Importance of radiative cooling and the resulting self-consistent spectra from GRMHD simulations of accretion onto Sgr A*

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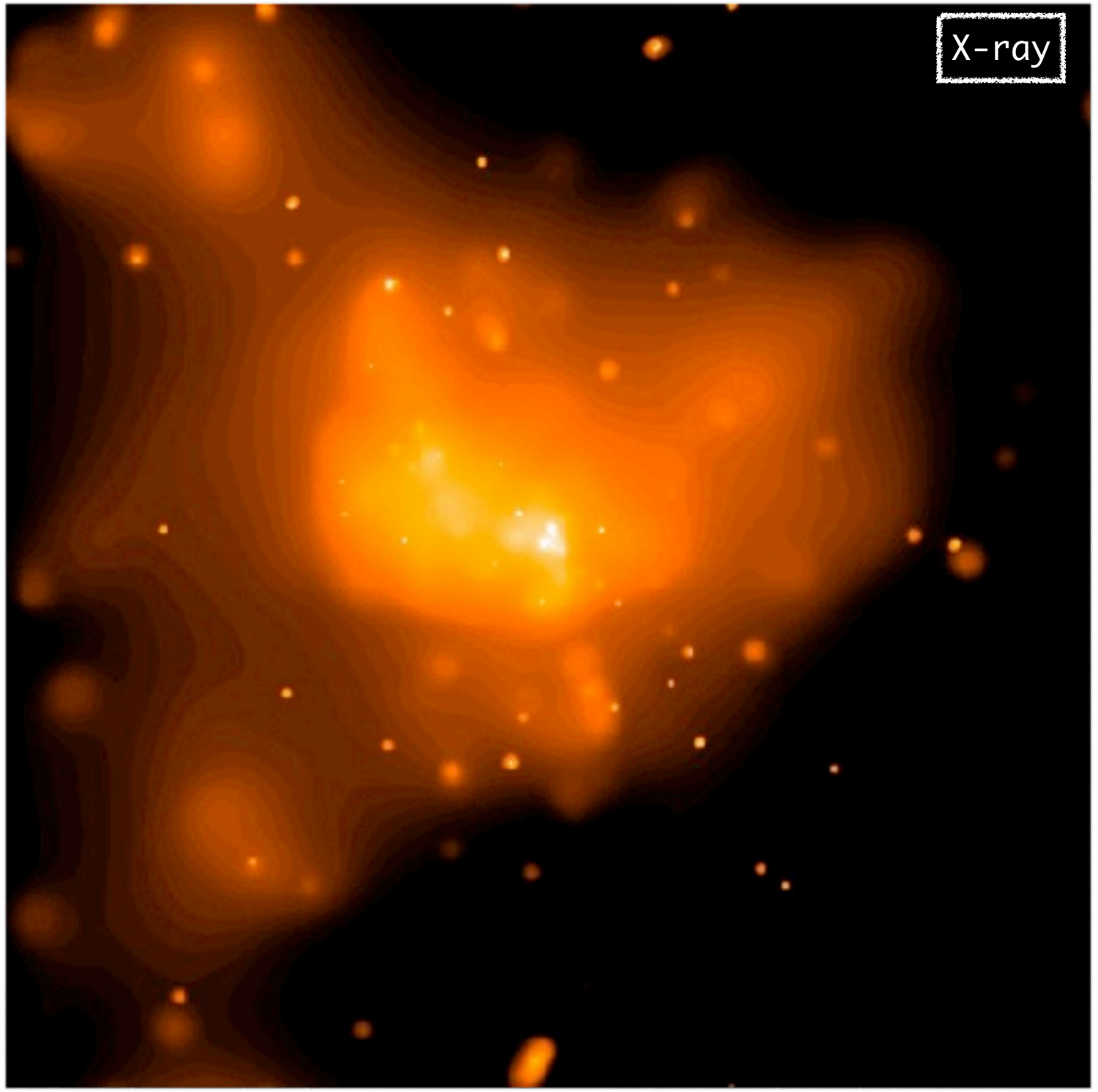
Black Hole Universe 2012 - Bamberg, June 18-22, 2012

Sgr A*



Sgr A*

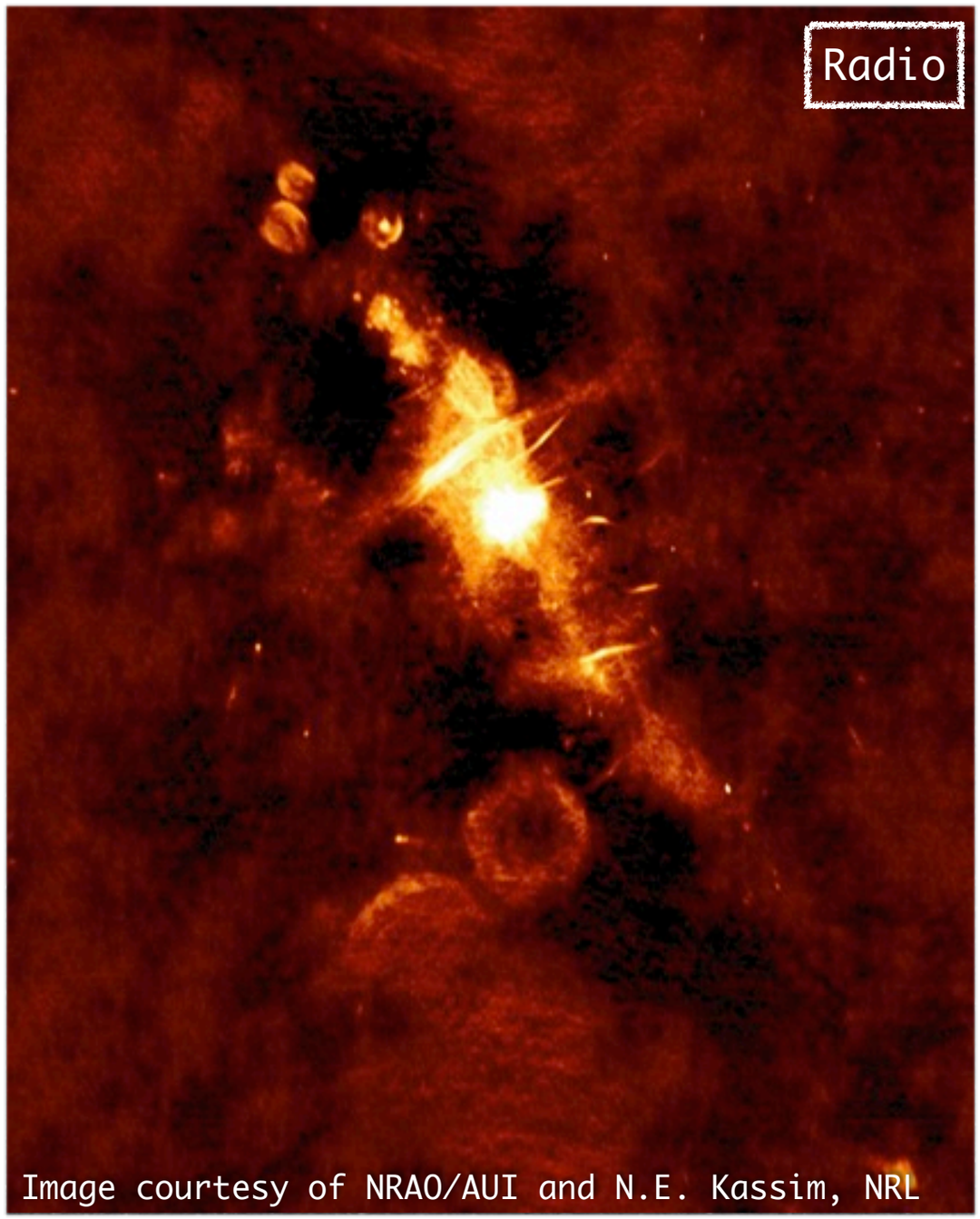


Image courtesy of NRAO/AUI and N.E. Kassim, NRL

Sgr A*

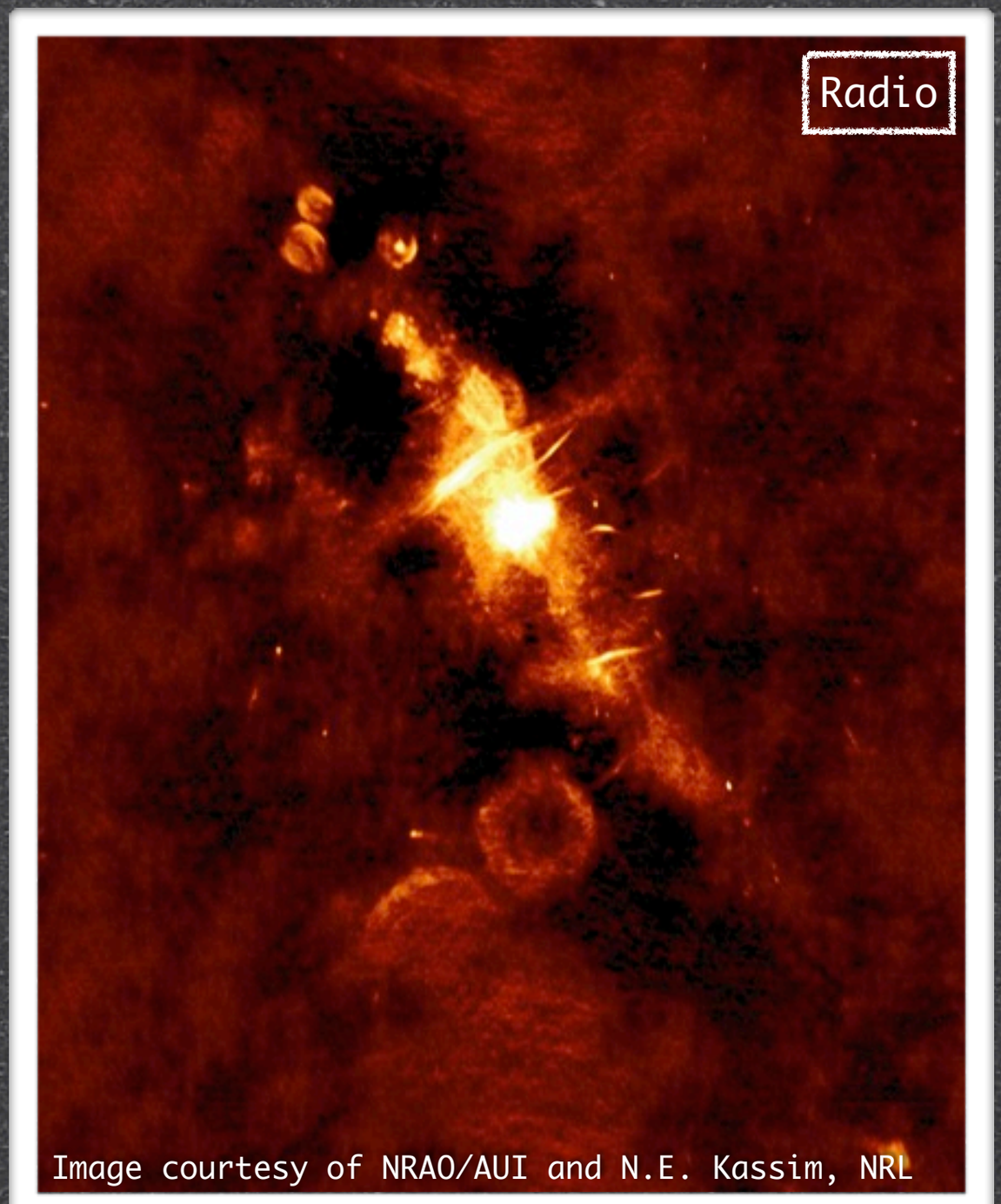
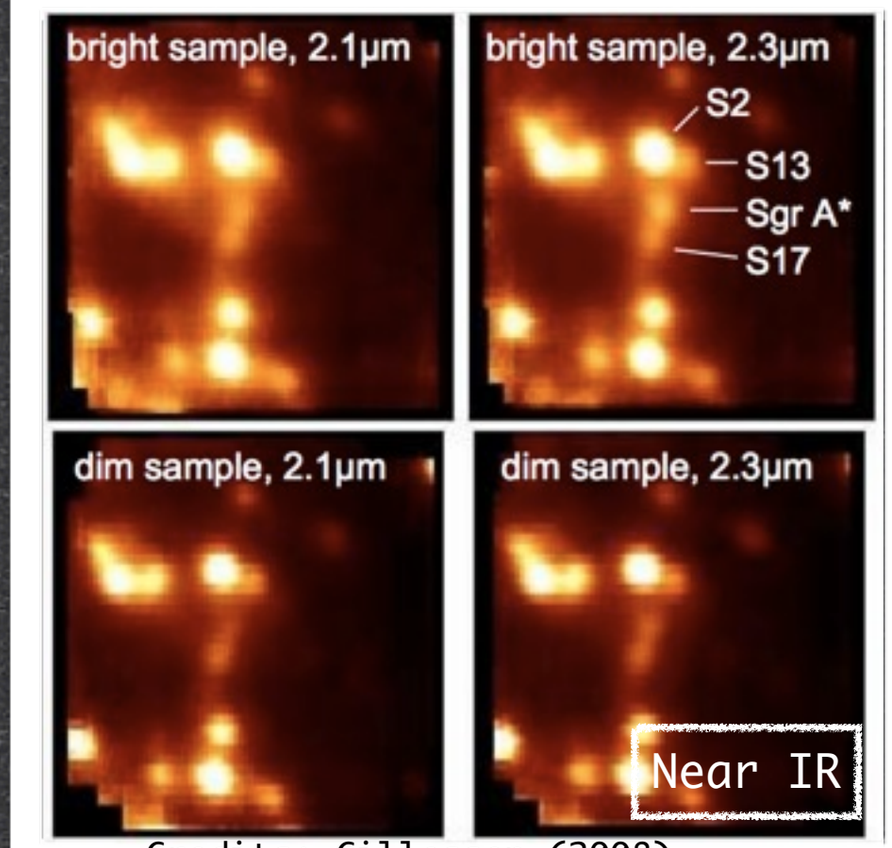
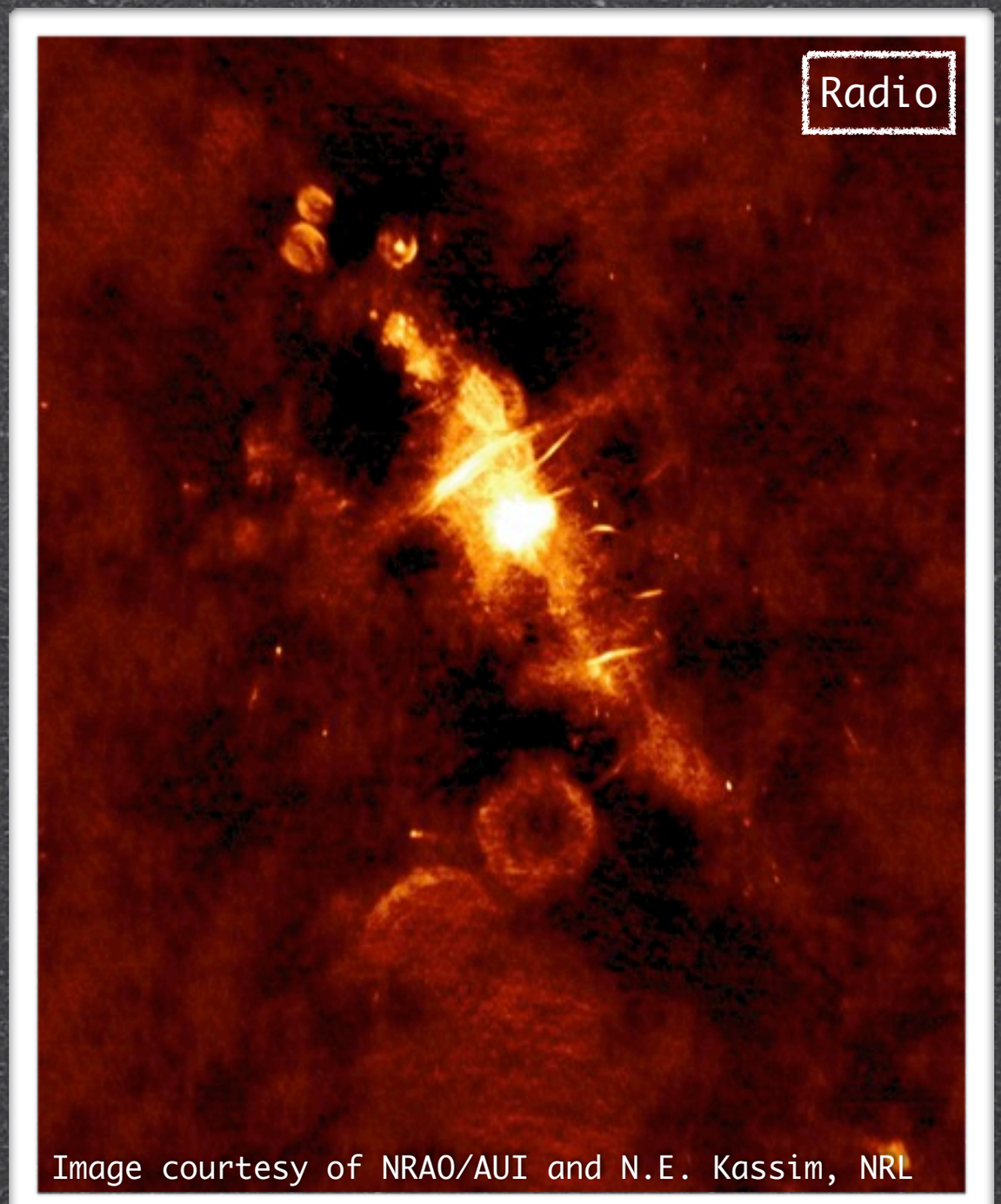


Image courtesy of NRAO/AUI and N.E. Kassim, NRL



Credits: Gillessen (2008)

Sgr A*



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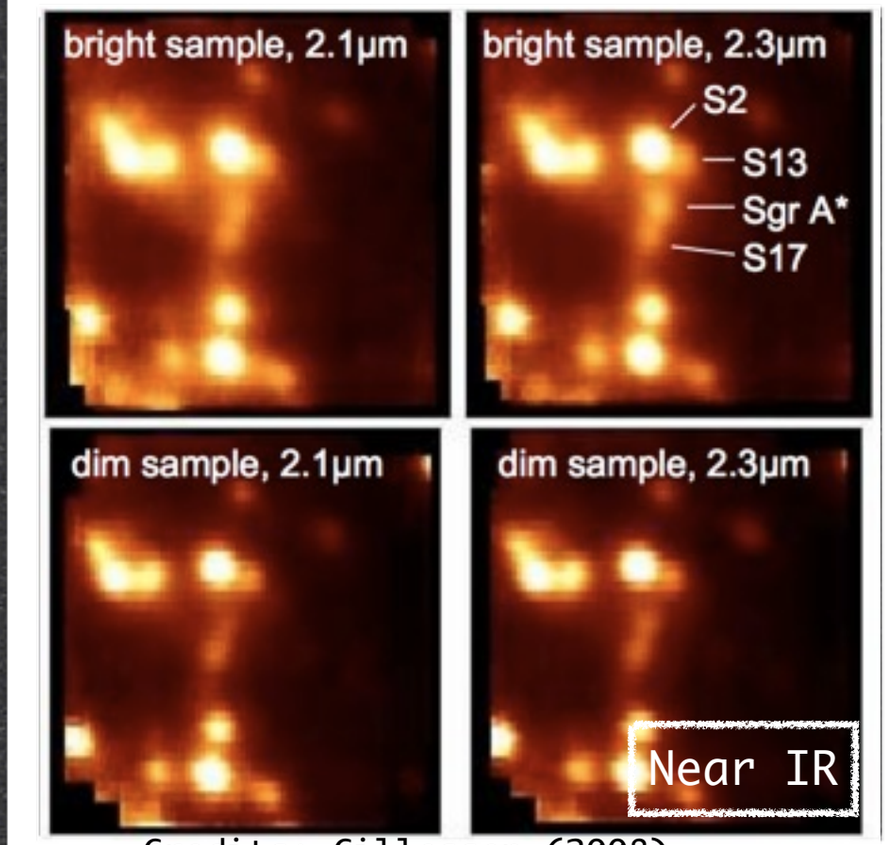
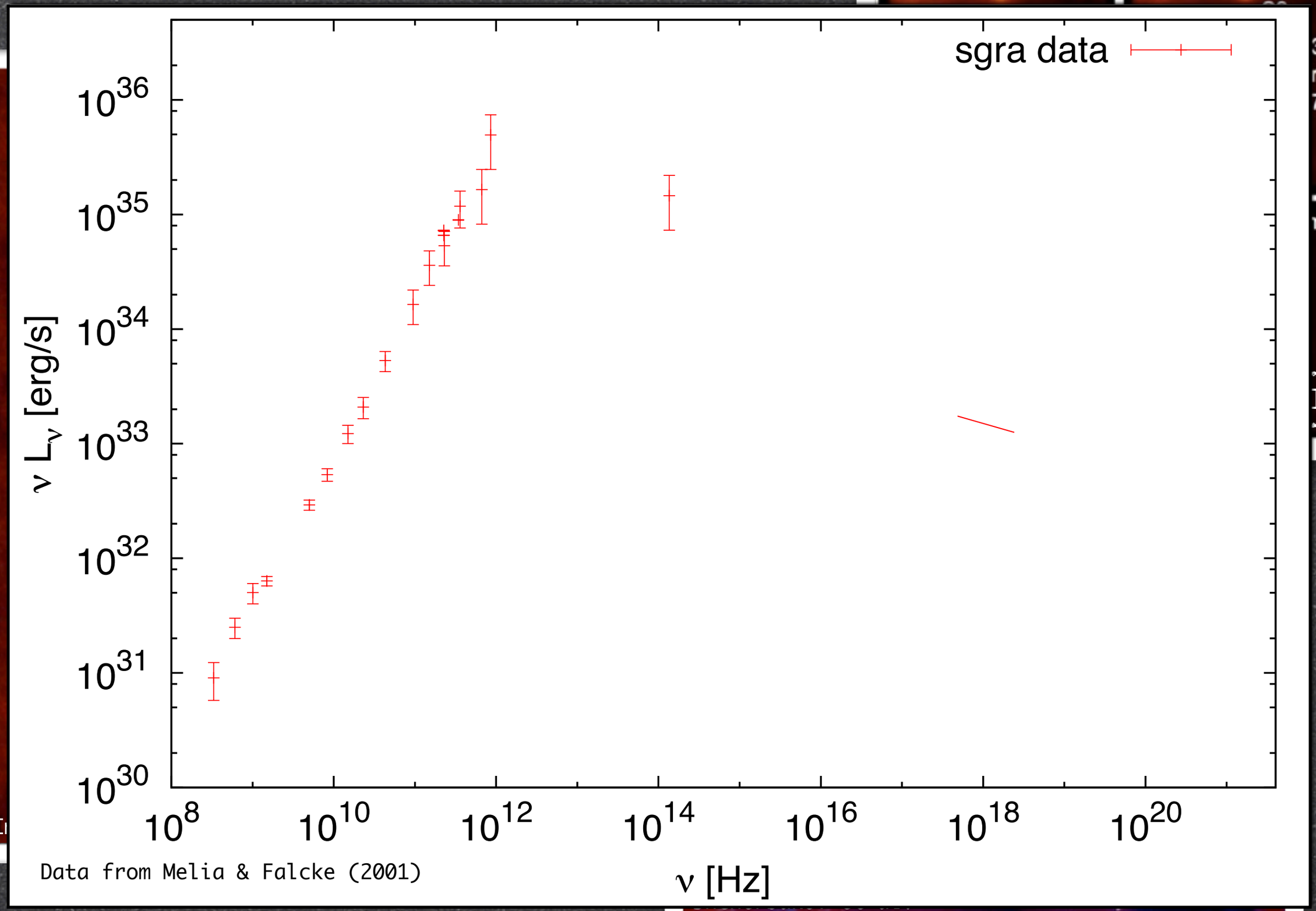


Credits: Gillessen (2008)

credit: X-ray: NASA/CXC/MIT/F. Baganoff, R. Shcherbakov et al.

Sgr A*


sgra data
10^{36}
10^{35}
10^{34}
10^{33}
10^{32}
10^{31}
10^{30}
νL_ν [erg/s]
10^{8}
10^{10}
10^{12}
10^{14}
10^{16}
10^{18}
10^{20}
ν [Hz]
Data from Melia & Falcke (2001)

bright sample, 2.1μm
bright sample, 2.3μm

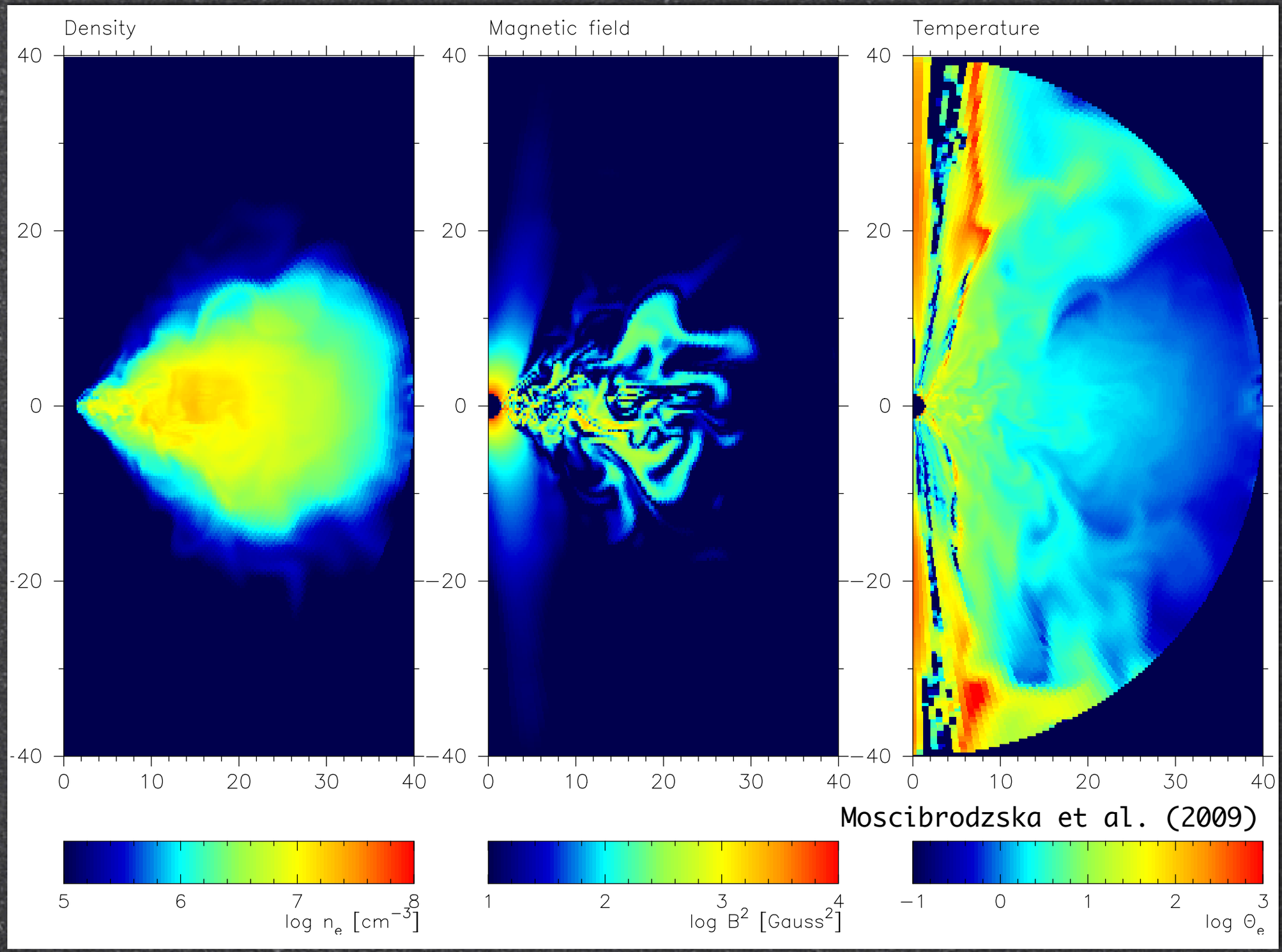
Sgr A*

- $M = 4.3 \pm 0.5 \times 10^6\ M_\odot$
- $D = 8.3 \pm 0.4$ kpc
- $2 \times 10^{-9}\ M_\odot/yr < \dot{M} < 2 \times 10^{-7}\ M_\odot/yr$

Ghez et al.(2008) - Gillessen et al.(2009)
Bower et al.(2005) - Marronne et al.(2007)

GRMHD

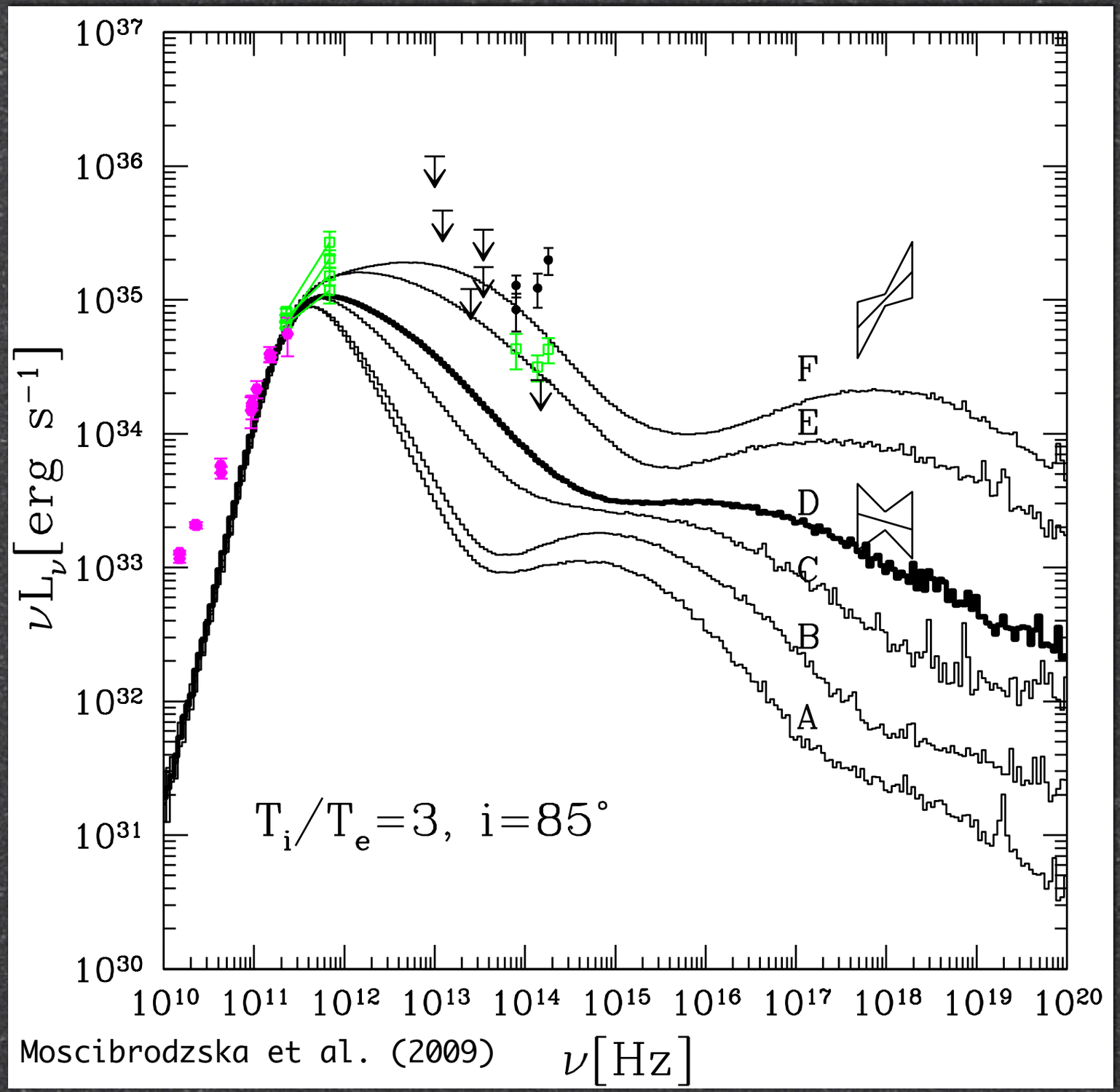
Goldston et al.(2005); Moscibrodzska et al.(2009); Dexter et al.(2009,2010); Hilburn et al.(2010); Shcherbakov et al.(2010); Shiokawa et al.(2012); Dolence et al.(2012); Dexter & Fragile (2012)



Moscibrodzska et al. (2009)

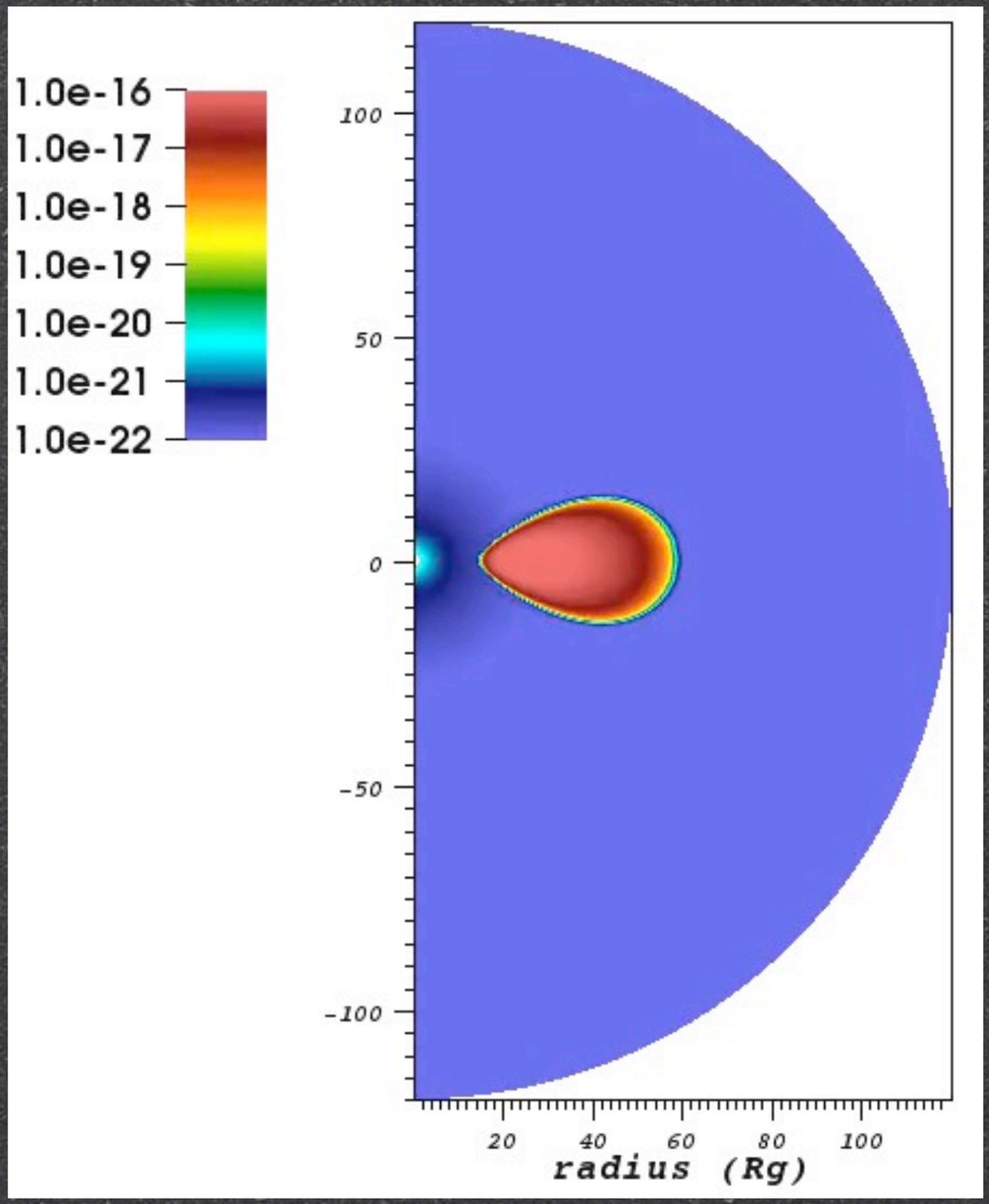
GRMHD

Goldston et al.(2005); Moscibrodzska et al.(2009); Dexter et al.(2009,2010); Hilburn et al.(2010); Shcherbakov et al.(2010); Shiokawa et al.(2012); Dolence et al.(2012); Dexter & Fragile (2012)



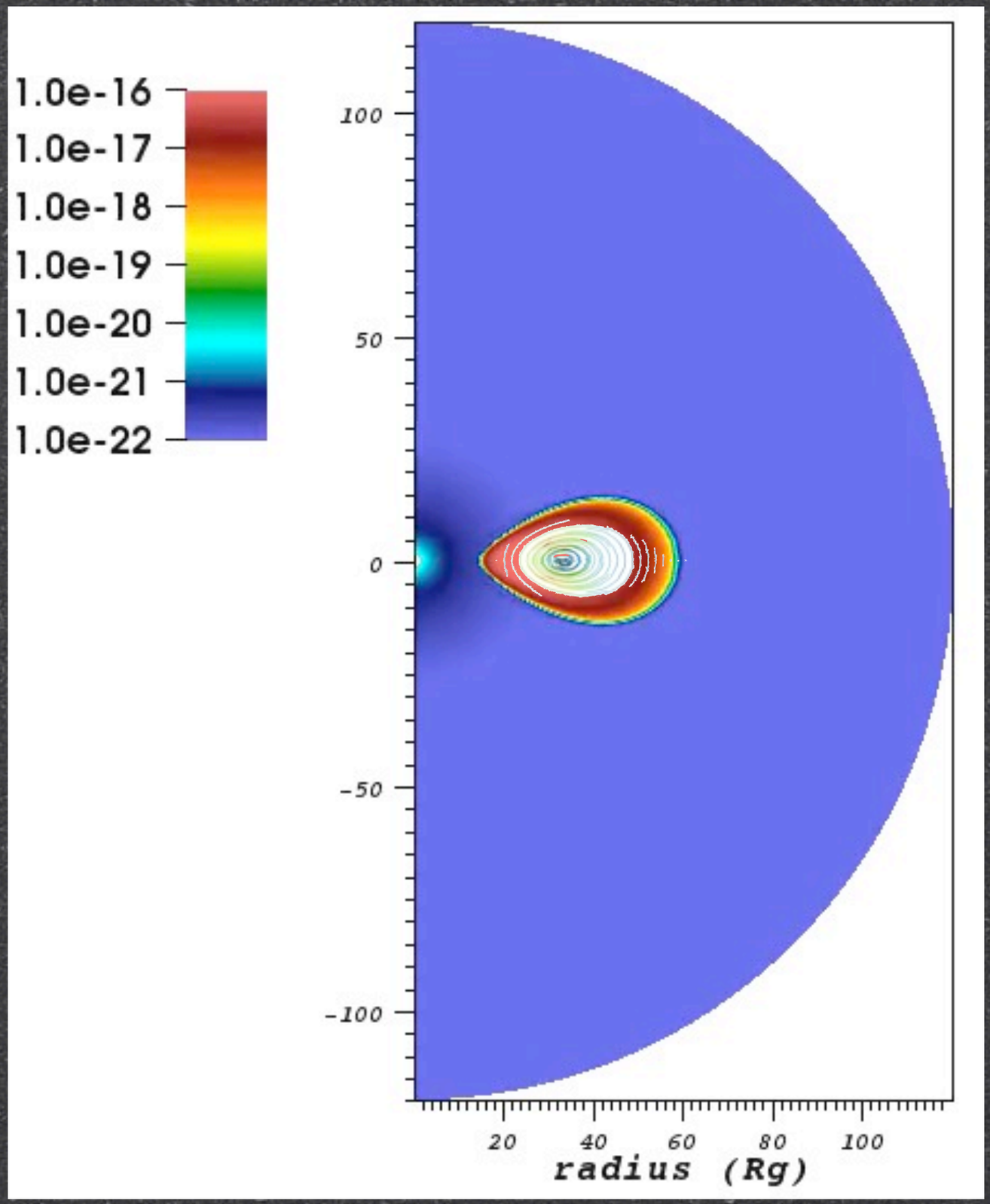
Moscibrodzska et al. (2009)

GRMHD + self-consistent radiative cooling



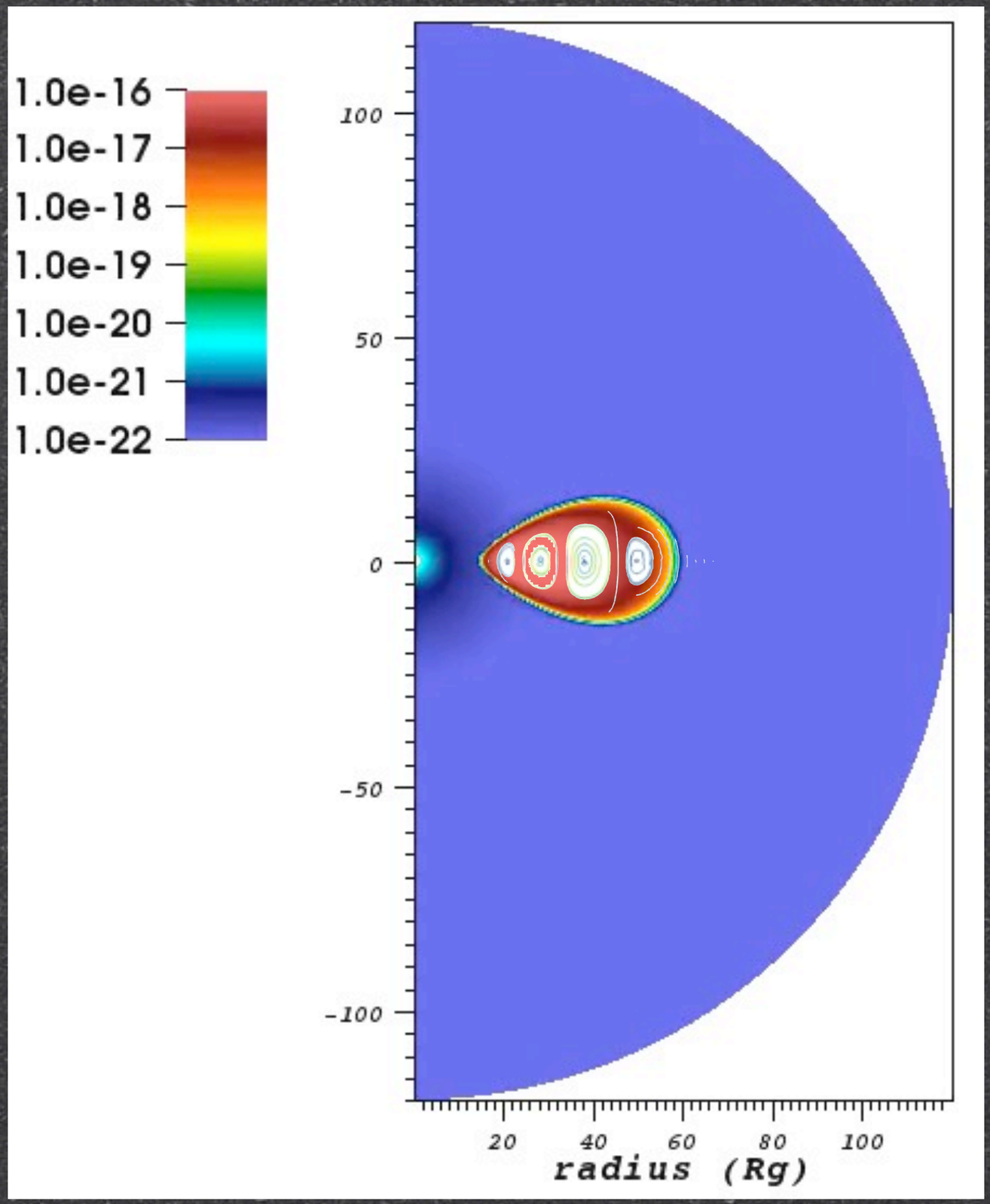
Dibi et al. (2012)

GRMHD + self-consistent radiative cooling



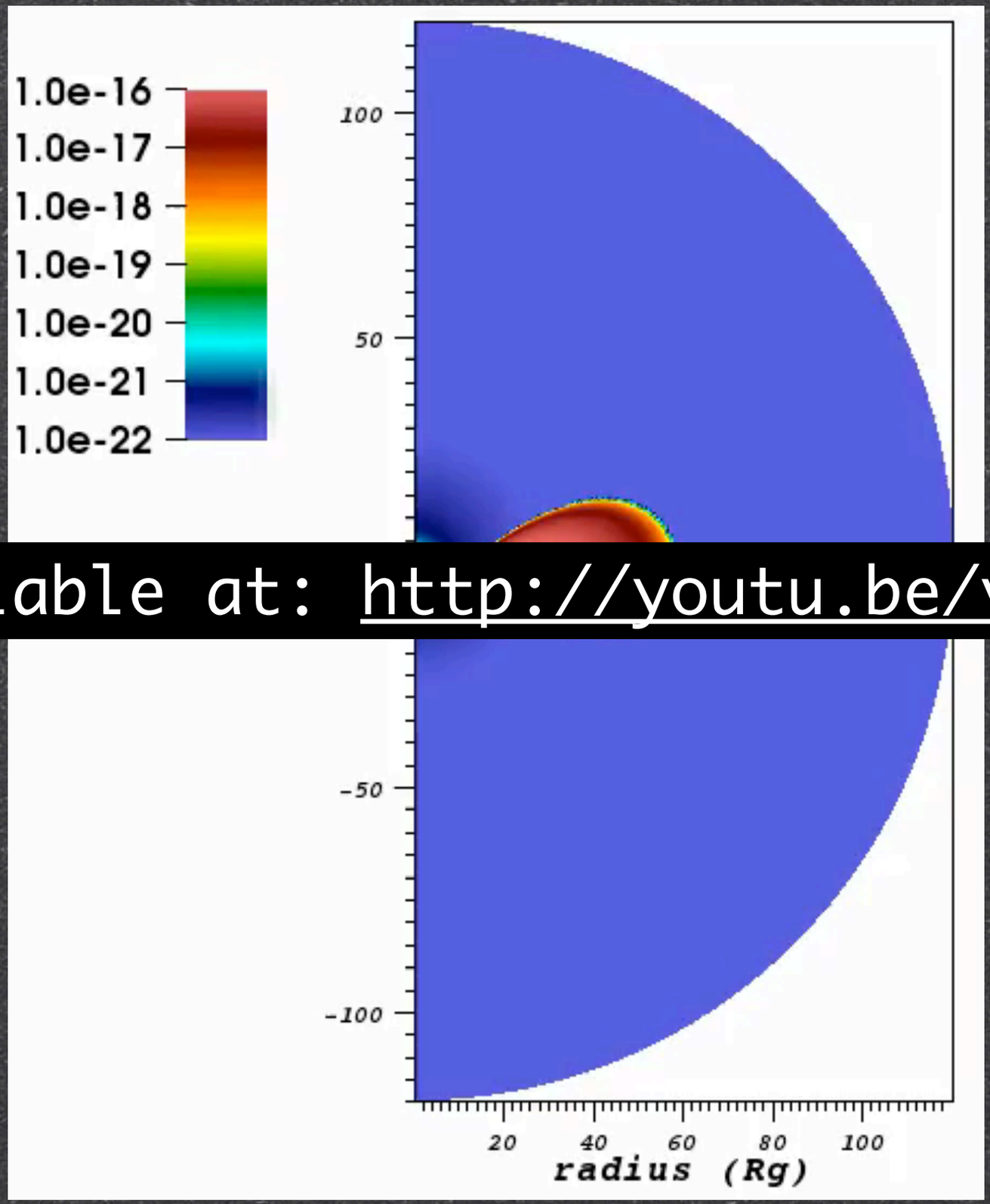
Dibi et al. (2012)

GRMHD + self-consistent radiative cooling



Dibi et al. (2012)

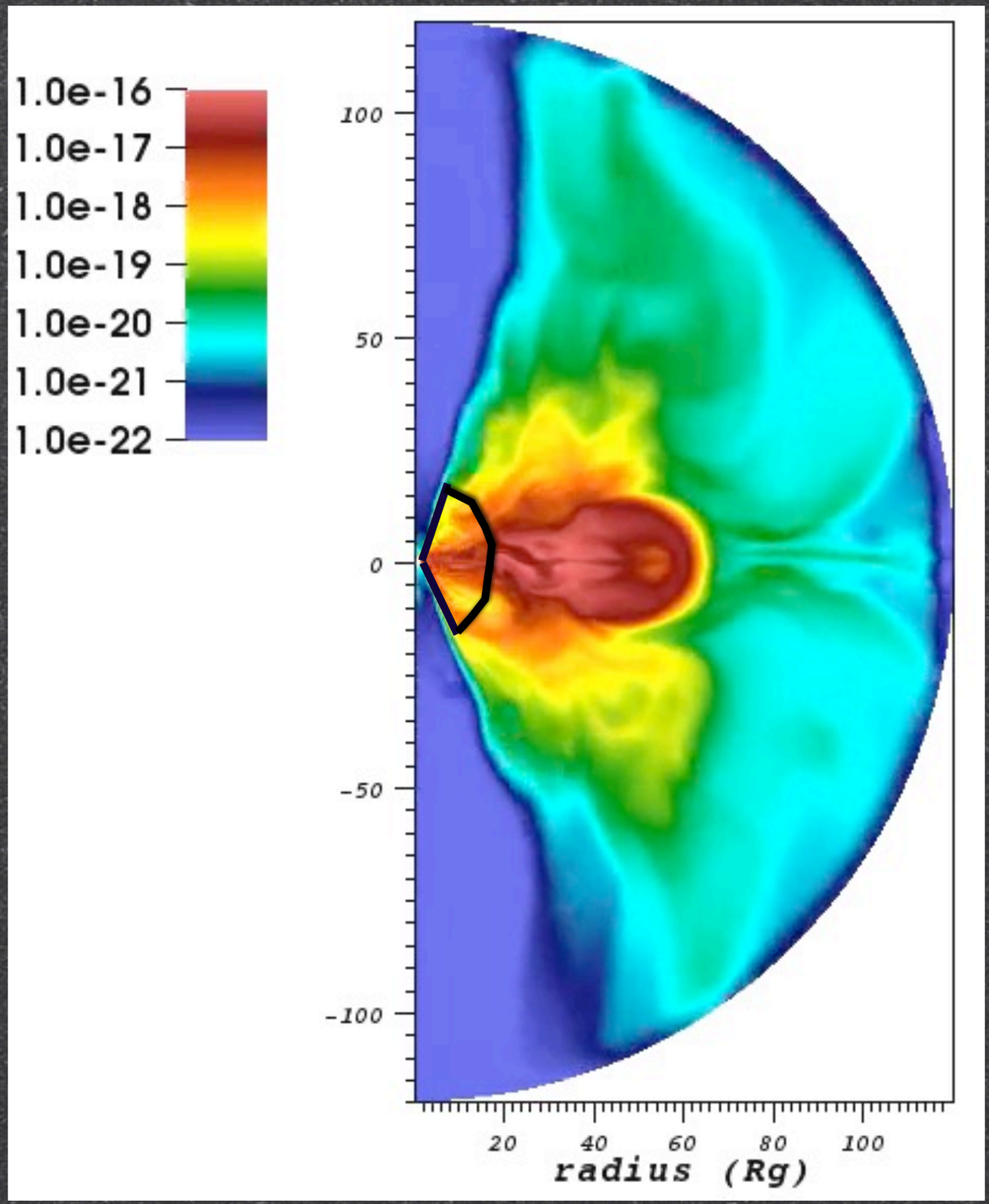
GRMHD + self-consistent radiative cooling



Video available at: http://youtu.be/vmdfz070MPo

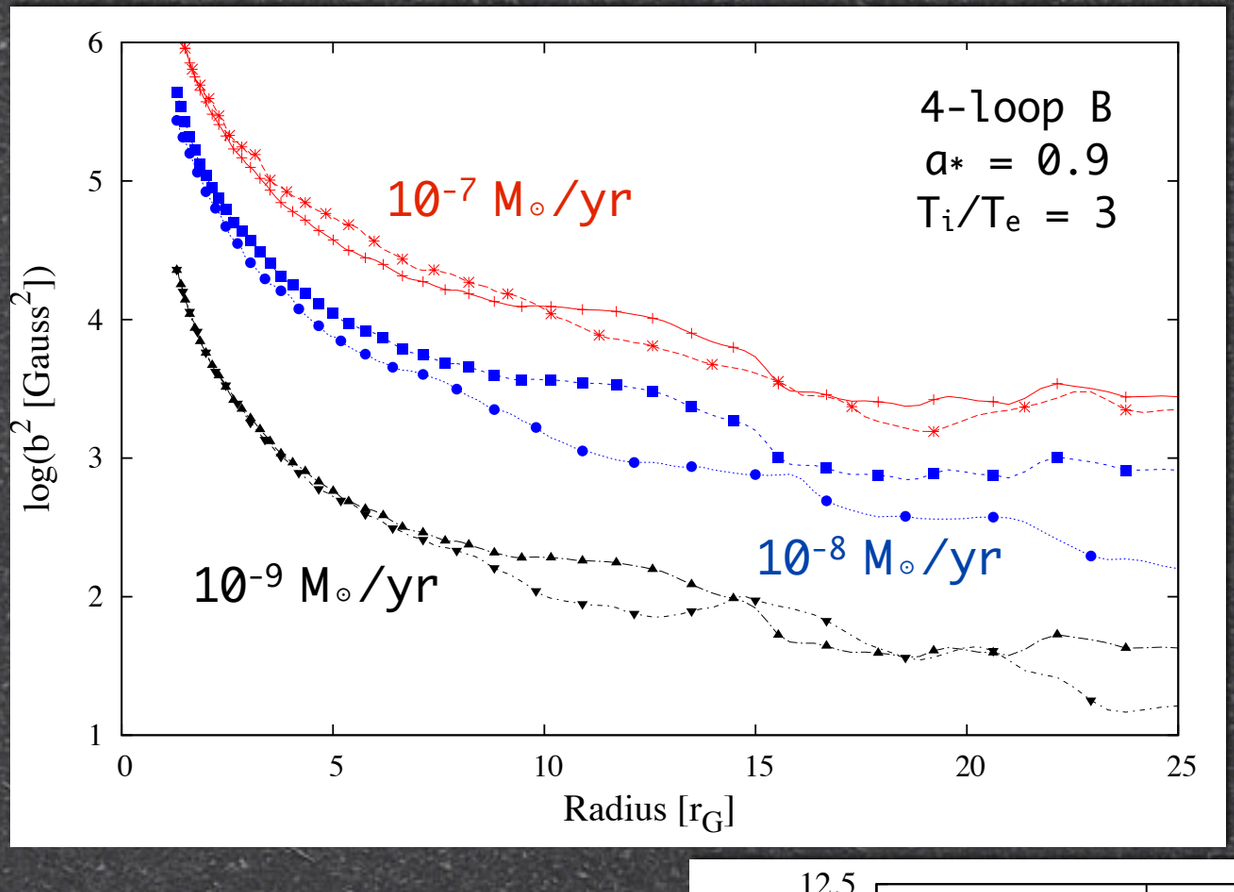
Dibi et al. (2012)

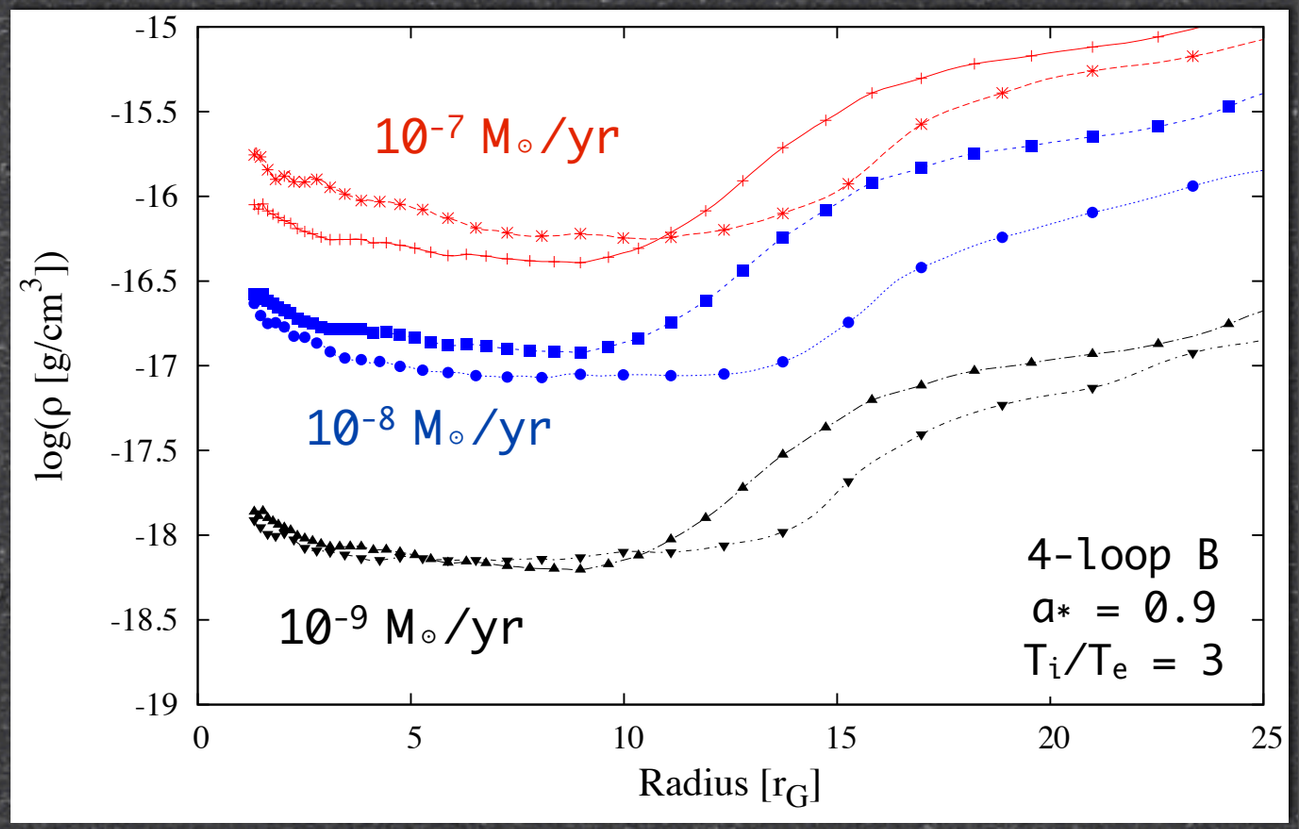
GRMHD + self-consistent radiative cooling

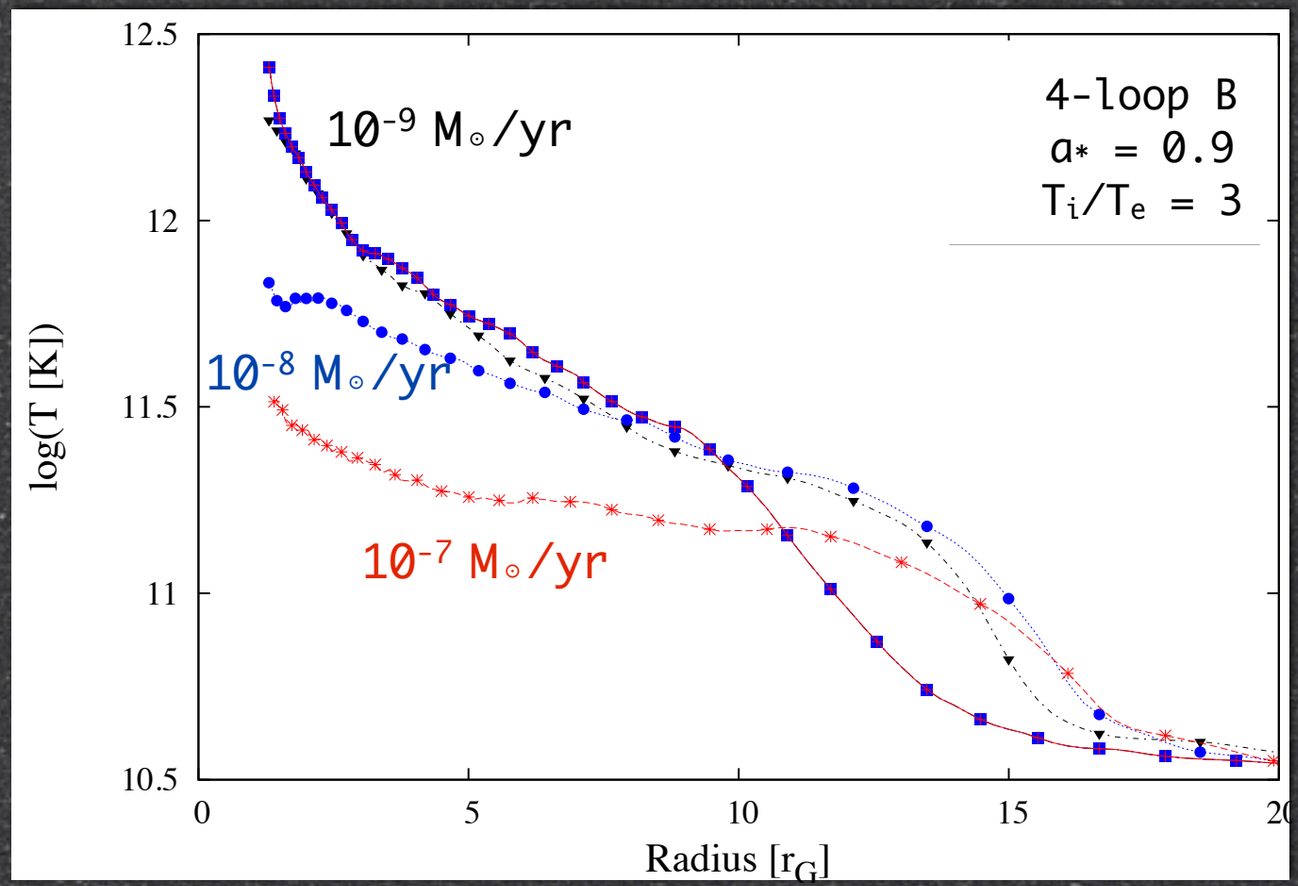


Dibi et al. (2012)

Importance of radiative losses

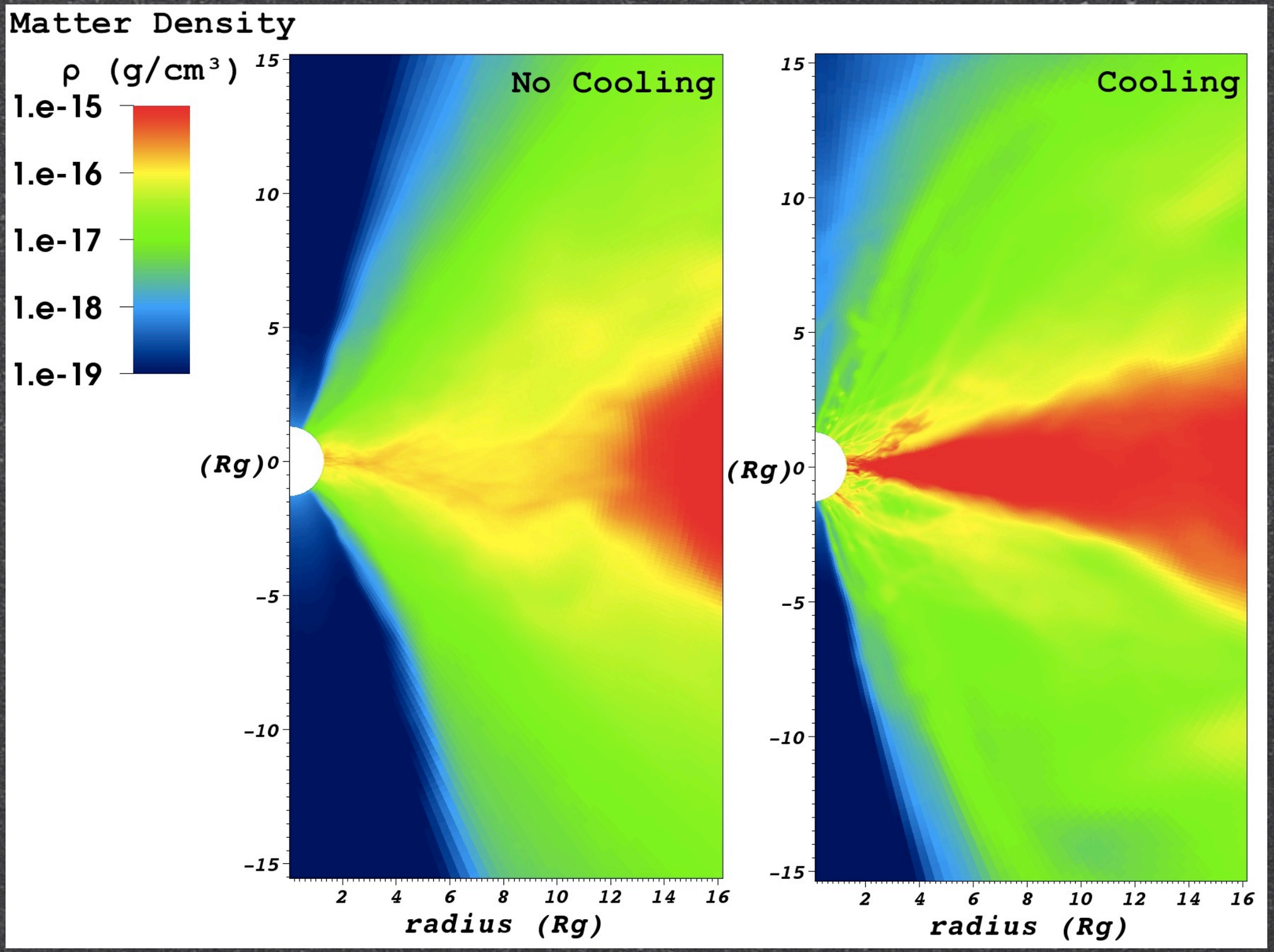






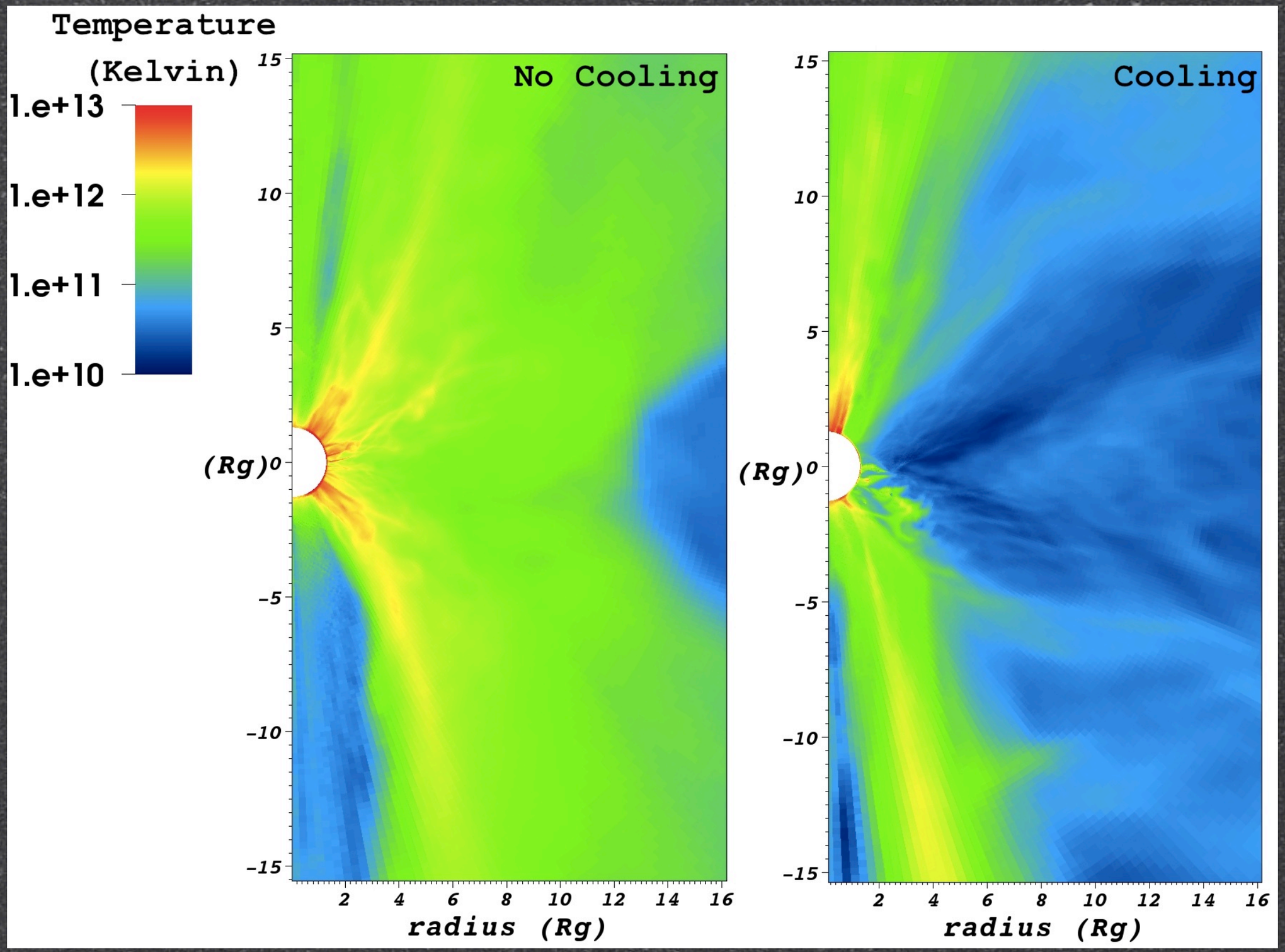
Dibi et al.(2012)

Importance of radiative losses



Dibi et al.(2012)

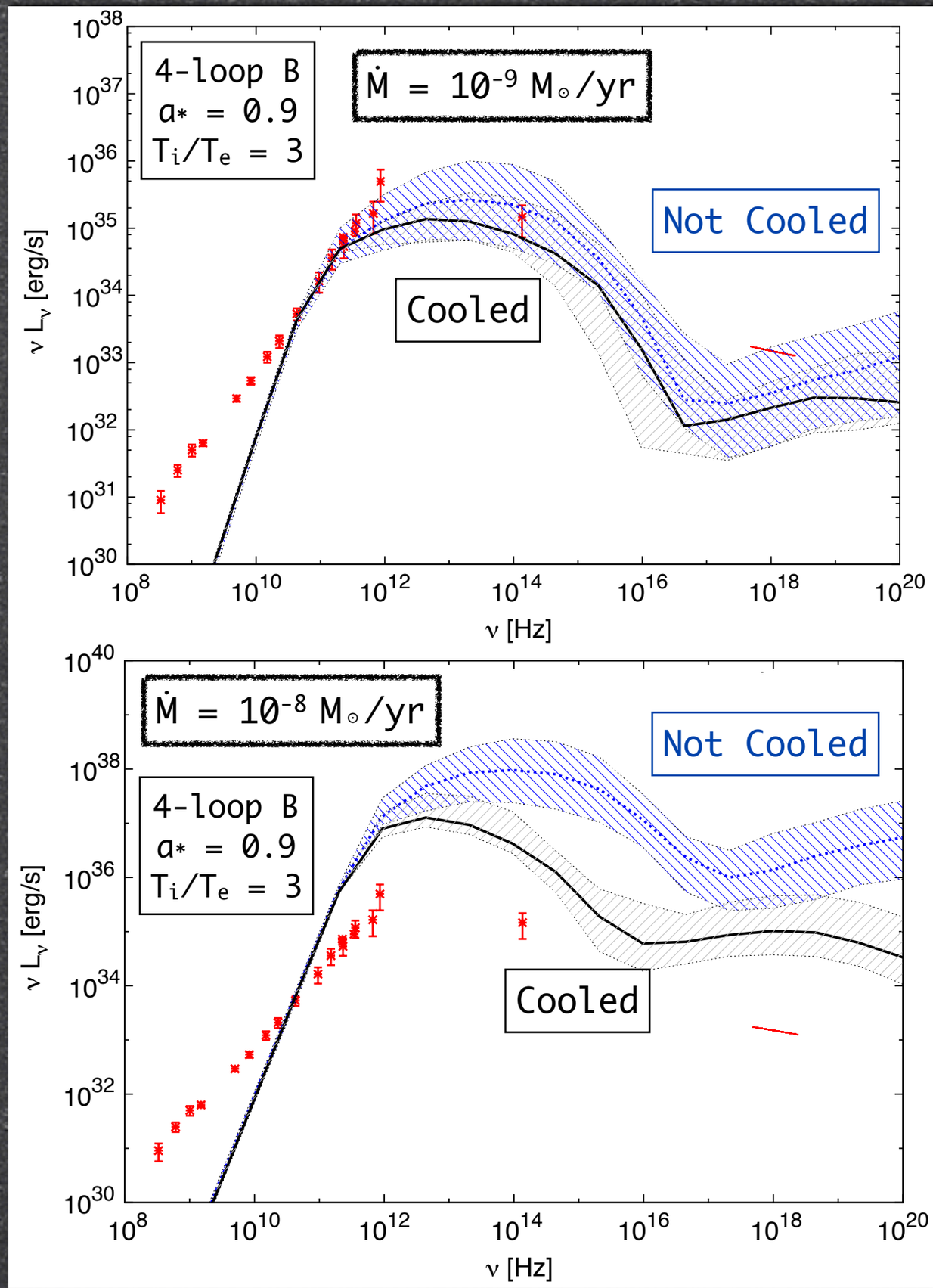
Importance of radiative losses

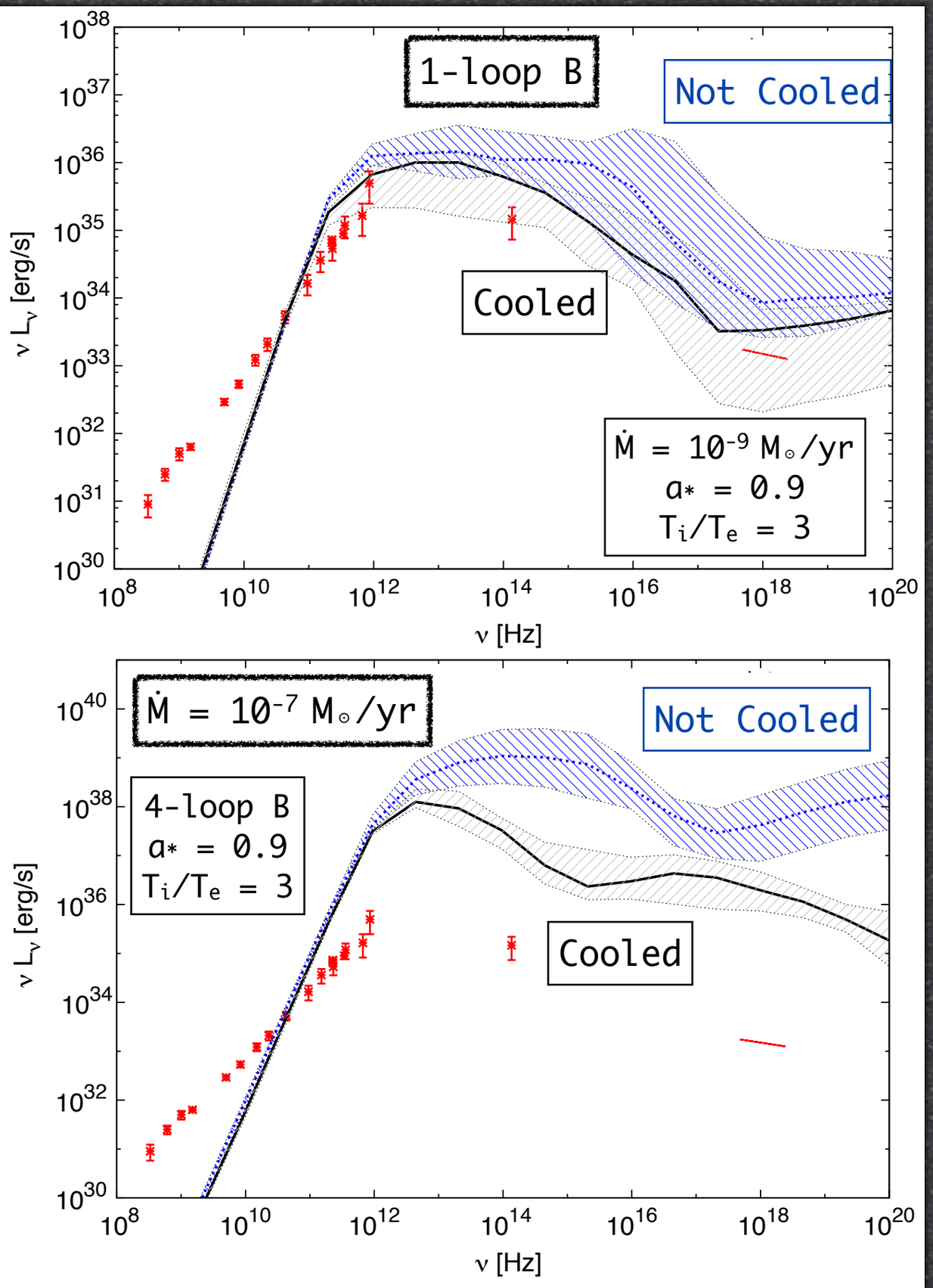


Dibi et al.(2012)

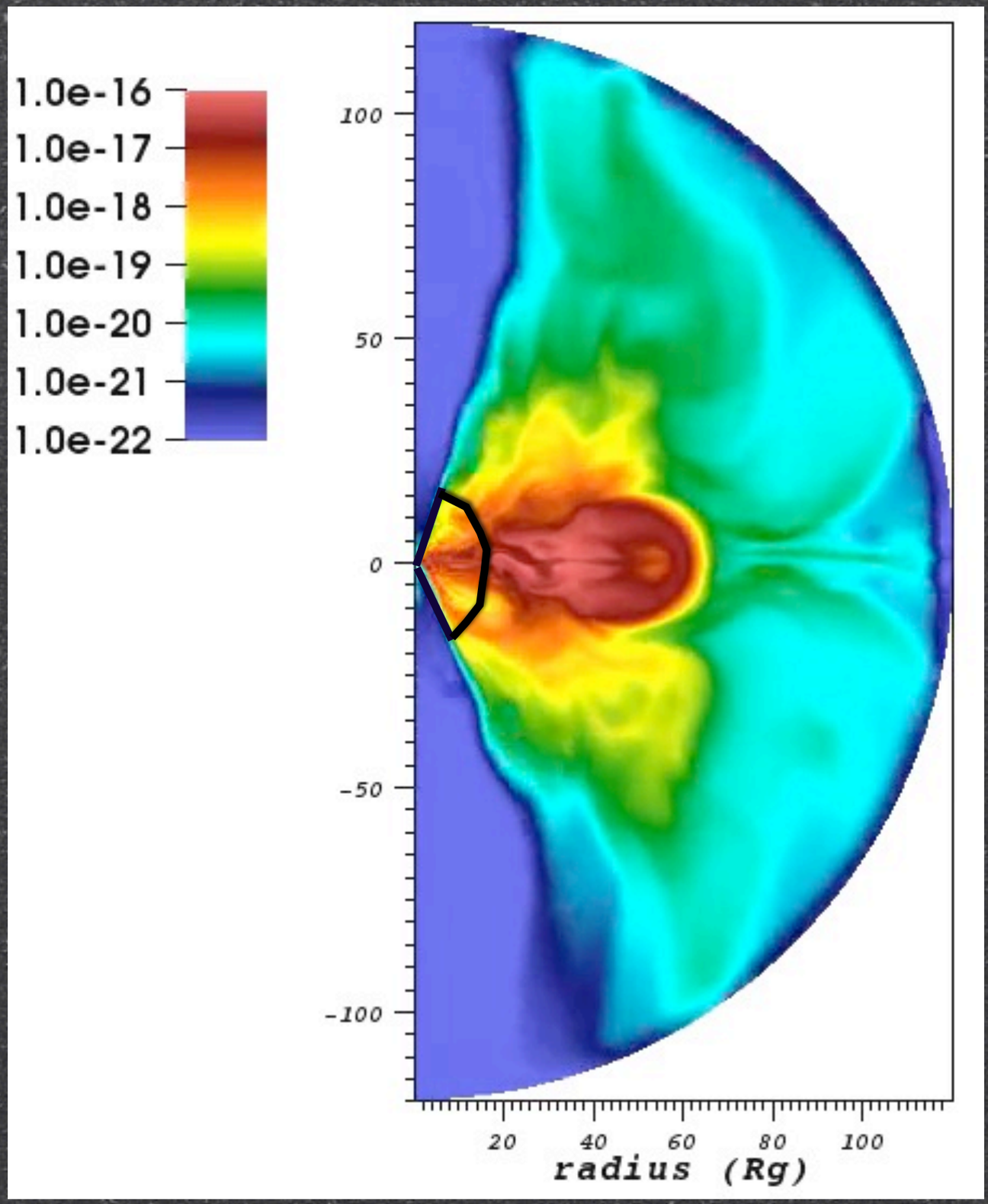
Self-consistent SEDs

Drappeau et al.(2012) [in prep]



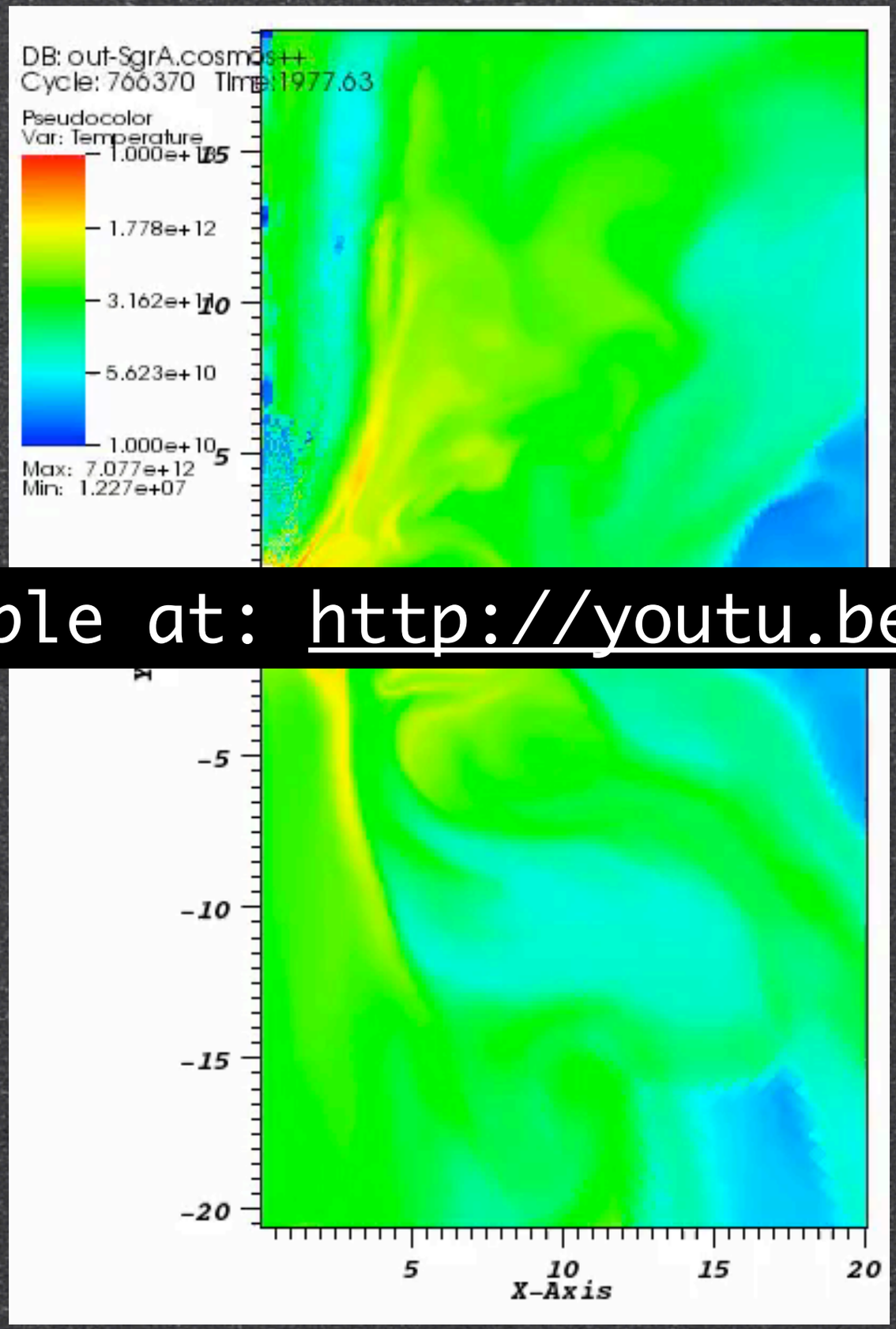


Emission from base of jets?



Dibi et al. (2012)

Flares or numerical artifacts?



Video available at: http://youtu.be/BrRxvhXixPw

Dibi et al. (2012)

Conclusions

- Radiative losses should be taken into account when $\dot{M} > 10^{-7}\ \dot{M}_{Edd}$
- The nature of the accretion flow and outflow is strongly dependent on the initial geometry (astro-ph.HE: 1206.3976v1)

The best fit of Sgr A* observations from our self-consistent SEDs is for:

- A low mass accretion rate of $10^{-9}\ M_{\odot}/yr$
- A rapid spinning black hole, $a_* = 0.9$
- A temperature ratio of $T_i/T_e = 3$
- A 4-loop magnetic field configuration