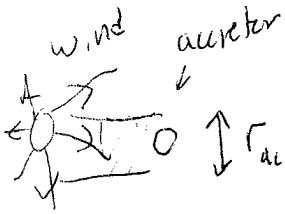
wind accretion ("Bondi-Hoyle-Lyttleton" accretion)

$$V_\infty^2 = V_w^2 + V_{orb}^2$$

M = mass of accretor

V_w = wind speed

V_{orb} = orbital speed



$$\frac{1}{2} V_\infty^2 = \frac{GM_{acc}}{r_{acc}}$$

$$\Rightarrow r_{acc} = \frac{2GM}{V_\infty^2}$$

$$\dot{M}_{acc} = \pi r_{acc}^2 \rho_\infty V_\infty = \frac{4\pi G^2 M_{acc}^2 \rho_\infty}{V_\infty^3}$$

assume $V_w \approx V_{w,\infty}$

wind velocity reaches asymptotic speed

$$V_{orb} = \left(\frac{GM_{tot}}{a}\right)^{1/2}$$

$$V_\infty^2 = \frac{GM}{a} + V_w^2 \approx \frac{GM}{a} + V_{w,\infty}^2$$

$$\rho_a = \frac{\dot{M}_w}{4\pi a^2 V_w}$$

$$\dot{M}_{acc} = \frac{\dot{M}_w}{4\pi a^2 V_w} \frac{4\pi G^2 M_{acc}^2}{V_\infty^3} = \frac{\dot{M}_w M_{acc}^2 G^2}{a^2 V_w \left(\frac{GM_{tot}}{a} + V_w^2\right)^{3/2}}$$

$$= \frac{\dot{M}_w M_{acc}^2 G^2}{a^2 V_w^4 \left(\frac{V_{orb}^2}{V_w^2} + 1\right)^{3/2}} = \frac{\dot{M}_w V_{orb}^4 M_{acc}^2}{M_{tot}^2 V_w^4 \left(1 + \frac{V_{orb}^2}{V_w^2}\right)^{3/2}}$$

$$= \dot{M}_w \left(\frac{M_{acc}}{M_{tot}}\right)^2 \frac{V_{orb}^4}{V_w^4 \left(1 + \frac{V_{orb}^2}{V_w^2}\right)^{3/2}}$$