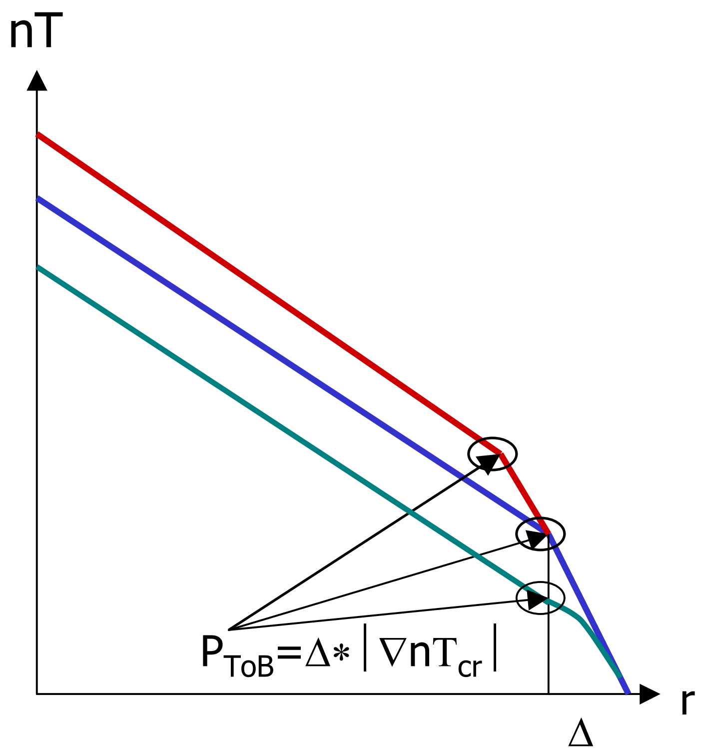
Why do we need to know the physics of edge barrier: a brief Introduction

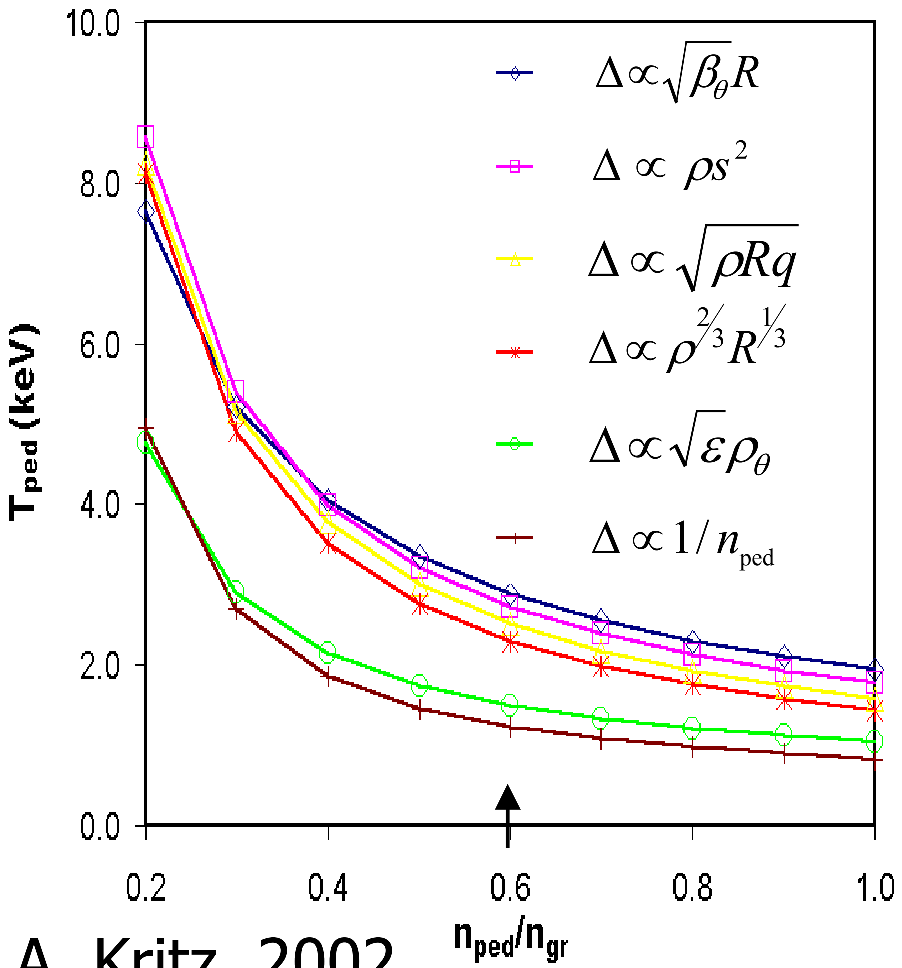
V. Parail

Why do we need to know the physics of edge barrier



- Plasma performance is largely controlled by the pressure on the top of edge barrier (due to profile stiffness);
- If we believe that pressure gradient within the barrier is controlled by ballooning stability $|\nabla nT| \leq |\nabla nT|_{cr}$ then ETB width Δ is one of the most important characteristics of ELMy H-mode;
- The level of non-uniformity within the ETB is another parameter, which might control plasma pressure on the top of barrier;

Pedestal Temperature Predicted for ITER



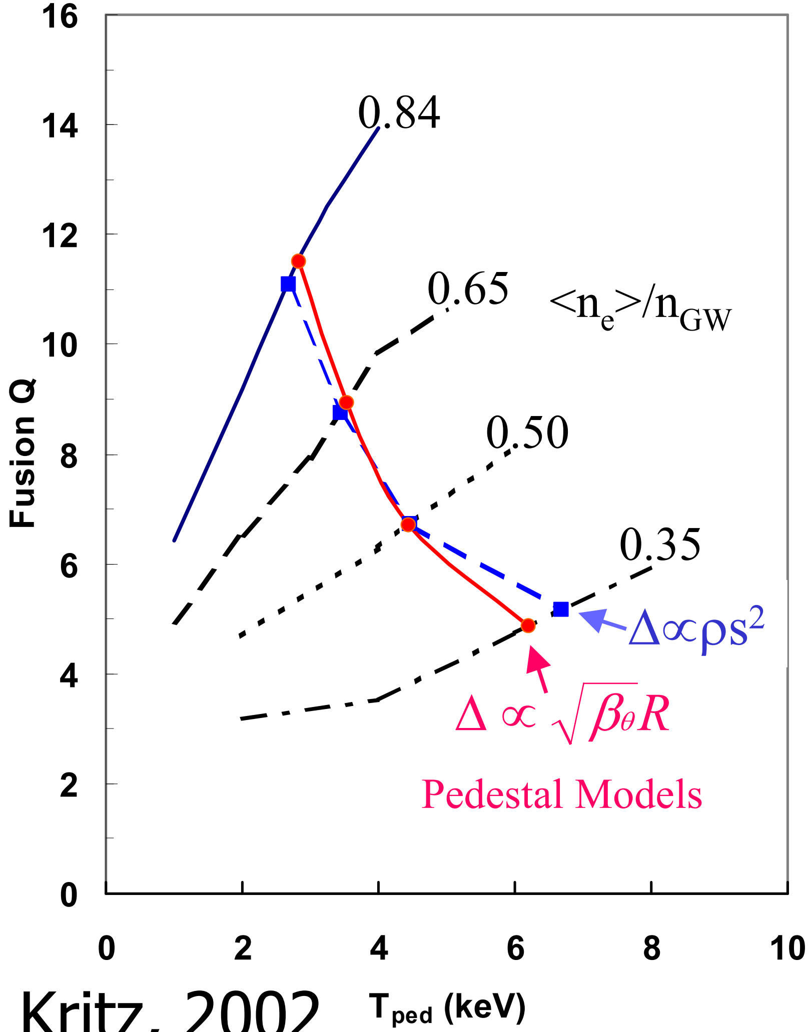
A. Kritz, 2002

Parameters for ITER	
R	6.2 m
a	2.0 m
I	15.0 MA
B	5.3 tesla
κ_{95}	1.7
δ_{95}	0.33
Z_{eff}	1.5
A_H	2.5 AMU
P_{aux}	40 MW

Pedestal pressure is almost independent of the pedestal density

Fusion Q vs T_{ped} for ITER

Two Pedestal Models and Multi-Mode Core Transport



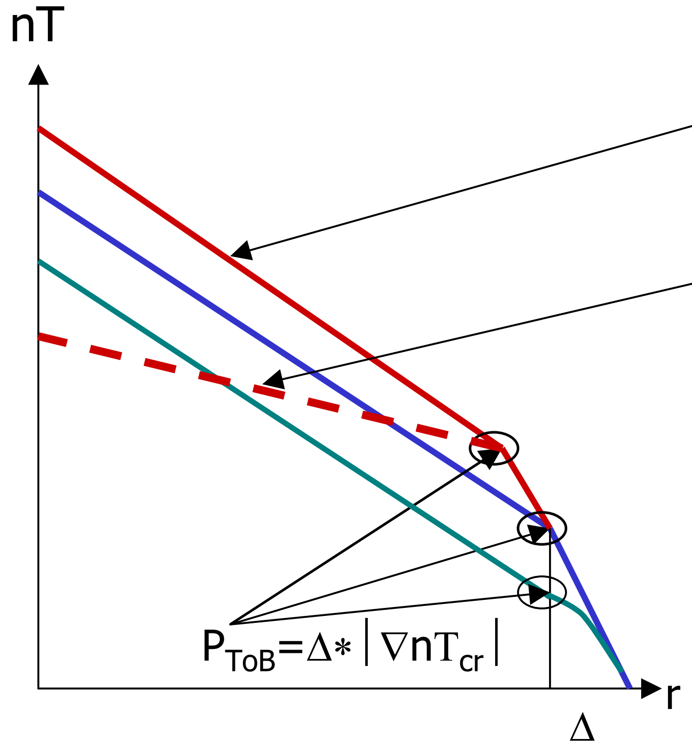
A. Kritz, 2002

- Fusion $Q \equiv 5\, P_\alpha / P_{aux}$
- ITER with P_{aux} = 40 MW with 2% Be + 0.12% Ar + Helium
- Fusion *Q* rises rapidly with T_{ped} with density held fixed
- However, T_{ped} is inversely related to n_{ped} and at higher T_{ped}, but lower n_{ped} fusion power decreases

Examples of Findings for ITER

R. Budny, APS 2005

- ELMy H-mode from GLF23 (in TSC) with T_{ped} = 5.5keV, I_p = 15MA has β_n 1.8, $H_{98} \simeq 1.0$, $Q_{DT} \geq 10$



What we might expect to learn by the end of this Working Session?

- that we understand physics of L-H transition and ETB formation for "standard" ITER conditions to an extent, which allows us to predict ITER performance for these "simple" cases;
- that we qualitatively understand how and why ETB width scales with plasma parameters (ρ^*, ν^*, β + plasma-wall interaction) and can project these trends towards ITER;
- I do NOT believe that we will be able to claim that we have one single model, which universally explain L-H transition and ETB formation. However:
    - I hope we should be able to say that current models have such and such limitations and should not be used outside certain safe range of plasma parameters;
    - that we will be able to bring different specialists towards closes collaboration with in working groups.