# INTERMEDIATE N MODE STABILITY IN THE NEGATIVE TRIANGULARITY TOKAMAKS

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## ABSTRACT

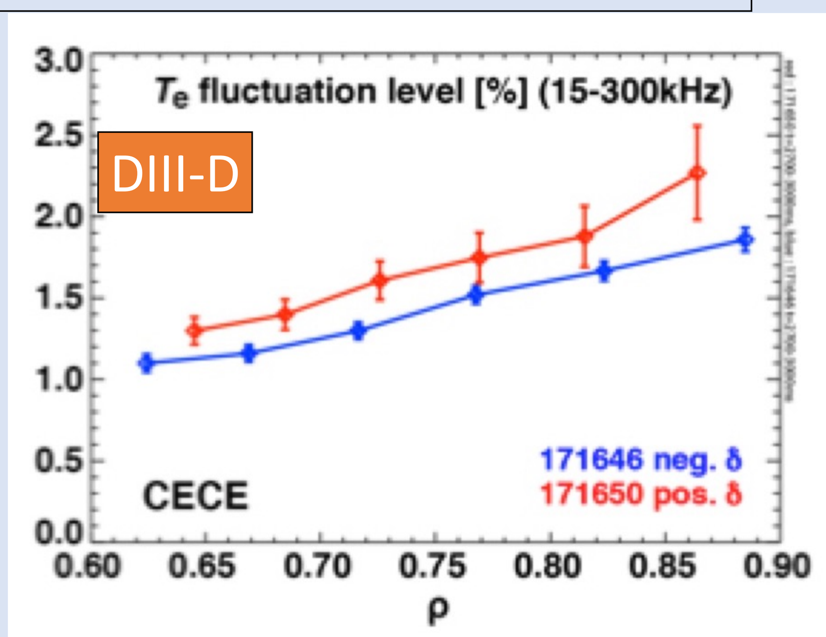

- The MHD Intermediate n mode stability in the negative triangularity tokamak is investigated in comparison with the positive triangularity case .
- Use the DIII-D-negative-triangularity-experiment-like equilibria.
- We found that, although the negative triangularity case is believed to be less stable for n=1 MHD modes than the positive triangularity case, the negative triangularity configuration is generally more stable than the positive triangularity one for intermediate n modes.


## BACKGROUND

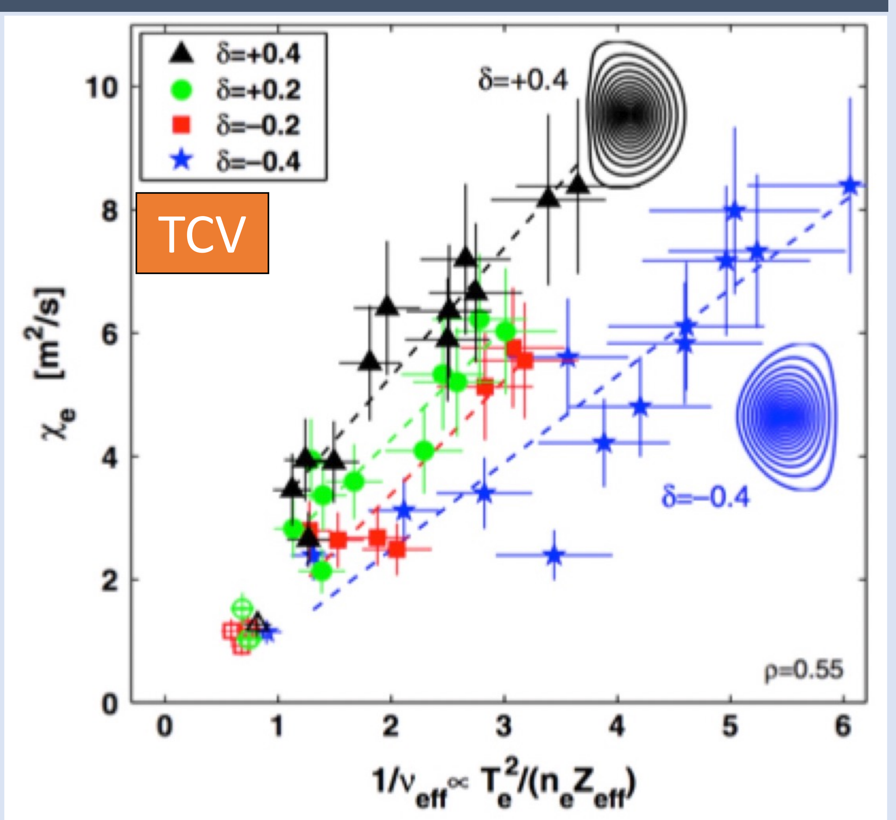
- The negative triangularity tokamak (NTT) is a possible solution for the divertor heating load issue due to ELMs. But, its stability remains to be fully assessed.
- TCV and DIII-D experiments constantly show that the transport level in the negative triangularity discharges is substantially lower than the positive triangularity discharges, although it is generally believed that the negative triangularity case is more unstable for low n MHD modes.
- The theoretical interpretation for these experimental observations is needed.

## Experimental observations

*Experiments: NTT has lower turbulent transport level:*




M. Austin,, APS-DPP, 2017




Y. Camenen, Nucl. Fus. 2007

## Equilibrium

**Use the VMEC code to extrapolate the g-file from the DIII-D experiments.**

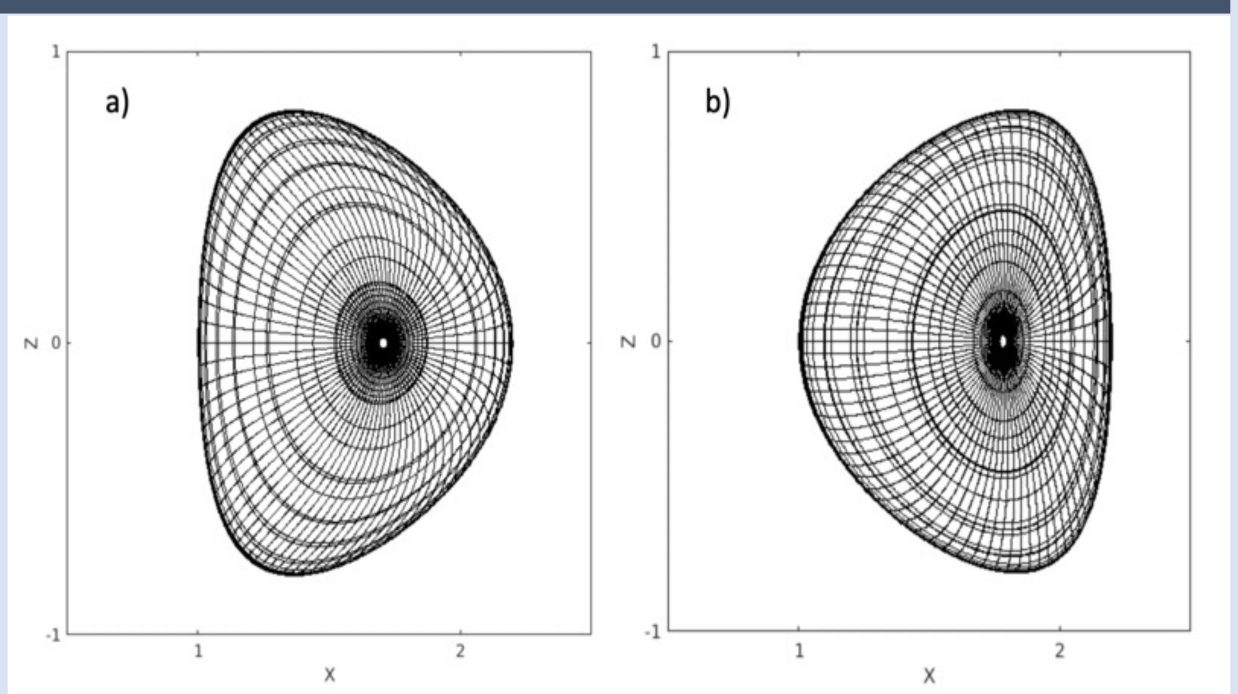



*Fig. 1. Cross sections of positive (a) and negative (b) triangularity equilibria for DIII-D derivative configurations.*

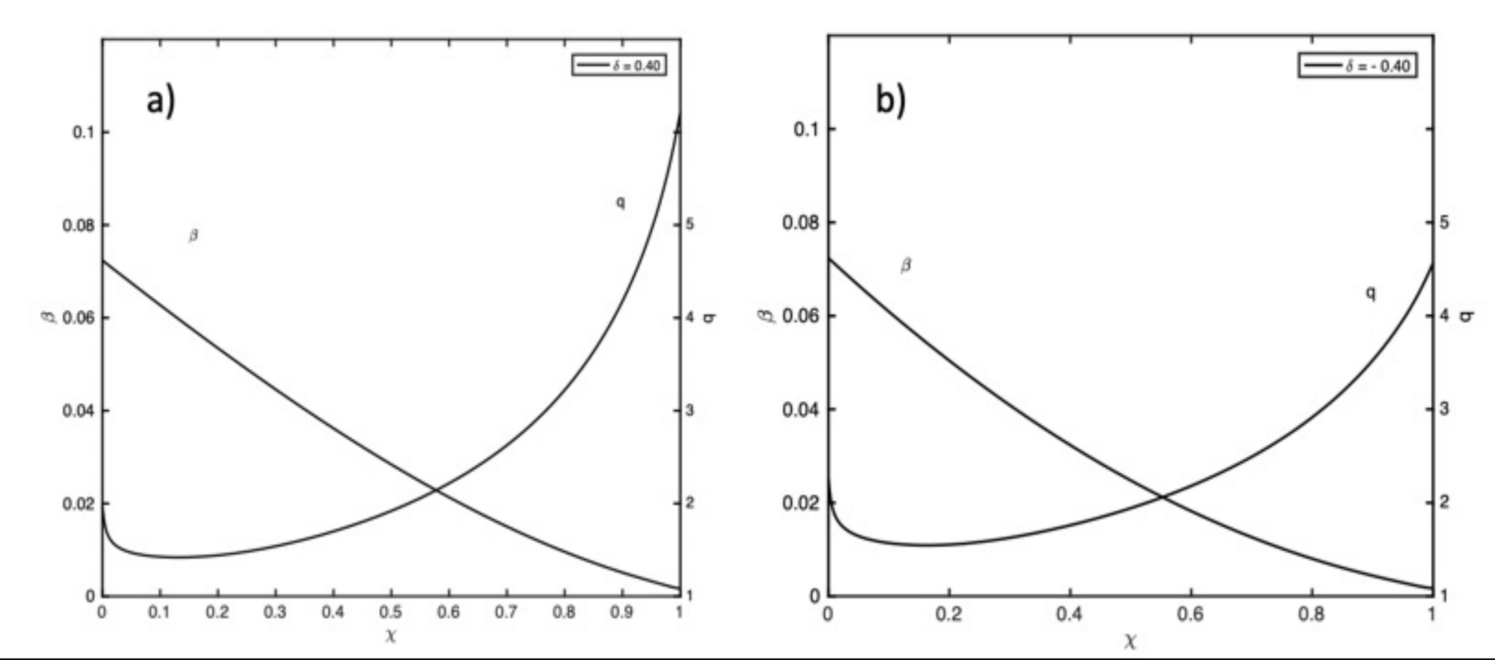


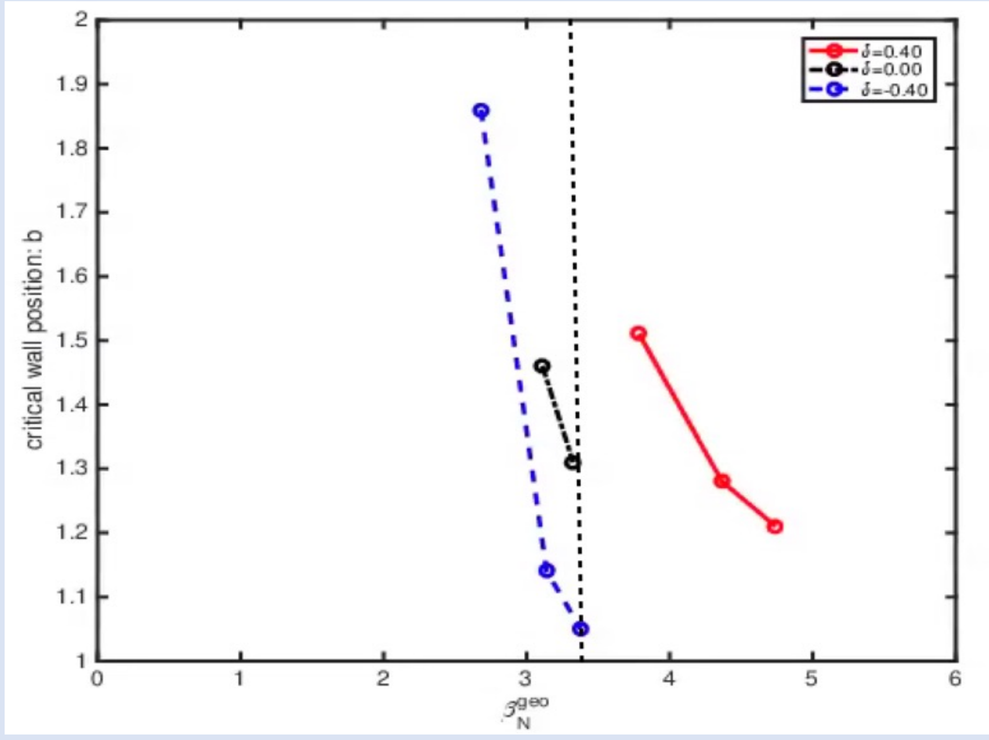

*Fig.2. Plasma beta and safety factor profiles versus poloidal magnetic flux $\chi$ for DIII-D derivative configuration with triangularity $\delta$ = 0.40 and -0.40 shown respectively in Part a) and b).*

## Stability

**Use AEGIS MHD stability code**

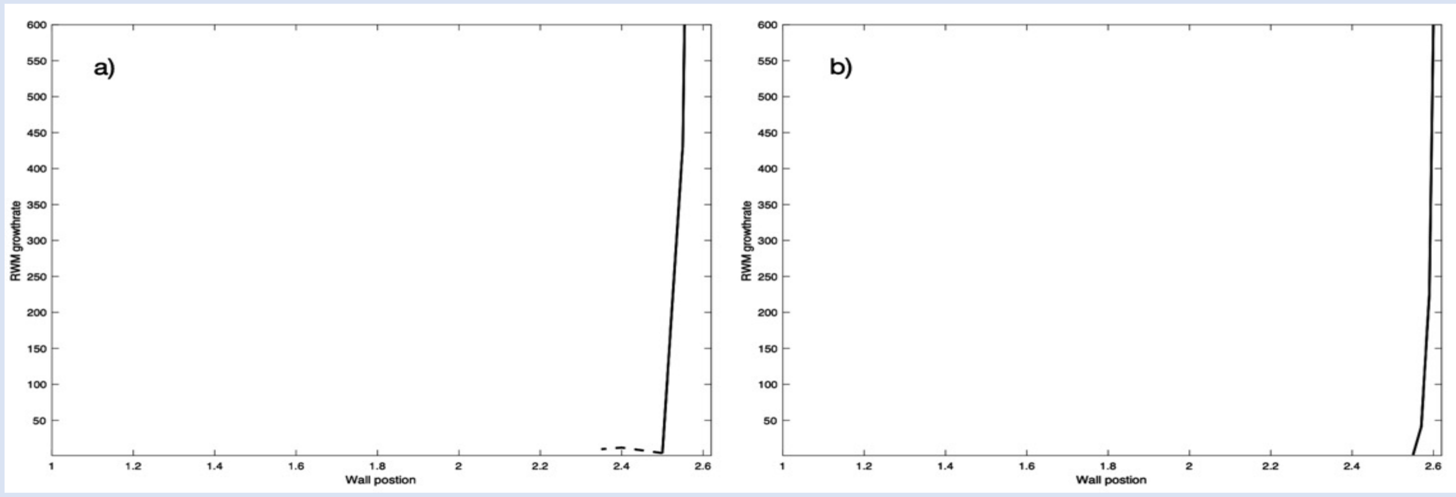
**n = 1 modes: NTT is less stable than PTT**

*Fig. 3. The critical wall position b normalized by the minor radius at midplane versus the beta normal $\beta_N^{geo}$ for three different triangularity case: $\delta$ = +0.40 (red), 0.00 (black), and -0.40 (blue). The vertical dotted line indicates the beta value for intermediate n mode studies*

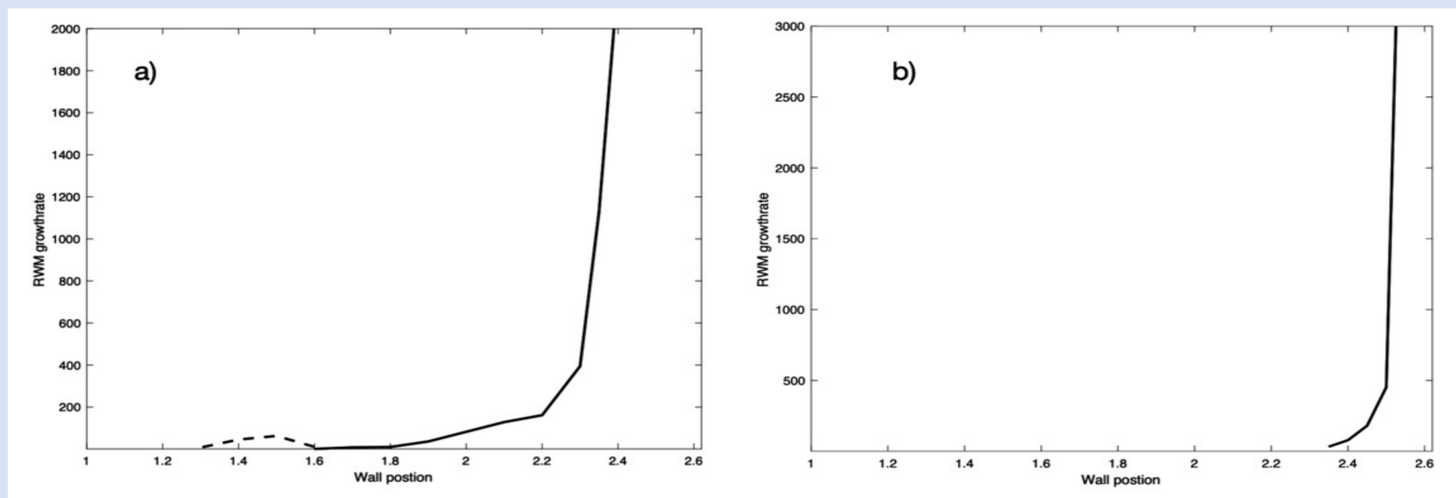



**Intermediate n modes: NTT is more stable than PTT**

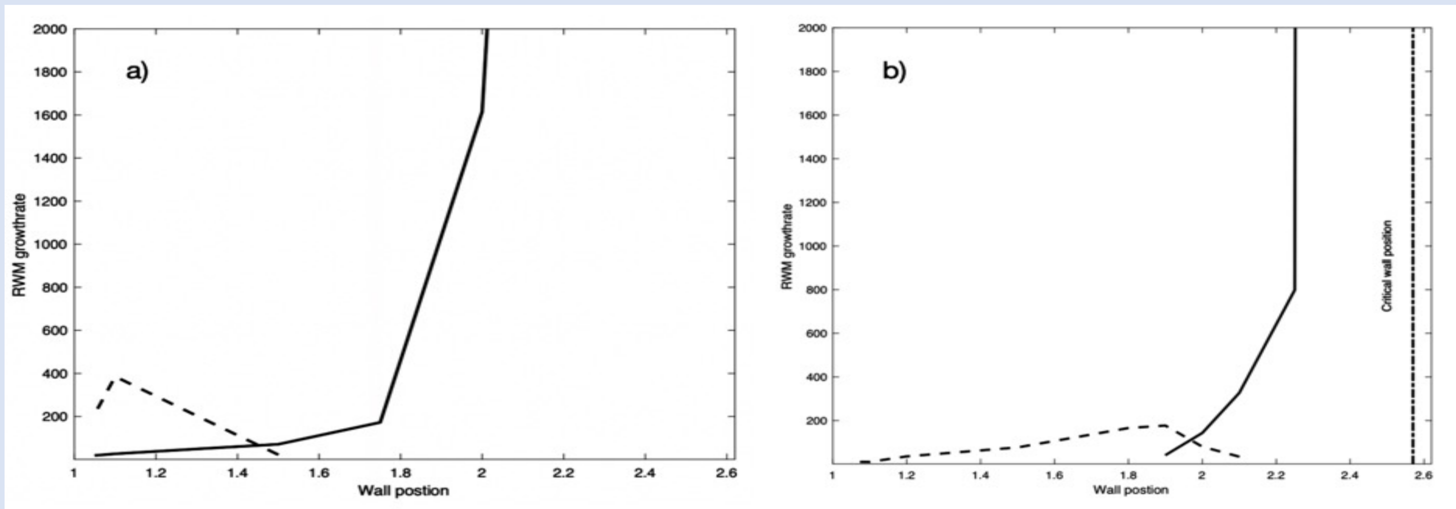
n = 3



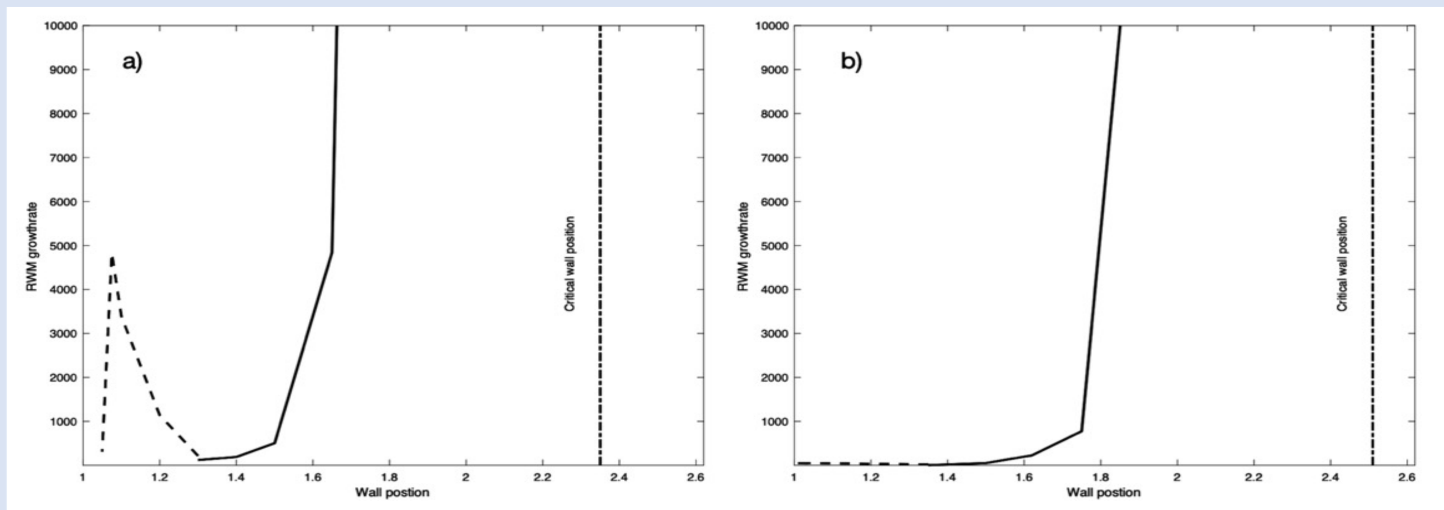

n = 5




n = 7




n = 10




Figs. 4-7. The growth rate vs the normalized wall position for n= 3, 5, 7 and 10. The results show that NTT (b) than PTT (a) has lower RWM growth rate. This is consistent with the experimental observations.

## CONCLUSIONS

- We found that NTT is more stable than PTT for intermediate n MHD modes although NTT is believed to be less stable for n=1 modes than PTT,
- Our numerical results are consistent with the experimental observations that NTT has lower turbulent transport level.
- The current work is based on the ideal MHD. It is relevant to the interpretation of the electromagnetic modes of low frequency.

## ACKNOWLEDGEMENTS

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