

# Overview of the COMPASS results

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<https://conferences.iaea.org/event/214/contributions/17018/>

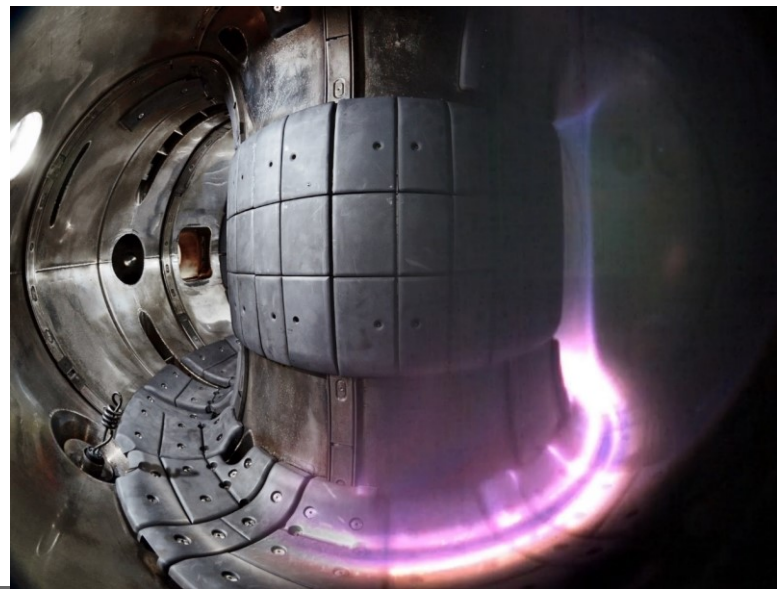
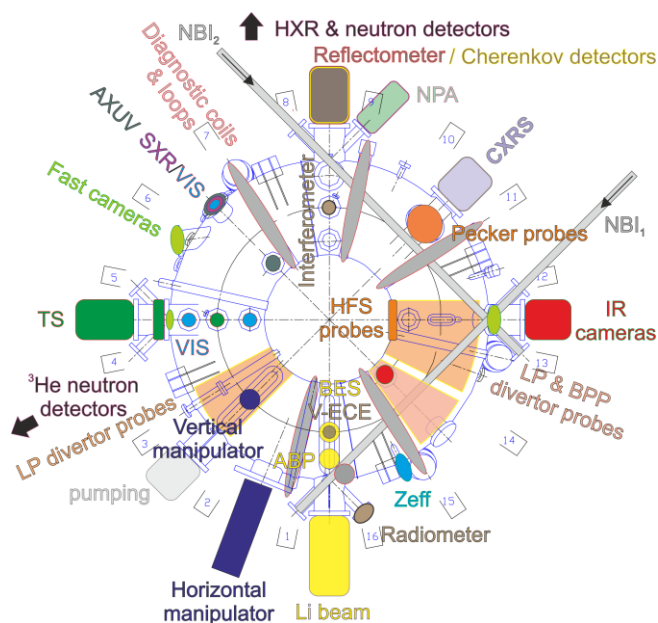
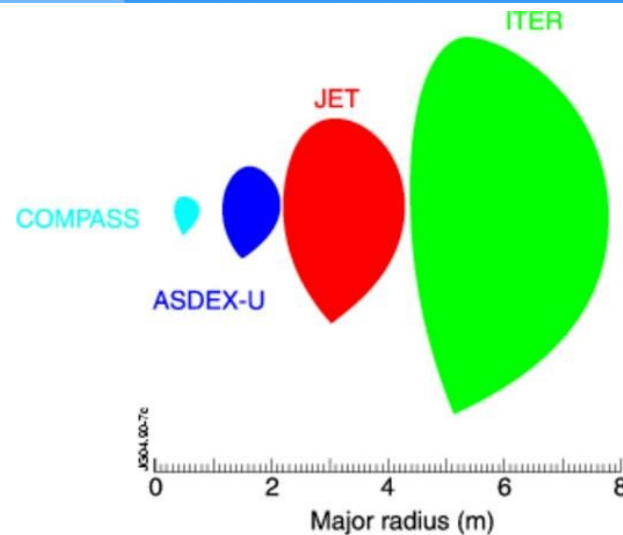


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European Structural and Investment Funds  
Operational Programme Research,  
Development and Education



## COMPASS tokamak (2009 – 2021):

- $R=0.56$  m,  $a=0.2$  m,  $B \leq 1.6$  T,  $I < 400$  kA
- ITER-like plasma geometry 1:10
- Ohmic & NBI-assisted H-mode
- **Neutral beam injection (NBI)** auxiliary heating:  
2 x 0.3 MW

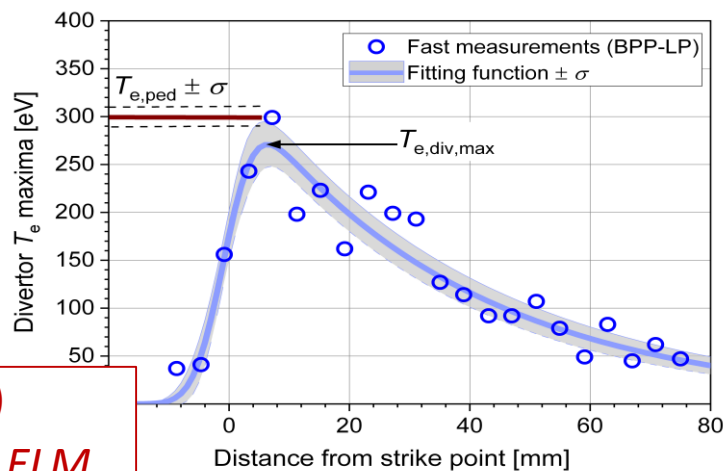


## Influence of the magnetic perturbation on L-H transition

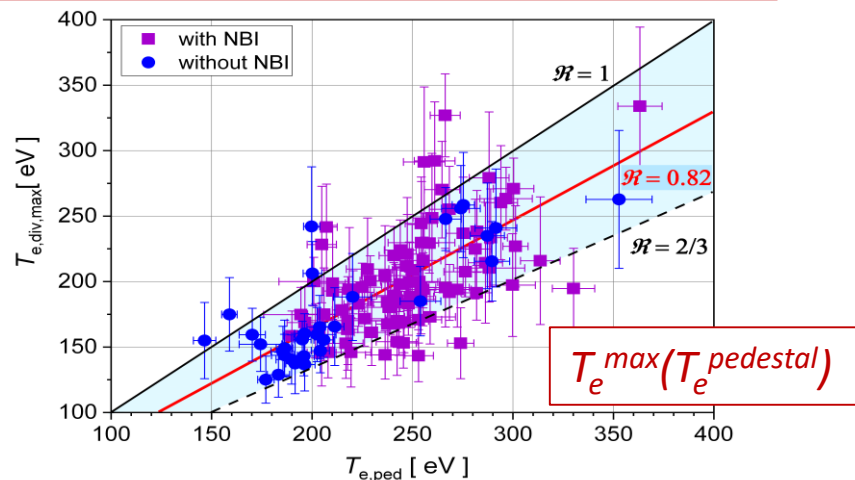
- ❑ Controlled HFS error field (EF) induced to
  - simulate a **central solenoid displacement (ITER)**
  - test EF **correction from the LFS and top/bottom**
- ❑ L-H transitions with **residual EF**:
  - **NBI-assisted** - disruption rate  $\sim 50\%$
  - **ohmic** - disruptions were **inevitable**
- ❑ critical parameter: **low plasma rotation during ohmic L-H transitions** in COMPASS
  - small external momentum ( $P_{\text{NBI}} < 100 \text{ kW}$ ) sufficient to prevent the disruption.

## High temporal resolution $T_e$ measurement on divertor during ELMs

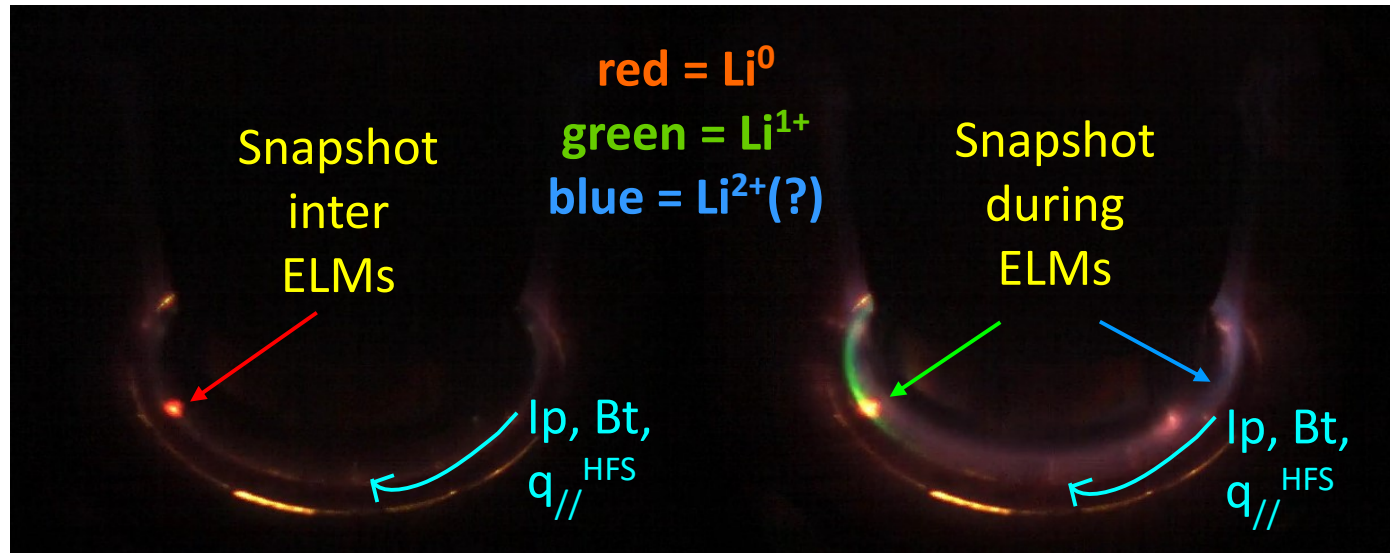
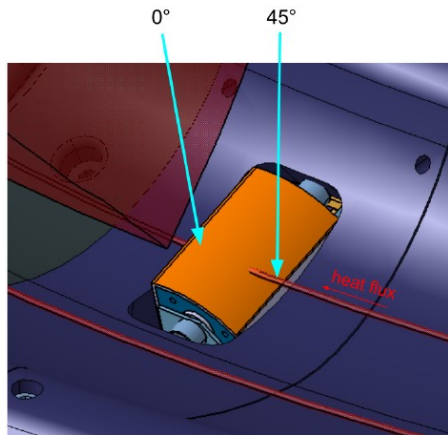
- ❑ Successfully resolved ELM filaments
- ❑ Representative maximum  $T_e$  at divertor obtained
  - ❖ close to the pedestal temperature
- ❑ Low energy transfer from electrons to ions observed
  - ❖ no enhancement of ELM ion energy →
  - ❖ → no physical sputtering of divertor material expected



$T_e^{max}(r)$   
during ELM



**First experiments ever using a LMD module (Li & LiSn alloy) in a divertor tokamak, in ELMy H-mode conditions**



No damage of CPS mesh & good power handling capabilities up to

$$q_{\text{dep}} = 12 \text{ MW/m}^2 \quad \& \quad \epsilon^{\text{ELM}} \sim 15 \text{ kJ/m}^2$$

- ❖ No droplet directly ejected from CPS surface
- ❖ No efficient vapor shielding
- ❖ No contamination of core/SOL plasmas by Sn

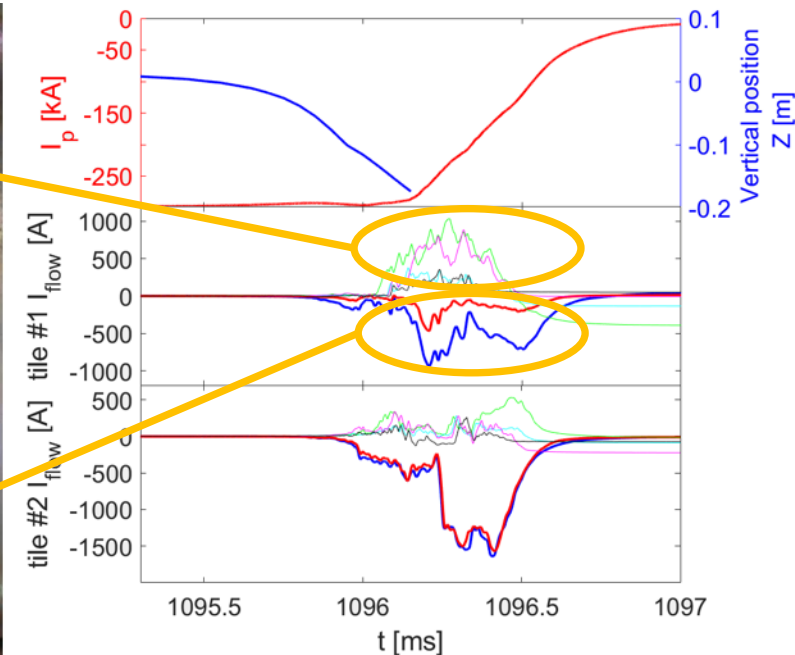
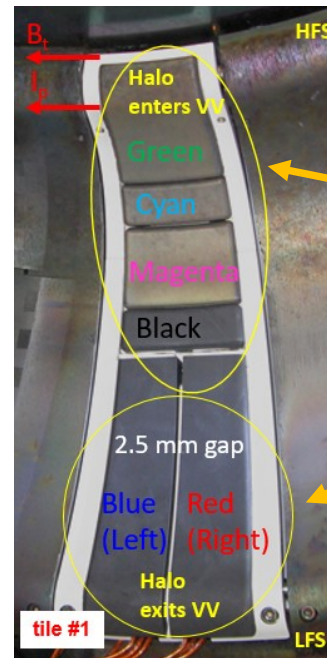
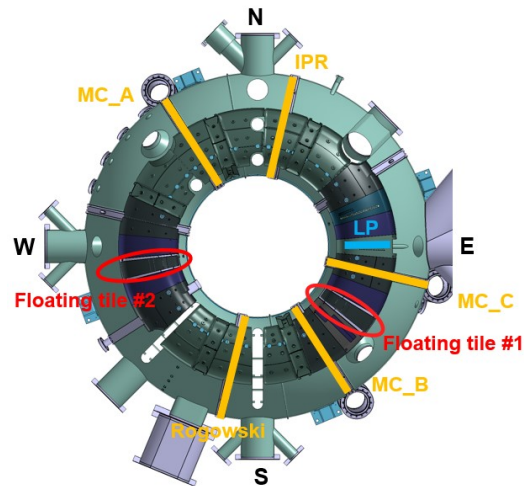


## Current flows towards the divertor during VDE

2 divertor tiles with gaps → eddy currents path

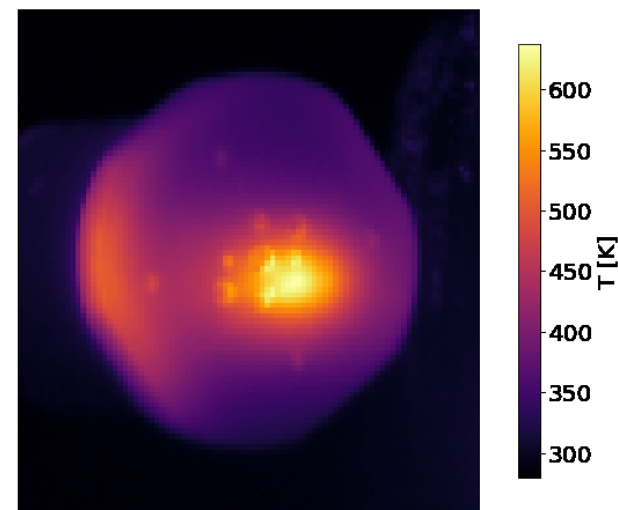
□ Halo current

□ Part of the eddy current  
(flows along the divertor and through the gaps according to ATEC model)



- ❑ RE generation, mitigation & suppression
- ❑ Mitigation strategies & control techniques
  - room temperature pellet injector;
  - active RE radial position control
- ❑ Average **RE energy** – calorimetry head:
  - ❖ hundreds of Joules up to 15 kJ
- ❑ Active **radial position control** of RE beam →
  - ❖ average impact energy lowered by 40%  
(compared to RE drifting toward LFS)
- ❑ New ways of the RE beam position control and mitigation were successfully tested
  - massive gas injection / impurity seeding /  
external magnetic perturbations /  
low-power electromagnetic waves

#20054, 1500 ms



*IR camera image  
of the RE beam  
impacting the  
calorimetry head*

- ❑ **COMPASS** – scientifically exploited at IPP in Prague in **2009 - 2021**
    - understanding of various phenomena in fusion plasmas
    - **contribution to the design of ITER**
    - **final shutdown in 2Q/2021**
  - ❑ Knowledge gained at COMPASS → **construction of COMPASS-U:**
    - $B_T \leq 5 \text{ T}$ ,  $I_p \leq 2 \text{ MA}$ ,  $R = 0.89 \text{ m}$ ,  $t_{\text{pulse}} \leq 5 \text{ s}$
    - **metallic first wall, high-temperature operation**
    - presently in final design phase
- 
- ❑ See the poster and preprint on *Overview of the COMPASS results* at <https://conferences.iaea.org/event/214/contributions/17018/>
  - ❑ More posters about COMPASS and COMPASS-U at this conference:
    - P3-1073 **M. Komm** (power exhaust at COMPASS)
    - P3-1072 **V. Yanovski** (disruption forces modelling for COMPASS-U)
    - P2-1169 **G. Zadvitskiy** (COMPASS-U NBI modelling)