(TG1) Multi-ion group report

Oct. 25, 2022 (M. Kobayashi)

Date: Oct. 24, 2022
Time: 13:53 -15:12
Shot#: 181280 – 181307 (28 shots)

Prior wall conditioning: D2
Divertor pump: On
Gas puff: D2 IPD: No
LID: No
NBI#(1, 2, 3, 4, 5)=gas(-, -, -, H, H)=P(-, -, -, 3.7, 4.8) MW
ECH(77GHz)=ant(5.5-U, 2-OUR)=P(703, 792)kW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2O-LR)=P(723, 799, 825) 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
Neutron yield integrated over the experiment = 2.4×10^{12}

Topics
1. Understanding of the origin and evolution of cosmic organic dust in an astrobiological context (I. Sakon)

Understanding of the origin and evolution of cosmic organic dust in an astrobiological context

20221024

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

Background & objectives:

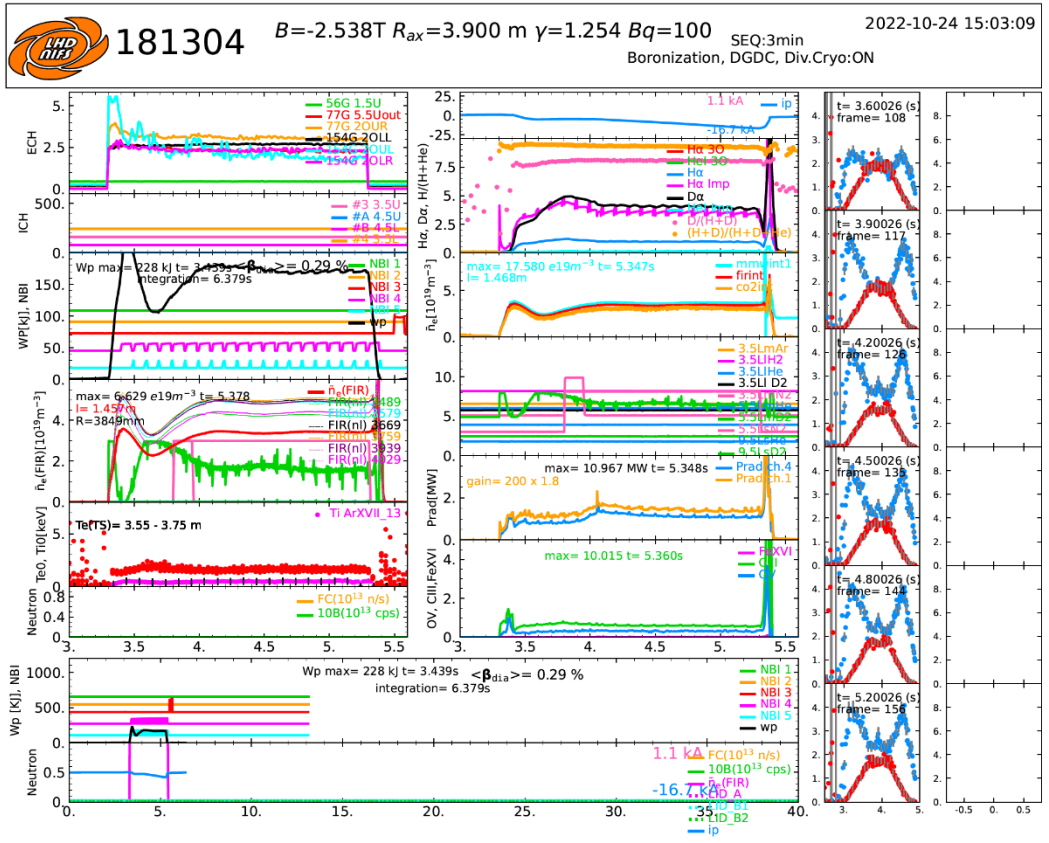
Since after the detection of unidentified infrared (UIR) bands in astrophysical environments, astronomers have demonstrated that the carriers are related to the organic compounds and are ubiquitous members of the interstellar and circumstellar medium of galaxies. However, the firm identification of the organic compounds in an actual astrophysical environment has not been made and our knowledge on their origin and the chemical link to the organic matter in our solar system is quite limited.

In the experiments on 24 Oct., hydrocarbon solids (Coronene $C_{24}H_{12}$ and Anthracene $C_{14}H_{10}$) are exposed to the LHD plasma (H2, D2, N2) by means of a movable sample holder in the 4.5-L port and collect organic dust on the Si substrate. We aim to investigate whether amine/imine chemical units, which may be a key in an astrobiological context, emerge in the sample after plama irradiation.

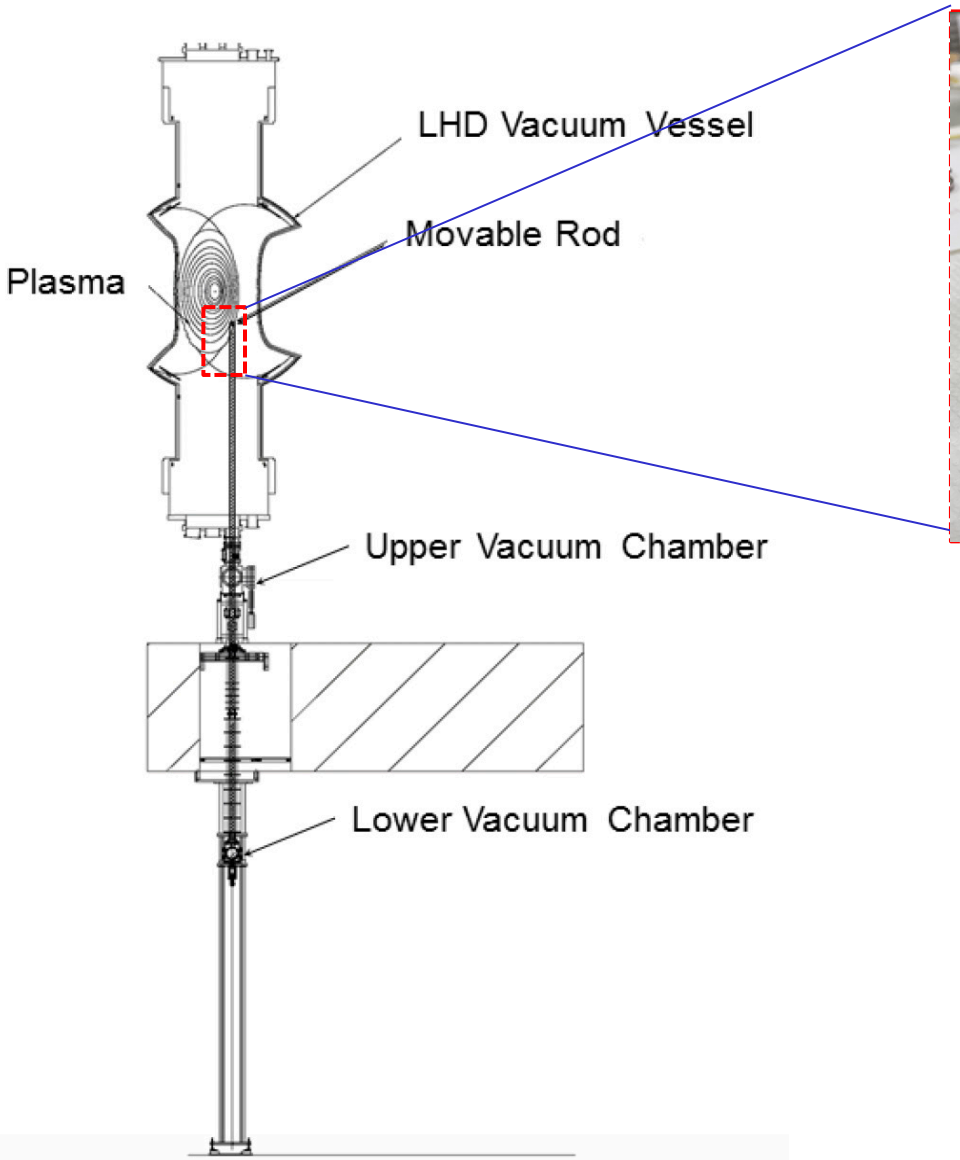
Results:

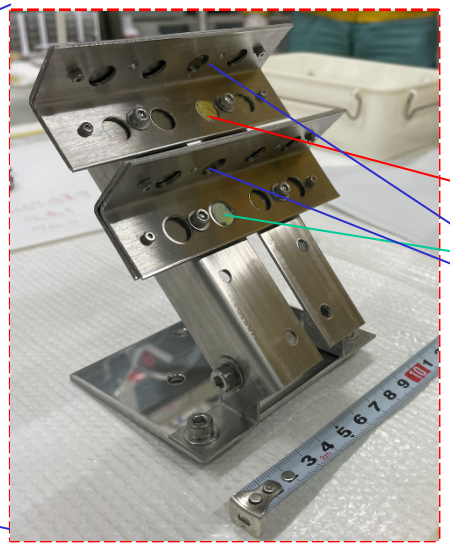
10mg of Coronene $C_{24}H_{12}$ on a Si substrate and 15mg of Anthracene $C_{14}H_{12}$ on a Si substrate are exposed to the Deuterium/Hydrogen (D/(D+H)>75%) and nitrogen plasma (low-energy part of the LHD plasma). N2 gas is supplied at 3.5L port and 5.5L port. Exposure duration is set to ~2.1 sec per shot. Experiment parameters of each shot are given in the following table. Optimization of the exposure duration and the location of the sample holders will be made in next experiments in December.

Shot ID	N2 (5.5L)	N2 (3.5L)	Exp. duration	Sample Holder
181301	1500msec	200 msec	~0.8 sec	l_{insert}=2.7910m
181302	1500msec	None	~0.2 sec	l_{insert}=2.7994m
181303	None	None	~2.1sec	l_{insert}=2.7994m
181304	1500msec	150msec	~2.1sec	l_{insert}=2.8088m



Experiment on LHD: Approach and Methodology





Experiment on 24 Oct.

C24H12 on Si substrate x 1
C14H10 on Si substrate x 1
Blank Si Substrates x 2

the movable sample holder installed in 4.5-L port (M. Shoji 2020)

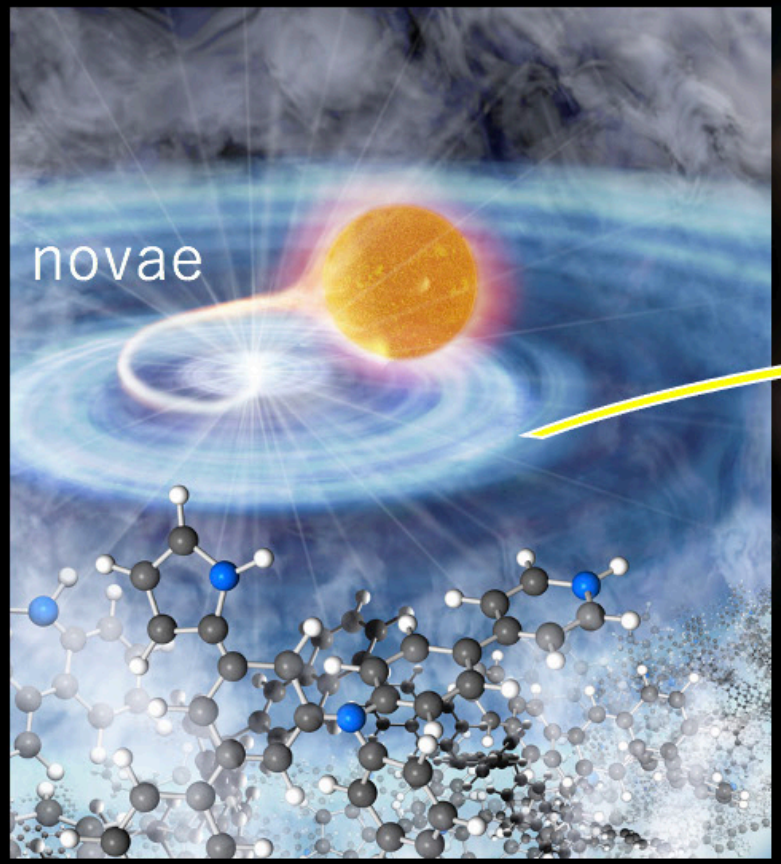
We plan to compare the IR (ATR FT-IR Microspectroscopy) and X-ray (X-ray Absorption Near-Edge Structure Analysis) properties of organic dust collected on the Si substrates at different slots
- The flow level of plasma
- The chemical composition of the plasma (H, N, C)
- The chemical composition of the raw carbonaceous solids (PAHs, filmy QCC, C60, Graphite, CNT etc.)

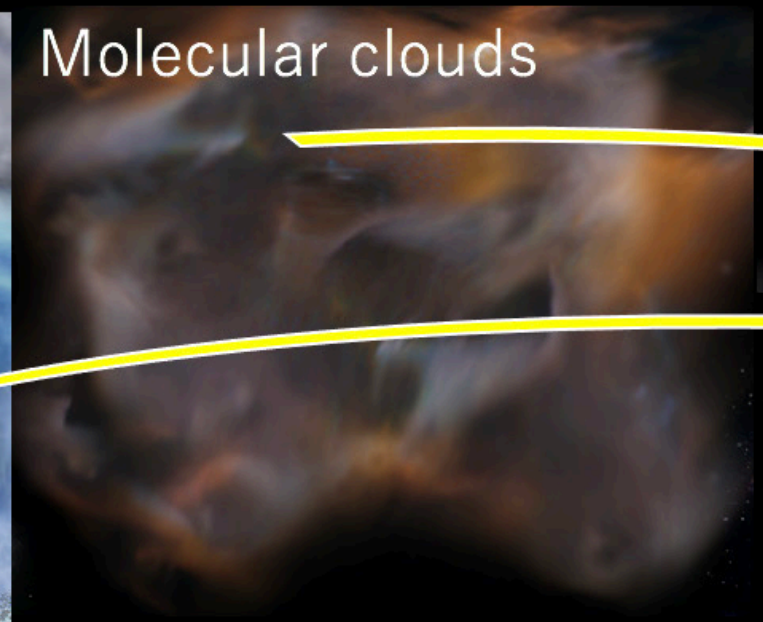
The obtained knowledge will help
- interpret the nature of the carriers of UIR bands observed around dusty novae with TAO/MIMIZUKU
- investigate the evolutional link between the organic dust synthesized in the stellar ejecta and the primitive organics in our solar system.

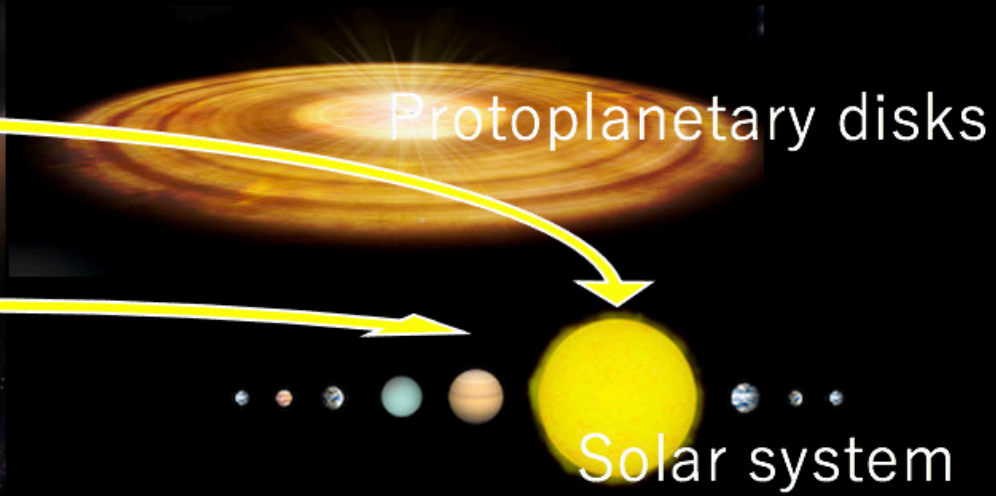
appendix

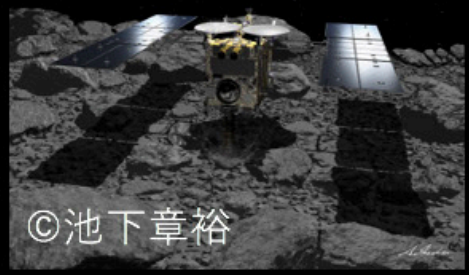
Understanding of the origin and evolution of cosmic organic dust in an astrobiological context

Itsuki Sakon, *Takashi Miyata (University of Tokyo), Takashi Onaka (Meisei University), Kensei Kobayashi, Yoko Kebukawa, Jun-ichi Takahashi (Yokohama National University), Masahiro Kobayashi, Hiroaki Nakamura, Mamoru Shoji, Suguru Masuzaki (NIFS)*

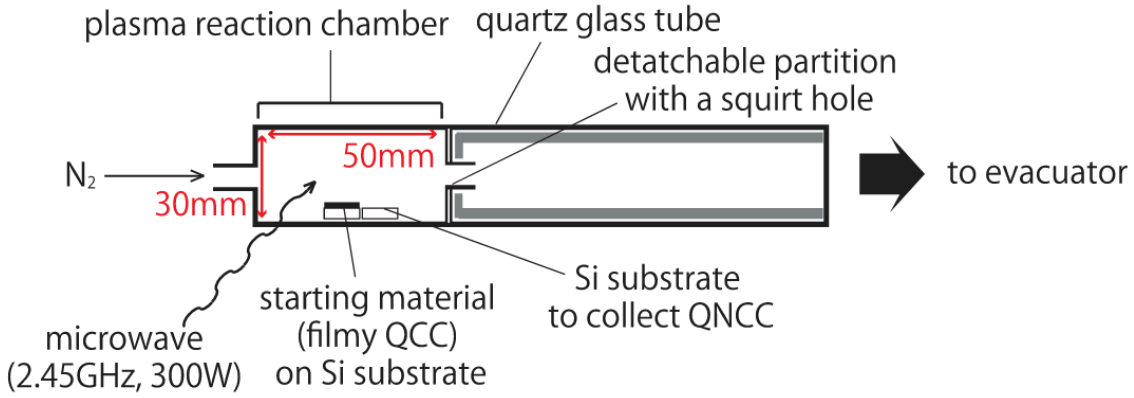


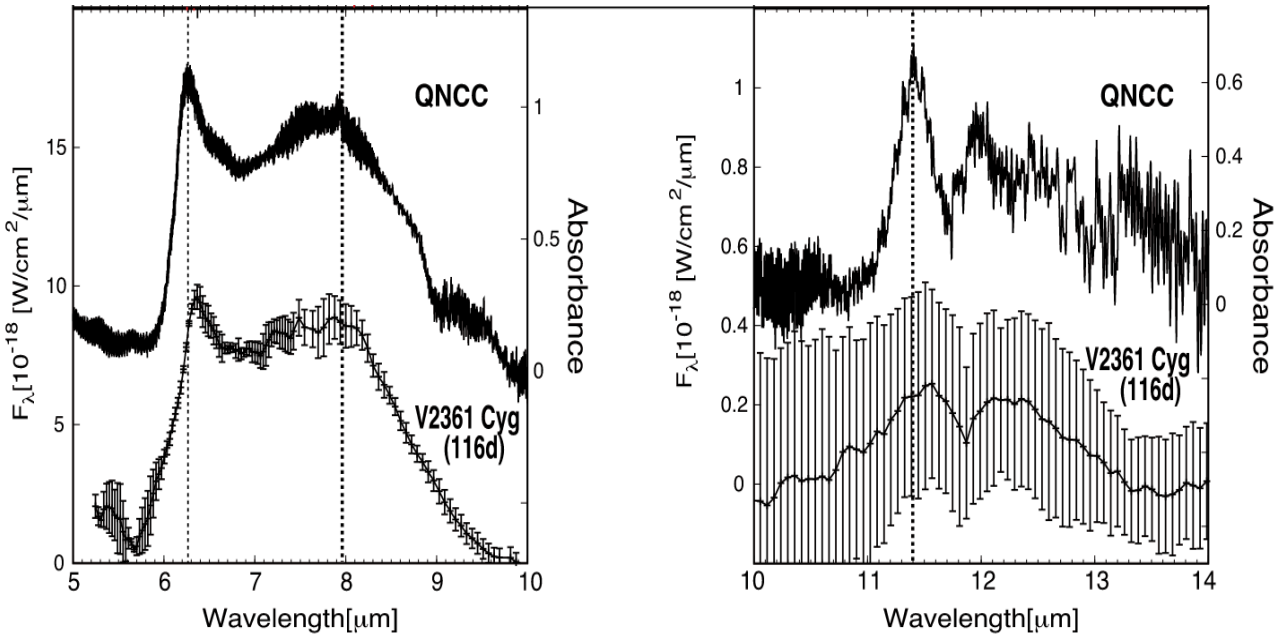




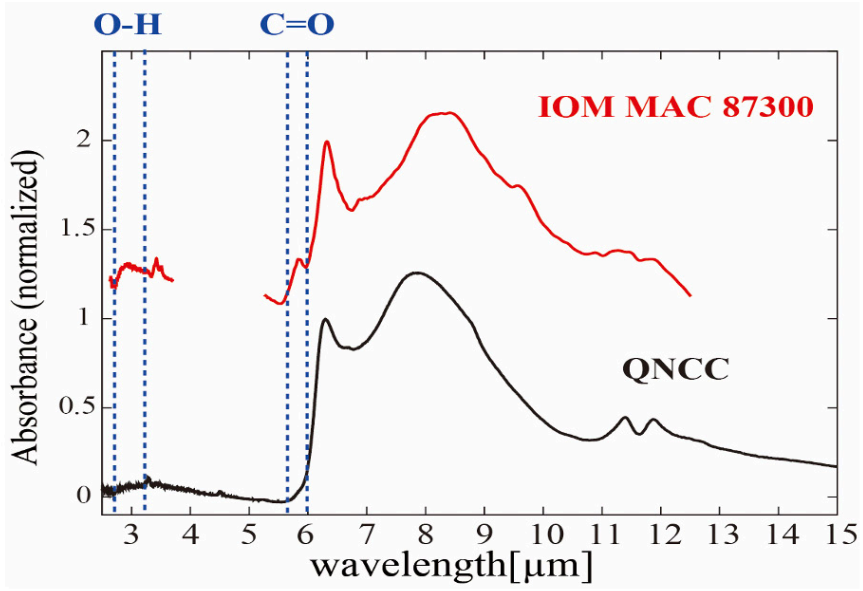


Quenched Nitrogen-included Carbonaceous Composites (QNCC; Endo, Sakon, Onaka et al. 2021, ApJ, 917, 103) as the best laboratory analog of organic dust formed in dusty classical novae





Nitrogen inclusion of N/C ~ 0.03–0.05 (molar ratio) in the form of amine is the key for the origin of the 8μm feature observed in the infrared spectra of dusty novae



Similarity in infrared spectral properties *between* ***the insoluble organic matter (IOM) extracted from carbonaceous chondrite*** *and* ***QNCC***