# Max-Planck-Institut für Plasmaphysik

# First neutral beam experiments on Wendelstein 7-X

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### Introduction

In the previous divertor campaign on Wendelstein 7-X (W7-X) the first experiments with neutral beam injection (NBI) were performed.

- 2 of 4 spruces in NI21 beam box
- Hydrogen injection at 55 keV
- 5s of injection achieved



#### **NBI only discharges** A1 C1 D1 D5 E5 ECCD + off-axis Discharges heated only by NBI exhibit different characteristics Continuous density rise • Strong core density peaking [10] 10] 10] Density Evolution (20181009.043) r/a=0.05 -r/a=0.15 r/a=0.25









Three dimensional depiction of the W7-X NBI, plasma and some first wall structures.

### **NBI** Injection into ECRH plasmas

Experiments began with injection of NBI into ECRH plasmas

- Predictions of wall loads necessitated a stepped approach
- ECRH plasmas allowed for careful control of plasma parameters
- NBI injection shows evidence of density increase at all radii
- Temperature profiles unchanged.
- High iota configuration allows for quantitative wall load comparison
- No damage to steel panels seen.









#### ECRH for density control

Reintroduction of ECRH clamps density rise

- 1-MW O2 ECRH added at 3s
- Core peaking suppressed
- Density rise arrested

r/a=0.35

01 × 10

Density

200

-200

-400

-600

-800

-1000

-1200

r/a=0.05 r/a=0.15  $\leq$ 

• Ion temperature > 1.5 keV momentarily



Density evolution showing reintroduction of ECRH killing the density rise and reducing density peaking in the core.

#### W7-X 20181009.034 | UTC: 13:10:00 | T0: 1539090600233392501 A1 C1 D1 D5 E1 E5 ECCD + off-axis [MW] – P<sub>ECRH</sub>setp $\cap$ ---- sniffer n<sub>e(TSvol2v10)</sub> [m<sup>-</sup> gas (Ar H2) n setpoint • T<sub>e (TS vol2 v10)</sub> [keV — Τ<sub>e (ECE13)</sub> T<sub>e (ECE24)</sub> i0 (XICS v06) Σ H/(H+He) line int. ratio 10<sup>2</sup> — inboard outboard — core rad. KJM+258 w7x ref 340 trim: -81 33 100 32 -81 5.0 0.0 1.0 2.0 3.0 6.0 4.0 t-t<sub>1</sub> [s] 05:38:45 2020 - version 1.3 - contact: astechow@ipp.mpg.de Overview plot of a discharge where 1MW of ECRH is added to an

NBI only discharge to bring back density control.

# Future upgrades

NBI Heating Upgrade (Std. Conf ~6x10<sup>19</sup> m<sup>-3</sup>)



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