(TG3) Spectroscopy group report

Jan. 13, 2022 (M. Goto)

Date: Jan. 12, 2022
Time: 15:15 – 18:30
Shot#: 176133 – 176192 (60 shots)
Prior wall conditioning: GD (D2)
Divertor pump: ON
Gas puff: H_2, Ar
Pellet: Mn (TESPEL), Fe, Er, C (Impurity pellet)

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H,)=P(3.5, 2.6, 3.8, 1.8/1.7, 0.0)MW
ECH(77GHz)=ant(5.5-U, 2-OUR)=P(0.703, 0.792)MW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2-OLR)=P(0.979, 0.930, 0.986)MW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0, 0, 0, 0)MW
Neutron yield integrated over the experiment = 1.7×10^{13}

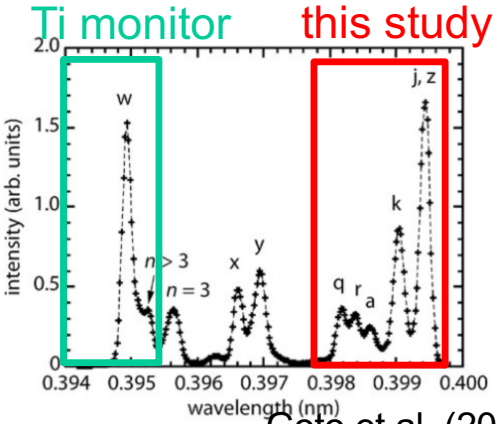
Topics

1. Relationship between energetic particles and MHD instability (Kawate)
2. Search on magnetic induced electric dipole transition using LHD (Li, Suzuki)
3. Collection and assessment of the transition data required for the quantitative studies of heavy element nucleosynthesis in neutron star mergers (Kato)

Diagnostics of high-energy electrons

T. Kawate, M. Goto, T. Oishi e

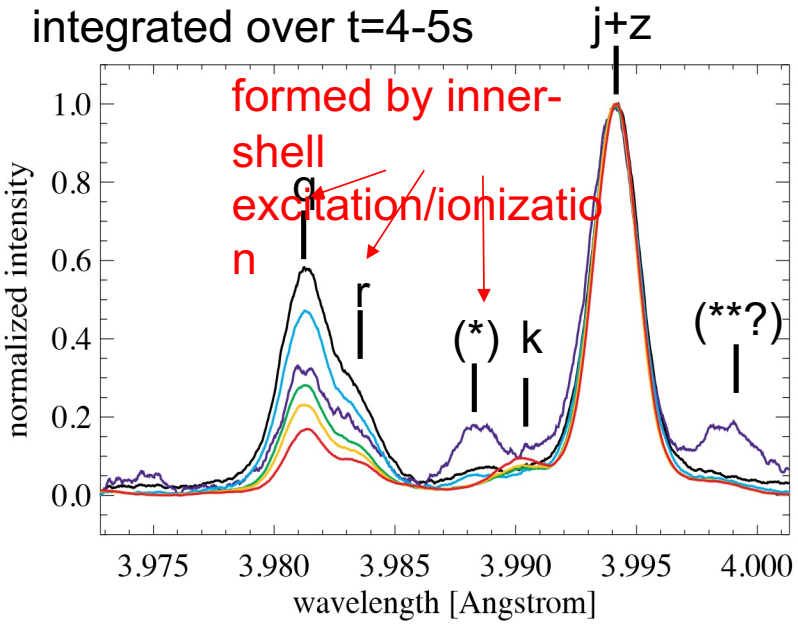
Background: Acceleration mechanisms of electrons in astro/solar plasmas have been discussed for long time but not been clarified. X-ray line spectroscopy can be a good diagnostics of high-energy electrons. Here we examine line ratios of He-like Ar line (z) and its satellite lines by changing T_e and N_e conditions in ECH plasmas



Goto et al. (2010

Experimental conditions:

(R_{ax}, B_t, γ, B_q) = (3.6 m, -2.75 T, 1.2538, 100%), H_2, Ar gas
#176133-176147, T_e ~ 8.5-22 keV, N_e ~ 0.48-1.64e19 m^{-3}



shot #	Te [keV]	Ne [1e19 m^{-3}]
176143	10.4	0.48
176133	15.0	0.70
176142	16.9	1.00
176137	13.9	1.36
176147	12.2	1.50
176141	10.6	1.53

Results:

- Data with various T_e and N_e conditions were obtained.
- Typical T_{Ar} @core ~ 2 keV in all the discharges
- Especially under conditions of N_e<1e19m^{-3}, Ar XVI lines formed by inner-shell excitation/ionization (q,r,(*)) got prominent
  - suggesting $T_e > T_{Ar}$ especially in low N_e
- one unidentified line (**?) was observed

details of Thomson scattering data as well as spatial distribution of Ar XVI by EUV, excitation cross section data, and T_e and N_e dependency will be analyzed

Search on magnetic induced electric dipole transitions using LHD

Objective: Magnetic induced transition (MIT) is a whole new area of atomic spectroscopy. These transitions are sensitive to externally applied magnetic fields, and important for tokamaks and solar corona. We expected to see some MIT lines in LHD with a typical magnetic field > 2.7 T, and the experimental data are combined with multiconfiguration Dirac-Hartree-Fock (MCDHF) as well as relativistic configuration-interaction calculations. Moreover, we try to establish an new entropy and density matrix calculation, which has been partly tested by us for endohedrally confined atoms, to this field.

Experimental conditions:

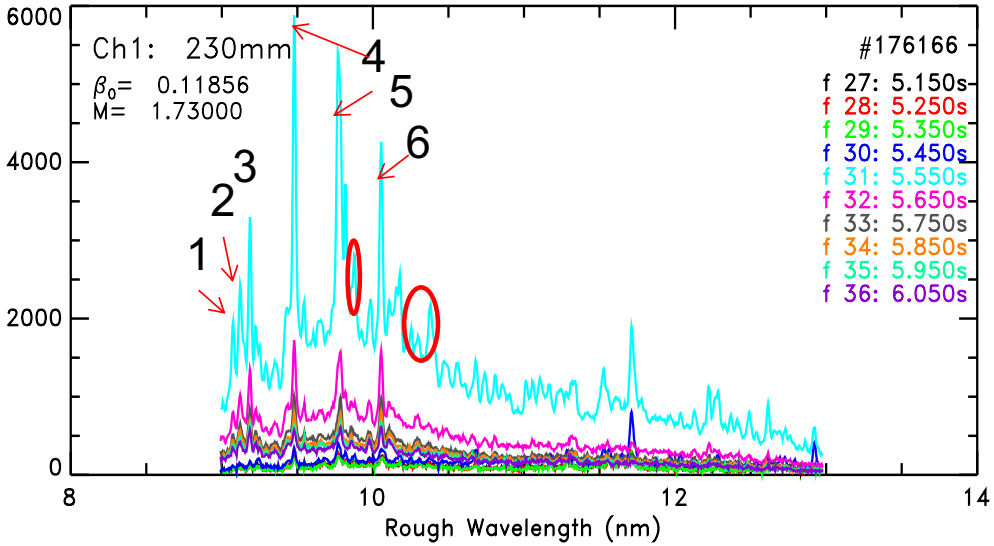
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.2538, 100.0%)
176148-176168

Experiment:

Emission spectra around the expected wavelengths of two regions from Ne-like and Cl-like Fe, Mn, Ar and Kr were measured using SOXMOS and EUV spectrometers at the same time.

Results:

We could observe complex spectra of these elements. We will make a wavelength calibration to look for the expected MIT lines to make a comparion with EBIT data.



1. Lines with labels 1-6 are E1 transition from Cl-like Kr. Theoretical line shape and position compares well with observation. I should check if these data have been reported previously anyway.
2. Lines with red circle lies atMIT transition positions, but might be blended with E1 transitions, careful assignment with help of EBIT observations of Cl-like Fe should been carried out with/without MIT.

TG3: Collection and assessment of the transition data required for the quantitative studies of heavy element

Proponent: D. Kato

Experimental conditions:
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 2.75 T, 1.2538, 100.0%), #176169 - #176185, NBI#1-5, ECH, H2 gas

Objectives
Measurements of high-resolution visible spectra of ablation cloud of Er.

Experiments
Carbon pellets containing Er powders were injected at 4.0s. NBI#1-3 were injected at 3.3-5.3s and NBI#4-5 were injected at 5.3-7.3s.

Preliminary results
We succeeded to observe Er lines in emission spectra of the ablation cloud. The line of Er II at 393.9 nm is identified. The splitting of the Er II line may be due to multiple Zeeman components. Detailed analysis is ongoing.