What parameters are necessary to analyze the high beta confinement properties for ISHCDB? And its definition?

On the low beta confinement properties,
$W_{p\text{-}dia}$, Φ_t^{v}, V_p^{v}, $R^{v}(\rho=1)$, a_p^{v}, $\iota_{2/3}^{V}$, B_{av}^{V}, B_0, R_0
P_{NB_pt}, P_{NB_eabs}, (P_{ECH}??, P_{ICH}??)
???

Most of configuration parameters change as beta increases.

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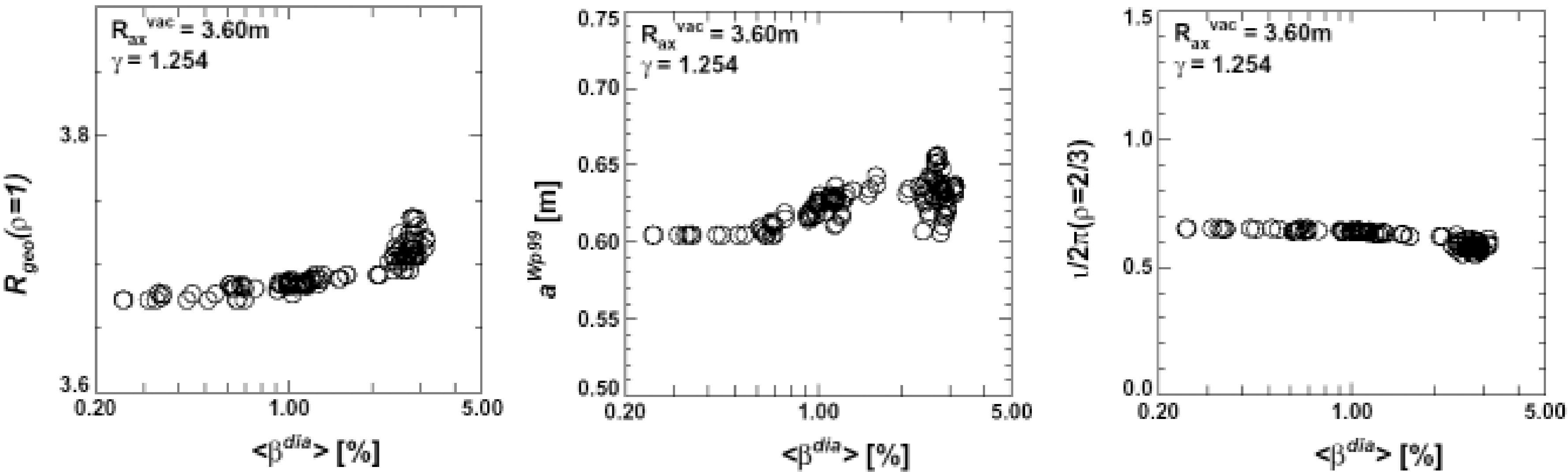
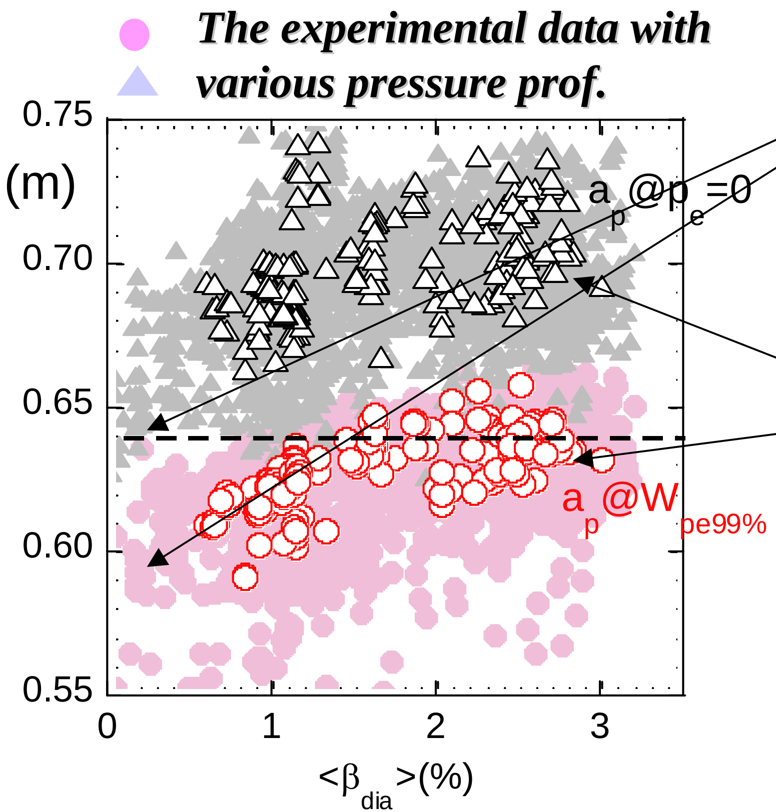


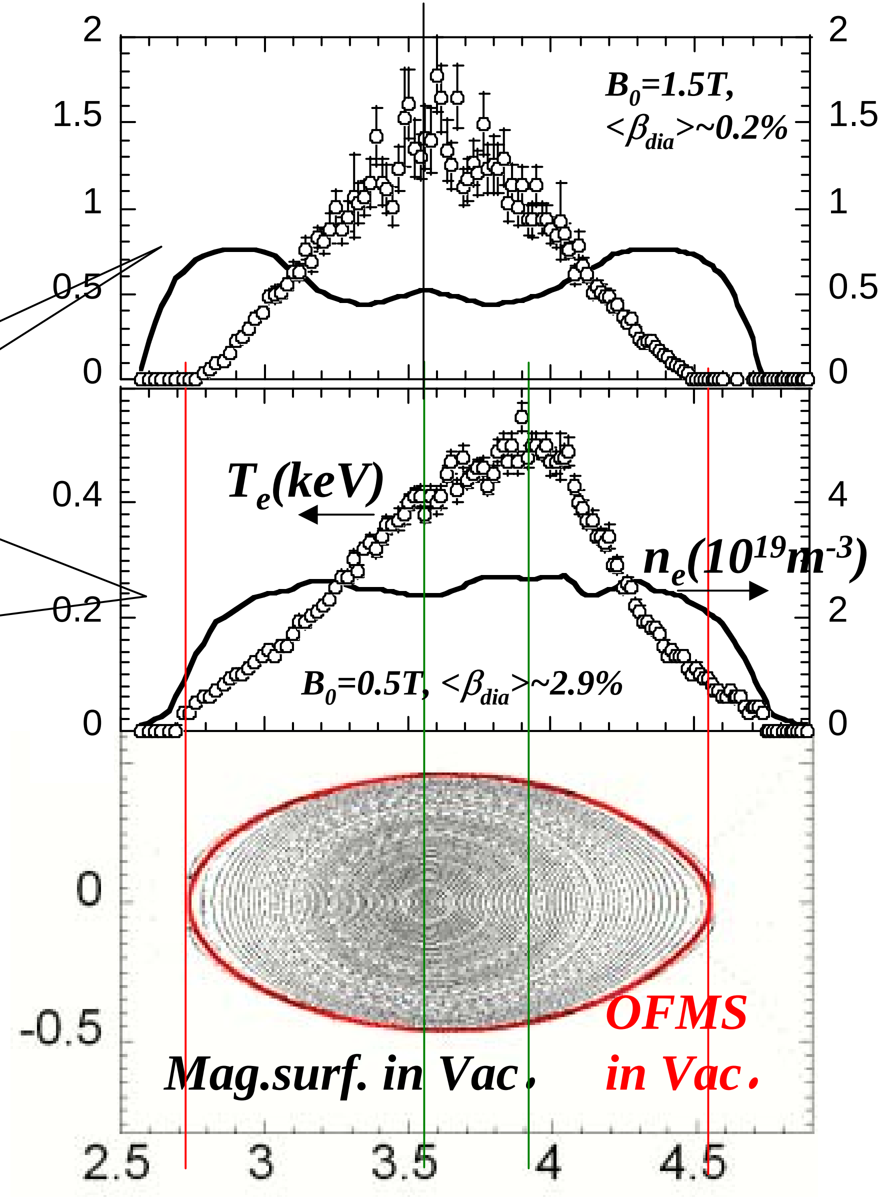
Fromby H.Funaba
, PFR to published

$$\tau_{ISS95} \propto a^{2.21} R^{0.65} P^{-0.59} n_e^{0.51} B^{0.83} \iota_{2/3}^{0.4}$$

Change of a_p due to β

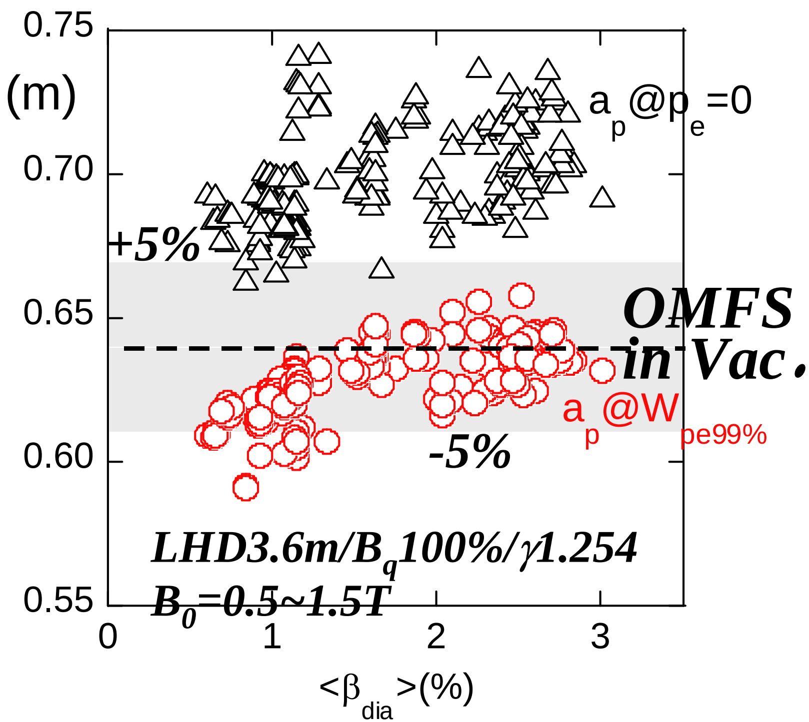


LHD3.6m/B_q100%/γ1.254
B_0=0.5~1.5T



Change of a_p due to β

The data with similar pressure profile to $\beta \sim (1-\rho^2)$.

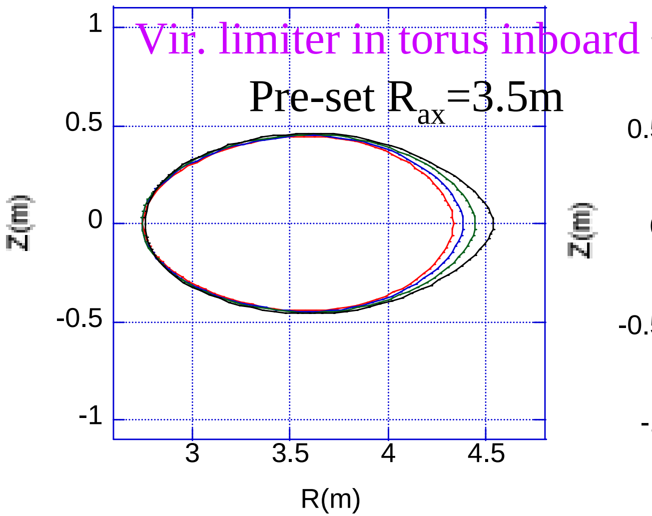


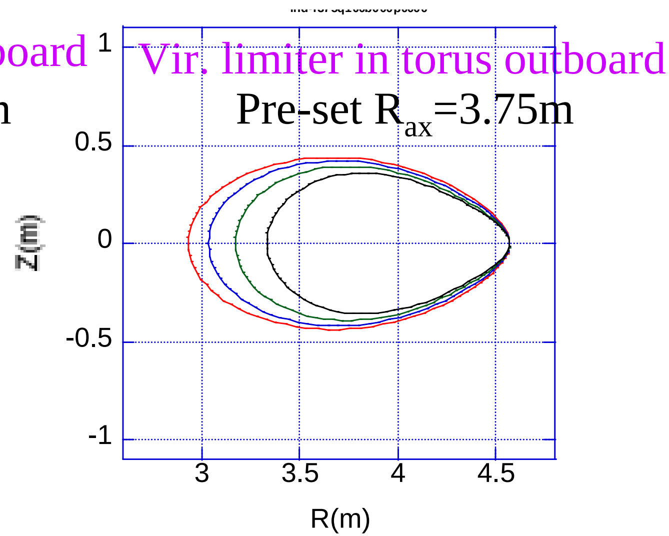
The "plasma radius" increases with beta value.
Finite pressure exists outside of the OMFS in Vac.
Both "plasma radius"s based on p_e=0 and W_{pe}=99% in β ~3% are larger by ~10% than those in low β.
The change of a_p is fairly large.
=> It changes t_E by >20% in ISS95.

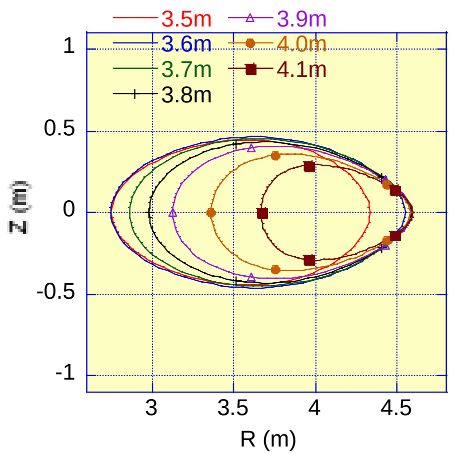
 # a_p in the LHD global confinement study at present
In low beta, a_p of the OMFS in Vac.
In high beta, a_p@$W_{pe99\%}$.

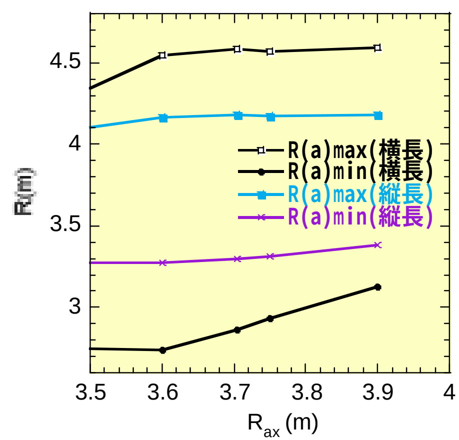
The definition of ρ =1 in LHD high beta plasmas I

ρ=1 suf. passes the torus outboard side of LCFS of vac. at holizontally elongated cross-section/ or the torus inboard side of LCFS of vac. at vertically elongated cross-section.









Change of mag. surf. due to B_V in vac.

The definition of ρ =1 in LHD high beta plasmas II

ρ=1 suf. passes the torus outboard side of LCFS of vac. at holizontally elongated cross-section/ or the torus inboard side of LCFS of vac. at vertically elongated cross-section.

pre-set R_{ax}=3.6m, B_q=100%, γ=1.254

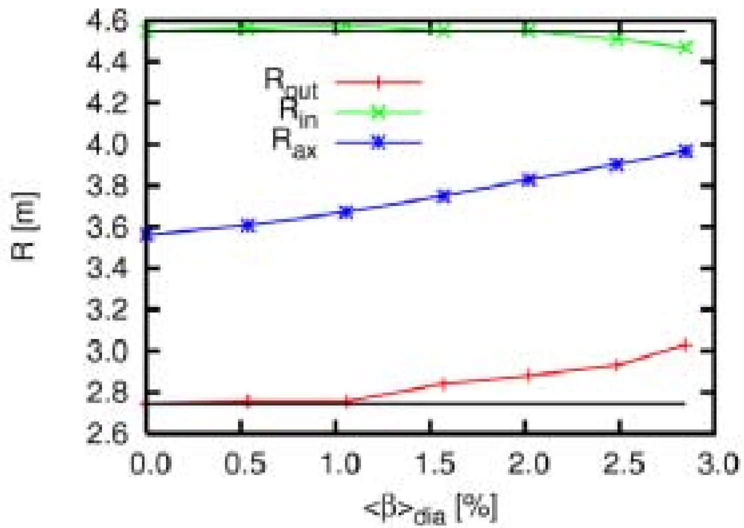
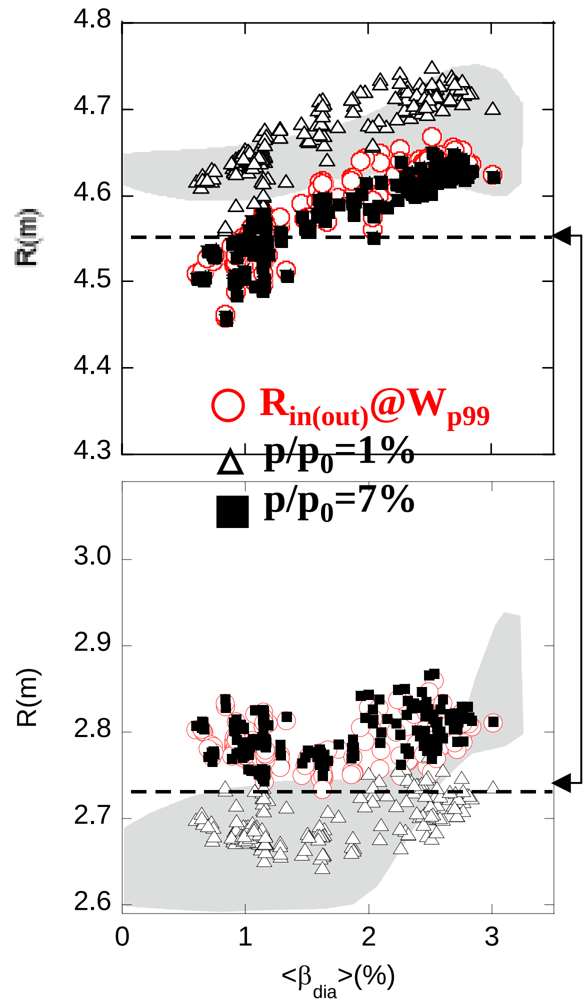


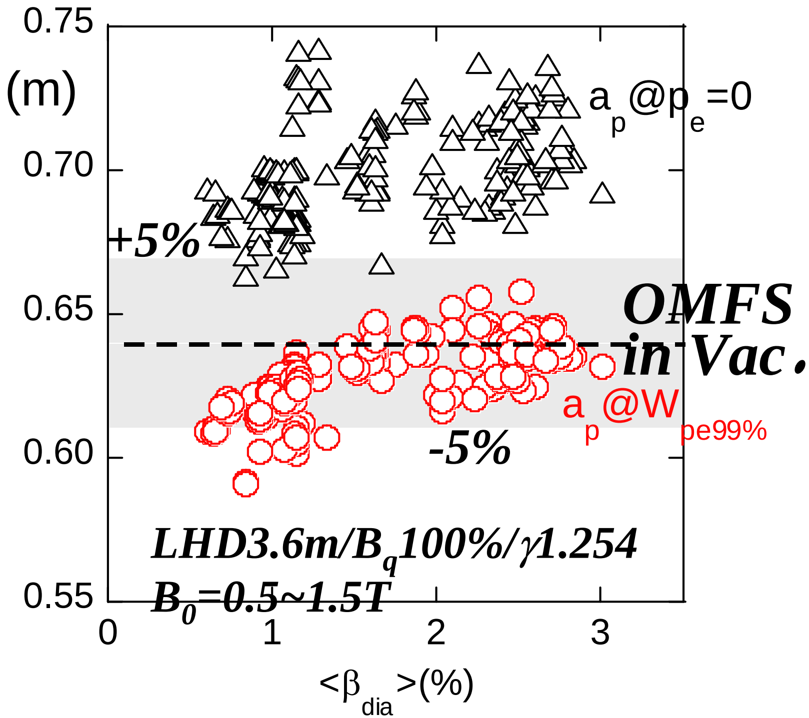
Fig.4 The change of positions of inward (red) and outward (green) LCFS on the plane corresponding to fig. 1is plotted as the function of $\langle\beta\rangle_{dia}$. The shift of the axis is also plotted for the reference (blue).

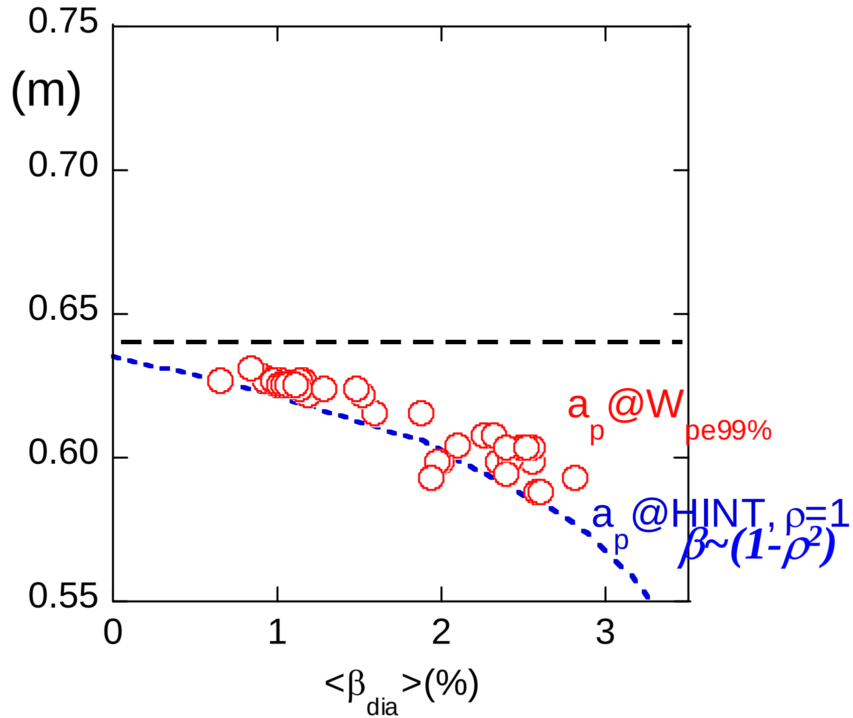


From Proceedings of ITC/ISHW2007
by Y.Suzuki

Change of a_p due to β

The data with similar pressure profile to $\beta \sim (1-\rho^2)$.



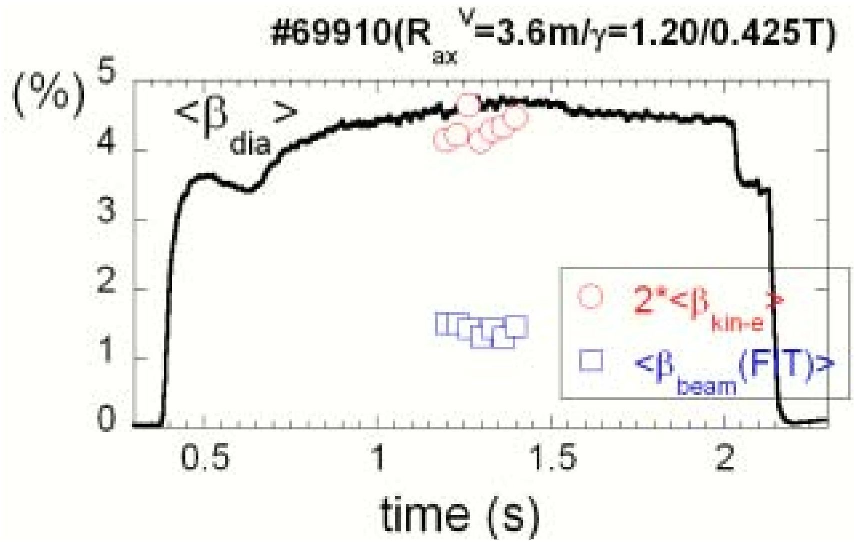


ρ=1 suf. passes the torus outboard side of LCFS of vac. at holizontally elongated cross-section.

Present and future definition of <β> in LHD

Present def.

$$\langle \beta_{dia} \rangle \equiv \frac{2W_{p-dia} / 3V_p^V}{B_{av}^V / 2\mu_0}$$



Port-through power //NBI *13.8MW*

$\langle\beta_{dia}\rangle$; 4.8% (β_{perp}~3.2)

$\langle\beta_{kin}\rangle$; *4.3%* (=2*$\langle\beta_{kin-e}\rangle$)

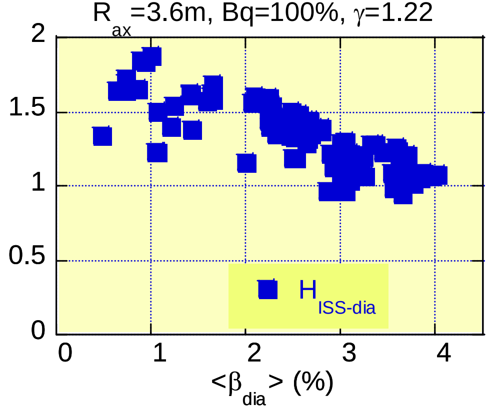
$\langle\beta_{beam}\rangle$; *1.5%* (Cal. by FIT code)

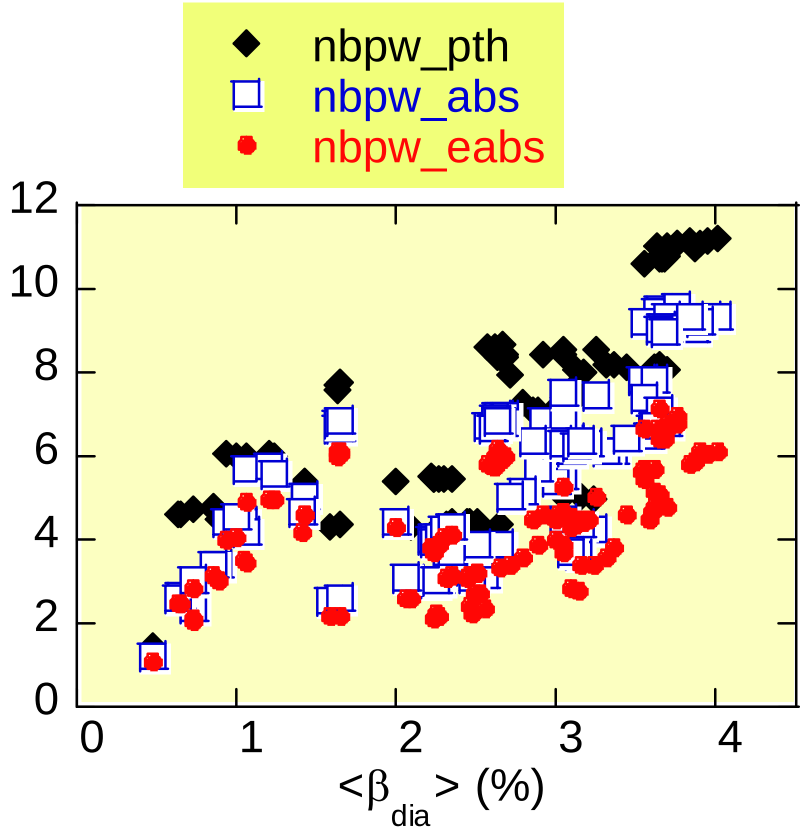
When Z_{eff}=2.5, $\langle\beta_{kin}\rangle$~3.6%($\beta_{perp}$~2.45),
$\langle\beta_{beam}\rangle_{perp}$~0.75%, $\langle\beta_{beam}\rangle_{ara}$~0.75%

$\langle\beta_{dia}\rangle$; based on the diamagnetic meast.
$\langle\beta_{kin}\rangle$; based on the T_e and n_e profile meas.
$\langle\beta_{beam}\rangle$; based on the calculation by FIT

A candidate of Future def.

$$\langle \beta \rangle \equiv \frac{2\left(W_{kin} + W_{beam}\right) / 3V_p^{Wpe99}}{B_{av}^{Wpe99} / 2\mu_0}$$





Hearting power of NBI in LHD

P_NB_pt; port through power

P_NB_abs; P_NB_pt - P_NB_st; P_NB_st(shine-through) is estimated by calory meter.

P_NB_ecabs; the prompt loss taken into account sot by shot by FIT in P_NB_abs

P_NB_cabs; calculated absorption power by FIT

What parameters are necessary to analyze the high beta confinement properties for ISHCDB? And its definition?

LHD has a lot of shots with profiles data. We would like to **register the data with high quality for ISHCDB**.

As high beta DB from LHD, we want to register $W_{p\text{-}dia}$, $P_{\_NB\_pt}$, B_{av}^{V}, $\iota_{2/3}^{V}$, a_{p}^{V}, $R^{V}(\rho=1)$, $W_{p\text{-}kine}$, $P_{\_NB\_eabs}$, $P_{\_NB\_ceabs}$, a_{p}^{Wpe99}, R^{Wpe99}, B^{Wpe99}, $\iota_{2/3}^{Wpe99}$.
in addition to the parameters needed in other devices.

=>

The data, the p_e profile analysis of which has been processed, and which has the P_{NBI_eabs}, will be registered.

Plasma minor radius; a_p

a_p^V; Based on LCFS in vacuum

As the equilibrium, select the best fitting data of the T_e profile

a_p^{Wpe99}; 99% of the integrated p_e is included. where p_e is estimated by profile measurements of T_e and n_e.

a_p^{pe0}; up to p_e=0.

$a_p(\rho=1)$; up to ρ=1 magnetic surface. The ρ=1 magnetic surface passes a point of LCFS in vacuum.

As the equilibrium, select the data with consistent $W_{p\text{-}dia}$ and the typical pressure profile.

$a_p^{model}(\rho=1)$; up to ρ=1 magnetic surface. The ρ=1 magnetic surface passes a point of LCFS in vacuum.

Rotational transform; $\iota_{2/3}$

Strongly depends on definition of a_p.

And current profile.

Plasma major radius

R_0; the major radius of the toroidally averaged magnetic axis in vacuum.

R_{av}^{v}; the major radius of the center of the toroidally averaged LCFS in vacuum.

R_{av}^{β}; the major radius the center of the toroidally averaged LCFS in finite beta.

R_{av}^{Wpe99}; the major radius the center of a toroidally averaged mag. surf. based on a_p^{Wpe99}.

Magnetic field strength

B_0; B_t at R_0 in vacuum.

B_{av}^{v}; the averaged B_t based on the Φ_t of LCFS in vacuum.

B_{av}^{β}; the averaged B_t based on the Φ_t in finite beta.

; This value is sensitive to the definition of a_p.

B_{av}^{Wpe99}; the averaged B_t based on a_p^{Wpe99}.