



**Present  
status of  
island study**

## **Magnetic Topology session**

# **Present status of island study**

**Y. NARUSHIMA NIFS**



# Outline

Present  
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island study

## **Background (Before 2009)**

**Island characteristics in quasi-steady state**

**5<sup>th</sup> CWGM (Stuttgart)**

**17<sup>th</sup> ISHW, 6<sup>th</sup> CWGM (Princeton)**

## **Recent status (2010)**

**23<sup>rd</sup> IAEA (Daejeon)**

**8<sup>th</sup> CWGM (Toki)**

## **Future plan (After 2010)**

**38<sup>th</sup> EPS (Strasbourg)**



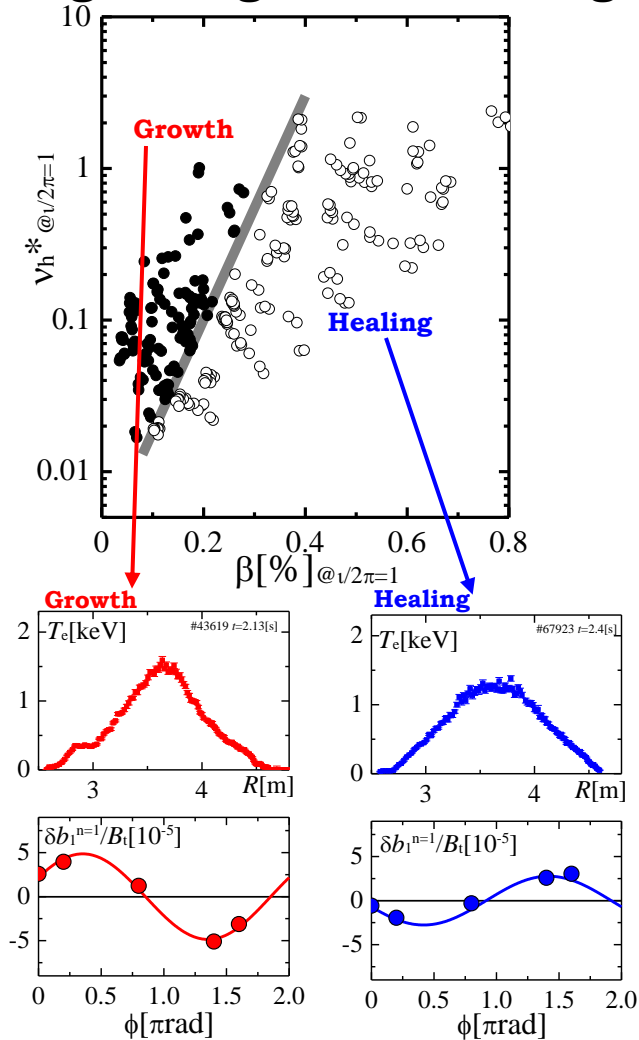
# Background (Before 2009)

Behavior of island depends on  $\beta$  and  $\nu$

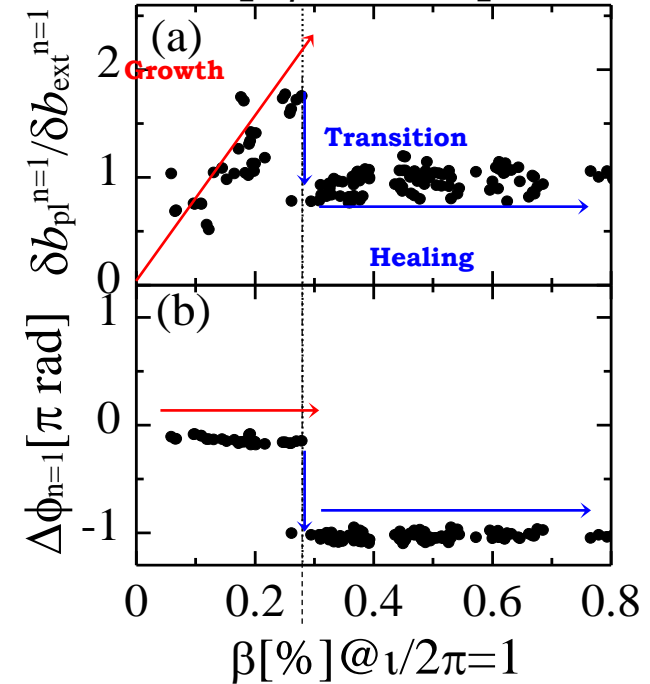
Y. NARUSHIMA, *et al.*, NF (2008)

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Region of growth & healing



Structure of plasma response field



Island's growth and healing depend on  $\beta$  and  $\nu$   
Self-healing appears at a certain  $\beta$



# Background (Before 2009)

5<sup>th</sup> CWGM (Stuttgart)

17<sup>th</sup> ISHW, 6<sup>th</sup> CWGM (Princeton)

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TJ-II

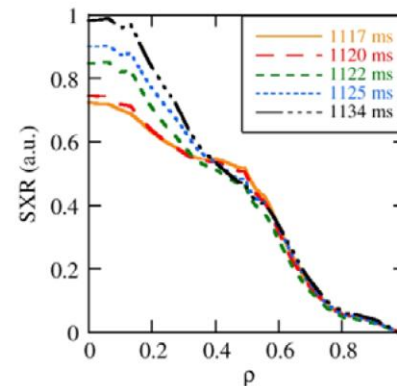
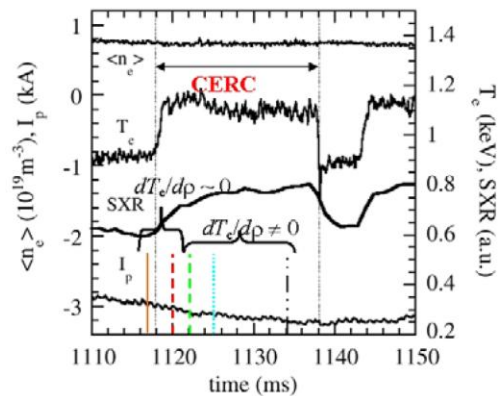


Fig. 5 Time evolution of electron density, electron temperature, SXR and plasma current in CERC formation (Left). SXR profiles (Right) [14]. (Color figure: www.cpp-journal.org).

Y. Narushima, *et al.*, CPP (2010)

LHD

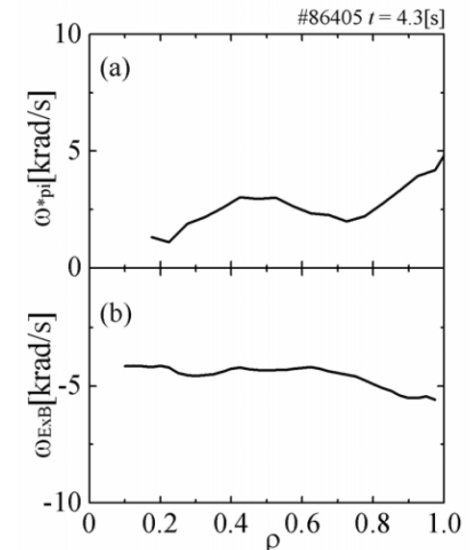


Fig. 7 Minor radius profile of ion diamagnetic angular velocity  $\omega_{pi}^*$  (a) and  $E \times B$  drift angular velocity  $\omega_{E \times B}$  (b).

👉 Island disappears when  $E_r$  increases  
👉 Focus on **poloidal flow**



# Recent status (2010)

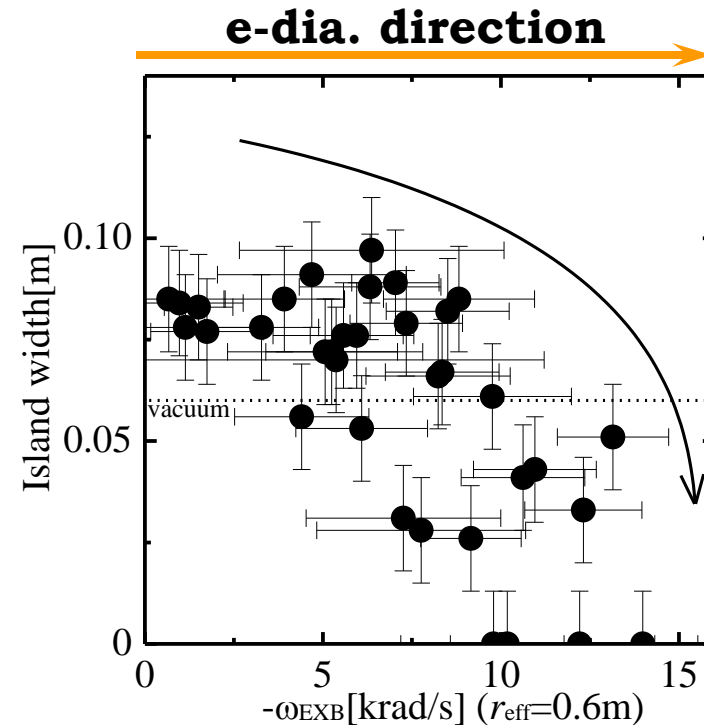
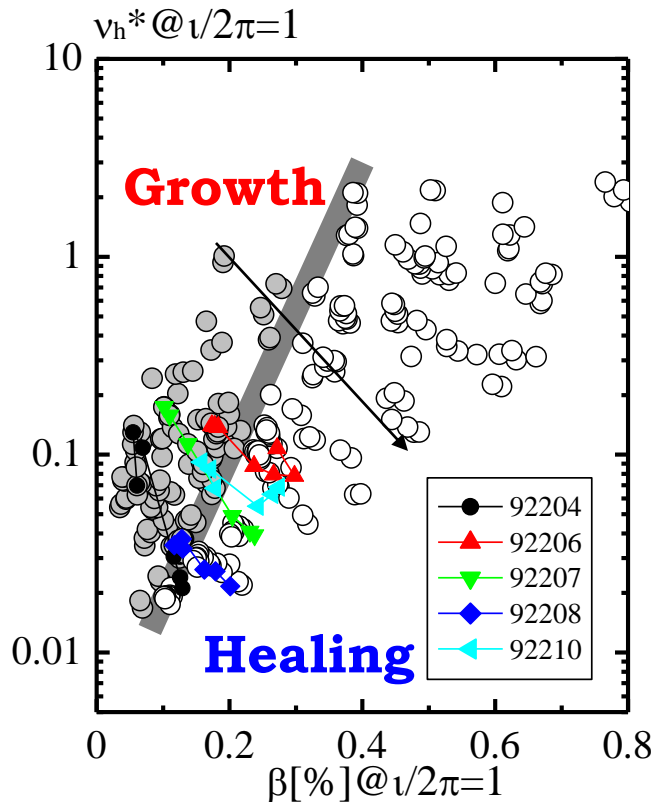
23<sup>rd</sup> IAEA (Daejeon)

Y. Narushima, *et al.*, 23rd IAEA FEC (2010)

Y. Narushima, *et al.*, Submitted to NF

## Experimental observation of poloidal flow Transition from **growth** to **healing**

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👉 Poloidal flow goes up **prior to** island transition

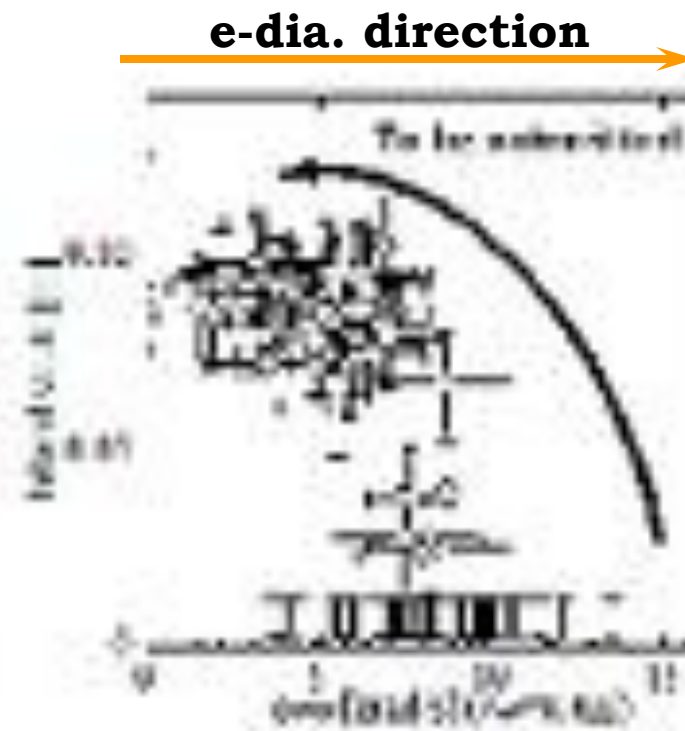
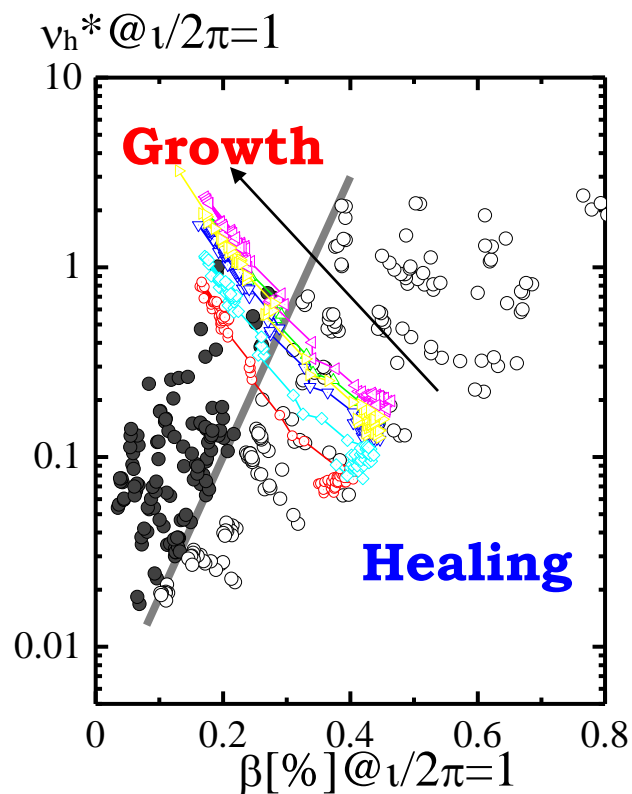


# Future plan (After 2010)

38<sup>th</sup> EPS (Strasbourg)

Experiment of opposite transition  
Transition from **healing** to **growth**

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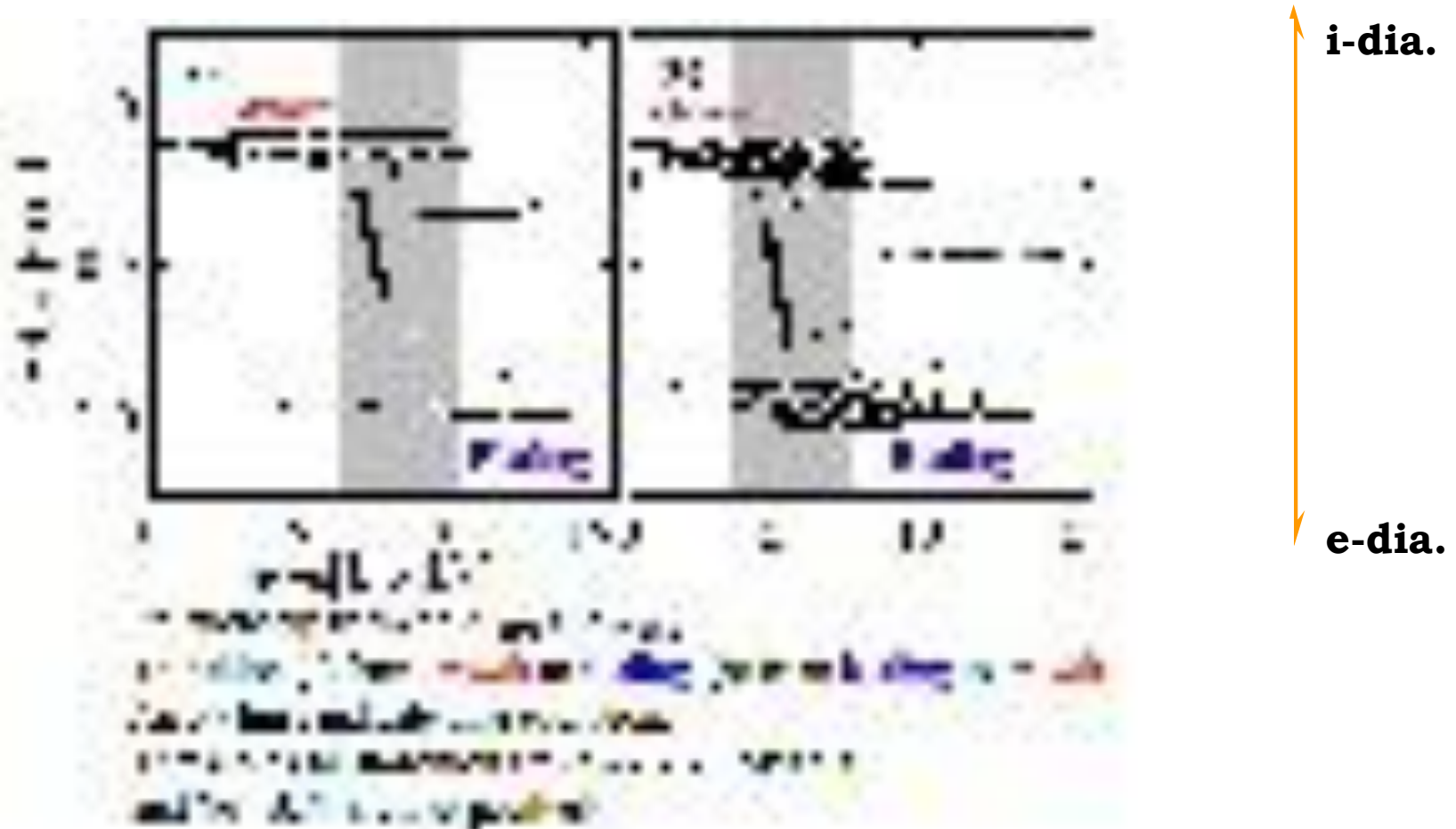
**Poloidal flow goes down prior to island transition**



# Future plan (After 2010)

38<sup>th</sup> EPS (Strasbourg) (To be submitted to PPCF)

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**Hysteresis** can be seen in island transition

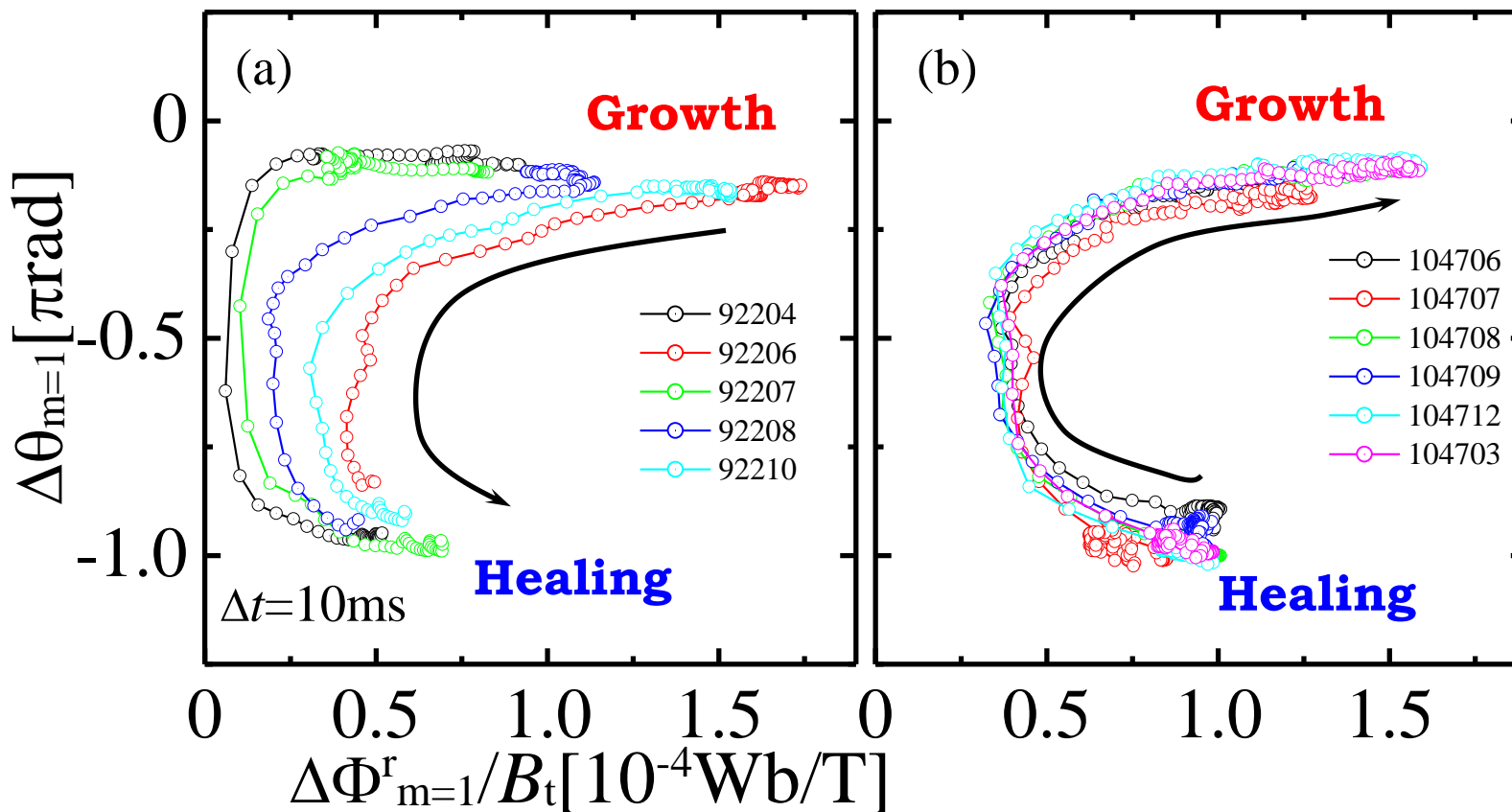
# Relationship between $\Delta\Phi_{m=1}^r$ & $\Delta\theta_{m=1}$



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**growth to healing**

**healing to growth**



Relationship between  $\Delta\Phi_{m=1}^r$  and  $\Delta\theta$ .

Transition (a) from growth to healing. (b) from healing to growth.

**Lower amplitude, faster rotation**



# Summary



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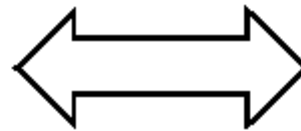
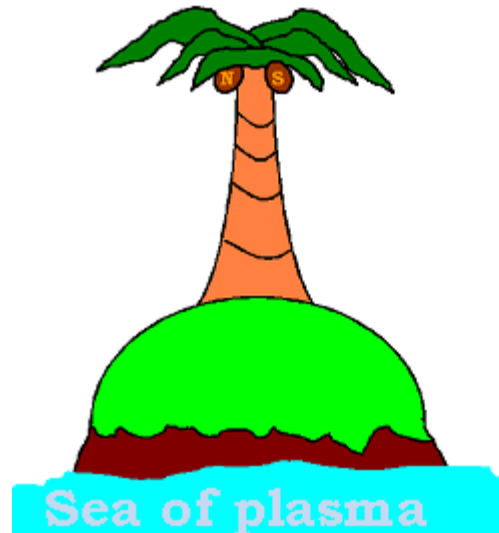
- ❏ Poloidal flow changes **prior to** island transition in both cases (growth  $\leftrightarrow$  healing).
- ❏ **Threshold** of poloidal flow when structure of plasma-response field is modified is **different** from value in transition from growth to healing.
- ❏ These results suggest existence of **hysteresis** in magnetic island transition dynamics.
- ❏ Mechanism of transition of magnetic island is left as an unsolved problem.
- ❏ Further progress of theoretical studies is expected to explain that phenomena.



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# References

Appears



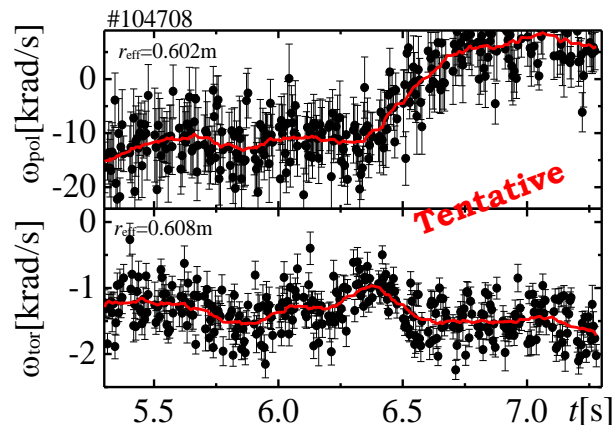
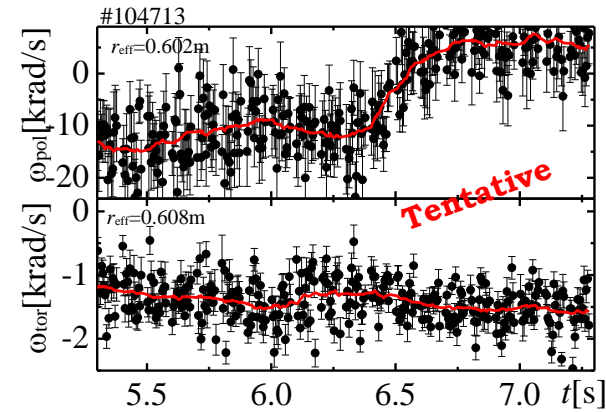
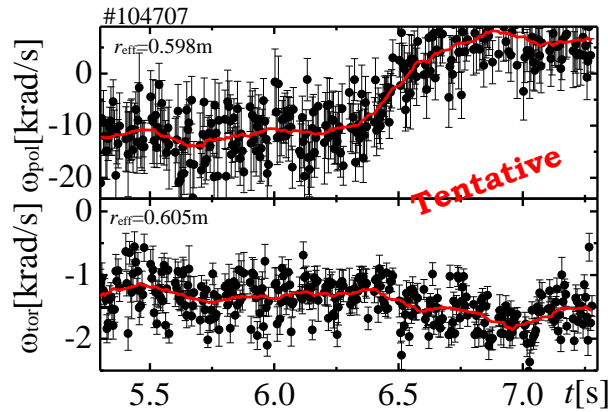
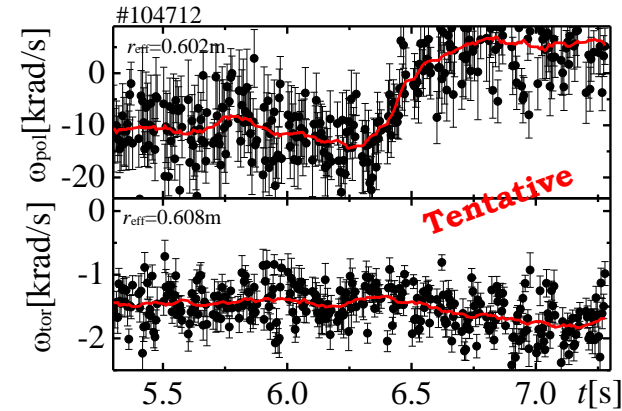
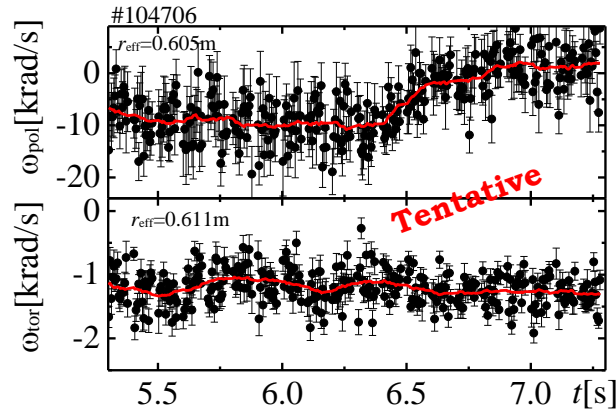
Disappears



# Toroidal flow and toroidal flow



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Waveforms of (a) poloidal  $\omega_{\text{pol}}$  and (b) toroidal flow  $\omega_{\text{tor}}$   
 Solid line indicates adjacent averaging.  
 $\omega_{\text{pol}}$  changes at  $t \sim 6.5\text{s}$  whereas  $\omega_{\text{tor}}$  does not change.