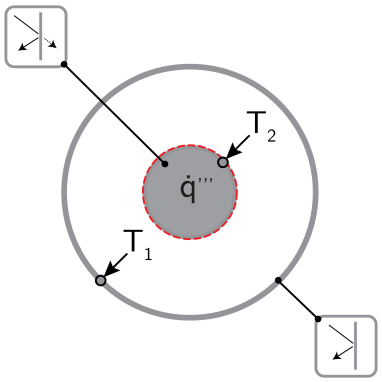
EB - Rad. - Net 02

Write the equation for the net heat transfer from object 1 to object 2 in thermal equilibrium, $\dot{Q}_{1\leftrightarrow 2}$. Make sure no view factors and surface brightness whenever possible remain within your expression.



Definition of the net heat flux:

$$\dot{Q}_{1\leftrightarrow 2} = \Phi_{12}\dot{Q}_1 - \cancel{\Phi_{21}}^{1}\dot{Q}_2$$

Heat fluxes:

Inner energy balance around body 2 yields:

$$\cancel{\frac{\partial U}{\partial t}}^{0} = \sum \dot{Q}_{\text{in}} - \sum \dot{Q}_{\text{out}}$$

$$\rightarrow -\dot{q}'''V = \alpha_2\Phi_{12}\dot{Q}_1 - \epsilon_2\sigma A_2 T_2^4$$

The surface brightness of body 2:

$$\dot{Q}_2 = \dot{Q}_{2,\epsilon} + \dot{Q}_{2,\rho} + \dot{Q}_{2,\tau}$$

$$\rightarrow \dot{Q}_2 = \epsilon_2\sigma A_2 T_2^4 + \rho_2\Phi_{12}\dot{Q}_1 + \tau_2\Phi_{12}\dot{Q}_1$$

Substituting and rewriting:

Substituting the surface brightness of body 2 into the definition of the net heat flux:

$$\dot{Q}_{1\leftrightarrow 2} = -\epsilon_2\sigma A_2 T_2^4 + (1 - \rho_2 - \tau_2)\,\Phi_{12}\dot{Q}_1$$

Which is equal to the found expression from the inner energy balance, and therefore:

$$\Rightarrow \dot{Q}_{1\leftrightarrow 2} = -\dot{q}'''V$$