Q, F and H

- Definitions: $F = P_\alpha / (P_\alpha + P_{ext})$ $\quad Q = 5\, P_\alpha / P_{ext}$
- Hence $F = Q/(Q+5)$ and $Q = 5F/(1-F)$
- F = "fraction of self heating" is a physics variable. We need F > 0.5 (Q=5) or 0.66 (Q=10) and as F -> 1, Q gets very large. F is a less sensitive variable and we really should focus on F
- Q is an "energy economics variable" and if we ever get in the range 5 < Q < 10 we can tweak it higher.
- Relation to H : the H-mode or L-mode confinement time enhancement factor.

$P_\alpha \alpha V n^2 T^2$ high T (or $V n^2 T^2 (T/10)$ low T)

α $n T W = n T \tau (P_\alpha + P_{ext})$ ignoring P_brem at very low T

hence $F \alpha n T \tau$ the " fusion product "

typically (at fixed B, a, R/a , q etc) $\tau \alpha H (P_\alpha + P_{ext})^{-1/3}$

and $nT \alpha H (P_\alpha + P_{ext})^{2/3}$

so $F \alpha H^2 (P_\alpha + P_{ext})^{1/3}$ or $F \alpha H^2 [P_{ext}/(1-F)]^{1/3}$

H = 1.15 (like top of RMSE =15%) means F increases by 30%

or F=0.5 (Q=5) goes to F=0.66 (Q =10) H=0.85 is not reported H = 1.15 is front page

- And higher sensivities are possible…….suppose in low T regime

$$P_{\alpha} \;\alpha\; T^{3} \;\alpha\; H^{3}\,(P_{\alpha}+P_{ext})^{2}$$

$$F = H^{3}\,[P_{ext} / (1-F)]$$