Electron Bernstein Waves Experiments

10.07.2019

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Aim of the Day

Demonstrate for the first time the possibility of EBWs reception @140 GHz from the over-dense region of a tokamak plasma core, using the ECRH front steering launcher

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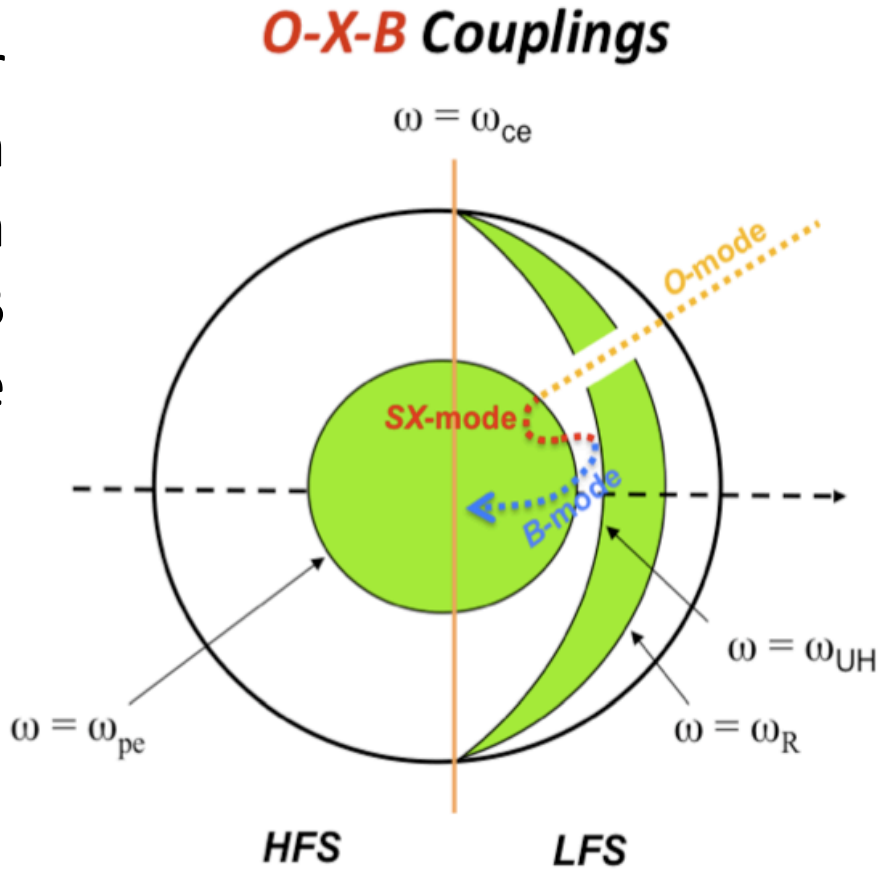
PLASMA TARGET and OPERATIONS

- **5.3 T - 500 kA** (700 kA or ramp 700 kA → 500 kA if necessary)
- Density ramp-up as in shot **#41953**, up to obtain a high density flat top around $n_e \approx 2.2E^{20}$ m^{-3} (very close to the density limit for 5.3 T), sustained for all the discharge without disruption
- Long discharges (2.5 s long)
- Repeat always identical, all changes will be perfrmed with the launcher and on radiometers side

Coupling Scheme for EBWs Detection

In a plasma with the resonant layer in an overdense region for a given frequency, the ECE is emitted from the plasma core through the O-X-B double mode conversion scheme but in the **reverse path (B-X-O)**.



Sketch of the O-X-B double mode conversion scheme

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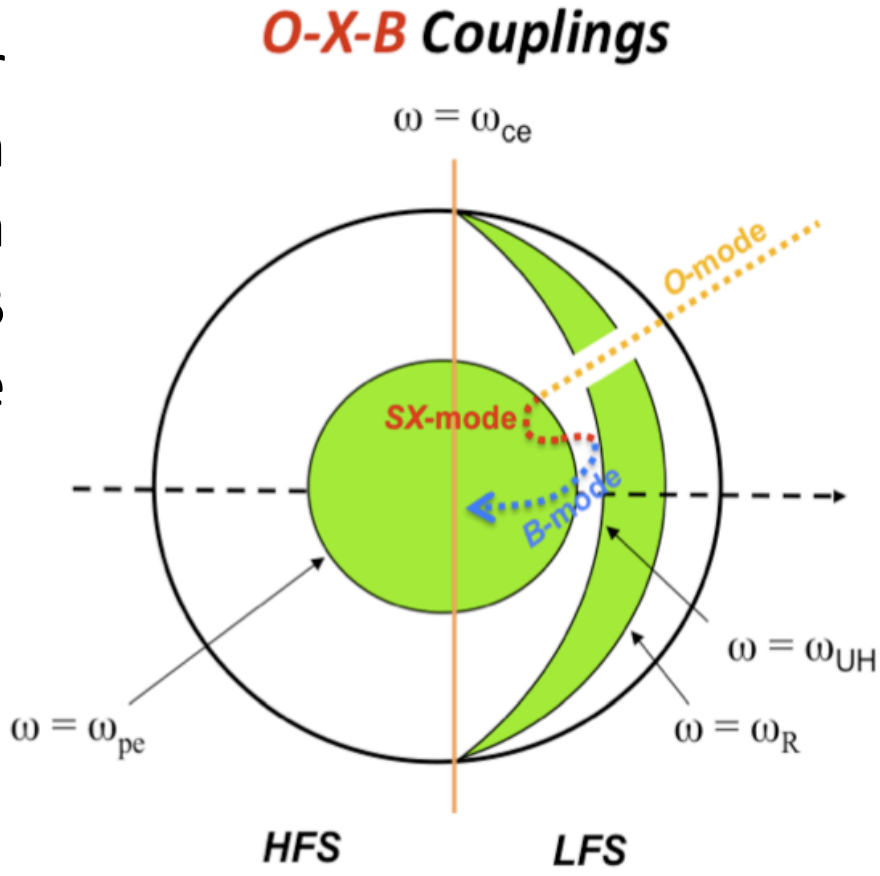
Proper poloidal and high toroidal angles needed for coupling the scheme

Very challenging in terms of steering operations

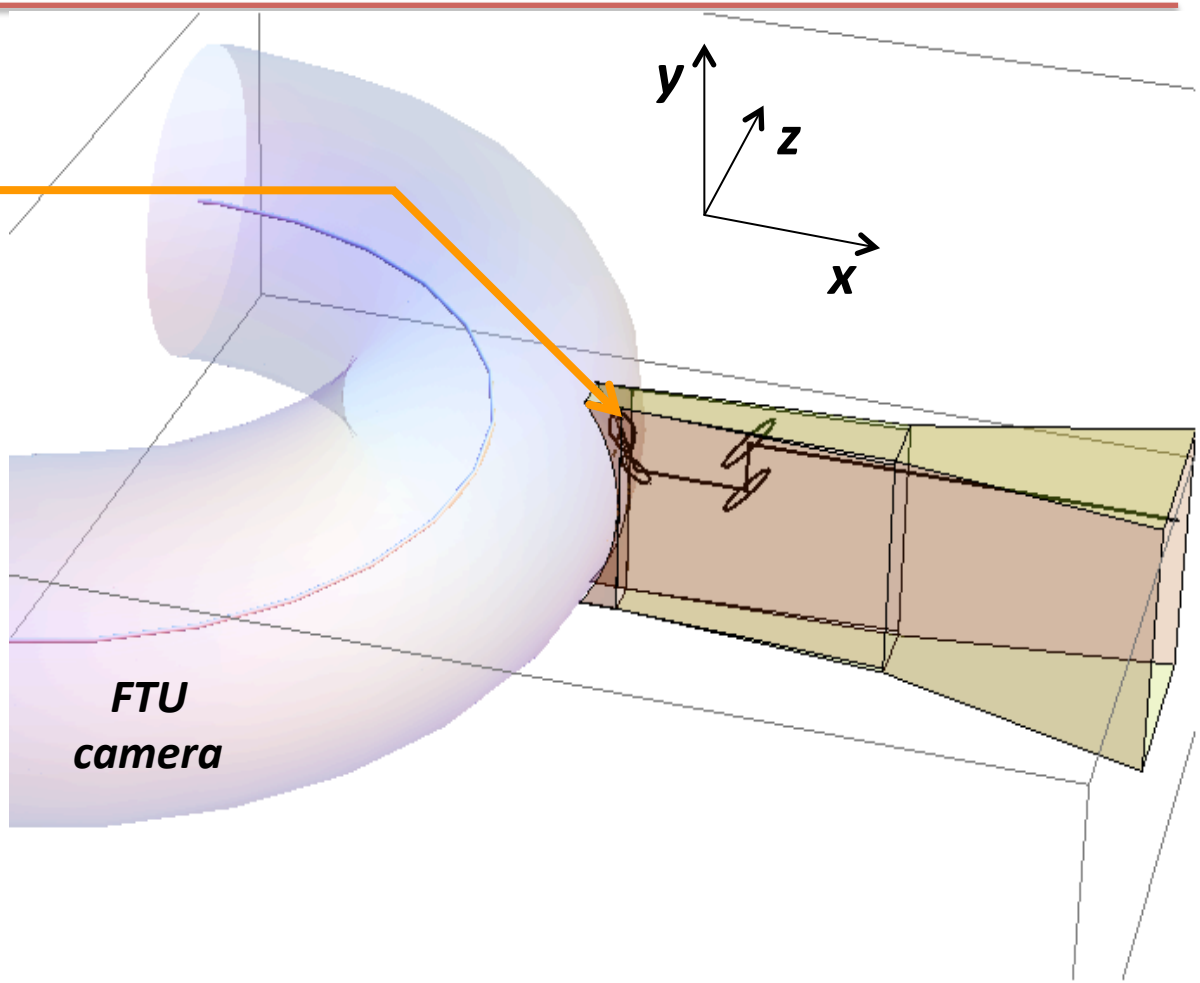


Sketch of the O-X-B double mode conversion scheme

Set-up for EBWs Detection

Reception point, **line #1** of the launcher:

- ***R = 1256.5 mm***
  (r = 321.5 mm)
- ***y = ± 145 mm***



Detection will be attempted by reaching the steering angles for the proper line of sights → protections on mirror position disabled

Expected Angular Line of Sight

Reaching the steering angles required for coupling O-mode originating by the B-X-O scheme @140 GHz is not trivial at all. Angles are on the limits of the launcher, beyond the protection limits.

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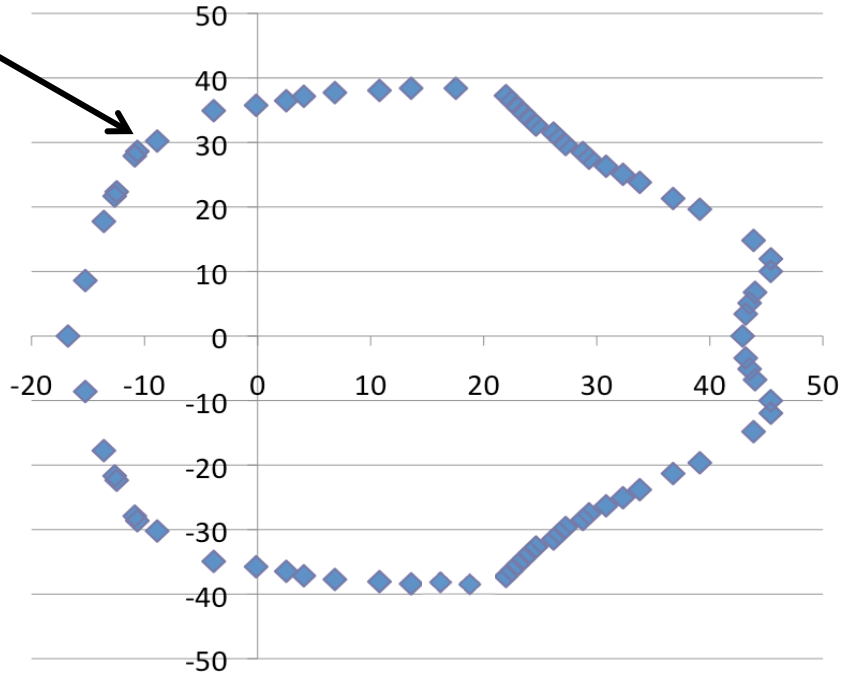

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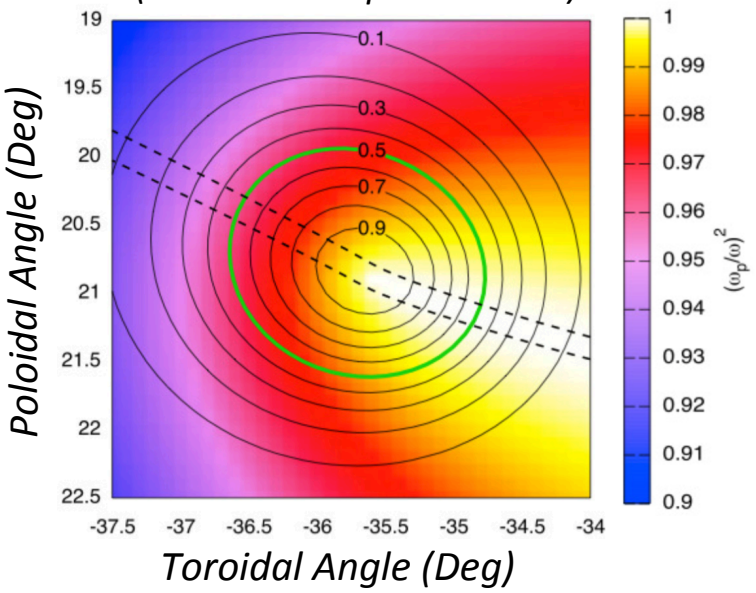
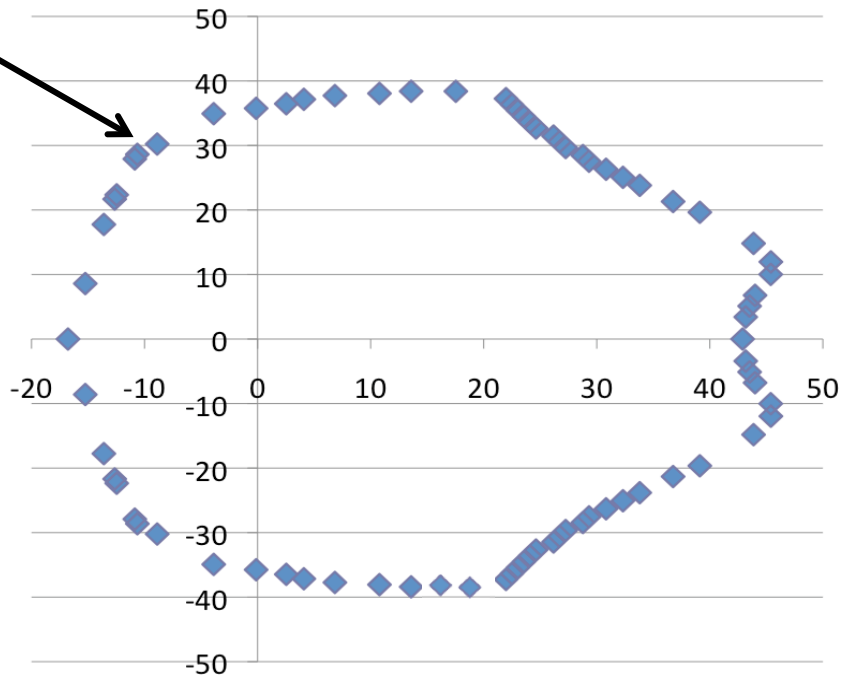
Conversion Efficiency
(simulated on plane waves)





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Toroidal ⇒ ~34.5°/37°
Poloidal ⇒ ~19.5°/22°

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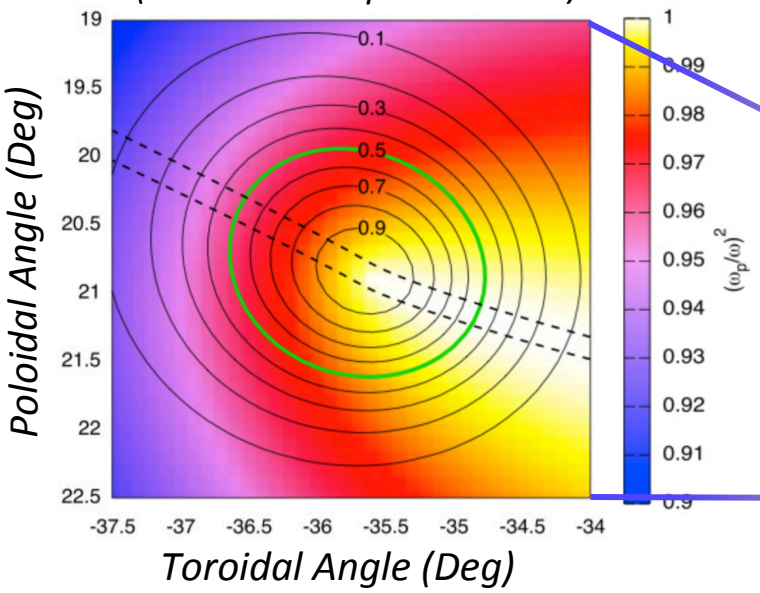
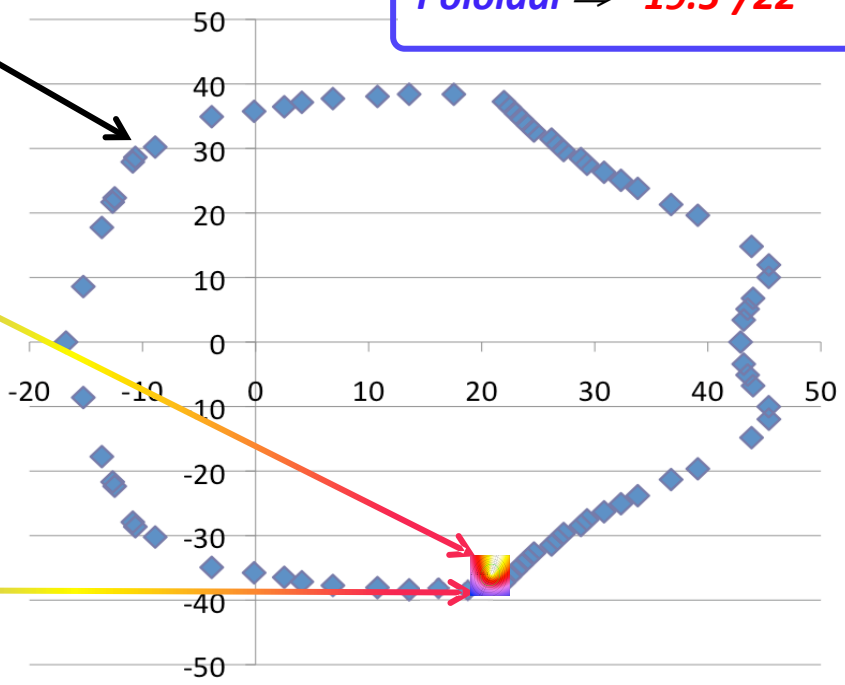
(simulated on plane waves)





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Requirements

Reference pulse:
#41953, but with long pulses >2 s

Machine requirements:
B_{min} - B_{max} (T) : 5.3 T → take #41953 and lengthen that to 2.5 s

I_{min} - I_{max} (kA) : 500 (possible 700 kA or current ramp 700 kA → 500 kA)
n_{min} - n_{max} (10^{20} particles m^{-3}) : ramp-up as in #41953 (up to ~2.4)

ECRH launcher: no power, only line #1 of the front steering launcher

Diagnostic requirements:
Electron Density (**with inversions of profiles**), Electron Temperature profiles, D_α

Modelling:
GRAY, SPECE