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Documentation of the International Stellarator Confinement Database (ISCDB)

Version ISS_DB_07_20

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Contents

I. INTERNATIONAL STELLARATOR CONFINEMENT DATABASE COLLABORATION

The collaboration is carried out under auspices of the
IEA implementing Agreement for
Cooperation in Development of the Stellarator Concept (2.10.1992).

The database is jointly hosted by
National Institute for Fusion Science (NIFS, Toki, Japan)
(`http://iscdb.nifs.ac.jp/`)
and Max-Planck-Institut für Plasmaphysik, EURATOM Association (IPP, Greifswald, Germany)
(`http://www.ipp.mpg.de/ISS/`).

The International Stellarator Confinement Database Collaboration is formed by:

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Discussions and contributions are gratefully acknowledged from:

C.D. Beidler, R. Brakel, V. Dose, P. Grigull, D. Hartmann,
M. Hirsch, K. Ida, Y. Igithkhanov, H. Maaßberg,
K. McCormick, D. Mikkelsen, S. Murakami, V. Tribaldos,
F. Wagner, A. Weller, and K. Yamazaki

and the Teams of

ATF, CHS, Heliotron-E, Heliotron-J, HSX, H-1, LHD, TJ-II, W7-A, W7-AS, W7-AS and W7-X.

II. CHANGES TO PREVIOUS VERSIONS

The following shots were found to occur doubled in the database ISS DB07_17_release. These shots were erased from the DB17_19_release leading to a diminishing of the total number of datasets from 3226 to 3197 (incl. 4 predictive values for W7-X).

1. ATF (11210, 0.372)
2. ATF (11217, 0.37)
3. ATF (11223, 0.37)
4. CHS (37025, 0.071)
5. W7-AS (25687, 0.44)
6. W7-AS (25843, 0.348)
7. W7-AS (25923, 0.3)
8. W7-AS (25927, 0.3)
9. W7-AS (25957, 0.497)
10. W7-AS (25993, 1.197)
11. W7-AS (25995, 1.197)
12. W7-AS (25998, 0.917)
13. W7-AS (26004, 0.309)
14. W7-AS (26005, 0.822)
15. W7-AS (26129, 0.3)
16. W7-AS (26191, 0.57)
17. W7-AS (26303, 0.597)
18. W7-AS (26305, 0.597)
19. W7-AS (26384, 0.558)
20. W7-AS (26422, 0.58)
21. W7-AS (26426, 0.5)
22. W7-AS (26437, 1.3)
23. W7-AS (26439, 1)
24. W7-AS (26439, 1.265)
25. W7-AS (26440, 0.7)
26. W7-AS (26440, 0.702)
27. W7-AS (26441, 0.25)
28. W7-AS (26919, 0.672)
29. W7-AS (26931, 0.56)

to read as *Device (shot, time)*.

As a preparation for a storage in a rational data-base system, the following column names have been renamed due to conflicts with reserved names.

- COMMENT → COMM
- UPDATE → UP_DATE
- DATE → SHOT_DATE
- TIME → SHOT_TIME
- WITH → WIONTH

III. DESCRIPTION OF COLUMNS

56 columns are compatible with the ISS95 database [8]. The designations and definitions are intended to be compatible with the ITER databases [4]. Present numbering refers to the database file ISS_DB05_17.JMP. Please, note that some columns represent *Derived Quantities* which means that their value is calculated within the spread-sheet.

General parameters

1. DATASOURCE
   Sources of data:

   - ISS_DB05 (859 observations, 812 enter ISS04 scaling): ISS95 Database Note: One ATF observation was lost from version 1 to version 17 (shot # 6864)
   - W7AS_ECRH_AFTER_DIVERTOR_INSTALLATION (29 observations, 29 enter ISS04 scaling): W7AS data (ECRH heating only) (Dinklage, Kus)
   - US_2003 (192 observations, 185 enter ISS04 scaling): W7-AS data collected by Stroth after ISS95 (7 shots) 25957, 26004, 31466,34224, 34609, 40031, 41213 PABSNBI missing
   - W7AS_HIGH_BETA (199 observations, 191 enter ISS04 scaling): W7-AS data collected by Weller 53053 (2x), 56950 (2x), 56953 (4x) excluded (see remark by Weller)
   - LHD_6th_EXP_CAMP_V2 (162 observations, 162 enter ISS04 scaling): data collected by Yamada
   - W7AS_NI (1 observation, 1 enters ISS04 scaling): W7-AS data containing NBI heating only data collected by Kus
   - TJ-II_Jan04_2 data collected by Ascasibar (1130 observations, 316 enter ISS04 scaling):
   - HELJ data by Sano (111 observations, 54 enter ISS04 scaling)
   - HSX data by Talmadge (539 observations, 0 enter ISS04 scaling) (HSX power & density scans in different configurations)
   - predictive (W7-X by Dinklage) (4 'observations', 0 enter ISS04 scaling)
   - BRAKEL data by Brakel (75 observations, 0 enter ISS04 scaling) (W7-AS ι- scan)
   - NF 41(1999)429 data entered by Dinklage (1 'observation', 0 enter ISS04) (ITER operation point)
   - HIRSCH data by Hirsch (2 observations, 0 enter ISS04) (L/H-mode in W7-AS)
   - GRIGULL/McCORMICK data by Grigull and Mc Cormick (60 observations, 0 enter ISS04) (HDH density scan in W7-AS (normal confinement, HDH attached, HDH detached in hydrogen discharges with hydrogen NBI heating)

   Grand total:
   3335 data sets / 1750 enter ISS04 scaling

2. COMM
   more detailed specifications, e.g. 'Power Scan,0.6x10E12,QHS,2003'

3. STELL
   Stellarator that has supplied the data:
   ATF, CHS, HELE, HELJ, LHD, TJ-II, W7-A, W7-AS, HSX
   W7-X and ITER are predictive data

4. STDSET
   Standard data set:
   0, not included in analyses for ISS04; (applies for 1476 data)
   1, included in present analyses (applies for 1750 data)

5. SHEAR_INDICATOR
   Magnetic field shear indicator:
   0 for shearless stellarators (W7-A, W7-AS, W7-X);
   1, otherwise

6. UP_DATE
   Last update:
   [YYYYMMDD]

7. SHOT_DATE
   Date of shot:
   [YYYYMMDD]

8. SHOT
   Shot number or the first shot number of a sequence

9. SEQ
   Sequence number (designated for a series of similar shots)

10. SHOT_TIME
    Time during the shot at which the data are taken

11. PHASE
    Phase of the discharge:
    STAT, stationary phase

Plasma composition

12. PGASA
    Mass number of the plasma working gas:
    1, H; 2, D; 3, ^{3}He; 4, He

13. PCHARGE
    Charge number of the plasma working gas:
    1, H; 1, D; 2, He
    Derived quantity:

```
switch PGASA
    case 1, 2: PCHARGE = 1
    case 4: PCHARGE = 2
    otherwise PCHARGE = missing
end
```

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

Device geometry

15. 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;
    For W7-AS high-beta data, the major radius is taken from VMEC calculations

16. 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

17. 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;
W7-AS high beta data, the minor radius is taken from VMEC calculations

18. VOLUME
    Plasma volume (m^{-3}):
    Derived quantity:
    VOLUME $= 2 \times \pi^2 \times$ AEFF$^2 \times$ RGEO
19. ASEPARATRIX
    Separatrix area (m^{-2}):
    Derived quantity:
    ASEPARATRIX $= 4 \times \pi^2 \times$ AEFF $\times$ RGEO
20. SEPLIM
    Minimum distance between the separatrix and the wall or the limiter(m)
21. CONFIG
    Device configuration:
    STD, standard configuration; LIM/STD, standard configuration with limiter

Machine conditions

22. WALMAT
    Material of the vacuum vessel wall:
    IN, Inconel; INCARB, Inconel with carbon; SS, stainless steel; SSCARB, stainless steel with carbon
23. LIMMAT Limiter material:
    C, carbon; BORC, boron carbide; SS, stainless steel; TIC, titanium-coated graphite
24. EVAP Evaporated material:
    C, carbonized; BOR, boronized; TI, titanium; CR, chromium; NONE, no evaporation

Magnetic configurations

25. BT
    Vacuum toroidal field at RGEO:
    ATF, calculated from coil current
26. IP
    Total plasma current (A):
    Positive values if it increases the vacuum iota (equivalent to the direction of the tokamak current)
27. VSURF
    Loop voltage at plasma boundary (V):
    positive values correspond to positive IP
28. IOTAA
    Rotational transform at the plasma edge (AEFF):
    W7-AS, from simple formula interpolating between available configurations
29. IOTA0
    Rotational transform at the plasma centre:
    W7-AS, from simple formula interpolating between available configurations
30. IOTA23
    Rotational transform at $\mathrm{r}_{\mathrm{eff}} = 2/3$AEFF:
    For the W7-AS high-beta data, the value is taken from VMEC calculations
    For the other devices see Ref. [8].

31. EPS_EFF23
effective helical ripple for $1/\nu$ transport at $r_{eff} = 2/3AEFF$:
(see, for example, Ref. [1], especially the equation on page 344).
For W7-AS, data were provided by C.D. Beidler (DKES results)
For LHD, data were provided by M.Yokoyama and S.Murakami (DCOM results). Finite beta effect is estimated from the interpolated expression of DCOM results.

32. PLATEAU23
Plateau factor at $\mathrm{r_{eff}} = 2/3\mathrm{AEFF}$
(see Eq. (25) in Ref. [3]).
Data provided by M. Yokoyama.

33. KAPPA
For LHD calculated by $(\kappa(\phi = 0) \times \kappa(\phi = \pi/20))^{1/2}$, i.e. averaging of local values at the vertically elongated position ($\phi = 0$) and the horizontally elongated position ($\phi = \pi/20$) where ϕ is the toroidal angle and $\kappa = (z_{max} - z_{min})/(R_{max} - R_{min})$ at the last closed flux surface.

Densities

34. NEBAR
Line average electron density ($\mathrm{m^{-3}}$):
W7-AS, if available, from microwave interferometer, otherwise from a central HCN chord

35. DNEBAR
Time derivative of NEBAR ($\mathrm{m^{-3}s^{-1}}$):
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 [6].

Impurities

36. ZEFF
Average plasma effective charge

37. PRAD
Total radiative power as measured with bolometry (W)

Input power

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

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

40. MECHl
Mode of primary ECH:
1, fundamental;
2, second harmonic

41. MECH2
Mode of secondary ECH:
1, fundamental;
2, second harmonic

42. 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

43. ENBIl
    Power-weighted neutral beam energy for the primary beams (V):
    W7-AS, sources 1+5; 1: 1/2 : 1/3 = 1:1:1

44. ENBI2
    Power-weighted neutral beam energy for the secondary beams (eV):
    W7-AS, sources 3+7; 1: 1/2 : 1/3 = 1:1:1

45. ENBI3 Power-weighted neutral beam energy for the secondary beams (eV)

46. RTANl
    Tangency radius for the primary beams

47. RTAN2
    Tangency radius for the secondary beams

48. RTAN3 Tangency radius for the secondary beams

49. PNBIl
    Port-through NBI power for the primary beams (W)

50. PNBI2
    Port-through NBI power for the secondary beams (W)

51. PNBI3
    Port-through NBI power for the tertiary beams (W)

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

53. 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

54. PICH
    Port-through ICRF power (W)

55. FICH
    ICRF frequency (Hz)

56. PABSICH
    ICRF absorbed power (W)

57. POH
    Ohmic heating power (W)

58. PTOT
    Total absorbed power (W):
    Derived quantity:
    PTOT = PABSECH+PABSNBI+PABSICH +POH

59. PFLUX
    Power flux through separatrix (Wm^{-2}):
    Derived quantity:
    PFLUX = PTOT/ASPEPARATRIX

Profile information

60. NE0
    Central electron density at RMAG (m^{-3}):
    Heliotron-E, taken from FIR;
    W7-AS, taken from a fit to a Thomson scattering profile

61. TE0
    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

62. WDIA
    Total plasma energy as determined by diamagnetic measurements (J):
    Heliotron-E, from kinetic profiles and the beam contribution calculated by the PROCTR code

63. DWDIA
    Time derivative of WDIA (W):
    `0`, for PHASE=STAT and PHASE=c;
    `missing`, otherwise

64. WMHD
    Total plasma energy as determined from MHD equilibrium (J):
    ATF, saddle loop is not calibrated, use for reference only

65. WETH
    Total thermal electron plasma energy (J):
    W7-AS, from Thomson scattering profiles

66. WIONTH
    Total thermal ion plasma energy (J):
    W7-AS, from simulation with neoclassical transport coefficients

67. WTH
    Total thermal plasma energy from kinetic measurements (J)

68. DWTH
    Time derivative of WTH (W)
    `0`, for PHASE=STAT and PHASE=c;
    `missing`, otherwise

69. WFPER
    Calculated total perpendicular fast ion energy (J)

70. WFPAR
    Calculated total parallel fast ion energy (J)

Energy confinement times

71. TAUEDIA
    Global confinement time based on diamagnetic measurement (s):
    Derived quantity:
    $\mathrm{TAUEDIA} = \mathrm{WDIA}/(\mathrm{PTOT} - \mathrm{DWDIA})$

72. TAUETH
    Thermal energy confinement time (s):
    Derived quantity:
    $\mathrm{TAUETH} = \mathrm{WTH}/(\mathrm{PTOT} - \mathrm{DWTH})$

Regression variables and scalings

73. LOG_A
    Derived quantity:
    LOG10 AEFF

74. LOG_R
    Derived quantity:
    LOG10 RGEO

75. LOG_P
    Derived quantity:
    LOG10 PTOT

76. LOG_N
    Derived quantity:
    (LOG10 NEBAR) - 19

77. LOG_B
    Derived quantity:
    LOG10 BT

78. LOG_I
    Derived quantity:

```
switch STELL
    case ATF, W7-A, W7-AS (except high-beta): LOG10(IOTAA+$(1-2/3)^2$ (IOTA0-IOTAA))
    case CHS: LOG10(IOTAA+$(1-2/3)^3$ (IOTA0-IOTAA))
    case HELE, HELJ: LOG10(IOTAA+$(1-2/3)^4$ (IOTA0-IOTAA))
    case LHD, TJ-II, HSX, W7-X, W7-AS high-beta: LOG10(IOTA23)
end
```

    see also E. (1) in Ref. [8].

79. LOG_TAU
    Derived quantity:

```
switch STELL
    case HELE, TJ-II: LOG10(TAUETH)
    otherwise: LOG10(TAUEDIA)
end
```

80. LOG_TAUE_ISS95
    ISS95 scaling:
    Exponents used: $a_0 = -0.079$, $a_a = 2.21$, $a_R = 0.65$, $a_P = -0.59$[13], $a_n = 0.51$, $a_B = 0.83$, $a_i = 0.4$

81. LOG_TAUE_W7
    ISS95W7 scaling.
    Exponents used: $a_0 = 0.115, a_a = 2.21, a_R = 0.74, a_P = -0.54, a_n = 0.50, a_B = 0.73, a_i = 0.43$

82. LOG_TAUE_LHD
    LHD scaling.
    Exponents used: $a_0 = 0.034, a_a = 2.00, a_R = 0.75, a_P = -0.58, a_n = 0.69, a_B = 0.84$, iota not used

83. LOG_TAUE_LG
    Lackner-Gottardi scaling.
    Exponents used: $a_0 = 0.68 * 0.0627, a_a = 2.00, a_R = 1.00, a_P = -0.60, a_n = 0.60, a_B = 0.80, a_i = 0.40$
    see also Ref. [8].

Dimensionless regression variables

84. TBAR
    Volume averaged temperature (eV):
    Derived quantity:
    $\mathrm{WDIA} \times \left(6 \times \pi^2 \times \mathrm{AEFF}^2 \times \mathrm{RGEO} \times \mathrm{NEBAR} \times 1.602 \times 10^{-19}\right)^{-1}$
    (for HELE and TJ-II WTH is used instead of WDIA)

85. LDEBYE
    Average Debye length:
    Derived quantity:
    $\left(\frac{8.8542\times10^{-12}\times\mathrm{TBAR}}{1.602\times10^{-19}\times\mathrm{NEBAR}}\right)^{1/2}$

86. LN_LAMBDA
    Average Coulomb logarithm:
    Derived quantity:
    $\ln\left(9\times\frac{4}{3}\times\pi\times\mathrm{NEBAR}\times\mathrm{LDEBYE}^3\right)$

87. RHOSTAR
    Ion gyro radius normalized by minor radium:
    Derived quantity:
    $\left(\frac{\mathrm{TBAR}\times2\times1.602\times10^{-19}}{\mathrm{PGASA}\times1.66055\times10^{-27}}\right)^{1/2}\times\frac{\mathrm{PGASA}\times1.66055\times10^{-27}}{\mathrm{PCHARGE}\times1.602\times10^{-19}\times\mathrm{BT}\times\mathrm{AEFF}}$
    see also Eq. (14) in Ref. [6], note that the ion charge is included in the aforementioned definition.

88. BETA
    Plasma beta:
    LHD beta corrected according to formula, Heliotron-E, calculated by the PROCTR code.
    Derived quantity:

```
switch STELL
        case LHD:
$0.722\times\left(\frac{2}{3}\times\frac{10^{\mathrm{LOG\_P}+\mathrm{LOG\_TAU}}}{\mathrm{VOLUME}}\Big/\frac{\mathrm{BT}^2}{2\times1.2566\times10^{-6}}\right)-0.023\times\left(\frac{2}{3}\times\frac{10^{\mathrm{LOG\_P}+\mathrm{LOG\_TAU}}}{\mathrm{VOLUME}}\Big/\frac{\mathrm{BT}^2}{2\times1.2566\times10^{-6}}\right)^2$
        otherwise: $\frac{2}{3}\times\frac{10^{\mathrm{LOG\_P}+\mathrm{LOG\_TAU}}}{\mathrm{VOLUME}}\Big/\frac{\mathrm{BT}^2}{2\times1.2566\times10^{-6}}$
end
```

89. MFP_ION
    Ion mean free path
    Derived quantity:
    $16\times\pi\times(8.8542\times10^{-12})^2\times(1.602\times10^{-19}\times\mathrm{PCHARGE})^{-4}\times(1.602\times10^{-19}\times\mathrm{TBAR})^2\times\mathrm{NEBAR}^{-1}\times\mathrm{LN\_LAMBDA}^{-1}$

90. NUSTAR Normalized collisionality: connection length/trapped particle mean free path [6]:
    Derived quantity:
    $\mathrm{RGEO}\times10^{-\mathrm{LOG\_I}}\times\left(\frac{\mathrm{RGEO}}{\mathrm{AEFF}}\right)^{3/2}\times\mathrm{MFP\_ION}^{-1}$

91. LOG_RHO
    Derived quantity:
    $\log_{10}(\mathrm{RHOSTAR})$

92. LOG_NU
    Derived quantity:
    $\log_{10}(\mathrm{NUSTAR})$

93. LOG_BETA
    Derived quantity:
    $\log_{10}(\mathrm{BETA})$

94. ISS04_ALL
    File Format (JMP) specific rows.
    Indicate rowstates and device grouping.
    All data are visible.

95. ISS04
    File Format (JMP) specific rows.
    Indicate rowstates and device grouping.
    Only data entering ISS04 are visible.

96. Grouping for ISS04
    Description of ISS04 subgroups.

IV. SELECTION OF THE STANDARD SET

A. ISS95

The standard data set used in all the regressions of Ref. [8] 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.
3. For W7-AS delete all discharges with high power densities given by the condition $PTOT/NEBAR > 3 \times 10^{14}\mathrm{Wm}^{-3}$.
4. For W7-AS, delete discharges 21089, 24734, 25966, 25969, 26000 and 26925.
5. 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.

B. W7-AS 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 considered (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 $r_{eff} = 2/3AEFF$.

The following shots are excluded from the standard data set:

53053 control coils not optimized → to be neglected: STDSET == 0
56950 ramp in vertical field → to be neglected: 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.

C. LHD data

PHASE was set to ”STAT”.

D. W7-AS NI data

(shot #50886) PHASE set to ”STAT”, PNBI1, PNBI2 set to missing, PABSNBI calculated by Werner.

E. TJ-II data

There are 1130 discharges from TJ-II in the database, belonging to 43 different magnetic configurations. For the standard data set used in the ISS04 scaling we have selected the configuration named 100_44_64, which has the largest number of discharges and $\iota_{2/3} = 1.60$. For TJ-II, the thermal confinement time has been used.

F. Heliotron J data

The data were collected by F. Sano. This data set refers to electron cyclotron heating (ECH) campaigns in Heliotron J (shots 5287-5302 and 6049-6140 in 2001 and shots 7776-8084 in 2002) under the on-axis and off-axis heating conditions by using 70-GHz, 0.4-MW focused 2nd harmonic ECH of X-mode. Only data with the standard (STD) magnetic configuration were considered, where the vacuum edge iota value is about 0.557 with low magnetic shear as well as with magnetic well depth of about 1.5% at the boundary. The internal plasma energy content was measured using the diamagnetic loop at the peak energy timing. The ECH absorption power was estimated using the TRECE code [9], where the calculated single-pass absorption efficiency for the flat density profile and the parabolic temperature profile is 0.429 for NEBAR $= 0.2 \times 10^{19}\,\mathrm{m}^{-3}$ and $T_e(0) =$ 1200eV,0.495 for NEBAR $= 0.8 \times 10^{19}\,\mathrm{m}^{-3}$and $T_e(0) =$ 500eV, and 0.598 for NEBAR $= 2 \times 10^{19}\,\mathrm{m}^{-3}$ and $T_e(0) =$ 250eV. In the present data set, the effective absorption efficiency of ECH was assumed to be 66% taking into account the assumed 20-40% multi-reflection effects. The off-axis heating shots (BT $=$ 1.17T and BT $=$ 1.30T) and shots 8082 and 8084 are excluded from the standard data set of on-axis heating ($1.17 <$ BT < 1.30).

G. HSX data

The vast majority of the shots come with ECH power less than 100 kW. Since the densities are in the $10^{17}\,\mathrm{m}^{-3}$ range, the major fraction of the stored energy can be suspected to be nonthermal. HSX confinement time does not scale with density and power in the way that the other stellarators do. Data were excluded for ISS04 (STDSET = 0).

H. W7-X data

The data refer to operational parameters given adopted from Grieger *et al.* [5]. The data do not incorporate any optimization considerations but are the scaling extrapolations. It is to be emphasized that these extrapolations are considerably smaller than the figures in the W7-X proposal. Data should not be used in any scaling (STDSET = 0).

I. BRAKEL

W7-AS data from the ι-scan shown in Fig. 2 of [2]. Data not used for ISS04 (STDSET = 0).

J. ITER

Reference for ITER operation from [7]. Data should not be used in any scaling (STDSET = 0).

K. HIRSCH

Comparative H- and L-mode data. Data not used for ISS04 (STDSET = 0). AEFF is an upper limit.

L. GRIGULL/McCORMICK

Density scan for divertor operation covering the transition from normal confinement (NC) to attached HDH to detached HDH operation. AEFF was determined from vacuum field calculations (Gourdon code). The absorbed power was estimated from extrapolations of the Penningsfeld formula. Data not used for ISS04 (STDSET = 0).

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[1] Beidler, C. D., and W. N. G. Hitchon, 1994, Plasma Phys. Control. Fusion **35**, 317.

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[13] Note: Since PTOT in the ISS95 scaling was used in MW, LOG_P is replaced by (LOG_P - 6) in LOG_TAUE_ISS95, LOG_TAUE_W7, LOG_TAU_LHD, LOG_TAU_LG