Topic 21 experiment

N . Vianello and V. Naulin for the Topic 21 SC team

13 Octobe 2017

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

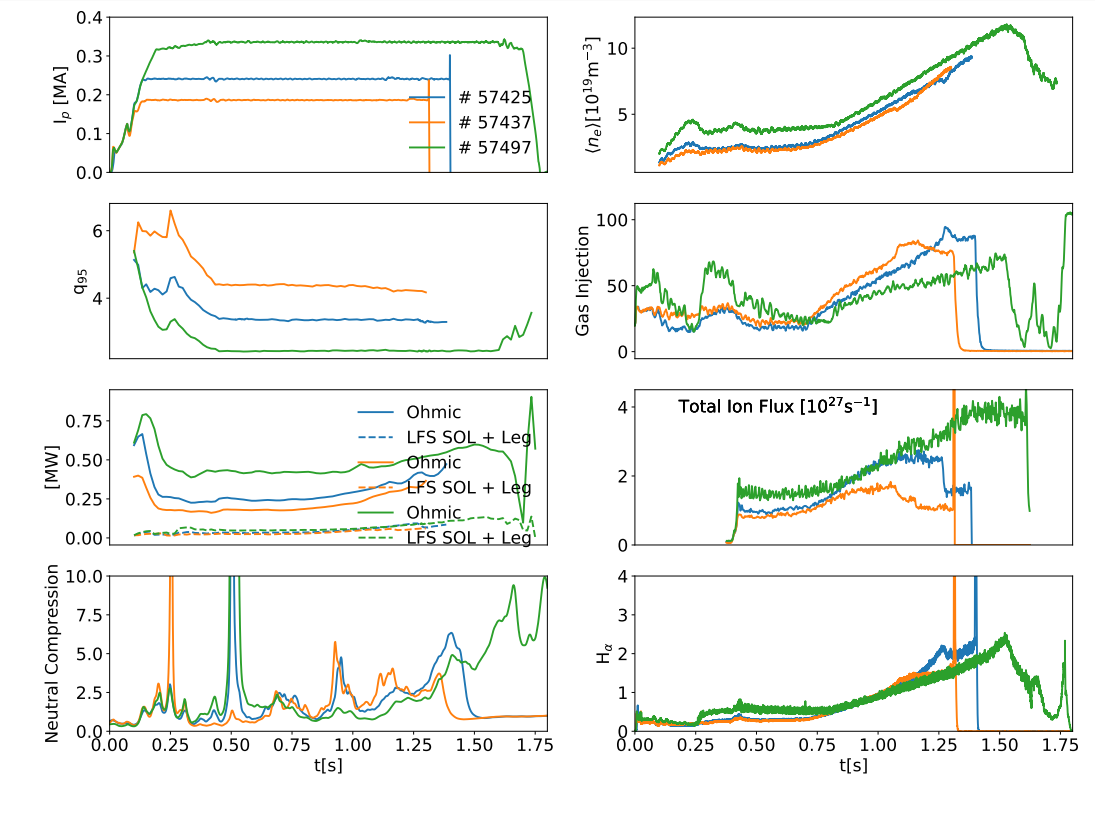
TCV experiments: boundary condition

- ✓ 2017 **objectives** listed after the General Planning Meeting
  1. Provide cross-machine L-Mode shoulder dependence on current both at constant Bt and at constant q_{95}
  2. Establish robust scenario for density shoulder profile in H-mode and establish dependence on fuelling/neutral profiles/divertor condition
  3. Study the role of ELM regimes, neutral compression, and particle density in filamentary transport and related shoulder formation.
  4. Identify the contribution of collisionality and seeding on filamentary transport and related shoulder formation.
  5. Determine the effect of filaments and shoulder formation on target heat loads in different Hmode plasmas.
- ✓ We still have a # 18 Shots available between Week 43 and 44

Accomplished program with respect to foreseen one

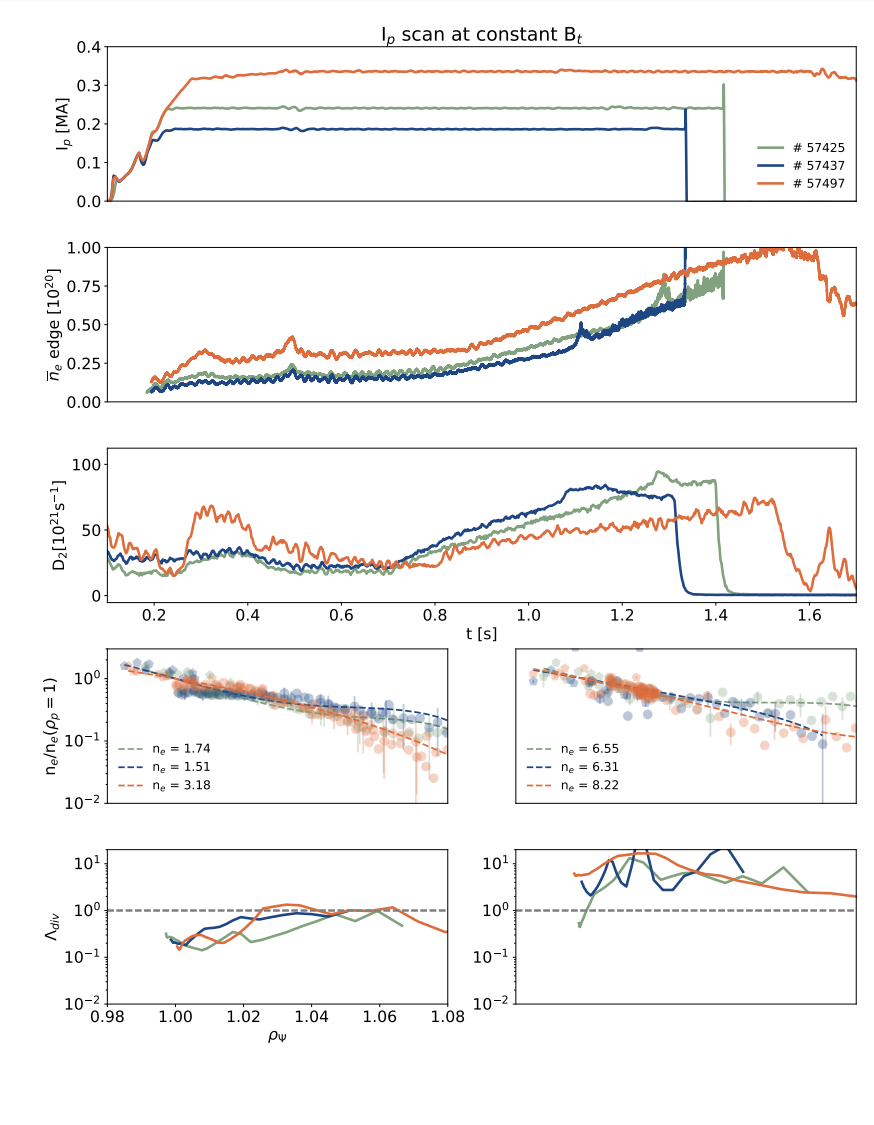
1. Shape from 57088, I_p = 245 kA, Reverse B_t, density ramp from Line Average Density = 3.8e19 @ 0.5 s to 11e19 @ 1.6s, Bt = 1.4T. Plunge @ 0.65, 1.52
2. Repeat # 1 with I_p=330 kA Bt=1.4T, same density ramp, same timing for plunges
3. Repeat # 1 with I_p=180 kA, Bt=1.4T, same density ramp, same timing for plunges
4. Repeat # 1 with q95=2.44 as # 2, adjust Bt consequently (Bt = 1.02T)
5. Repeat # 3 with q95=2.44 as # 2, adjust Bt consequently (Bt=0.8T)
6. Shape and current from # 1. Stop puffing once the divertor is formed to get low collisionality case. ECRH ramp from 0.9s (150 kW–500 kW)
7. Repeat # 6 with intermediate density value between # 6 and #1 density at 0.65s.
8. Repeat density ramp of Shot # 2 in DN configuration
9. Repeat density ramp of Shot # 3 in DN configuration
10. Repeat # 1 in forward field
11. Repeat # 3 in forward field

Current scan at constant B_ϕ



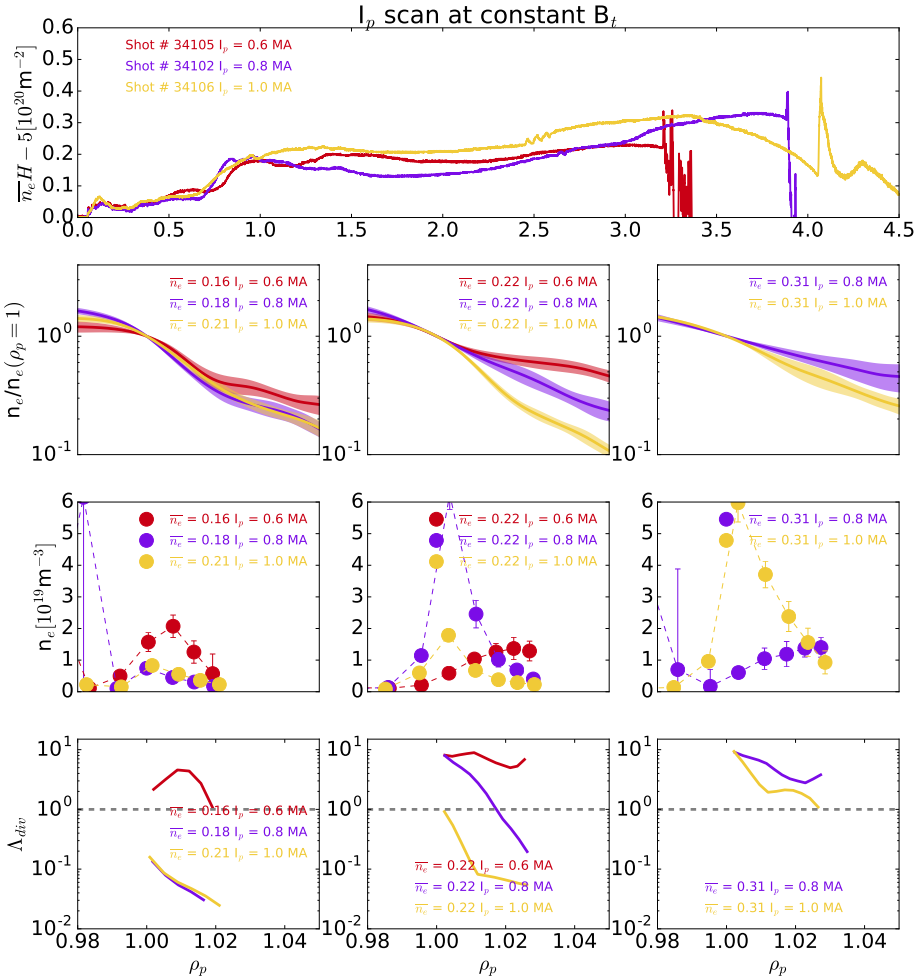
- ✓ Confirming results from Topic-25 increasing the current reduces the ion flux rollover density threshold
- ✓ Neutral compression seems slightly reduced at higher current
- ✓ Ohmic power different but power radiated from the LFS divertor seems similar among the shots
- ✓ Comparable H_α emission from target

Current scan at constant B_ϕ



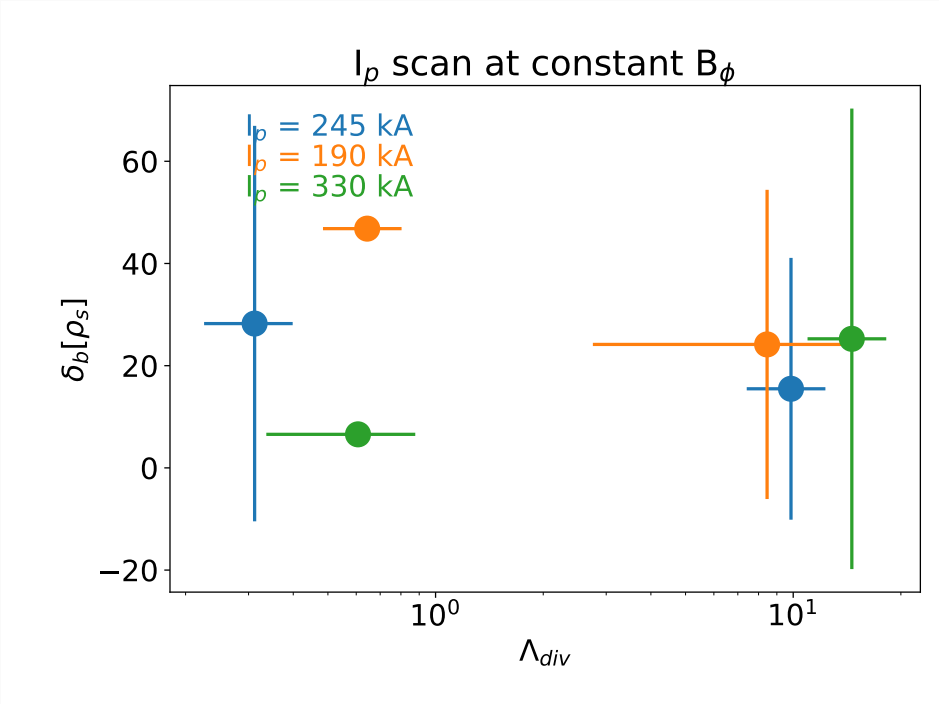
- ✓ Confirming results from Topic-25 increasing the current reduces the ion flux rollover density threshold
- ✓ Neutral compression seems slightly reduced at higher current
- ✓ Ohmic power different but power radiated from the LFS divertor seems similar among the shots
- ✓ Comparable H_α emission from target
- ✓ Profiles from RCP suggests that at lower I_p flattening is easier even with similar values of Λ_{div}

Current scan at constant B_ϕ



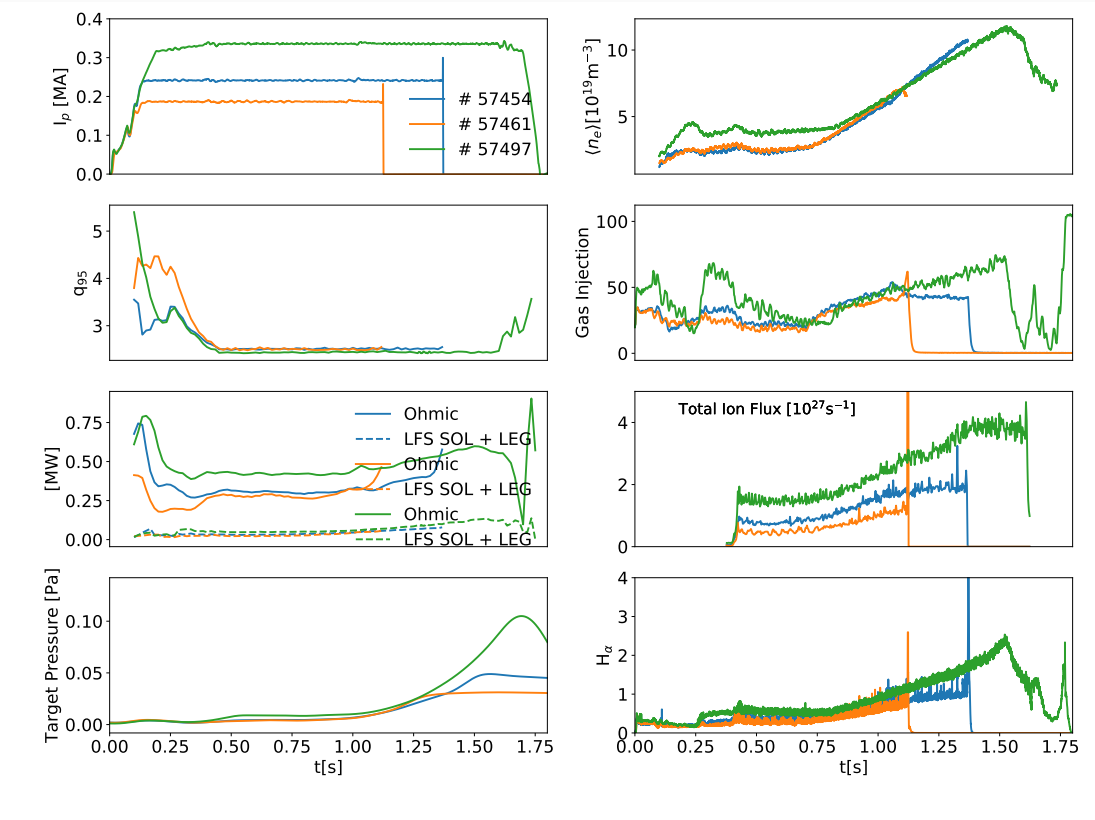
- ✓ Confirming results from Topic-25 increasing the current reduces the ion flux rollover density threshold
- ✓ Neutral compression seems slightly reduced at higher current
- ✓ Ohmic power different but power radiated from the LFS divertor seems similar among the shots
- ✓ Comparable H_α emission from target
- ✓ Profiles from RCP suggests that at lower I_p flattening is easier even with similar values of Λ_{div}
- ✓ Confirmed by similar observation in AUG

Current scan at constant B_ϕ



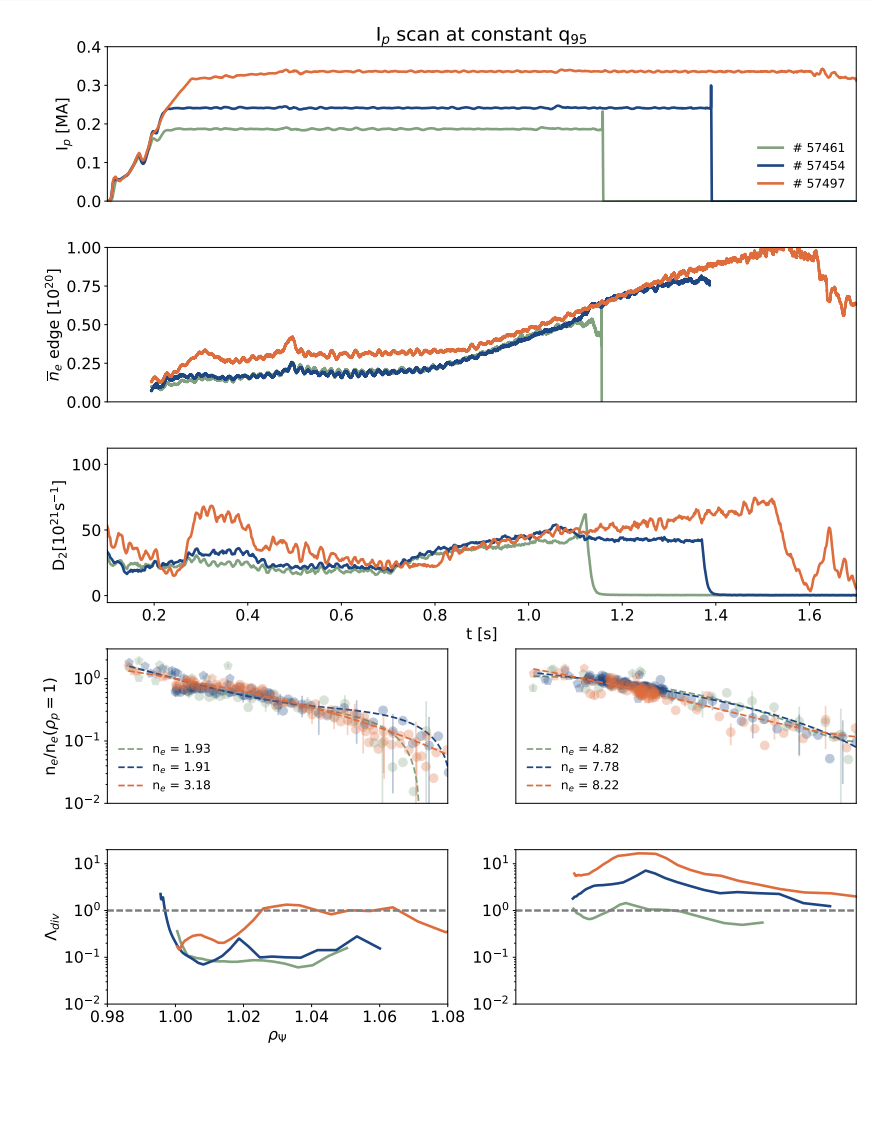
- ✓ Confirming results from Topic-25 increasing the current reduces the ion flux rollover density threshold
- ✓ Neutral compression seems slightly reduced at higher current
- ✓ Ohmic power different but power radiated from the LFS divertor seems similar among the shots
- ✓ Comparable H_α emission from target
- ✓ Profiles from RCP suggests that at lower I_p flattening is easier even with similar values of Λ_{div}
- ✓ Confirmed by similar observation in AUG
- ✓ No clear evidences in terms of blob-size actually but analysis is limited to a single spatial region (5-10 mm from the separatrix)

Current scan at constant q_{95}



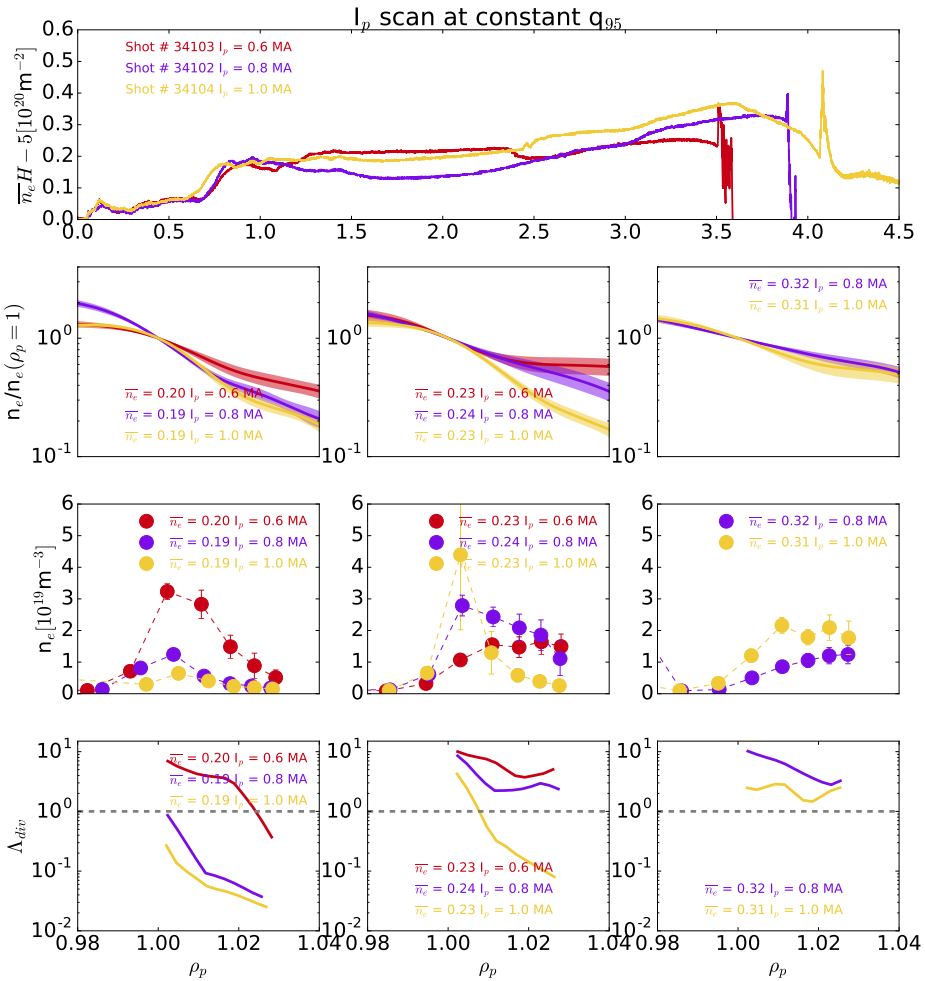
- ✓ Unusual scenarios with B_{phi} up to 0.8T. No rollover on at any of the current
- ✓ Expected higher target neutral pressure increase at higher current

Current scan at constant q_{95}



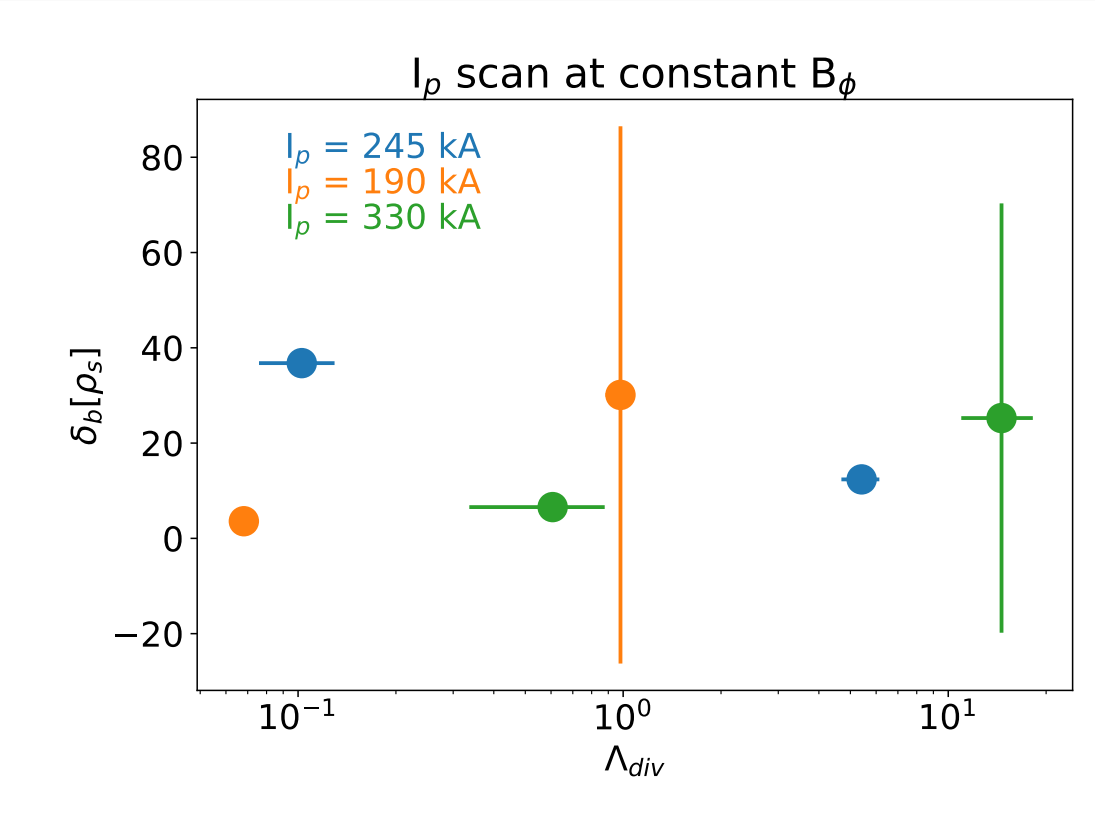
- ✓ Unusual scenarios with B_{phi} up to 0.8T. No rollover on at any of the current
- ✓ Expected higher target neutral pressure increase at higher current
- ✓ Profiles from RCP does not exhibit a clear trend with the current. We should increase the number of points in reciproation. We lack at high density at low current or eventually a point at even higher current

Current scan at constant q_{95}



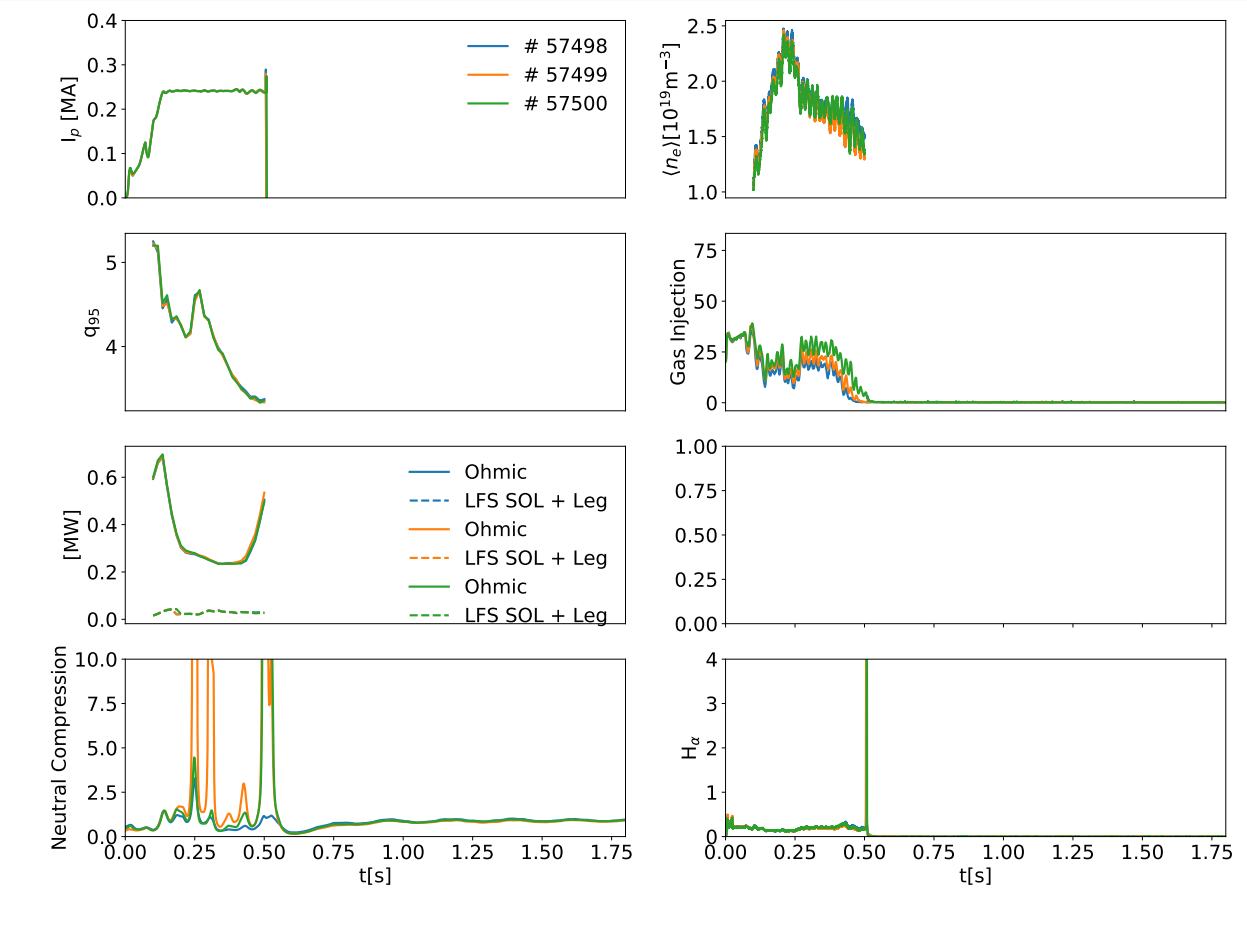
- ✓ Unusual scenarios with B_{phi} up to 0.8T. No rollover on at any of the current
- ✓ Expected higher target neutral pressure increase at higher current
- ✓ Profiles from RCP does not exhibit a clear trend with the current. We should increase the number of points in reciproation. We lack at high density at low current or eventually a point at even higher current
- ✓ In AUG the things are different and even with the same q_{95} flattening is easier at lower current

Current scan at constant q_{95}



- ✓ Unusual scenarios with B_{phi} up to 0.8T. No rollover on at any of the current
- ✓ Expected higher target neutral pressure increase at higher current
- ✓ Profiles from RCP does not exhibit a clear trend with the current. We should increase the number of points in reciproation. We lack at high density at low current or eventually a point at even higher current
- ✓ No clear evidences in terms of blob-size actually but analysis is limited to a single spatial region (5-10 mm from the separatrix)

Attempt for low collisionality



All the attempt to perform a low collisionality case disrupted whenever density decreases below a certain threshold

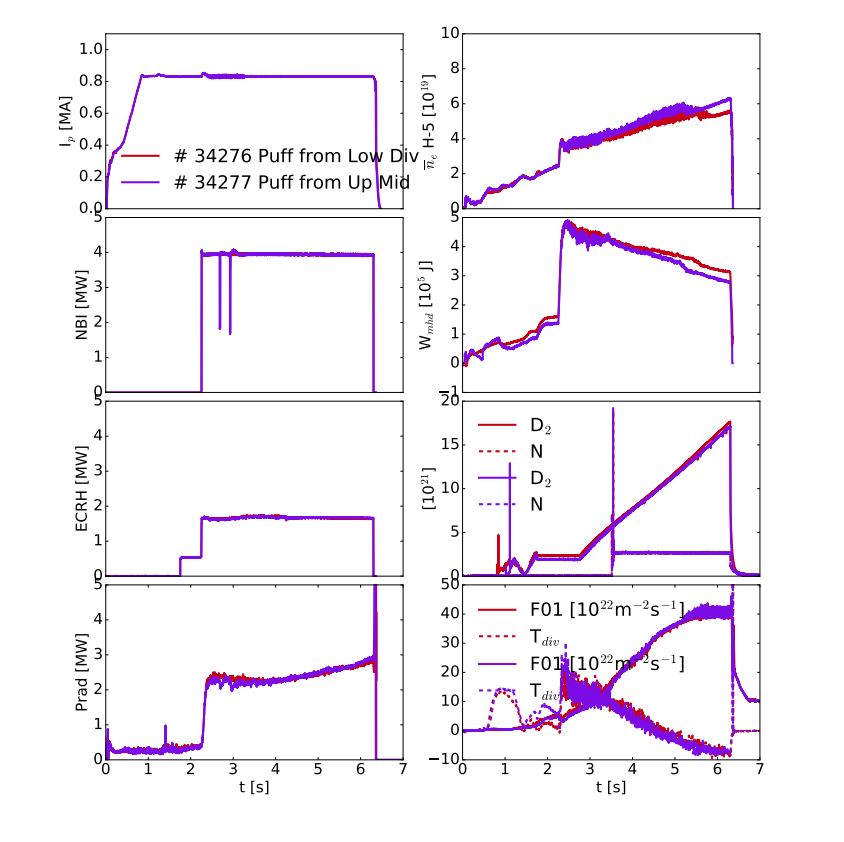
To be done

1. Evaluation of parallel flow profile (in progress)
2. Further statistical analysis on RCP
3. We could repeat a couple of shots with wall mounted probe in J_{sat} for statistics at the wall to be compared with AUG
4. DSS and multicam analysis

To be done in L-Mode

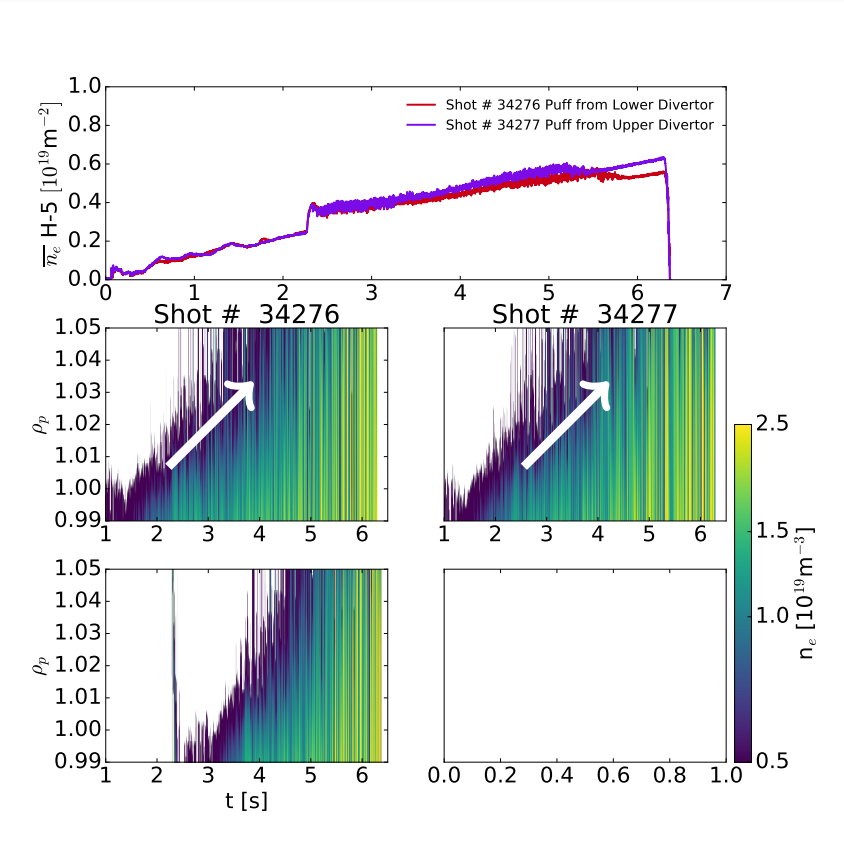
1. Low collisionality case useful for baseline scenario with no shoulder at all
2. A point at higher current at constant B_ϕ (I don't think we have still room for reducing the field further)
3. Repeat density ramp of Shot # 2 in DN configuration at fixed B_ϕ
4. Repeat density ramp of Shot # 3 in DN configuration at fixed B_ϕ
5. 2 Shots for performing a current scan in forward B field

To be done in H-Mode



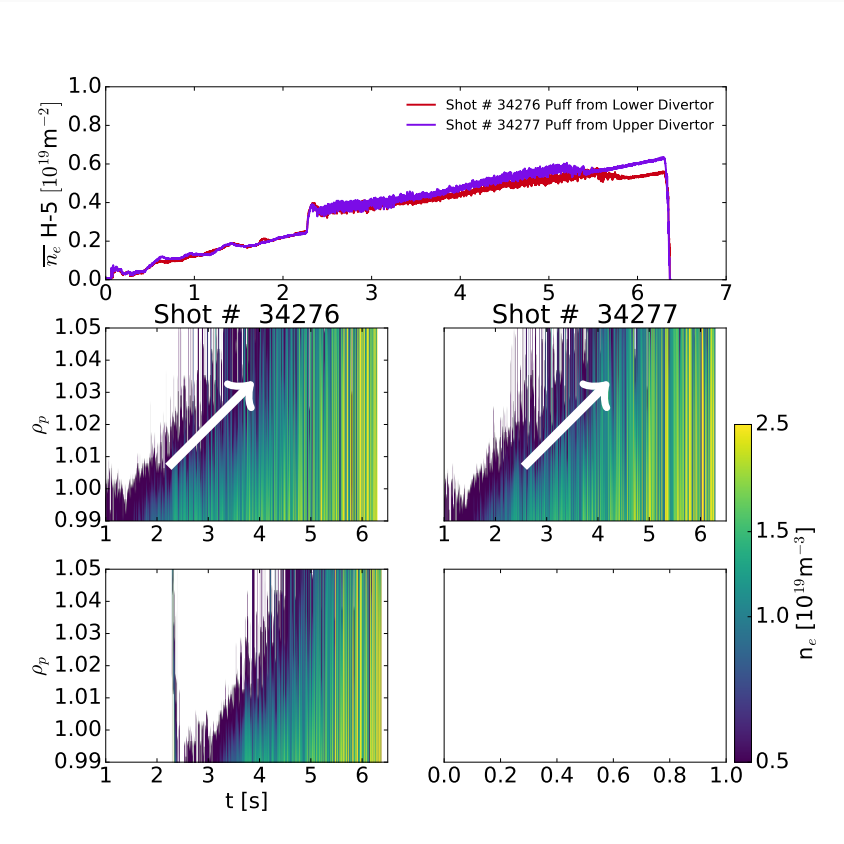
- ✓ This is the scenario obtained in AUG without cryo-pump which is the best comparison possible with TCV. Density ramp together with N seeding for divertor cooling up to the degraded H-Mode

To be done in H-Mode



- ✓ This is the scenario obtained in AUG without cryo-pump which is the best comparison possible with TCV. Density ramp together with N seeding for divertor cooling up to the degraded H-Mode
- ✓ This clearly exhibits a saturation of SOL profile which is our target

To be done in H-Mode



- ✓ This is the scenario obtained in AUG without cryo-pump which is the best comparison possible with TCV. Density ramp together with N seeding for divertor cooling up to the degraded H-Mode
- ✓ This clearly exhibits a saturation of SOL profile which is our target
- ✓ We will hear from Benoit and Christian which are the reliable scenarios which can actually been obtained so far on TCV