Science with SWIFT.

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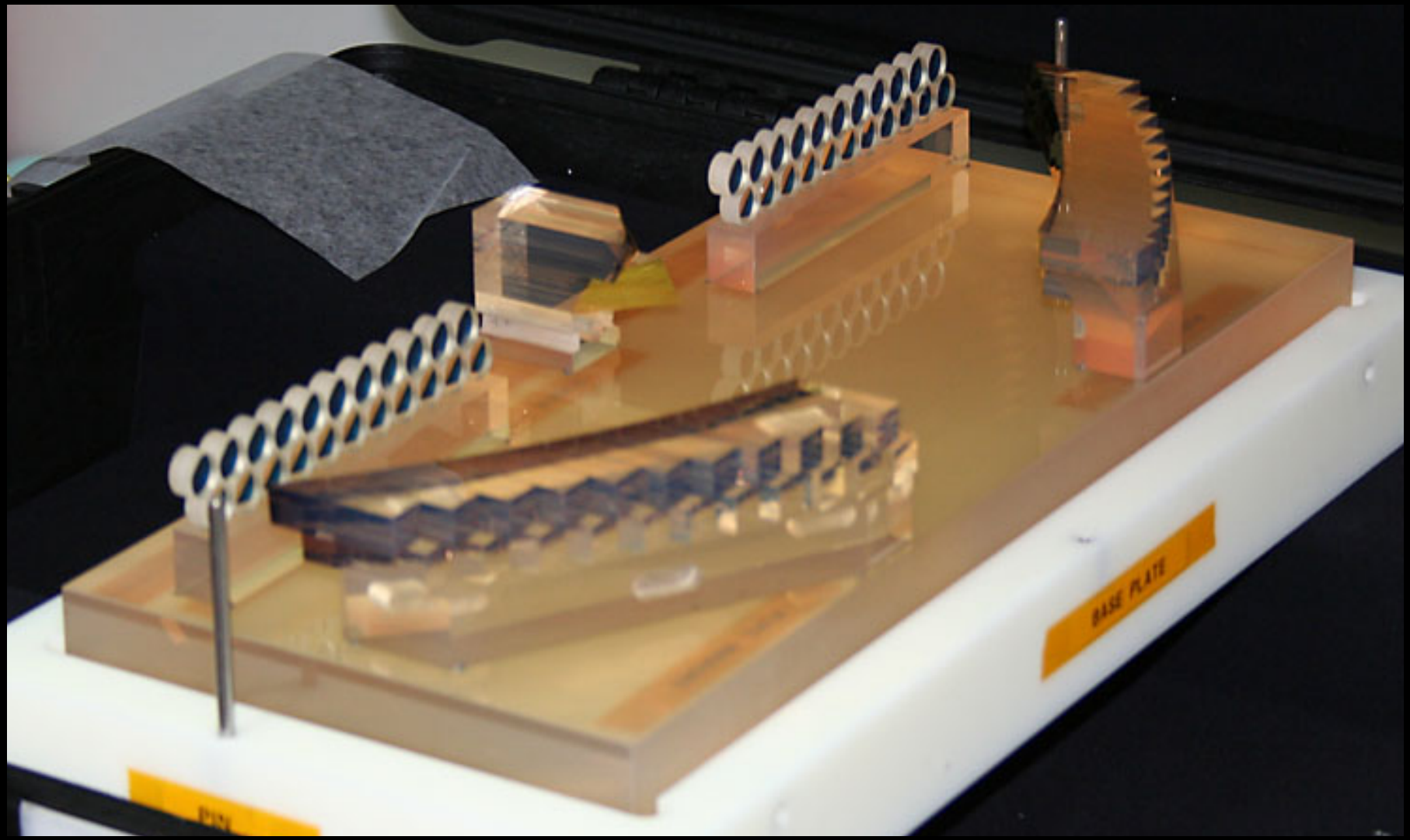
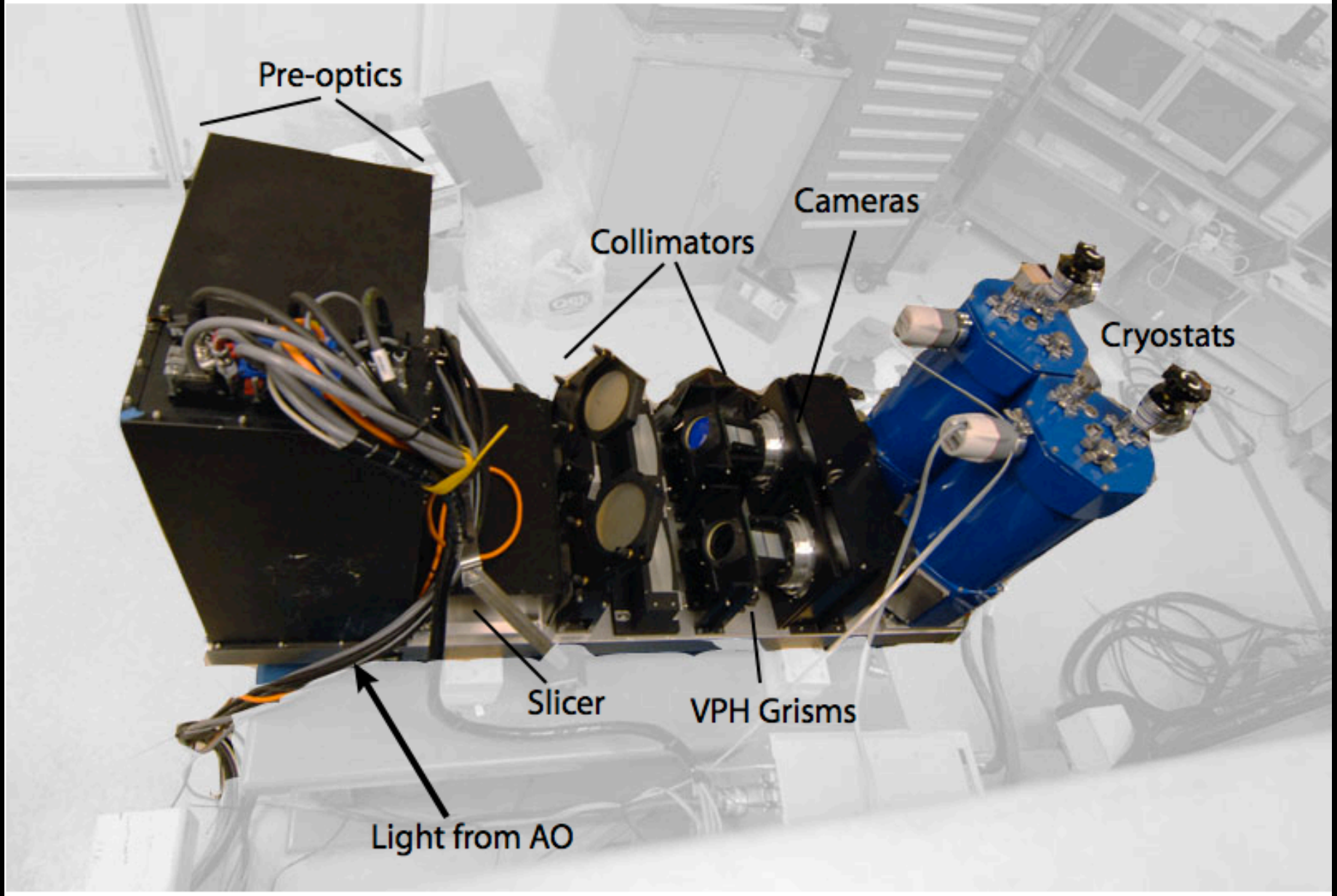
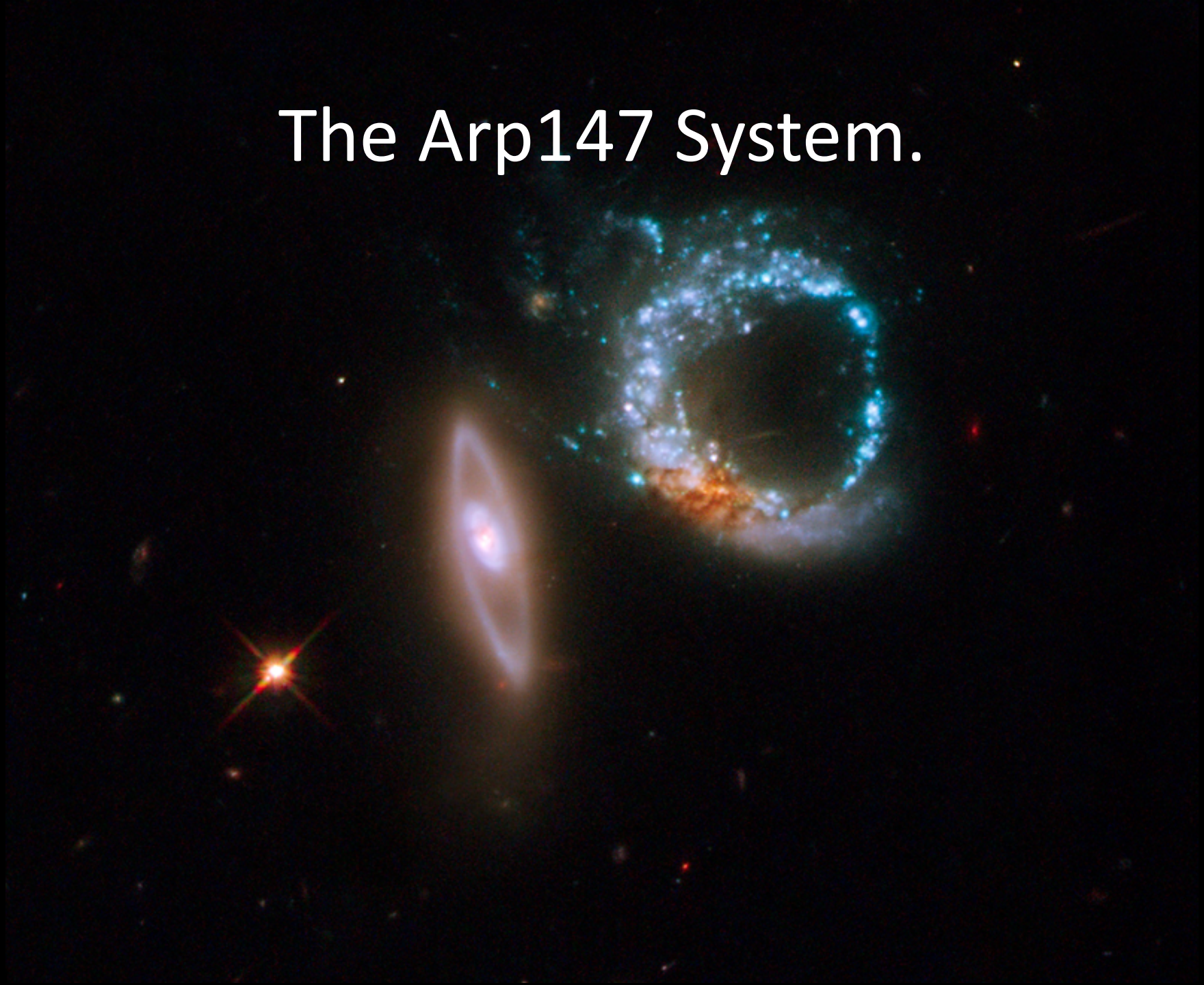
Collaborators: Roger Davies, Ryan Houghton, Nic Scott, Aprajita Verma.

What is SWIFT?

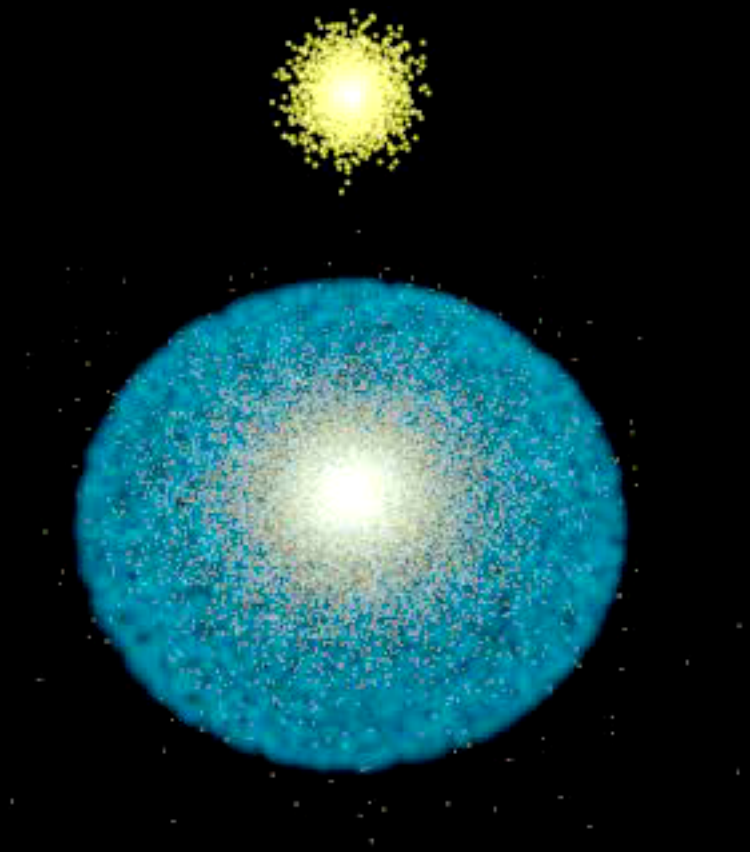



Pre-optics
Collimators
Cameras
Cryostats
Slicer
VPH Grisms
Light from AO

The Arp147 System.



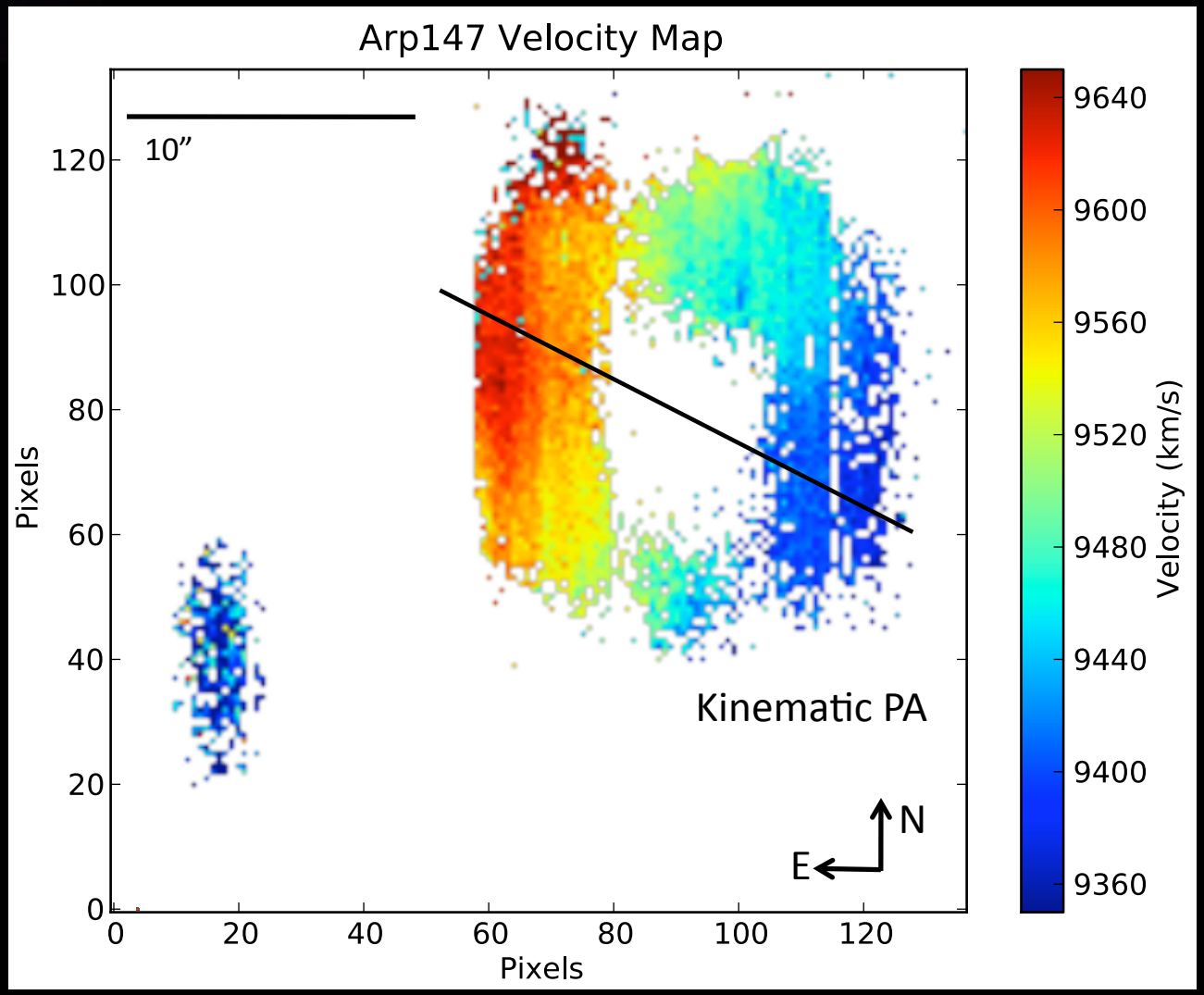
Arp147

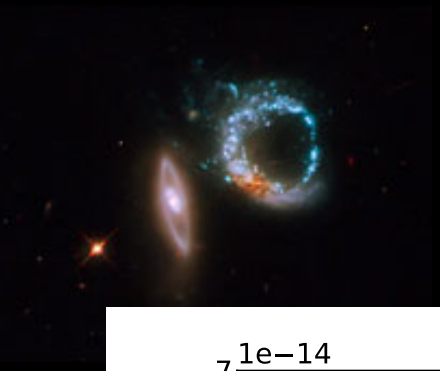


Mihos & Hernquist 1994

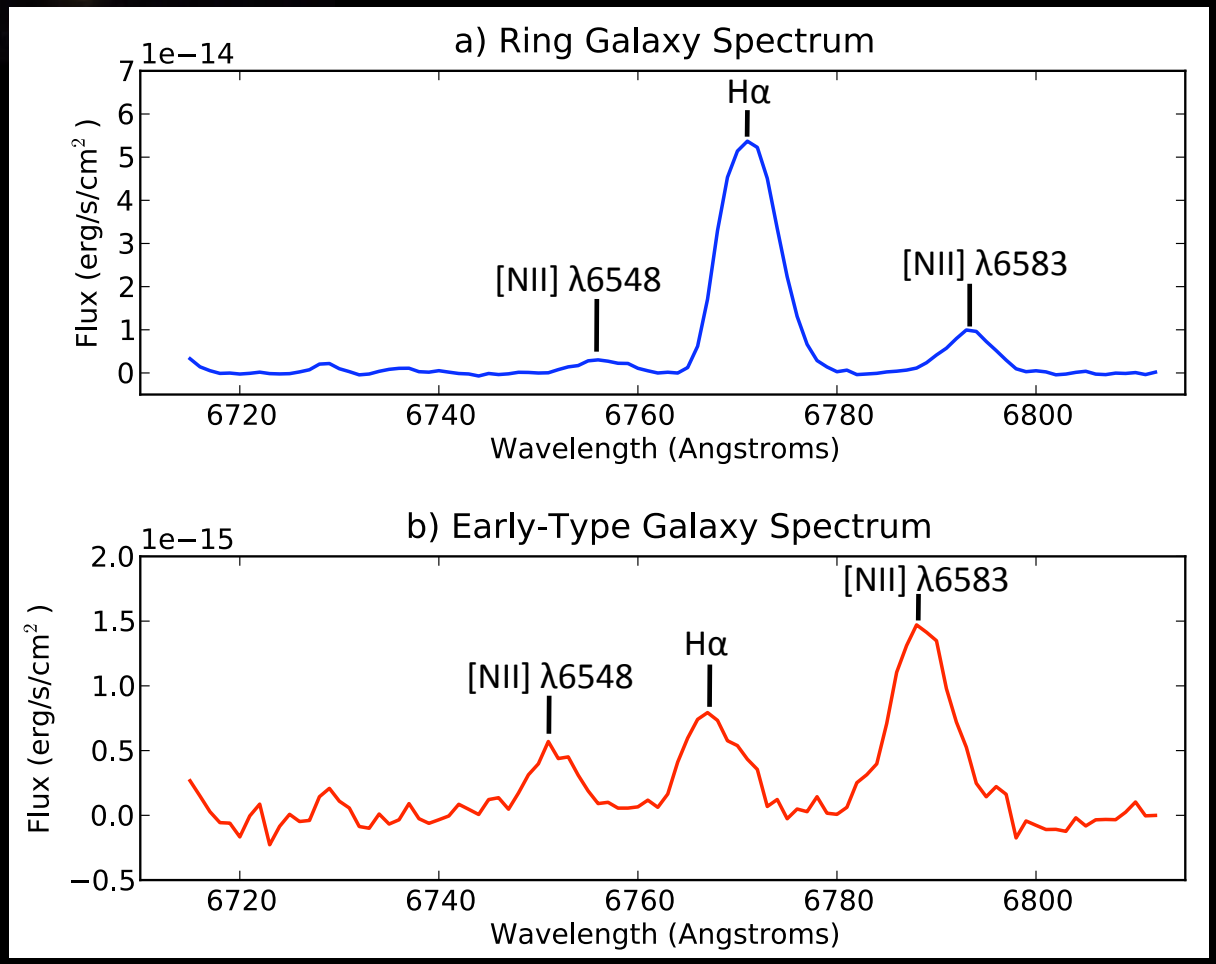
Off-axis collision: Gerber et al. 1992

Arp147


Arp147 Velocity Map
10”
Kinematic PA
N
E
Pixels
Pixels
0
20
40
60
80
100
120
Velocity (km/s)
9640
9600
9560
9520
9480
9440
9400
9360

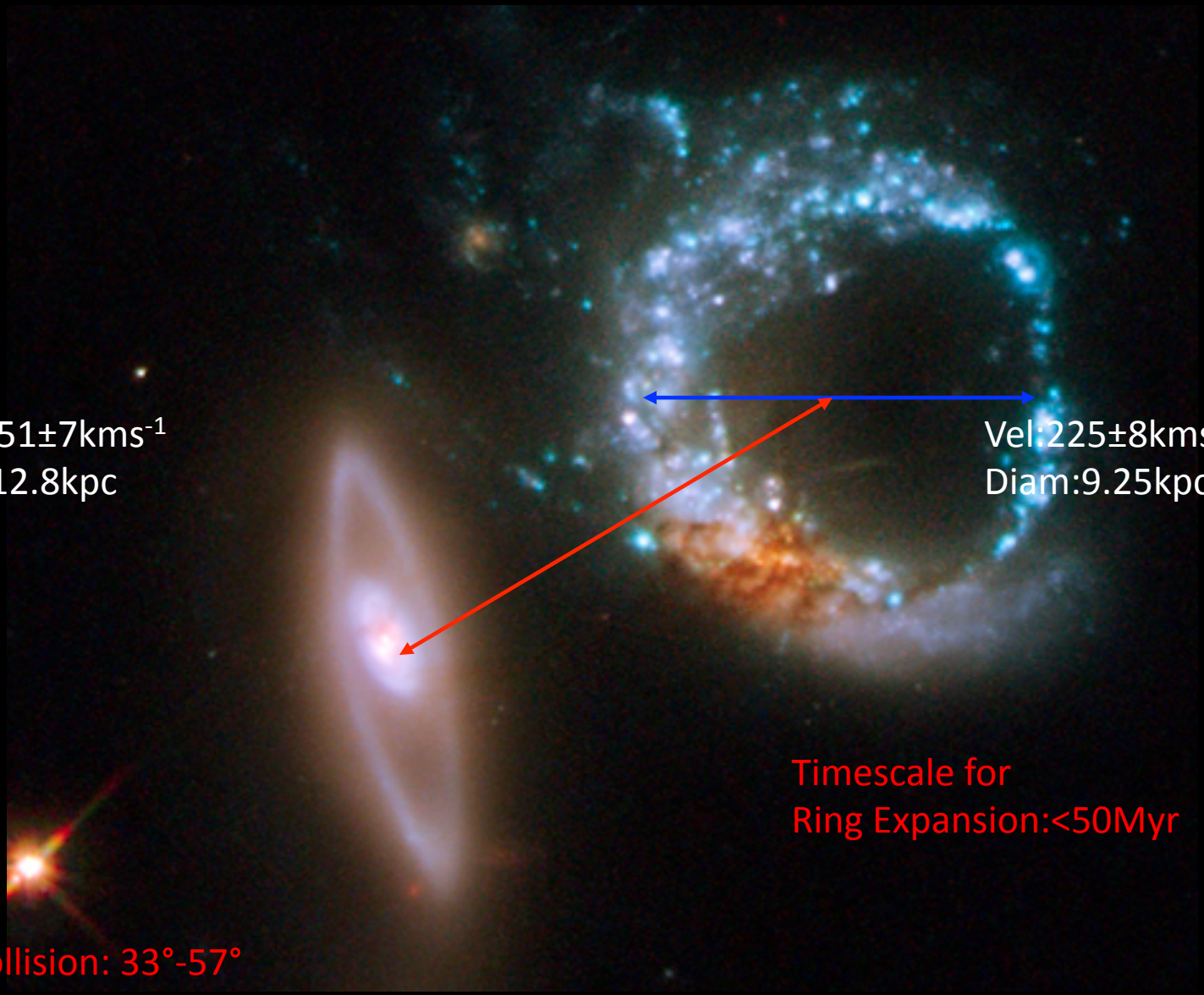


Arp 147



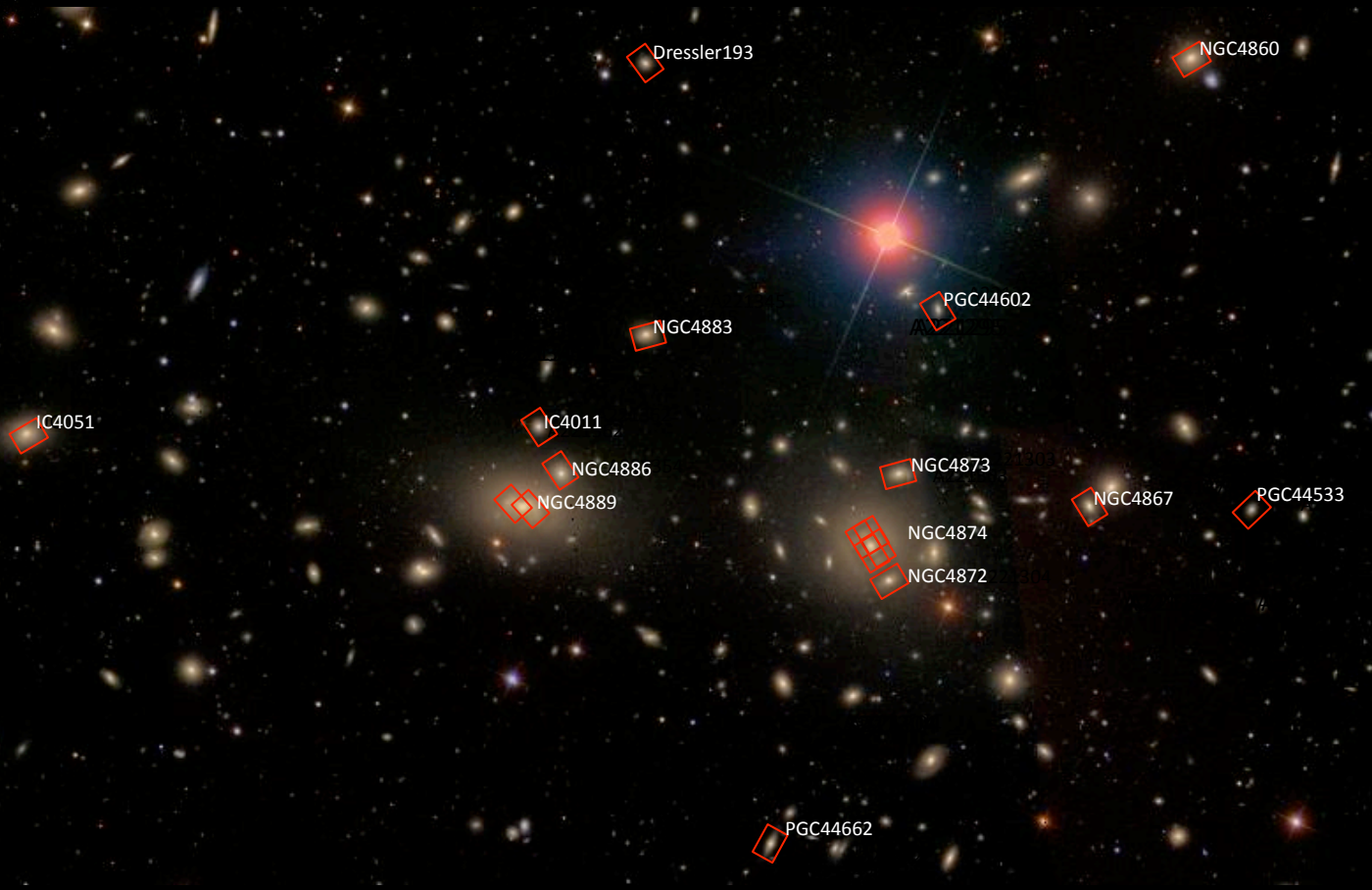
Ring Galaxy SFR:
$6.5M_{\odot}$/yr – 6Myr
ETG SFR:
$0.1M_{\odot}$/yr – 11Myr

Calculated Formation Timescales.



The Coma ETG Sample

- We observed a sample of 14 early-type galaxies in the Coma cluster, selected from the catalogue of Scodeggio+(1998)
- Coma is an ideal target for FP observations, containing many nearby ETGs covering a range of masses, all with a common distance
- Our sample was evenly divided between 7 logarithmic bins in velocity dispersion, covering the range σ=80-400 kms^{-1}
- Galaxies were typically covered out to ~1 R_e, with multiple pointings where necessary

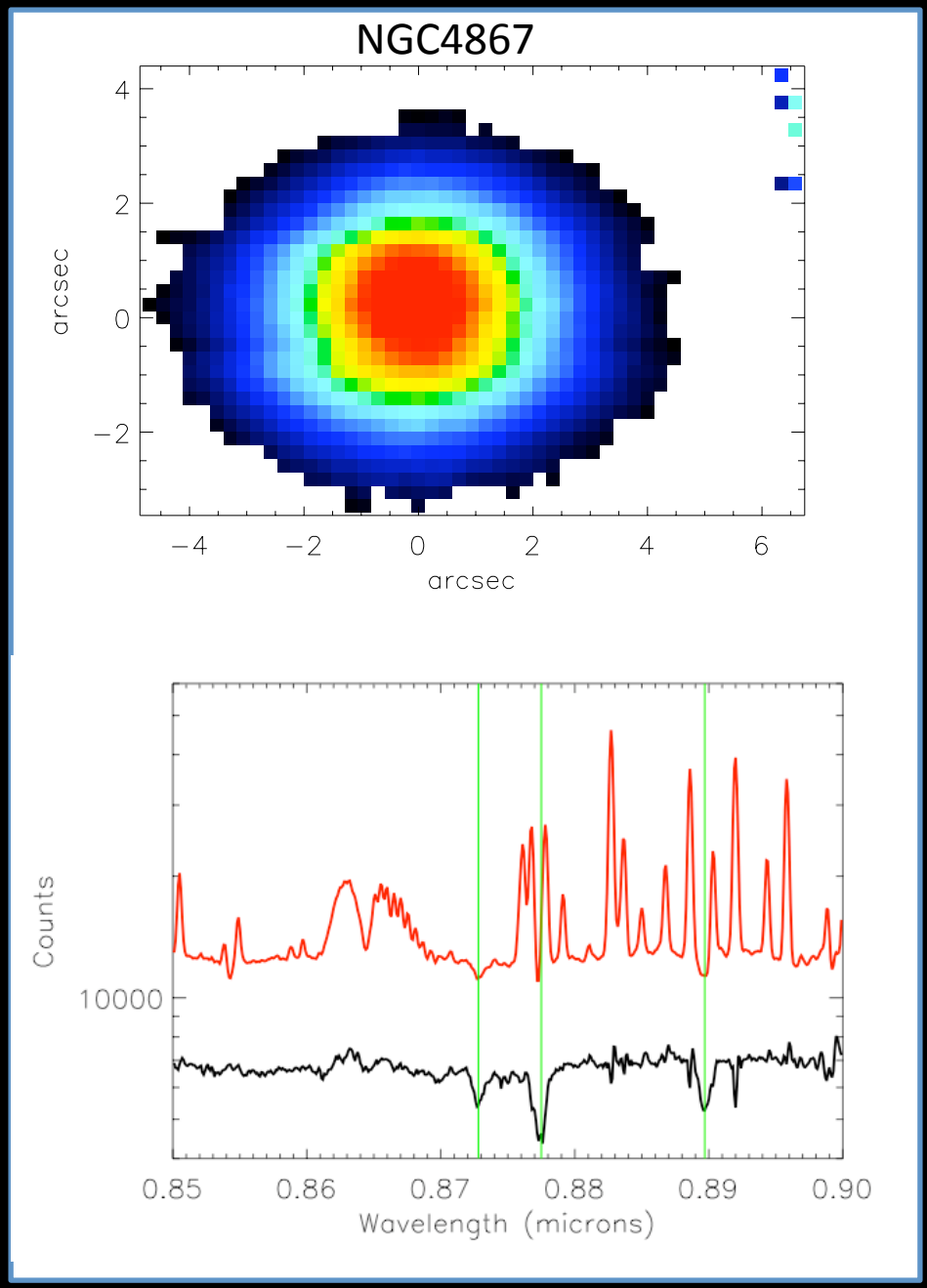


SDSS *gri* image of the Coma cluster

Slides Courtesy of Nic Scott.

SWIFT Observations

- 20 min exposures used to limit impact of cosmic rays
- Exposures stacked to give a S/N ratio ~60 within 1 R_e
- For objects with R_e < 5" a nod-on chip observing strategy was used
- For larger objects separate sky exposures were taken
- For the three largest galaxies with R_e > 20" we constructed a mosaic of each object from multiple pointings
- Data was reduced using the dedicated SWIFT IRAF pipeline (see Ryan Houghton's poster)
- A sophisticated sky subtraction scheme was used, fitting and subtracting the continuum and emission line components of the sky background separately – the sky line flux is ~100 times that in the absorption features so good sky subtraction is essential
- High S/N spectra measured within elliptical apertures of major-axis radius 1 R_e were extracted to measure the FP parameters

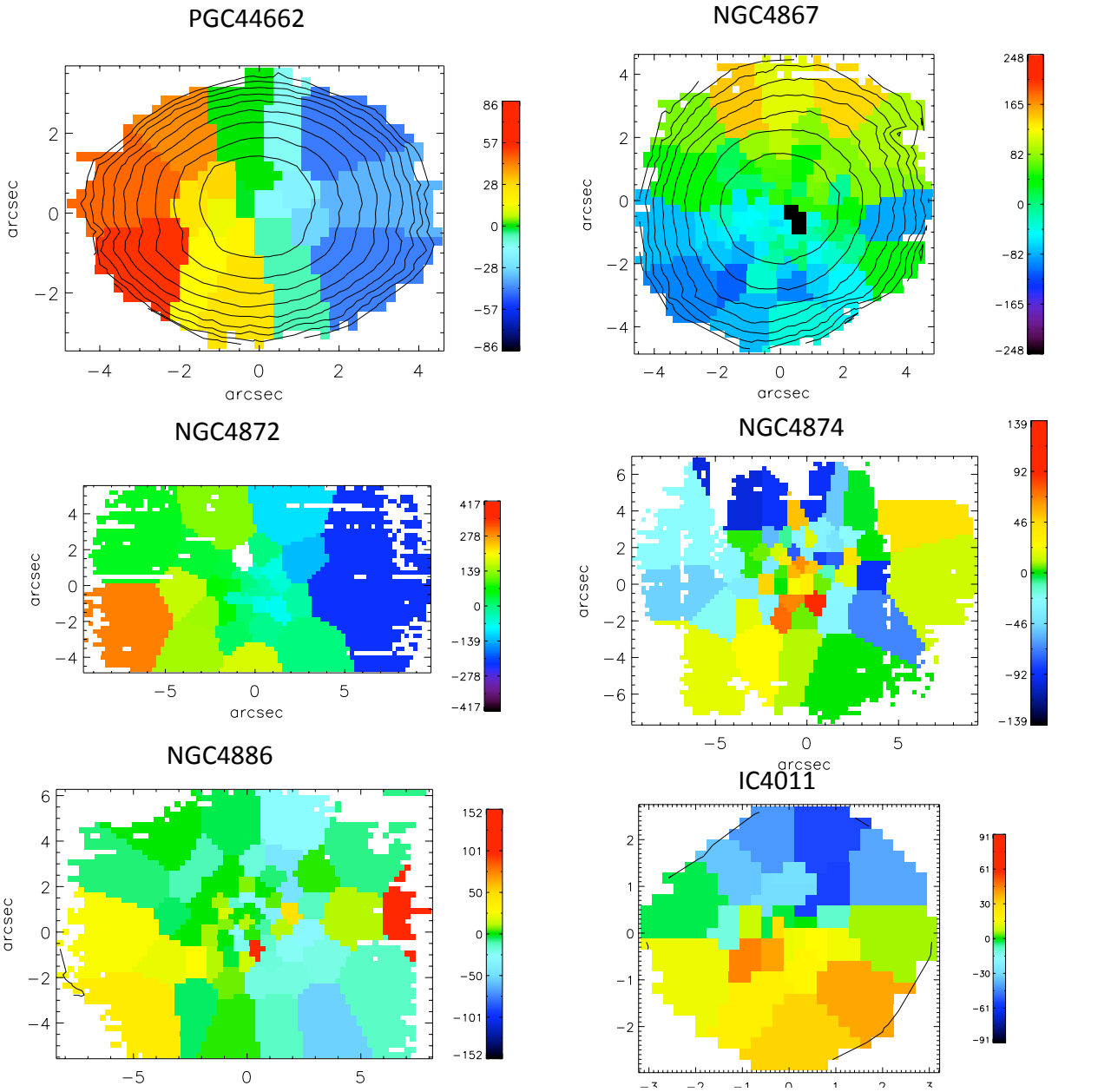


Slides Courtesy of Nic Scott.

Kinematics of Coma ETGs

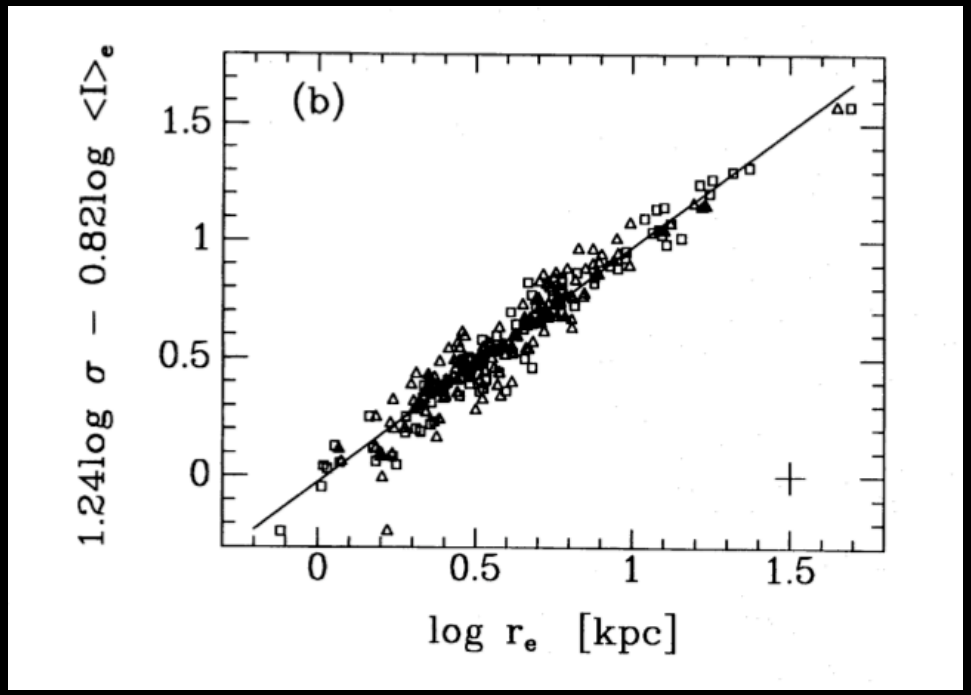
- Voronoi binning (Cappellari & Copin) used to achieve a uniform S/N ~ 40 per spatial bin per Å
- The penalized PiXel Fitting code of Cappellari and Emsellem (pPXF) used to extract galaxy kinematics from the Calcium Triplet
- For each galaxy we constructed maps of the velocity and velocity dispersion
- Quantifying the angular momenta of these galaxies via the λ_R parameter (Emsellem et al.) and measuring the FP parameters is currently ongoing

Slides Courtesy of Nic Scott.



An IFU study of the Fundamental Plane

- The Fundamental Plane (FP) is a key diagnostic of early-type galaxy (ETG) evolution
- The Virial Theorem predicts a tight relationship between the effective radius (R_e), and surface brigthness (I_e) and velocity dispersion (σ_e) within that radius
- To properly measure these quantities we require spatially resolved, 2D spectroscopic data
- The tilt of the observed FP compared to the Virial prediction is a key tool in understanding the dark matter content of ETGs – to accurately quantify this tilt we require IFU observations of a sample of ETGs



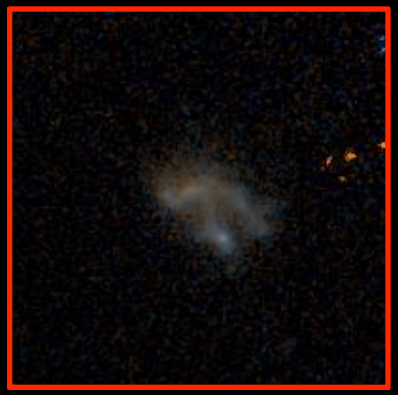
The FP of Jorgensen+96 using long-slit observations of several hundred cluster ETGs

Slides Courtesy of Nic Scott.

High Redshift Galaxy Kinematics

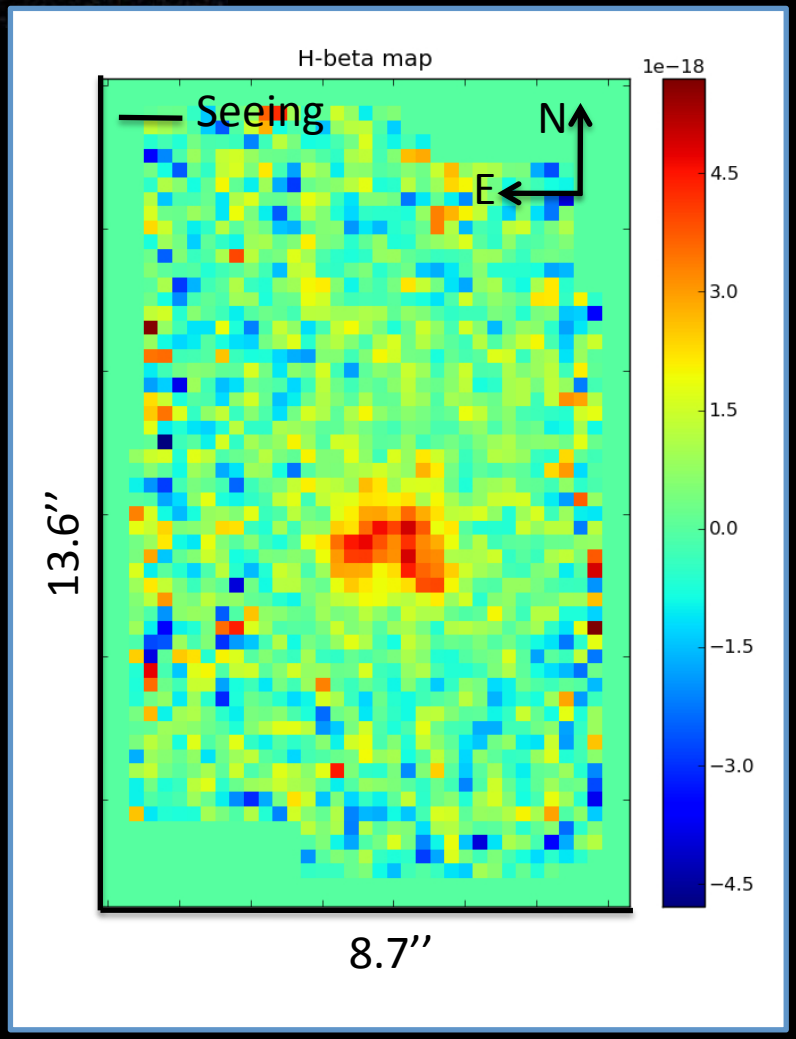
Bulge+Disc
z=0.8
SWIFT Obs:
OII at 6755nm
OIII at 9125nm

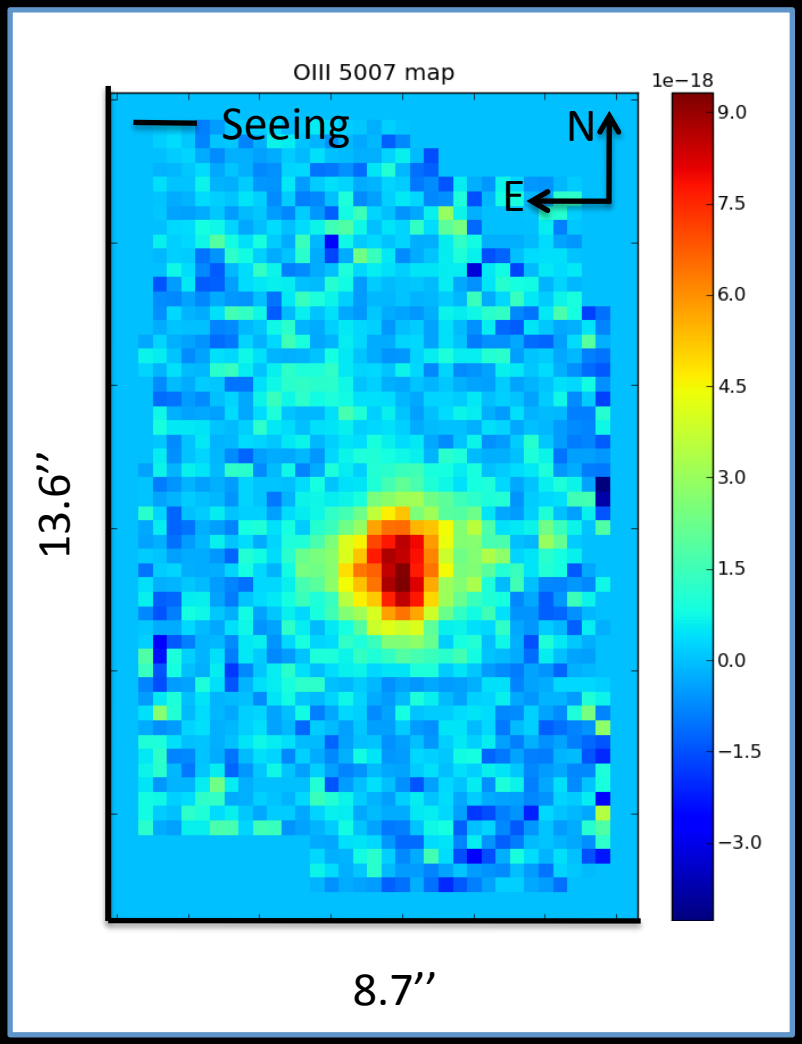
Ring
z=1.16
SWIFT Obs:
OII at 8106nm

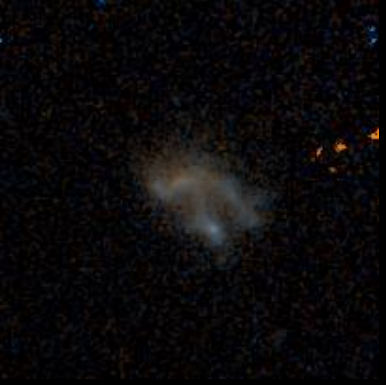


Eagle
z=0.8
SWIFT Obs:
OII at 6592nm
OIII at 8855nm

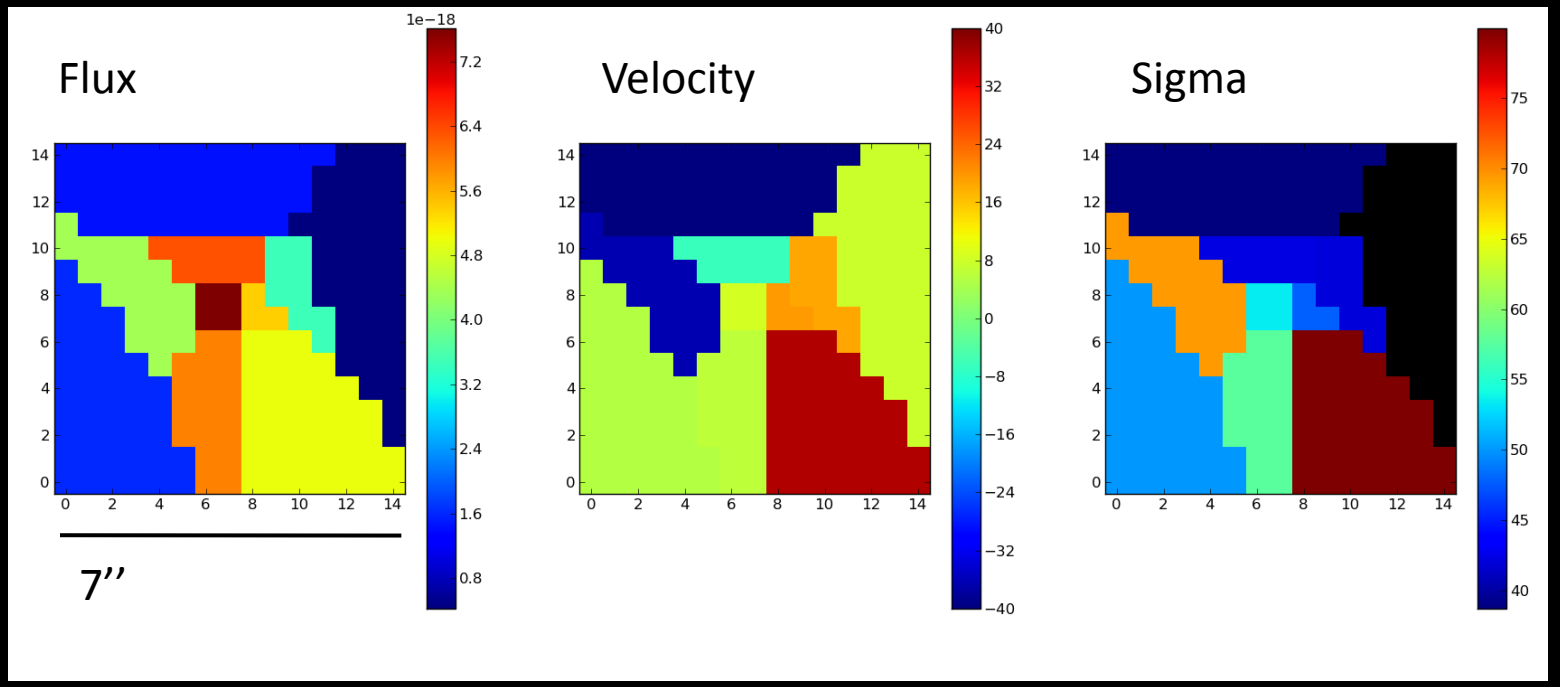
The Eagle


H-beta map
Seeing
N
E
1e−18
4.5
3.0
1.5
0.0
−1.5
−3.0
−4.5
13.6’’
8.7’’


OIII 5007 map
Seeing
N
E
1e−18
9.0
7.5
6.0
4.5
3.0
1.5
0.0
−1.5
−3.0
13.6’’
8.7’’



The Eagle


Flux
1e−18
7.2
6.4
5.6
4.8
4.0
3.2
2.4
1.6
0.8
7’’
Velocity
40
32
24
16
8
0
−8
−16
−24
−32
−40
Sigma
75
70
65
60
55
50
45
40

Conclusion

- SWIFT – many and varied science cases.
- IFU data very valuable for its 3D nature.
- The future is bright!

Questions.

Science Cases.

- Arp147
- Coma
- Eagle (high-z)
- Aprajita's Lens?
- Mention Ly-alpha?

Coma Text

- Veronoi binning (Cappellari & Copin ??) used to achieve a uniform S/N ~ 40 per spatial bin per Å
- The penalized PiXel Fitting code of Cappellari and Emsellem (??, pPXF) used to extract galaxy kinematics from the Calcium Triplet
- For each galaxy we constructed maps of the velocity and velocity dispersion
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Coma Cluster Science

- The sample