



Lyman Edges in Supermassive BH Binaries

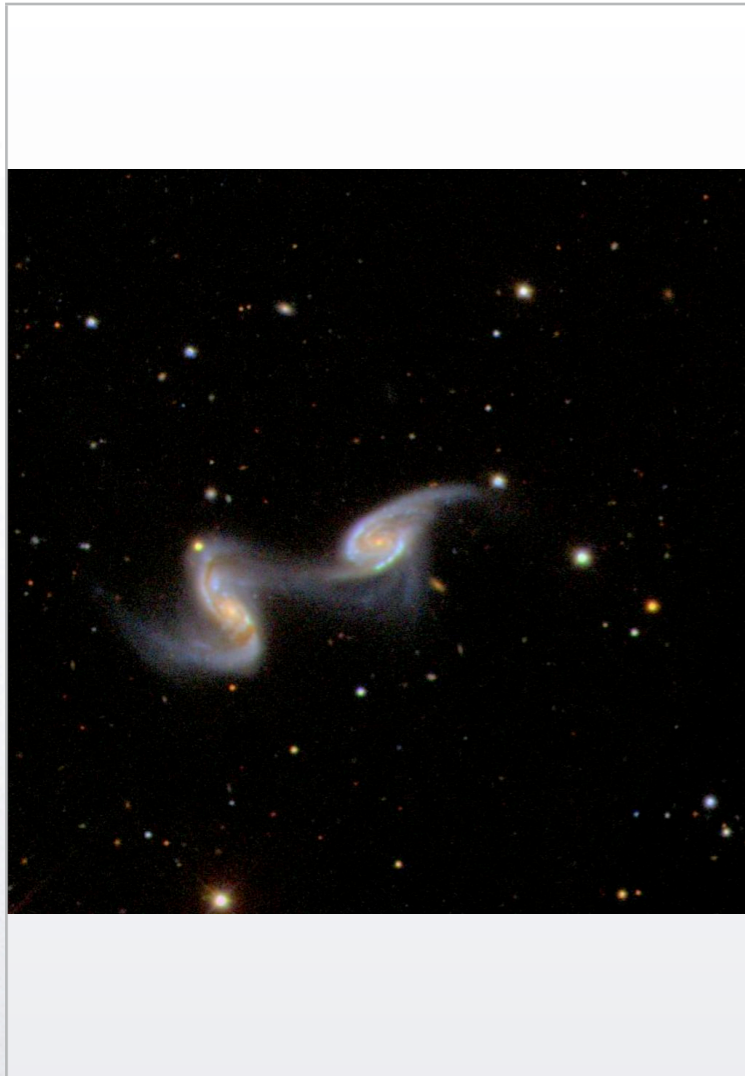
Aleksey Generozov
Zoltan Haiman



Motivation

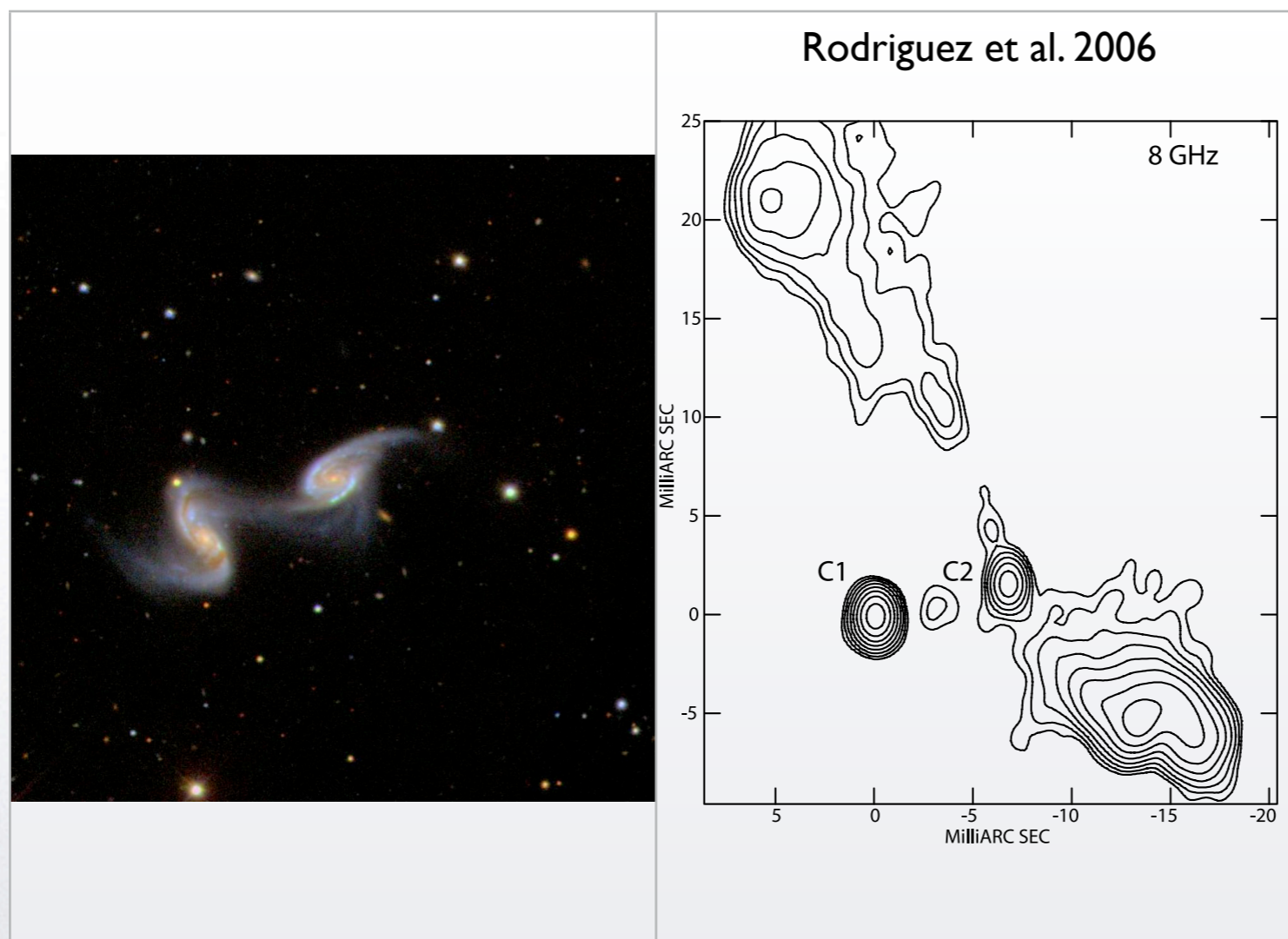


Motivation



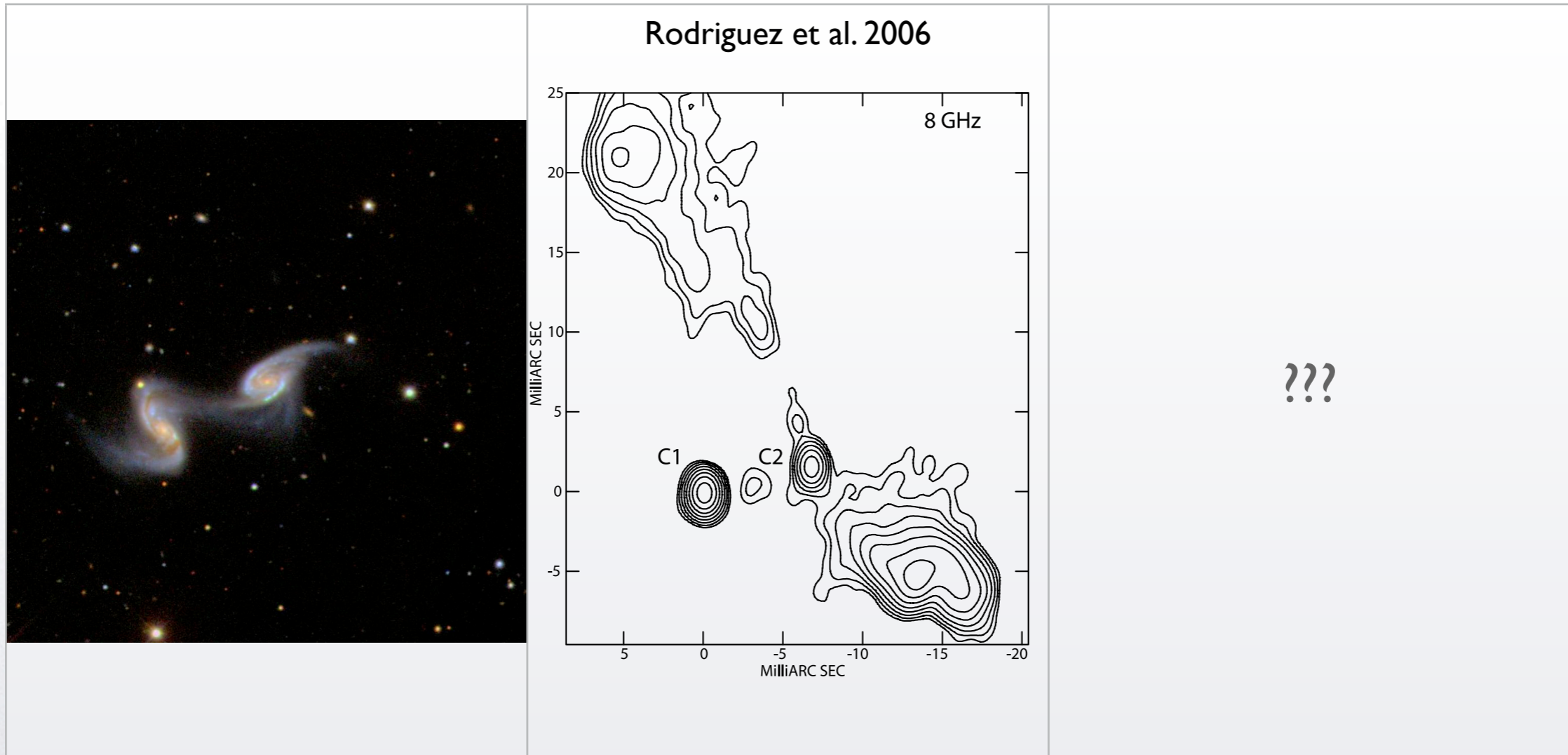


Motivation





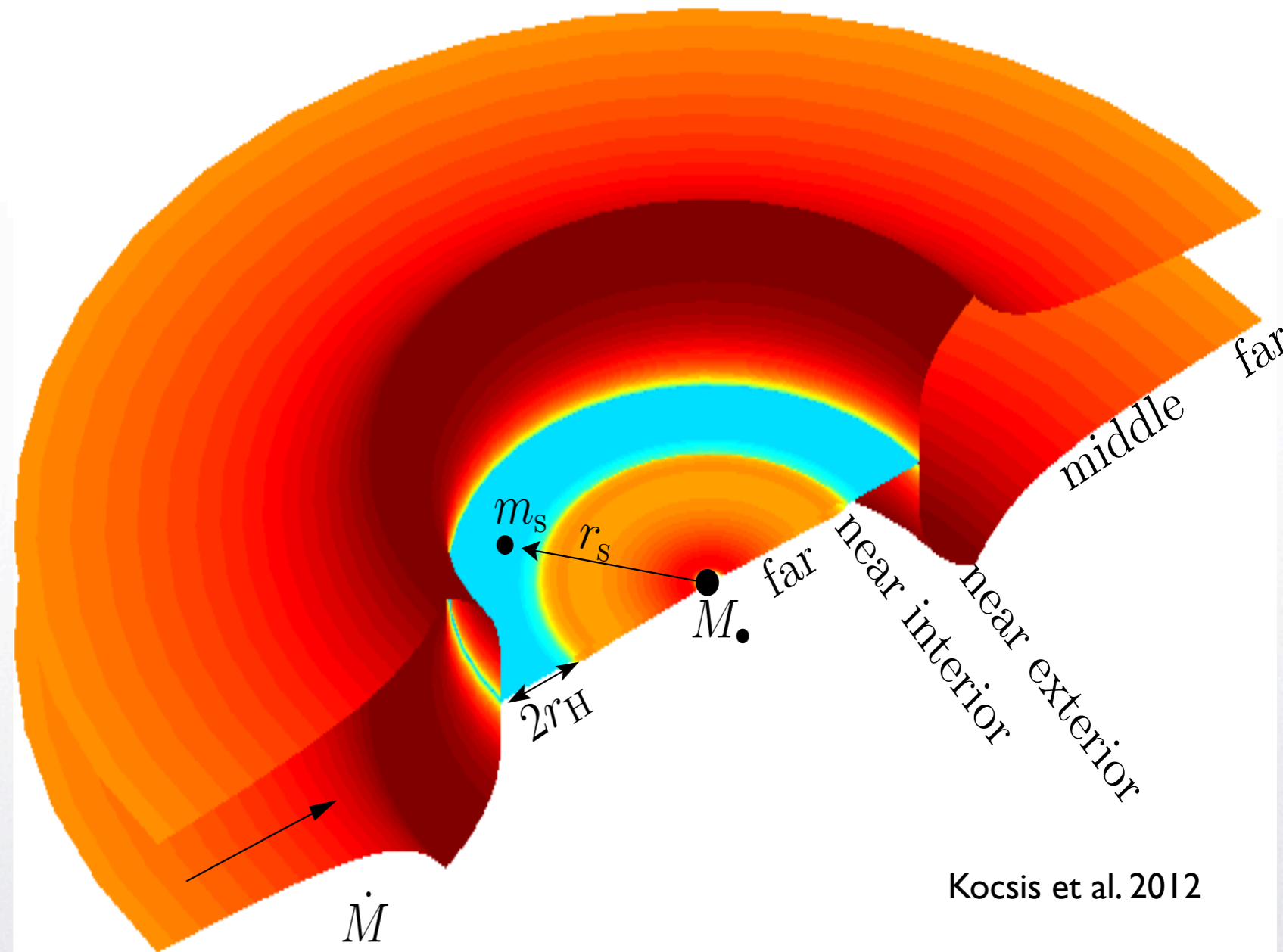
Motivation





Circumbinary disk

- Viscosity spreads the disk
- Torques clear material
- Gap forms in disk (??)

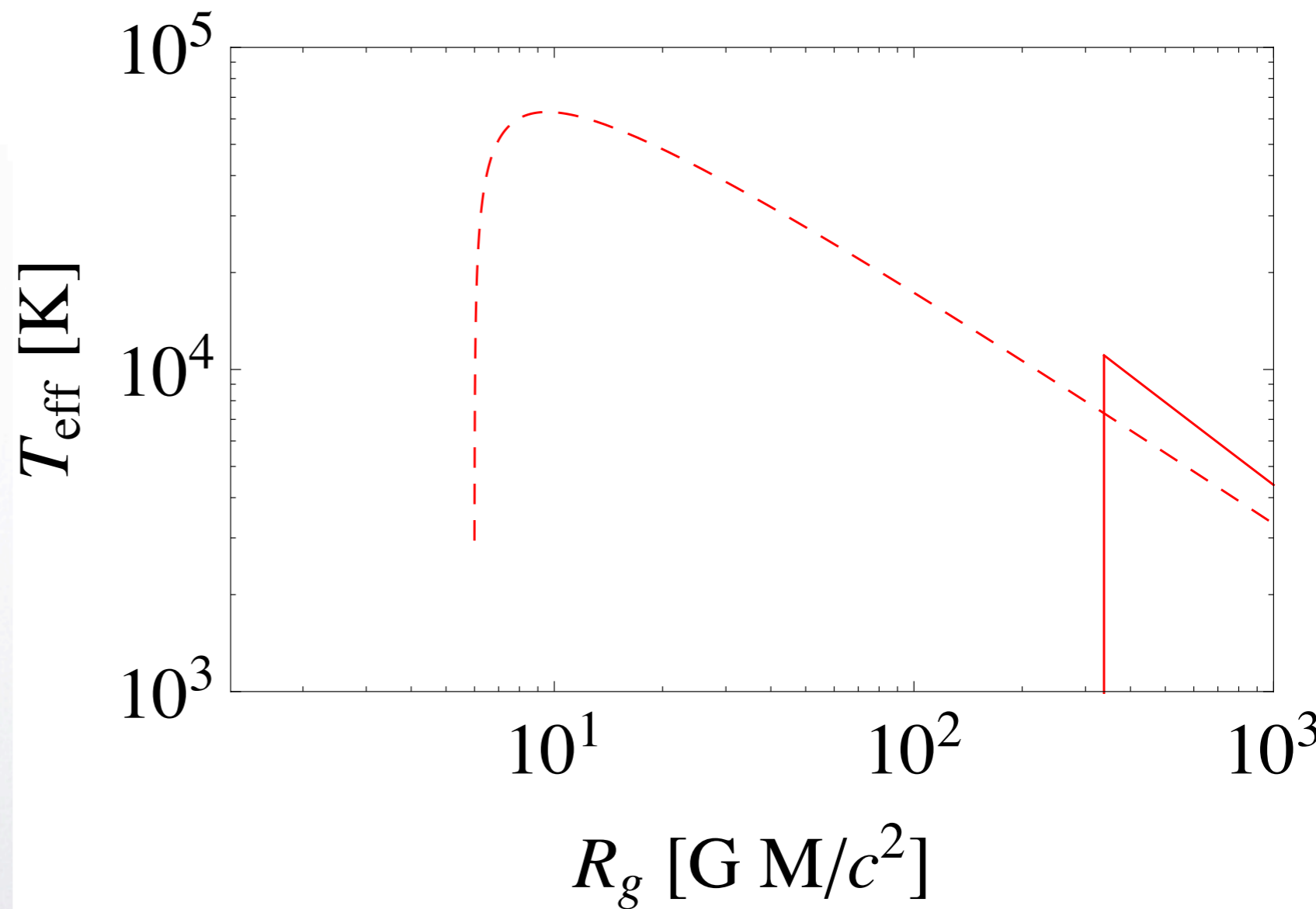


Kocsis et al. 2012



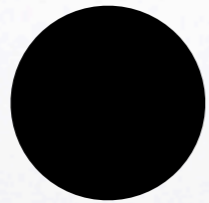
Single BH vs. Binary BH

- Binary disk truncated
- Cooler
- Neutral H



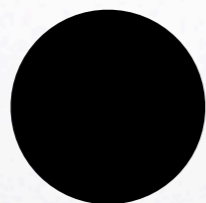


M





M

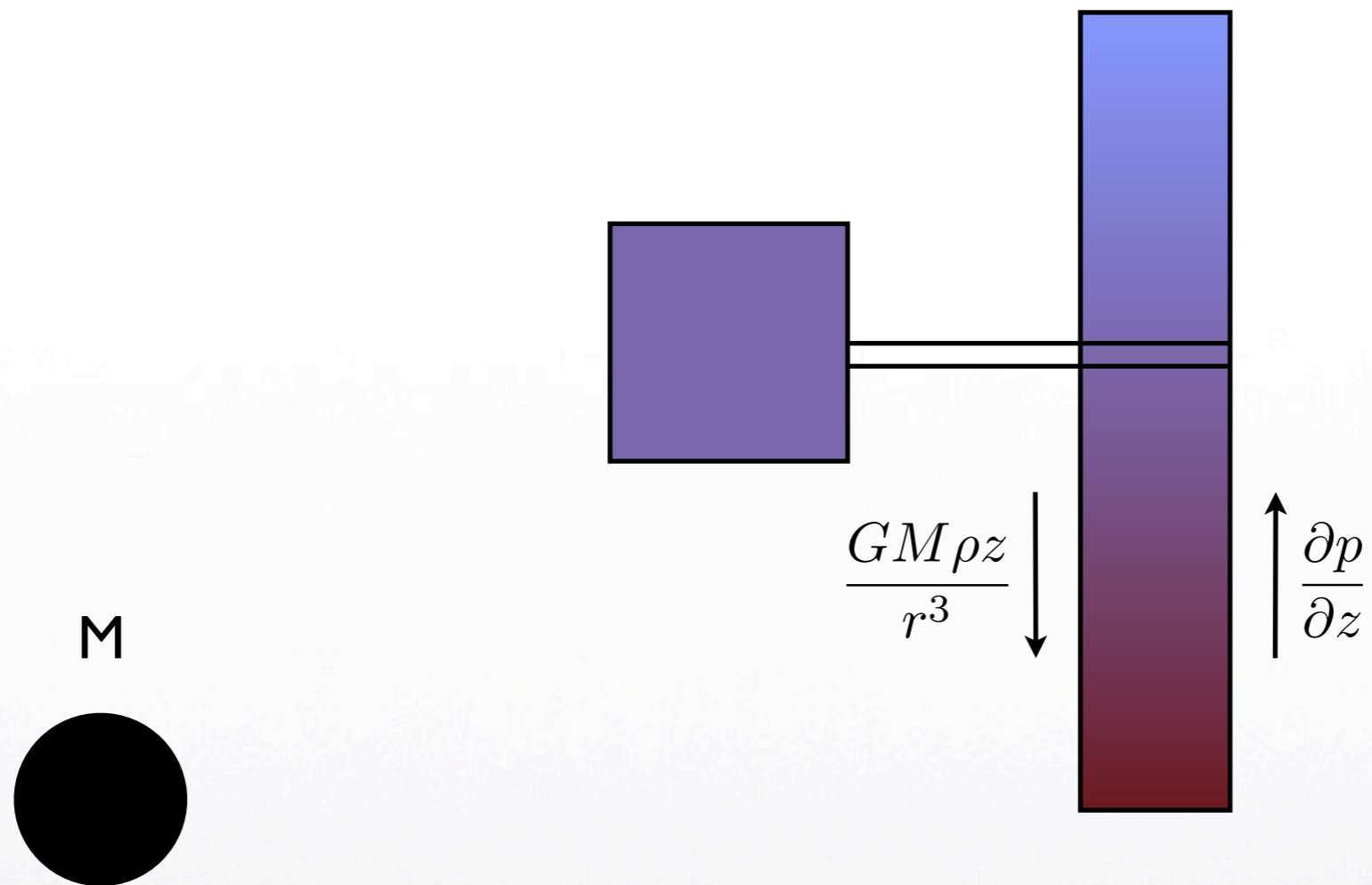


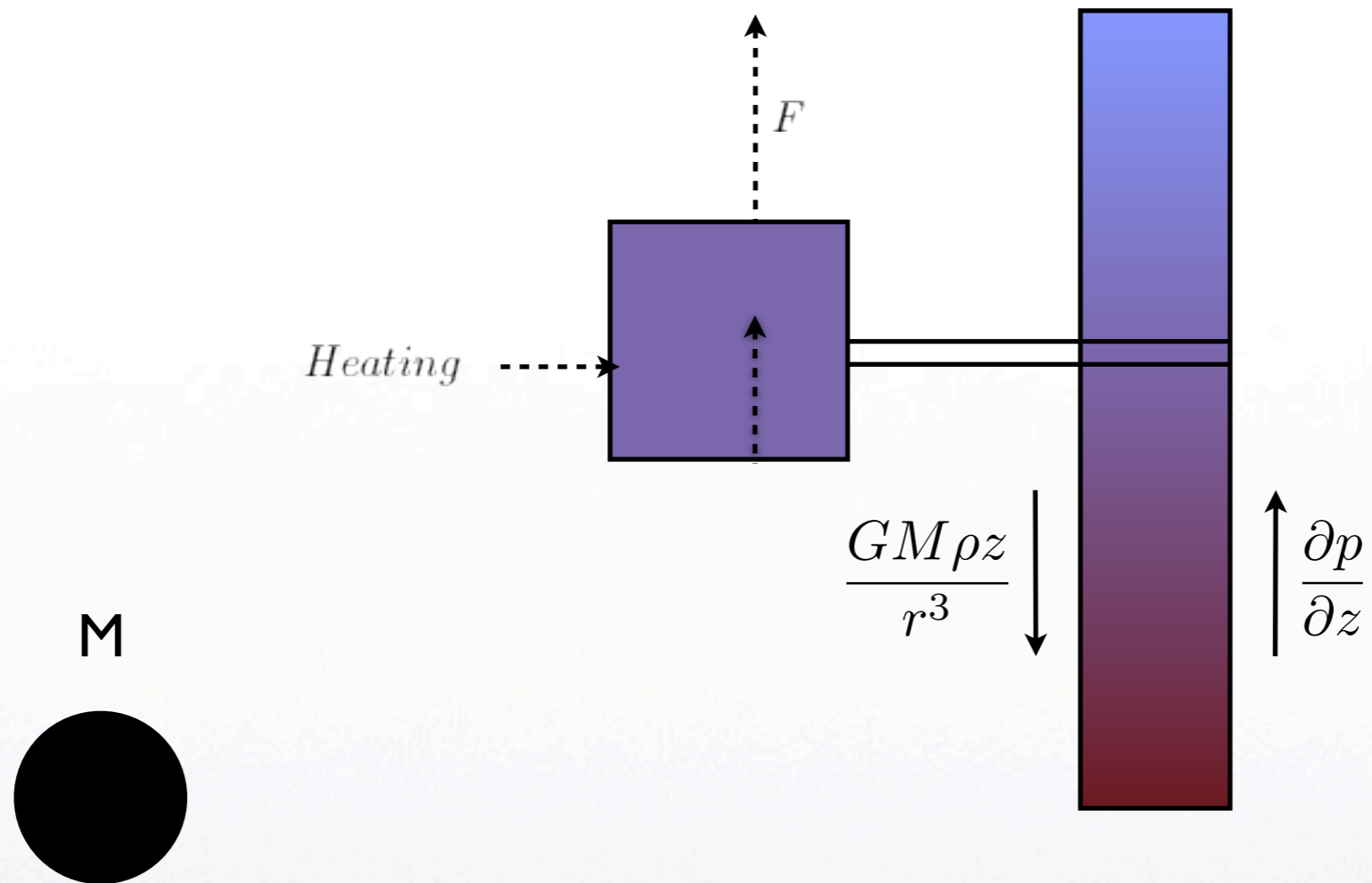


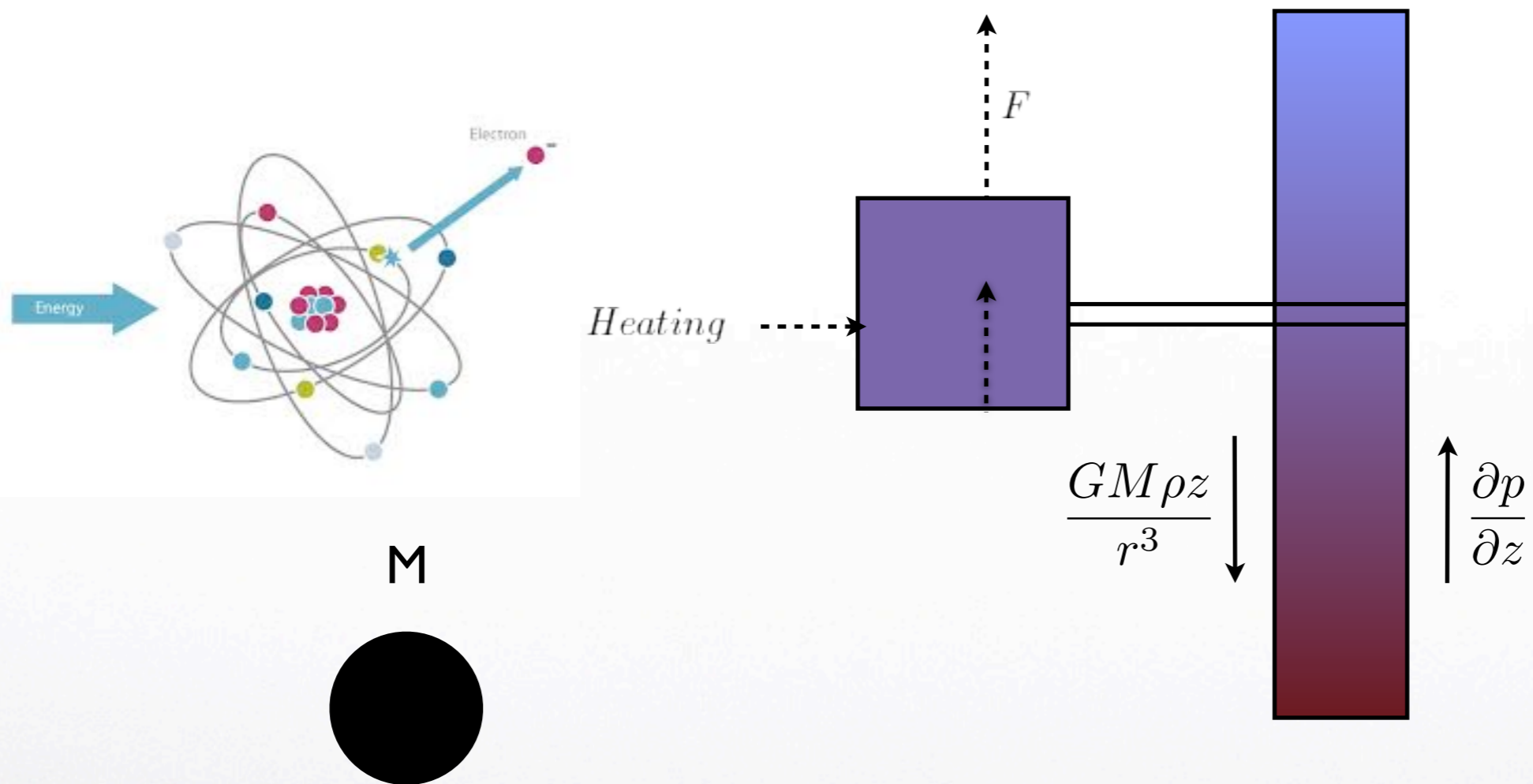
$$\frac{GM\rho z}{r^3}$$



$$\frac{\partial p}{\partial z}$$



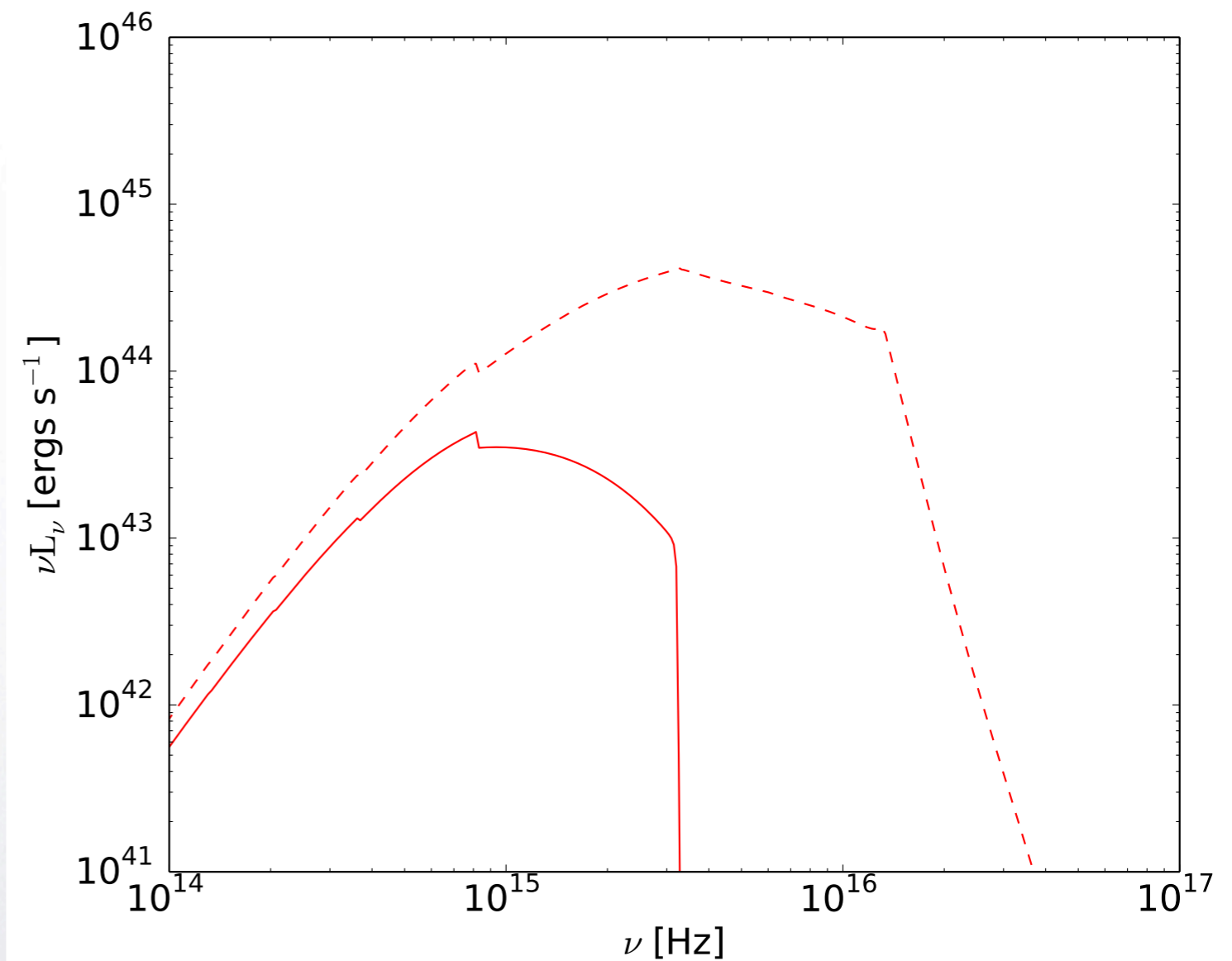






Single BH vs. Binary BH

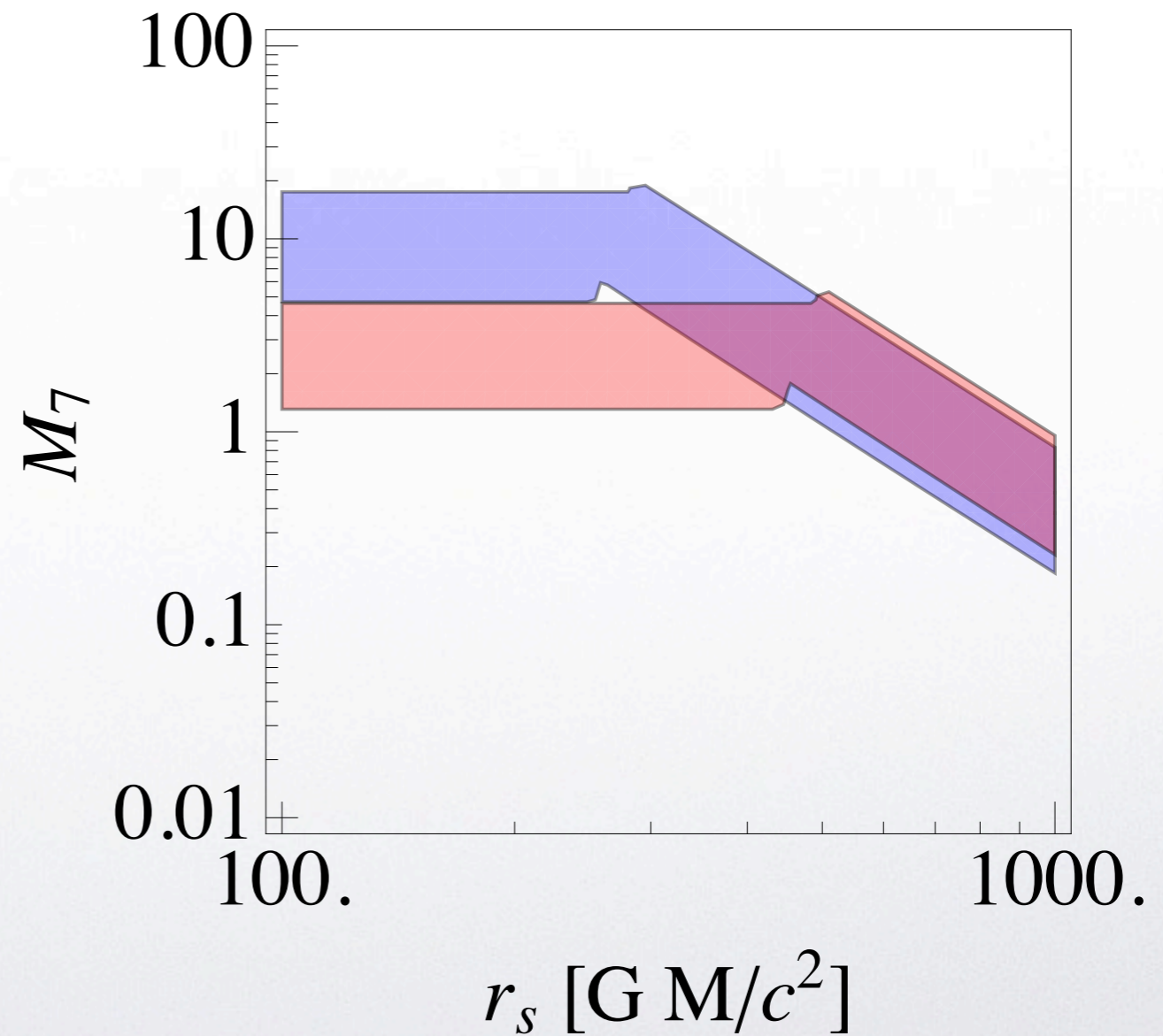
- Neutral H imprints edge
- 3.28×10^{15} Hz.





Edge parameter space

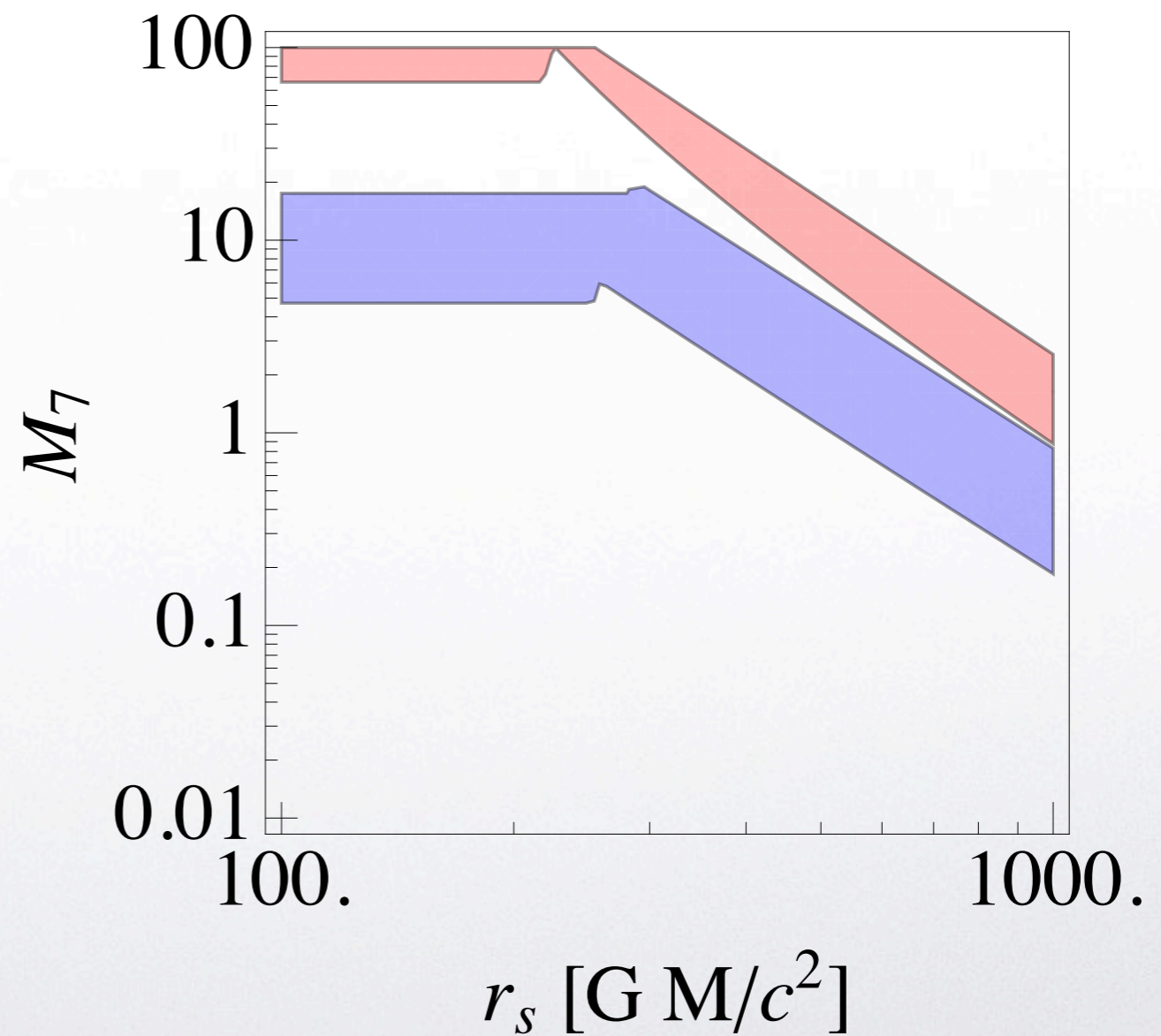
- m-Eddington ratio
q-Mass ratio
- $m=0.1, q=0.05$
(blue)
- $m=0.1, q=1$
(red)





Edge parameter space

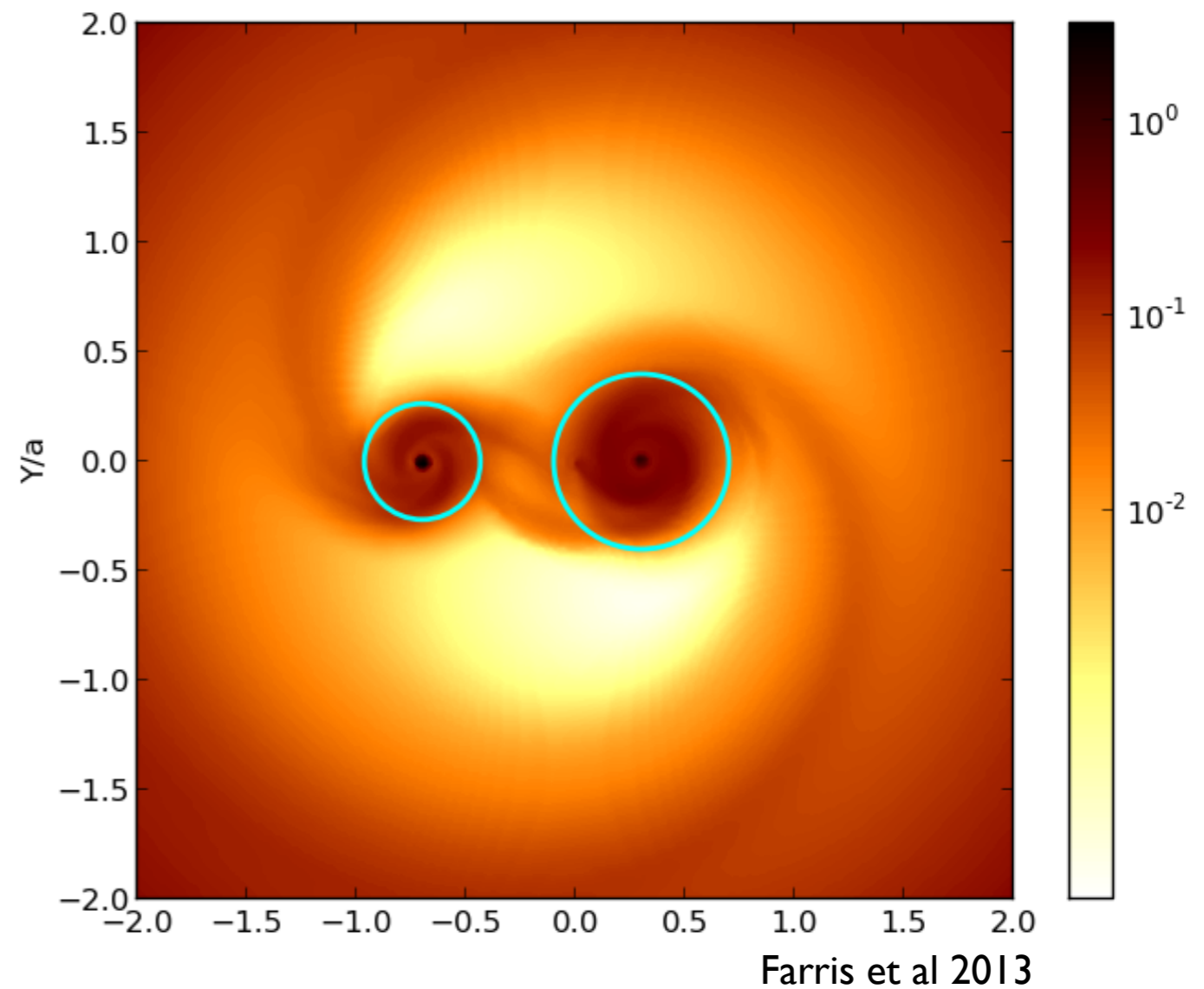
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(blue)
- $m=1, q=0.05$
(red)





Caveat: Mini-disks

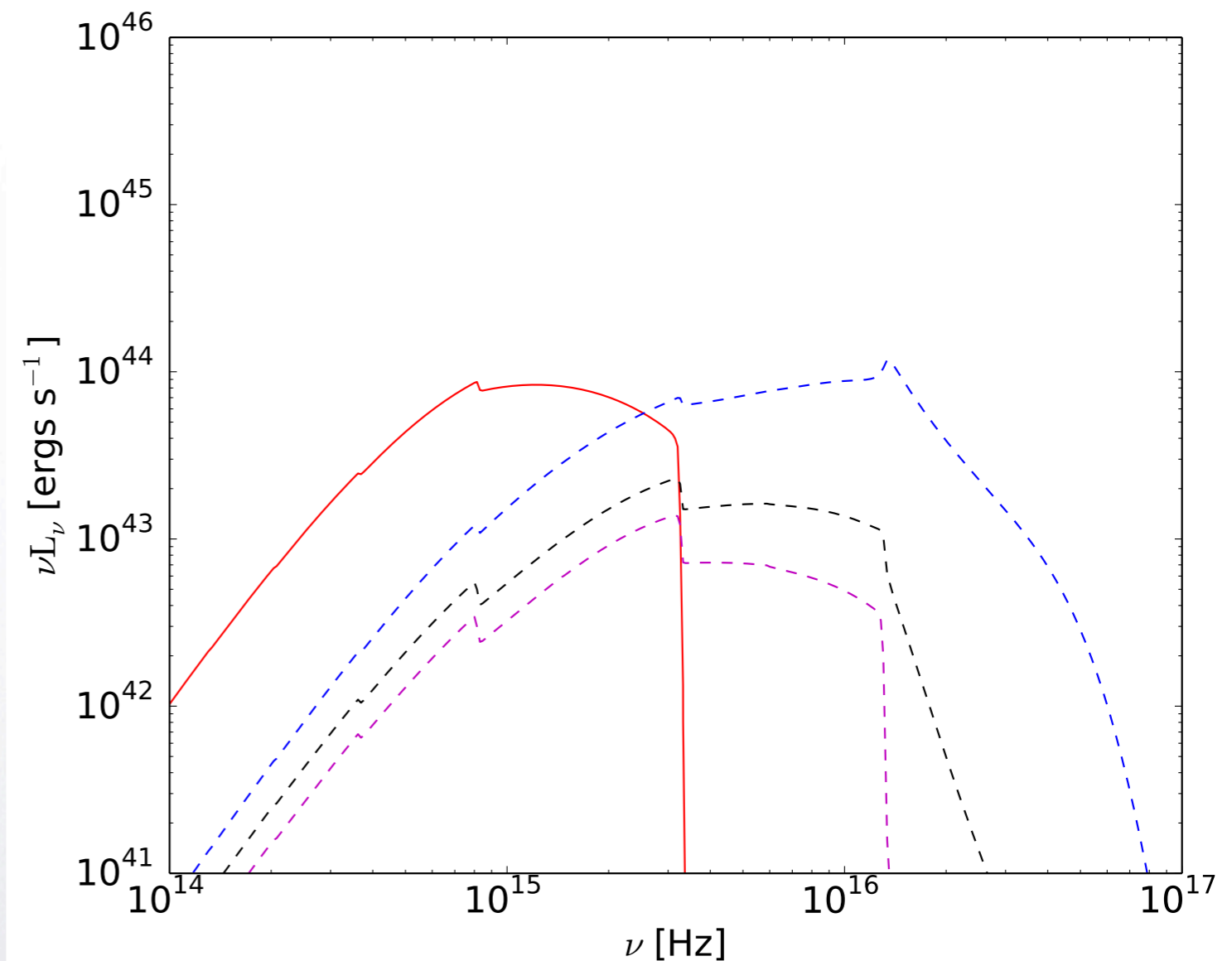
- Cavity not empty
- Binary pulls off streams
- Mini-disks
(Farris et al. 2013)





Mini-disks (spectrum)

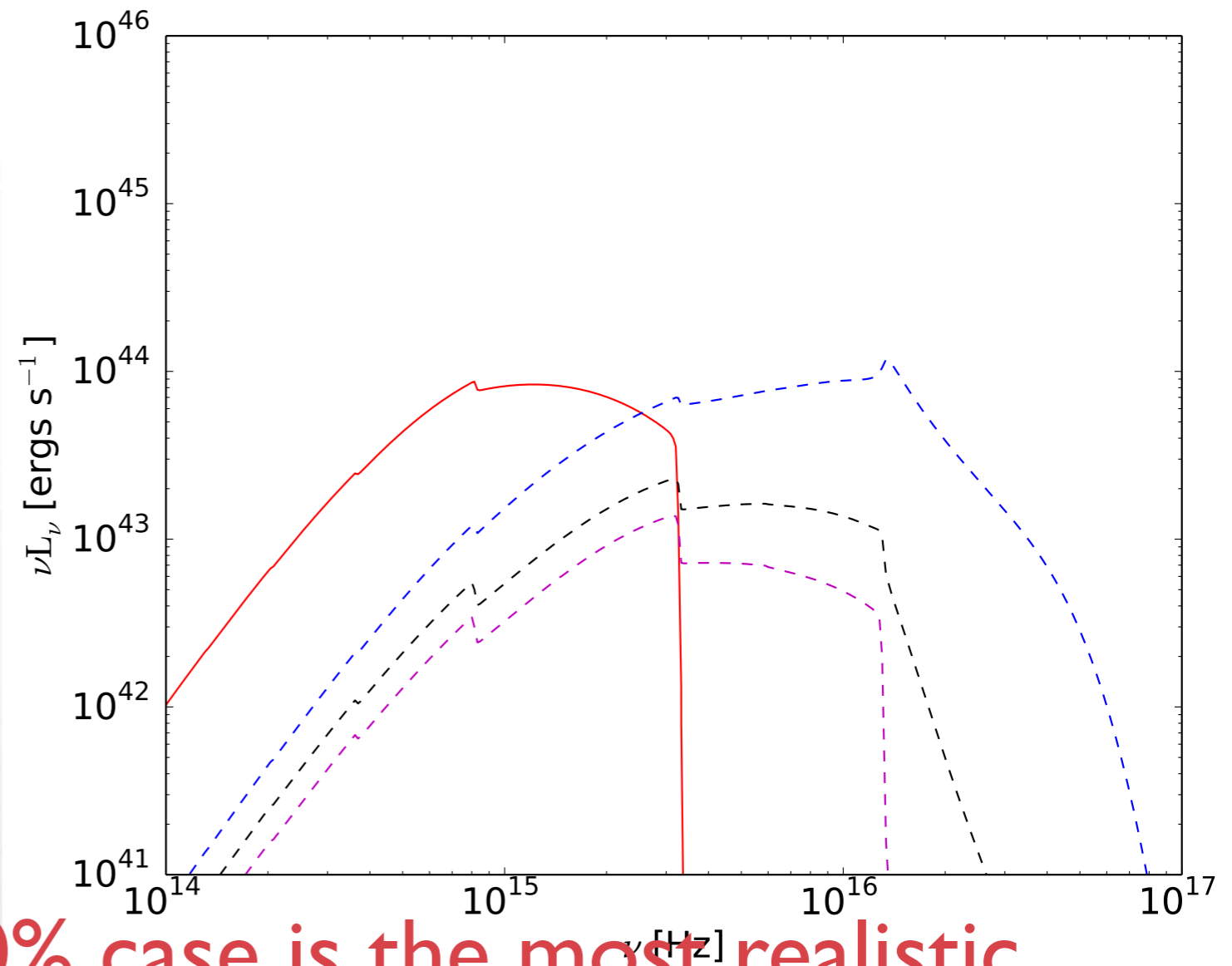
- Solid (circumbinary)
- Broken (secondary mini)
- $\dot{M}_{\text{mini}} / \dot{M}_{\text{circum}}$
 - Blue: 50%
 - Black: 10%
 - Magenta: 5%





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Farris et al. 2013: 50% case is the most realistic

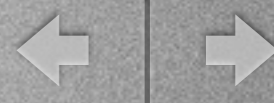


Effects of Minidisks

- Mini-disks suppress edge
- Persistence of mini-disks depends on viscosity in central cavity
 - Highly uncertain
 - Shi et al. 2012



Summary



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- Application to gravitational waves.