COMPASS
INSTITUTE OF PLASMA PHYSICS ASCR

OV/P-3
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Overview of Recent COMPASS Activities

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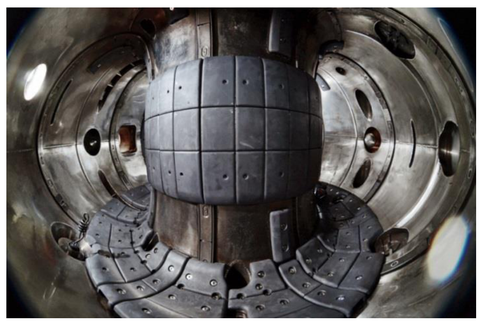
The recent COMPASS activities were focused on:

- **Edge and SOL physics** (RMP, GAM study, Pedestal scaling, L-H transition vs. X-point height)
- **Core physics and high freq. oscillations** (Alfven Eigenmode oscillations, Runaways Electrons)
- **Plasma-surface interactions** (power deposition on LEs in support of ITER divertor monoblock shaping)

COMPASS parameters

Major radius	0.56 m
Minor radius	0.18 - 0.23 m
Plasma current	< 350 kA
Magnetic field	0.8 - 2.1 T
Triangularity	0.5 - 0.7
Elongation	1.6 - 1.8
Pulse length	< 1 s
P_{NBI}	2 x 0.3 MW

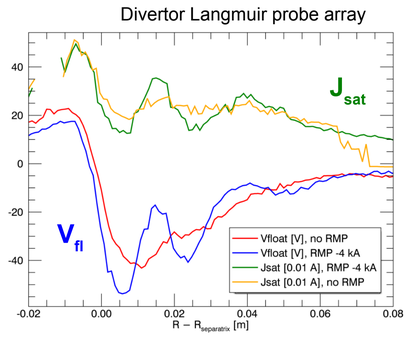


1. Edge and SOL physics

Resonant Magnetic Perturbation studies

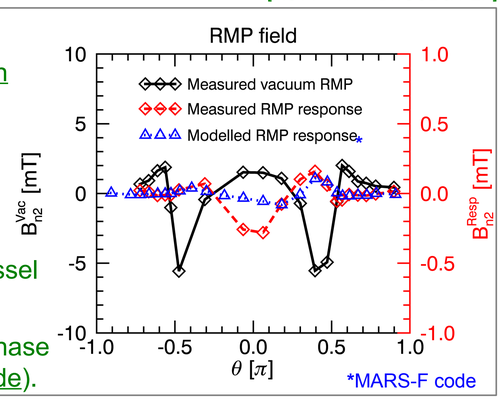
[MST1 + ITPA DivSOL & PEP]

Divertor Langmuir probe array



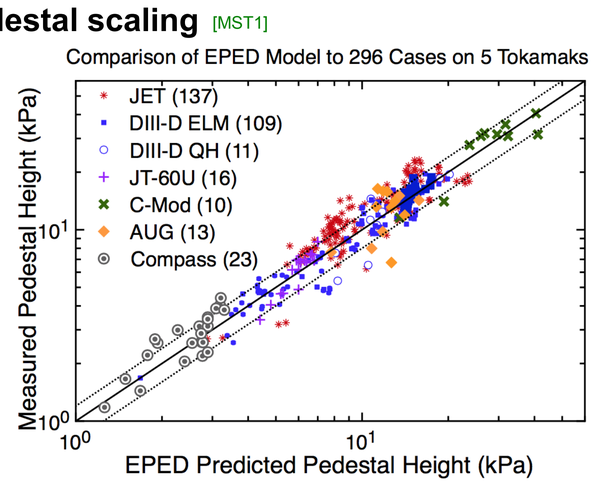
- RMP w/ n = 2 coil config. (L-mode)
  → clear splitting of the OSP
  → correlation between J_{sat} & V_{fl}

- Poloidal distribution of:
  original RMP perturbation
  &
  RMP response field
  measured by a unique set of 100 saddle loops.
  → full coverage of the vessel
- Measurements show that response field is in anti-phase to the applied field (L-mode).



+ RMP increases ELM freq. in ohmic H-mode via a density pump-out.

Pedestal scaling [MST1]

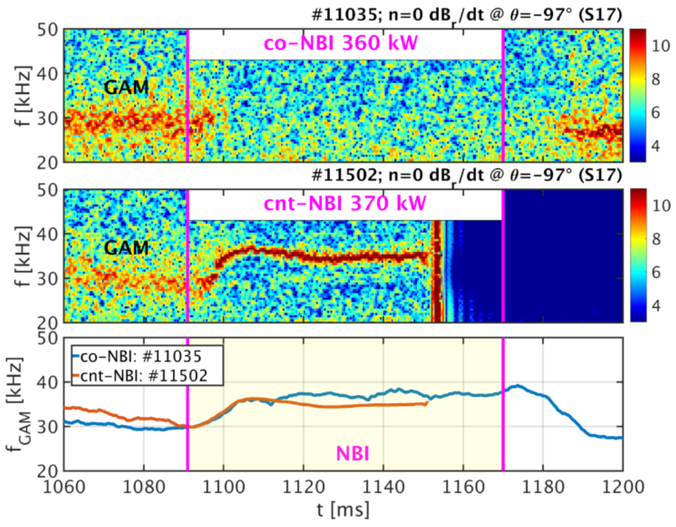


- HRTS measurements of Type-I ELM in both ohmic/NBI-assisted H-modes ($160 < I_P < 330$ kA).
- Profiles fitted modified hyperbolic tangent → ped. widths & heights.
- Dimensionless param.
- 23 selected pedestals reproduced by the EPED
  → predictions for 5 other tokamaks.

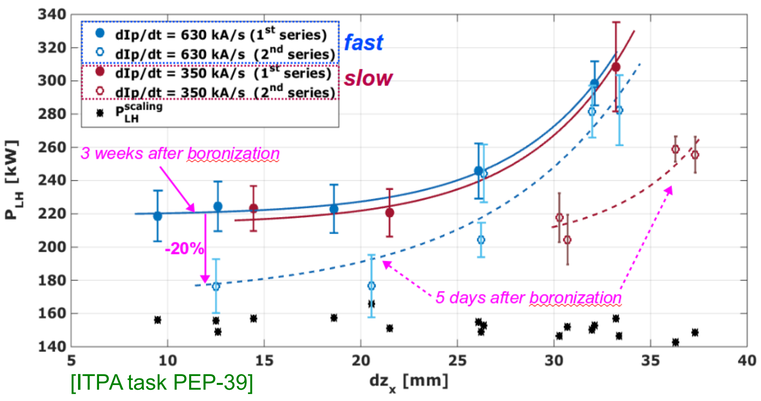
[see **EX / P6-35** on Thursday]

Geodesic Acoustic Mode in COMPASS

- GAM freq. 25-40 kHz in diverted ohmic & L-modes discharges.
- Non-local structure w/ constant freq. over several cm inside LCFS.
- Oscillations of U_p, V_{fl}, E_r & T_e of ~1eV.
- $\delta v_p / \langle v_p \rangle \sim 1$
- GAM freq. increases with NBI heating.
- GAM amplitude changes for different NBI injections (suppressed for co-NBI & increased for counter-NBI).
  → "related to a change of tor. plasma flow and parallel current" [Elfimov].



L-H transition vs. X-point height



[ITPA task PEP-39]

- 2 sets of experiments in ohmic:
  a) I_P ramp-up at fixed X-point heights
  b) X-point movement at fixed I_P
- P^{LH} decreases with decreasing X-point
- P^{LH} depends on wall conditions
- A 6kHz mode is observed prior transition (and disappear in H-mode) for high X-point shots
- m/n = 4/(-1) mode in ion diamagnetic drift direction under investigation.

2. Core Physics and High Freq. Oscillations

Alfven Eigenmode (AE) oscillations

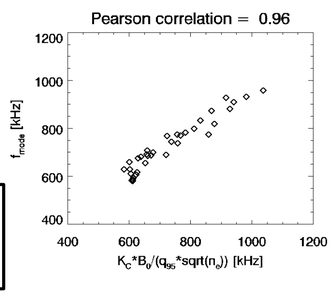
COMPASS features different types of high freq. oscillations following AE scaling:

$$f_A = \frac{1}{2\pi R q(r)} \frac{B_0}{\sqrt{\mu_0 \rho(r)}}$$

- Bursting, short-lived oscillations *(LFS, 800-2500 kHz)*
- Continuous, long-lived oscillations *(mainly HFS)*

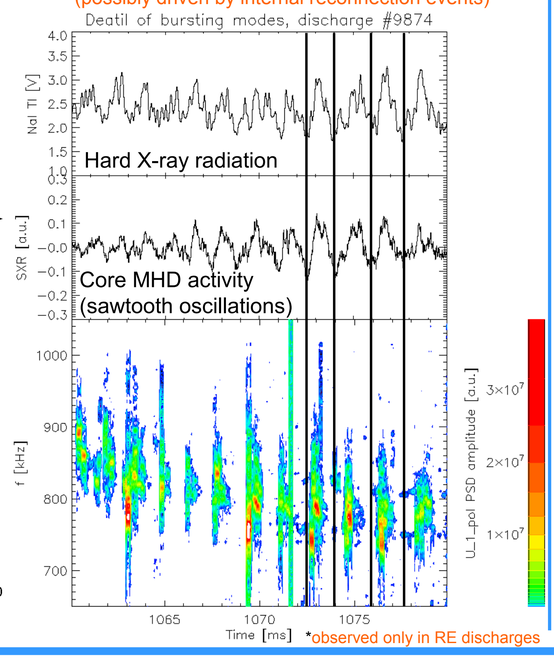
Similarities w/ TFTR & AUG ohmic AE oscillations:

- Amplitude parametric scaling
- Spatial localization
- Band structure
- Amplitude drop after H-L trans.
- Possible excitation mechanism as in AUG



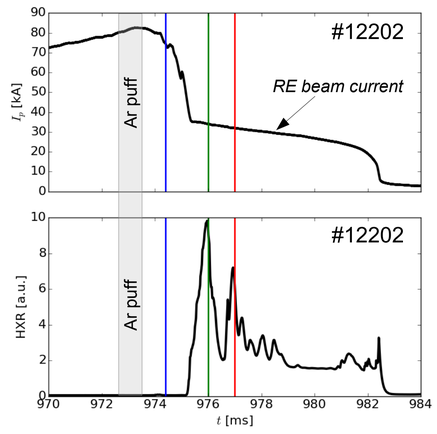
COMPASS is open for collaborations (modeling/theory)

Chirping Alfven oscillations at high frequencies*
(possibly driven by internal reconnection events)



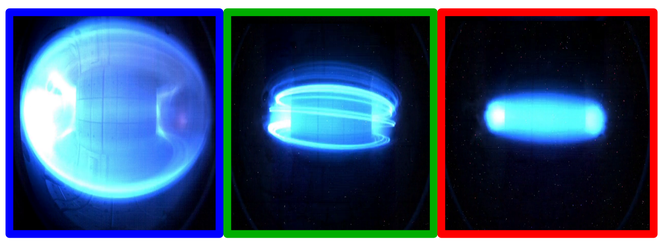
Runaway electron (RE) experiments

- Ar MGI disruption in I_P ramp-up is initiated
  → post-disruptive beams are generated.
- Studies in support of MST1 devices.
- Unique results using fast camera (8 kHz) and detailed magnetic diagnostics.
- Initial formation of filamentary structures observed.



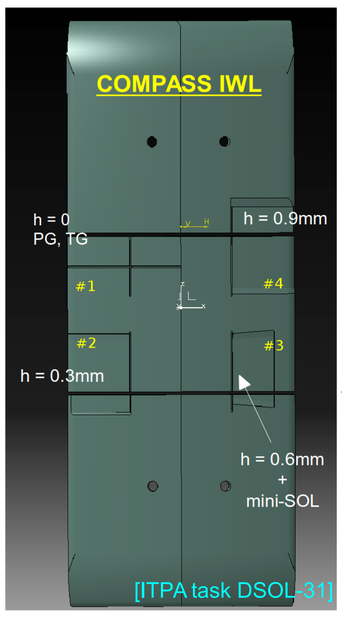
- Generation and losses of RE in quiescent discharges (no disruption, low density).
- Strong correlation between MHD and RE loss.
- Model benchmarking (METIS+LUKE).

[see **EX / P6-34** on Thursday]



3. Plasma Surface Interactions

Power deposition on leading edges in COMPASS

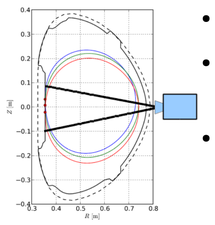


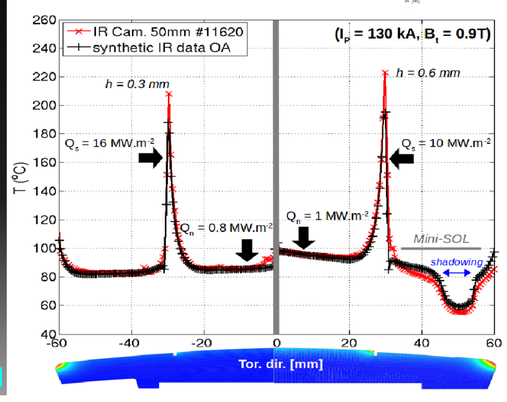
IWL:

- 1 apex, 2 facets
- slope: **2.5°**

Confined plasma
SOL

- 4 regions w/ LEs
- h = 0, 0.3, 0.6, 0.9 mm





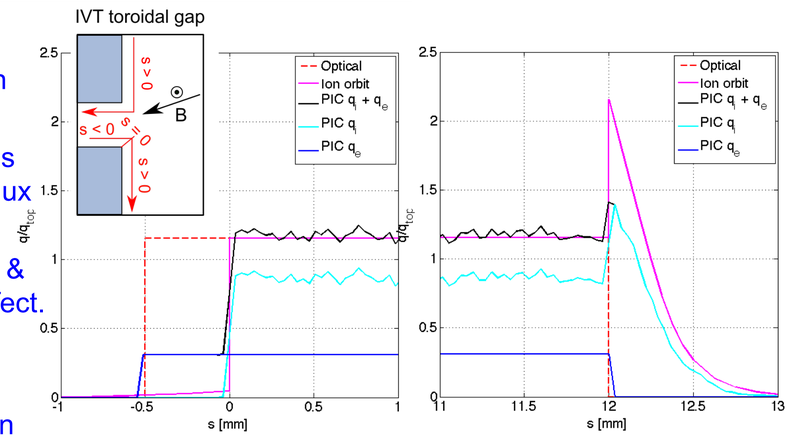
- High res. IRcam (0.3mm/px).
- Mini-SOL to reproduce 2013 JET lamella melting exp.
- 2D FEM thermal calc. using power fluxes from Optical Approximation (OA).
- Synthetic T^{surf} convoluted w/ IRcam transfer function allows direct comparison with $T^{surf,IR}$.

- OA = valid approach.
- Mini-SOL not responsible for any power mitigation (as in JET).
- PIC simulations → Power fluxes.
- Larmor smoothing not observed.
- Electron-dominated regime show better agreement.

Particle-in-cell simulations of power deposition on ITER divertor vertical target monoblocks

ITER contract no. ITER/CT/14/4300001069

- Ion orbit calculations do not account for E-field in the sheath but are fast.
- PIC simulations* done to assess role of the E-field on the heat flux distribution (very long).
- Small differences between IOC & PIC → E-field has negligible effect.
- Ion orbit calculations good approximation.
- However, role of electrons (in an electron dominated regime) has to be assessed.



Heat flux distribution along a TG during a 2500 eV ELM

ELM ions (up to 5 keV) HAVE LARGE LARMOR RADII
→ THEY CAN PENETRATE EASILY INTO GAPS

*[M. Komm et al., to be submitted to Nucl. Fus.]

ACKNOWLEDGEMENT:

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COMPASS posters: **J. Mlynar (REs → EX / P6-34)** *[Thursday]*
& **M. Komm (Ped. scaling → EX / P6-35)** *[Thursday]*

EUROfusion

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The views and opinions expressed herein do not necessarily reflect those of the European Commission.