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PRELIMINARY INVESTIGATION OF W45+, W46+ SPECTRA BY USING SH-ELECTRONBEAMIONTRAP FOR COMPARISON OF SPECTRA FROM TOKAMAK

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OUTLINES

I. Background

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III. Experimental Investigations

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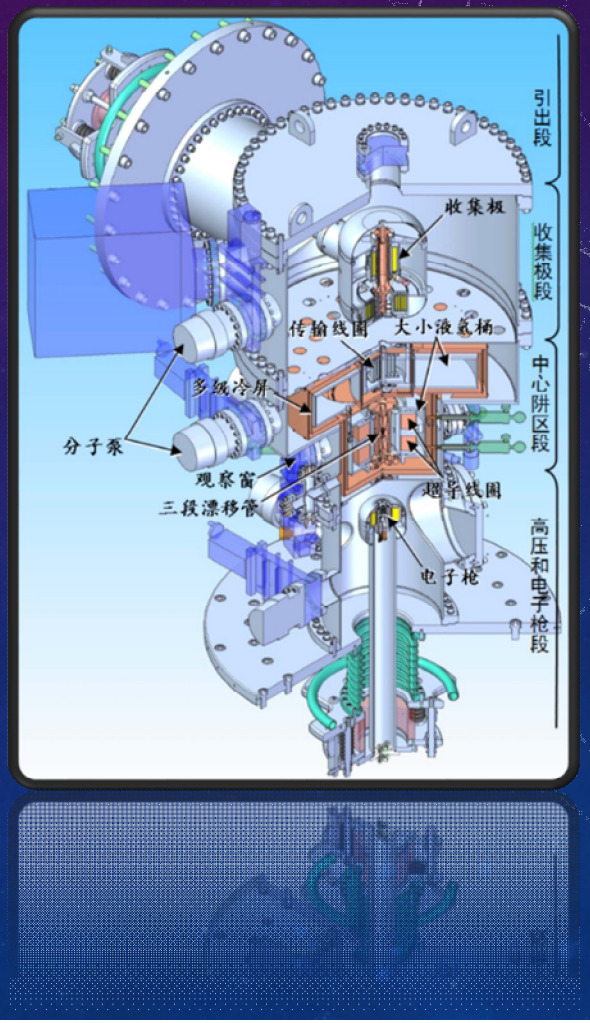


I. BACKGROUND

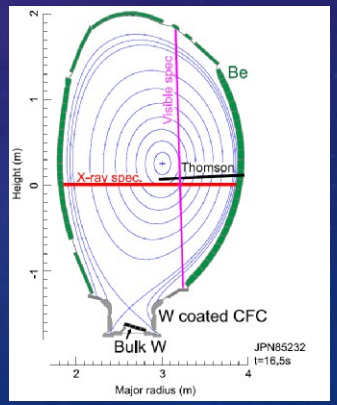
BACKGROUND

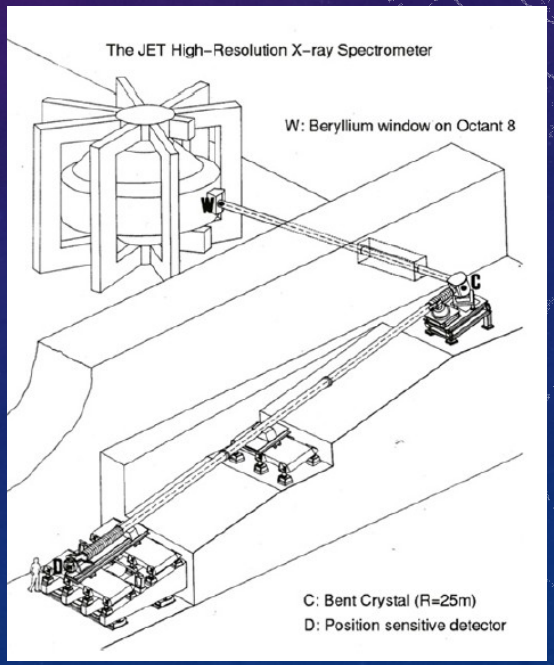
- Tungsten will be a strong candidate of the material for ITER divertor. ALL Spectroscopies related to tungsten were then become highlight fields.

- In many Tokamaks (like JET), in order to provide the physics and engineering basis for the exploitation of ITER, tungsten divertors are installed.

BACKGROUND

In order to diagnose the W concentration in the plasma, a high resolution X-Ray crystal spectrometer at JET has been upgraded with the wavelength window from around 5.2Å

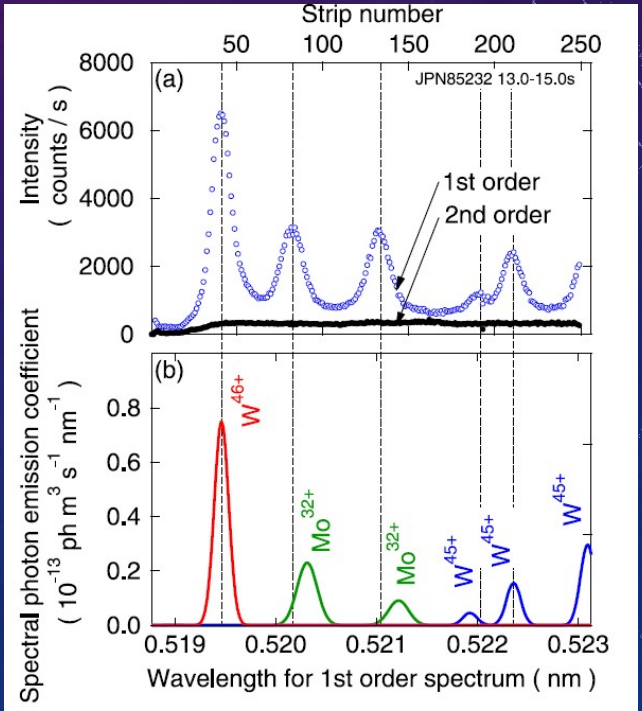




BACKGROUND

Comparison of the spectrum measured by the upgraded X-ray spectrometer with that calculated by flexible atomic code for W45+,W46+ and Mo32+ at different electron temperatures and densities.

The figure shows the spectral at a temperature of 4 keV and a density around 10^{19} m^3.



BACKGROUND

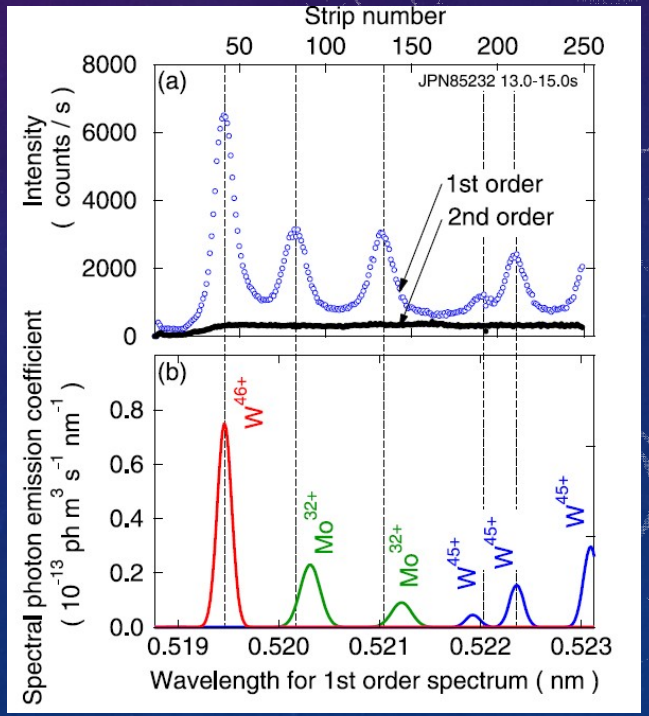
- There are two basic tasks that will be done through analyzing these spectral.
  - Line identification
  - Intensity analysis for W and Mo concentrations

BACKGROUND

- Some considering about these two tasks.
  - 1. The Doppler shift (and broadening).

    A relative Doppler shift between W and Mo can be inferred.

    If there is no Doppler shift, the wavelength identification and then line identification will be more deterministic!
  - 2. A lot of calculation will be carried on for Data which will be used for the concentrations analysis.



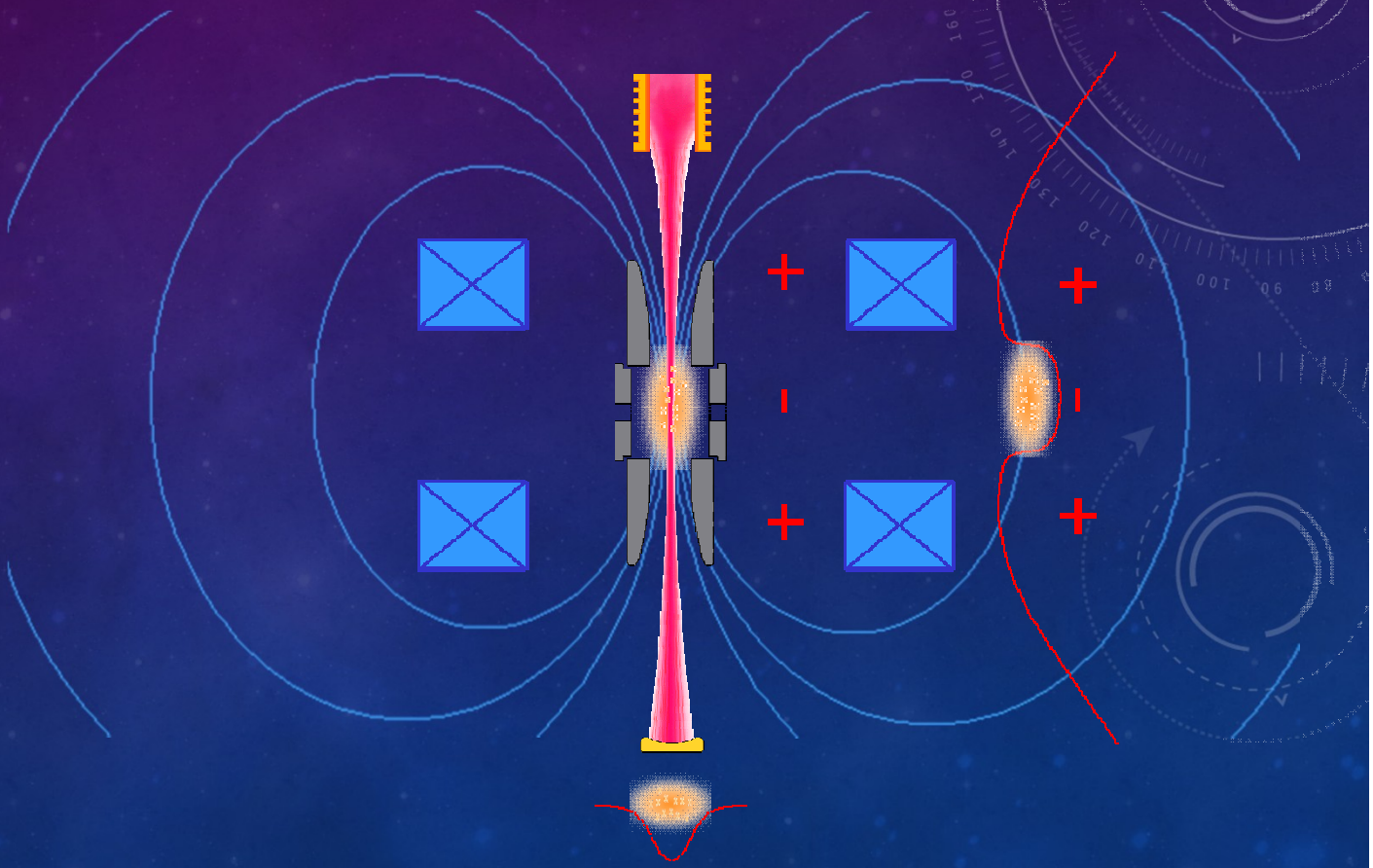
BACKGROUND

- 2. A lot of calculation will be required for the Data which will be used for the concentrations analysis. .
  - As the environment of plasma in Tokamak is usually very complex and full of variations, The Data from calculations and simulation will not be easy to verify.

If there is a more stable and controllable plasma with its parameters separately adjustable, the data verification and the model test will be more reliable!

EBIT BRIEF INTRODUCTION

- Electron Beam Ion Trap (EBIT) probably is one of such apparatus which was designed to process disentangling studies of Plasmas.
  - Almost no Doppler shift
  - Ne, Ee(Te), P(E,T), B, Element
  - Static and dynamic



II. MOTIVATION

MOTIVATION (A EBIT PLASMA)

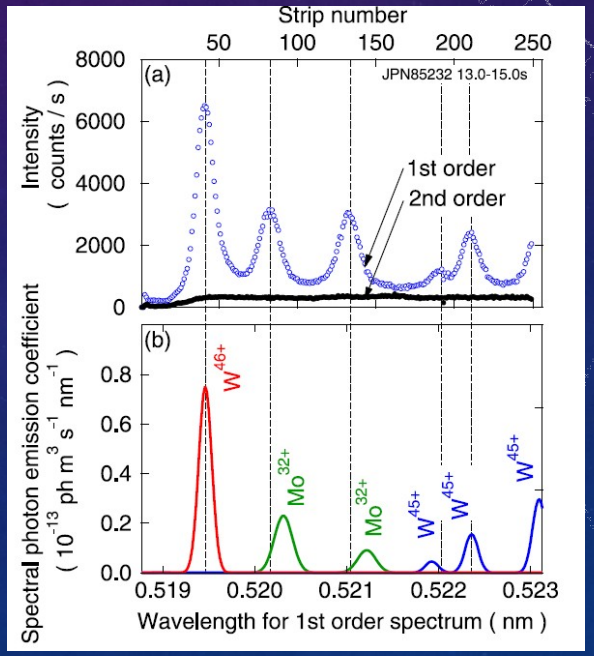
1. A flat crystal spectrometer was made and equipped on the SH-EBIT, with a resolving power($\lambda/\Delta\lambda$) around 5000 at 5Å.
2. SH-EBIT could cover a electron beam energy region from 1keV-150KeV, quasi-monoenergetic and freely adjustable. (Maxwellian attempt)
3. The electron beam density could reach 10^{12} cm^3 around 4keV.
4. The magnetic field at the plasma could be adjusted freely from 1.5-4 T.
5. W and Mo can be injected in the plasma separately or simultaneously and under control.

MOTIVATION

- Measure precise wavelengths of those transitions of W and Mo at that wavelength region. It may be useful to identify the Doppler shift in the spectral from JET.
- Check the FAC calculations, by comparing spectral acquired at different electron energies. Especially on the line ratios from the same charge state ions.

MOTIVATION

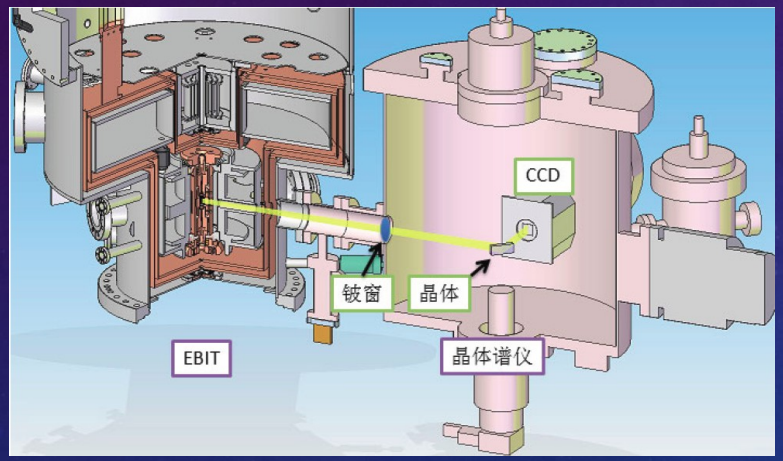
- Measure the E1 and M2 transition of Mo32+ (lines may need a check). To check the discrepancy between calculation and experiment.
- Inject both W and Mo, and vary their abundances, and compare results with Tokamak's.

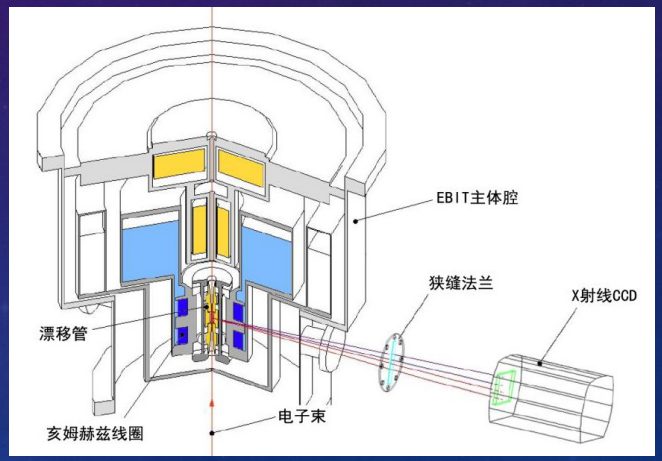


III. EXPERIMENTAL INVESTIGATIONS

EXPERIMENTAL INVESTIGATIONS

- Demonstration of connection between EBIT and flat crystal spectrometer





- Slit imaging system

EXPERIMENTAL INVESTIGATIONS

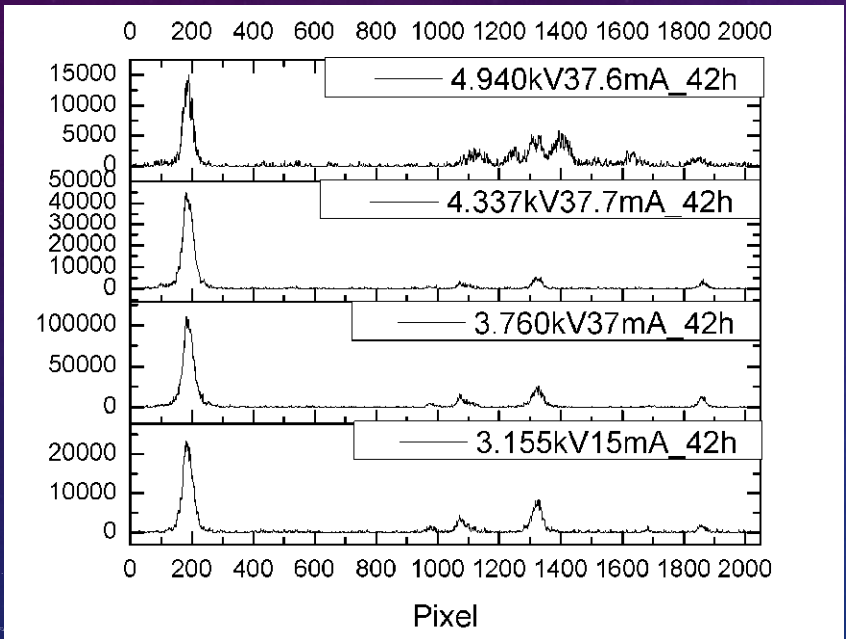
- The preliminary experiments' parameters :

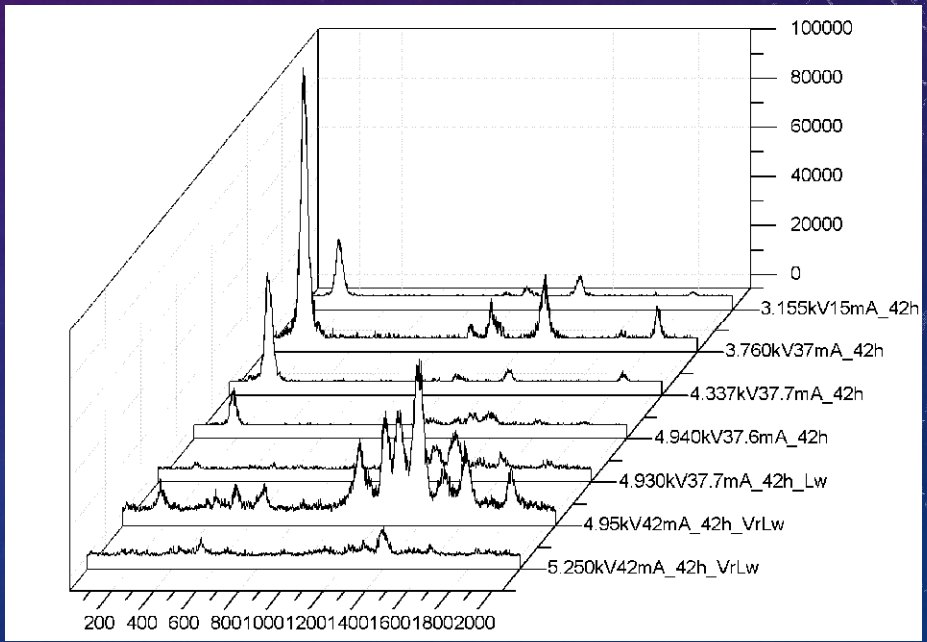
Ee	Ie
3.155kV	15mA
3.76kV	37mA
4.337kV	37.7mA
4.94kV	37.6mA
4.93kV	37.7mA
4.95kV	42mA
5.25kV	42mA

- Magnetic field: 3T
- Only W(CO)6 injected

IV. SOME RESULTS AND DISCUSSIONS

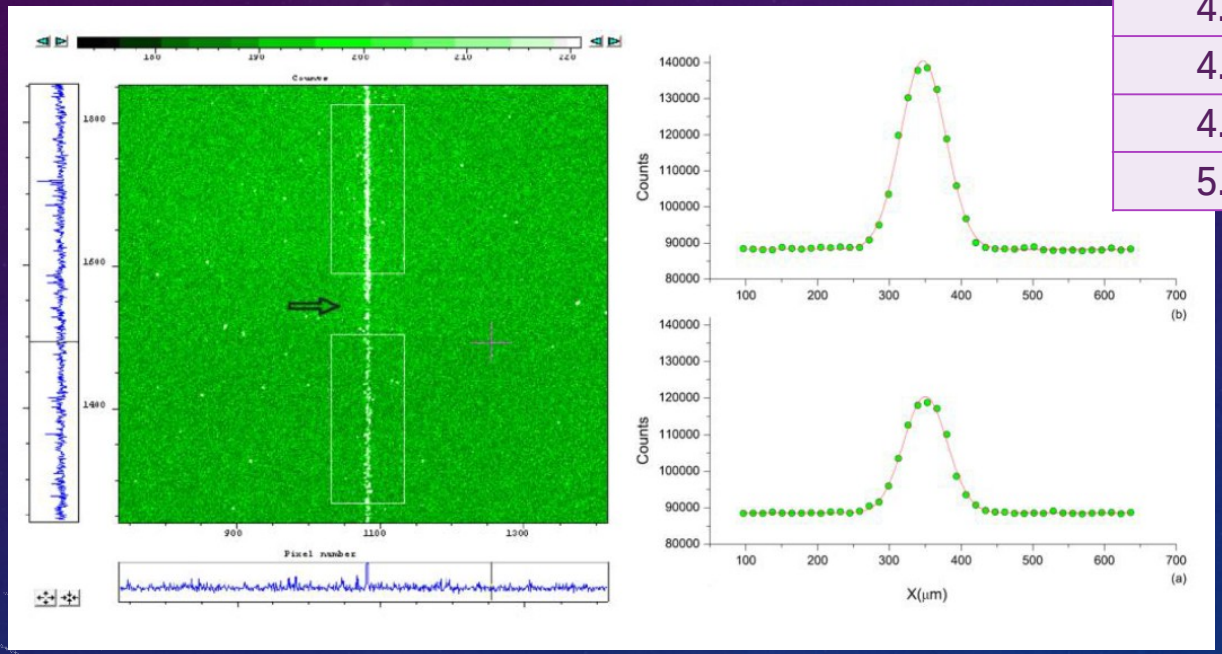
SPECTRA OF W

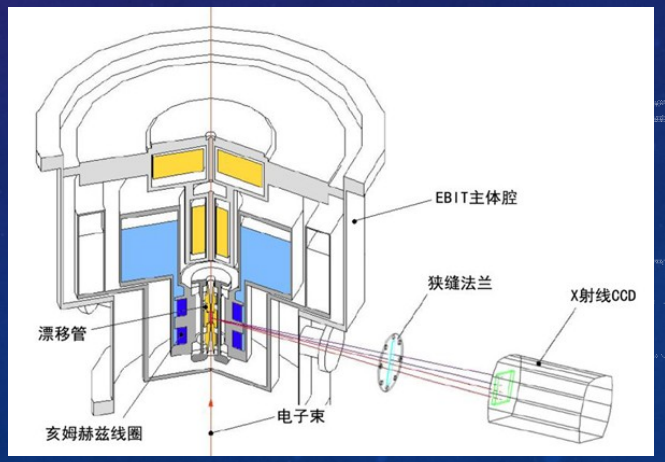

0 200 400 600 800 1000 1200 1400 1600 1800 2000
4.940kV37.6mA_42h
4.337kV37.7mA_42h
3.760kV37mA_42h
3.155kV15mA_42h
Pixel


100000
80000
60000
40000
20000
0
3.155kV15mA_42h
3.760kV37mA_42h
4.337kV37.7mA_42h
4.940kV37.6mA_42h
4.930kV37.7mA_42h_Lw
4.95kV42mA_42h_VrLw
5.250kV42mA_42h_VrLw
200 400 600 800 1000 1200 1400 1600 1800 2000

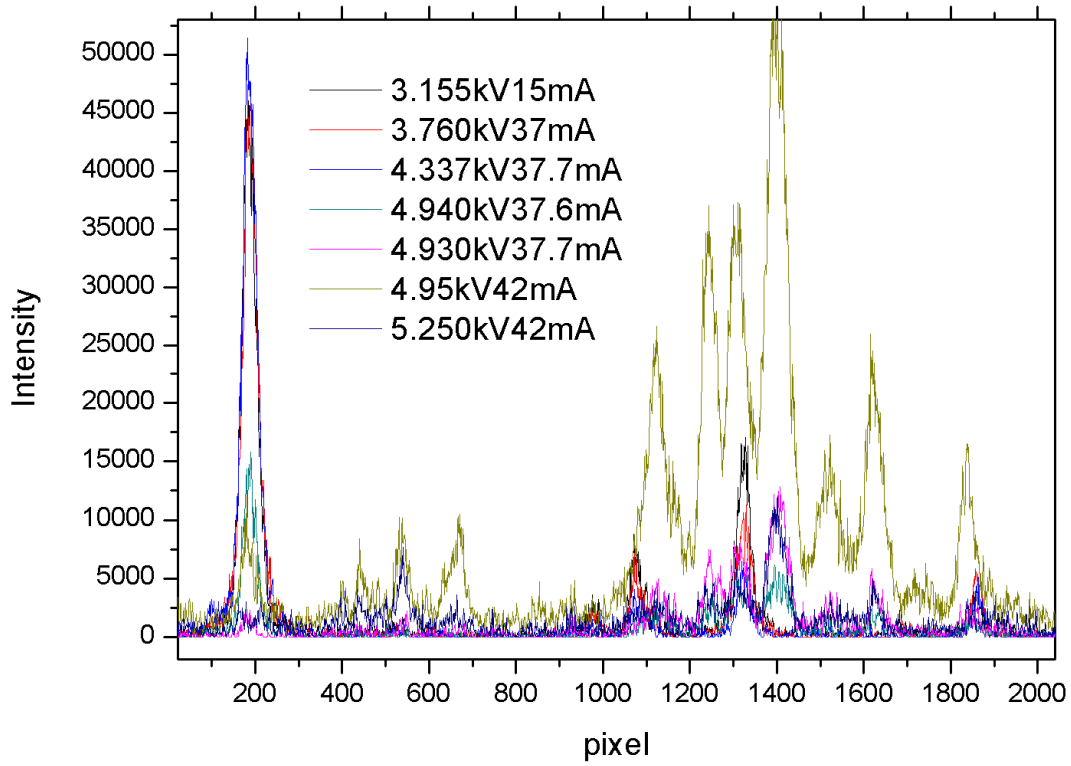
IMAGING RESULTS

Ee	Ie	Ne /cm-3
3.155kV	15mA	2.5E+12
3.76kV	37mA	6. 3E+12
4.337kV	37.7mA	5.1E+12
4.94kV	37.6mA	5.9E+12
4.93kV	37.7mA	7.7E+12
4.95kV	42mA	8.6E+12
5.25kV	42mA	8.4E+12

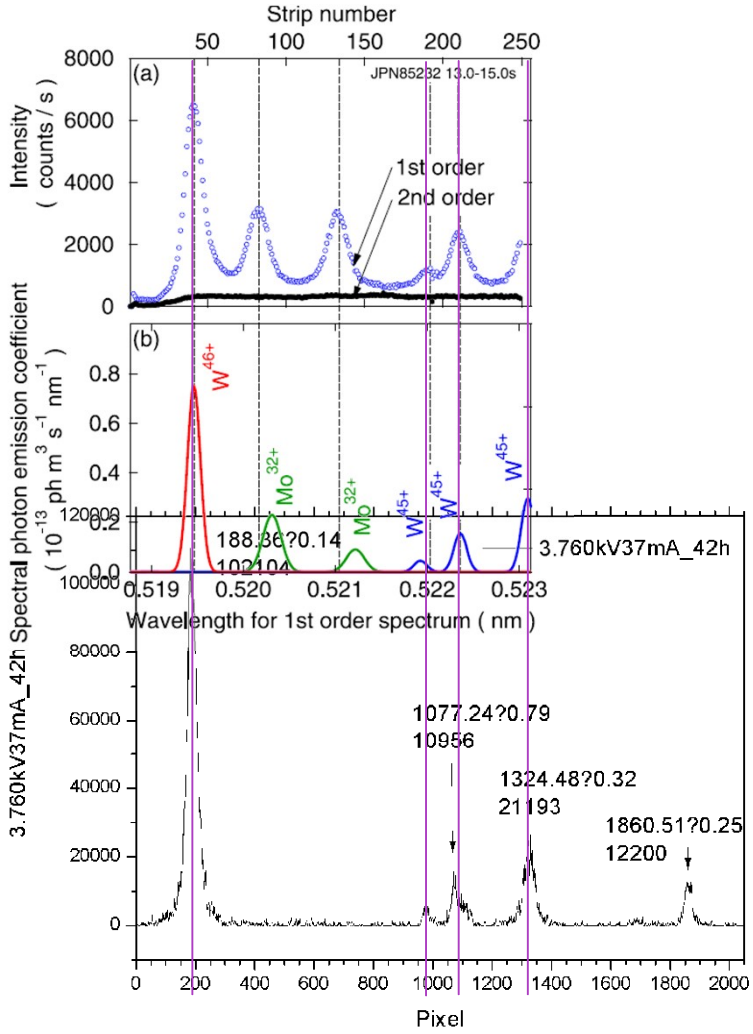


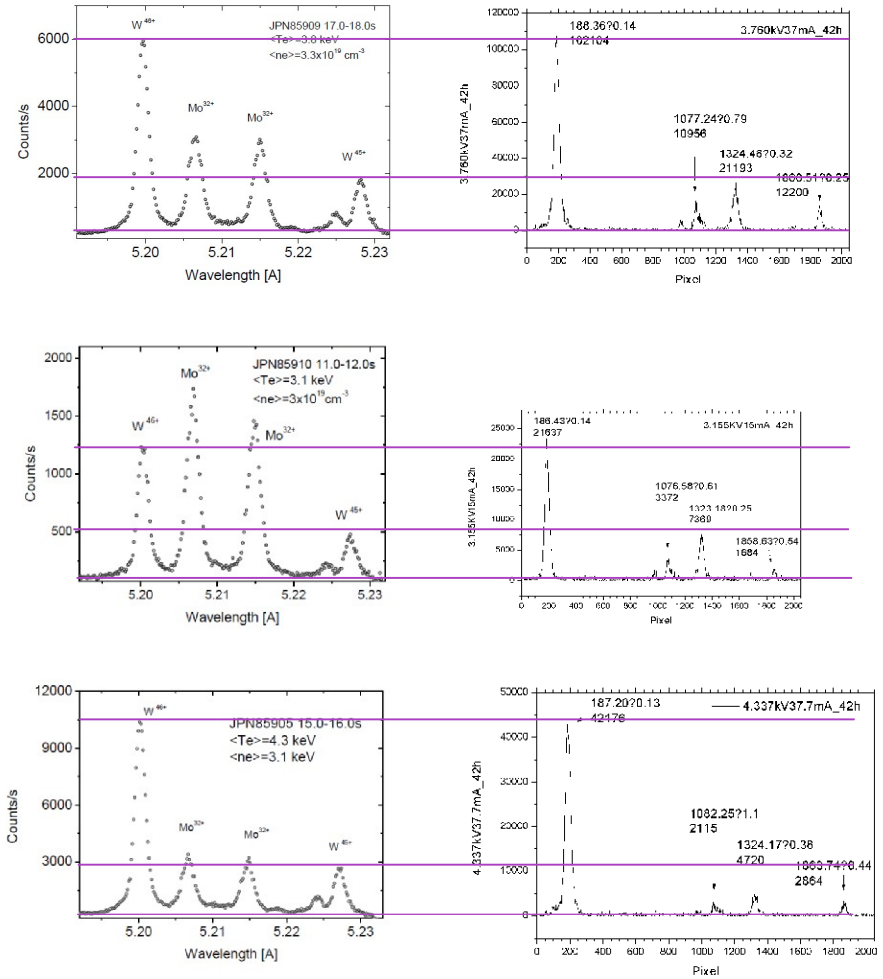


SOME LINES NOT IDENTIFIED FOR HIGHER ELECTRON ENERGY, WAITING FOR MORE INVESTIGATIONS



COMPARISON WITH JET DATA





NEXT STEPS

- Mo is prepared to injected into the plasma. Measurements will be arranged for different parameters of plasma
- Mixture of W and Mo will be injected into the plasma.
- More calculation will be done for further analysis.

THANK YOU FOR YOUR ATTENTION!

Communications and Collaborations are warmly welcomed.