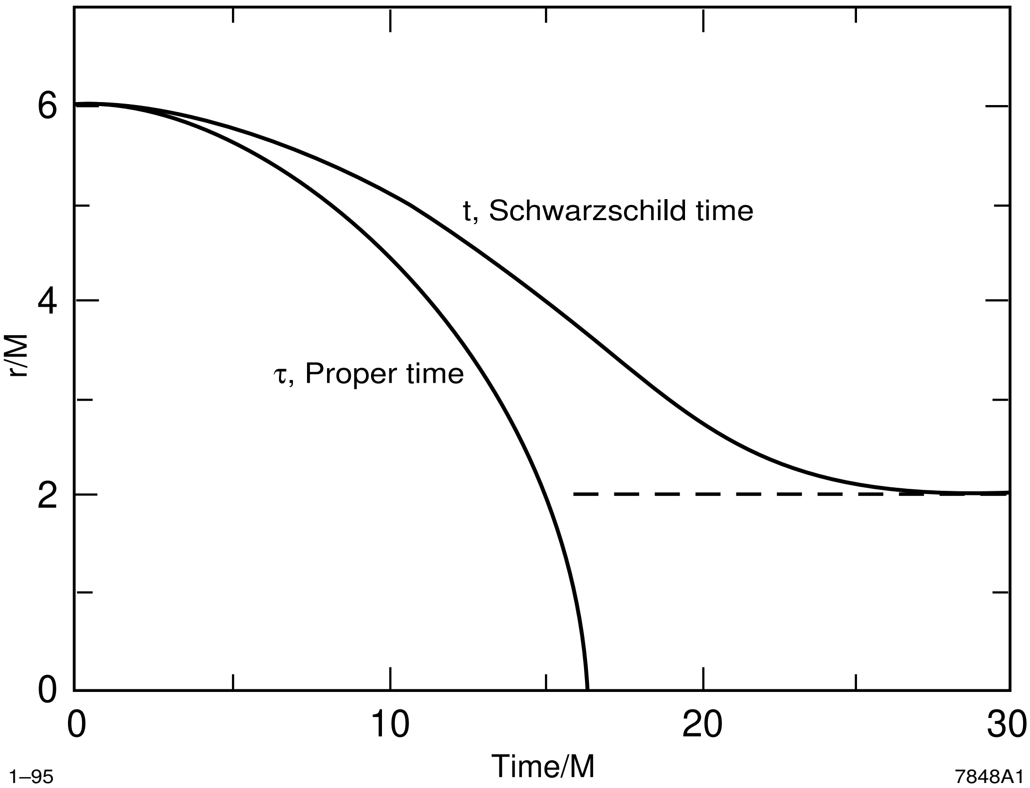
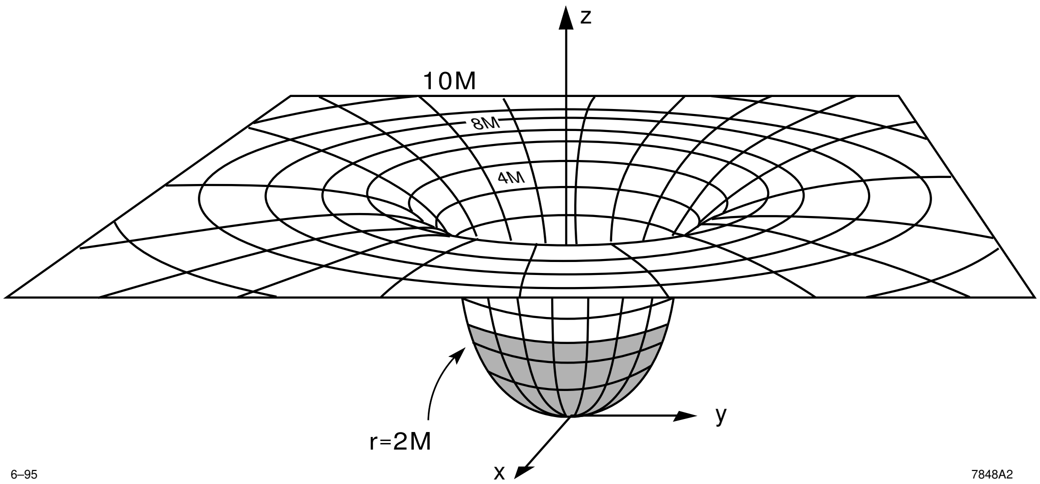
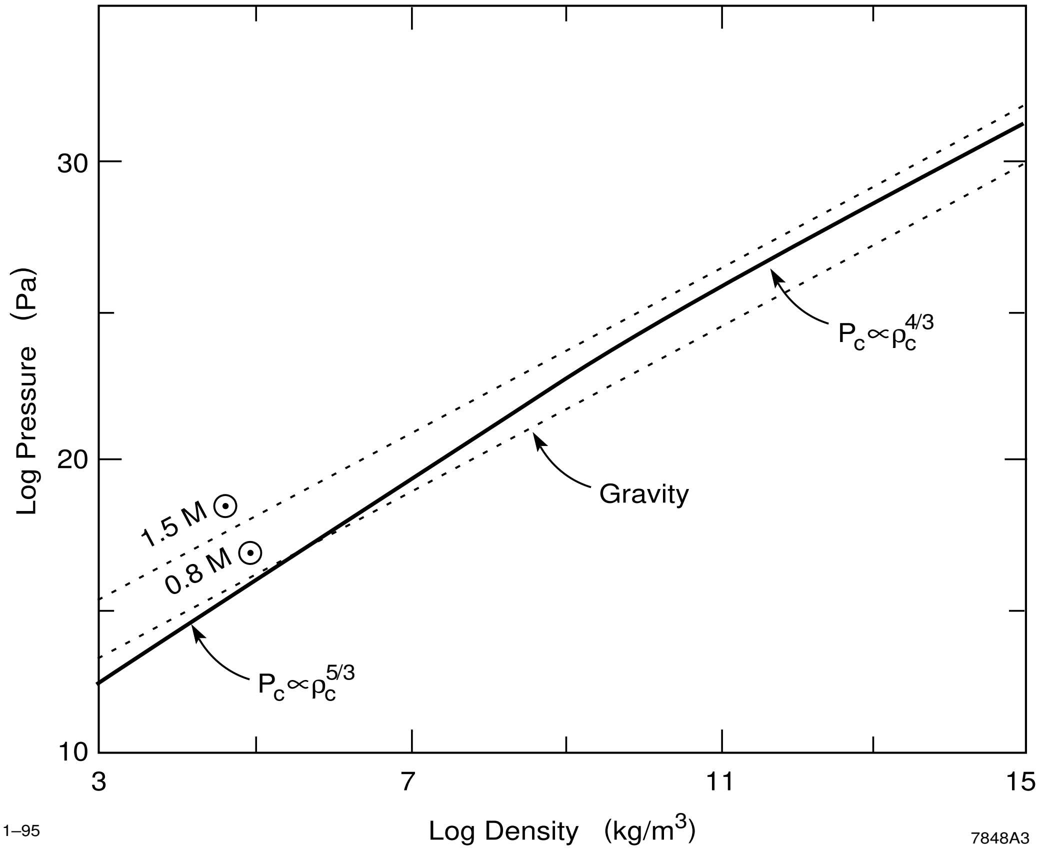


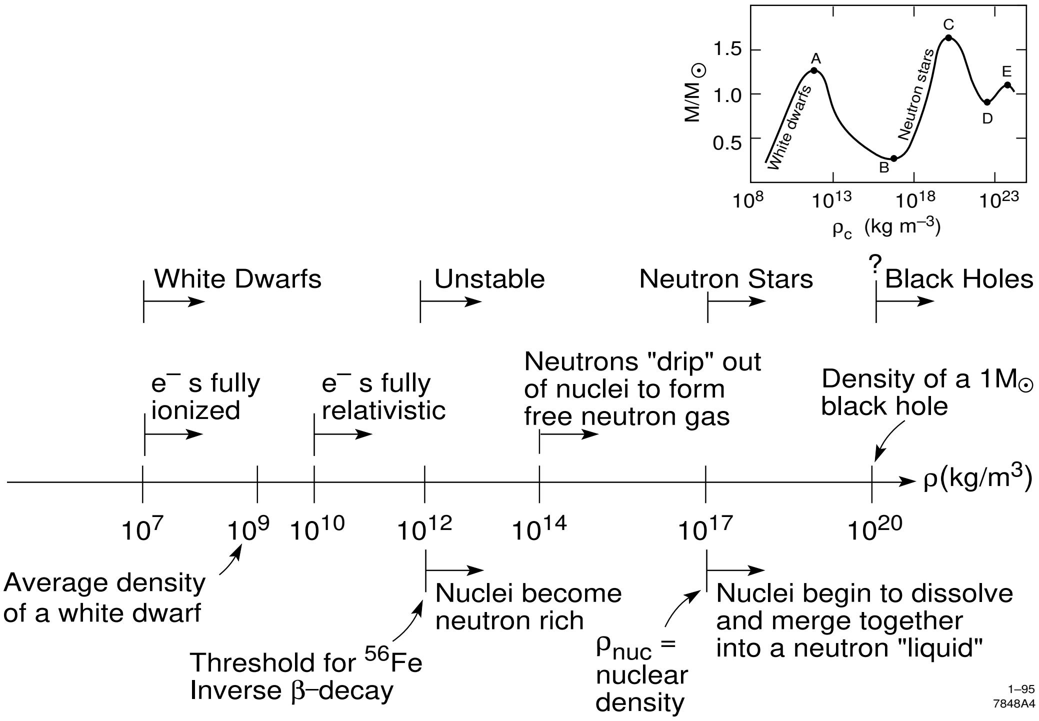
t, Schwarzschild time
τ, Proper time
r/M
Time/M
0
2
4
6
0
10
20
30
1–95
7848A1



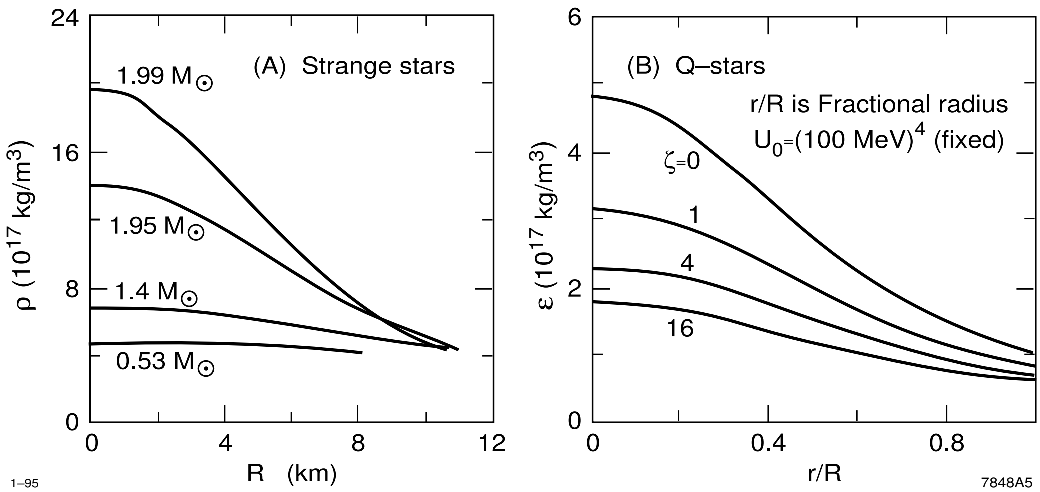
z
10M
8M
4M
r=2M
y
x
6–95
7848A2



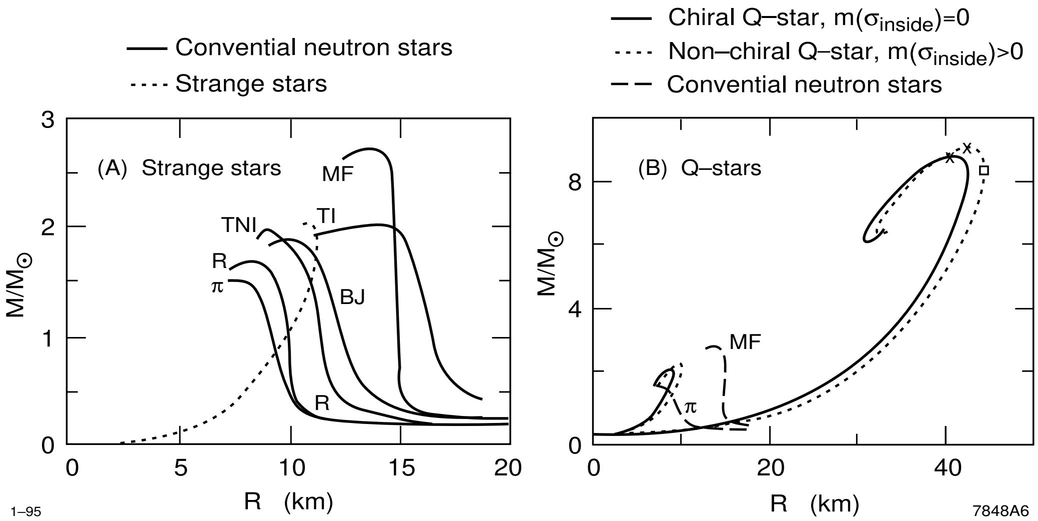
30
20
10
3
7
11
15
Log Pressure (Pa)
Log Density (kg/m^3)
1.5 M ⊙
0.8 M ⊙
Gravity
$P_c \propto \rho_c^{5/3}$
$P_c \propto \rho_c^{4/3}$
1–95
7848A3



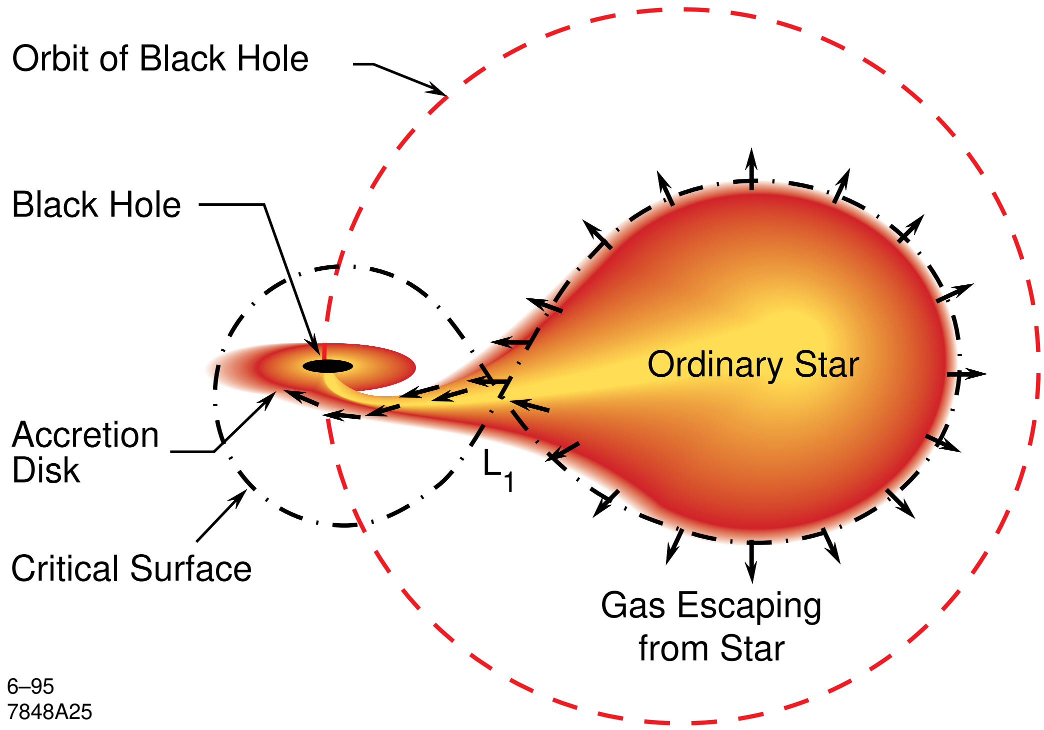
M/M⊙
1.5
1.0
0.5
A
B
C
D
E
White dwarfs
Neutron stars
10^8
10^{13}
10^{18}
10^{23}
ρ_c (kg m^{-3})
White Dwarfs
Unstable
Neutron Stars
? Black Holes
e^- s fully ionized
e^- s fully relativistic
Neutrons "drip" out of nuclei to form free neutron gas
Density of a 1M⊙ black hole
ρ(kg/m^3)
10^7
10^9
10^{10}
10^{12}
10^{14}
10^{17}
10^{20}
Average density of a white dwarf
Nuclei become neutron rich
Threshold for ^{56}Fe Inverse β–decay
ρ_{nuc} = nuclear density
Nuclei begin to dissolve and merge together into a neutron "liquid"
1–95
7848A4

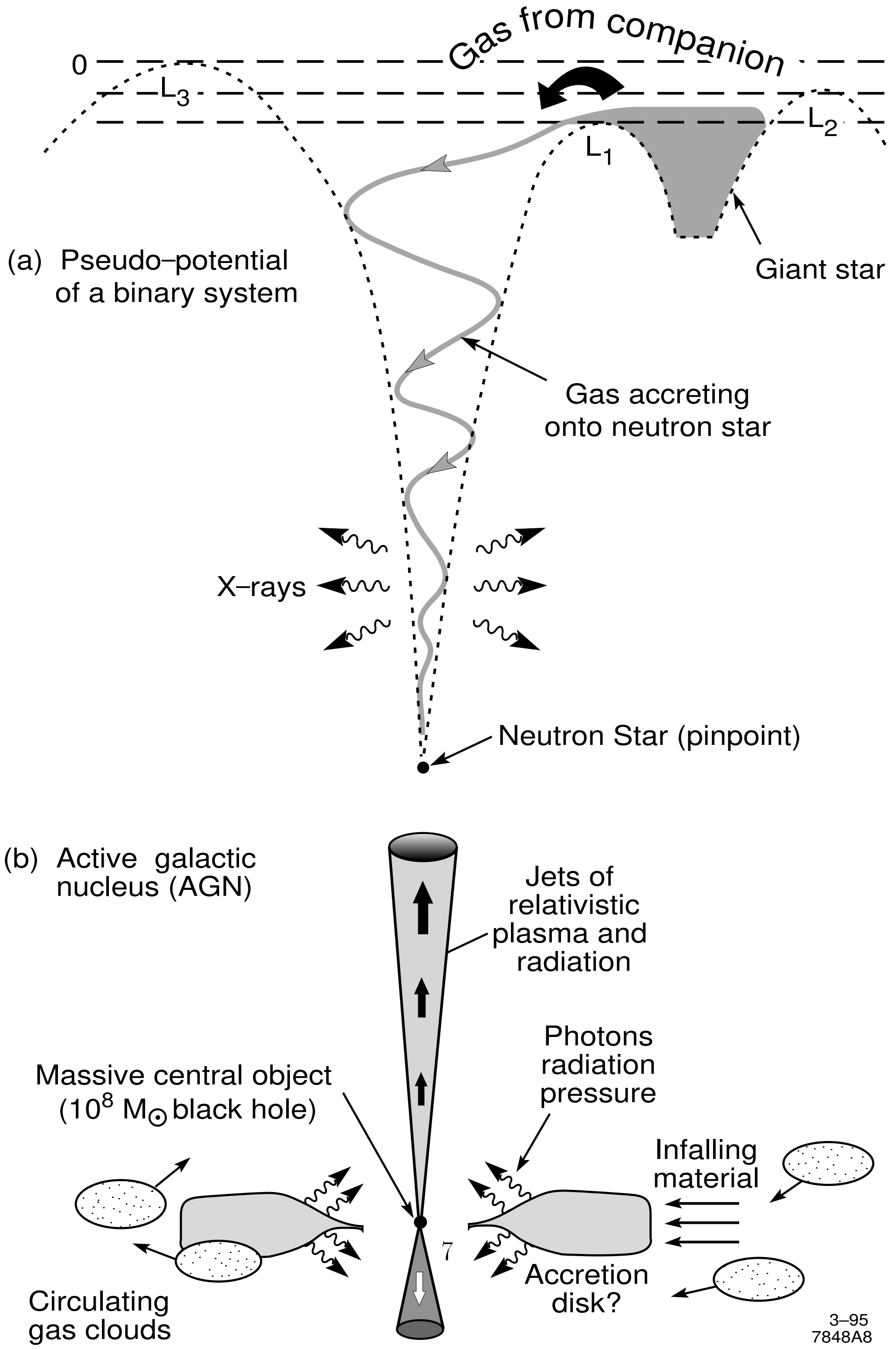


(A) Strange stars
1.99 M⊙
1.95 M⊙
1.4 M⊙
0.53 M⊙
ρ (10^{17} kg/m^3)
R (km)
0
4
8
12
16
24
(B) Q–stars
r/R is Fractional radius
U_0=(100 MeV)^4 (fixed)
ζ=0
1
4
16
ε (10^{17} kg/m^3)
r/R
0.4
0.8
2
6
1–95
7848A5

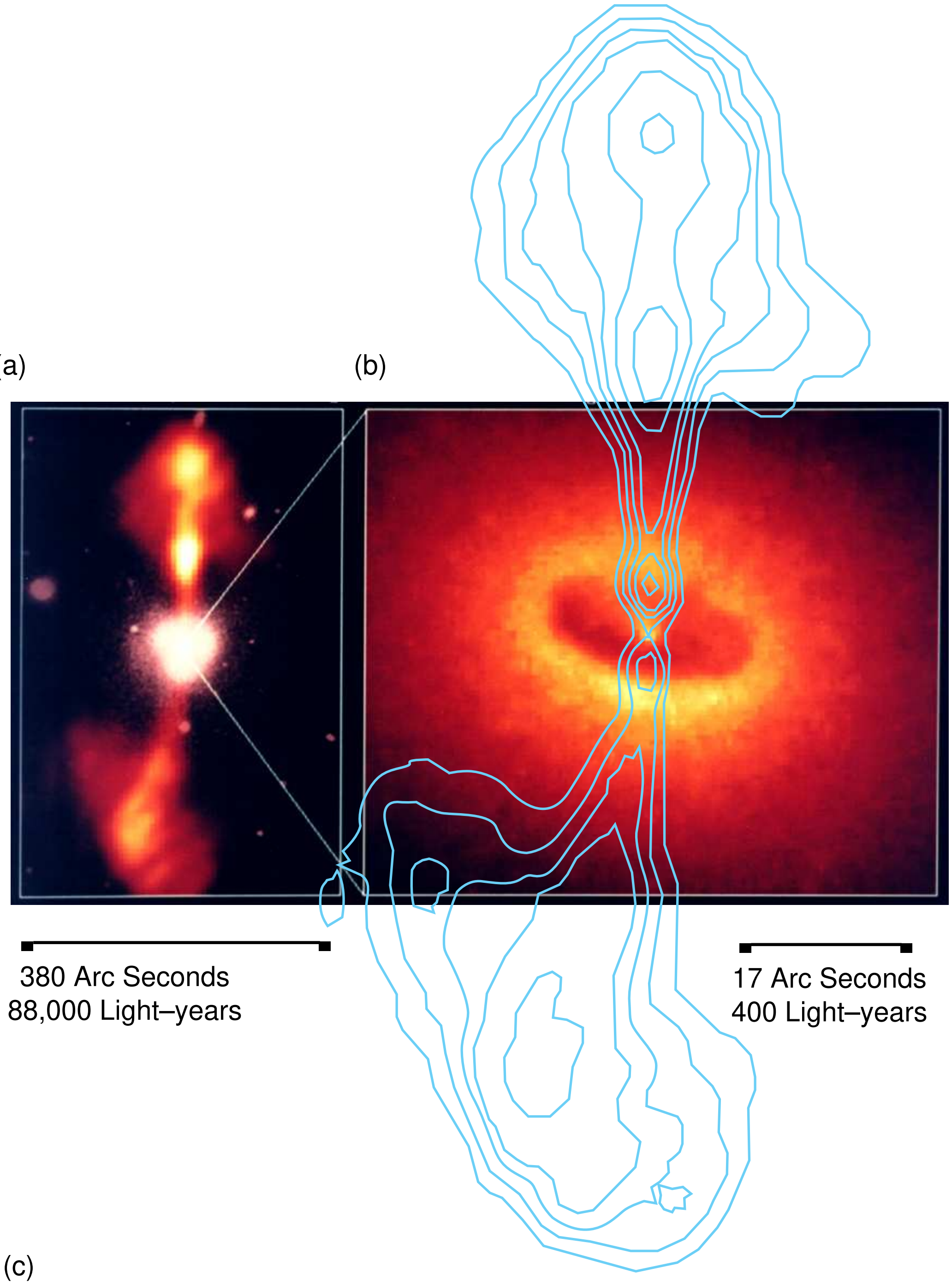


Convential neutron stars
Strange stars
(A) Strange stars
MF
TNI
TI
R
π
BJ
R
M/M⊙
R (km)
1–95
Chiral Q–star, m(σinside)=0
Non–chiral Q–star, m(σinside)>0
Convential neutron stars
(B) Q–stars
MF
π
M/M⊙
R (km)
7848A6

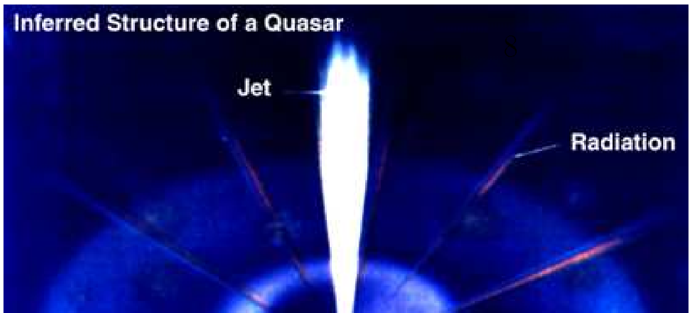

Orbit of Black Hole
Black Hole
Accretion Disk
Critical Surface
Ordinary Star
L_1
Gas Escaping from Star
6–95
7848A25

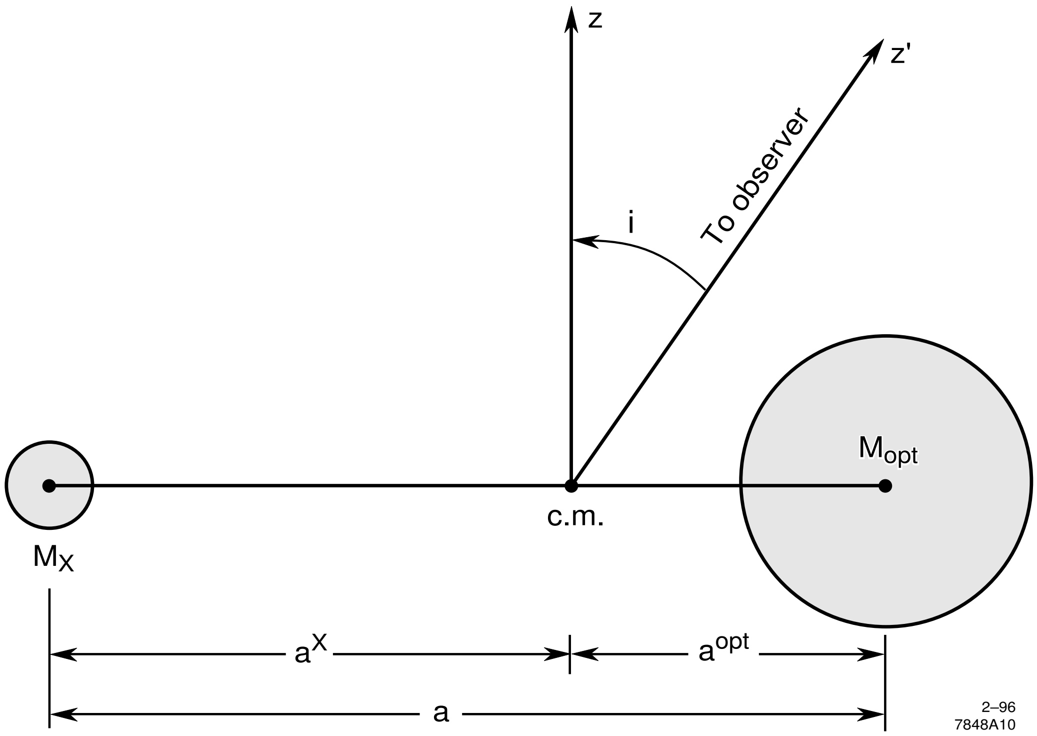

Gas from companion
0
L_3
L_1
L_2
Giant star
(a) Pseudo–potential of a binary system
Gas accreting onto neutron star
X–rays
Neutron Star (pinpoint)
(b) Active galactic nucleus (AGN)
Jets of relativistic plasma and radiation
Photons radiation pressure
Massive central object (10^8 $M_\odot$ black hole)
Infalling material
Circulating gas clouds
Accretion disk?
3–95
7848A8

(a) (b)


380 Arc Seconds
88,000 Light–years
17 Arc Seconds
400 Light–years

(c)


Inferred Structure of a Quasar
Jet
Radiation


z
z'
To observer
i
M_opt
c.m.
M_X
a^X
a^opt
a
2–96
7848A10