University of Durham

M82:

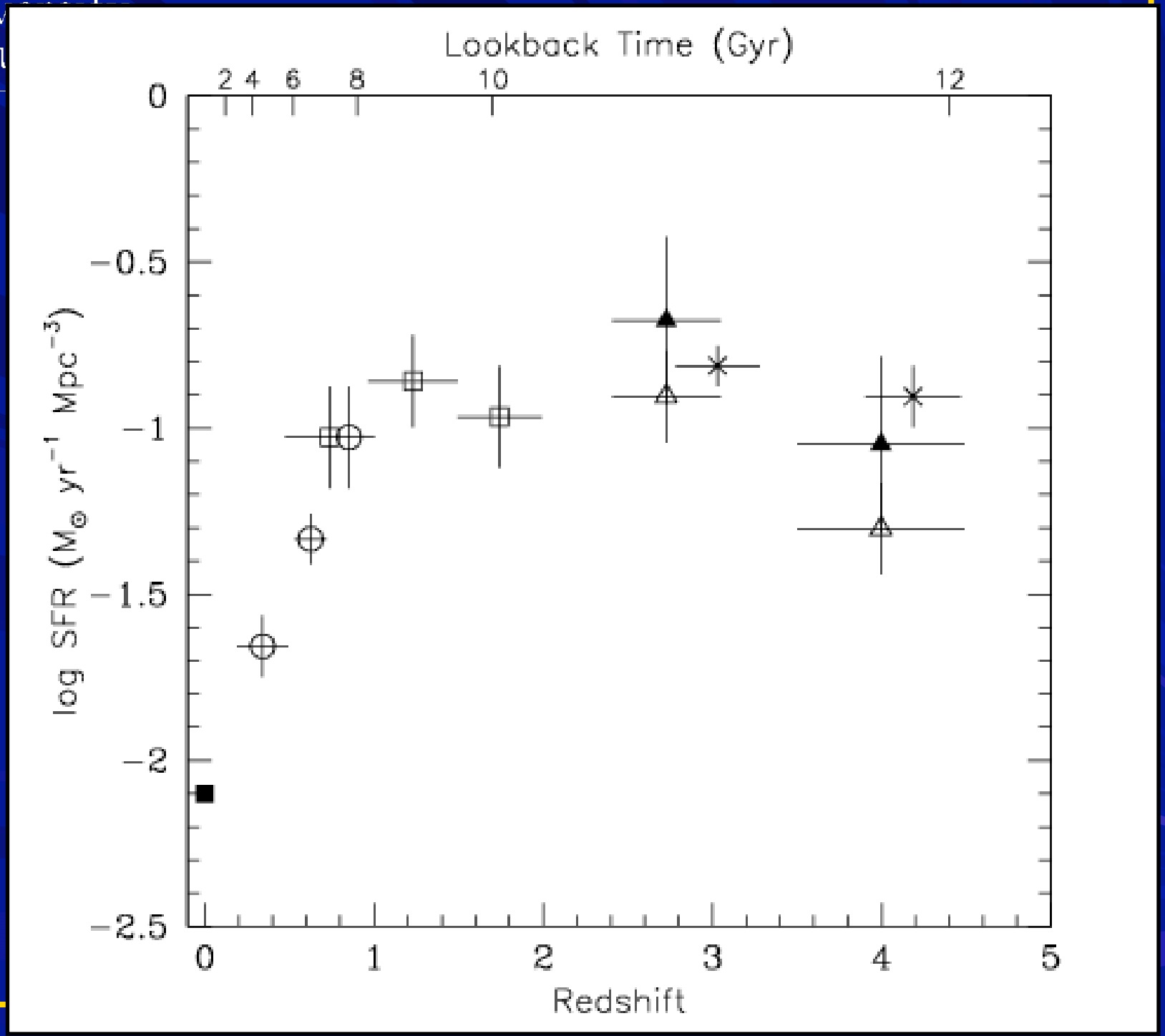
Blue disk-like spiral galaxy
v_{rot} = 100km/s

Outflow:
Extent of filaments: upto 11kpc

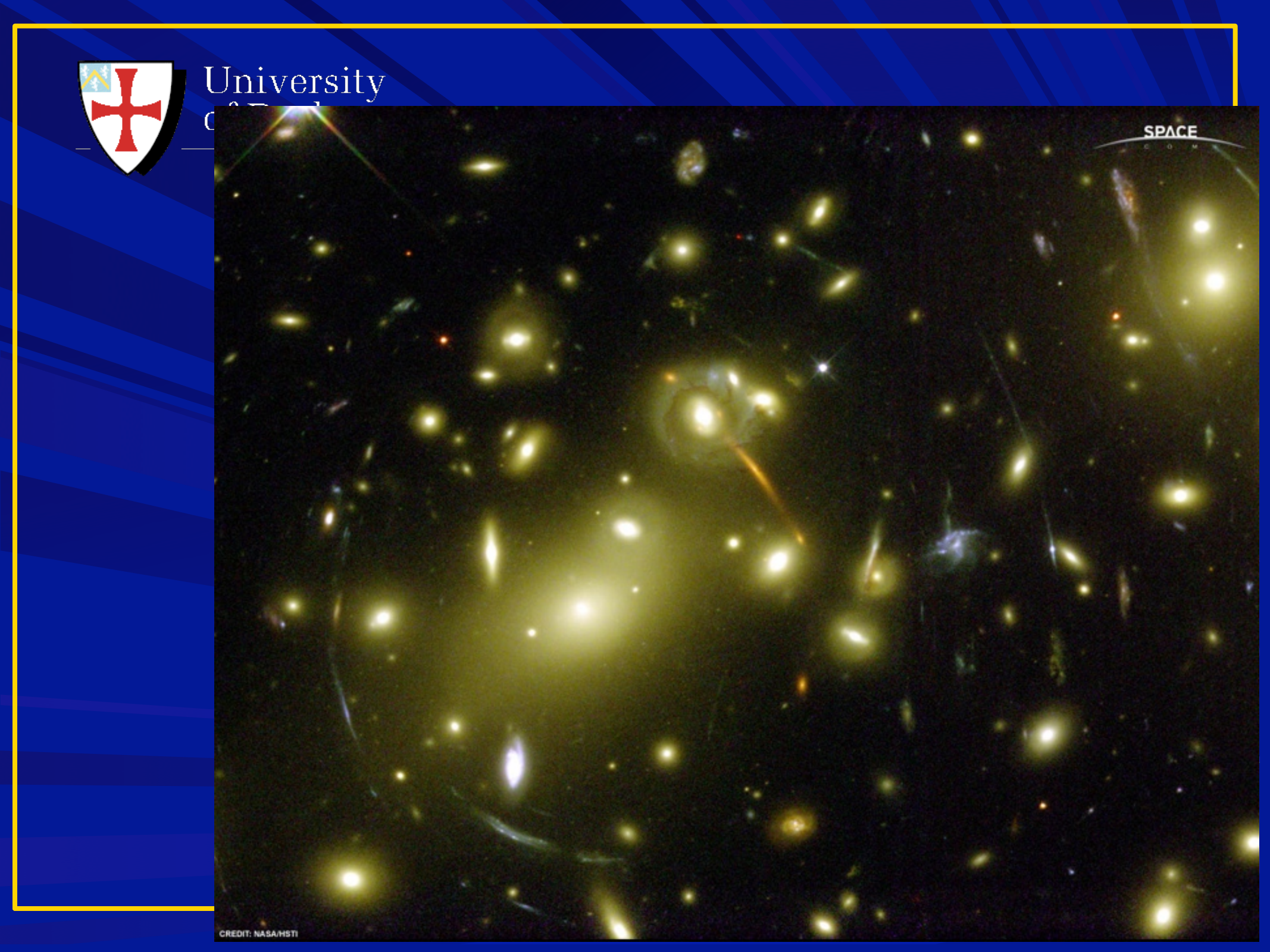
Velocity of flow: 600km/s

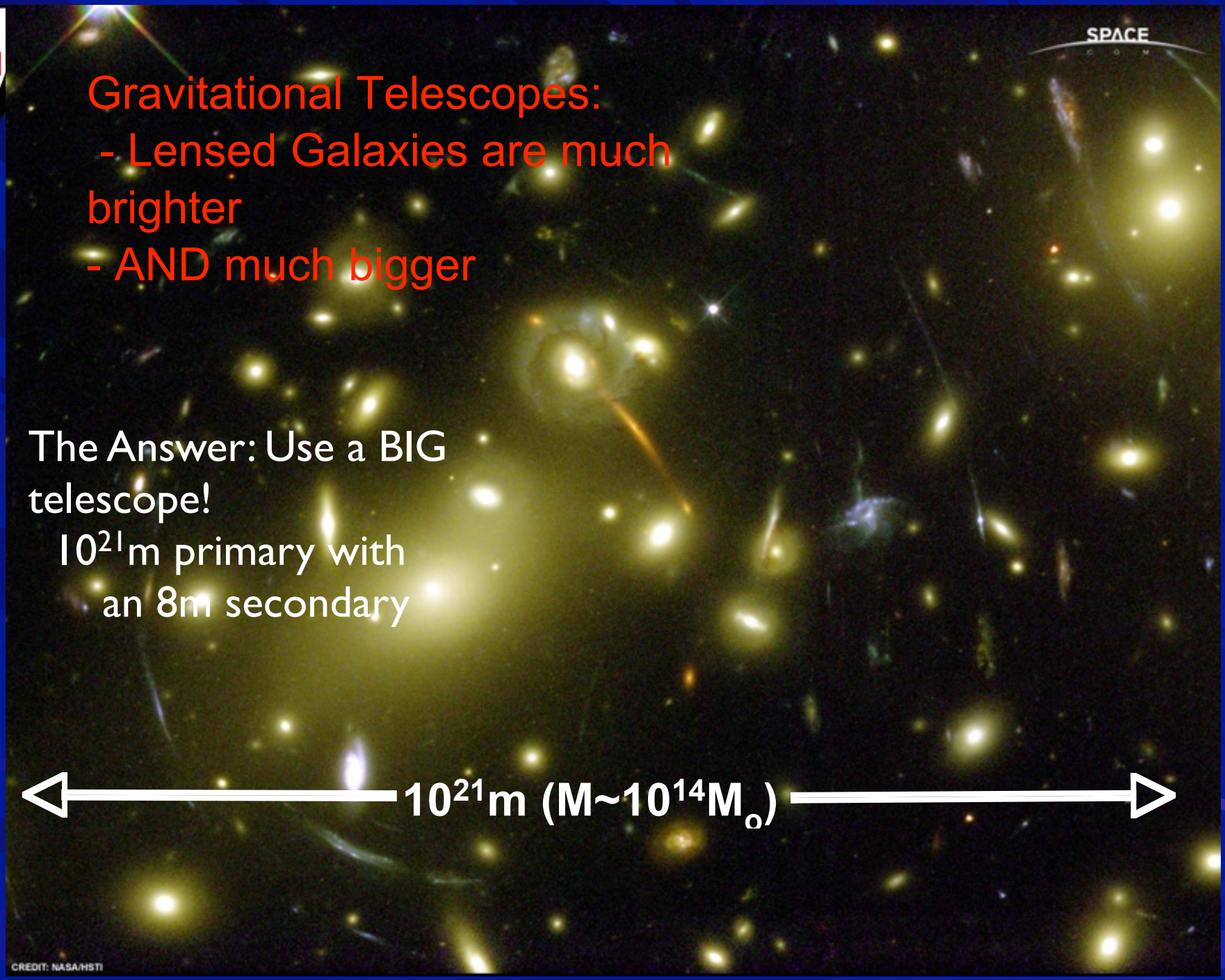
Geometry: Limb brightened cone

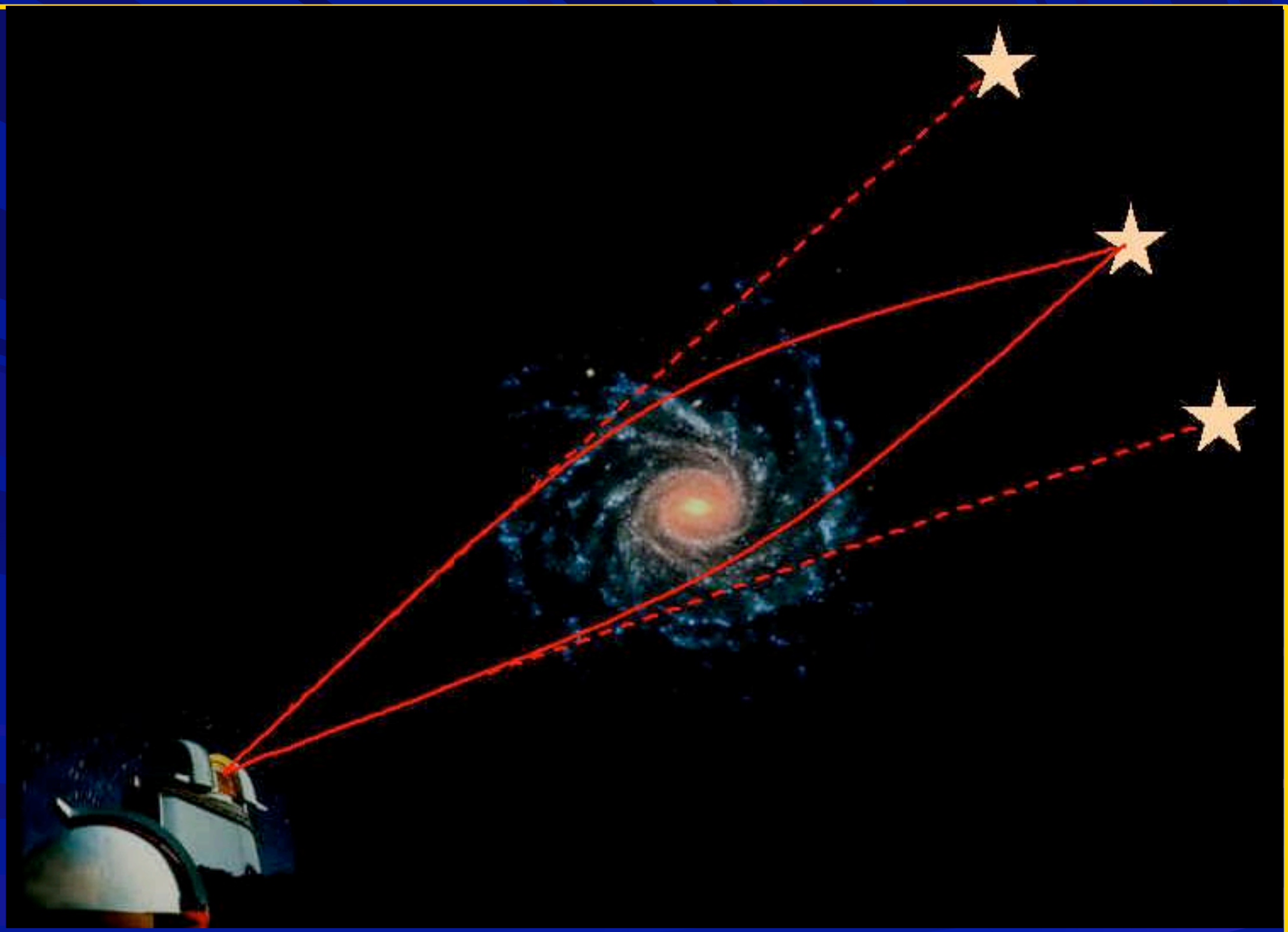
$M'_{wind} \sim M'_{*}$

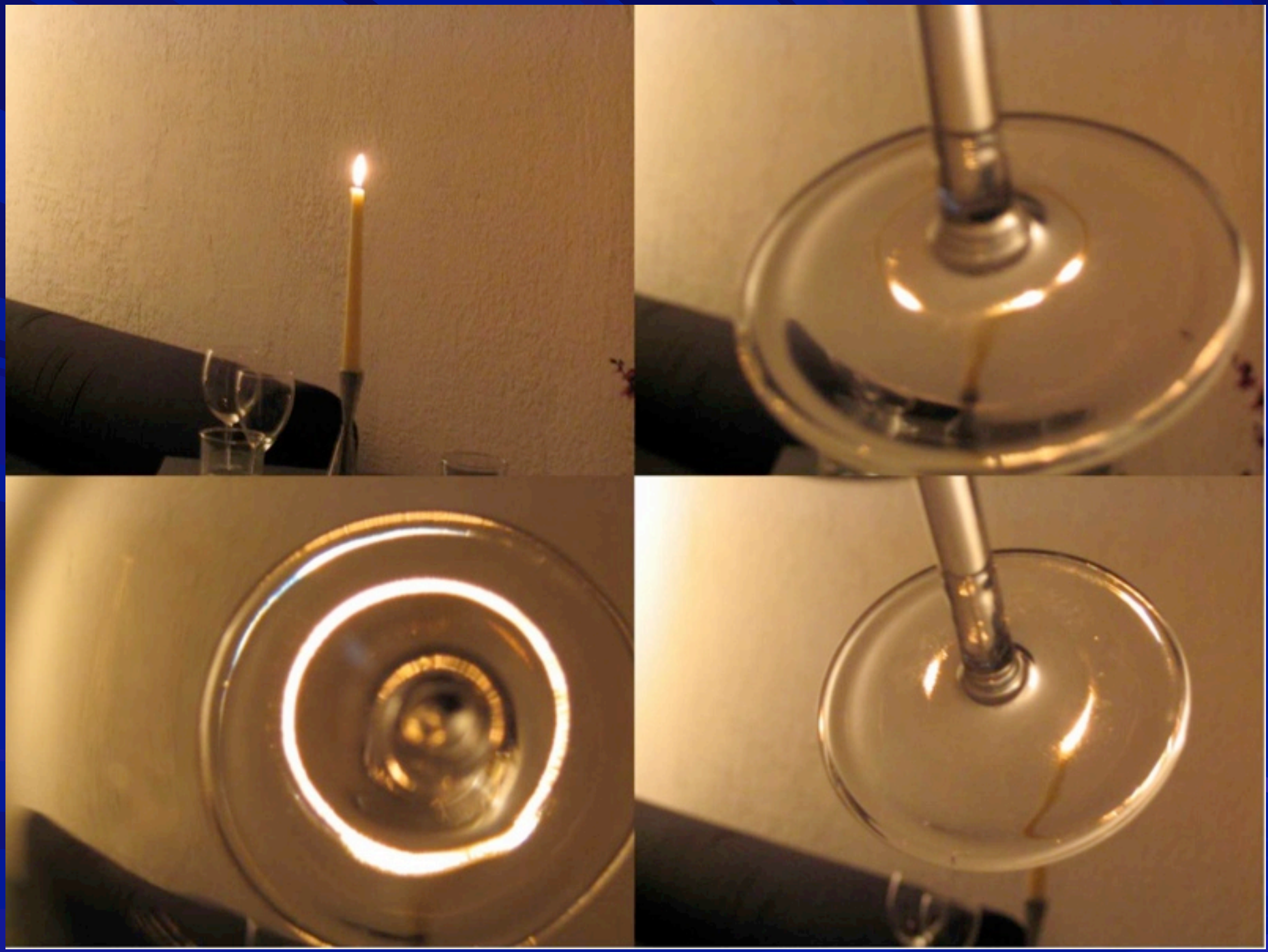

Lookback Time (Gyr)
2
4
6
8
10
12
0
−0.5
−1
−1.5
−2
−2.5
log SFR ($M_\odot$ yr^{-1} Mpc^{-3})
0
1
2
3
4
5
Redshift

0.8” corresponds to 7kpc at z=2
so M82 subtents ~0.2” (4 HST/ACS pixels)

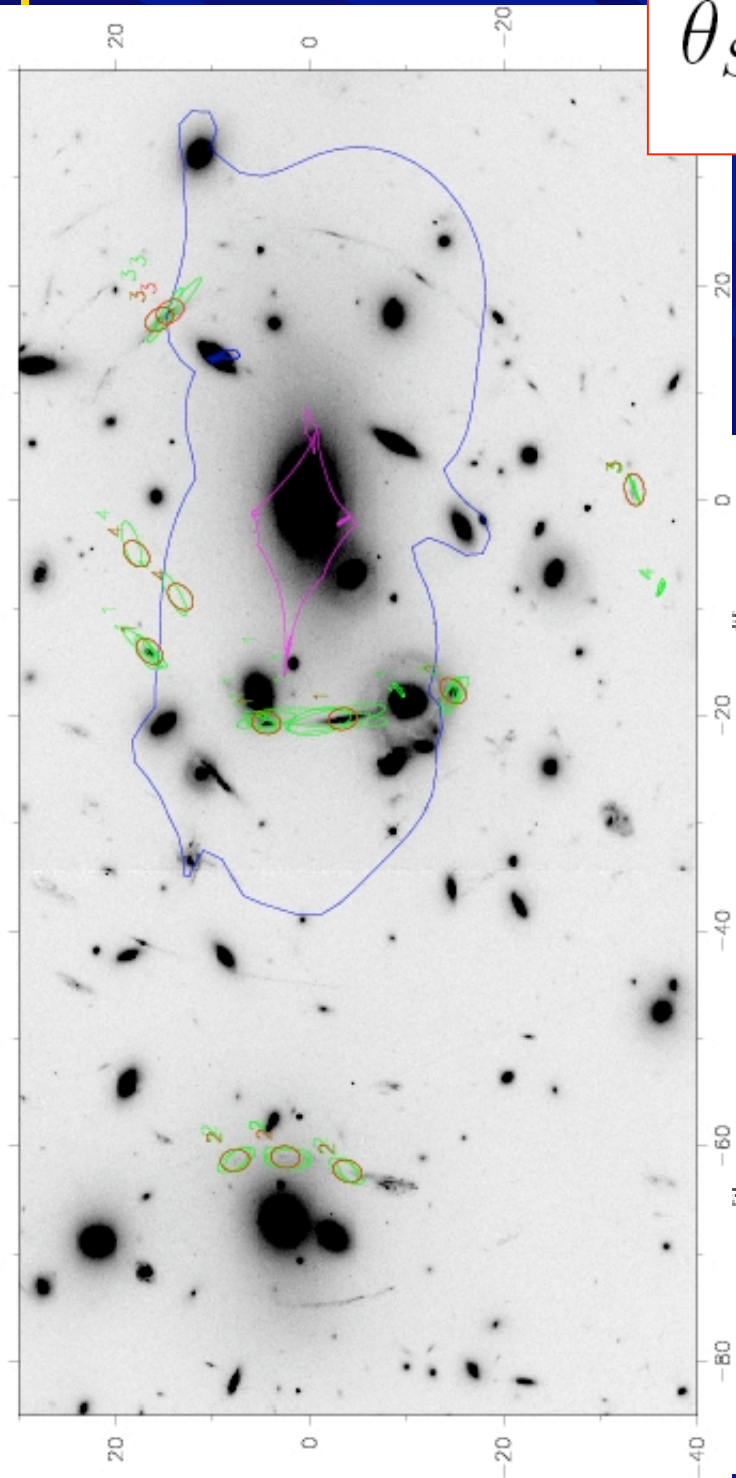

SPACE
CREDIT: NASA/HSTI

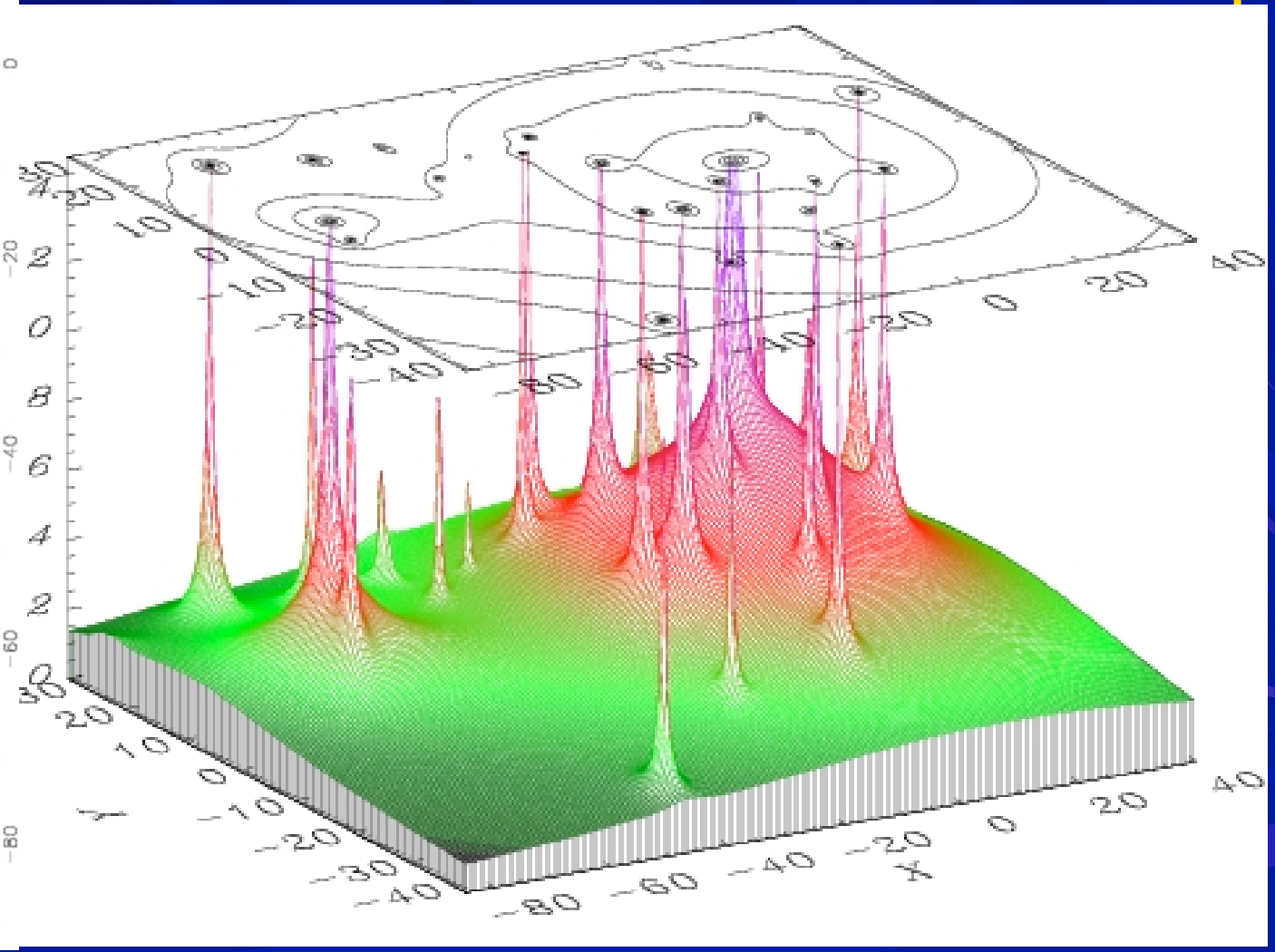

Gravitational Telescopes:
- Lensed Galaxies are much brighter
- AND much bigger
The Answer: Use a BIG telescope!
10^{21}m primary with an 8m secondary
10^{21}m (M~$10^{14}M_o$)
SPACE
CREDIT: NASA/HSTI





$$\vec{\theta}_S = \vec{\theta}_I - \frac{2D}{c^2}\vec{\nabla}\phi_N^{2D}(\vec{\theta}_I) = \vec{\theta}_I - \vec{\nabla}\varphi(\vec{\theta}_I)$$



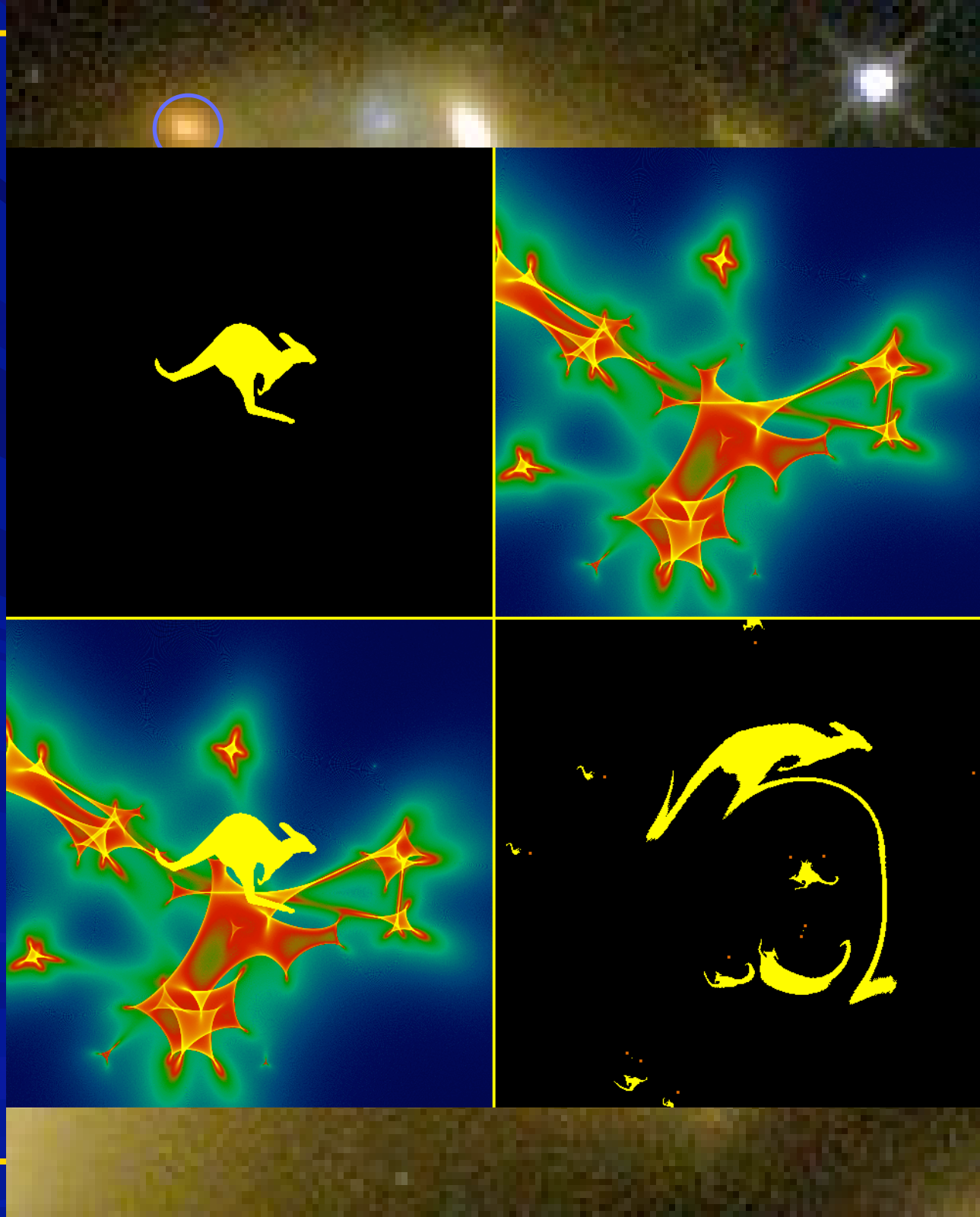


University of Durham

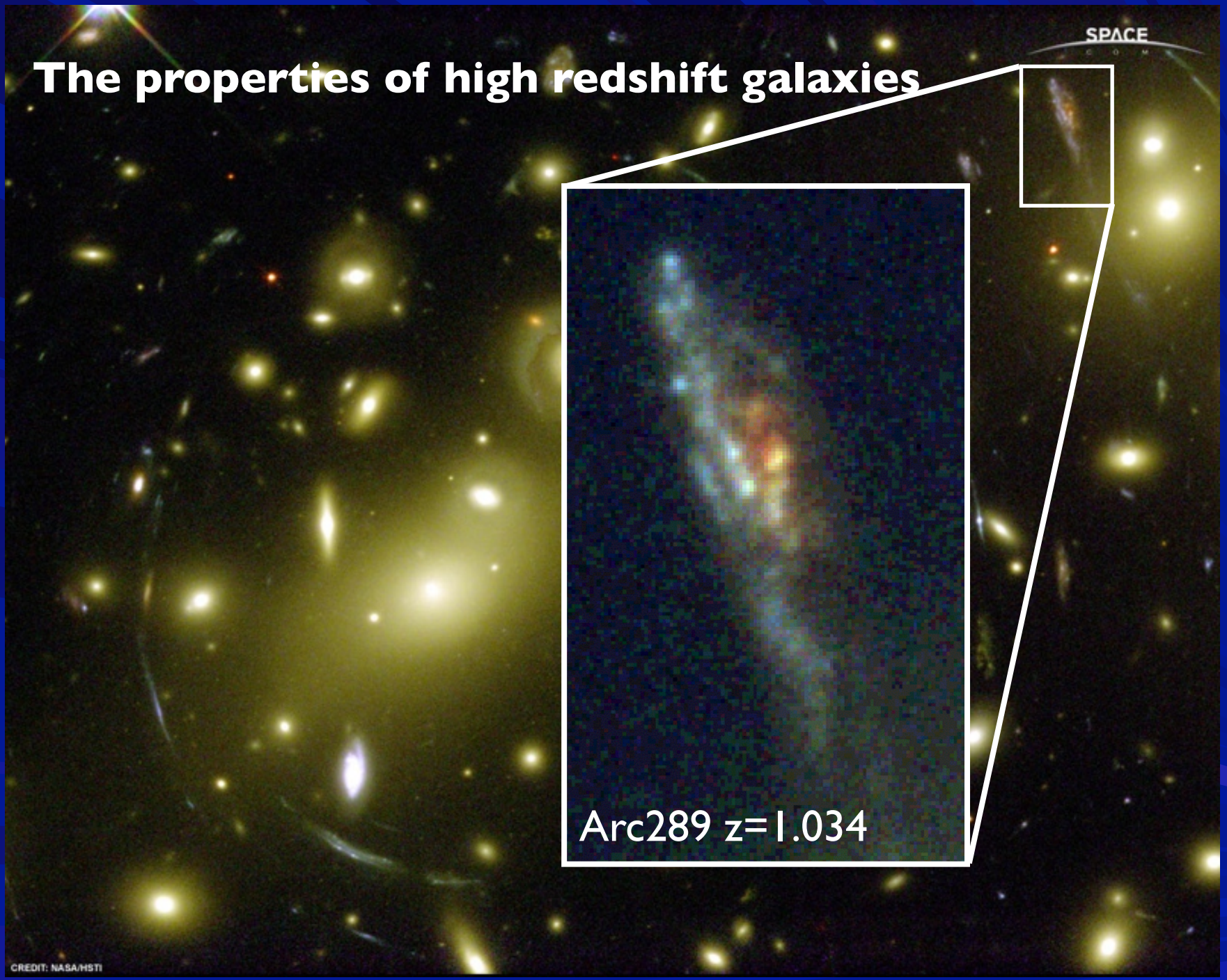
Strong Galaxy-Galaxy Lensing in Cluster

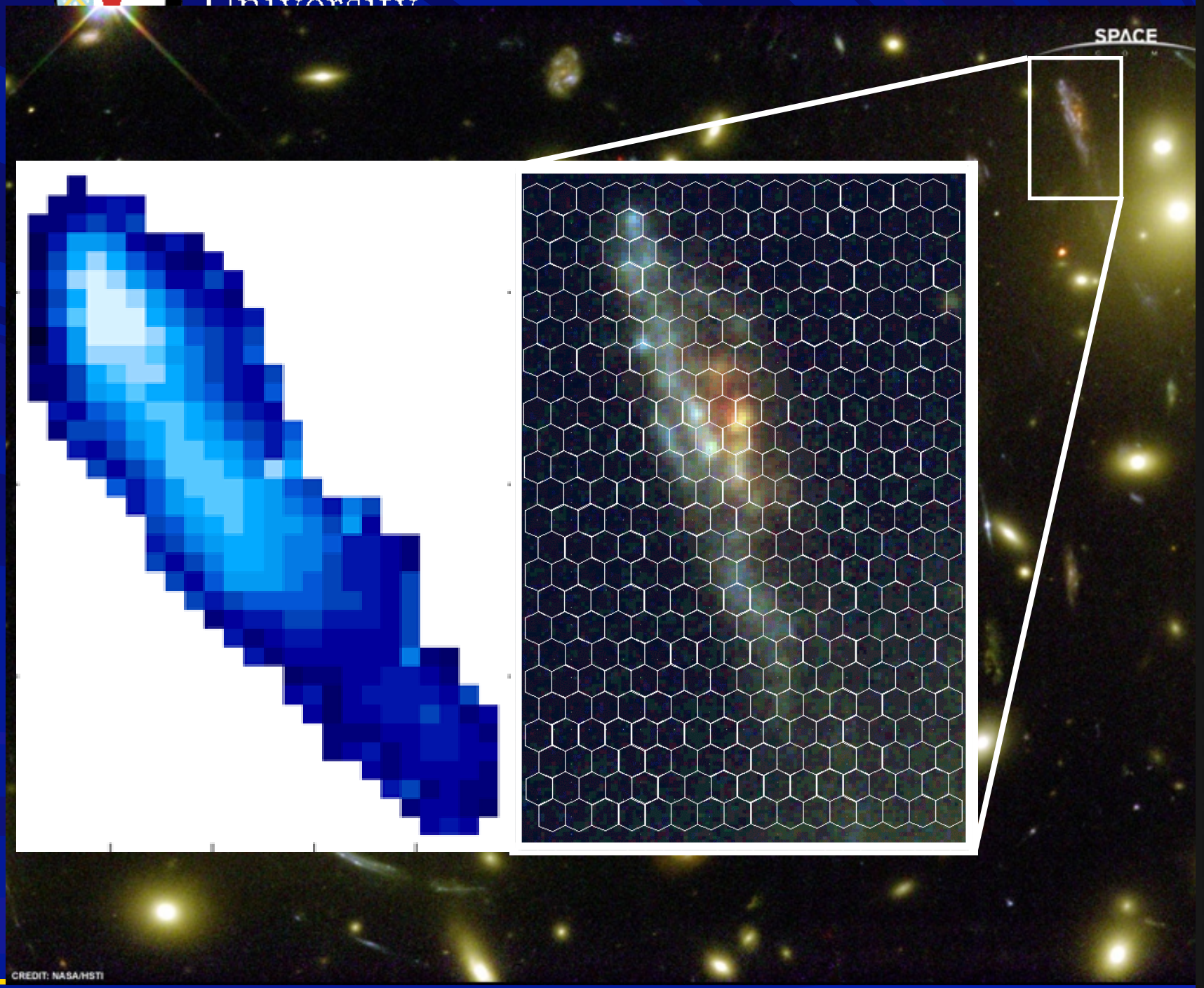
Cluster Galaxies are breaking arcs into smaller ones, adding new images of the lensed galaxy.

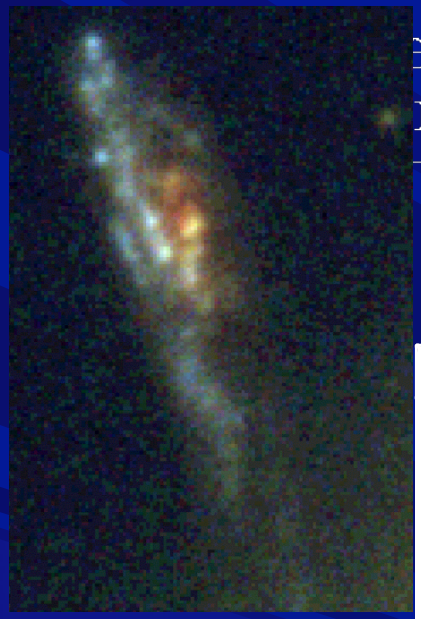
Abell 2218, arc at z=0.702, with 8 images identified (the arc is the merging of 2 images)



The properties of high redshift galaxies

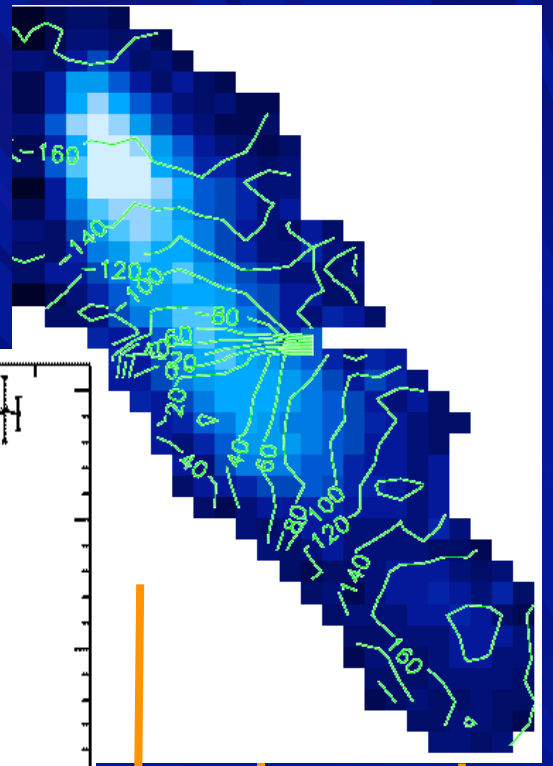



SPACE
CREDIT: NASA/HSTI

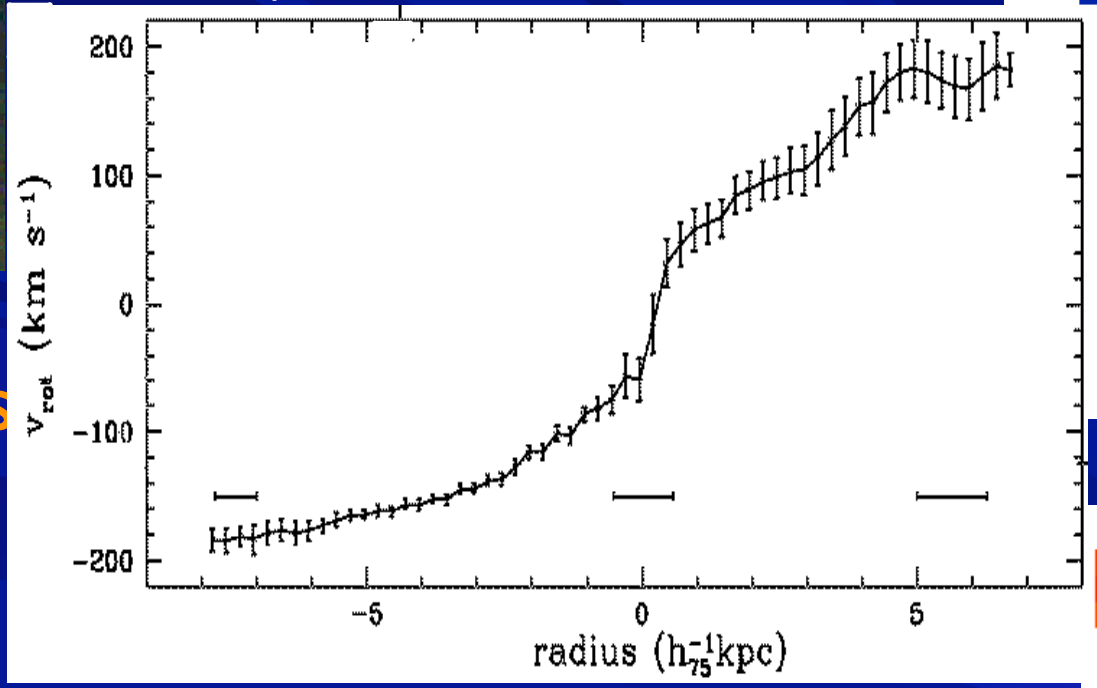


ersity
rham

the "3D" view

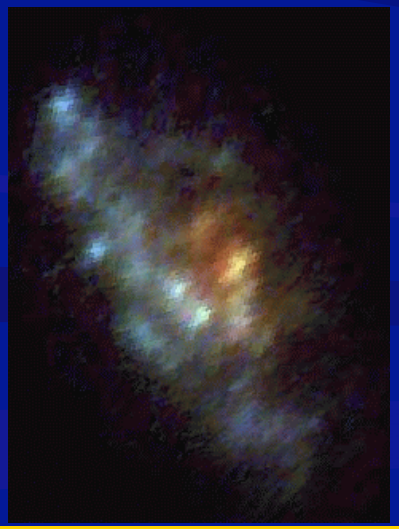


Probably the best z=1 rotation curve in the world!

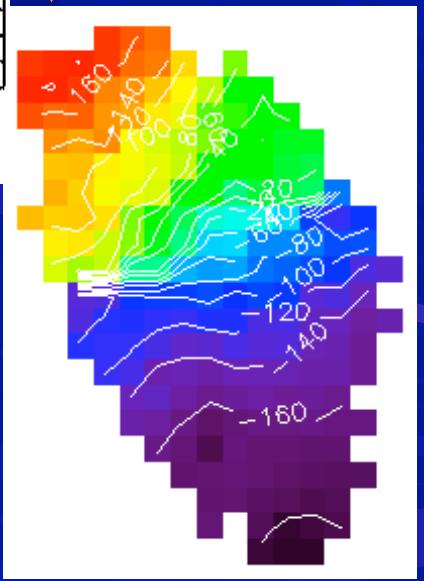


unlens

unlensed

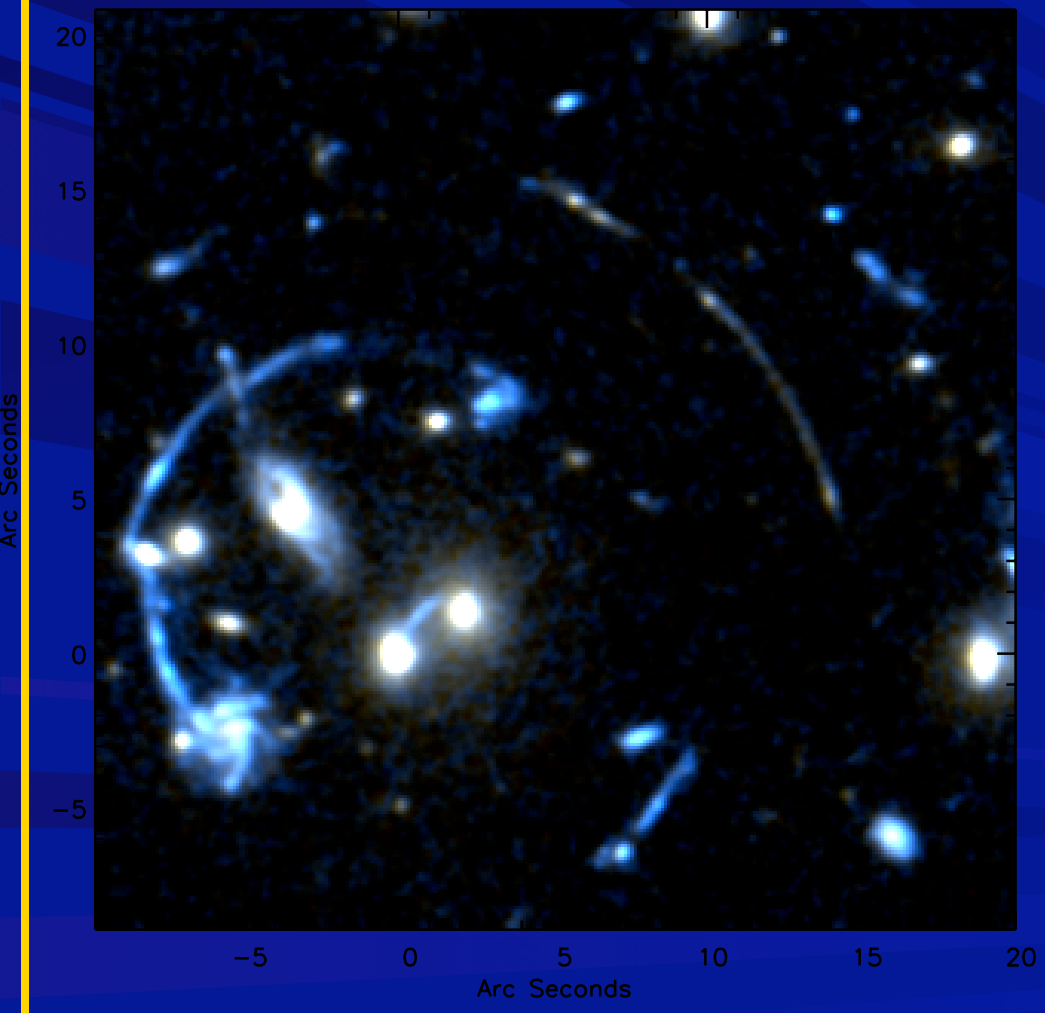


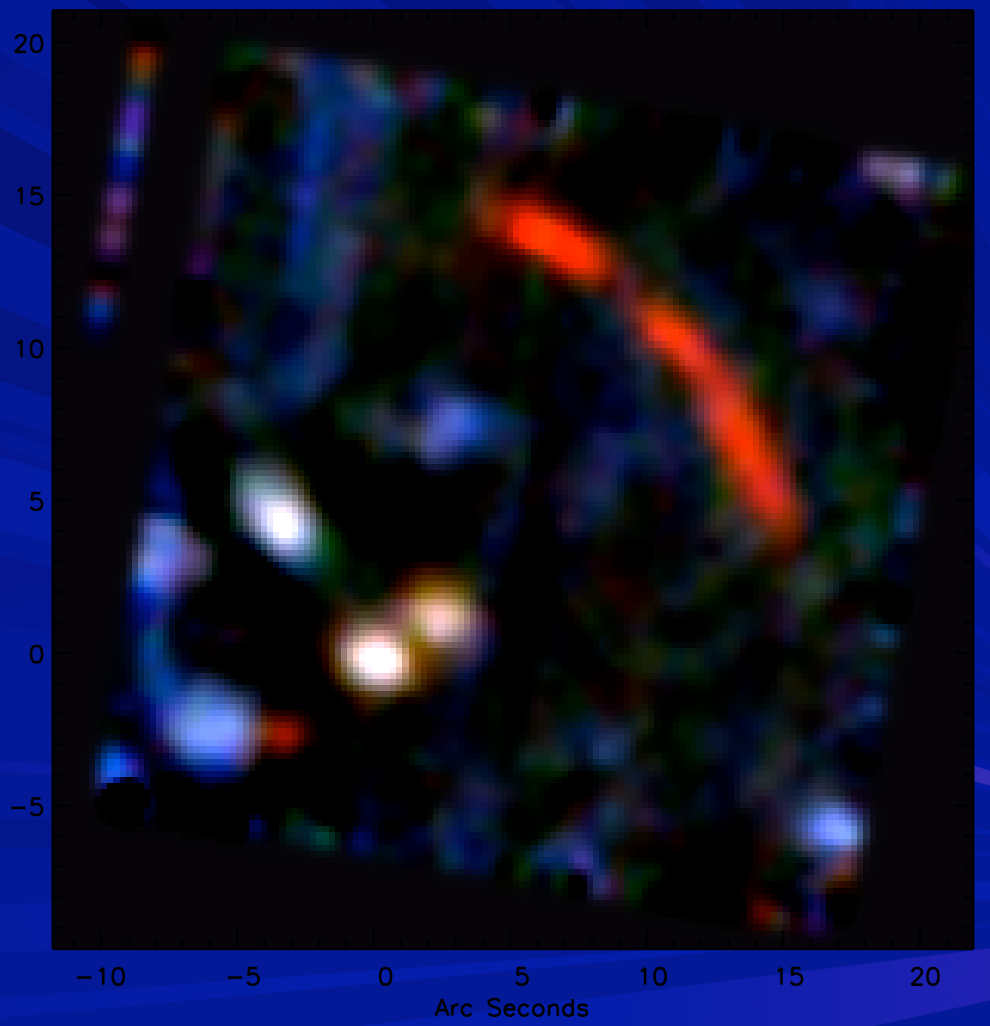
the "3D" view

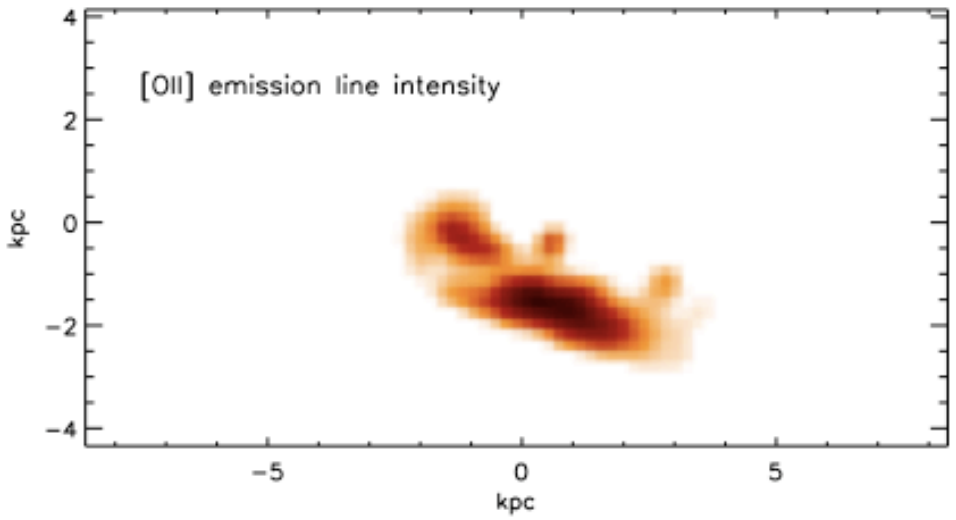


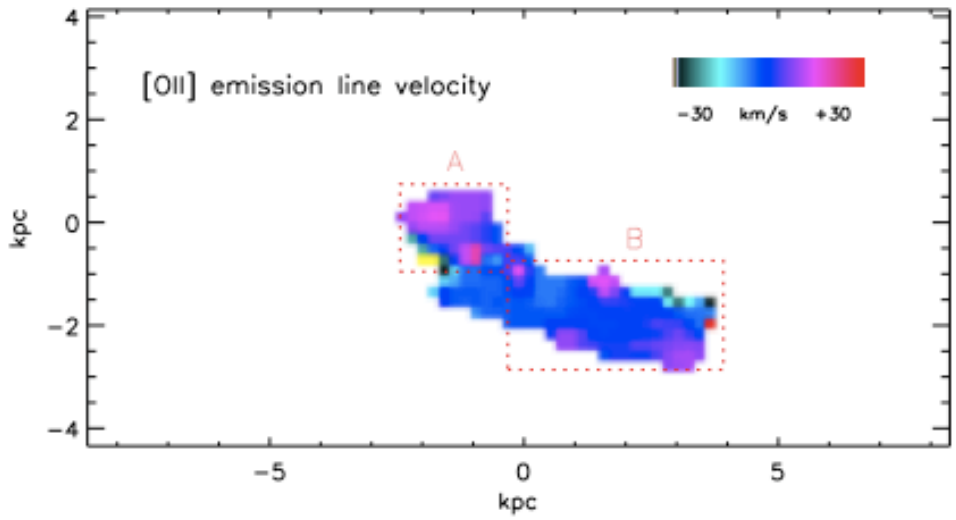
University of Durham

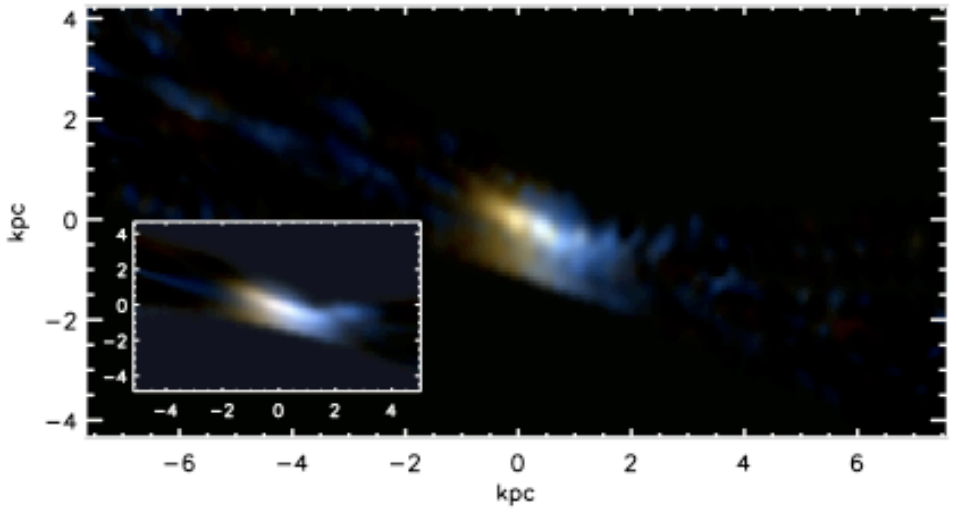
The highest redshift galaxies

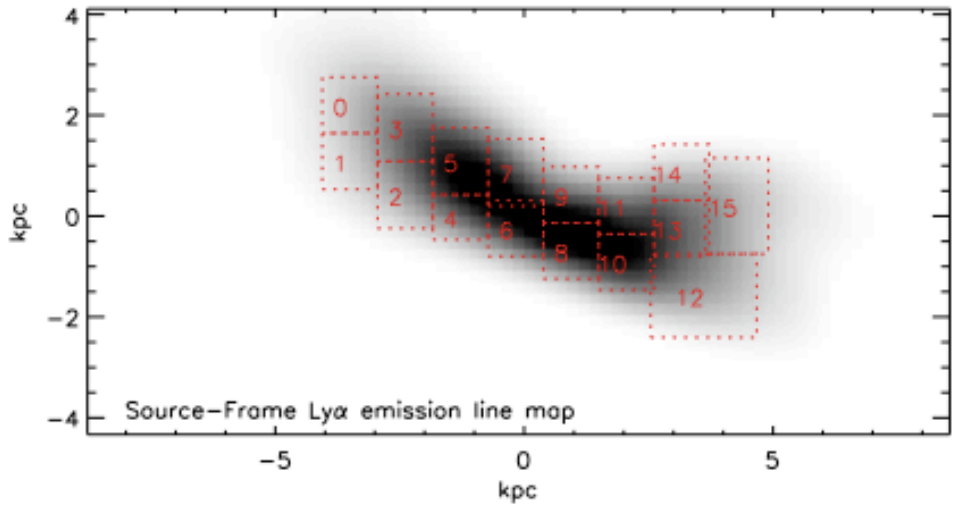




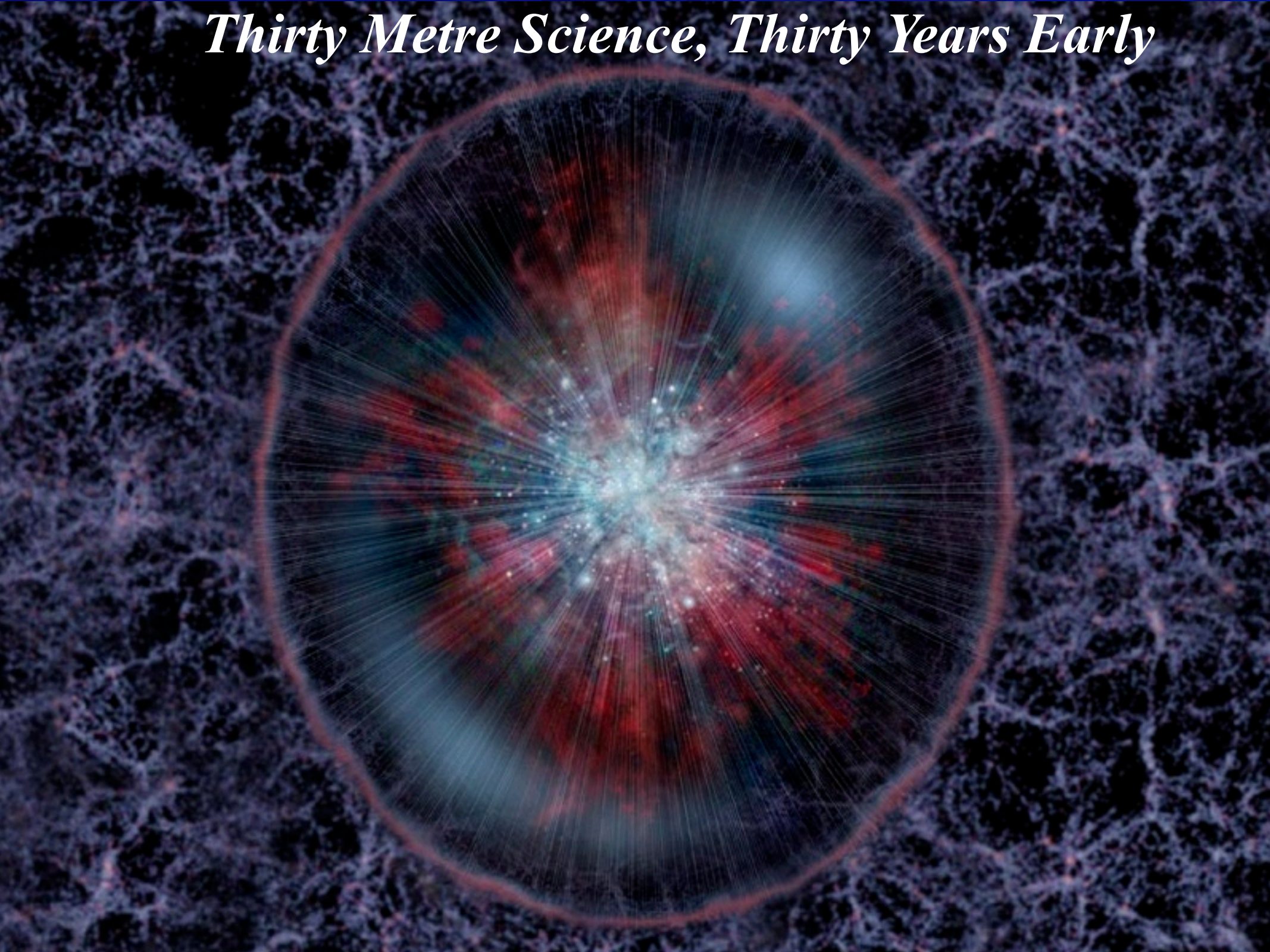

[OII] emission line intensity
kpc
kpc

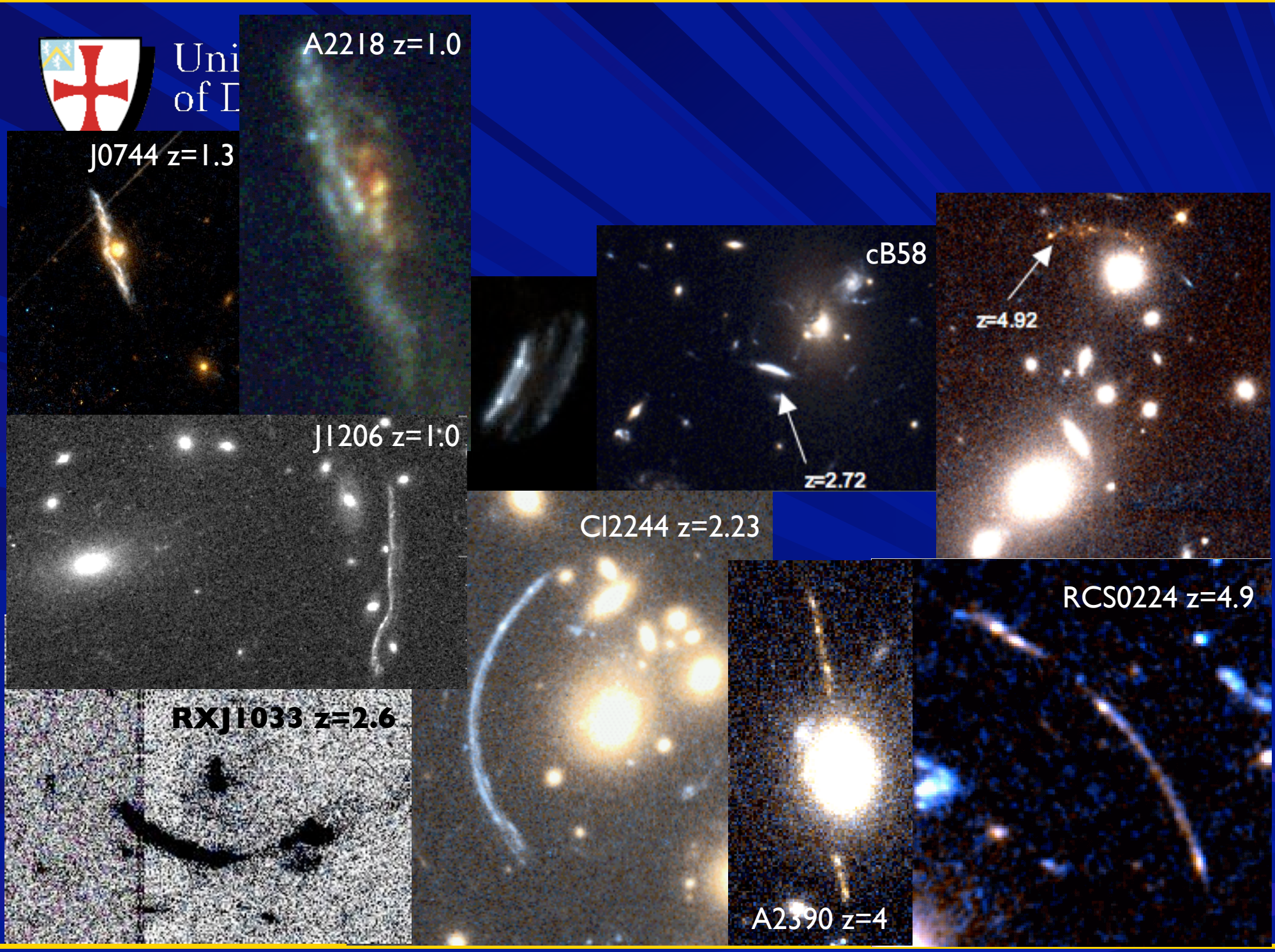

[OII] emission line velocity
-30 km/s +30
A
B
kpc
kpc


kpc
kpc


0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Source-Frame Lyα emission line map
kpc
kpc

Thirty Metre Science, Thirty Years Early




Uni
of L
A2218 z=1.0
J0744 z=1.3
cB58
z=4.92
z=2.72
J1206 z=1.0
Cl2244 z=2.23
RXJ1033 z=2.6
A2390 z=4
RCS0224 z=4.9