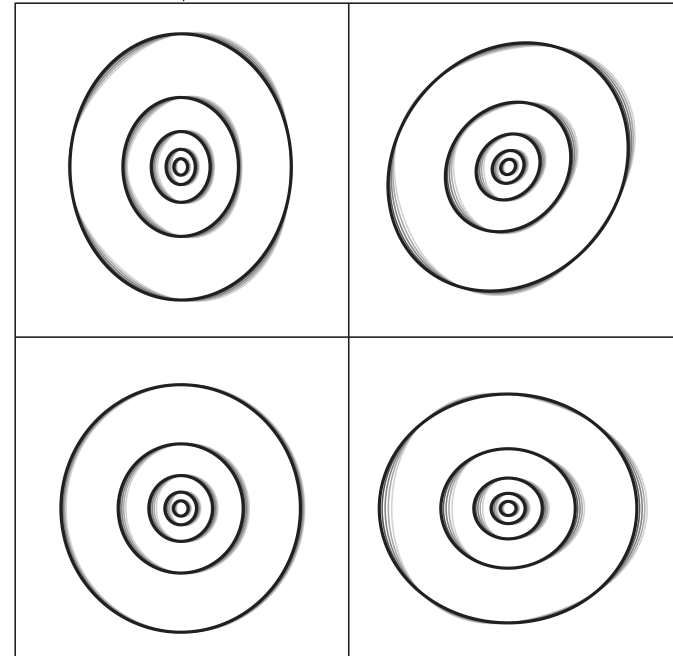


Taylor et al. (2017), MNRAS 468, 5004

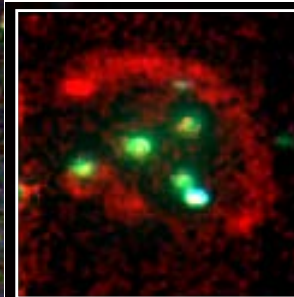
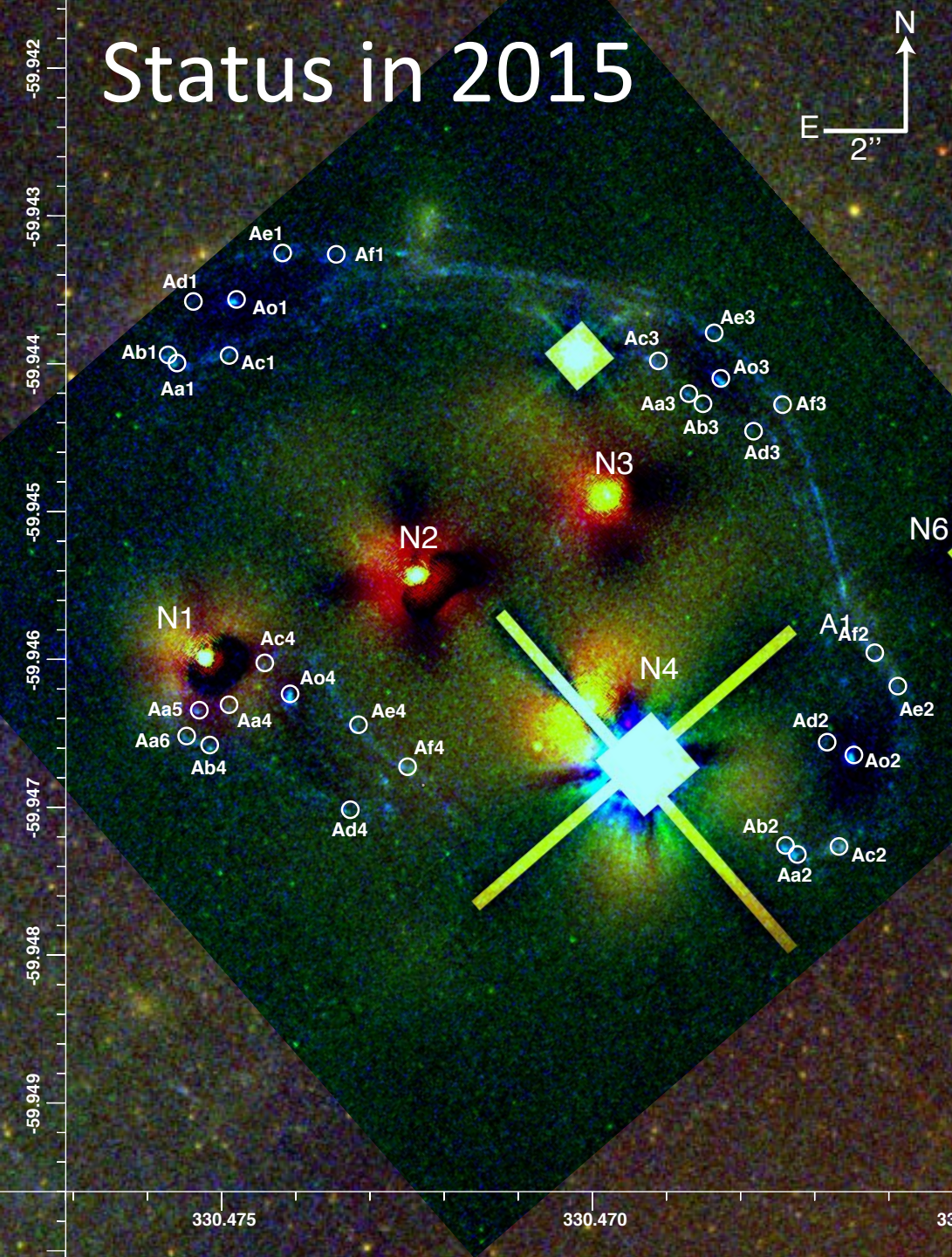
Inside r_s/β



Outside r_s/β



Status in 2015

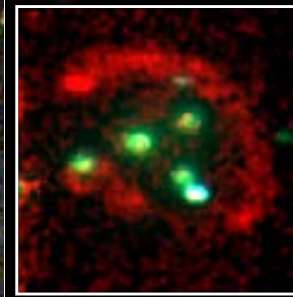
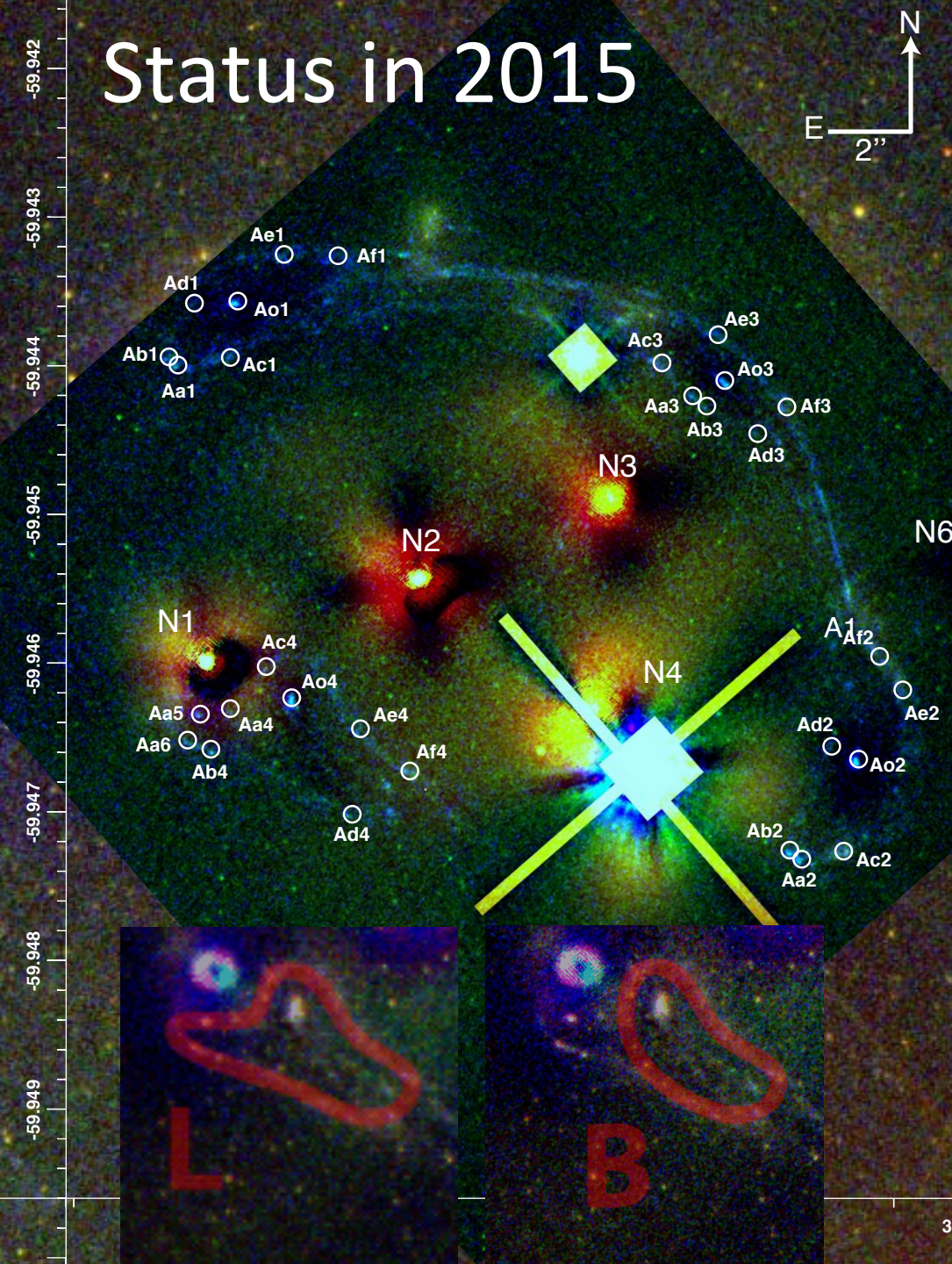


VIMOS 5hrs

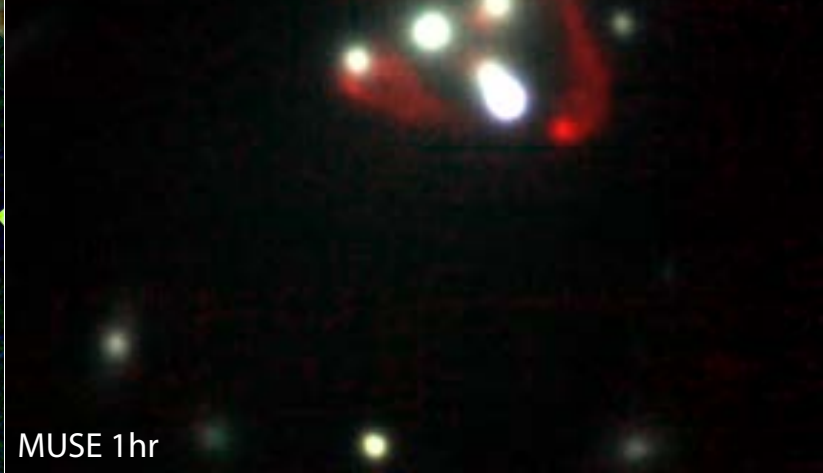


MUSE 1hr

Status in 2015



VIMOS 5hrs

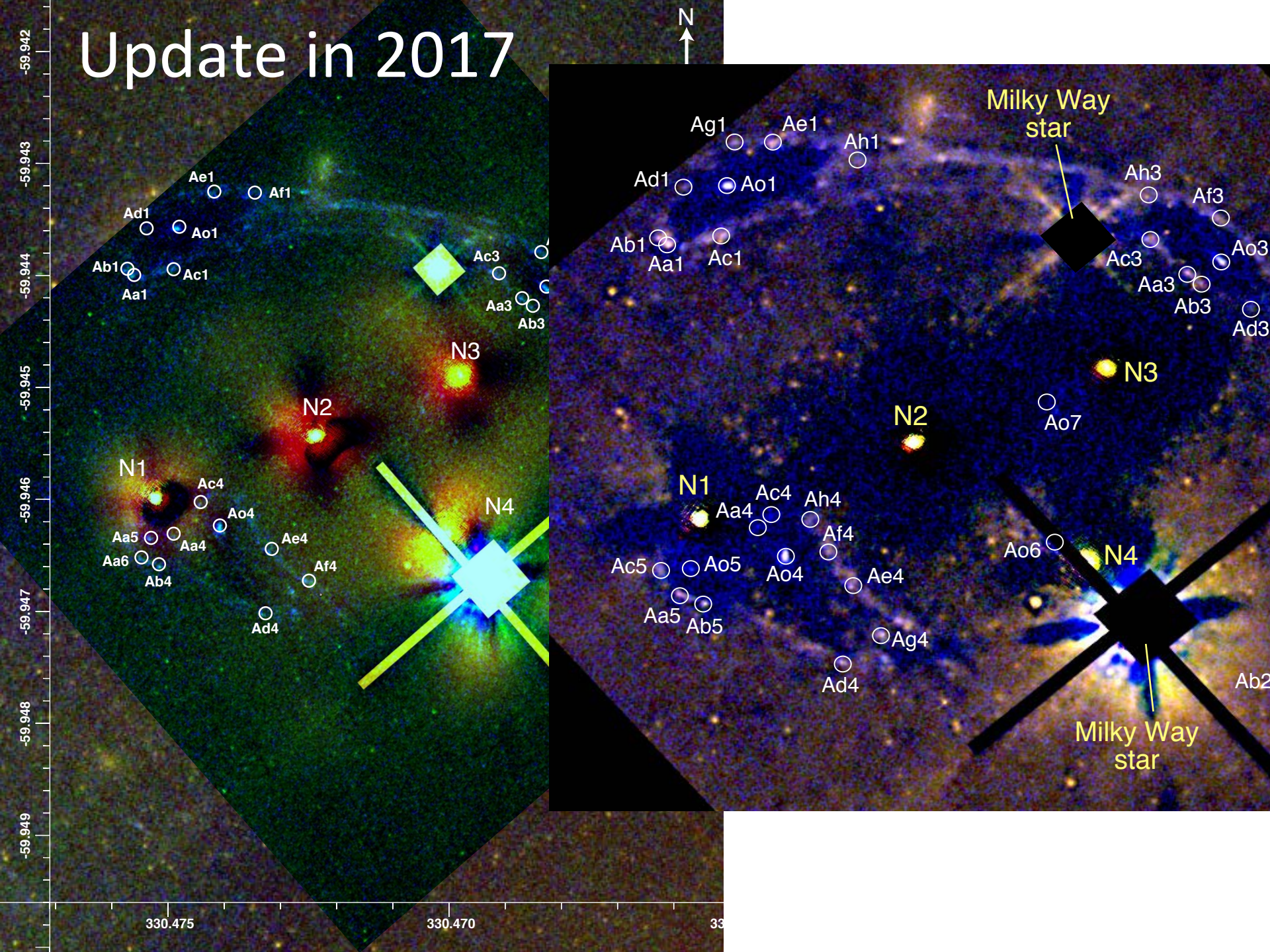


MUSE 1hr

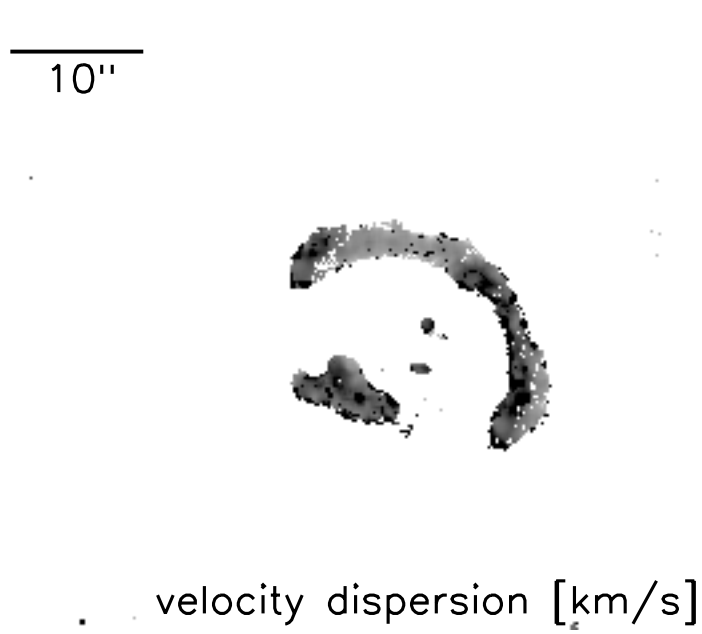
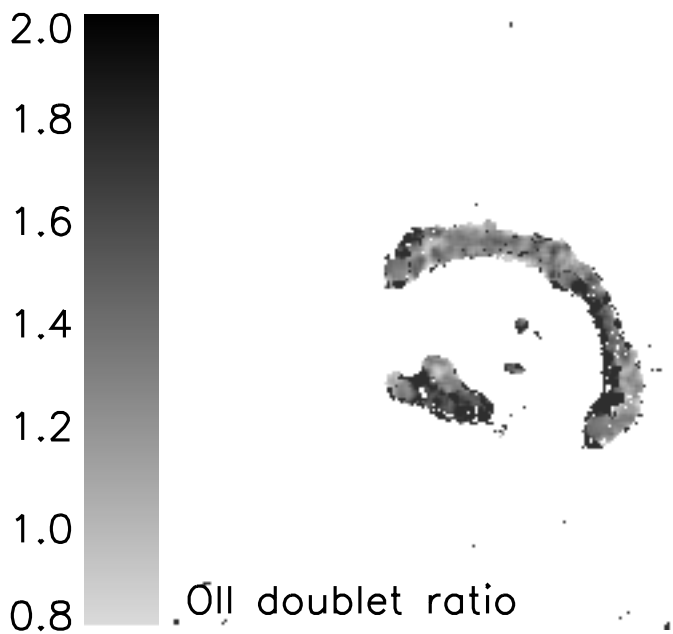
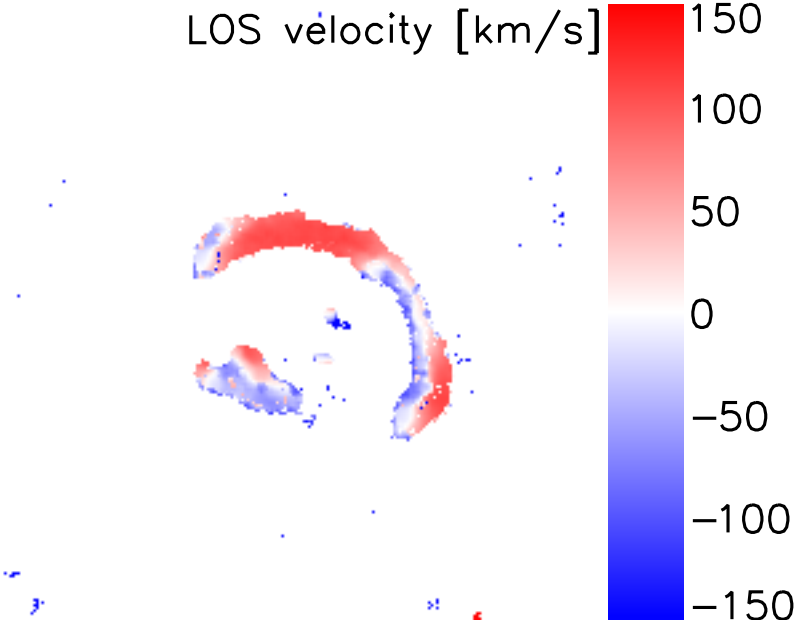
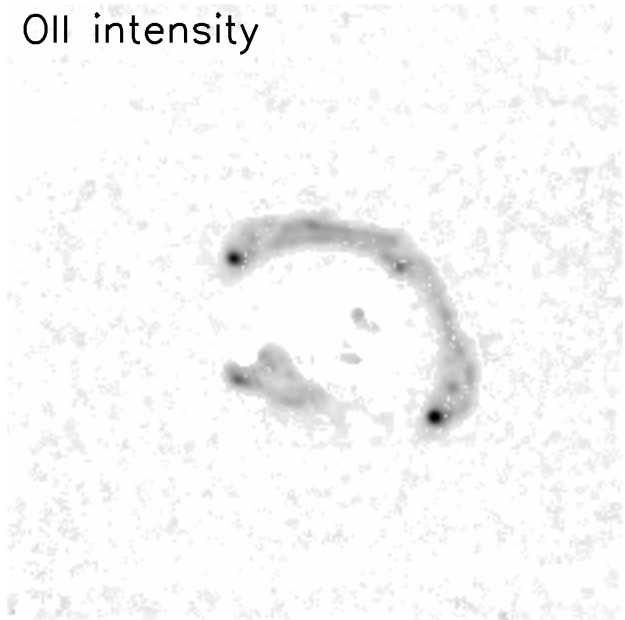
Most difficult part of the data analysis was matching (counter)images of the many multiply-imaged star-forming knots.

Colours/morphology/brightness in HST imaging complicated by bright foregrounds; IFU spectroscopy shallow.

Update in 2017

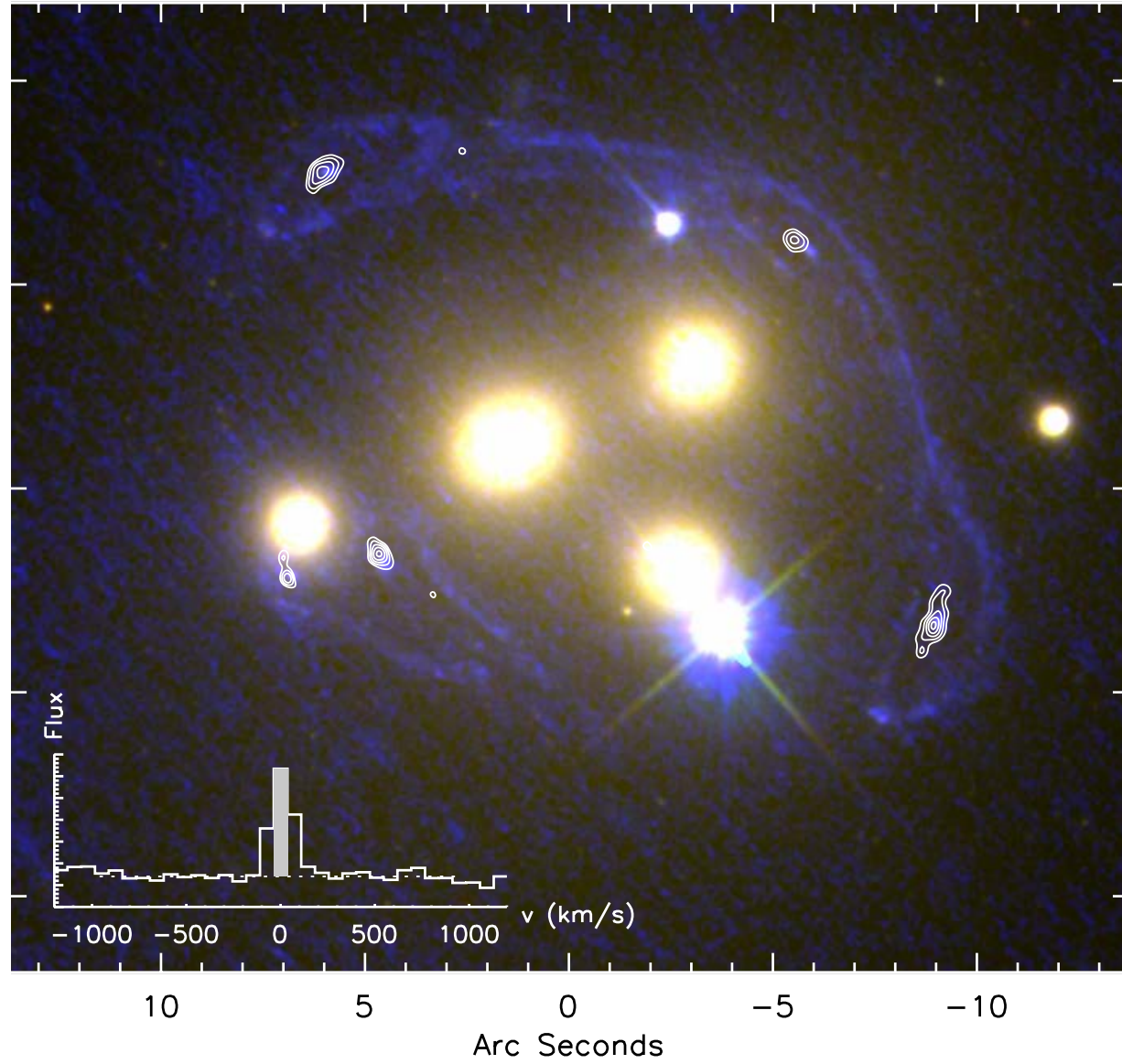


MUSE optical+IR integral field spectroscopy

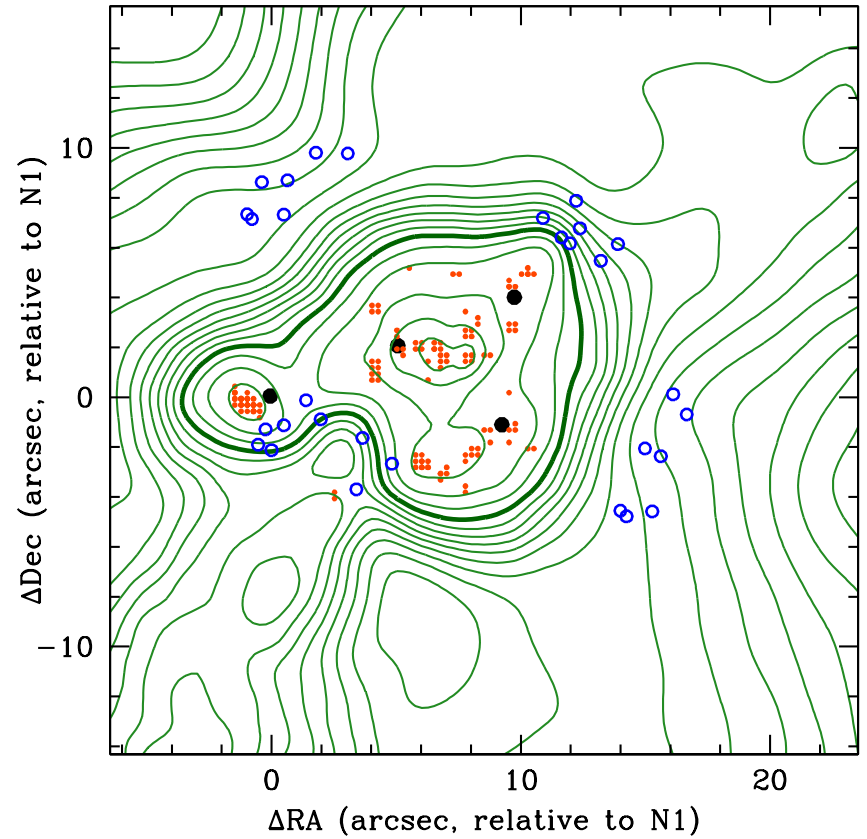
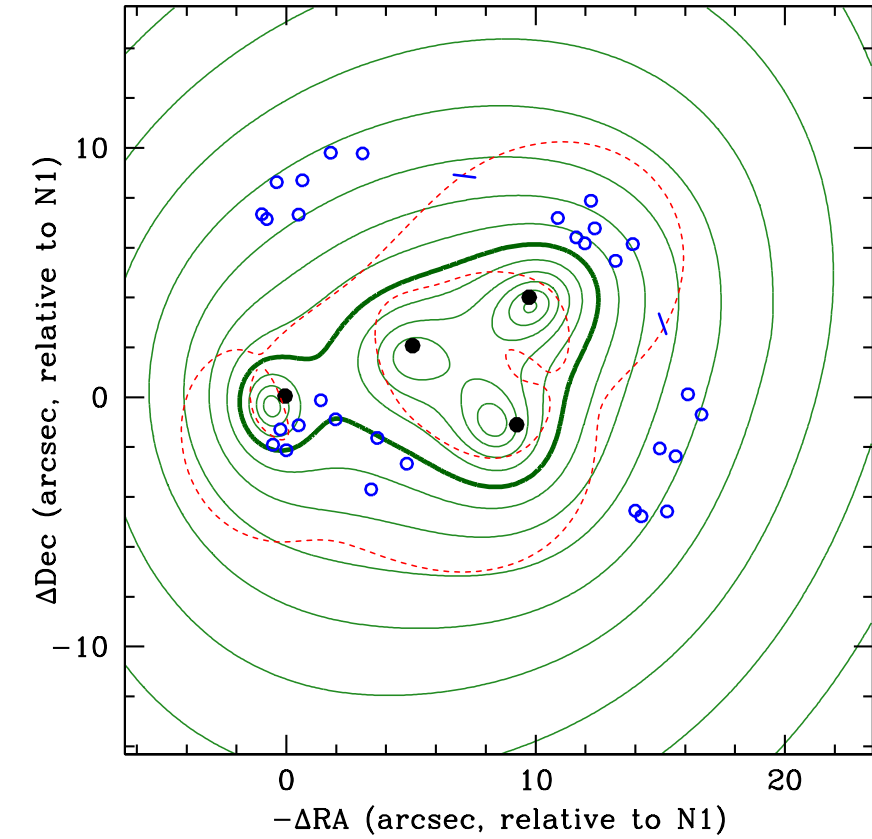


10''

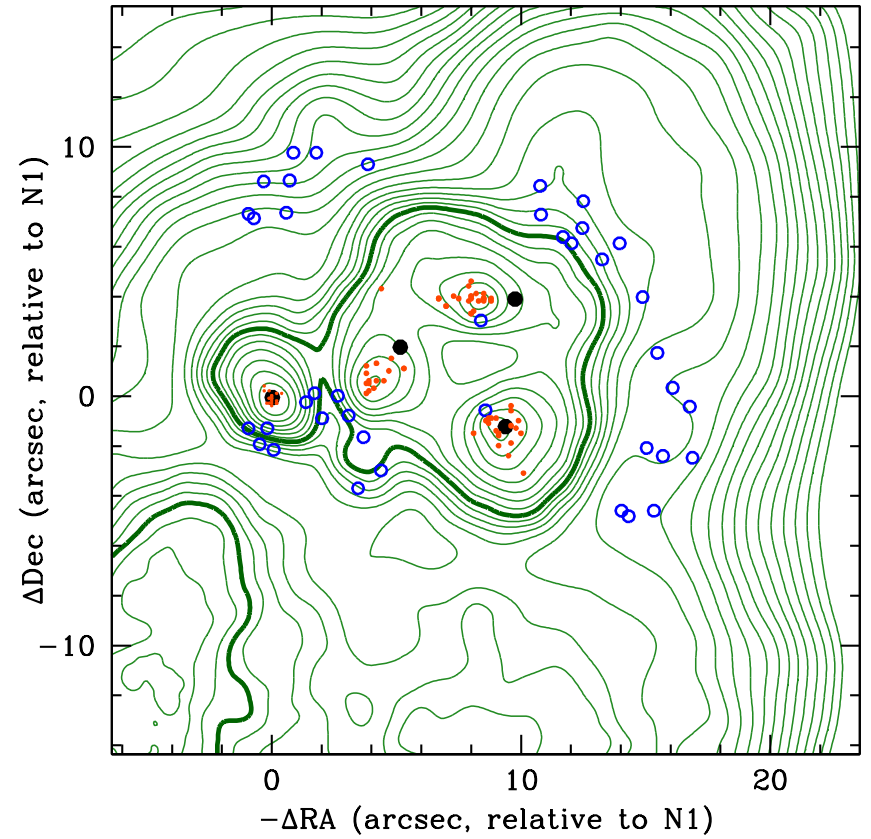
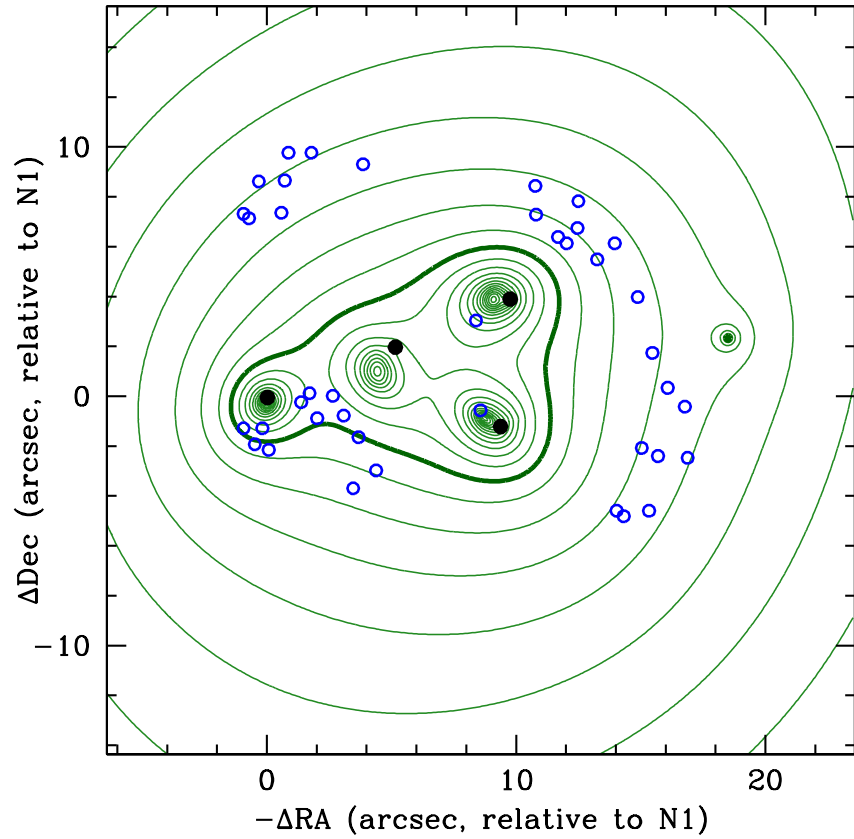
ALMA mm integral field spectroscopy (contours; background image HST)



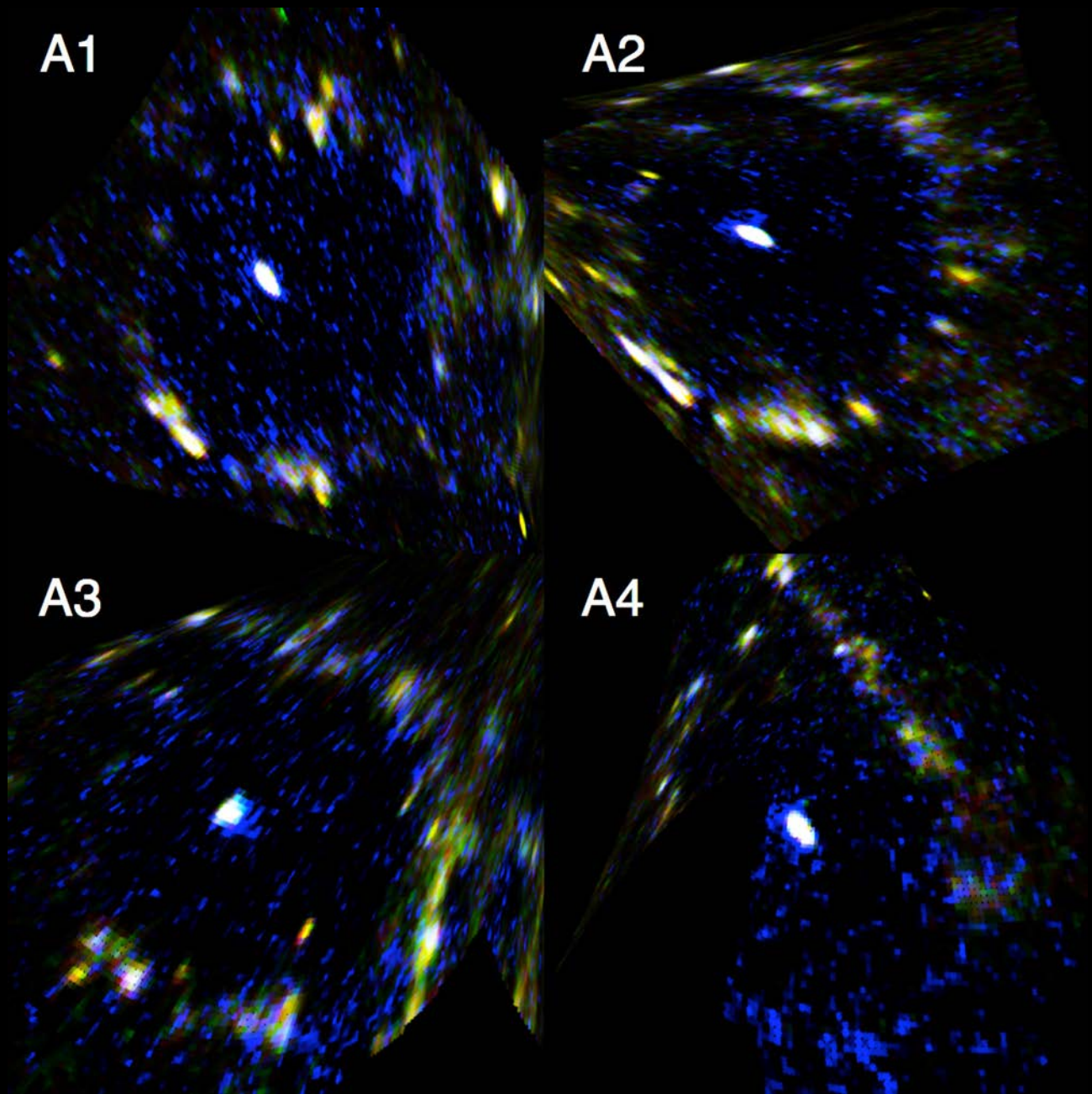
A3827 mass distribution - 2015



A3827 mass distribution - 2017



Source reconstruction



Conclusions

Strong lens identification is key

ALMA is AMAZING for this! MUSE AO currently being commissioned.
Consistency between parametric & non-parametric lensing models.
Absolute normalisation of $\langle \text{rms} \rangle_{\text{image}}$ should mean something.

There now exist many simulations of SIDM, and many observable quantities

Spatial offset

Mass/light ratio

Skewness

Sphericity

Change in |ellipticity| as function of radius

Rotation of ellipticity as a function of radius

Inner profile slope α

Haibo Yo's profile...

Exciting prospects for future observations

HST BUFFALO

MUSE AO

SuperBIT 2019

?HST clusters large programme?

Question (to theorists/simulators)

Which observable should we be measuring?

There now exist many simulations of SIDM, and many observable quantities

Spatial offset

Mass/light ratio

Skewness

Sphericity

Change in |ellipticity| as function of radius

Rotation of ellipticity as a function of radius

Inner profile slope α

Haibo Yo's profile...

On cluster scales, galaxy scales or dwarf scales?