

Summary of JE IOS-1.1

***ITER baseline, at $q_{95}=3$, $\beta_N=1.8$, $n_e=0.85 \times n_{GW}$
(D, H, He)***

***October 2011
G. Sips***

IOS-1.1: ITER baseline, at $q_{95}=3$, $\beta_N=1.8$, $n_e=0.85n_{GW}$

Contributors (2011):

G. Jackson (DIII-D), G. Sips (JET), J. Schweinzer (AUG), S. Wolfe (C-Mod)

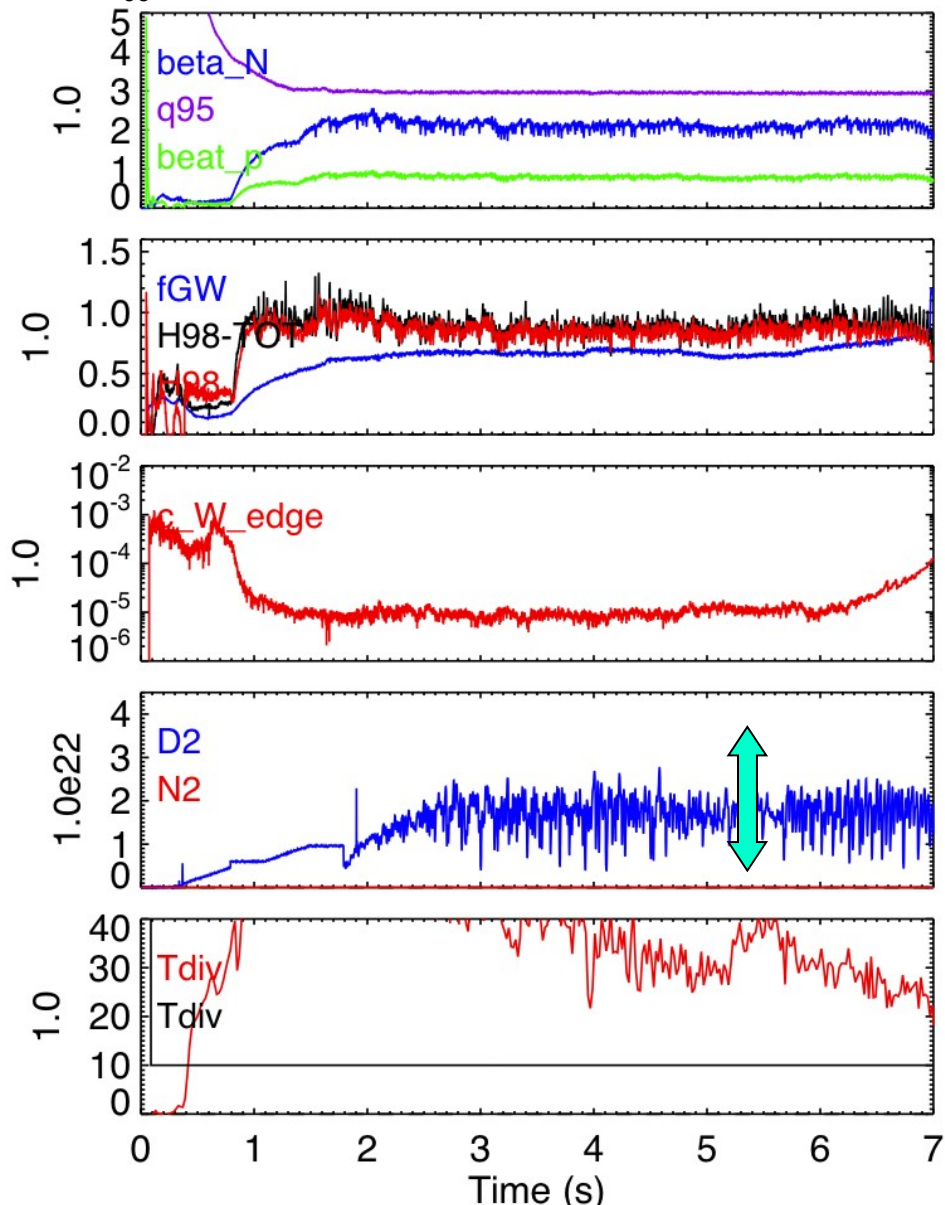
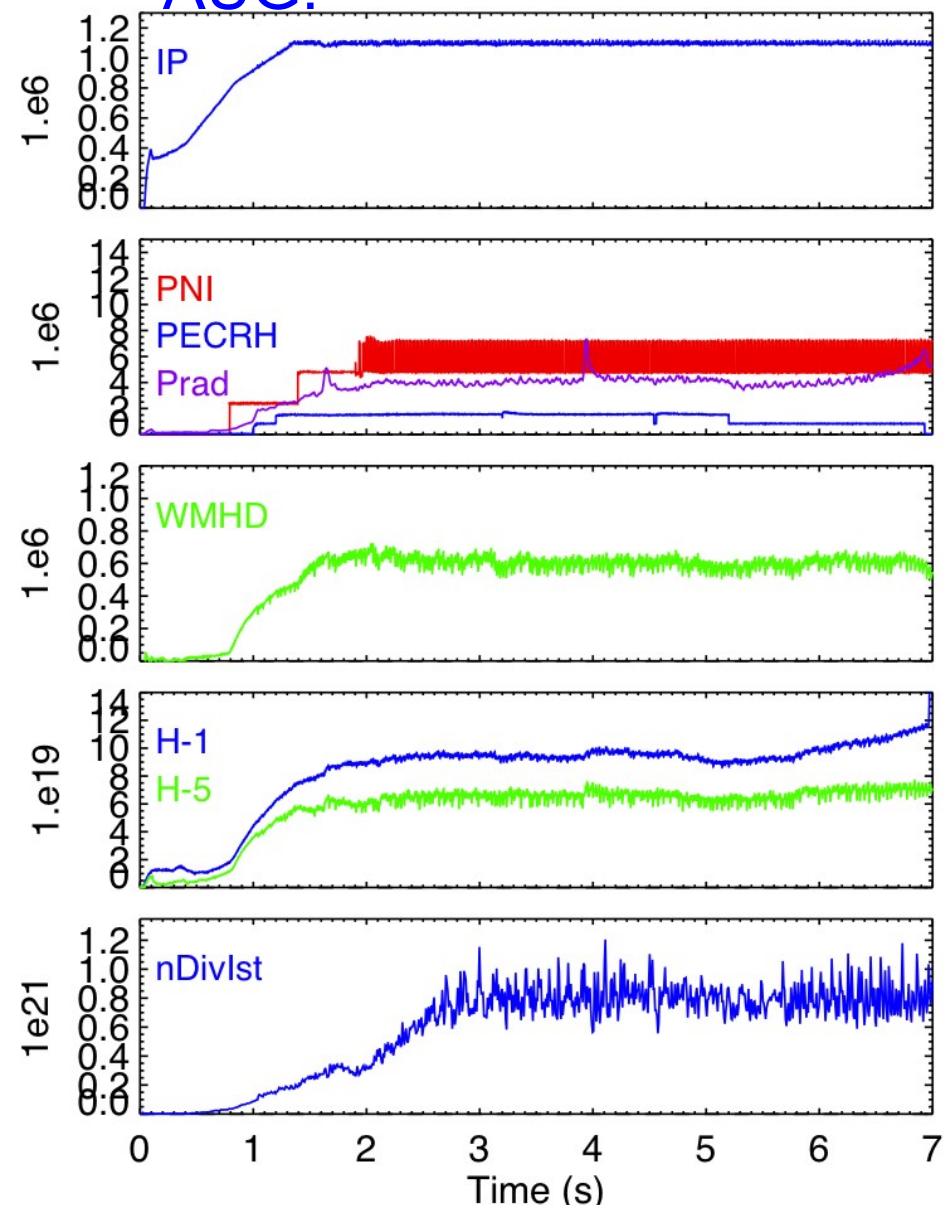
Results until April 2011:

- JET: Only results from 2010: Stationary $H_{98} \sim 1$, only at $P_{tot}/P_{L-H} = 1.3-2$, $I_p \rightarrow 4.5\text{MA}$. Comparison between NBI and ICRH.
- C-Mod: Improved ramp-up phase to 1.3MA/5.3T, prepare for pulses at 2.7T. $I_p = 650\text{ kA}$, $q_{95} = 3-3.2$, $\beta_N \leq 1.9$, $H_{98} = 0.8-0.95$, $\kappa \sim 1.75$, $f_{GW} \leq 0.72$.
- DIII-D: Data analyses: Stability of long pulse operation at $q_{95}=3 \rightarrow n=1$ tearing modes. Planning for the 2011 run campaign
- AUG: Stable discharges for 4 sec, still limited by the length of the ECRH high power phase: Parameters: $H_{98}=0.85-1.0$, $\beta_N=2-2.3$ at $q=3.0$, $f_{GW}=0.7$. $I_p=1.1\text{MA}$, $B_t=1.8\text{ T}$, $P_{ECRH}=1.5\text{ MW}$, $P_{NBI}=6.3\text{ MW}$. $\delta_{upper} \sim 0.10$, $\delta_{lower} \sim 0.39$

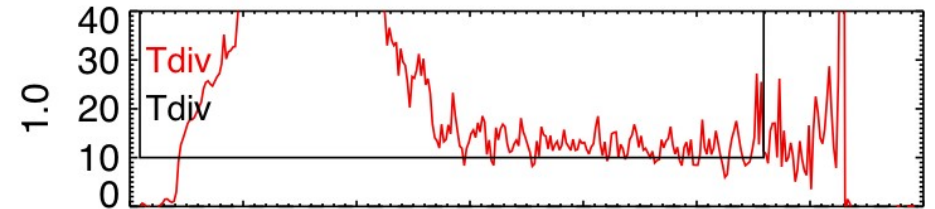
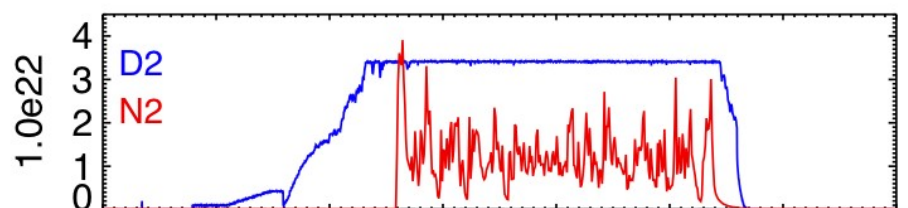
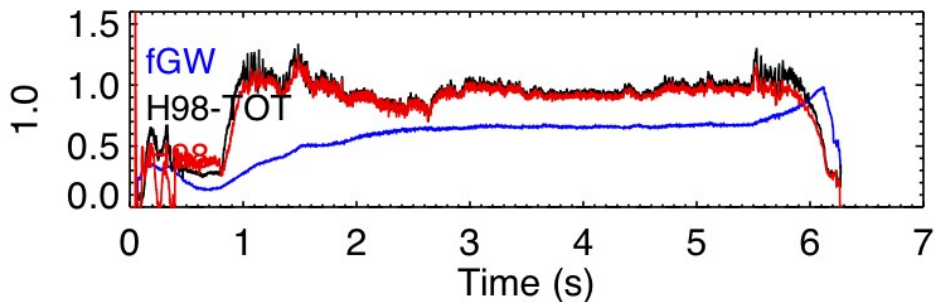
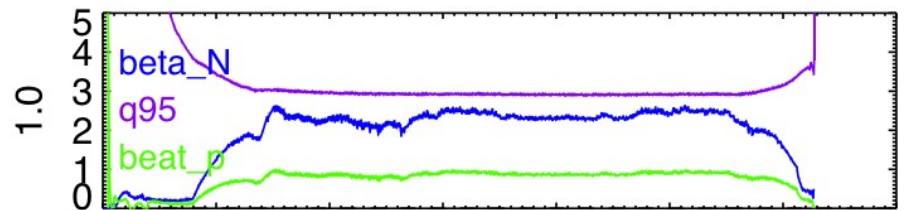
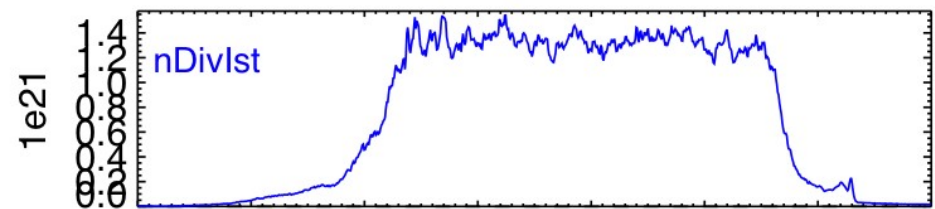
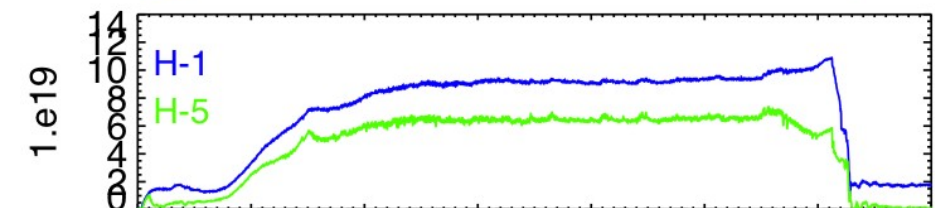
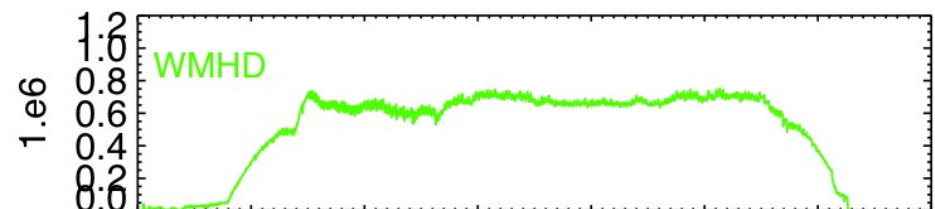
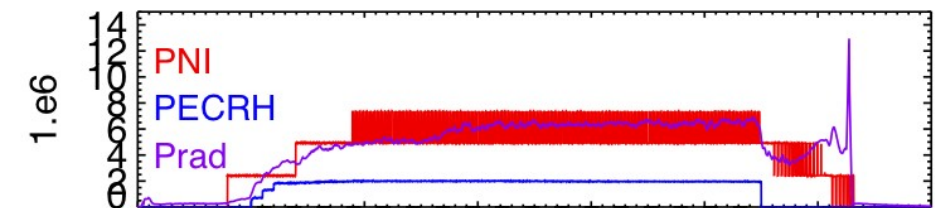
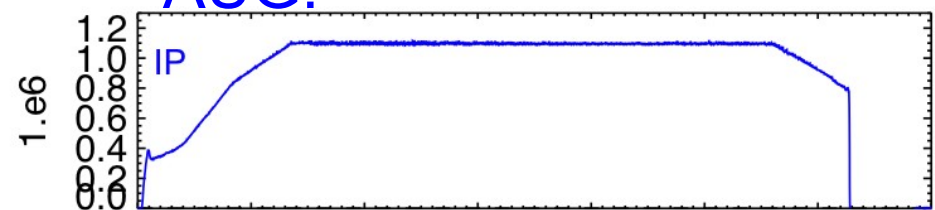
AUG:

- In 2011 AUG has done ≈ 10 $q_{95}=3$ discharges (1.1MA / 1.8T) with ECRH in X3 mode, $\delta = 0.25$, $\kappa = 1.75$
- In stable phases f_{GW} is clamped to 65% and cannot be changed by gas puff rate \rightarrow In 2012 use pellet fuelling and use higher δ .
- N seeding leads to cold divertor and keeps the confinement slightly above 1.
- β_N is always higher than the ITER target of 1.8
- In 2012: Use 1.2MA/1.2T with high power ICRH (boron coated tiles next to ICRH antenna's)

AUG:

#26634: $q_{95}=3$: 1.1MA / 1.8T with medium D puff

AUG:

#26869: $q_{95}=3$: 1.1MA / 1.8T with N seeding

Time (s)

Time (s)

C-Mod:

- C-Mod has not obtained any new experimental data since those reported last April (shutdown)
- C-Mod should be resuming operation this fall, plans regarding IOS-1.1 remain the same.
- Continued exploitation of the 2.7T, 2nd harmonic proton heating regime at target β_N and f_{GW} , including ramp-down studies from nominal target condition.
- Possible extension of the 2.7T regime to He majority plasma, if steady H-mode can be obtained (we have no positive experience with EDA H-mode in Helium majority plasmas).
- Attempts to access $\beta_N \sim 1.8$ with ITER-like parameters at 5.4T, initially at lower f_{GW} due to fuelling and ICRF restrictions.

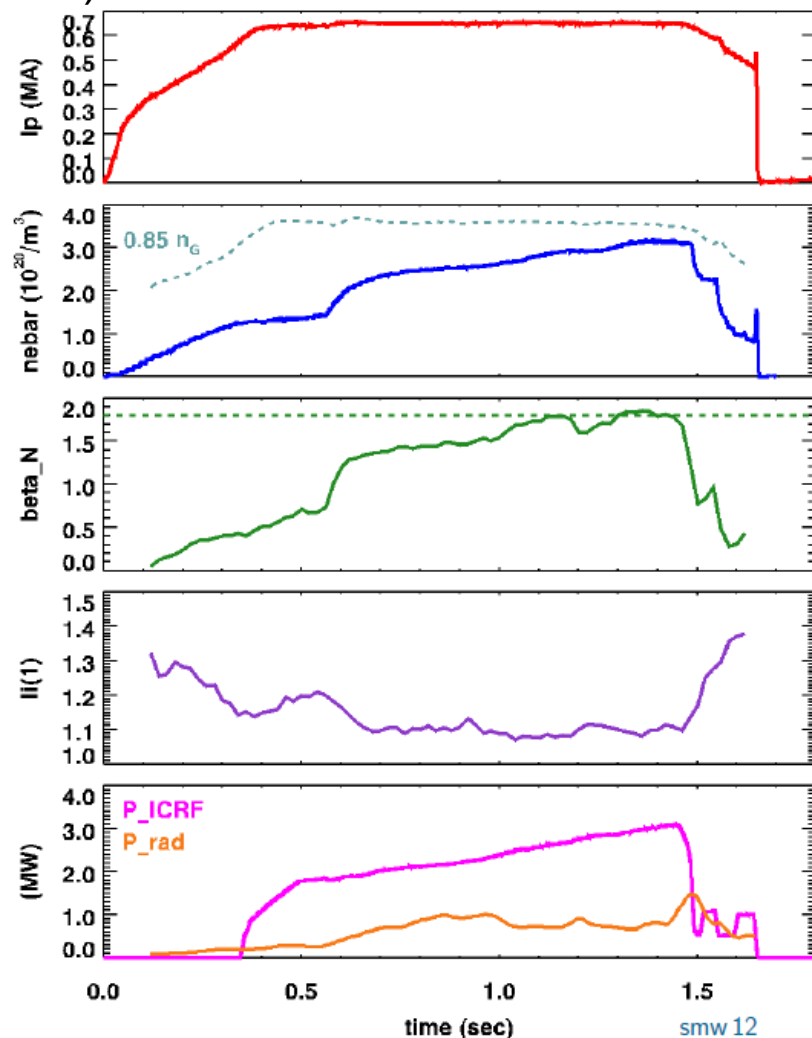
C-Mod: $B_T = 2.7\text{T}$ operation allowing access to simultaneous parameters throughout discharge (result shown in April 2011)

Targeting $q_{95} \sim 3$, $\beta_N \sim 1.7$,
 $\kappa \sim 1.8$, $n/n_{Gr} \sim 0.85$, $H_{98} \sim 1$

Used $B_T = 2.7\text{ T}$, 2nd harmonic H-minority heating at 80 MHz

$I_p = 650\text{ kA}$, $q_{95} = 3\text{-}3.2$, $\beta_N \leq 1.9$
 $H_{98} = 0.8\text{-}0.95$, $\kappa \sim 1.75\text{m}$
 $n/n_{Gr} \leq 0.72$

High β_N discharges show $\sim 10\text{ kHz}$ mode, some found to have $n = 2, 3$ (NTM?) & sometimes small ELM activity in addition to EDA QC mode



DIII-D:

- Performed a 1 day experiment in ITER similar discharges to try to obtain dominant electron heating. Unfortunately, these experiments were plagued with tearing modes.
- Only up to about 250 ms, with dominant ECH (electron) heating, but these phases are not long enough to draw any conclusions for ITER or the joint experiments.
- Sawtooth mitigation that might have helped reduce the seed island amplitude below the tearing mode threshold.
- Extensive discussions with ITER IO about development of He versions of the baseline scenario. After consideration, this was deferred to 2012.

IOS-1.1: ITER baseline, at $q_{95}=3$, $\beta_N=1.8$, $n_e=0.85n_{GW}$

JET: Extensive scenario development (deuterium only) at $q_{95}\sim 3$ with the new Be/W wall. Ramp-up, ramp-down, flat top, entry into H-mode, exit from H-mode and flat top phase

AUG: More discharges comparing heating schemes (NBI/ICRH/ECRH). Use pellet fuelling and use higher δ . Use 1.2MA/1.2T with high power ICRH (boron coated tiles next to ICRH antenna's)

C-Mod: Exploitation of the 2.7T, 2nd harmonic proton heating regime at target β_N and f_{GW} , including ramp-down studies from nominal target condition. Possible use of He majority plasma. Possibly extend experiments to 5.4T.

DIII-D: Dominant ECH (electron) heating in ITER target discharges at $q_{95}\sim 3$. Develop He versions of the baseline scenario.

→ Continue IOS-1.1 in 2012