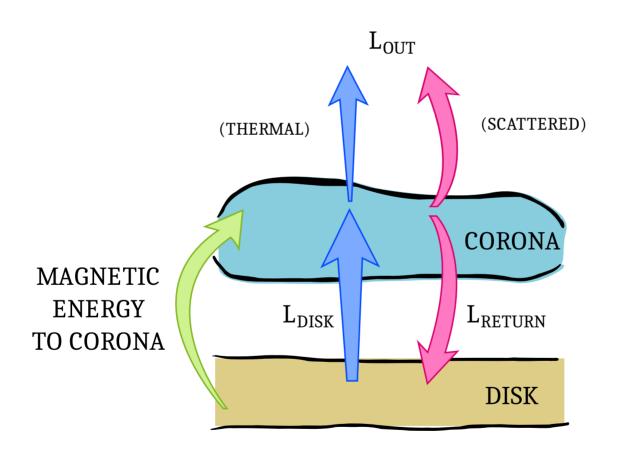
ENERGY BALANCE BETWEEN DISK AND CORONA

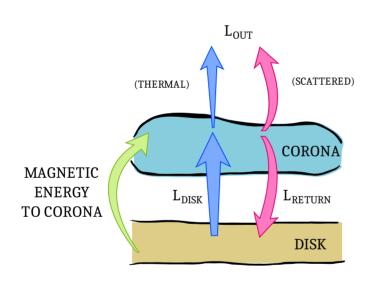
LERA TYNYANSKAYA, MICHAL BURSA, MICHAL DOVČIAK

Astronomical Institute of the Czech Academy of Sciences

The Model



Equations for disk-corona energy balance II.



$$L_{
m OUT} = e^{- au} \, L_{
m DISK} + rac{1}{2} ig[(1 - e^{- au}) L_{
m DISK} + L_{
m SC} ig] \ L_{
m RET} = rac{1}{2} ig[(1 - e^{- au}) L_{
m DISK} + L_{
m SC} ig] \ L_{
m DISK} = L_{
m RAD} + L_{
m RET} \ L_{
m ACC} = egin{cases} ({
m radiative\ cooling}) & L_{
m RAD} = lpha \, L_{
m ACC} \ ({
m magnetic\ fields}) & L_{
m SC} = (1 - lpha) \, L_{
m ACC} \ \end{pmatrix} \
ightarrows L_{
m OUT} = L_{
m ACC} \ ({
m energy\ conservation}) \ \end{cases}$$

Equations for disk-corona energy balance III.

$$egin{aligned} L_{ ext{OUT}} &= (\mathbf{1} - oldsymbol{k}) \, L_{ ext{DISK}} + oldsymbol{k} \, e^{- au} \, L_{ ext{DISK}} + rac{1}{2} ig[oldsymbol{k} (1 - e^{- au}) L_{ ext{DISK}} + L_{ ext{SC}} ig] \ &L_{ ext{RET}} &= rac{1}{2} ig[oldsymbol{k} (1 - e^{- au}) L_{ ext{DISK}} + L_{ ext{SC}} ig] \ &L_{ ext{DISK}} &= L_{ ext{RAD}} + L_{ ext{RET}} \ &\Longrightarrow L_{ ext{OUT}} &= L_{ ext{ACC}} \ & ext{(energy conservation)} \end{aligned}$$

Equations for disk-corona energy balance IV.

$$egin{aligned} L_{ ext{OUT}} &= \left[(1-k) + k\,e^{- au} + rac{1}{2}k(1-e^{- au})
ight]\,L_{ ext{DISK}} + rac{1}{2}(1-lpha)\,L_{ ext{ACC}} \ L_{ ext{RET}} &= \left[rac{1}{2}k(1-e^{- au})
ight] + rac{1}{2}(1-lpha)\,L_{ ext{ACC}} \ L_{ ext{DISK}} &= lpha\,L_{ ext{ACC}} + L_{ ext{RET}} \end{aligned}$$

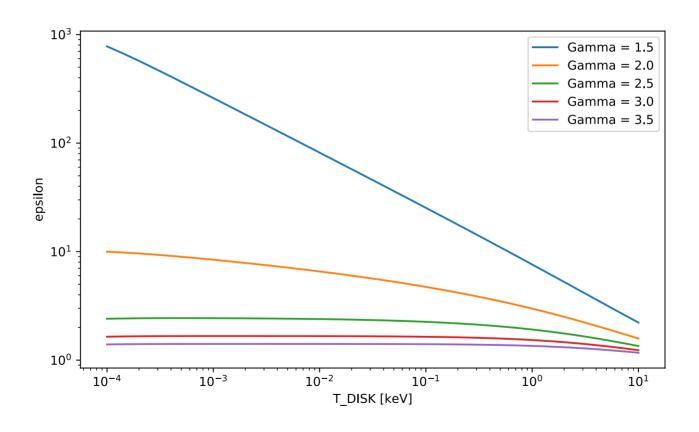
Equations for disk-corona energy balance V.

$$egin{aligned} L_{ ext{OUT}} &= ext{thermal} + ext{scattered} \ &= ext{(black-body)} + ext{(nthcomp)} \ L_{ ext{NTHCOMP}}(T_{ ext{DISK}}^{ ext{eff}}, \Gamma, T_e) = rac{1}{2}(1-e^{- au})\,k\,L_{ ext{DISK}} + rac{1}{2}\,L_{ ext{SC}} + rac{1}{2}\,k\,e^{- au}\,L_{ ext{DISK}} \ L_{ ext{OUT}} &= (1-k)\,L_{ ext{DISK}} + k\,e^{- au}\,L_{ ext{DISK}} + rac{1}{2}ig[k(1-e^{- au})L_{ ext{DISK}} + L_{ ext{SC}}ig]
ightarrow \ &
ightarrow L_{ ext{OUT}} = ig[1-k+rac{1}{2}\,k\,e^{- au}ig]\,L_{ ext{DISK}} + L_{ ext{NTHCOMP}}(T_{ ext{DISK}}^{ ext{eff}}, \Gamma, T_e) \end{aligned}$$

Equations for disk-corona energy balance VI.

$$L_{
m NTHCOMP} = rac{1}{2}(1-e^{- au})\,k\,L_{
m DISK} + rac{1}{2}\,L_{
m SC} + rac{1}{2}\,k\,e^{- au}\,L_{
m DISK} \ N_{
m NTHCOMP} = rac{1}{2}\,k\,N_{
m DISK} \ ar{E}_{
m NTHCOMP} = rac{L_{
m NTHCOMP}}{N_{
m NTHCOMP}} = L_{
m NTHCOMP}/(rac{1}{2}\,k\,\sigma_p\,T_{
m DISK}^{
m eff}\,^3) \ ar{E}_{
m DISK} = rac{L_{
m DISK}}{N_{
m DISK}} = L_{
m DISK}/(\sigma_p\,T_{
m DISK}^{
m eff}\,^3) \ \epsilon = rac{ar{E}_{
m NTHCOMP}}{ar{E}_{
m DISK}} = rac{2}{k}\,rac{L_{
m NTHCOMP}}{L_{
m DISK}}$$

Equations for disk-corona energy balance - ϵ

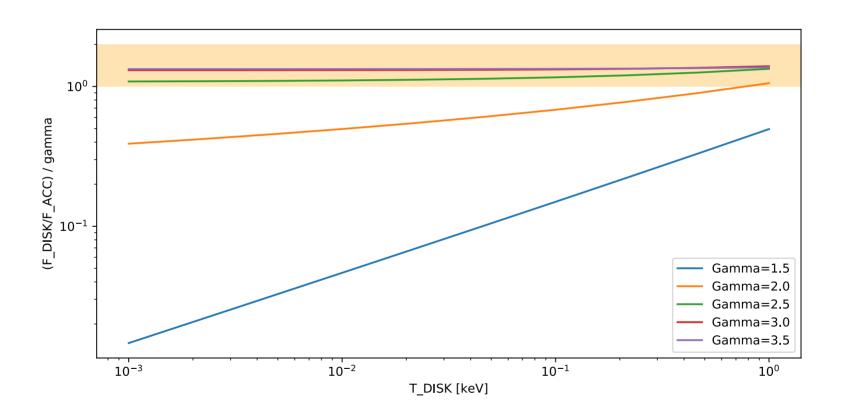


Equations for disk-corona energy balance VII.

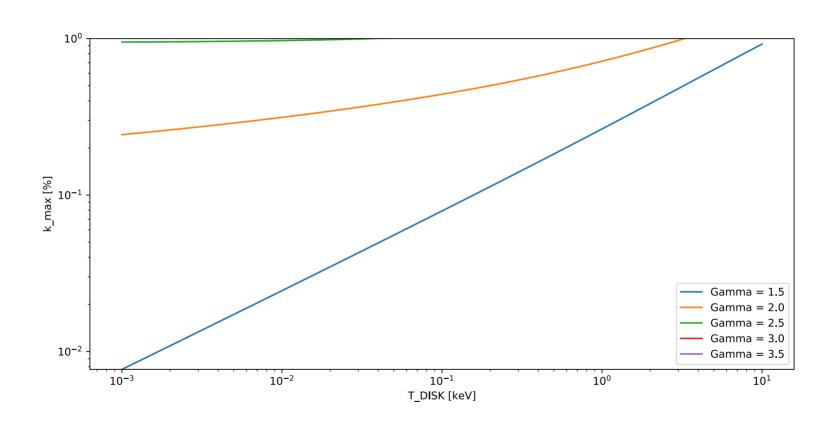
$$egin{aligned} L_{ ext{OUT}} &= \left[1-k+rac{1}{2}\,k\,e^{- au}
ight]\,L_{ ext{DISK}} + L_{ ext{NTHCOMP}}(T_{ ext{DISK}}^{ ext{eff}},\Gamma,T_e) \ &rac{L_{ ext{OUT}}}{L_{ ext{DISK}}} &= 1-k+rac{1}{2}\,k\,(\epsilon+e^{- au}) = rac{2-k(1-e^{- au})}{1+lpha} \ &k = rac{2(1-lpha)}{lpha(\epsilon+e^{- au})+(\epsilon-e^{- au})+2lpha} \ &k \leq rac{2}{\epsilon-e^{- au}}\;, \quad \epsilon > 1 \end{aligned}$$

(NOTE: LOCAL ANALYSIS ONLY)

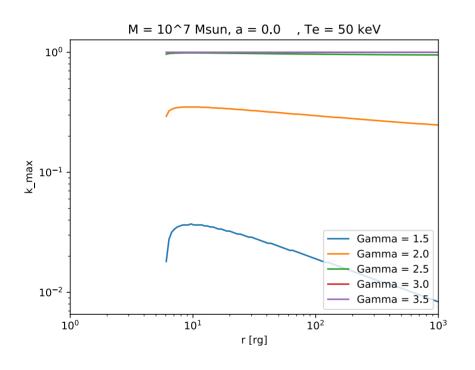
Conditions for energy balance

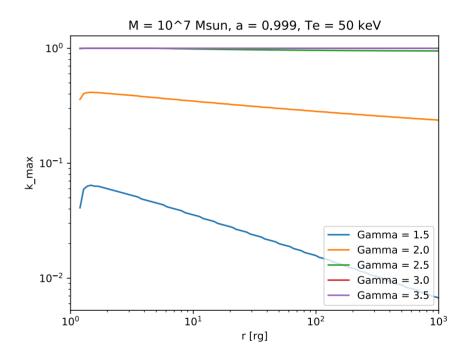


Maximal coverage factor



Maximal coverage factor





Summary

Slab geometry corona with 100% coverage can only work for steepest photon indexes.

Cold parts of the disk do not produce enough power to energize coronal electrons.



In most cases, corona must be patchy and/or temporaly flaring and spatially limitted.