Documentation of DB07

7-12-03 A. Dinklage
16-12-03 A. Kus, A. Dinklage: Database renamed to Documentation_of_DB07_01_next
18-12-03 A. Kus: DB07_02
06-01-04 DB07_03
09-01.04 A. Dinklage: Remarks on high beta data

12-01-04 DB07_04

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References

1 Description of Columns

56 columns are compatible with the ISS95 database [1]. Subsequent columns are introduced along with database extensions. Numbering in parentheses refers to ISS95 numbering.

General Parameters

1. (-) DATASOURCE
Indicates the source of data:
ISS_DB05 (859 observations): ISS95 Database
W7AS_ECRH_AFTER_DIVERTOR_INSTALLATION (28 observations): W7AS data (ECRH heating only) (Dinklage, Kus)
US_2003 (192 observations): W7-AS data collected by U. Stroth after ISS95
W7AS_HIGH_BETA (199 observations): data collected by A. Weller
LHD_6th_EXP_CAMP_V2 (162 observations): data collected by H. Yamada

2. (-) COMMENT
A place for comments

3. (1.) STELL
Stellarator that has supplied the data: ATF, CHS, HELE, W7-A, W7-AS, LHD, TJ-II, HELJ

4. (2.) UPDATE
Last update [YYMMDD]

5. (3.) DATE
Date on which the shot was taken [YYMMDD]

6. (4.) SHOT
Shot number or the first shot number of a sequence

7. **(5.)** **SEQ**

Sequence number (designated for a series of similar shots)

8. **(6.)** **TIME**

Time during the shot at which the data are taken

9. **(7.)** **PHASE**

Phase of the discharge: STAT, stationary phase

Plasma composition

10. **(8.)** **PGASA**

Mass number of the plasma working gas: 1, H; 2, D; **3,** 3He; 4, ‘He

11. (9.) **BGASA**

Mass number of the NBI gas: 1, H; 2, D

12. **(10.)** **RGEO**

Major radius of the last closed flux surface [m]:
ATF, (Rmax+Rmin)/2;
Heliotron-E, 2.17 m **+** radial displacement;
W7-AS, 2 m **+** radial displacement

13. **(11.)** **RMAG**

Major radius of the magnetic axis in the vacuum geometry [m];
Heliotron-E, 2.2 m **+** radial displacement;
W7-AS, 2.05 m **+** radial displacement

14. **(12.)** **AEFF**

Effective minor radius [m]:
ATF, the **t =** 1 radius, which is usually not in contact with the wall;
CHS,radius limited by the inner wall;
Heliotron-E, radius of the last closed flux surface before the ergodic region;
W7-AS, last closed flux surface from simple formula interpolating between available configurations

15. **(13.)** **SEPLIM**

Minimum distance between the separatrix and the wall or the limiter [m]

16. **(14.)** **CONFIG**

Plasma configuration: STD, standard configuration; LIM/STD, standard configuration with limiter

Machine conditions

17. **(15.)** **WALMAT**

Material of the vacuum vessel wall: IN, Inconel; INCARB, Inconel with carbon; SS, stainless steel; SSCARB, stainless steel with carbon

18. **(16.)** **LIMMAT**

Limiter material: C, carbon; BORC, boron carbide; SS, stainless steel; TIC, titanium-coated graphite

19. (17.) EVAP

Evaporated material: C, carbonized; BOR, boronized; TI, titanium; CR, chromium; NONE, no evaporation

Magnetics

20. (18.) BT

Vacuum toroidal field at RGEO [TI: ATF, calculated from coil current

21. (19.) IP

Total plasma current [A]: Positive values if it increases the vacuum iota (equivalent to the direction of the tokamak current)

22. (20.) VSURF

Loop voltage at plasma boundary [V]: positive values giving positive IP

23. (21.) IOTAA

Rotational transform at the plasma edge (AEFF):
W7-AS, from simple formula interpolating between available configurations

24. (22.) IOTA0

Rotational transform at the plasma centre:
W7-AS, from simple formula interpolating between available configurations

25. (23.) BETDIA

Toroidal beta based on the diamagnetic measurement (fraction, not %) :
Heliotron-E, calculated by the PROCTR code

26. (24.) NEBAR

Line average electron density [m^{-3}]:
W7-AS, if available, from microwave interferometer, otherwise from a central HCN chord

27. (25.) DNEBAR (DNEDT)

Time derivative of NEBAR [m^{-3}/s]:
ATF, only steady state → set to 0;
Heliotron-E, only steady state → set to 0;
W7-AS, only steady state → set to 0
Corresponds to DNELDT variable in the International Global H-mode Confinement Database [2].

Impurities

28. (26.) ZEFF

Average plasma effective charge

29. (27.) PRAD

Total radiative power as measured with bolometry [W]

Input power

30. (28.) PECHl
Port-through power for primary ECH:
Heliotron-E, sum of 53 GHz powers;
W7-AS, sum of 70 GHz powers

31. (29.) PECH2
Port-through power for secondary ECH:
W7-AS, sum of 140 GHz powers

32. (30.) MECHl
Mode of primary ECH: 1, fundamental; 2, second harmonic

33. (31.) MECH2
Mode of secondary ECH: 1, fundamental; 2, second harmonic

34. (32.) PABSECH
Total absorbed ECH power [W]:
CHS, from radiation level at plasma collapse;
Heliotron-E, from power switch-off experiments;
W7-AS, 90 and 100% absorption in first and second harmonics, respectively

35. (33.) ENBIl
Power-weighted neutral beam energy for the primary beams [V]:
W7-AS, sources 1+5; 1: ½ : 1/3 = 1:1:1

36. (34.) ENBI2
Power-weighted neutral beam energy for the secondary beams [V]:
W7-AS, sources 3+7; 1: ½ : 1/3 = 1:1:1

37. (35.) RTANl
Tangency radius for the primary beams

38. (36.) RTAN2
Tangency radius for the secondary beams

39. (37.) PNBIl
Port-through NBI power for the primary beams [W]

40. (38.) PNBI2
Port-through NBI power for the secondary beams [W]

41. (39.) PABSNBI
Total absorbed NBI power corrected for shine-through, orbit and charge exchange losses [W]:
CHS, according to an expression deduced from
HELIOS Monte Carlo calculations;
Heliotron-E, according to the HELIOS Monte Carlo beam orbit following code;
W7-AS, according to a simple formula deduced from Fafner calculations

42. (40.) PICH
Port-through ICRF power [W]

43. (41.) FICH

ICRF frequency [Hz]

44. (42.) PABSICH

ICRF absorbed power

45. (43.) POH

Ohmic heating power [W]

46. (-) PTOT

Total absorbed power [W]:
PTOT = PABSECH+PABSNBI+PABSICH +POH;
The column formula also allows a manual setting of single values

Profile information

47. (44.) NE0

Central electron density at RMAG [m^{-3}]:
Heliotron-E, taken from FIR;
W7-AS, taken from a fit to a Thomson scattering profile

48. (45.) TEO

Central electron temperature at RMAG [eV] :
Heliotron-E, taken from a fit to a Thomson scattering profile;
W7-AS, taken from a fit to a Thomson scattering profile

Energies

49. (46.) WDIA

Total plasma energy as determined by diamagnetic measurements [J]:
Heliotron-E, from kinetic profiles and the beam contribution calculated by the PROCTR code

50. (-) DWDIA

Time derivative of WDIA [W]:
0, for PHASE=STAT and PHASE=c;
missing, otherwise

51. (47.) WMHD

Total plasma energy as determined from MHD equilibrium [J]:
ATF, saddle loop is not calibrated, use for reference only

52. (48.) WETH

Total thermal electron plasma energy
W7-AS, from Thomson scattering profiles

53. (49.) WITH

Total thermal ion plasma energy [J]:
W7-AS, from simulation with neoclassical transport coefficients

54. (50.) WTH

Total thermal plasma energy from kinetic measurements [J]

55. **(-)** **DWTH**
Time derivative of WTH [W]
0, for PHASE=STAT and PHASE=c; **???**
missing, otherwise

56. (51.) WFPER
Calculated total perpendicular fast ion energy [J]

57. (52.) WFPAR
Calculated total parallel fast ion energy [J]

Energy confinement times

58. (53.) TAUEDIA
Global confinement time based on diamagnetic measurement [s]:
TAUEDIA = WDIA/ (PTOT-DWDIA)

59. (54.) TAUETH
Thermal energy confinement time
TAUETH = WTH/ (PTOT-DWTH)

Extra information

60. (55.) COFRANBI
Ratio of co-injected beam port through power to total NBI power:
Heliotron-E, perpendicular injection is set to 1;
W7-AS1 sources(5 + 6 + 7 + 8)/all sources (*Bt* > 0)

61. (56.) STDSET
Standard data set:
0, not included;
1, included in present analyses

62. (-) LOG_A
Log10 (AEFF)

63. (-) LOG_R
Log10 (RGEO)

64. (-) LOG_P
Log10 (PTOT)

65. (-) LOG_N
Log10 (NEBAR/10^{19})

66. (-) LOG_B
Log10 (BT)

67. (-) LOG_I

Log10 (ι (ρ)),
where ι(ρ) has been calculated using formula (1) on page 1065 in [1].

68. (-) LOG_TAUEDIA

Log10 (TAUEDIA)

69. (-) FIT_FORMULA

JMP formula for nonlinear fit,
Log10(a_0) + a_a * LOG_A + a_R * LOG_R + a_P * LOG_P + a_n * LOG_N + a_B * LOG_B + a_i * LOG_I

70. (-) LOG_TAUEDIA_ISS95

JMP formula for nonlinear fit, using ISS-95 regression parameters,
a_0=-0.079, a_a=2.21, a_R=0.65, a_P=-0.59, a_n= 0.51, a_B=0.83, a_i= 0.4

Because PTOT in the ISS95 scaling was used in MW, LOG_P is replaced by LOG_P - 6
in calculation of **LOG_TAUEDIA_ISS95, LOG_TAUEDIA_W7, LOG_TAUEDIA_LHD, LOG_TAUEDIA_LG**

71. (-) LOG_TAUEDIA_W7

JMP formula for nonlinear fit, using regression parameters gained from W7-AS subset of DB05,
a_0=0.115, a_a=2.21, a_R=0.74, a_P=-0.54, a_n= 0.50, a_B=0.73, a_i= 0.43

72. (-) LOG_TAUEDIA_LHD

JMP formula for nonlinear fit, using regression parameters gained from LHD subset of DB05,
a_0=0.034, a_a=2.00, a_R=0.75, a_P=-0.58, a_n= 0.69, a_B=0.84, iota not used

73. (-) LOG_TAUEDIA_LG

JMP formula for nonlinear fit, using Lackner-Gottardi scaling formula,
a_0=0.68*0.0627, a_a=2.00, a_R=1.00, a_P=-0.60, a_n= 0.60, a_B=0.80, a_i=0.40

2 Changes of ISS95

- Data # 847-859 (W7-A)
  PHASE set to STAT (were missing)
- Data # 292-846 (ATF, CHS, HELE)
  POH set to 0 (were missing)
- Data # 847-859 (W7-A)
  PABSICH set to 0 (were missing)

3 Description of Database Retrieval for W7-AS Data by IDA (2003)

· STELL (Defined in idaini.f.)
· UPDATE (idwgle.pfo)
Equal to w7as.shot_description(swdate).
· DATE (idwgle.pfo)
Equal to w7as.shot_description(shdate).
· SHOT (idwgls.pfo)

- SEQ (idwgle.pfo)

Set to missing .

- TIME (idwgls.pfo)
- PHASE (idwgls.pfo)

Can be changed manually by editing the timepoint list.

- PGASA (idwgls.pfo)

Equal to w7as.shot_description(gas).

- BGASA (idwgle.pfo)

Depends on w7as.nbi_beamline(pnbb).

- RGEO (idwgle.pfo)

Depends on w7as.shot_description(dr36).

- RMAG (idwgle.pfo)

Depends on w7as.shot_description(dr36).

- AEFF (idwgls.pfo)

Equal to w7as.shot_description(aplasma).

- SEPLIM (idwgle.pfo)

Depends on w7as.shot_description(rlimtop, rlimbot, aplasma).

- CONFIG (idwgle.pfo)

Depends on w7as.ecrh_gyr(amodec, laec, lhec).

- WALMAT (idwgle.pfo)

Fixed to `SSCARB'.

- LIMMAT (idwgle.pfo)

Depends on the shot number (BORC for shots $<$ 15201, TIC otherwise).

- EVAP (idwgle.pfo)

Depends on w7as.vacuum(conevnt).

- BT (idwgls.pfo)

Equal to abs. value of w7as.shot_description(b036).

- IP (idwgls.pfo)

Equal to w7as.operation(ipl).

- VSURF (idwgle.pfo)

Equal to w7as.operation(vloop).

- IOTAA (idwgls.pfo)

Equal to w7as.shot_description(ioexa).

- IOTA0 (idwgle.pfo)

Equal to w7as.shot_description(ioex0).

- BETDIA (idwgle.pfo)

Depends on WDIA, RGEO, AEFF, BT.

- NEBAR (idwgls.pfo, id_nebar.pfo)

Depends on w7as.operation(nehcn2, nemu, nemw6) and w7as.diag_param(chlhcn2, chlmu).

- DNEDT (idwgle.pfo)

Set to missing .

- ZEFF (idwgle.pfo)

Set to missing .

- PRAD (idwgle.pfo)

Depends on w7as.operation(pradbu, pradbo).

- PECH1 (idwgle.pfo)

Depends on w7as.ecrh_gyr(pmxec, fec).

- PECH2 (idwgle.pfo)

Depends on w7as.ecrh_gyr(pmxec, fec).

- MECH1 (idwgle.pfo)

Depends on PECH1 and BT.

- MECH2 (idwgle.pfo)

Depends on PECH2 and BT.

- PABSECH (idwgls.pfo)

Equal to w7as.operation(pect).

- ENBI1 (idwgle.pfo)

Depends on PNBI1.

- ENBI2 (idwgle.pfo)

Set to missing . (Coding error?)

- RTAN1 (idwgle.pfo)

Depends on PNBI1.

- RTAN2 (idwgle.pfo)

Set to missing . (Coding error?)

- PNBI1 (idwgle.pfo)

Depends on w7as.nbi_beamline(pmxnb).

- PNBI2 (idwgle.pfo)

Depends on w7as.nbi_beamline(pmxnb).

- PABSNBI (idwgls.pfo, id_nipr.pfo)

See sources for details.

- PICH (idwgle.pfo)

Set to null.

- FICH (idwgle.pfo)

Set to null.

- PABSICH (idwgle.pfo)

Set to null.

- POH (idwgle.pfo)

Depends on w7as.operation(vloop, ipl), that means VSURF and IP.

- NE0 (idwgls.pfo, id_rfit.pfo)

A fit value.

- TE0 (idwgls.pfo, id_rfit.pfo)

A fit value.

- WDIA (idwgls.pfo)

Equal to w7as.operation(wdia).

- WMHD (idwgle.pfo)

Set to missing .

- WETH (idwgle.pfo)

Equal to w7as.transport(wekin).

- WITH (idwgle.pfo)

Equal to w7as.transport(wikin).

- WTH (idwgle.pfo)

Equal to WETH+WITH.

- WFPER (idwgle.pfo)

Set to missing .

- WFPAR (idwgle.pfo)

Set to missing .

- TAUEDIA (idwgle.pfo)

Depends on w7as.operation(dwdia), WDIA, PABSECH, PABSNBI, POH.

- TAUETH (idwgle.pfo)

Depends on WTH, PABSECH, PABSNBI, POH.

- CONFRANBI (idwgle.pfo)

Depends on w7as.nbi_beamline(pmxnb).

- STDSET (idwgle.pfo)

Set to 1.

4 Selection of the Standard Set for ISS95

The standard data set used in all the regressions of Ref. [1] can be obtained from the entire database under the following conditions:

(1) Delete discharges in helium.
(2) For ATF, delete discharge 6842.
(3) For Heliotron-E, delete discharge 53 705.
(4) For W7-AS1 delete all discharges with high power densities given by the condition $P_{abs}/\langle n_e \rangle > 3 \times 10^{14}$ W m^3.
(5) For W7-AS, delete discharges 21089, 24734, 25966, 25969, 26000 and 26925.
(6) Use the diamagnetic energy confinement time; only for Heliotron-E must the thermal confinement time be used. For observations included in the standard set, the parameter STDSET is set to 1. Otherwise this parameter
is set to 0.

5 Remarks on high beta data

The data were collected by A. Weller. This data set refers to high beta campaigns in W7-AS. Only data with beta > 1.5 % were considerd (199 observations). High beta data always may be afflicted from configuration effects, such as islands or corrugated boundary structures. This has to be taken into consideration for iota values larger than 0.5. The iota value of the data set is iota at r = 2/3 a.

The following shots are excluded from the standard data set:

53053 control coils not optimized -> to be negelcted STDSET == 0
56950 ramp in vertical field -> to be negelcted STDSET == 0
56953 LAST W7AS SHOT -> 0.28 s not stationary - to be neglected and smaller times STDSET == 0

Shot 51373 can be regarded to document the effect of control field coils; the control current of which is zero and has to be compared with shot 51385 in order to document the optimization of the plasma position due to the control coils.

References:

[1] U. Stroth et al., NF **36** (1996) 1063.
[2] http://efdasql.ipp.mpg.de/HmodePublic/DataDocumentation/ - Datainfo/DB3varlist.htm