(SG1) Multi-phase and Atomic/Molecular physics group report

June 4, 2024 (M. Kobayashi)

Date: May 31, 2024
Time: 15:35 -16:45
Shot#: 192477 – 192499 (23 shots)

Prior wall conditioning: No
Divertor pump: On
Gas puff: H2, N2 IPD: No
LID: No
NBI#(1, 2, 3, 4, 5)=gas(-, -, -, -, -)=P(-, -, -, -, -) MW
ECH(77GHz)=ant(5.5-U, 2-OUR)=P(698, 380)kW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2O-LR)=P(705, 889, 982) kW
ECH(116GHz)=ant(2O-LR)=P(-)kW
ECH(56GHz)=ant(1.5-U)=P(-)kW
ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(-, -, -, -) MW

Topics

1. Understanding of the evolution of cosmic organic dust in reaction with plasma (I. Sakon)

Understanding of the evolution of cosmic organic dust in reaction with plasma

20240531

(I. Sakon, T. Miyata, T. Onaka, K. Kobayashi, Y. Kebukawa, J. Takahashi, M. Tanaka, H. Nakamura, M. Shoji, S. Masuzaki, M. Kobayashi)

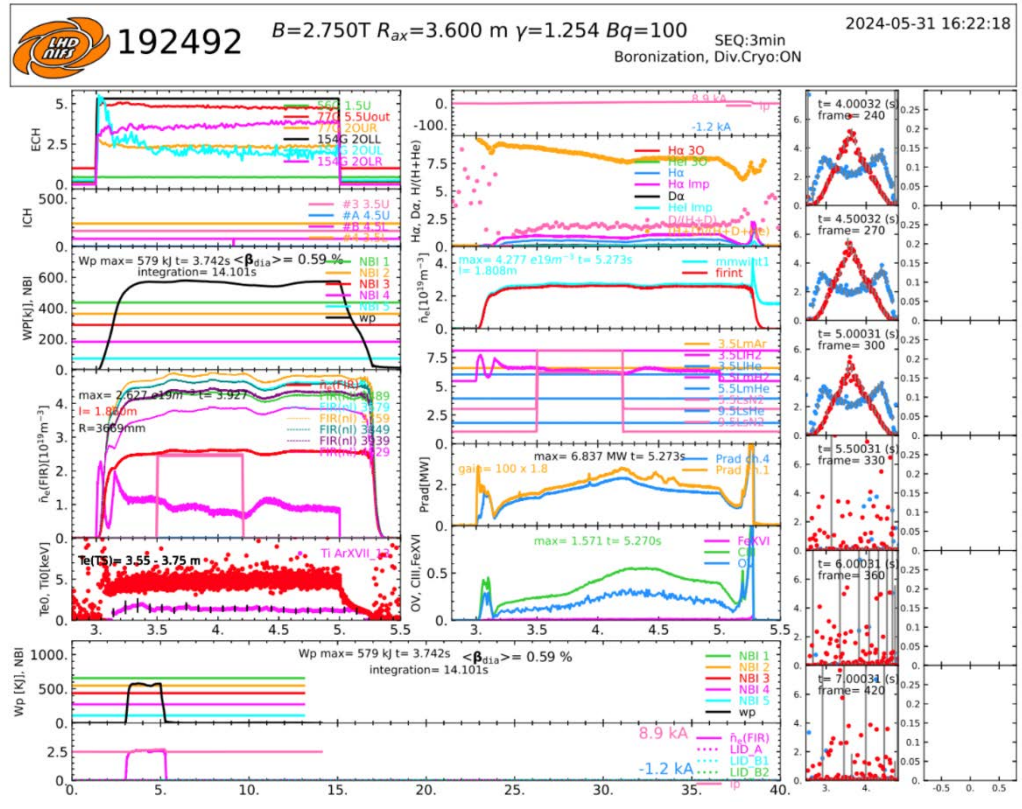
Background & objectives: In the previous run (Cycle 24 experiment), the experiment was conducted at the LHD of the NIFS, irradiating hydrocarbon dust with a relatively low-energy plasma (hydrogen and nitrogen) at the outer edge of the LHD plasma. Preliminary analysis revealed changes in infrared properties of filmy QCC that reproduce the characteristics of peculiar unidentified infrared bands observed in galaxies with weak active galactic nuclei (Smith et al. 2007) and in elliptical galaxies (Bregman et al. 2008; Kaneda et al. 2005), characterized by the absence of the 6-9μm bands corresponding to stretching modes of aromatic C-C bonds and the presence of only the 11-14μm bands corresponding to out-of-plane bending modes of aromatic C-H bonds. While the polycyclic aromatic hydrocarbons (PAHs) hypothesis is widely accepted in astronomy as the carrier of these bands, the exact understanding of their nature is incomplete. Thus, the identification of the carrier responsible for these bands and the determination of the physical factors giving rise to their characteristics remain unresolved for galaxies with weak active galactic nuclei and elliptical galaxies. Here we propose exposure experiment of hydrocarbon solids to the Large helical Device (LHD) plasma by means of a movable sample holder in the 10.5-L port and collect organic dust on the Si or SiO2 substrate.The present study aims to understand the properties of interstellar organic matter in space, based on an integrated approach involving astronomical observations, experimental astrophysics, and molecular dynamics simulations.

Reference:[1] J. D. Bregman et al. 2008, ASP Conf. Ser. 381, 34, [2] I. Endo, I. Sakon, T. Onaka et al. 2021, ApJ, 917, 103, [3] H. Kaneda et al. 2005, ApJ, 632, 83, [4] J. D. T. Smith et al. 2007, ApJ, 656, 770

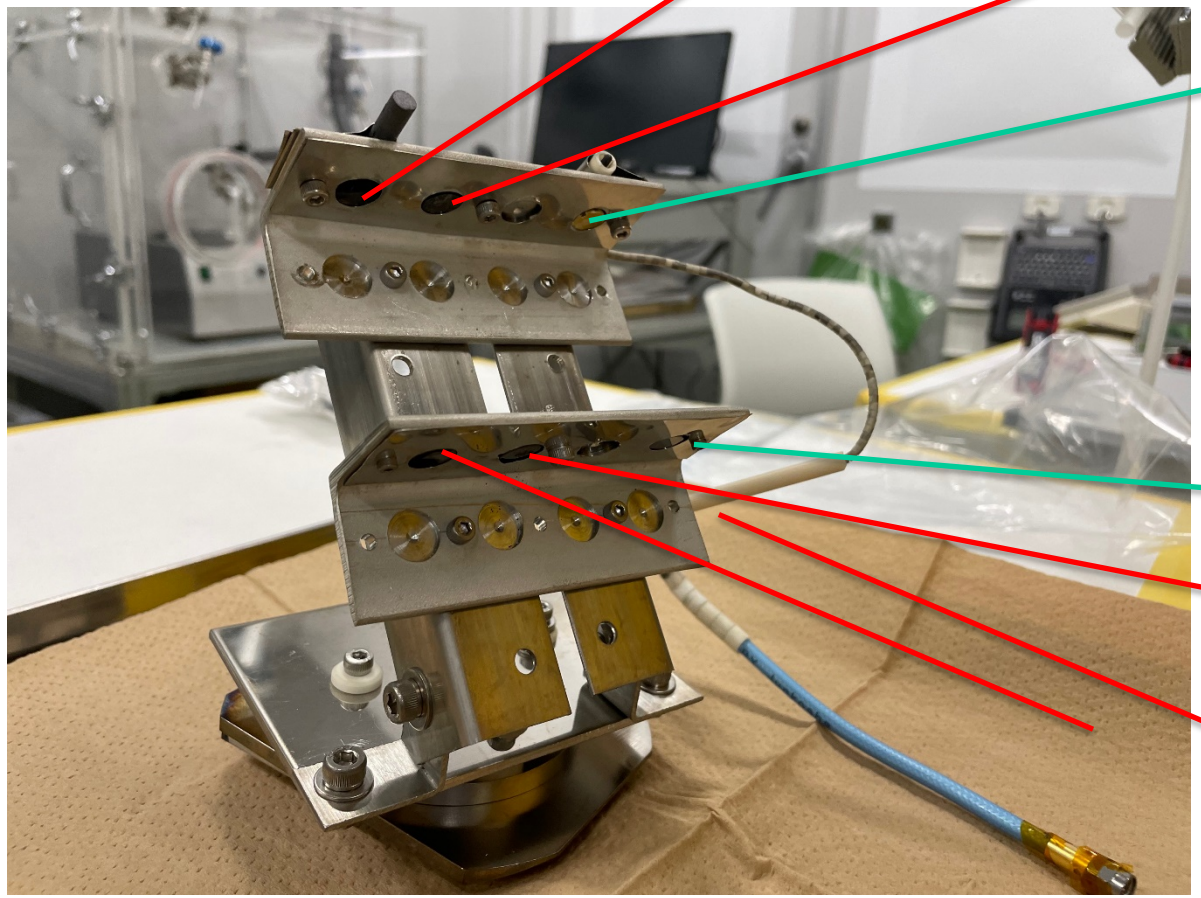
Results: 10mg of Coronene $C_{24}H_{12}$ on a SiO2 substrate (x1), a few mg of filmy QCC on a Si substrate (x2), a few mg of QNCC on Si substrate (x2) and a blank Si substrate (x1) are exposed to the Hydrogen and nitrogen plasma (low-energy part of the LHD plasma). N2 are supplied at 3.5L, 5.5L and 9.5L port. Experiment parameters of each shot are given in the following table. The probe attached to the holder confirmed that reaction with plasma flow of >1x10^{21} ions/s/m^2 (TBR) was achieved for each shot.

Shot ID	N2 (3.5L)	N2 (5.5L)	N2 (9.5L)	comment
192479	200ms	1500ms	1500ms	-300mm, collapse
192480	None	None	None	-300mm
192481	150ms	1500ms	1500ms	-300mm, collapse
192482	None	None	None	-300mm
192483	100ms	1500ms	1500ms	-300mm, collapse
192484	None	None	None	-300mm
192485	None	1500ms	1500ms	-300mm, collapse
192486	None	None	None	-300mm
192487	None	800ms	800ms	-300mm, OK
192488	None	800ms	800ms	-100mm, collapse
192489	None	None	None	-100mm

Shot ID	N2 (3.5L)	N2 (5.5L)	N2 (9.5L)	comment
192490	None	800ms	800ms	-50mm, collapse
192491	None	None	None	-50mm
192492	None	700ms	700ms	-30mm, OK
192493	None	700ms	700ms	-30mm, OK
192494	None	700ms	700ms	-10mm, OK
192495	None	700ms	700ms	-20mm, collapse
192496	None	None	None	-25mm
192497	None	700ms	700ms	-25mm, collapse, no ECH
192498	None	None	None	-25mm
192499	None	700ms	700ms	-25mm, OK



Experiment on LHD (cycle 25) at National Institute for Fusion Science



QNCC#1 on Si substrate

Filmy QCC #1 on Si substrate (retrial of 20240510 experiment)

C24H12 on SiO2 substrate
(retrial of 20240510 experiment)

blank Si substrate

Filmy QCC #2 on Si substrate
(retrial of 20240510 experiment)

QNCC#2 on Si substrate