

EFTSOME 2011 - Workshop on Electric Fields, Turbulence and Self-Organization in Magnetized Plasmas

Strasbourg, France July 4-5, 2011

- Stewart Zweben (USA) - Relationship between edge zonal flows and L-H Transitions in NSTX*
- Yuhong Xu (Germany) – Recent results on long-range correlations and zonal flows in TEXTOR*
- Garrard Conway (Germany) - Plasma flows and turbulence interaction in ASDEX-Upgrade*
- Teresa Estrada (Spain) - Shear flows and turbulence interaction during L-H transitions in TJ-II*
- Sylvie da Graca (Portugal) - Influence of external biasing potential on plasma flows in TJ-II*
- Tim Happel (Germany) - Scale-selective turbulence reduction in H-mode plasmas in the TJ-II*
- Andreas Kramer-Flecken (Germany) - GAM structure at TEXTOR - radial and toroidal correlations*
- Carlos Silva (Portugal) - Mean and fluctuating $E \times B$ shear flows on the ISTTOK edge plasma*
- Aleksey Gurchenko (Russia) - GAM dynamics and spatial structure in the FT-2 tokamak*
- Takuma Yamada (Japan) - Experimental investigation of streamers*
- Bernhard Schmid (Germany) - Turbulent structure formation in the edge of a stellarator plasma*
- Troy Carter (USA) - Studies of flows and turbulence in the Large Plasma Device*

Second Day

Elisabeth Wolfrum (Germany) - Edge dynamics during the ELM cycle

Bernhard Nold (Germany) – Turbulence around the separatrix with probes in ASDEX Upgrade

Hans Werner Müller (Germany) - Intermittency and Transport on Open Field Lines

John Rice (USA) - Observations of core toroidal rotation reversals in Alcator C-Mod

Eleonora Viezzer (Germany) - Edge radial electric field profiles from charge exchange at ASDEX

Milan Rajkovic (Serbia) - Spatiotemporal chaos, stochasticity and coherent structures

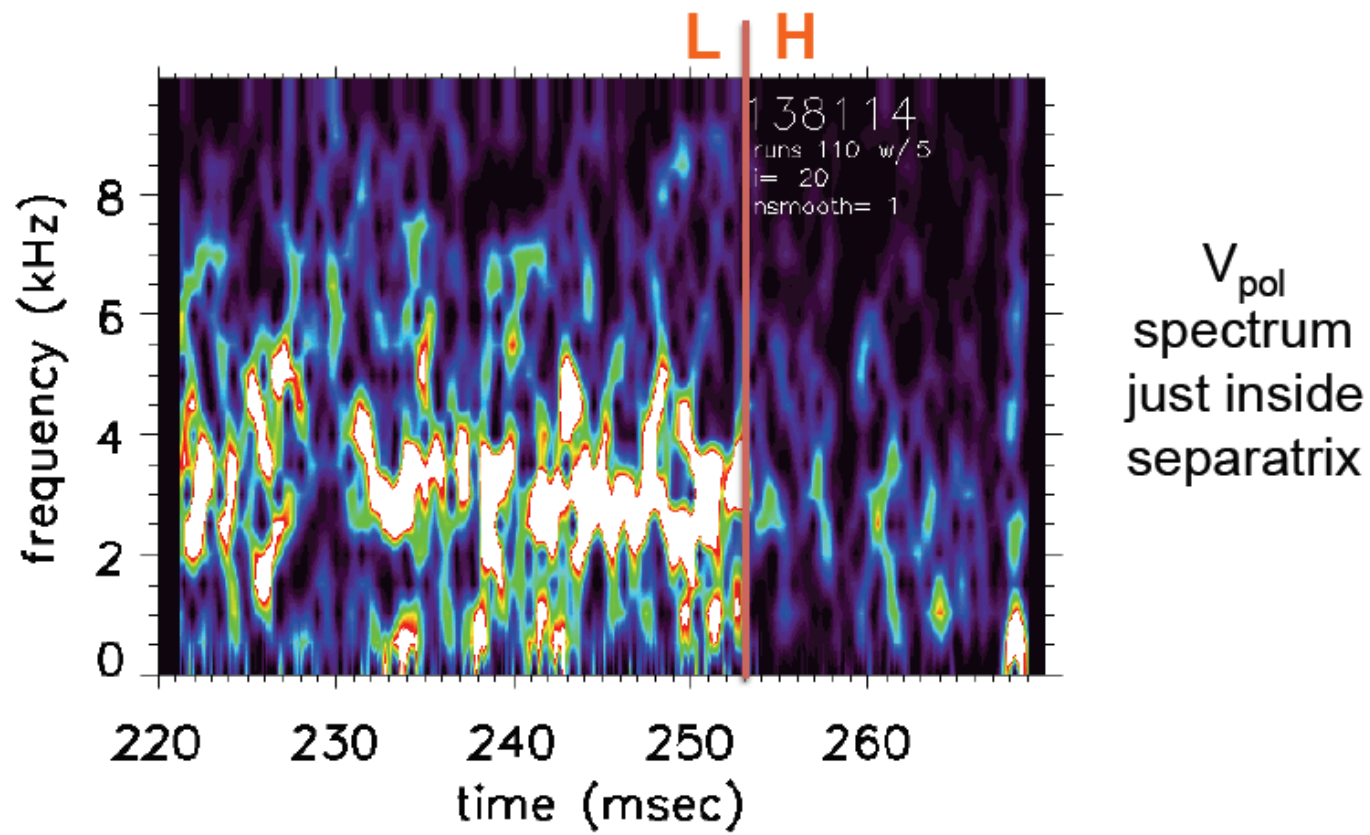
Pascale Hennequin (France) - Measurement of k spectra and comparison with theory

Miklos Porkolab (USA) - Gyrokinetic studies of turbulent transport in Alcator C-Mod plasmas

Next workshop after EPS 2012 in Stockholm, Sweden

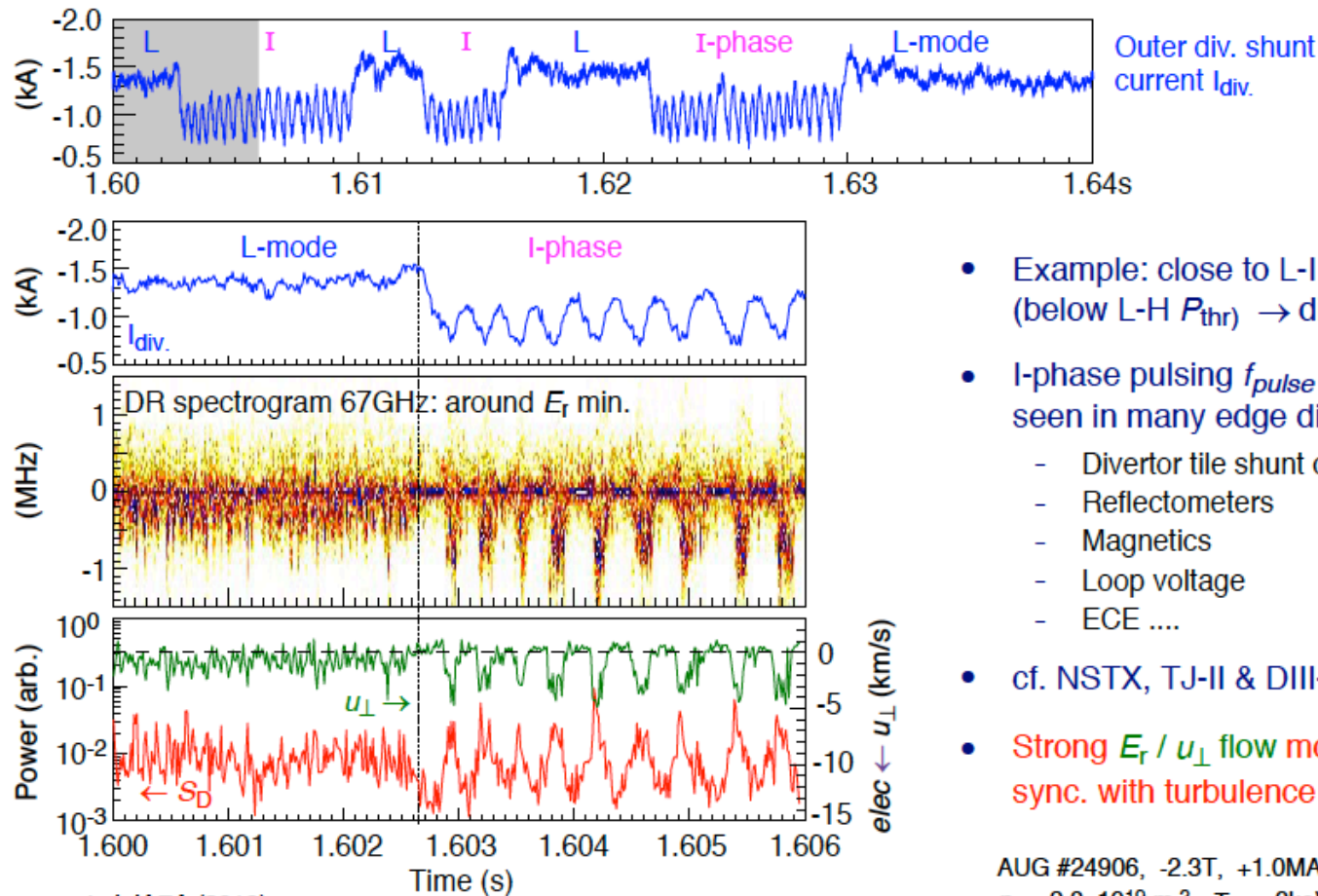
Zonal Flow Spectrum in NBI Case

- See near-coherent peak at ~ 3 kHz preceding transition





Turbulence & E_r behaviour in I-phase

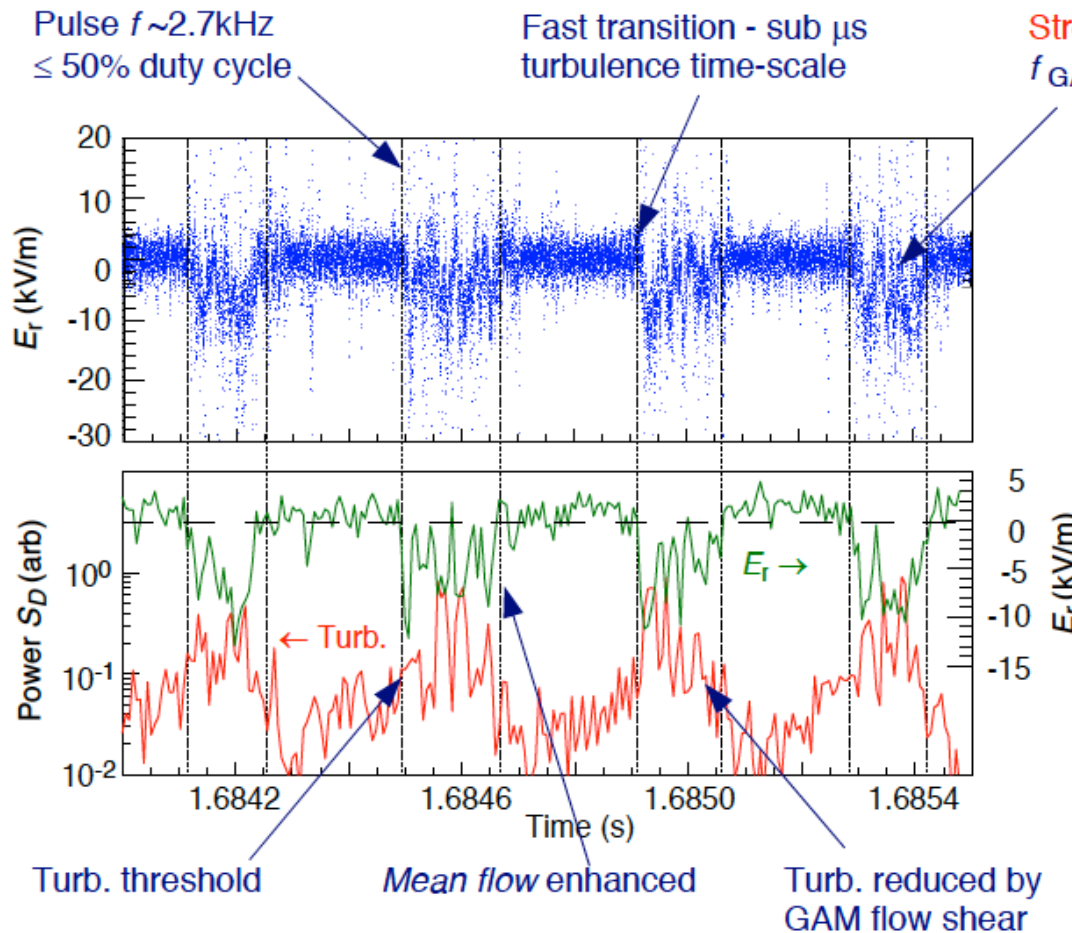


- Example: close to L-I transition (below L-H P_{thr}) \rightarrow dither
- I-phase pulsing $f_{pulse} \sim 2 - 4\text{kHz}$ seen in many edge diagnostics:
 - Divertor tile shunt currents
 - Reflectometers
 - Magnetics
 - Loop voltage
 - ECE
- cf. NSTX, TJ-II & DIII-D results
- Strong E_r / u_{\perp} flow modulation sync. with turbulence level S_D

AUG #24906, -2.3T, +1.0MA, $q_{95} \sim 4$
 $n_e = 2.8 \times 10^{19} \text{ m}^{-3}$, $T_{e0} \sim 3\text{keV}$, 1.0MW ECH



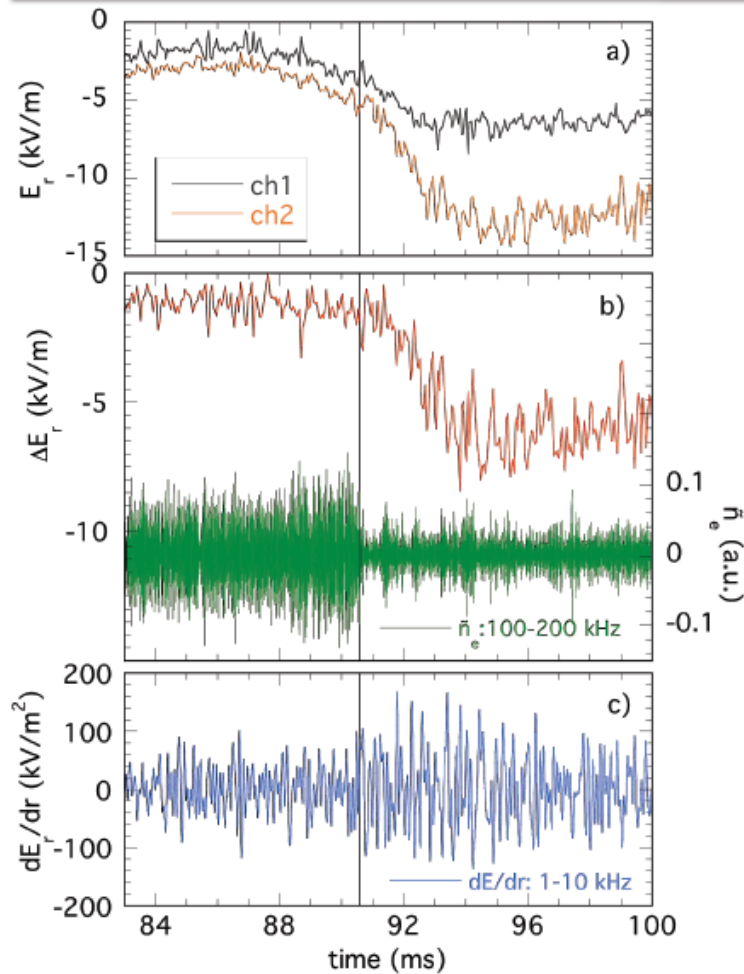
Turb. & flow interaction: Limit-cycle oscillation



- Doppler $f_D = d\phi/dt$ (50ns resolution)
- Turbulence threshold → Drives flow & GAM → Shear erodes turb.
- Limit-cycle behaviour
- GAM E_r shearing rate > turb. de-correlation τ_c
- Equilibrium time scale: I-phase supports larger edge $\nabla P \rightarrow$ mean flow

Conway et al. IAEA (2010), PRL (2011)

Oscillating sheared flow at the L-H transition



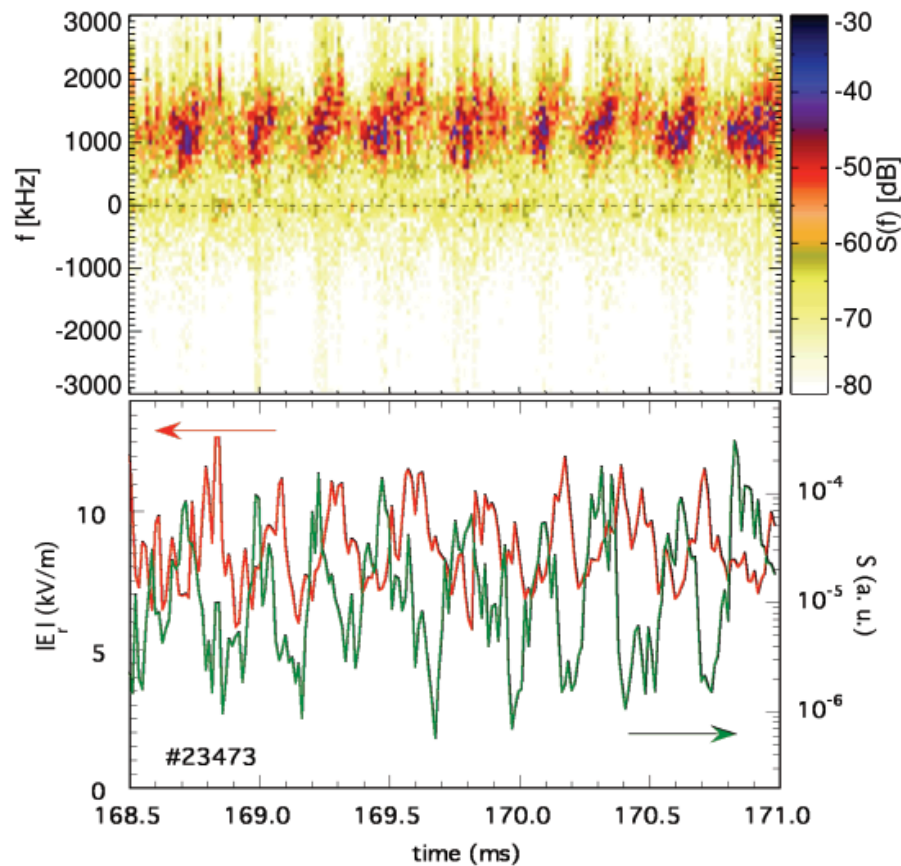
The turbulence reduction precedes the increase in the mean sheared flow, but it is simultaneous with the increase in the low frequency oscillating sheared flow:

Mean sheared flow is not the unique element to explain the suppression of turbulence at the transition, oscillating sheared flow has to be also considered

Interaction of turbulence and flows



Spectrogram of Doppler reflectometer signals: \tilde{n} (colour code) and E_r (frequency)



The time evolution of E_r and \tilde{n} (obtained by fitting a Gaussian function to the spectra) shows a predator-prey behaviour: periodic behaviour of E_r and \tilde{n} with the predator (flow) following the prey (turbulence) with a phase delay of 90°



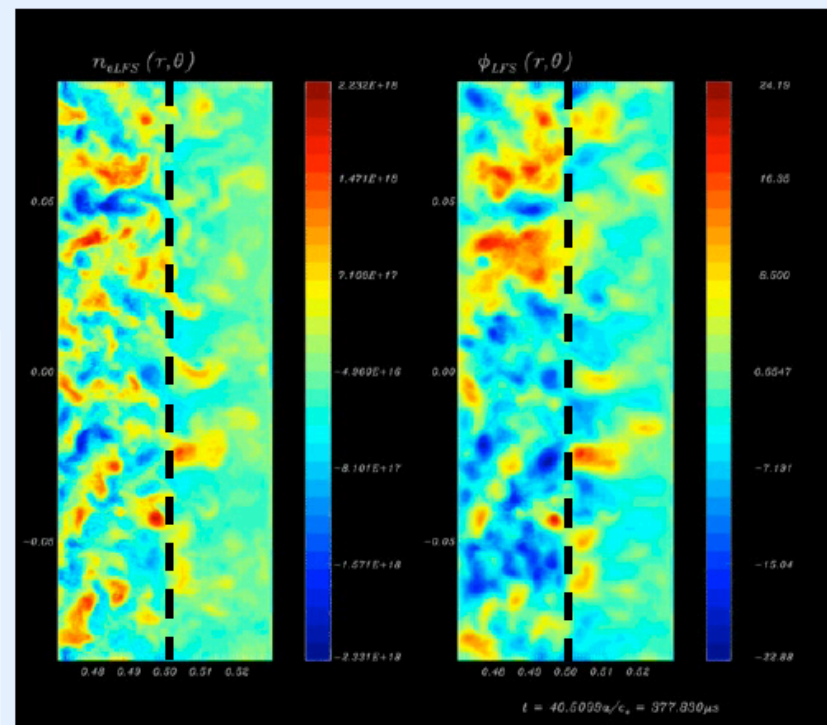
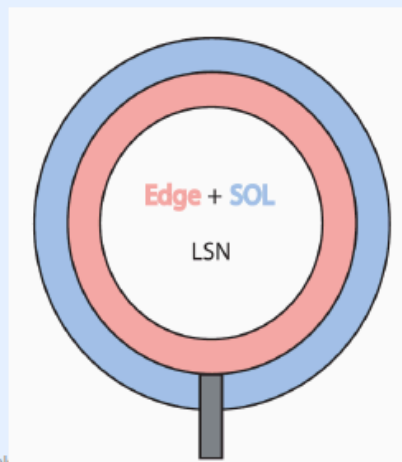
Turbulence simulation with GemR



Electro-magnetic gyrofluid model with global geometry

[S.J. Zweben, B.D. Scott, PoP 16 (2009)]

- ▶ Self consistent background profiles
- ▶ Transition from edge to SOL
[T.T. Ribeiro, B.D. Scott, PPCF 50 (2008)]
- ▶ Simulation of AUG discharge and probe
- ▶ No plasma probe interaction



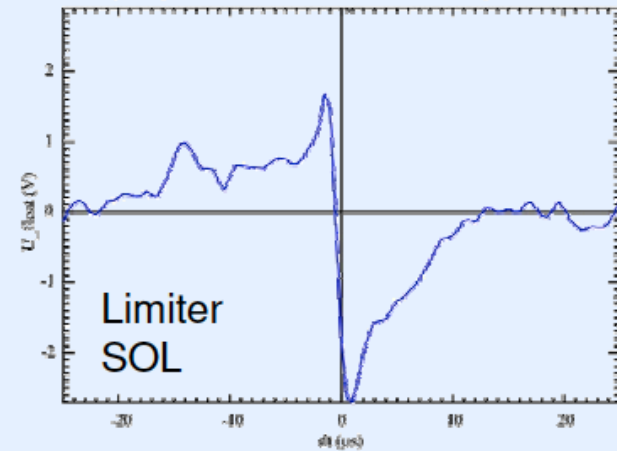
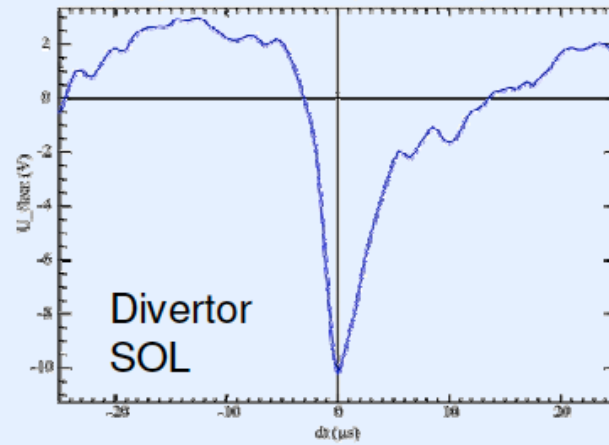
[T.T. Ribeiro, 2011]



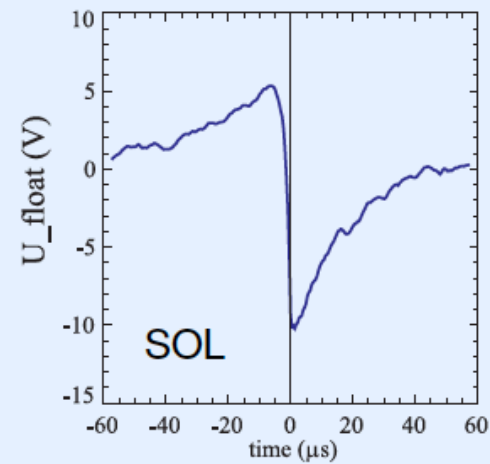
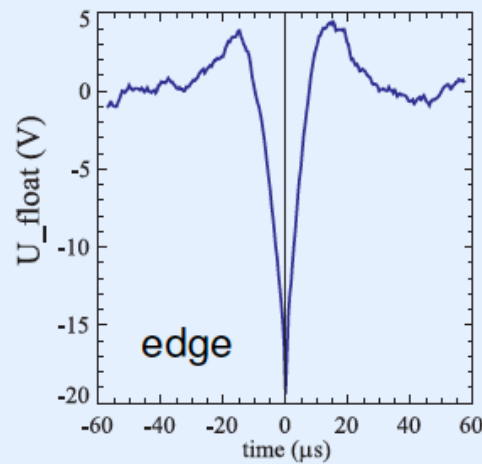
Comparison of floating potentials



ASDEX Upgrade experiment:



GemR simulation:



► Agreement of simulation and measurement