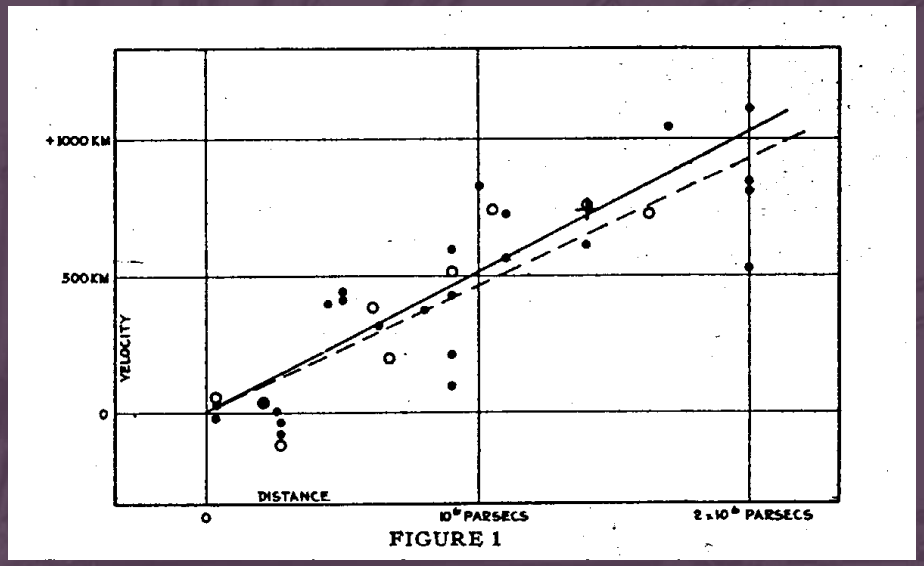
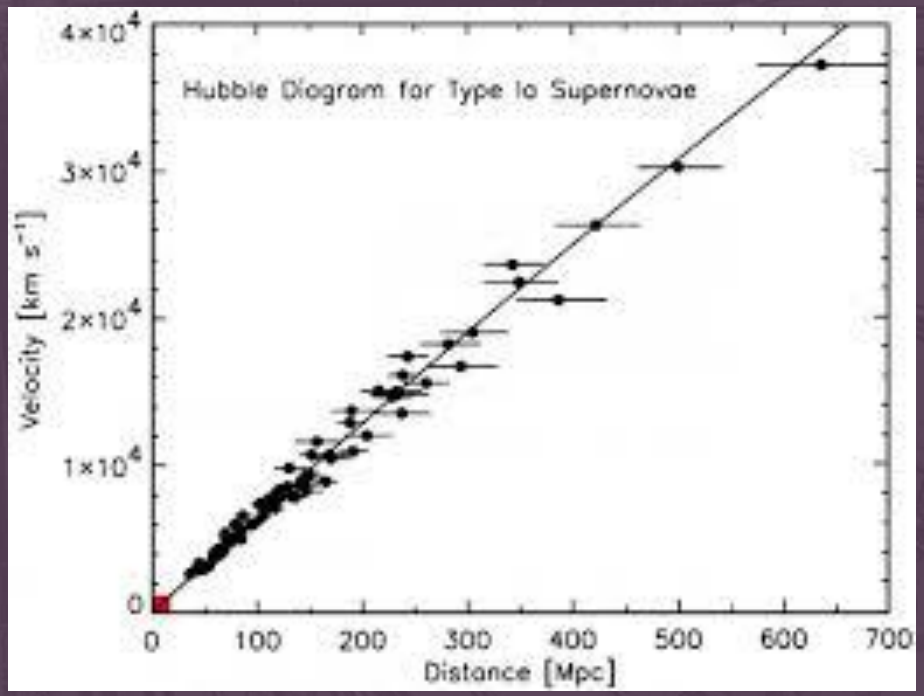
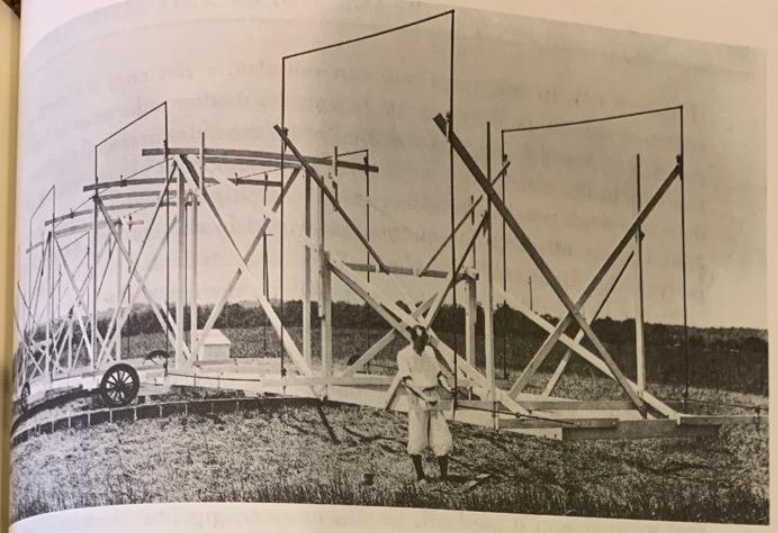
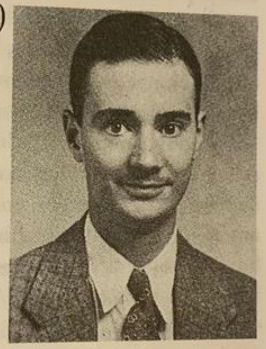

+1000 KM
500 KM
0
VELOCITY
DISTANCE
0
10⁶ PARSECS
2×10⁶ PARSECS
FIGURE 1


Hubble Diagram for Type Ia Supernovae
Velocity [km s⁻¹]
4×10⁴
3×10⁴
2×10⁴
1×10⁴
0
0
100
200
300
400
500
600
700
Distance [Mpc]

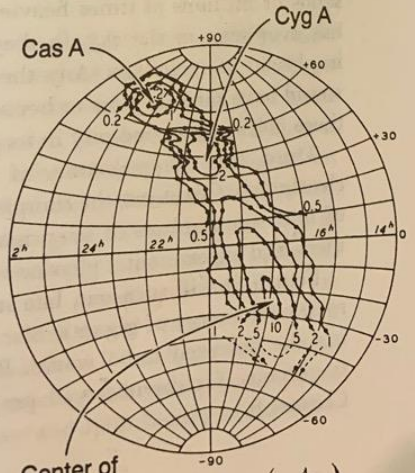


(a)

(b)



(c)

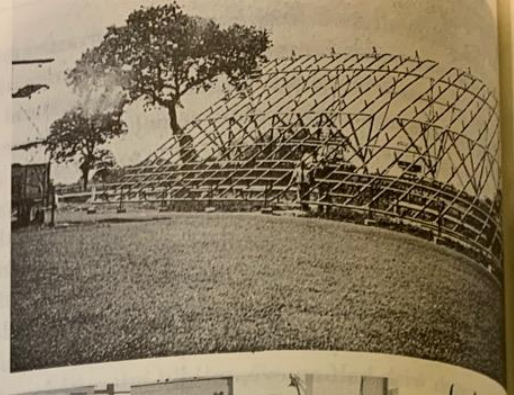

Cas A
Cyg A
+90
+60
+30
0
-30
-60
-90
0.2
0.2
2
0.5
0.5
2h
24h
22h
18h
14h
2.5
10
5
2
1
Center of
our galaxy

(d)

Centaurus A Radio Galaxy (VLT KUEYEN + FORS2)

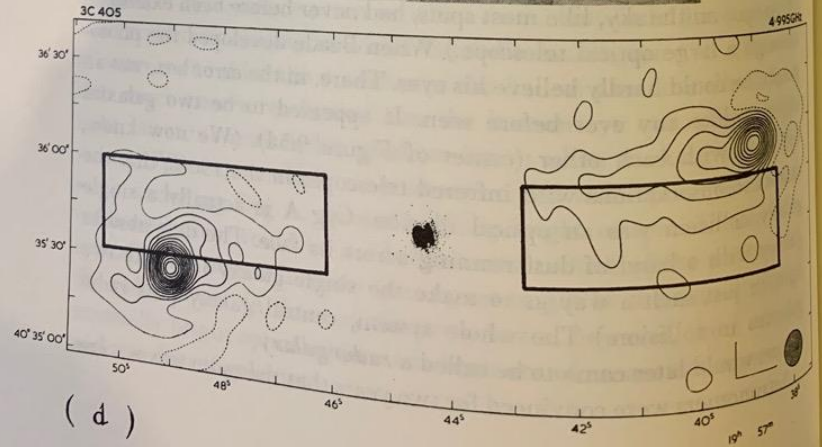
ESO PR Photo 05h/00 (8 February 2000)

(a)

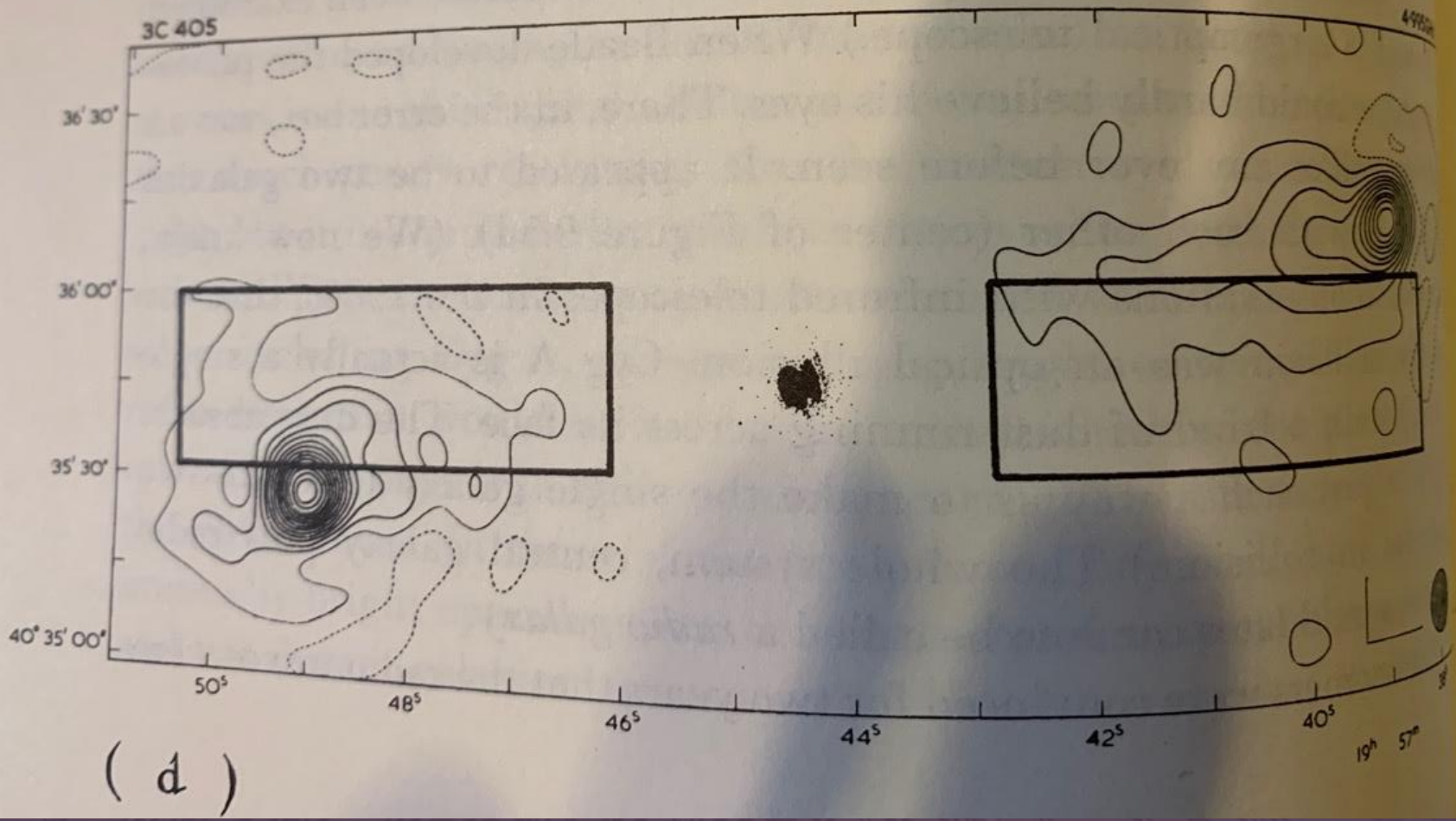


(b)

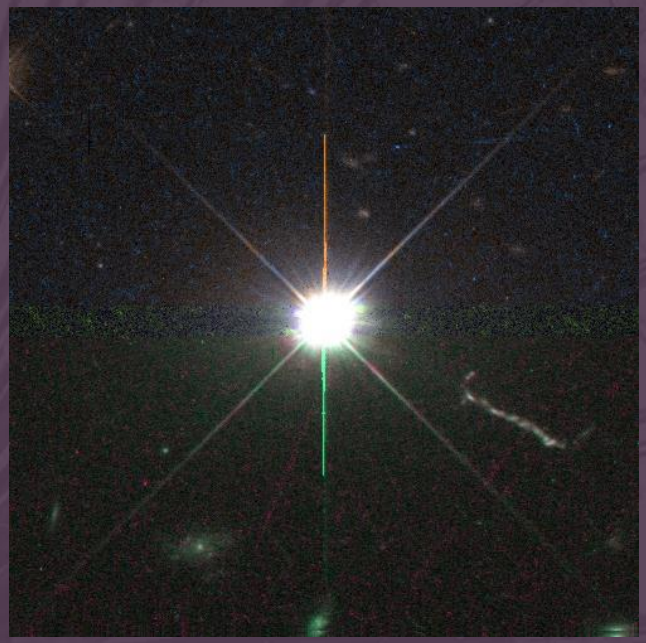
(c)

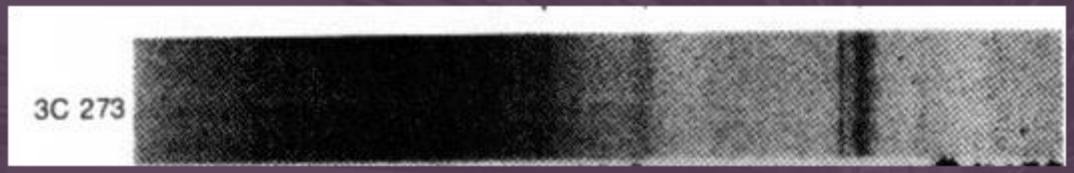

3C 405
4995GH
36' 30"
36' 00"
35' 30"
40° 35' 00"
50s
48s
46s
44s
42s
40s
38s
19h 57m

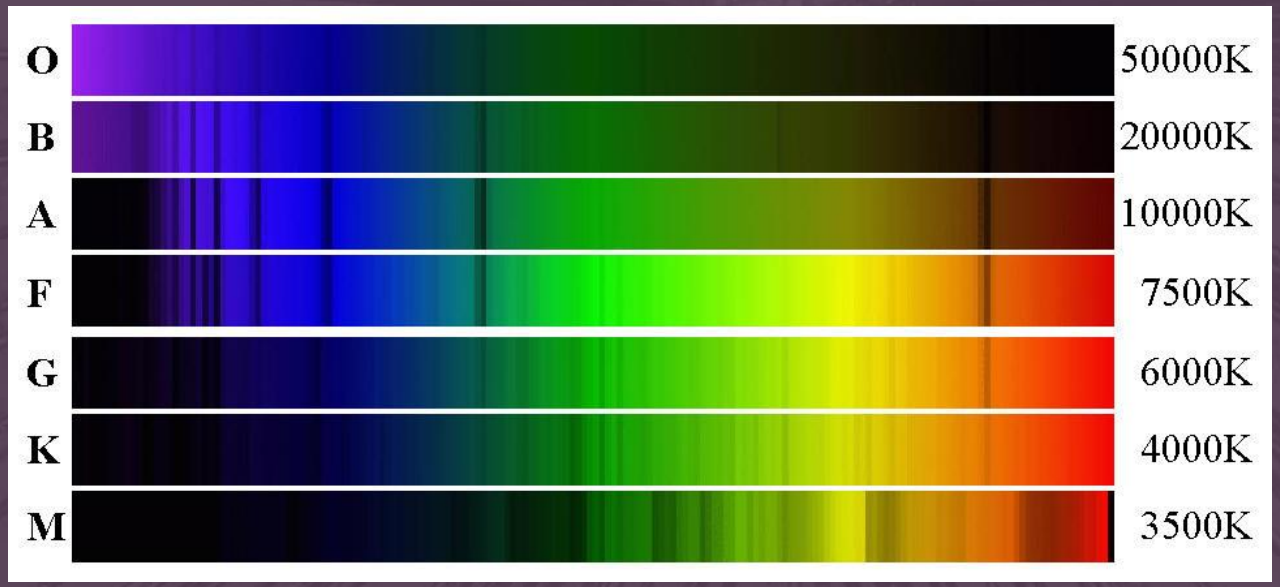
(d)


3C 405
4.995m
36' 30"
36' 00"
35' 30"
40° 35' 00"
50^s
48^s
46^s
44^s
42^s
40^s
19^h 57^m

(d)




3C 273


O
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6000K
K
4000K
M
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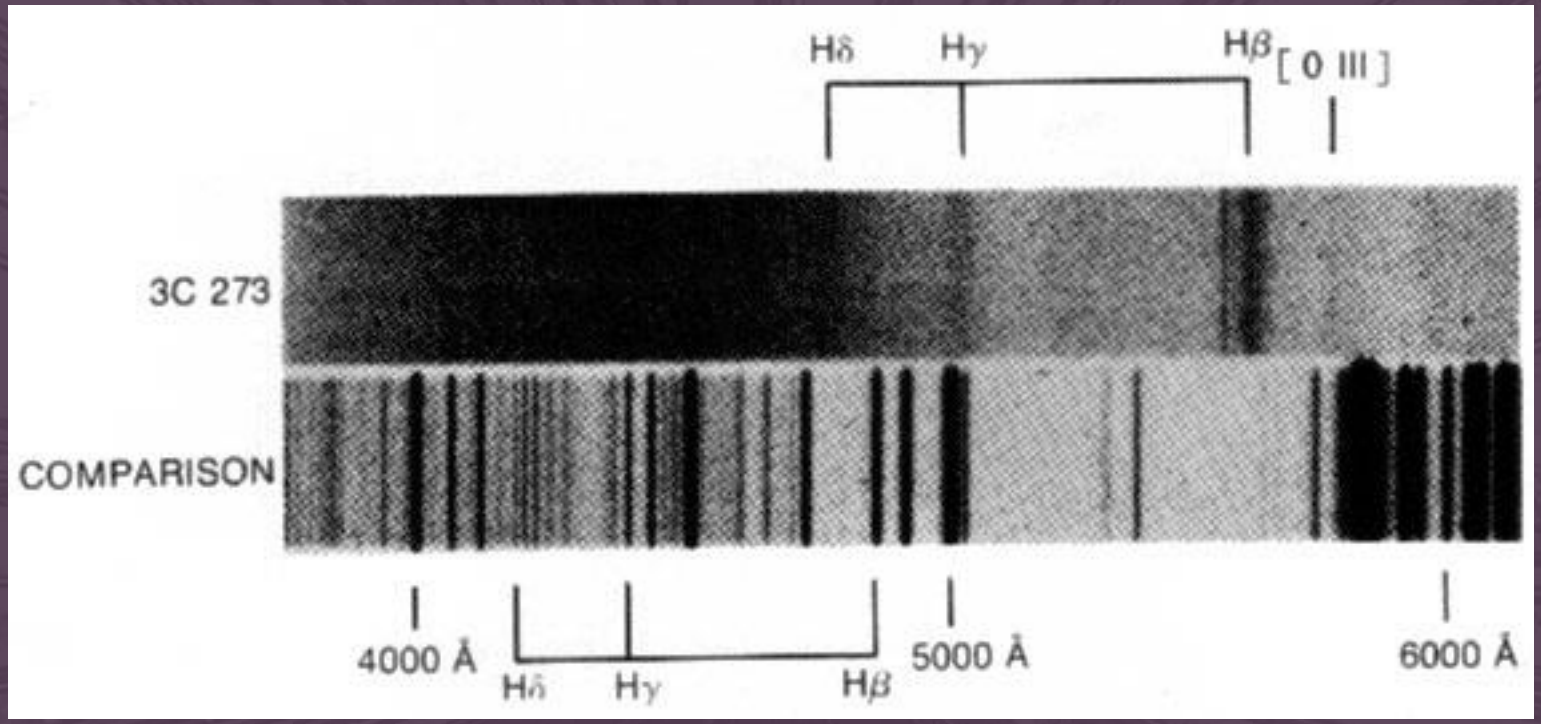
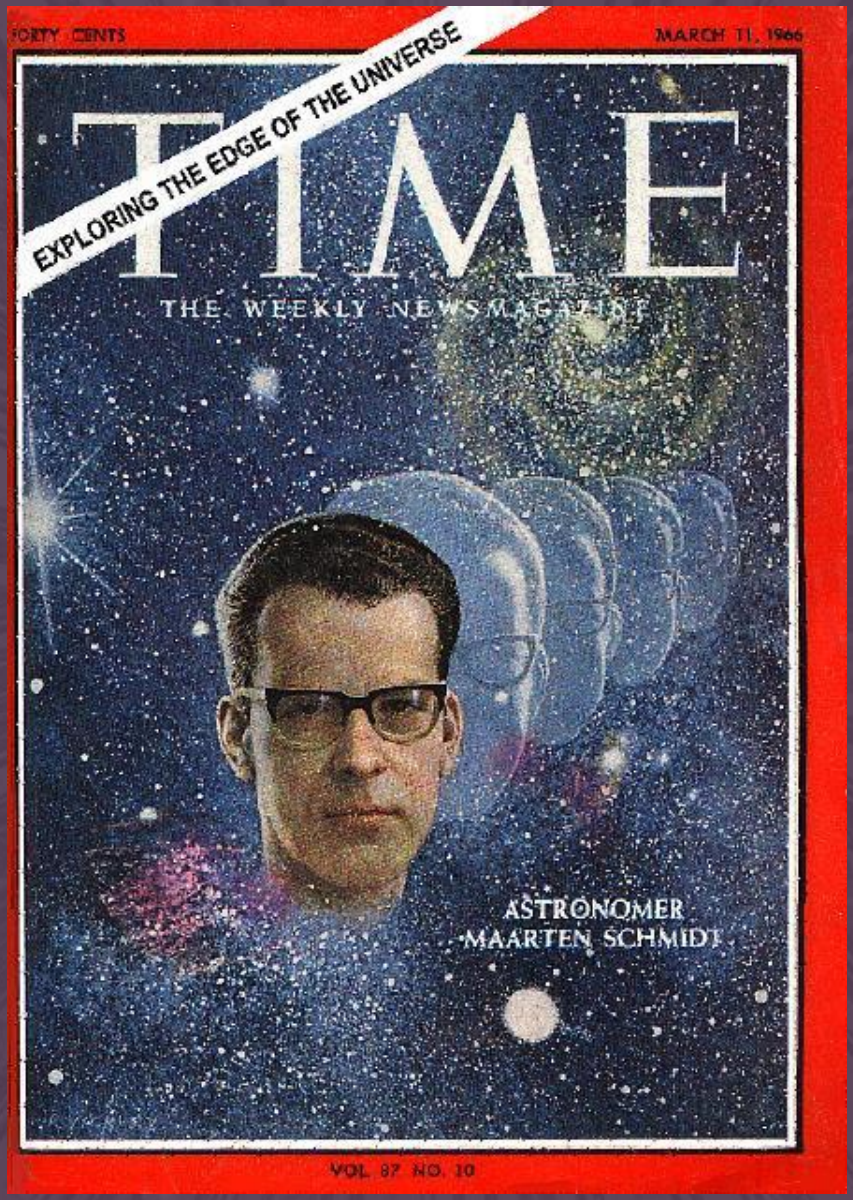
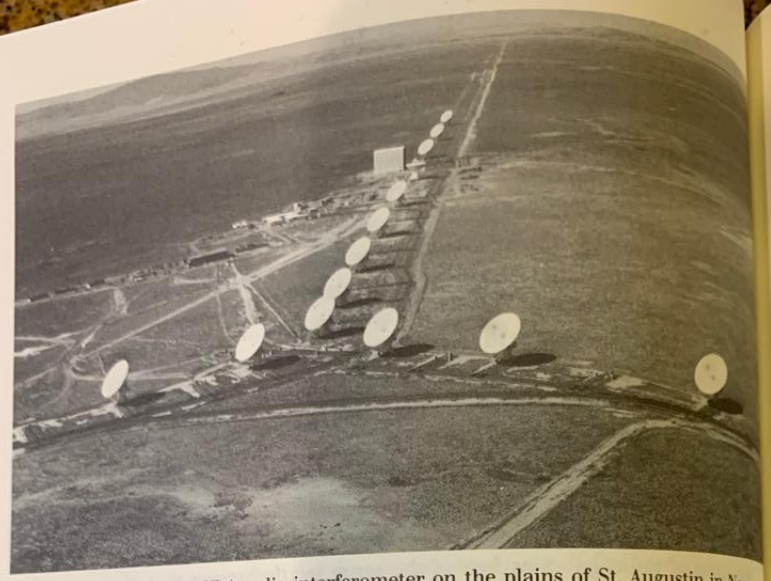
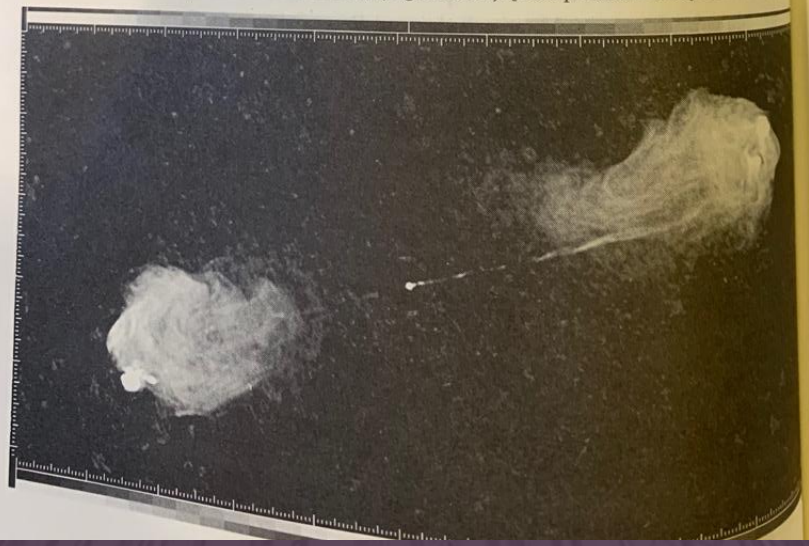

Hδ
Hγ
Hβ
[O III]
3C 273
COMPARISON
4000 Å
Hδ
Hγ
Hβ
5000 Å
6000 Å


FORTY CENTS
MARCH 11, 1966
EXPLORING THE EDGE OF THE UNIVERSE
TIME
THE WEEKLY NEWSMAGAZINE
ASTRONOMER
MAARTEN SCHMIDT
VOL. 87 NO. 10



9.5 *Top:* The VLA radio interferometer on the plains of St. Augustin in New Mexico. *Bottom:* A picture of the radio emission from the radio galaxy Cygnus A made with the VLA by R. A. Perley, J.W. Dreyer, and J.J. Cowan. The jet that feeds the right-hand radio lobe is quite clear; the jet feeding the left lobe is much fainter. Notice the enormous improvement in resolution of this radio-wave picture compared with Reber's 1944 contour map which did not show the double lobes at all (Figure 9.1d), and with Jennison and Das Gupta's 1953 radio map which barely revealed the existence of the lobes (two rectangles in Figure 9.3d), and with Ryle's 1969 contour map (Figure 9.3d). [Both pictures courtesy NRAO/AUI]



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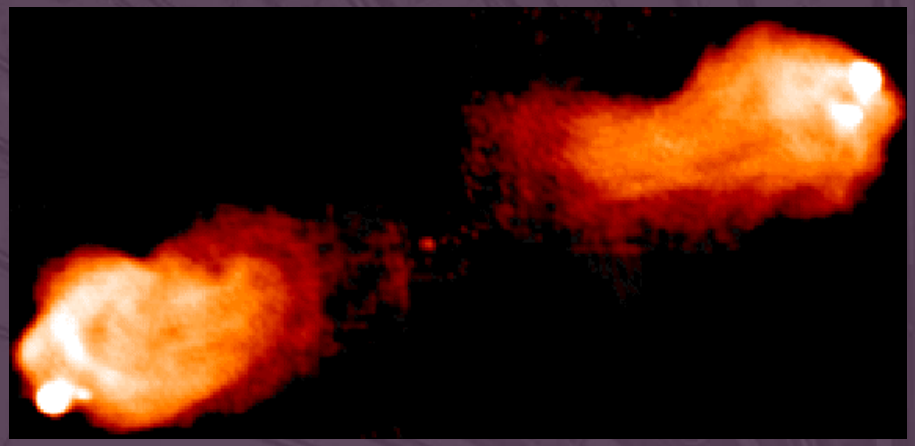
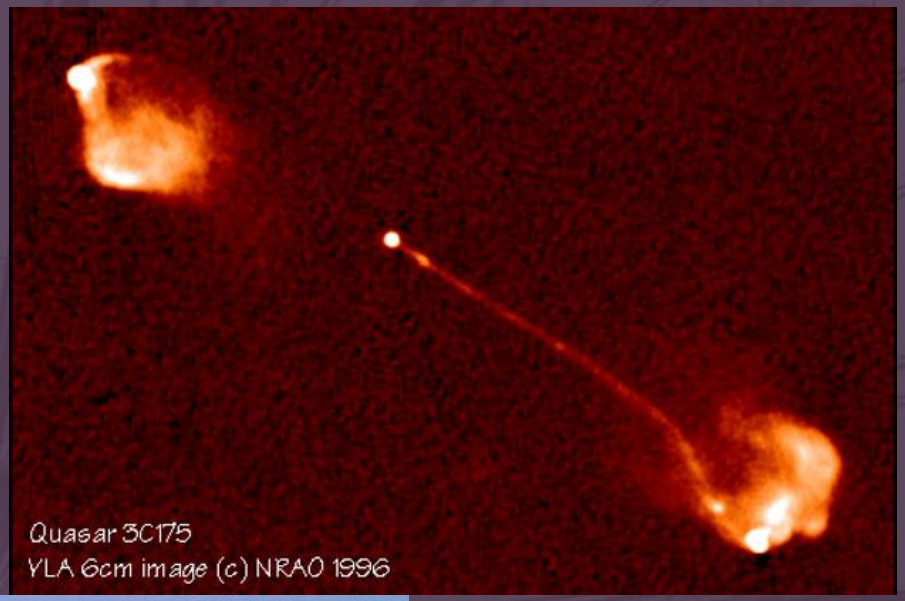
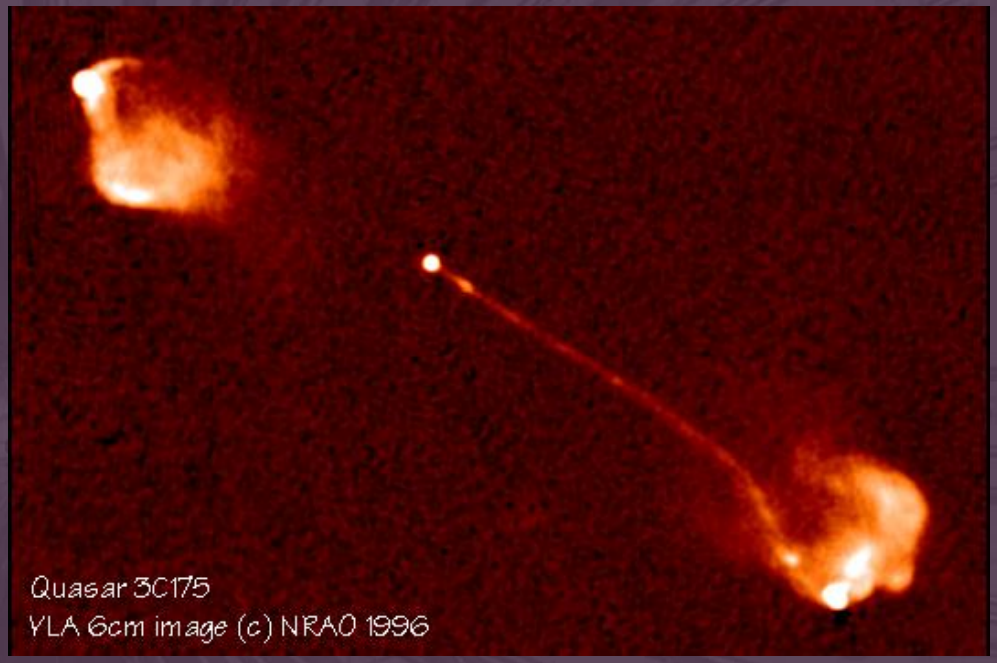
The Very Large Array

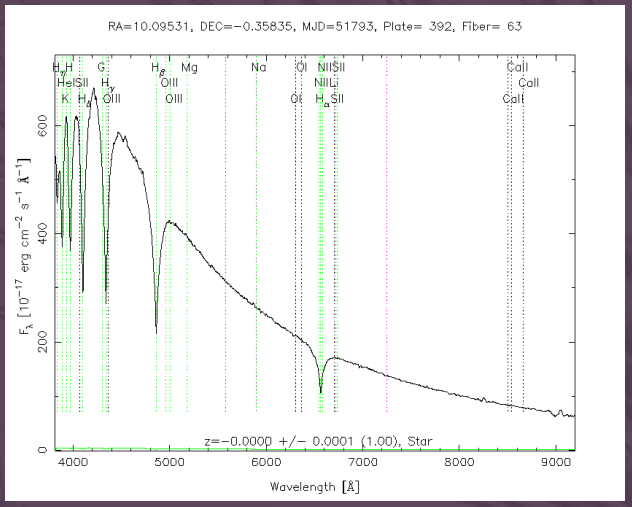
Cygnus A' (optical and radio)

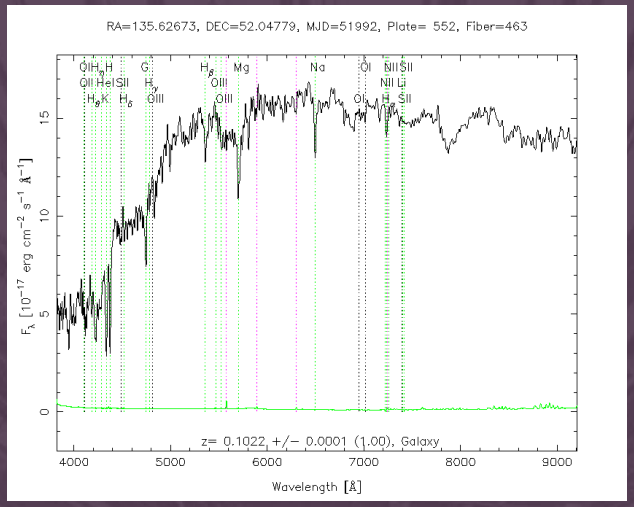


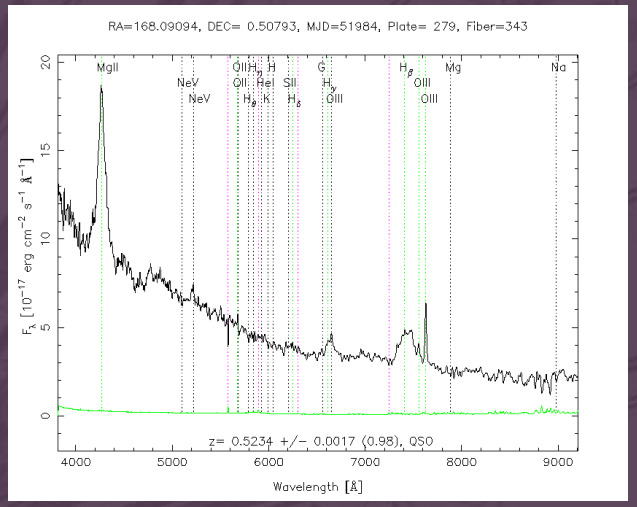

Quasar 3C175
VLA 6cm image (c) NRAO 1996



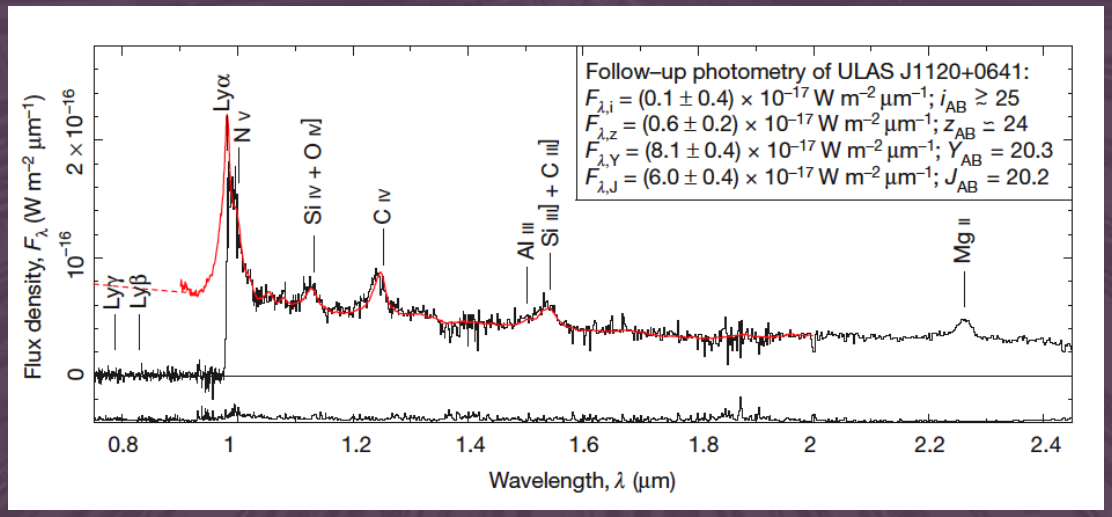
Quasi-stellar Radio Source (Quasar)



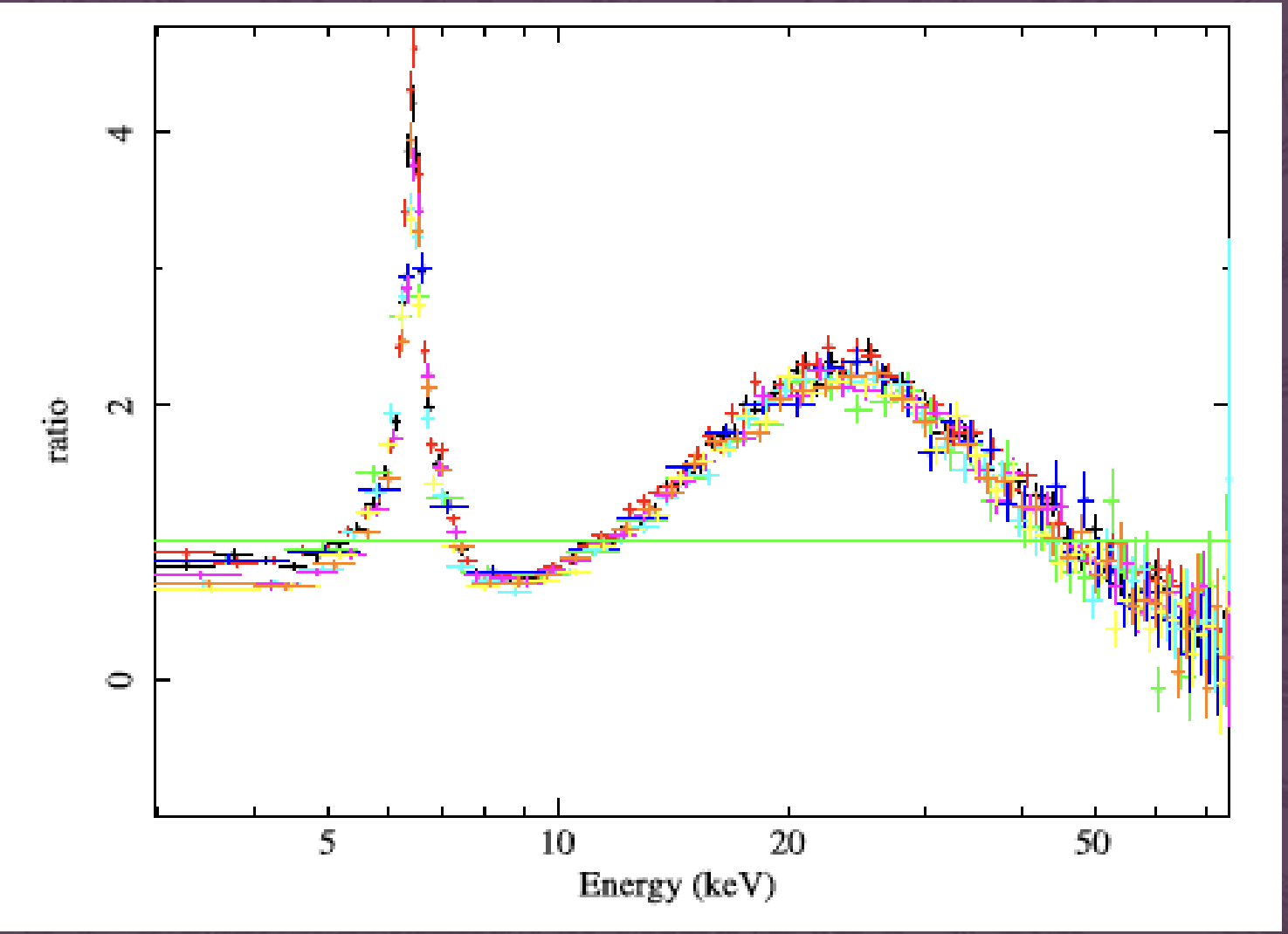




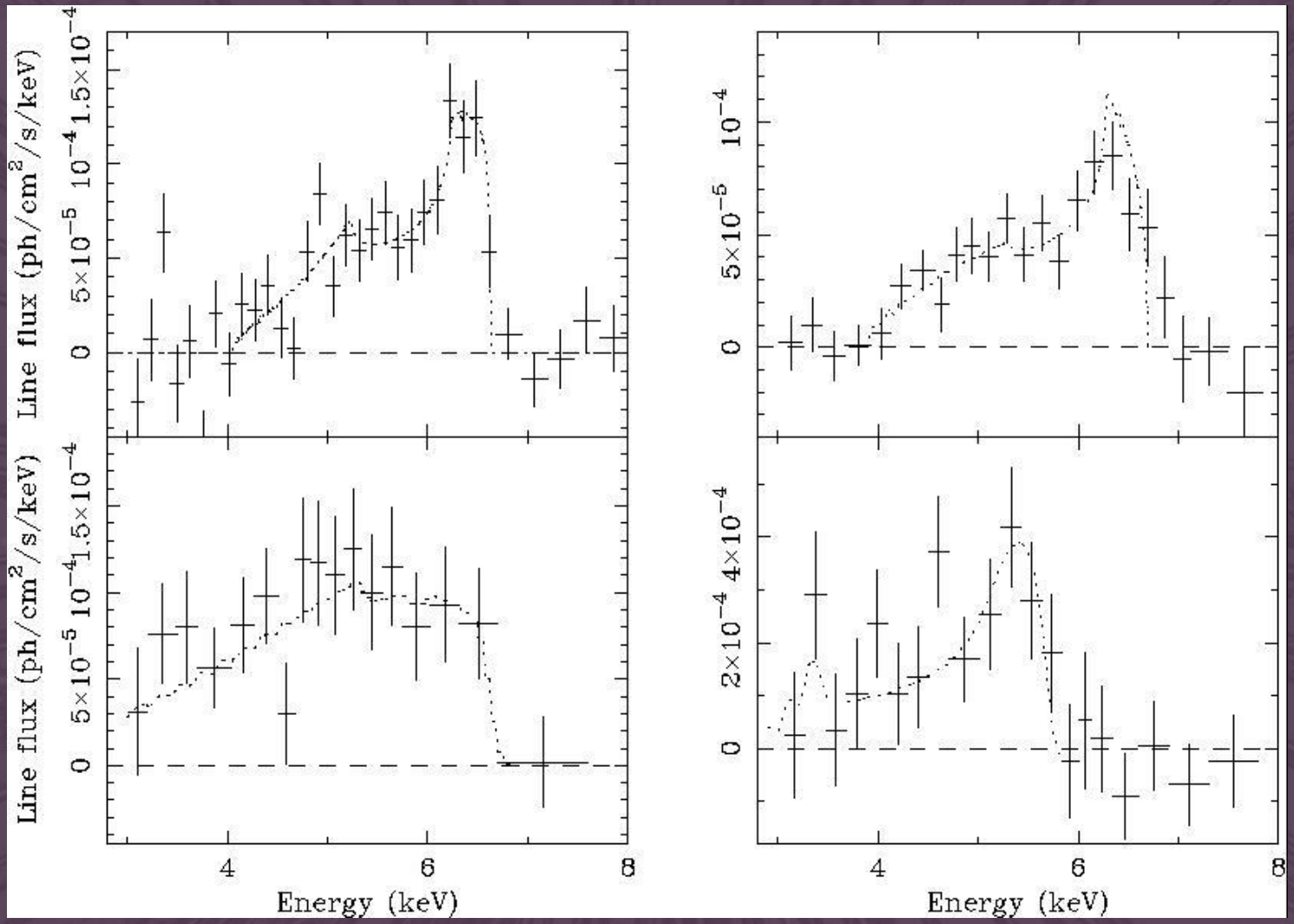
White dwarf Galaxy Quasar



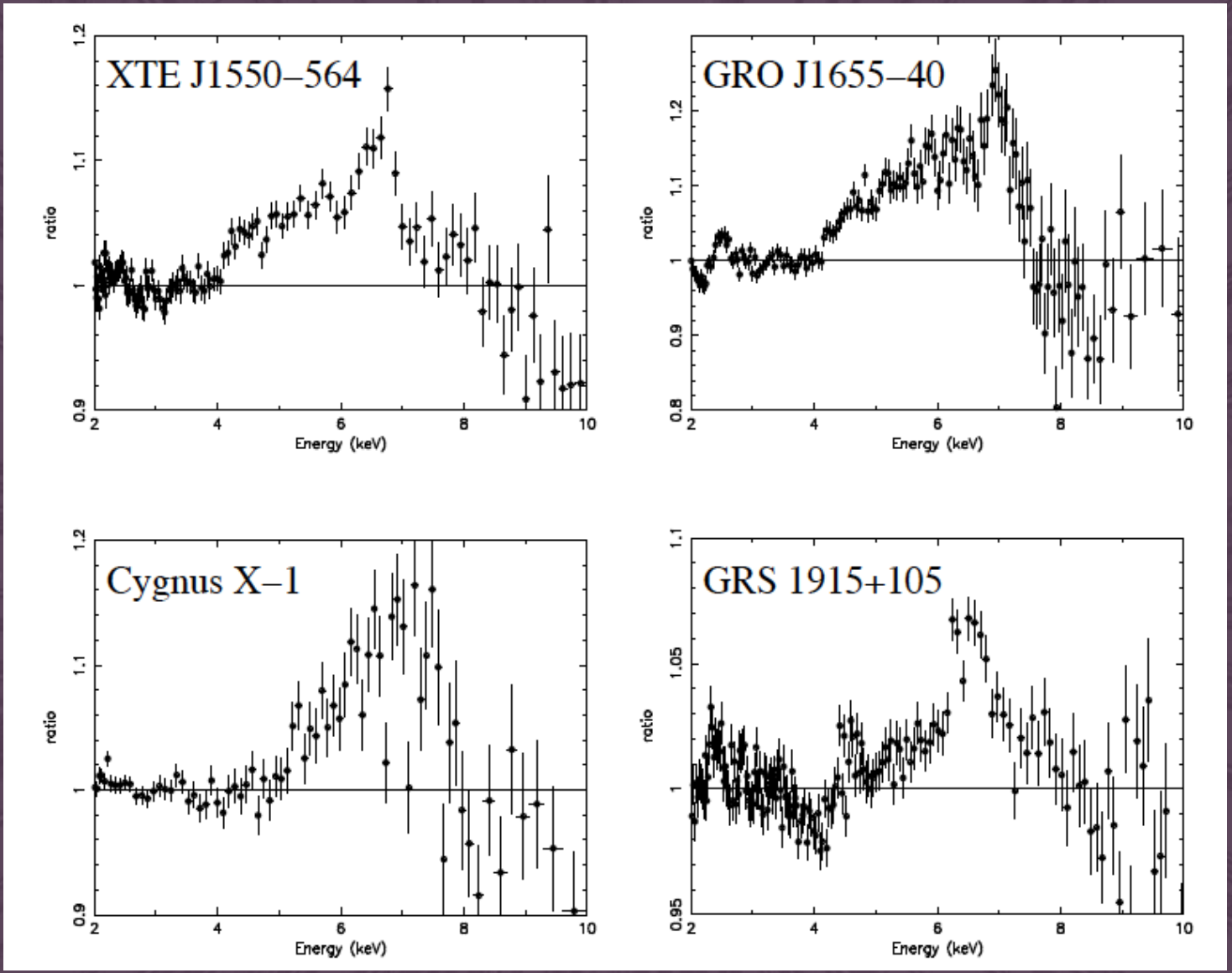
A very distant quasar: The expansion of the universe has stretched the wavelengths of its light by a factor of 8.



X-ray spectrum of Circinus active nucleus, Arevalo et al. 2014

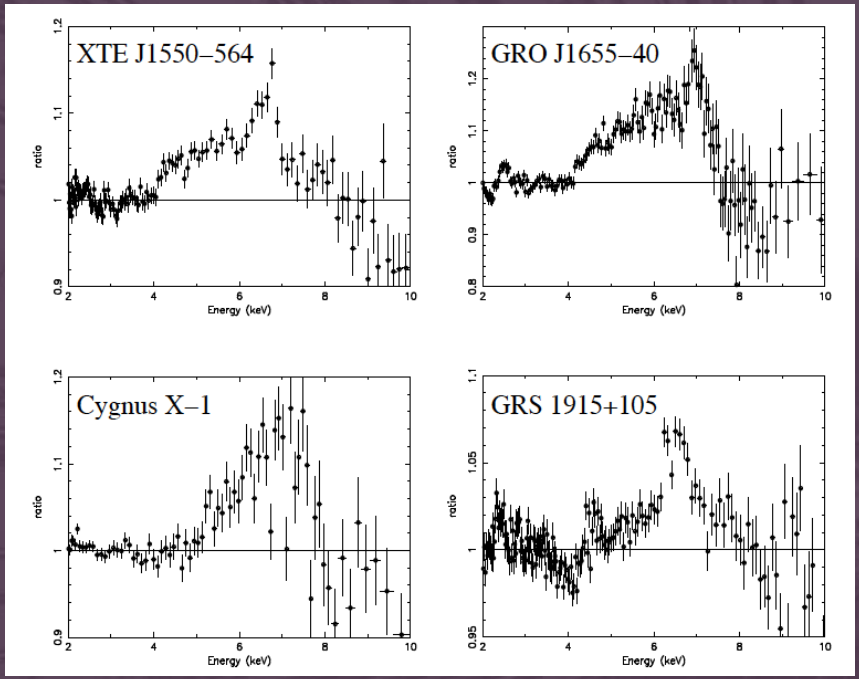


X-ray iron lines from nearby quasars. Broad because of large Doppler shifts. Asymmetric because of gravitational redshifts.

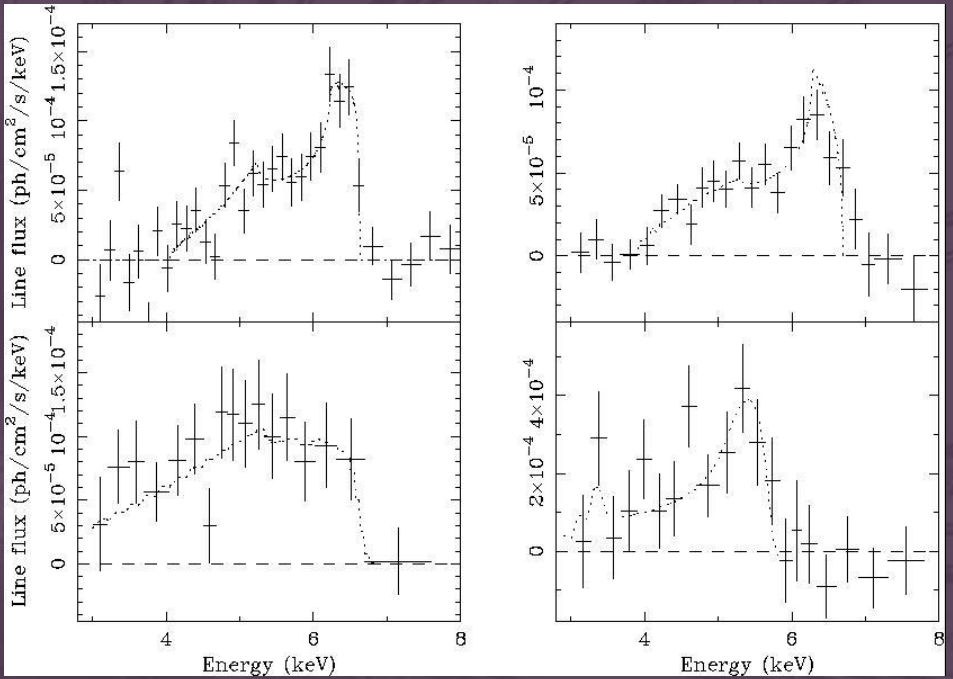


X-ray iron lines of four stellar mass black holes

From Miller 2007, ARAA



Stellar mass black holes in the Milky Way



Supermassive black holes in nearby quasars