

# Invitation to Joint Experiment on LHD

The 14th campaign in 2010  
6th Oct. – 24th Dec.

Could be extended to  
mid. Feb. 2011



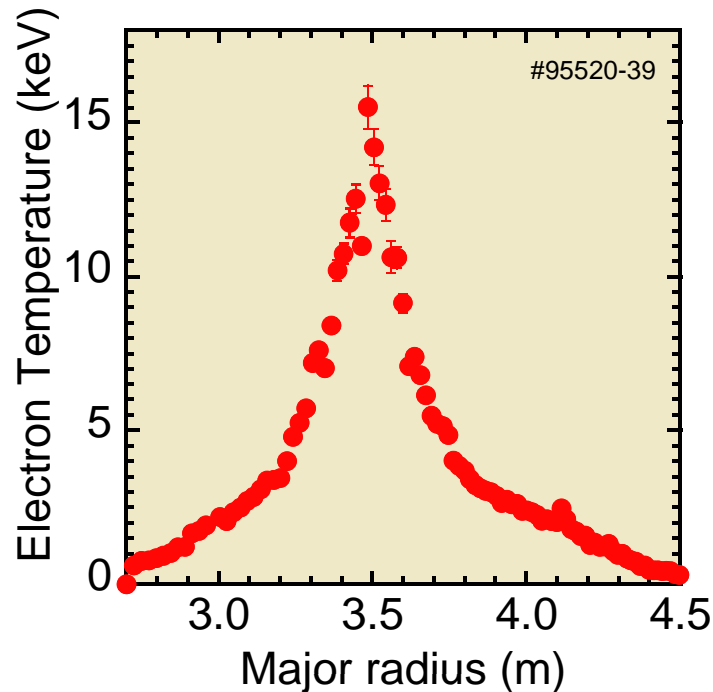
H.Yamada. LHD Experiment Group

7th CWGM  
Greifswald 30th June to 2nd July, 2010



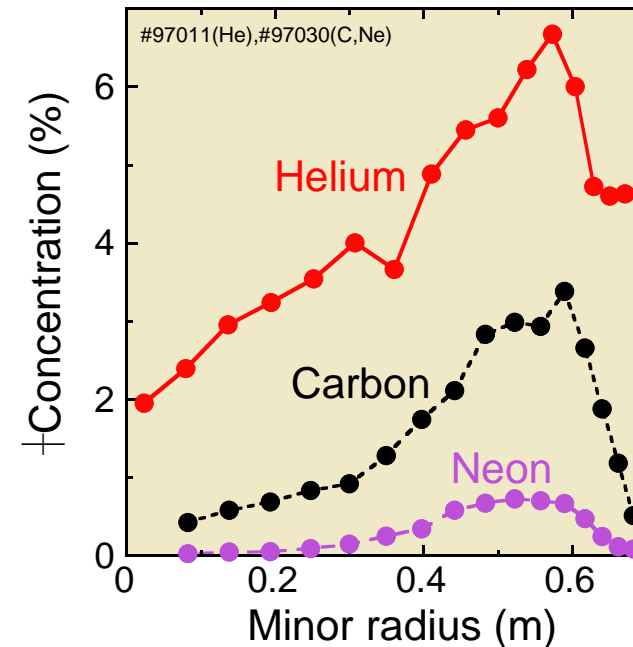
# Highlights from 13th Experimental Campaign in 2009

## Electron temperature of 15keV



- ✓ Development of 77 GHz ECH by collaboration with Tsukuba Univ.
- ✓ Suppression of anomalous transport in the geometry with reduced effective helical ripple and confinement improvement in electron root (CERC)
- ✓ Improvement of accuracy in electron temperature measurement by Thomson scattering

## Mass/charge dependence of impurity hole



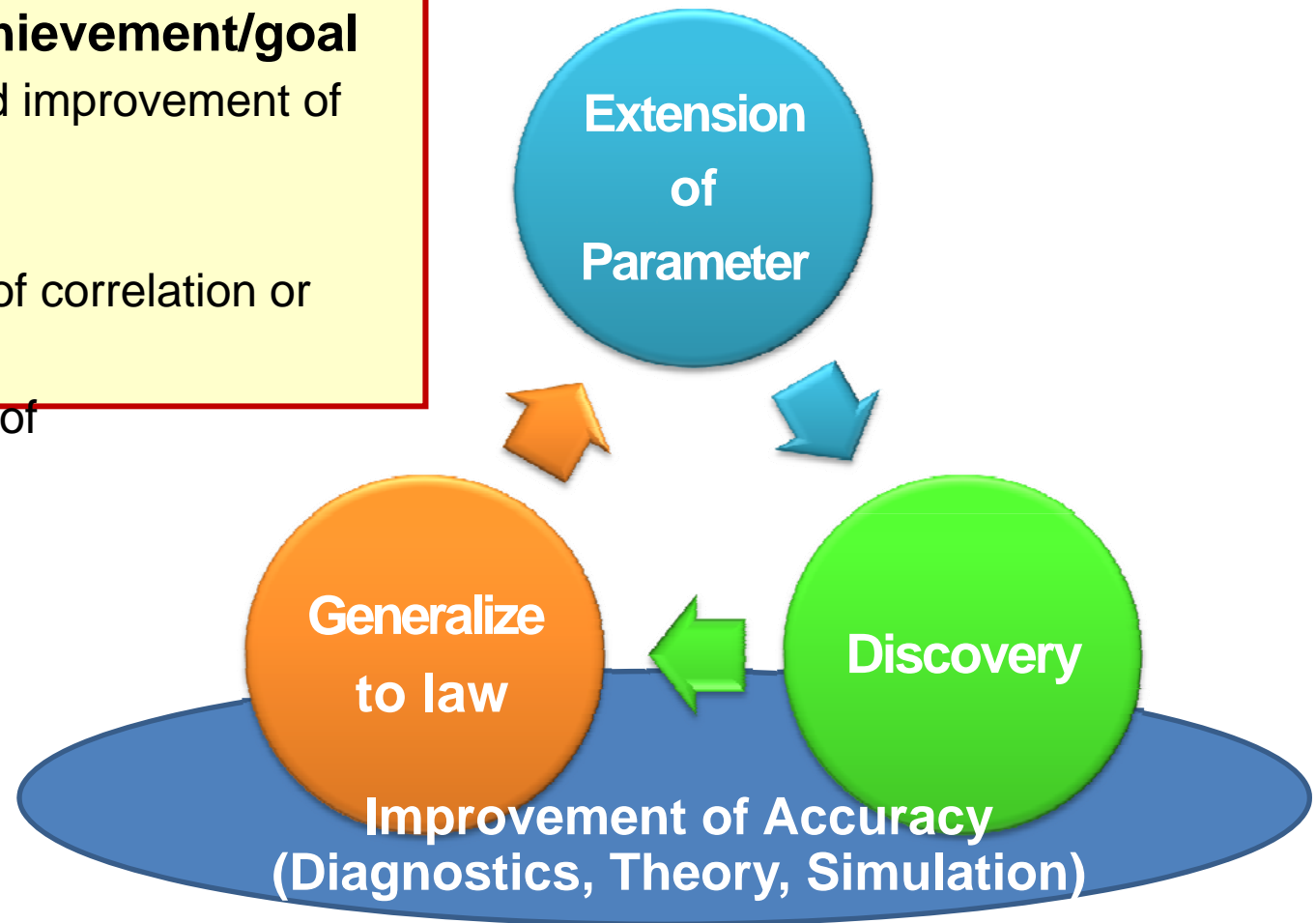
- ✓ Confinement improvement leading to high-ion temperature
- ✓ Improvement of accuracy of impurity concentration measurement by CXRS with 40 keV NBI
- ✓ Qualitative assessment by integrated database of atomic and molecular processes



## Point and Orientation of Experimental Strategy

### Identification of achievement/goal

- 1) Extension and improvement of plasma parameter
- 2) Discovery
- 3) Identification of correlation or causality
- 4) Improvement of accuracy/probability



Then, in the next experimental campaign

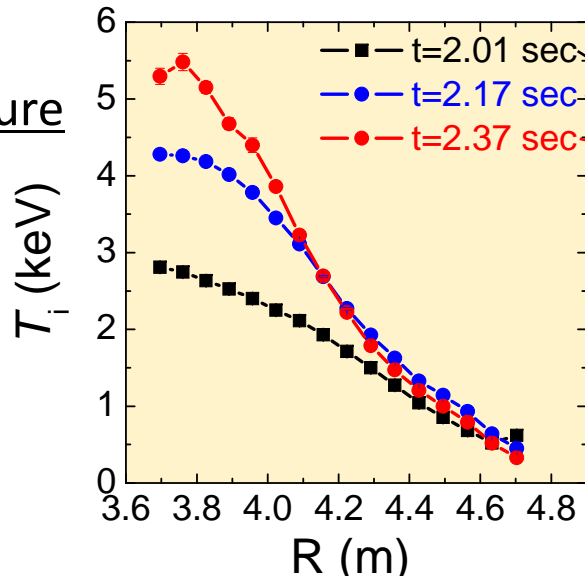
- 1) What is prospected as extension of the present knowledge and infrastructure ?
- 2) What is a critical unresolved issue ?
- 3) What do we need to solve it ?



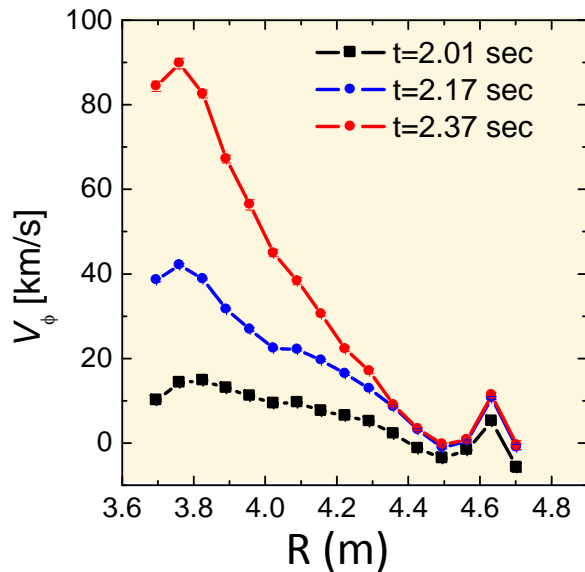


# Confinement Improvement leading to high Ti : indicates correlation between thermal and momentum transport

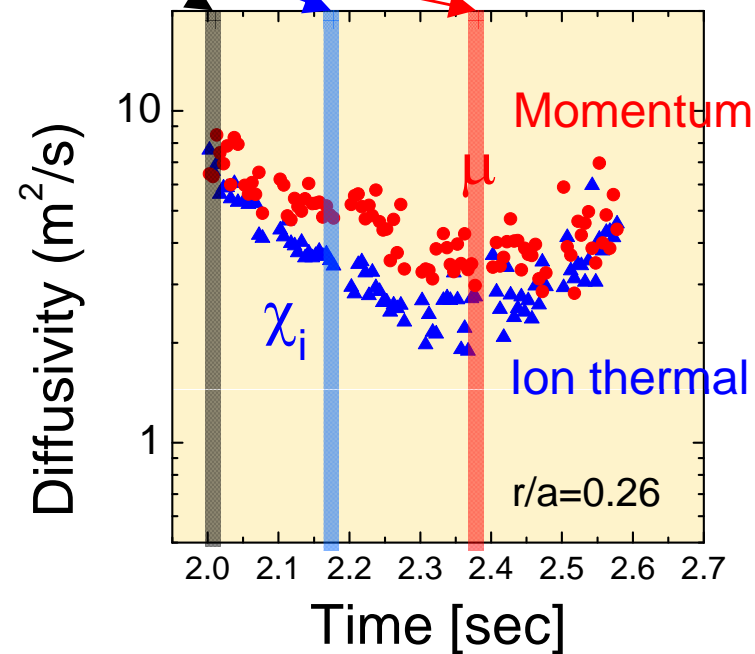
Ion Temperature



Toroidal Rotation



Ion thermal diffusivity and toroidal momentum diffusivity is almost the same and correlated



Diffusivity is reduced to 1/3

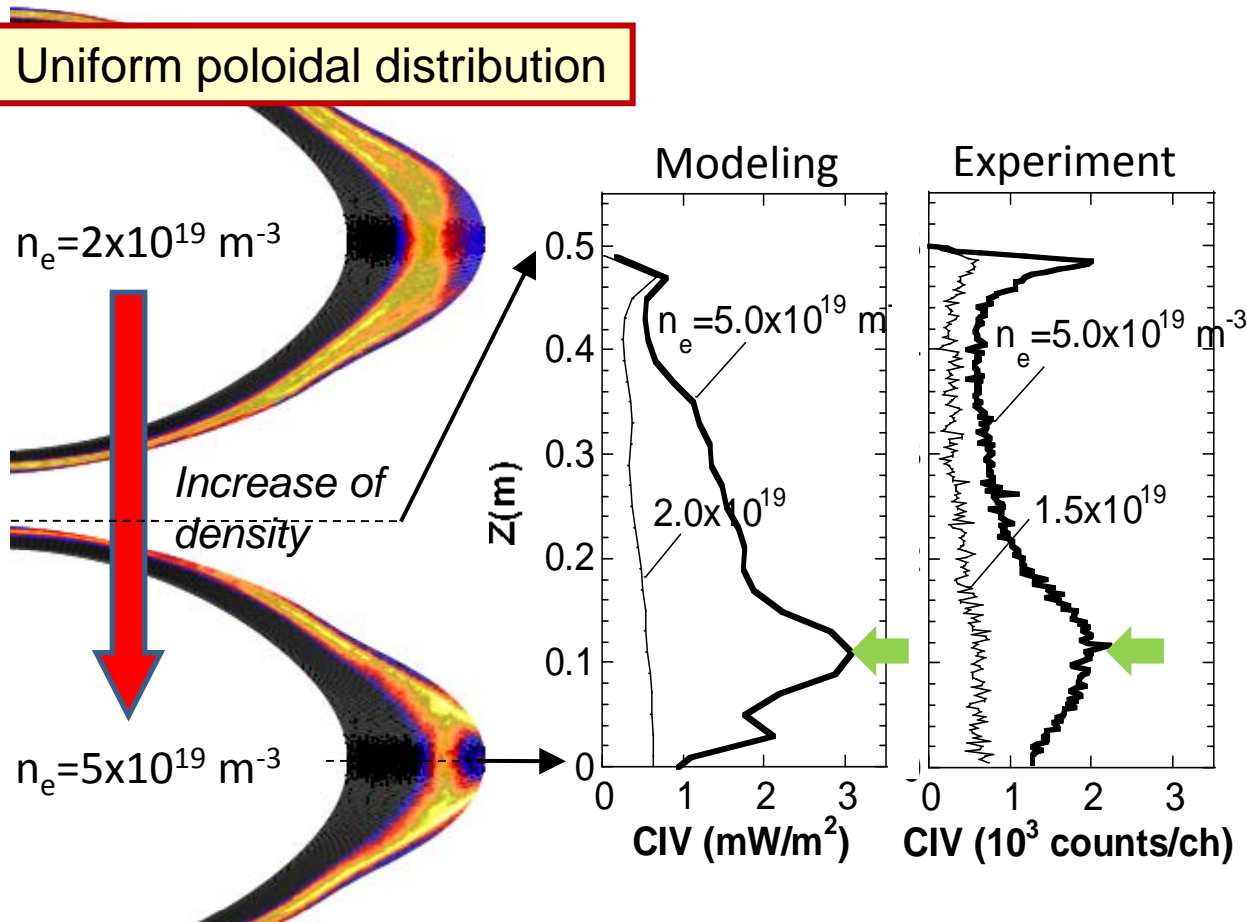


# Impurities are pushed back to divertor in high density

3-D modeling & experiment demonstrate screening effect by friction force

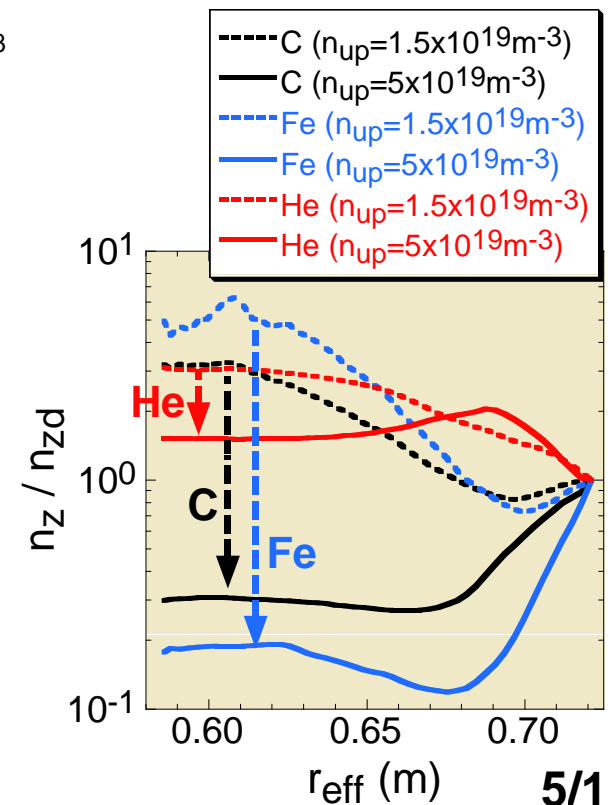
Distribution of C<sup>3+</sup> population (3-D modeling)

Uniform poloidal distribution



According to the model, screening effect is reinforced more in heavier impurities

Pushed back to divertor by screening  
→ reflects structure of magnetic field lines



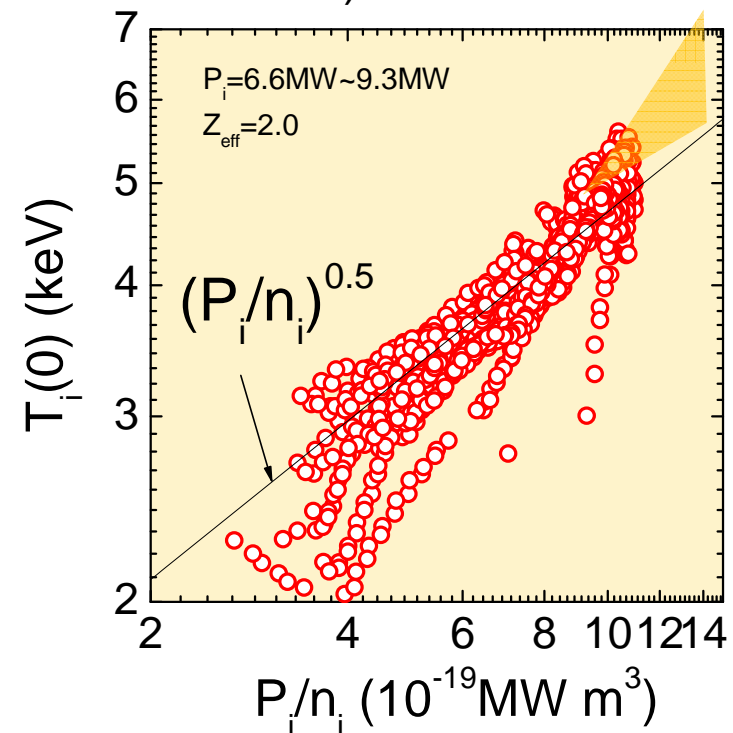
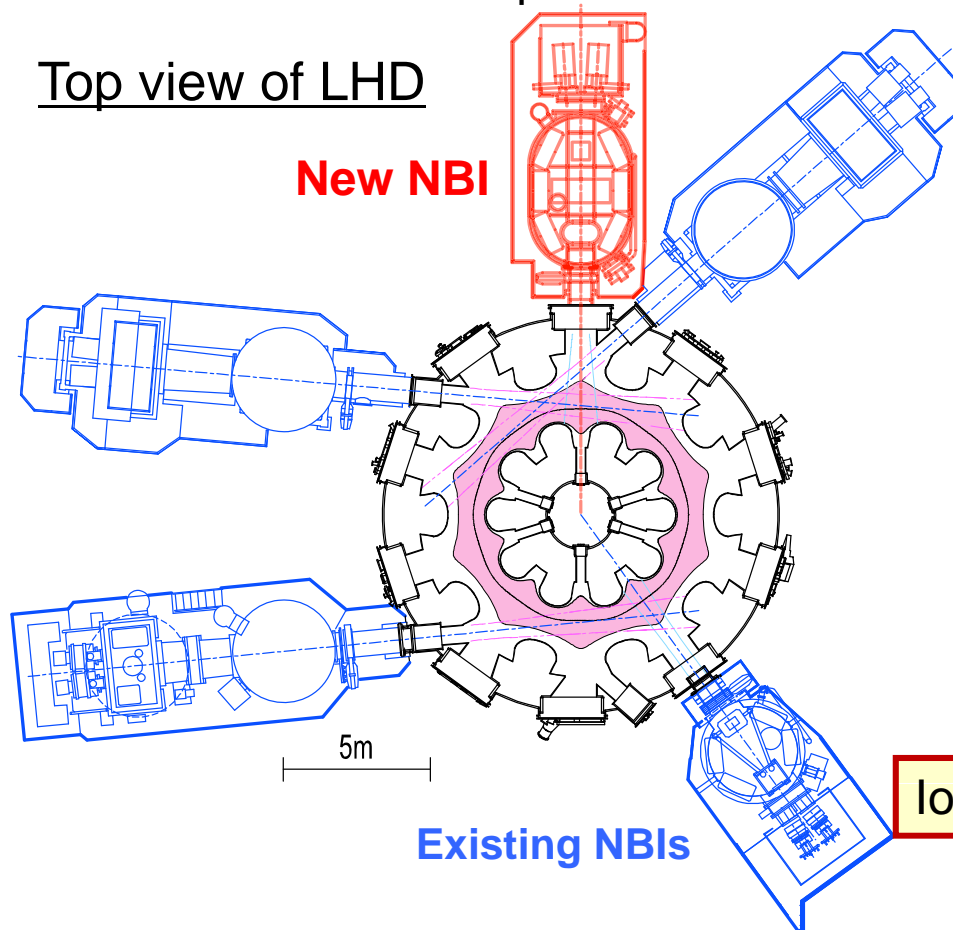


# New facilities in the 14 Exp. Comp. (1)

**5th NBI will be available**

**Perpendicular Injection Power: 6MW, Voltage: 60keV**

- Total NBI power increases from 23 MW to 29 MW
  - Higher temperature, in particular Ti
  - Improvement of CXRS (Ti and V in 2 kHz)

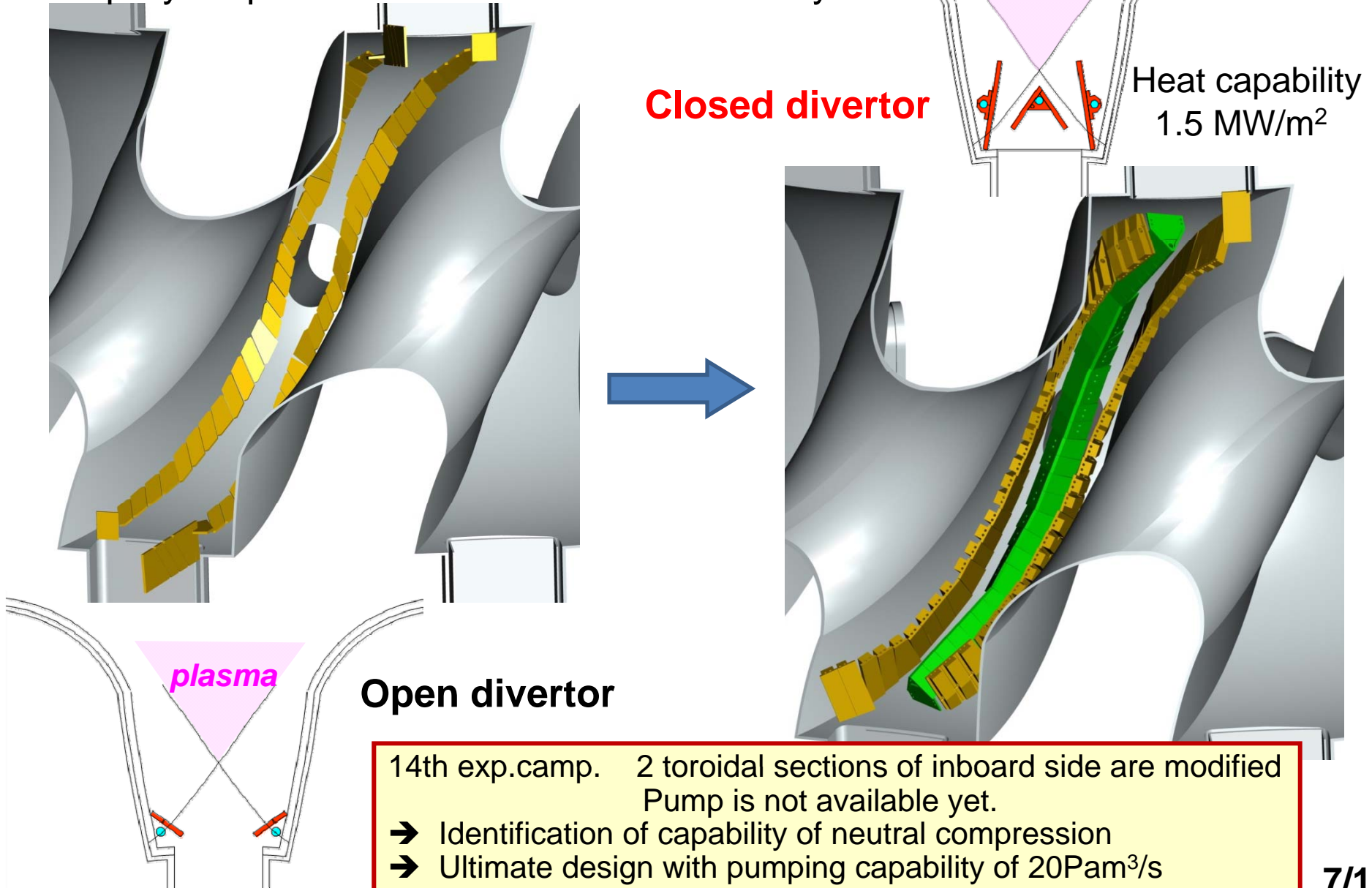


Ion temperature is enhanced with  $(P_i/n_i)^{0.5}$  ?



# New facilities in the 14 Exp. Comp. (2)

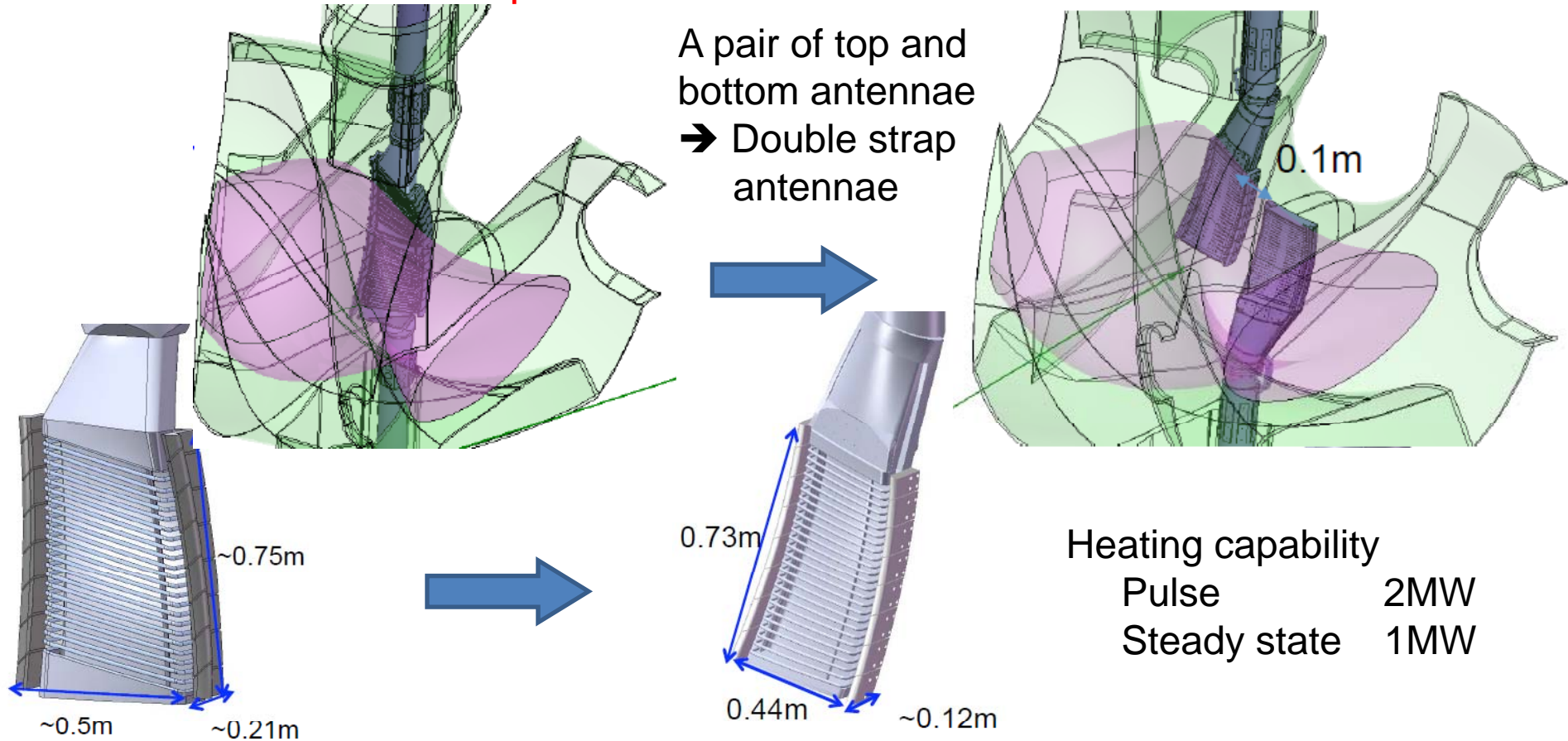
Step-by-step modification to closed divertor system





# New facilities in the 14 Exp. Comp. (3)

Restart of ICRF experiment with new antenna



- ✓ Accommodate two straps in toroidal direction
  - Control toroidal wave number by phase control of currents
    - Improvement of electron heating efficiency by Landau dumping
    - Suppression of impurity contamination by reduction of sheath



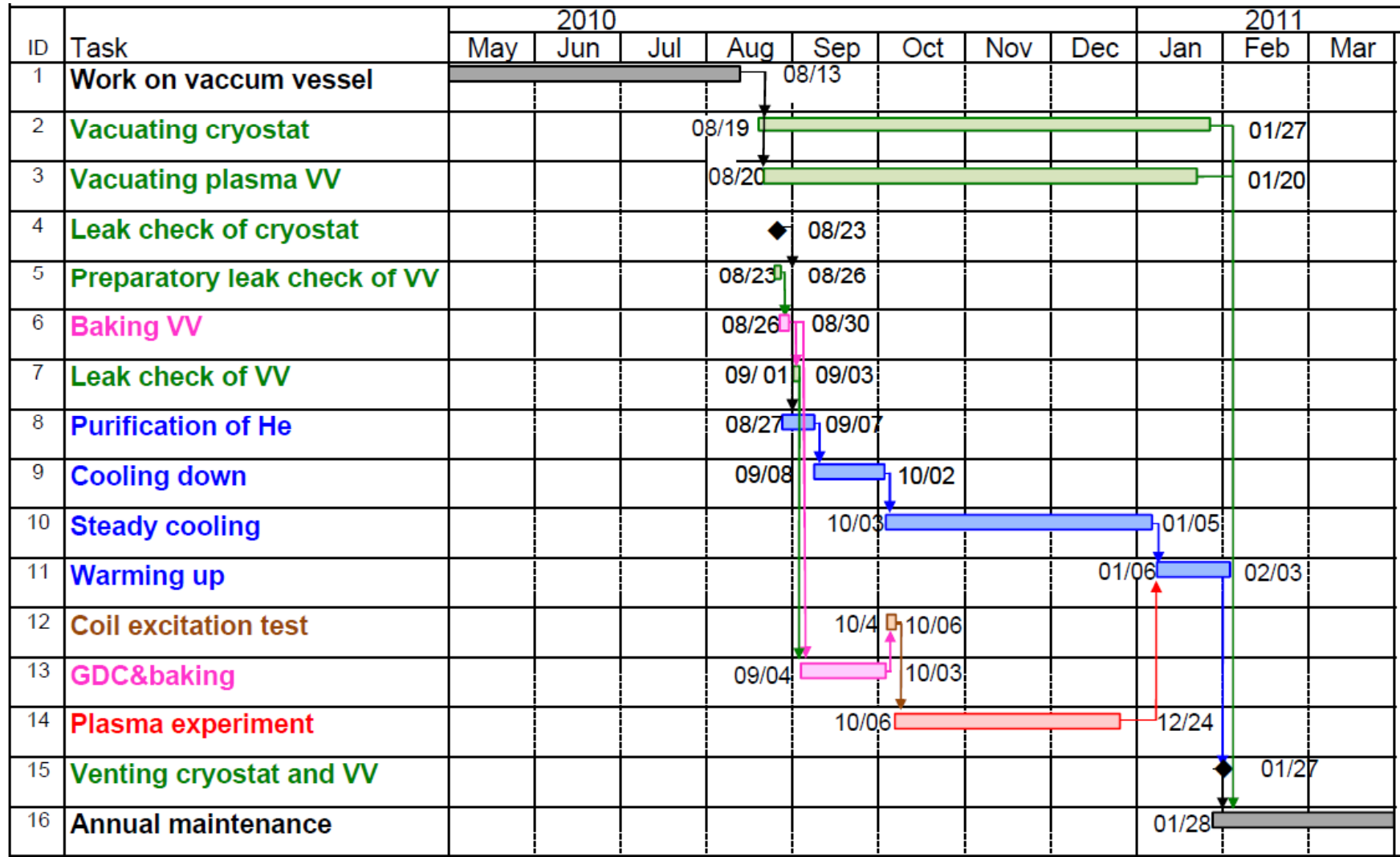


## LHD Experiment Theme Groups and Leaders

	Experiment Theme Group	Co-leader	Sub-leader
1	Confinement improvement in high density by divertor	T.Morisaki	S.Masuzaki
2	Extension of high-temperature regime	M.Osakabe S.Murakami (Kyoto Univ.)	H.Takahashi I.Yamada
3	High-performance steady-state regime / Physics of wave heating	R.Kumazawa H.Idei (Kyushu Univ.)	H.Igami
4	Extension of high- $\beta$ regime / MHD equilibrium and stability	Y.Suzuki K.Nagasaki (Kyoto Univ.)	S.Sakakibara
5	Thermal and particle transport in core plasmas / Atomic and molecular processes by LHD plasma	N.Tamura S.Inagaki (Kyushu Univ.)	I.Murakami A.Shimizu
6	Edge plasma physics and plasma wall interaction	T.Akiyama N.Ohno (Nagoya Univ.)	N.Ashikawa
7	Physics of high-energy particles / Physics of wave heating	M.Isobe S.Yamamoto (Kyoto Univ.) H.Idei (kyushu Univ.)	K.Saito M.Nishiura
8	Device engineering experiment	H.Chikaraishi	S.Hamaguchi



# Schedule of 14th Experimental Campaign in 2010



Availability : 12 weeks, 41 days, 6,100 shots