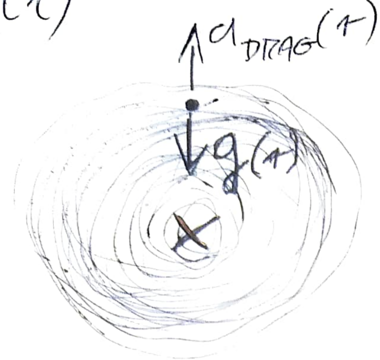
(ii)



GASEOUS
PROTOPLANET

SHOW:

IF $v_t(r) \ll v_{ff}(r)$

$\Rightarrow \Delta r / r \ll 1$

WHERE Δr IS DISTANCE
UNTIL $v_t(r)$ REACHED.

v_t IS REACHED WHEN $g(r) = a_{DRAG}(r)$

PROPOSITION SEEMS TRUE INTUITIVELY BUT
I DON'T KNOW HOW TO PROVE IT.

$v_t(r)$ IS REACHED WHEN $a_{DRAG}(r) = g(r)$.

$$\frac{3 \rho_{PL} \dot{r}^2}{8 \rho_{ROCK} b} = g(r) = \int_0^r \rho_{PL}(r') 4\pi r'^2 dr' \frac{1}{r^2}$$

$$\underbrace{\left(\frac{dr}{dt}\right)^2}_{v_t \text{, IF ABOVE EQUALITY HOLDS}} = \frac{8 \rho_{ROCK} b}{3 \rho_{PL} r^2} \int_0^r \rho_{PL}(r') 4\pi r'^2 dr'$$

$$v_t(r) = \frac{8 \rho_{ROCK} b}{3 \rho_{PL} r^2} \int_0^r \rho_{PL}(r') 4\pi r'^2 dr'$$

CONDITIONS FOR $\dot{r} \approx v_t(r)$ $\forall r$

$\dot{r} \approx v_t(r)$ IF:

- HAD THE PARTICLE ACCELERATE MORE, THIS ACCELERATION WOULD BE BALANCED (IE DECELERATED) BY AN INCREASED $a_{DRAG}(r)$
- FOR THE ABOVE POINT, IT SHOULD BE TRUE THAT:
  - NO SUDDEN DECREASE IN $S_{PL}(r)$ AS r DECREASES.
  - NO SUDDEN INCREASE IN ρ_{ROCK} OR b AS r DECREASES.

$$\frac{db}{dt} = A\, S_{PL}(r)\left(\frac{dr}{dt}\right)^3 \quad \cancel{\Rightarrow b(t) = \int A\, S_{PL}(r)\left(\frac{dr}{dt}\right)^3 dt}$$

$$\Rightarrow b(t(r)) = \int^{t(r)} A\, S_{PL}(r')\left(\frac{dr'}{dt'}\right)^3 dt'$$

$$= \int^{t(r)} A\, S_{PL}\, \dot{r}'^2\, dr'$$

IF $\dot{r} = v_t$, WE HAVE:
(WHICH IS REASONABLE GIVEN IT IS LOSING SIZE)

$$b(t) = \int^{t(r)} A \rho_{PL} \frac{64 \rho_{ROCK}^2 b^2}{9 \rho_{PL}^2 r'^2} \left(\int_0^{r'} \rho_{PL} \, 4\pi r''^2 \, dr'' \right)^2 dt'$$

$$= \int^{t(r)} A \rho_{PL} \frac{64 \rho_{ROCK}^2 b^2}{9 \rho_{PL}^2 r'^2} \left(\frac{4}{3} r'^3 \pi \right)^2 dt'$$

$$\cancel{= \int^{t(r)}} \propto \left[r^4 \right]^{t(r)}$$

WHICH IS WRONG.