(IA) Session Report

May 28, 2024 (M.Goto)

Date: May 24, 2024
Time: 10:25 – 14:45
Shot#: 191878– 191965 (88 shots)
Prior wall conditioning: No
Divertor pump: Off
Gas puff: $H_{2,}$ Ar
Pellet: No

NBI#(1, 2, 3, 4, 5) = gas(H, H, H, H, He)=P(4.0, 2.1, 2.0, 3.5, max 3.8) MW
ECH(77GHz) = ant(1.5-Uo, 5.5-U, 2-OUR)=P(-, 0.698, 0.38) MW
ECH(154GHz) = ant(2-OLL, 2-OUL, 2-OLR)=P(0.70, 0.806, 0.980) MW
ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(-, -, -, -) MW

Topics

1. Sub-Alfvenic harmonic ICEs modulated by He beam injection (G. Yun(POSTECH), H. Igami)
2. Excitation of ultra higher harmonic ICEs with MHD instabilities during He beam injection (H. Igami)
3. Comparison of turbulent transport between LHD and W7-X (H. Sakai (Kyushu U.), K. Tanaka)

-Sub-Alfvenic harmonic ICEs modulated by He beam injection
-Excitation of ultra higher harmonic ICEs with MHD instabilities during He beam injection

G. Yun, S. Hong, H. Igami

Shot #: 191879-191965 Magnetic configuration: (R_{ax}, Polarity, B_t, γ, B_q) = (3.60, CW, 2.75, 1.2538, 100),

Background and motivation:

Energetic ions can transfer energy to waves, which is an important dissipation mechanism in plasma and can be utilized for diagnostics of fusion-born alpha particles and beam ions.

We investigate the bursts of sub-Alfvenic harmonic ICEs and very high order harmonic ICEs driven by He beam ions, as a proxy to fusion-born alpha particles. We aim to find the conditions of ICE burst events by changing the position of the superposition resonance.

Control parameters:

- background density
- beam energy of BL5 (45, 53, 60 and 65 keV)
- number of ion sources of BL5

* Plasma sustained by tangential NBs and 5 ECH

Pattern	A	B	C	D	E	F	G	H
# of Ion Sources	2	2	2	2	1	1	3	4
BL5(He) Beam Energy (keV)	65	60	53	45	45	60	45	45

Sub-Alfvenic harmonic ICEs modulated by He beam injection
Excitation of ultra higher harmonic ICEs with MHD instabilities during He beam injection

G. Yun, S. Hong, H. Igami

Results

- At the same beam energy, larger RF burst occurred at lower density even with lower number of the ion sources
- At the same energy and same density, the peak intensities and RF bursts are larger with larger number of ion sources

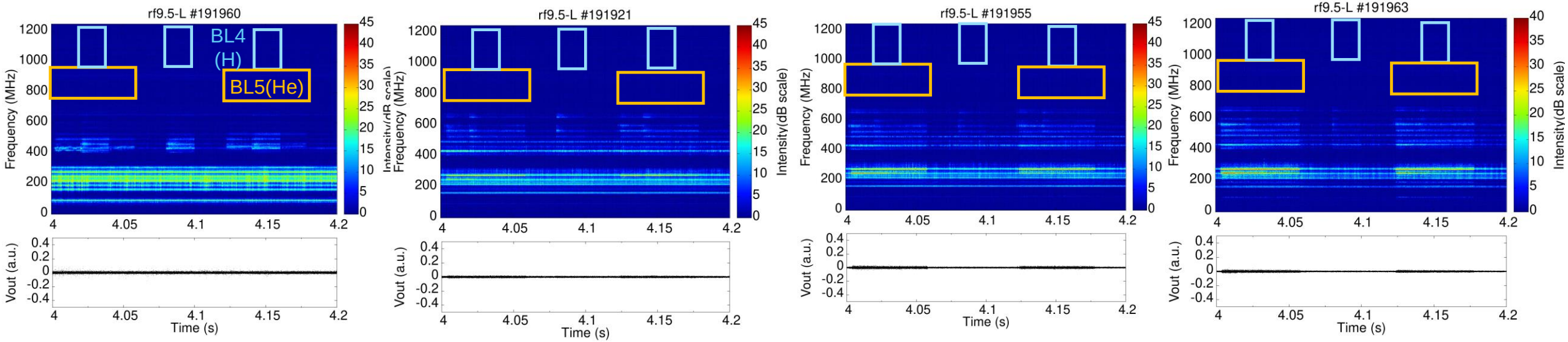
45keV BL5 He beam As the density decreases, the ratio of V_beam/V_A decreases.

E 45keV, 1sources.
n_e :1.5e19 v_b/v_A : 0.45

D 45keV, 2sources.
n_e :2.5e19, v_b/v_A : 0.58

G 45keV, 3 sources
n_e :2.5e19 v_b/v_A : 0.58

H 45keV 4 sources
n_e :3e19 v_b/v_A : 0.64



Sub-Alfvenic harmonic ICEs modulated by He beam injection
Excitation of ultra higher harmonic ICEs with MHD instabilities during He beam injection

G. Yun, S. Hong, H. Igami

Results

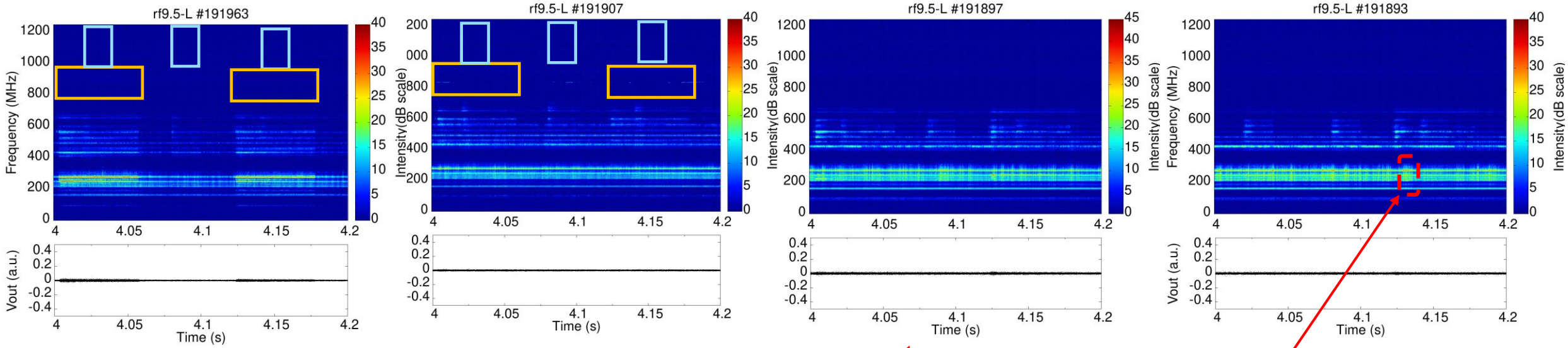
- RF bursts were prominent for $v_{\mathrm{beam}}/v_A < 0.65$ with beam energies 45, 53, 60, and 65 keV
- With the same injection power, RF bursts were more prominent at larger beam energy
- Chirping-up were observed for high beam energy and low density cases (e.g. 65keV, 2e19m^-3).

H 45keV 4 sources
n_e :3e19 v_b/v_A : 0.64

C 53keV, 2sources.
n_e:2.5e19, v_b/v_A : 0.63

B 60keV, 2sources.
n_e:2e19, v_b/v_A : 0.60

A 65 keV, 2sources.
n_e:2e19, v_b/v_A : 0.62



Same injection power

Chirping-up

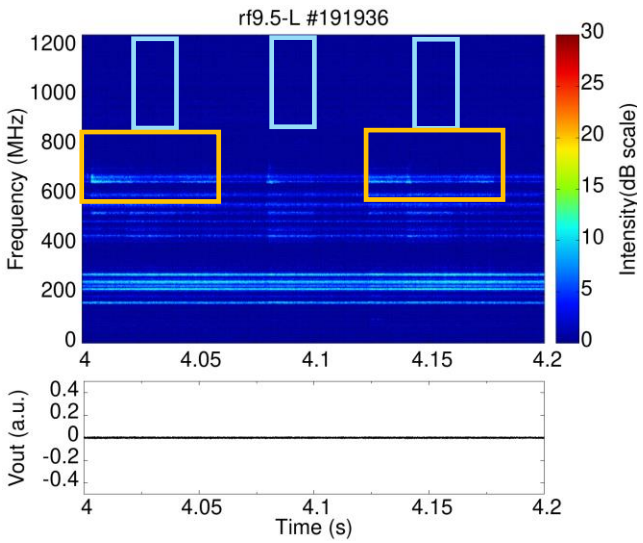
Sub-Alfvenic harmonic ICEs modulated by He beam injection
Excitation of ultra higher harmonic ICEs with MHD instabilities during He beam injection

G. Yun, S. Hong, H. Igami

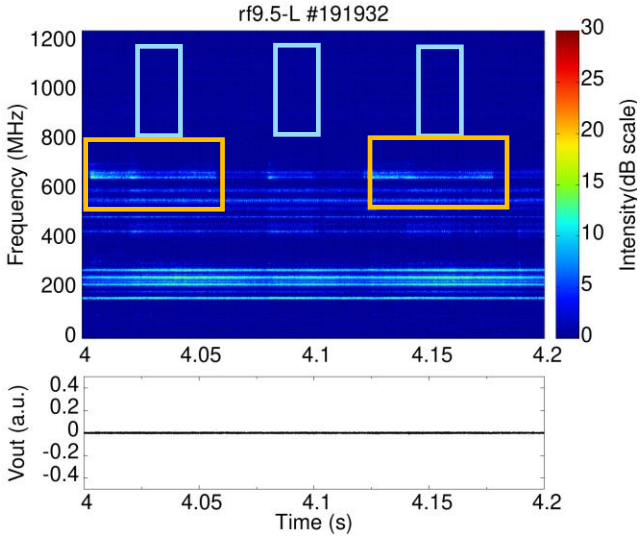
Results

- RF bursts were not observed $v_{\mathrm{beam}}/v_A > 0.8$

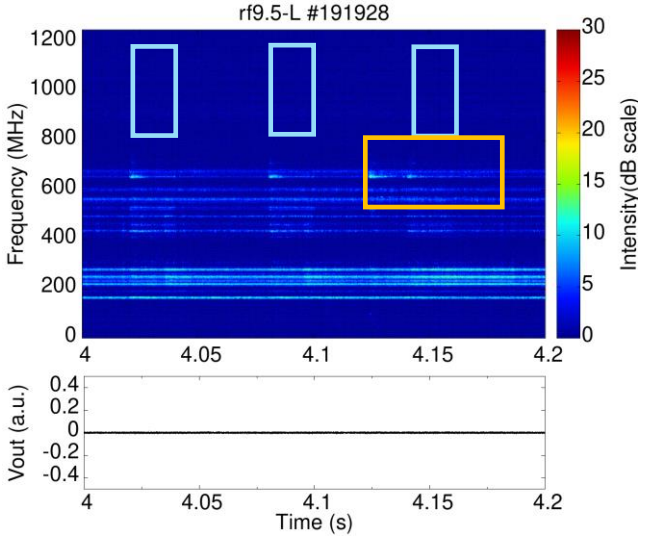
C 53keV, 2sources.
n_e:4e19, v_b/v_A : 0.80



B 60keV, 2sources.
n_e:4e19, v_b/v_A : 0.84



A 65 keV, 2sources.
n_e:4e19, v_b/v_A :0.88



Conclusion

- Prominent RF bursts were observed for $v_{\mathrm{beam}}/v_A < 0.65$ for each scanned beam energy
- RF intensities are stronger with higher beam energy and lower density.
- We plan to analyze spectra of RF signals in detail to identify the condition of ICE bursts.

Comparison of turbulence driven transport between LHD and W7-X (He/H-case as piggy-back)

H. Sakai (Kyushu Univ.), K. Tanaka

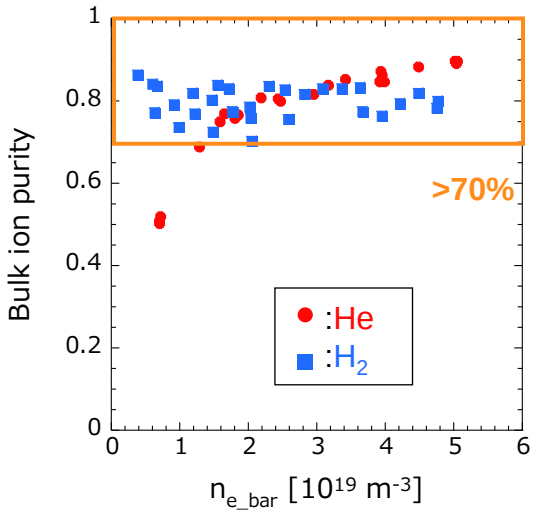
Shot No: #191770~191813 (piggy-back, 5/23), #191880~191959 (piggy-back, 5/24)
Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW(5/23)/CW(5/24), 2.75 T, 1.2538, 100 %)
Gas-puff: He(5/23), H_2(5/24)

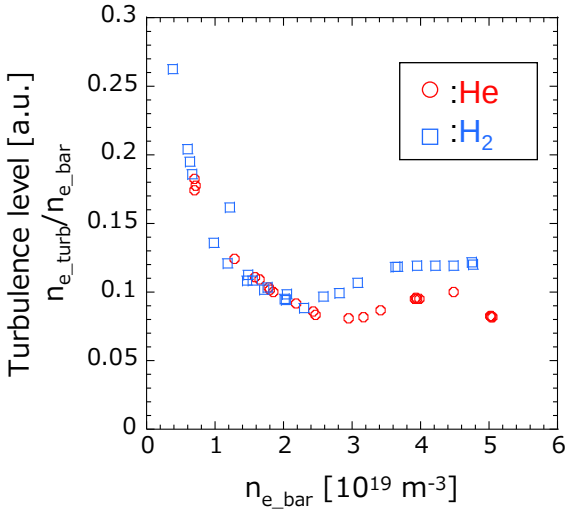
Approach

At 4/19, our experiment was not conducted well due to ECH trouble. Therefore, the experiment was re-conducted as piggy-back at 5/23 and 24, in Masuzaki-san(for He-rich) and Igami-san(for H-rich)'s machine time respectively. Flat-top electron density was scanned shot-by shot between 0.5x to 5.0x.

Result

- ✓ High bulk ion purity could be realized in the density range between 1.2x-5.0x in He and 0.6x-4.8x in H. The fine density scan was successful and turbulence transition was observed in both cases (It should be noted that the ECH power was different).
- ✓ Comparative data on ne and Te profiles by TS could be obtained between two devices in similar line-averaged electron density and heating power.
- ✓ Detail analyses, e.g. turbulence analysis on PCI and heat transport analysis will be performed.





ECH power: 2MW, ne_bar: 1.5x in W7-X, 1.59x in LHD