From Accretion Flow to Particle Acceleration: New Relativistic MHD jet solutions including Gravity

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Sera Markoff
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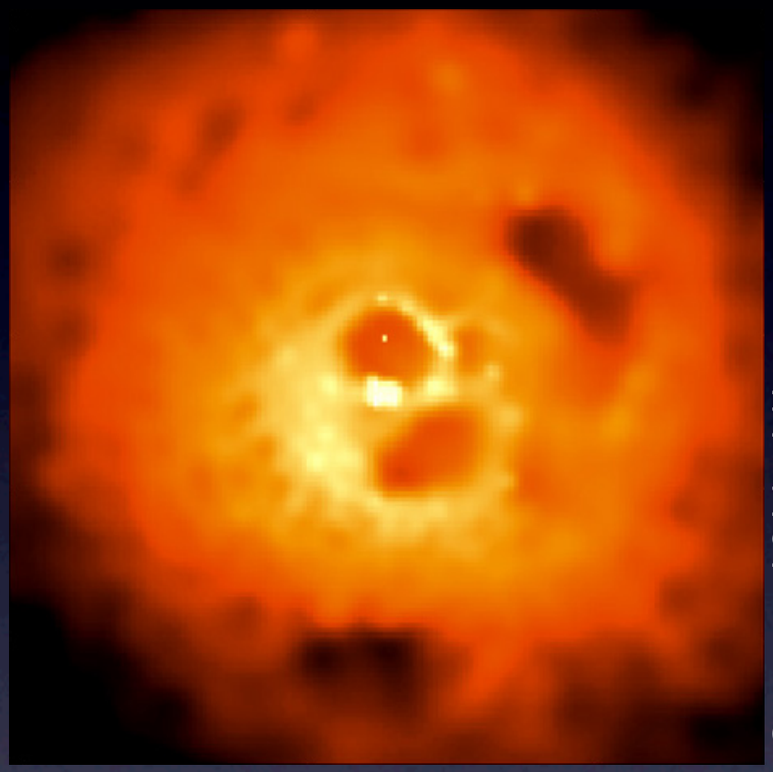
Introduction

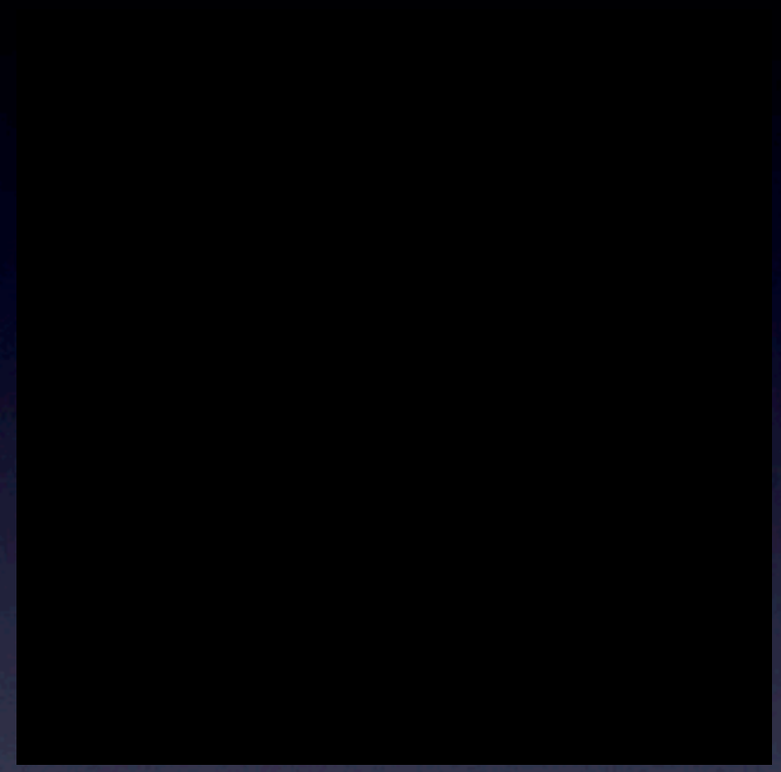


Credit: NASA/IoA/A.Fabian et al.

Perseus cluster

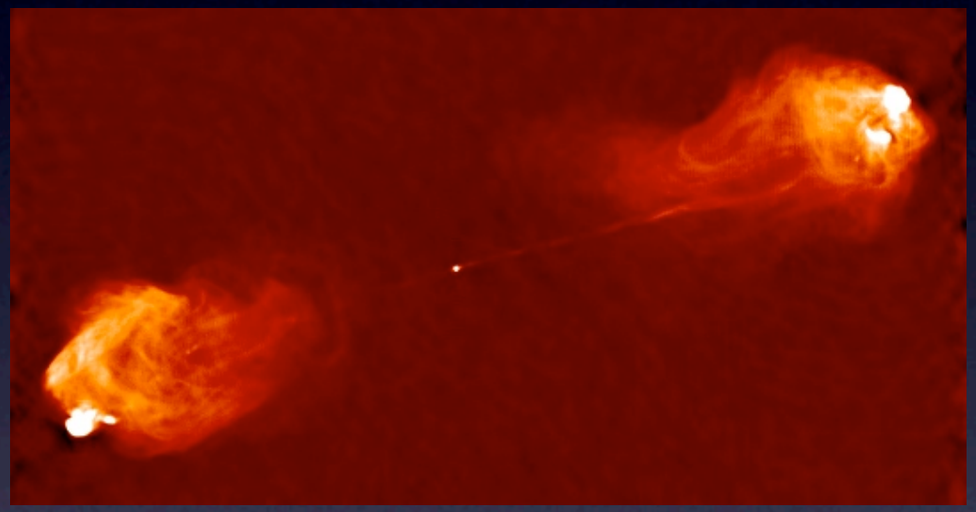
Credit: SOHO/EIT consortium

Young stellar object



Gamma-ray flashes

Jets!

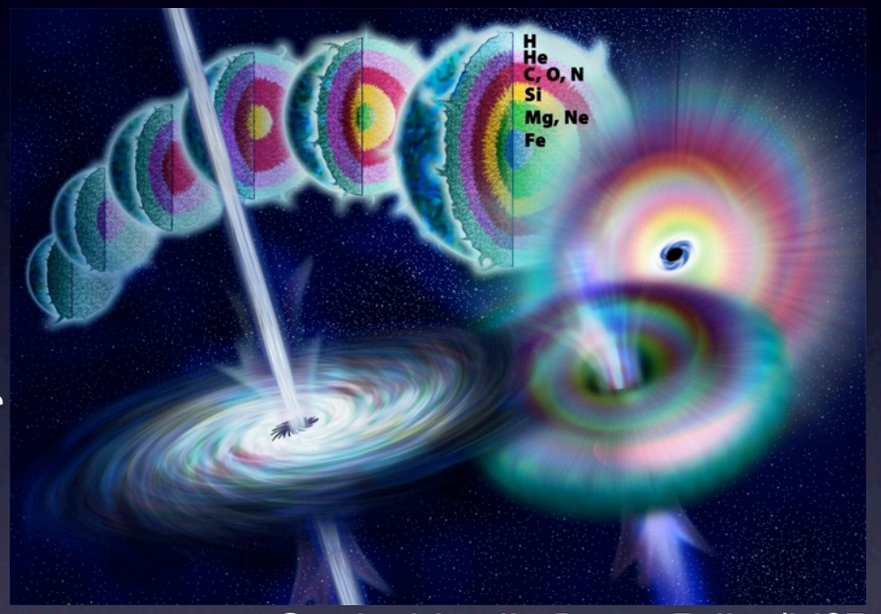


Credit: C. Carilli

Cygnus A

Credit: Universidad Nacional Autonoma de Maxico/ JPL/STSci/ESA

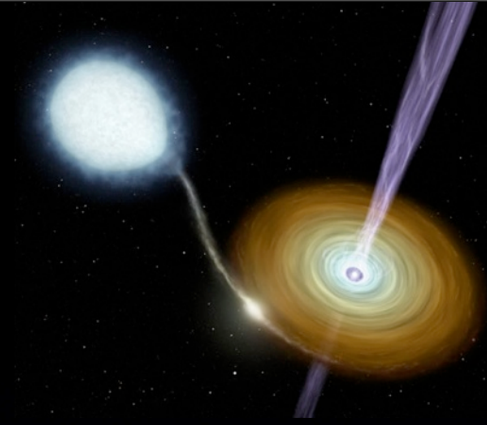
HH 30

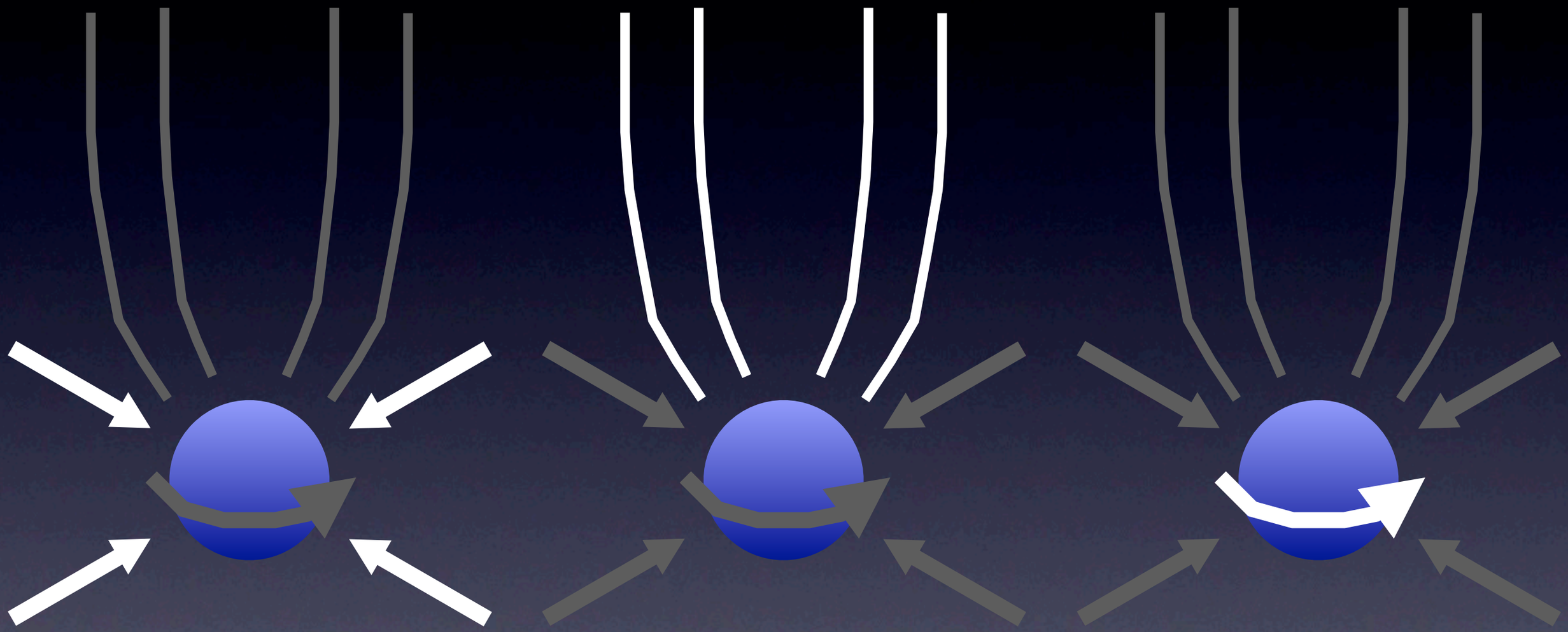


Credit: Nicolle Rager Fuller/NSF

Gamma-ray burst

Ingredients



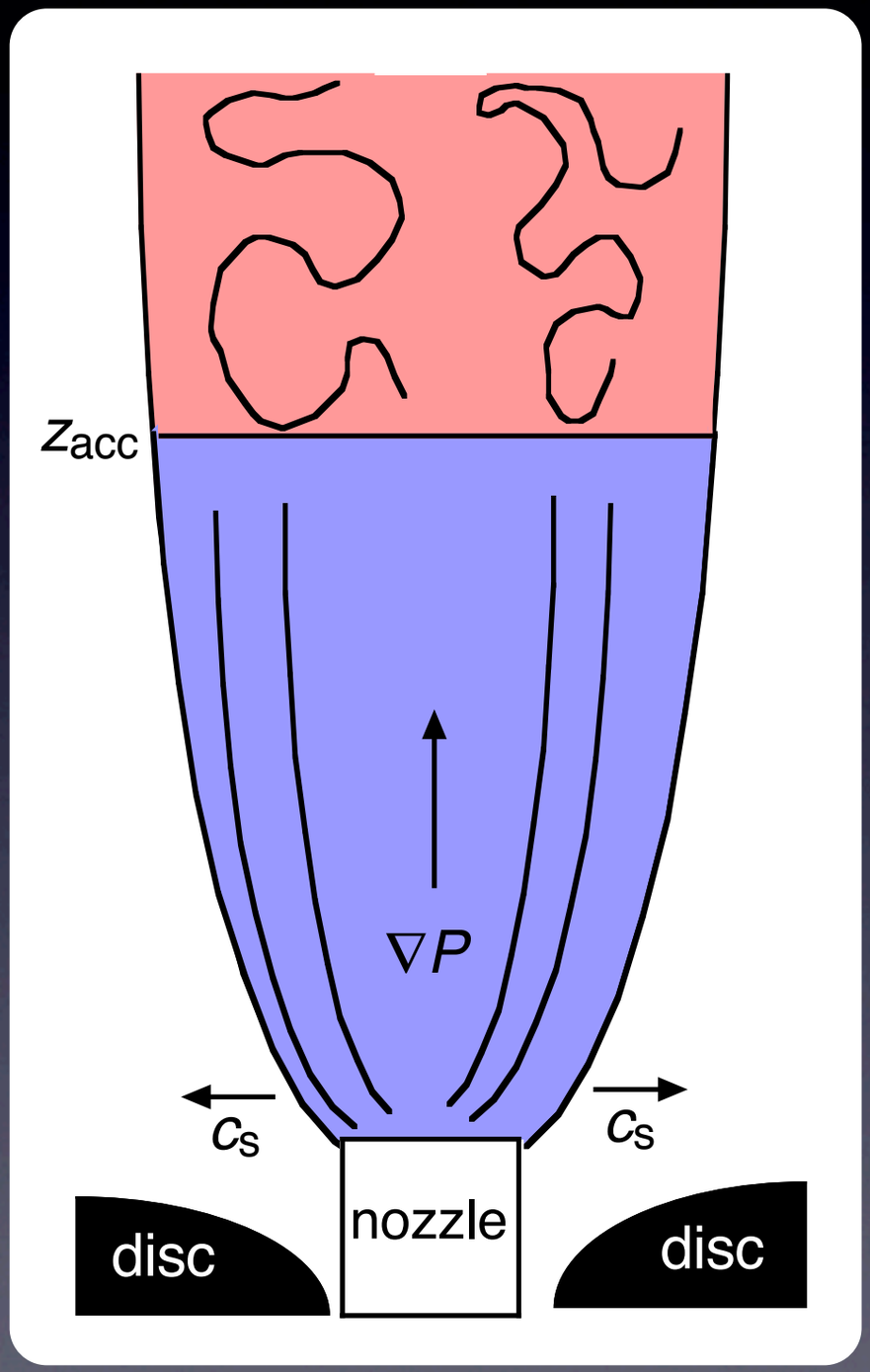


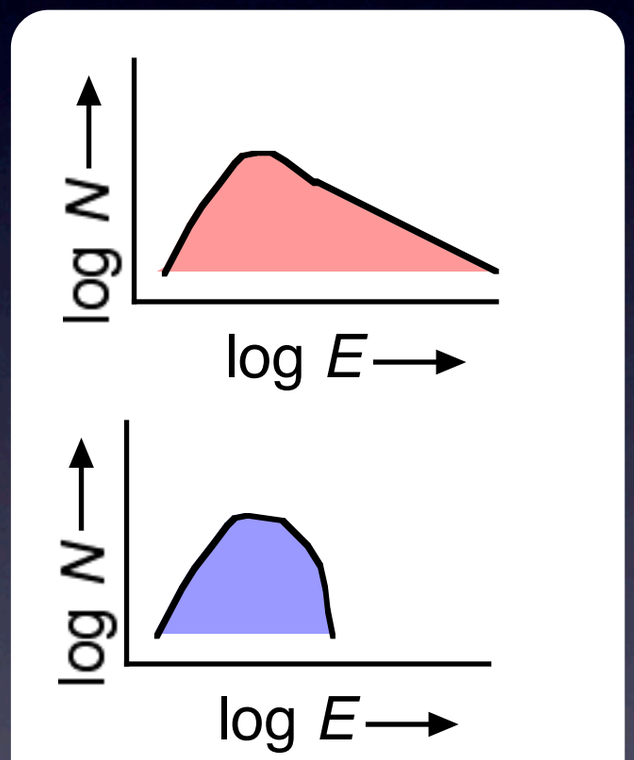
Accretion

Magnetic fields

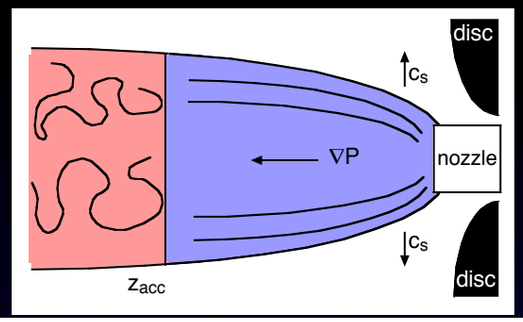
Rotation

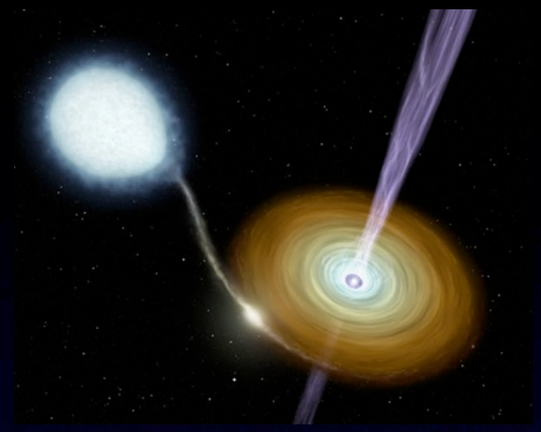
Acceleration region

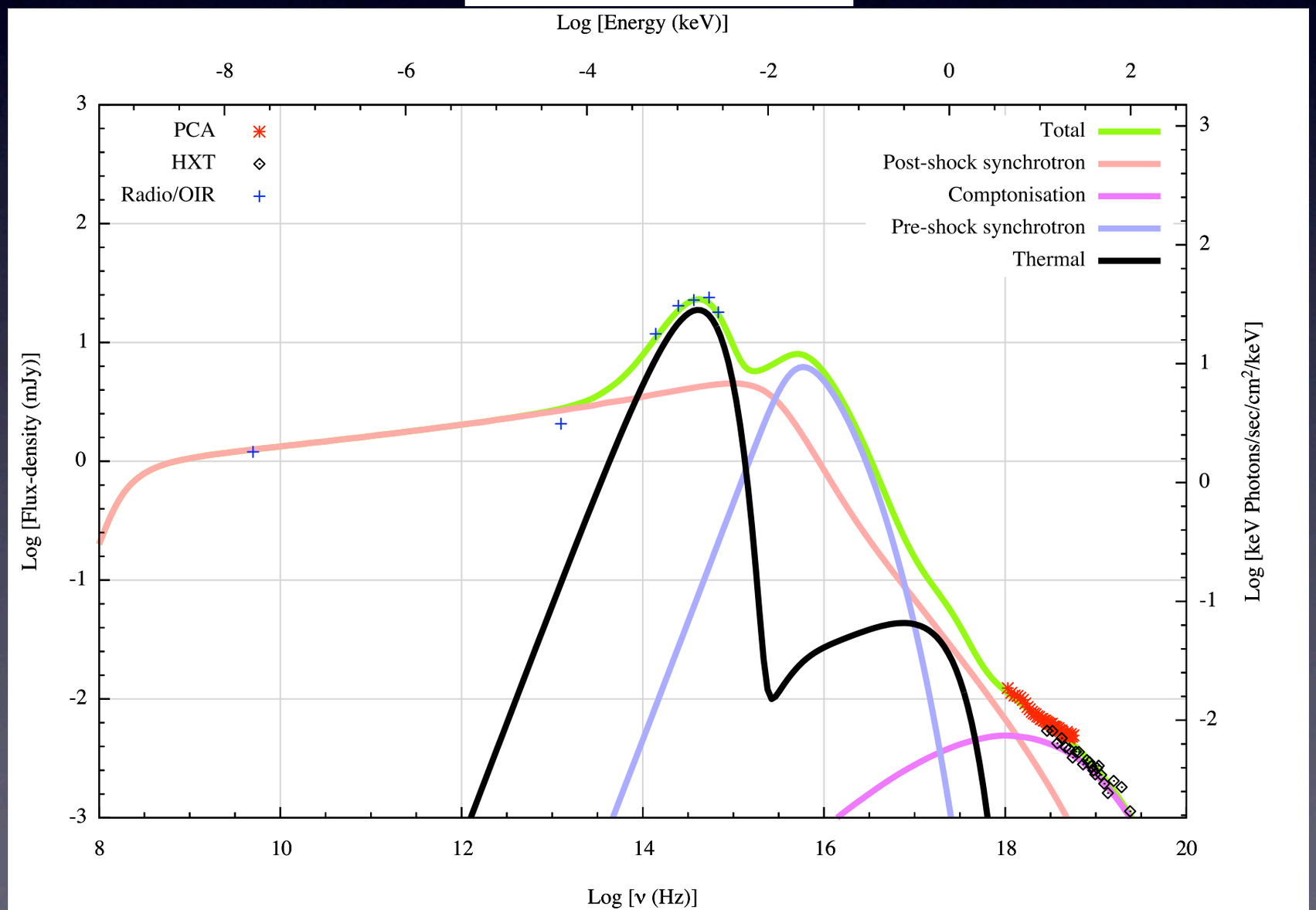




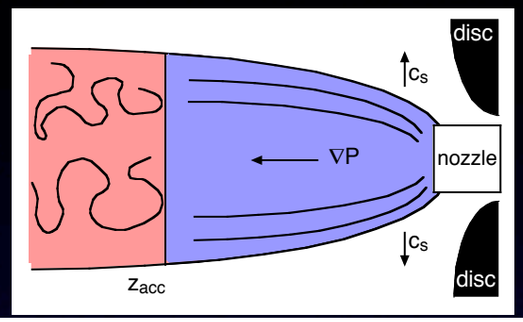
Spectral fitting

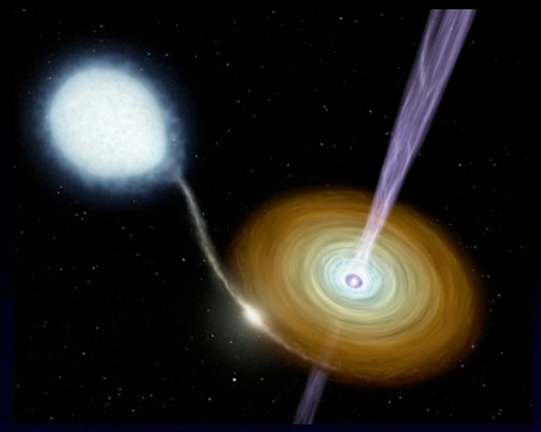


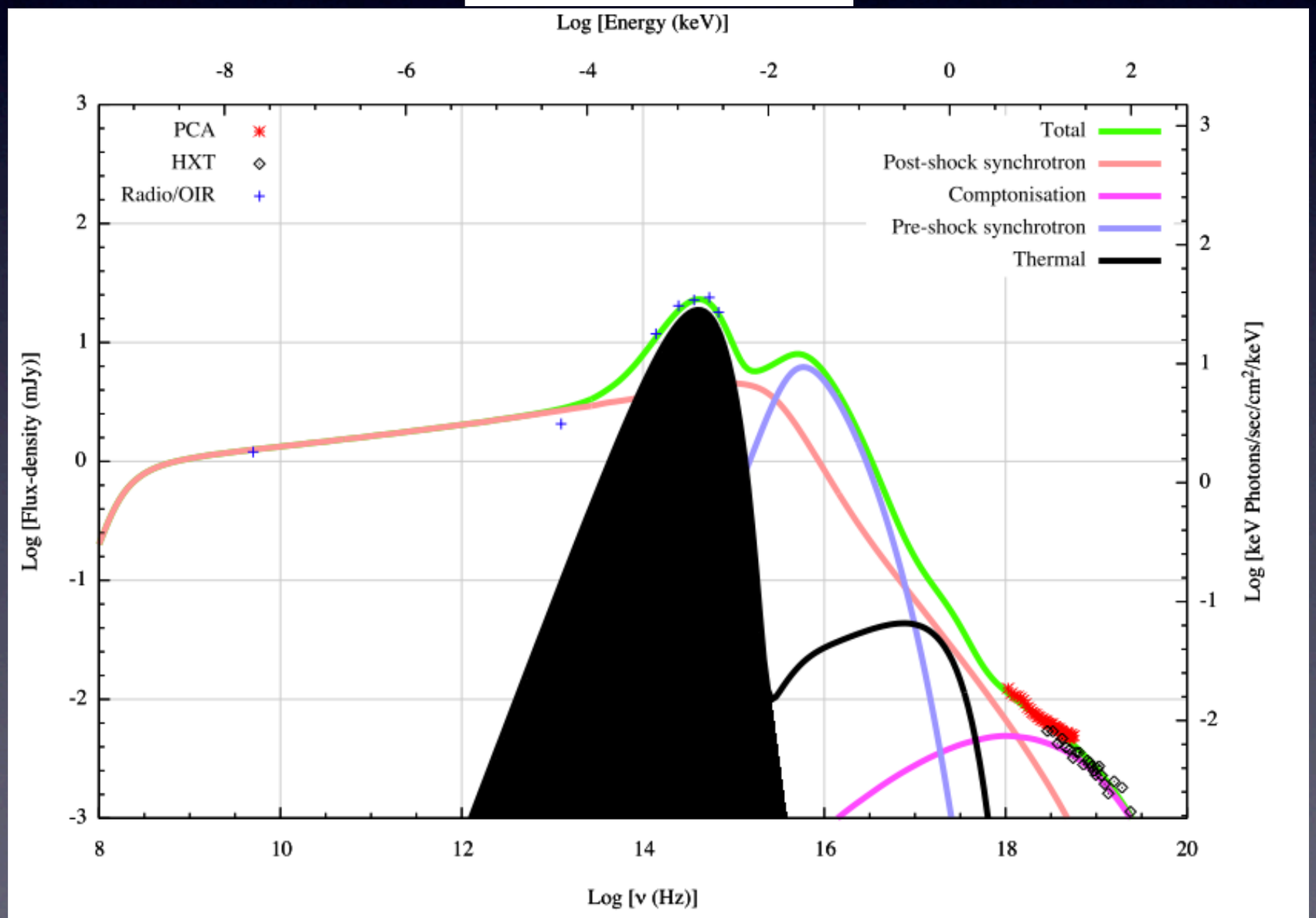




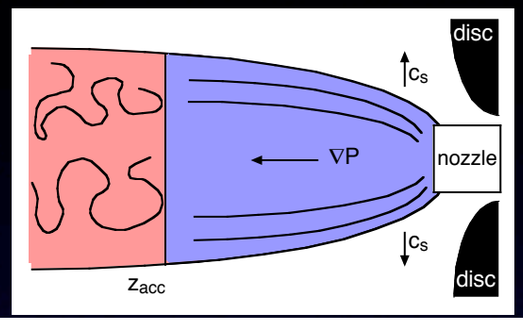
Spectral fitting

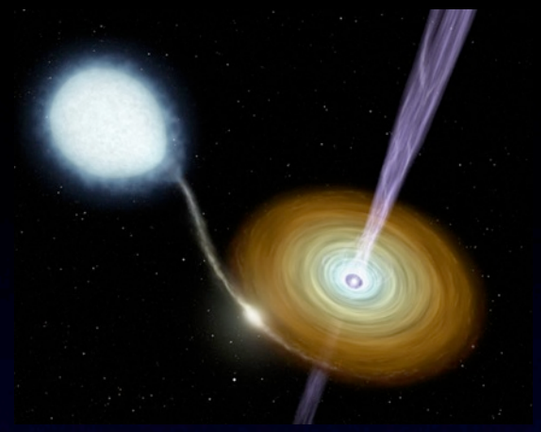


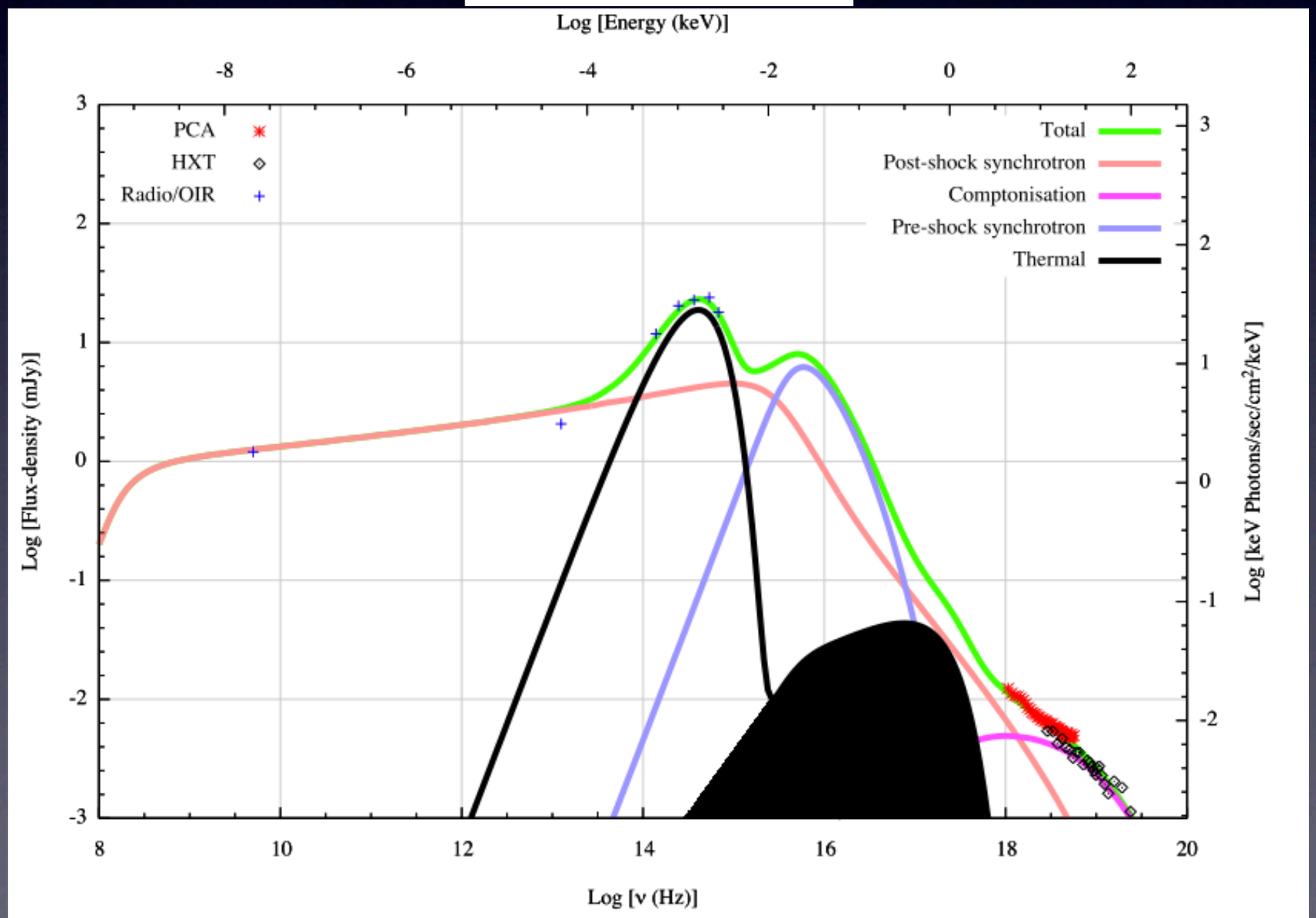




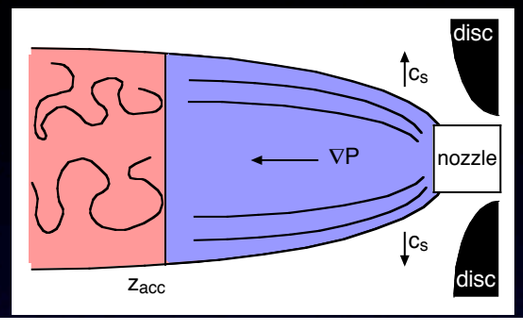
Spectral fitting

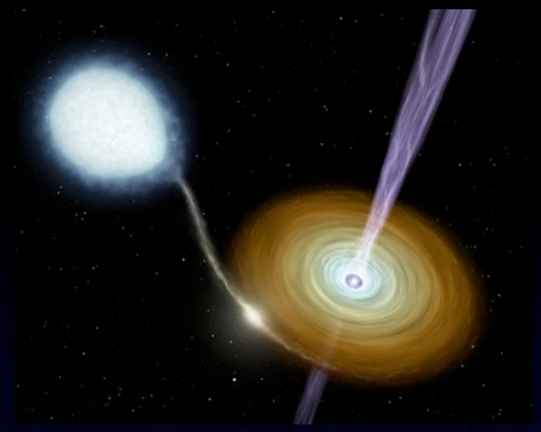


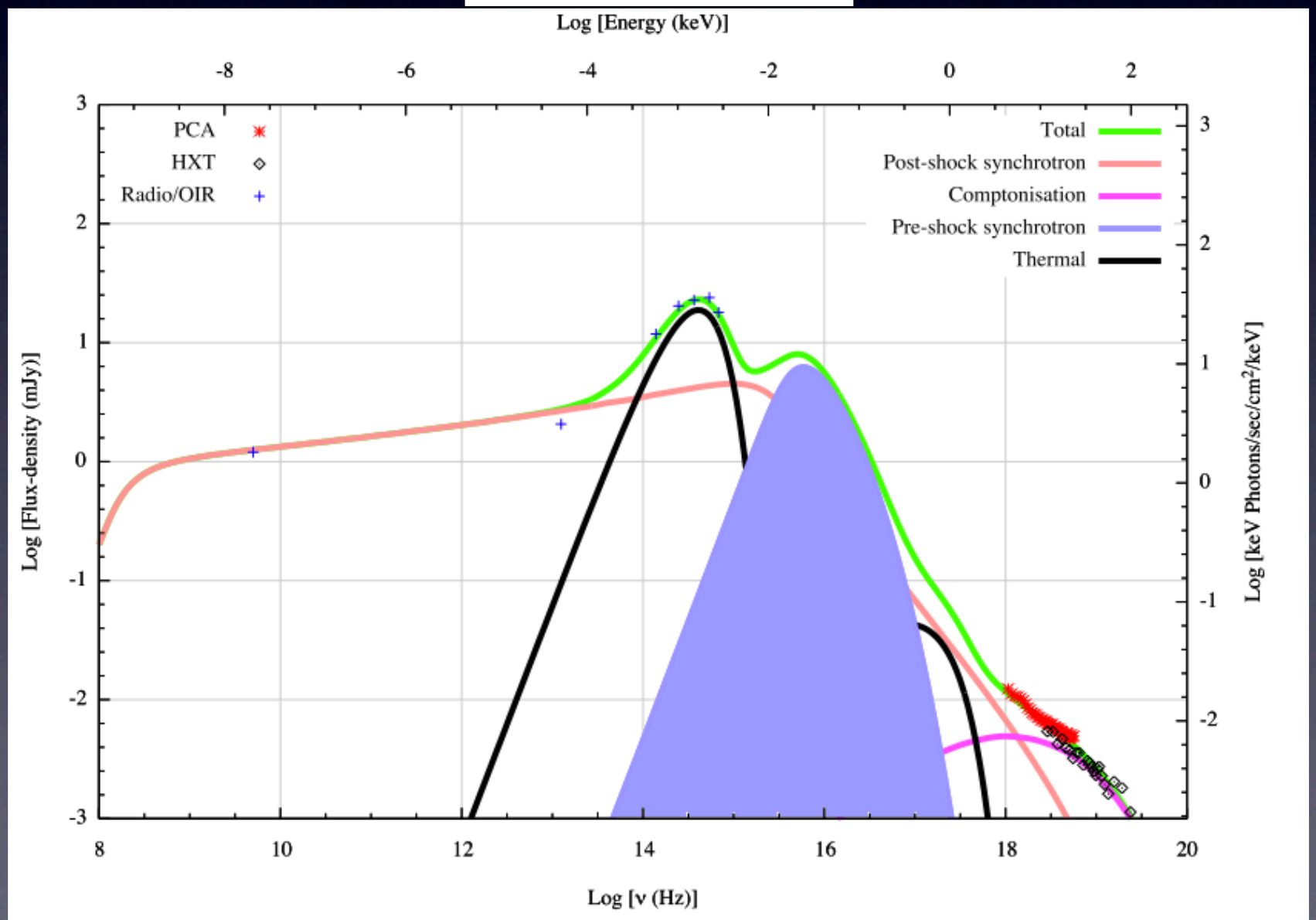




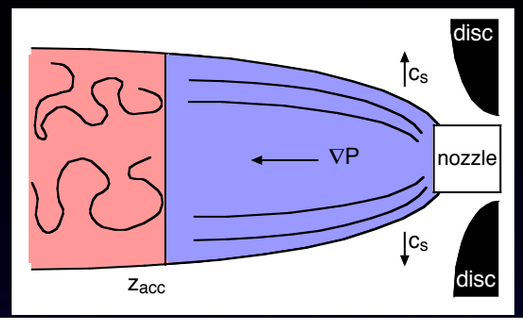
Spectral fitting

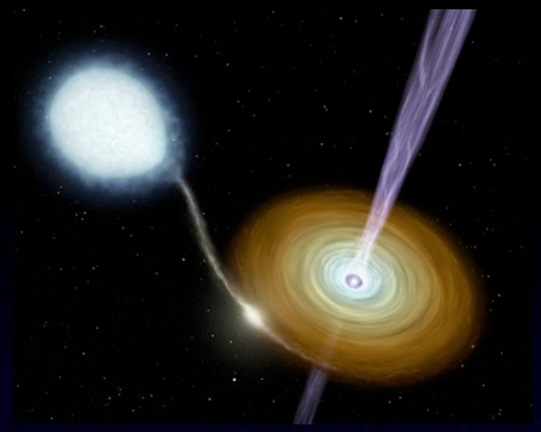


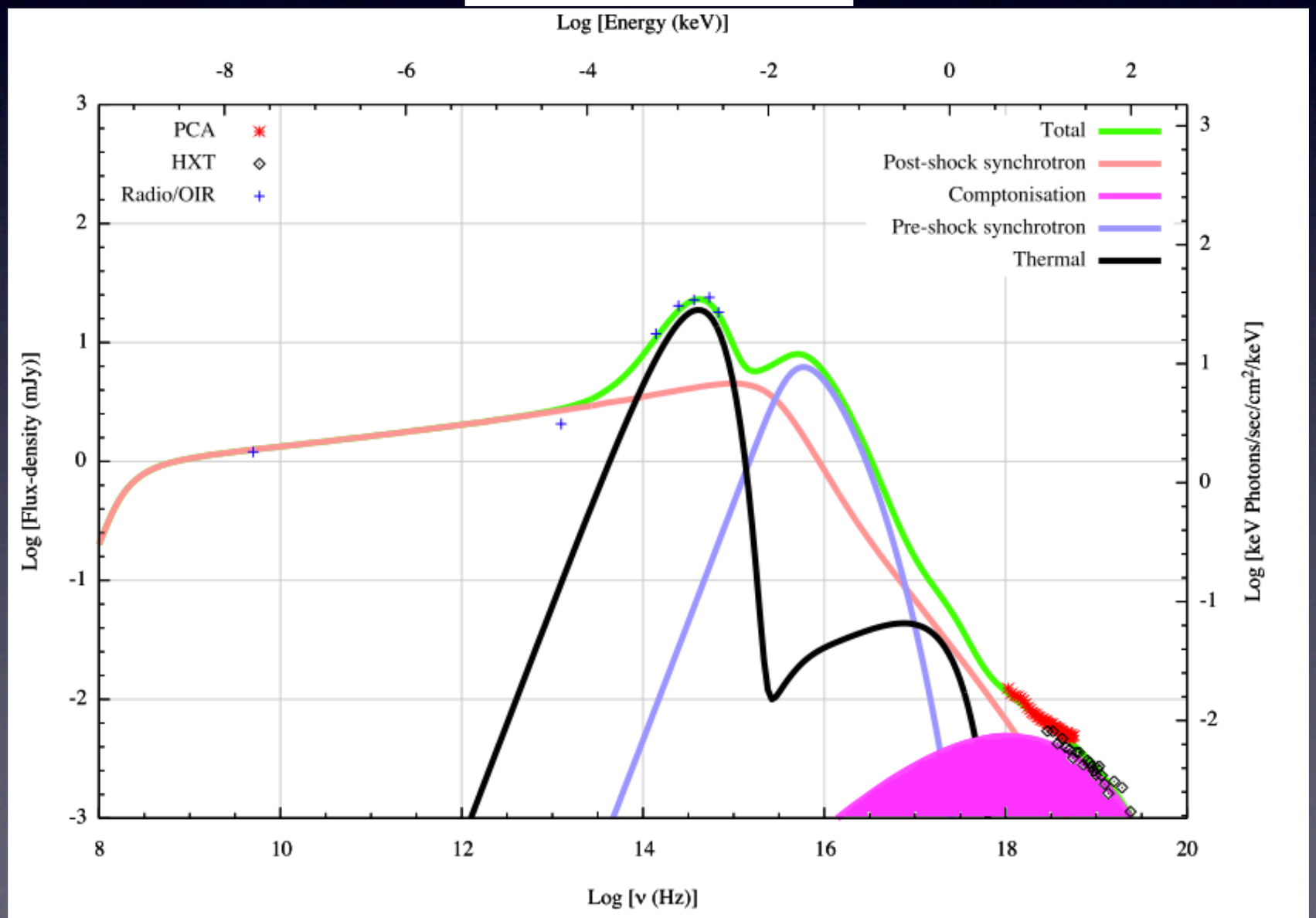




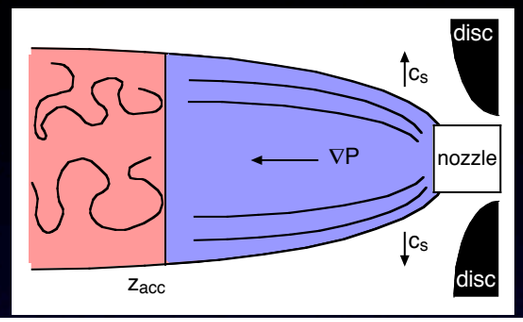
Spectral fitting

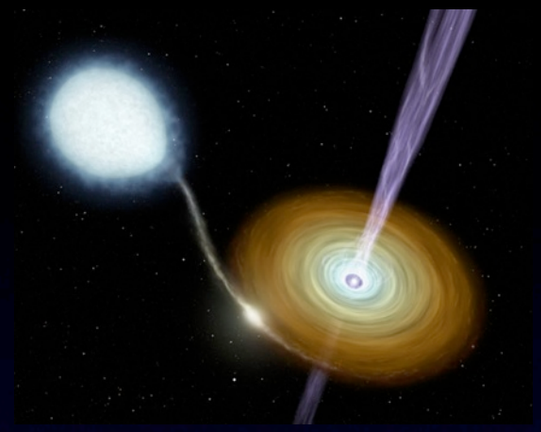


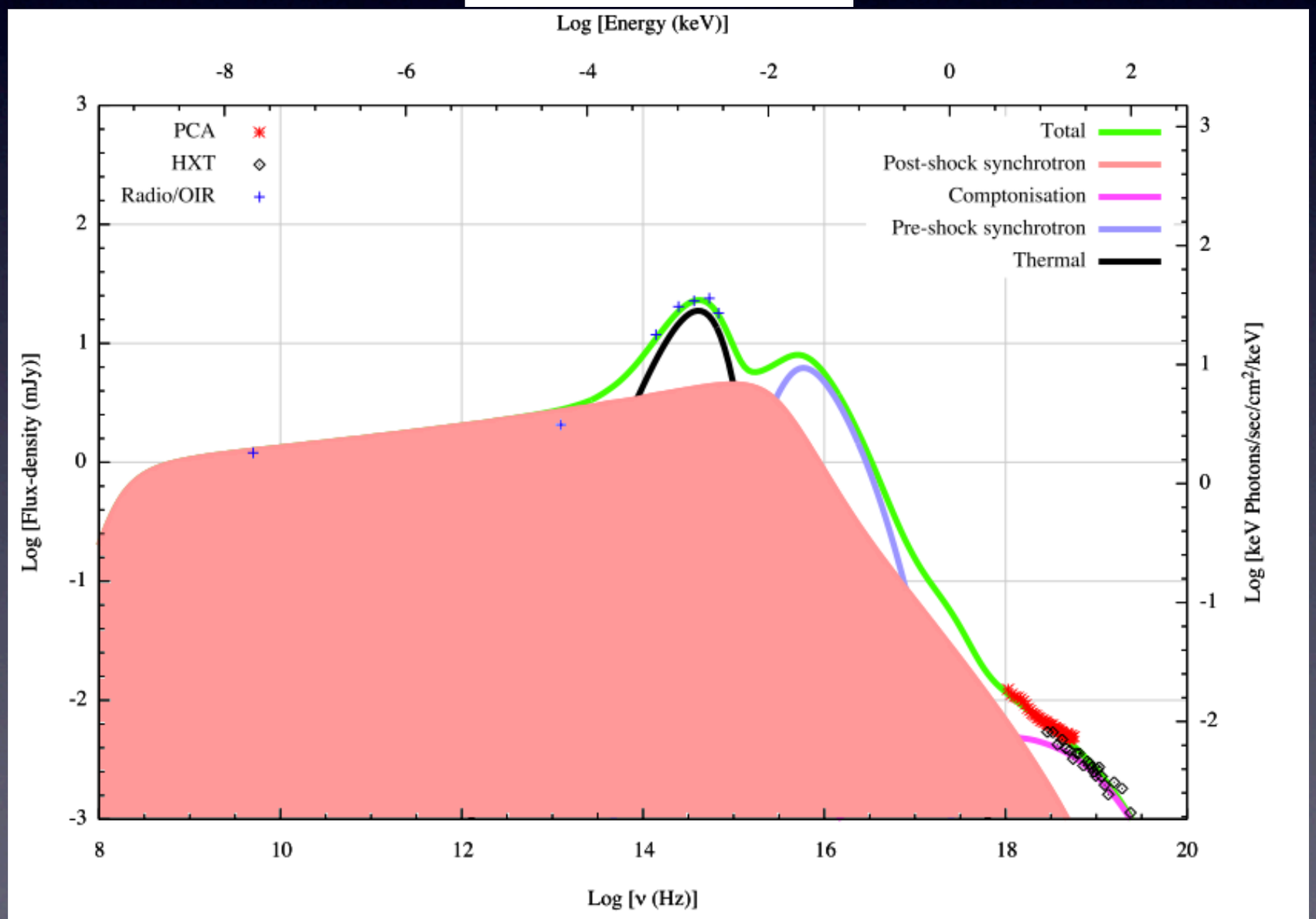




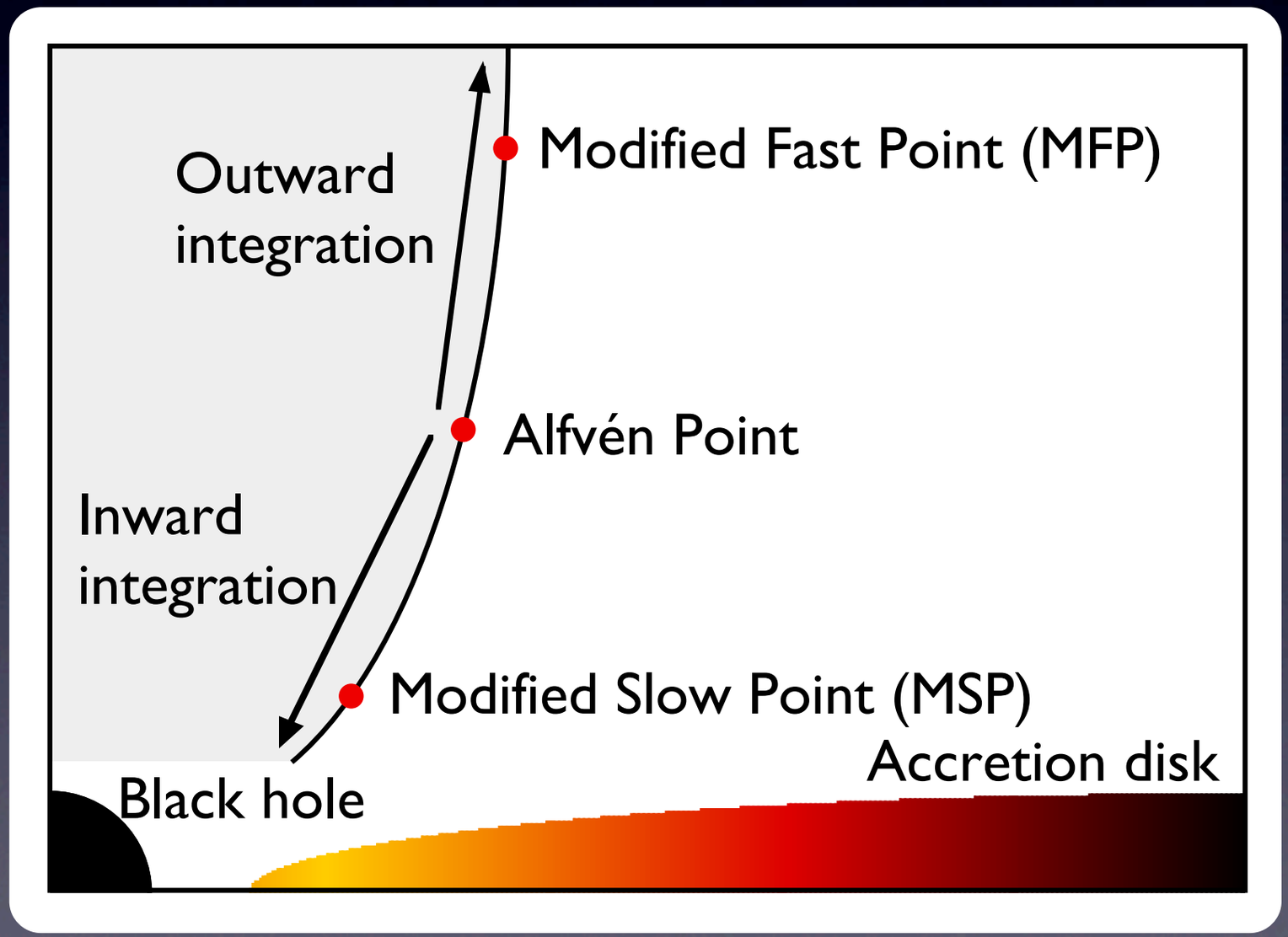
Spectral fitting





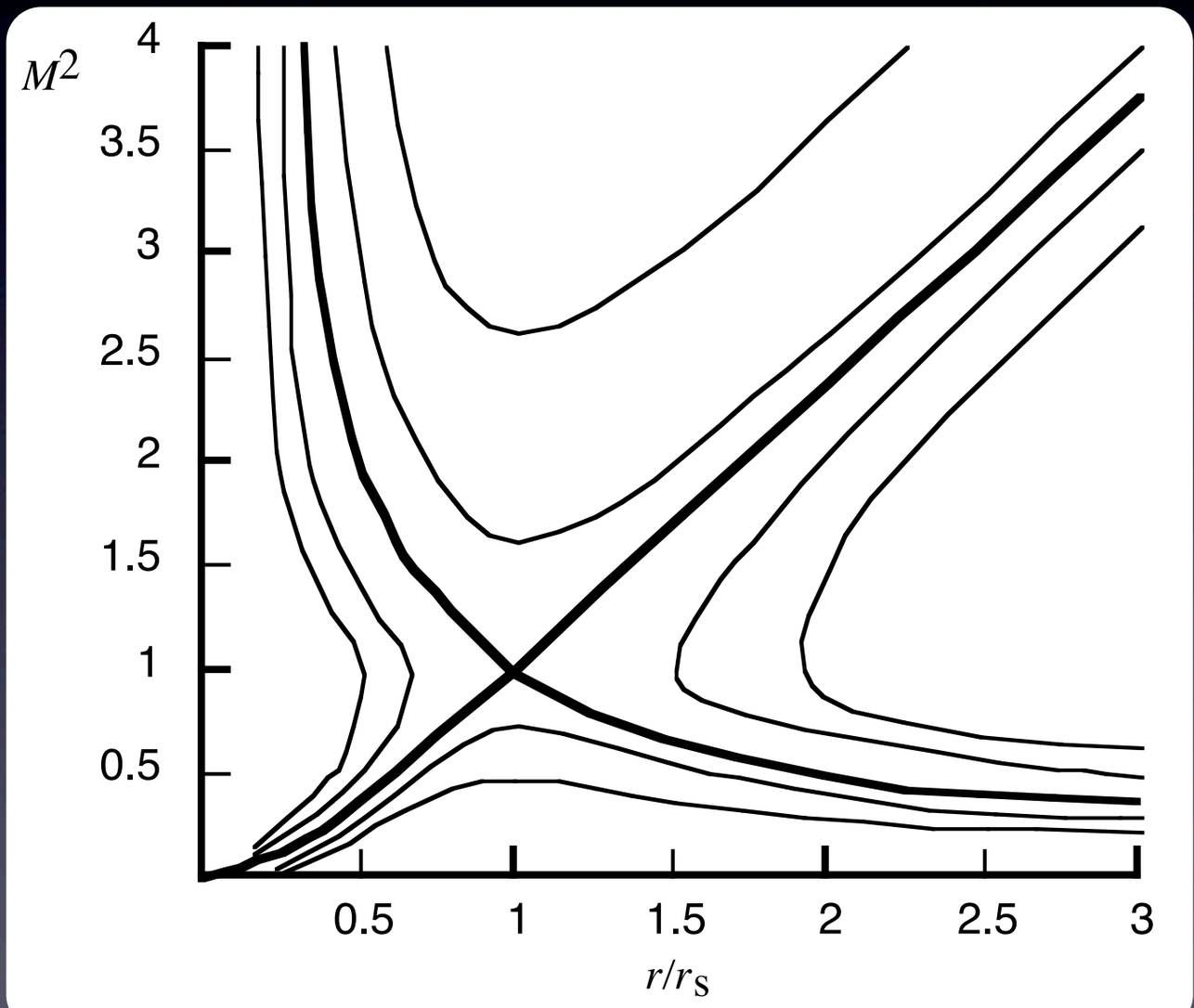


Critical surfaces

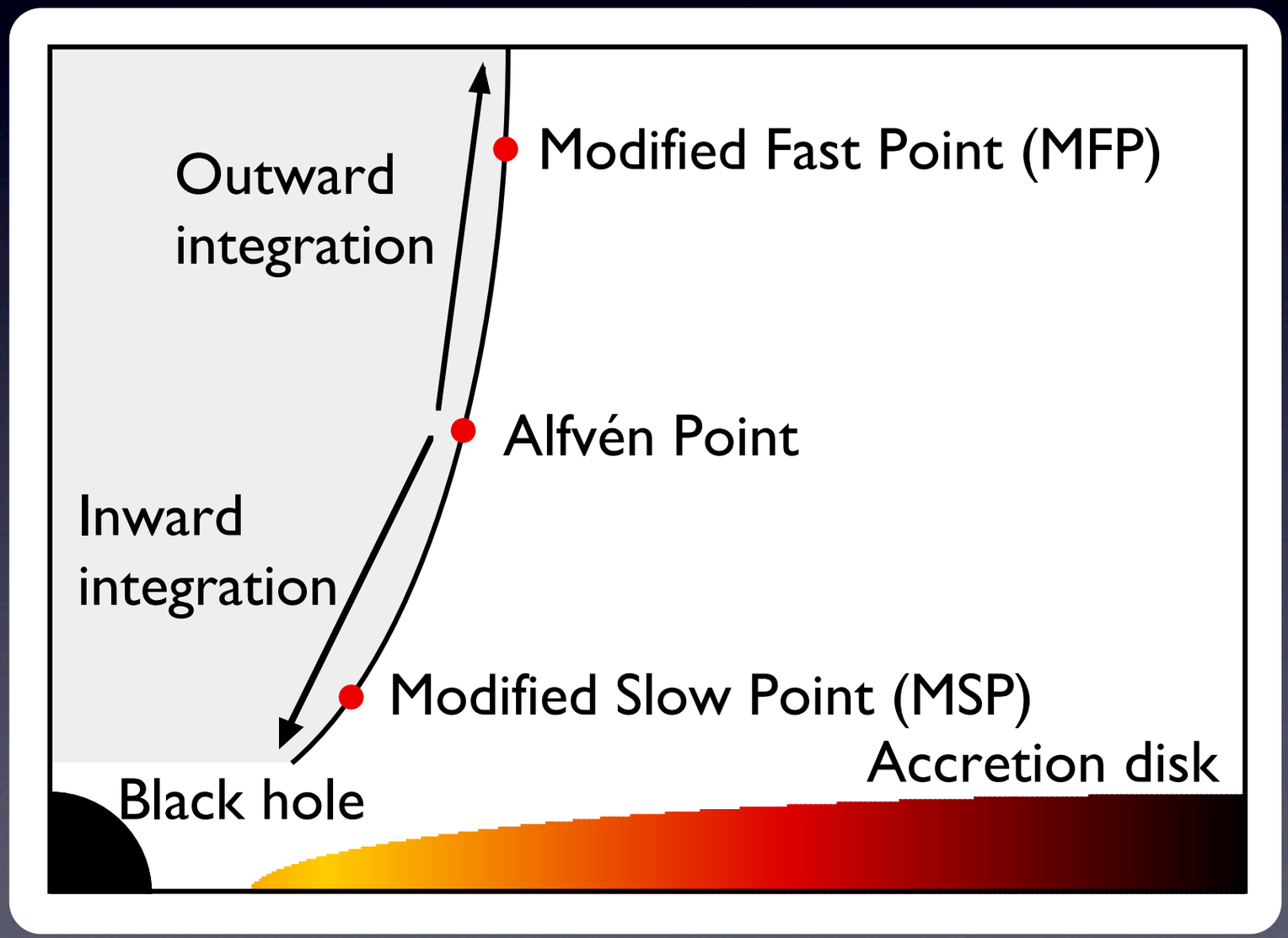


Parker wind

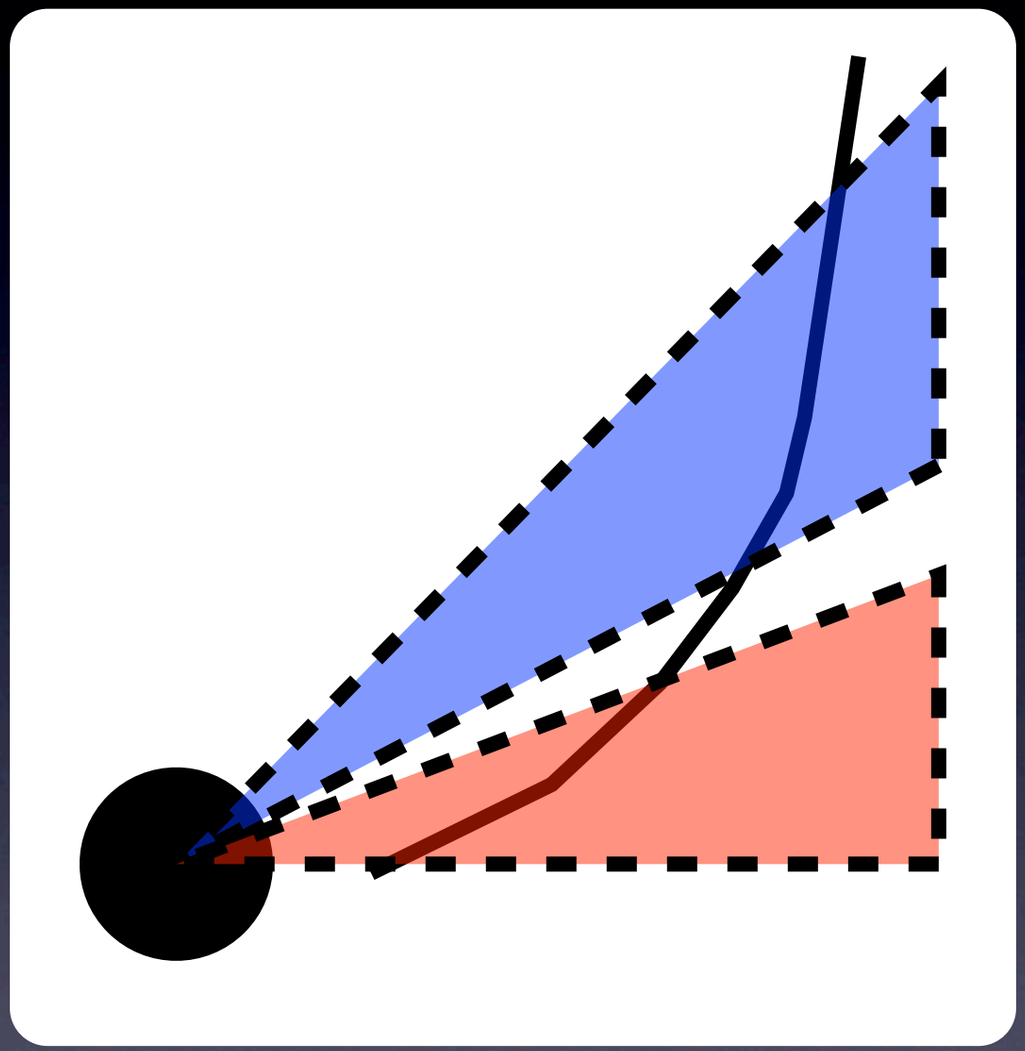
$$\frac{\mathrm{d}v^2}{\mathrm{d}r} = -\frac{2GM}{r^2}\left[\frac{1-\left(\dfrac{2c_\mathrm{s}^2 r}{GM}\right)}{1-\dfrac{c_\mathrm{s}^2}{v^2}}\right]$$



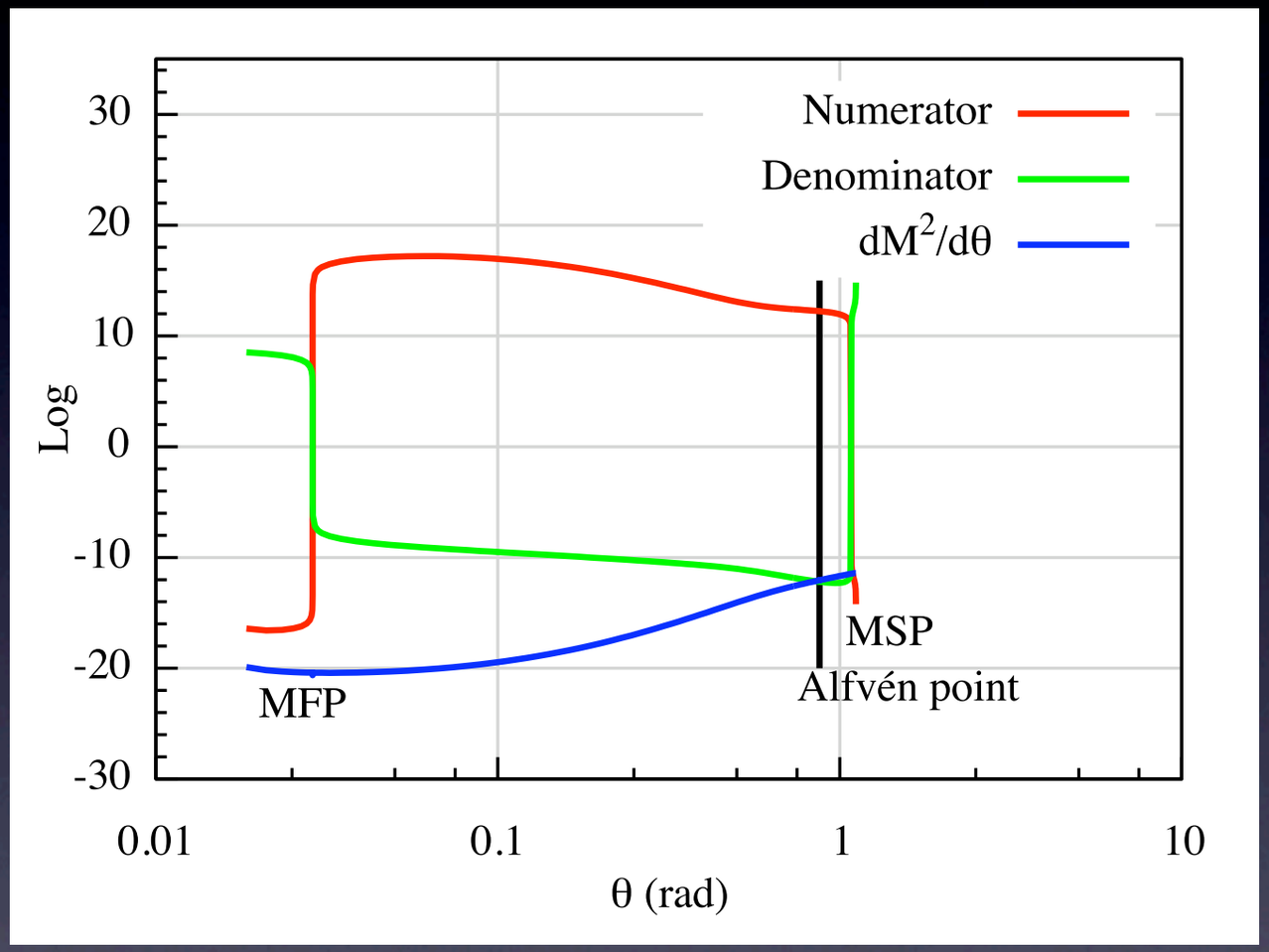
Singular surfaces

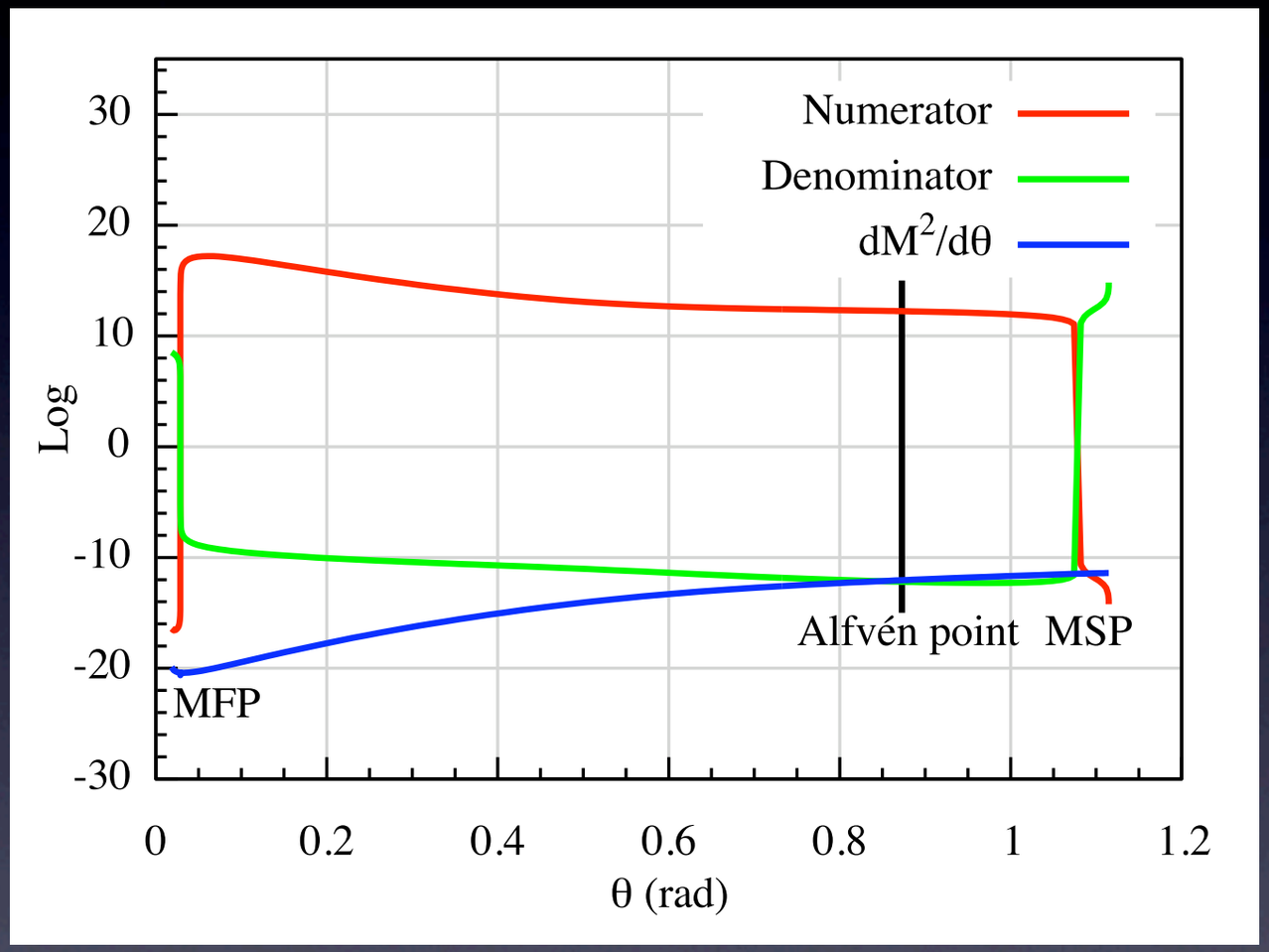


Combined solution

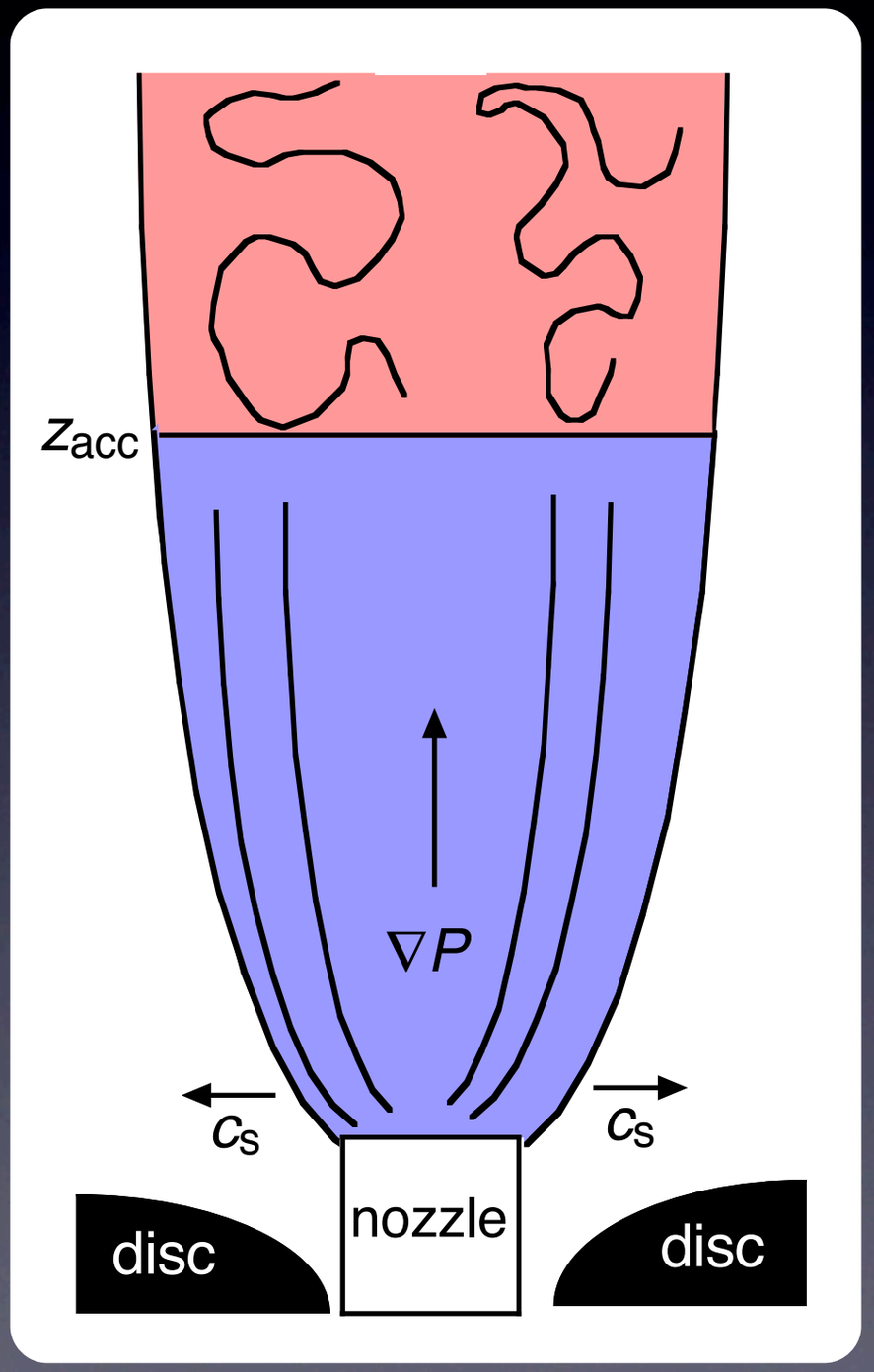


Critical solution



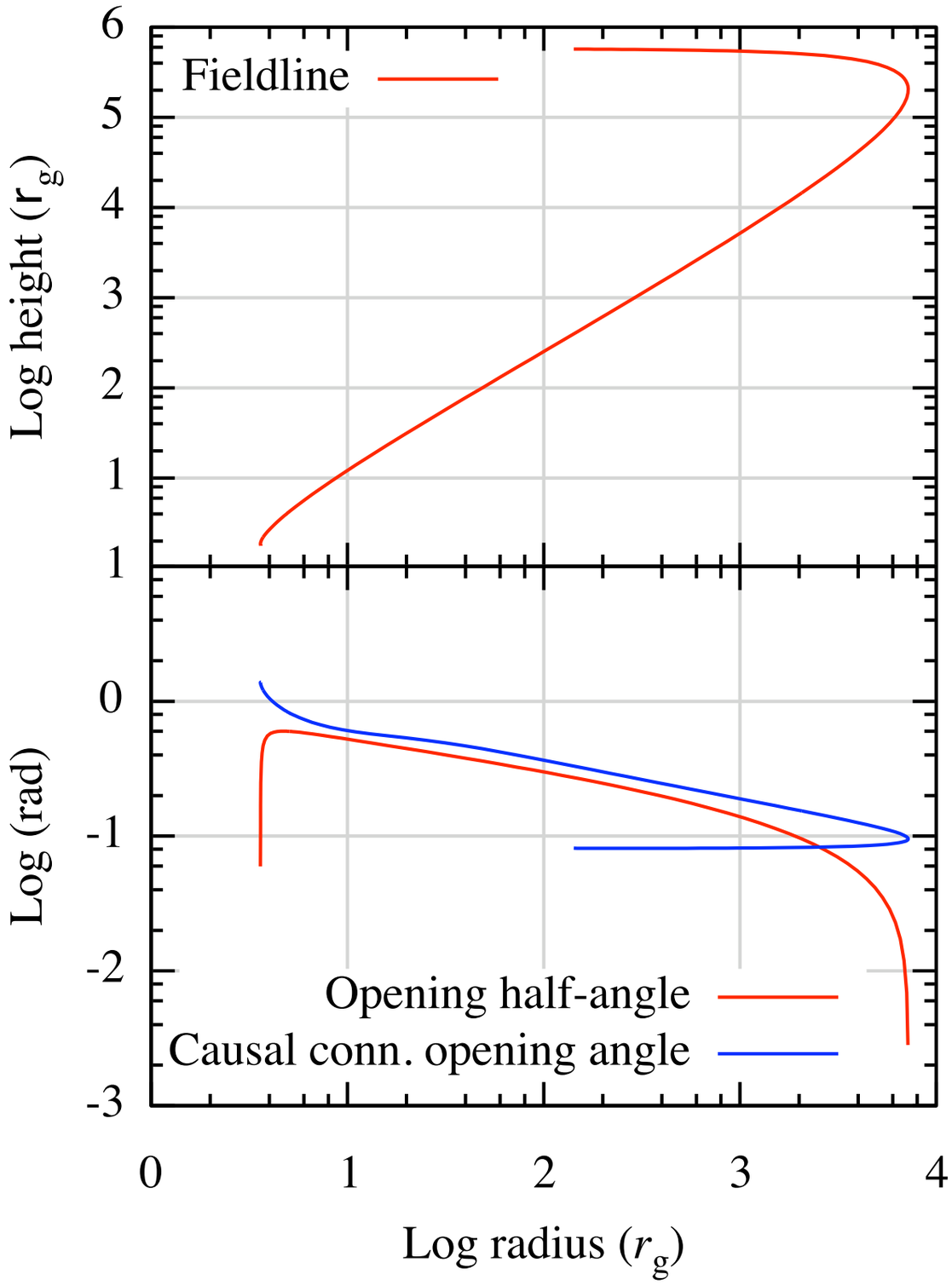


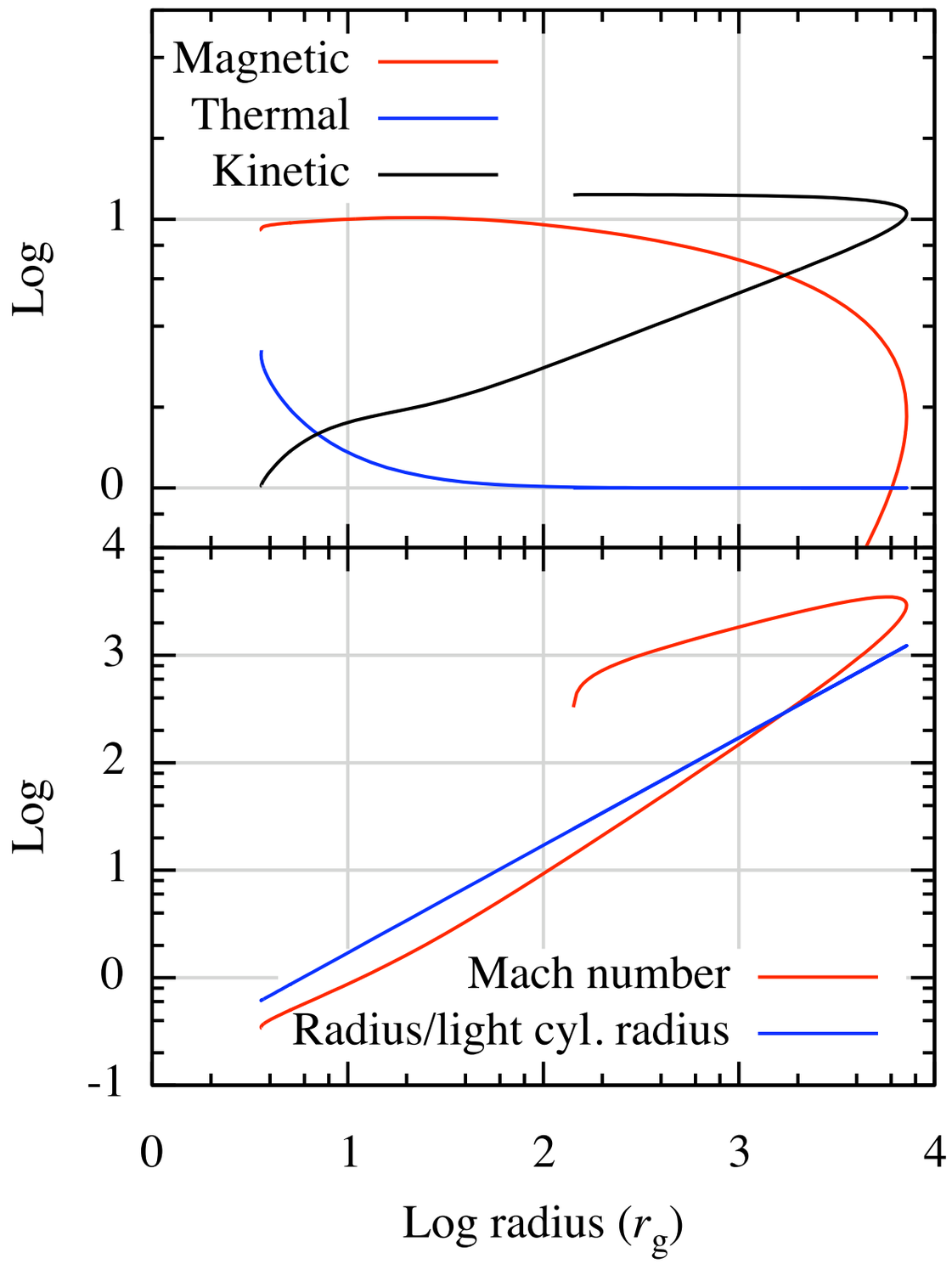
Connections

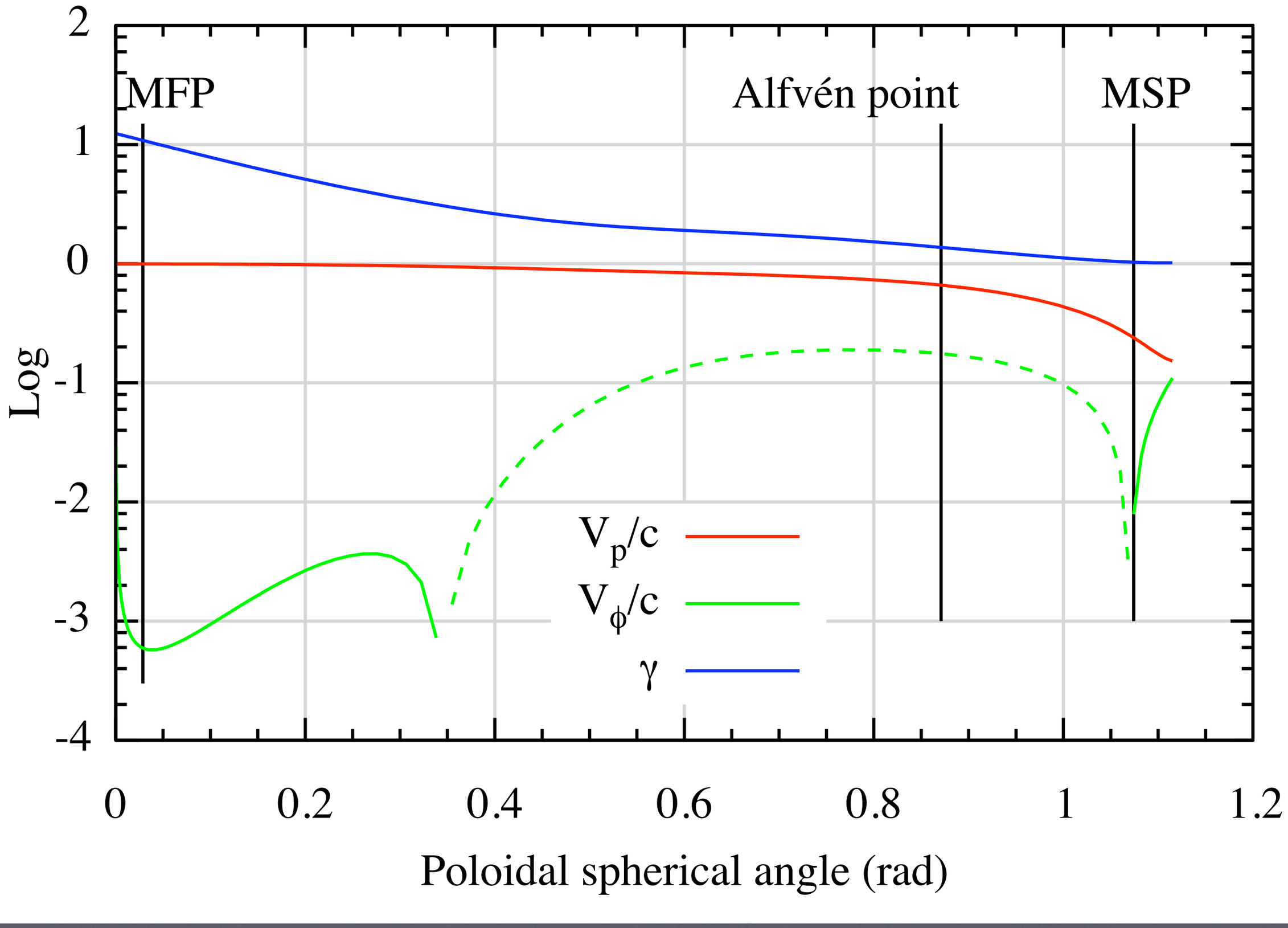


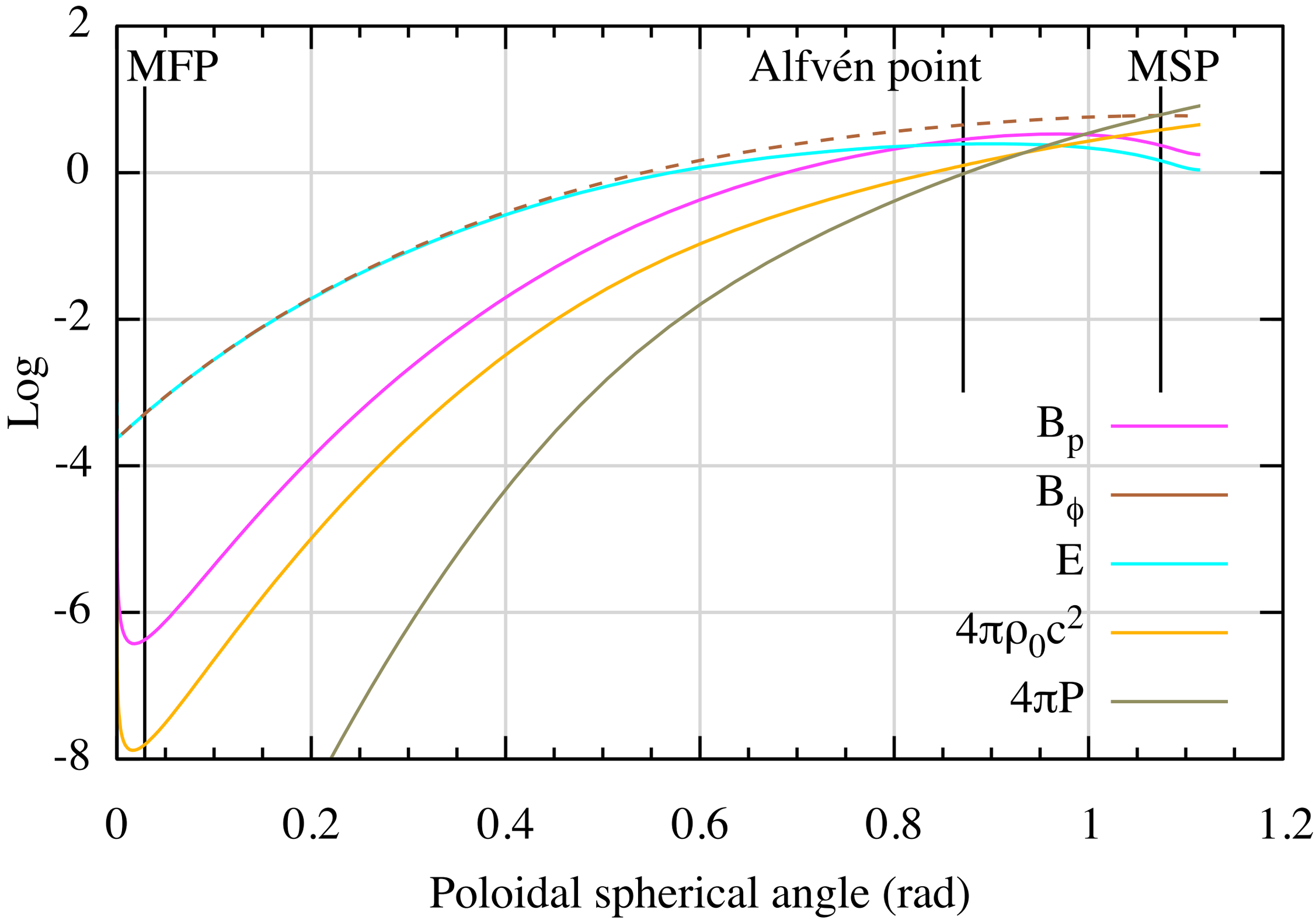
Conclusions

- The shock location helps us understand the spectrum
- Self-consistent model to determine shock location


Fieldline
Log height (r_g)
Opening half-angle
Causal conn. opening angle
Log (rad)
Log radius (r_g)


Magnetic
Thermal
Kinetic
Log
Mach number
Radius/light cyl. radius
Log
Log radius (r_g)


MFP
Alfvén point
MSP
2
1
0
-1
-2
-3
-4
Log
V_p/c
V_ϕ/c
γ
0
0.2
0.4
0.6
0.8
1
1.2
Poloidal spherical angle (rad)


MFP
Alfvén point
MSP
2
0
-2
-4
-6
-8
Log
B_p
B_ϕ
E
$4\pi\rho_0 c^2$
$4\pi P$
0
0.2
0.4
0.6
0.8
1
1.2
Poloidal spherical angle (rad)