# Study of dust dynamics in the NSTX

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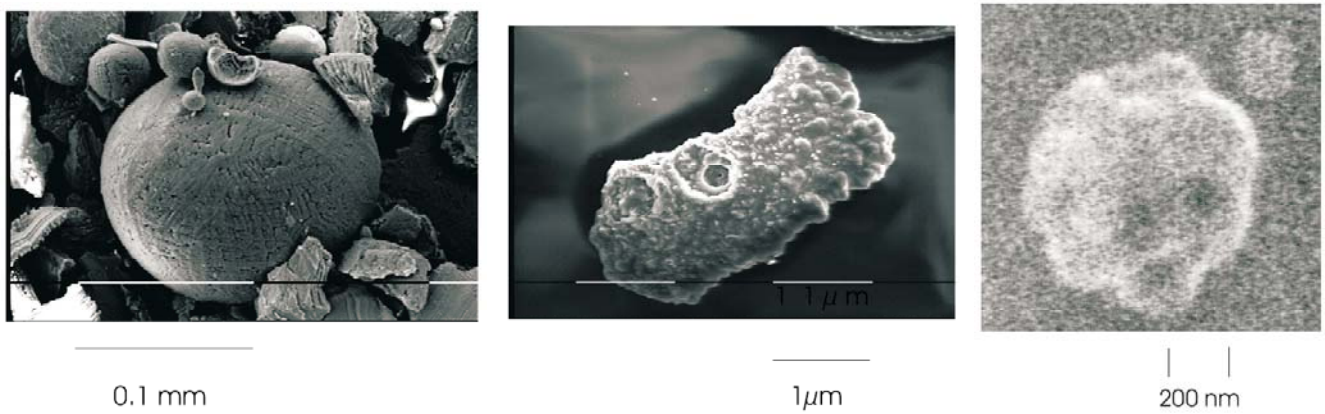
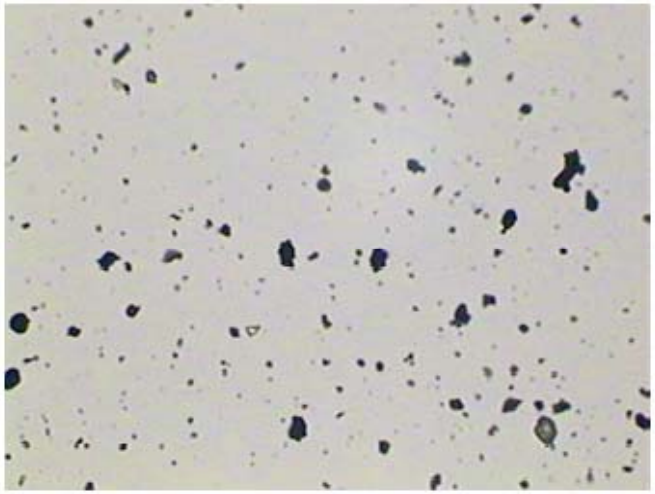
+ everyone who is interested!

- Significant amount of dust particles is observed in the chambers of fusion devices




Winter, (TEXTOR) Plasma Phys. Contr. Fusion, 1998

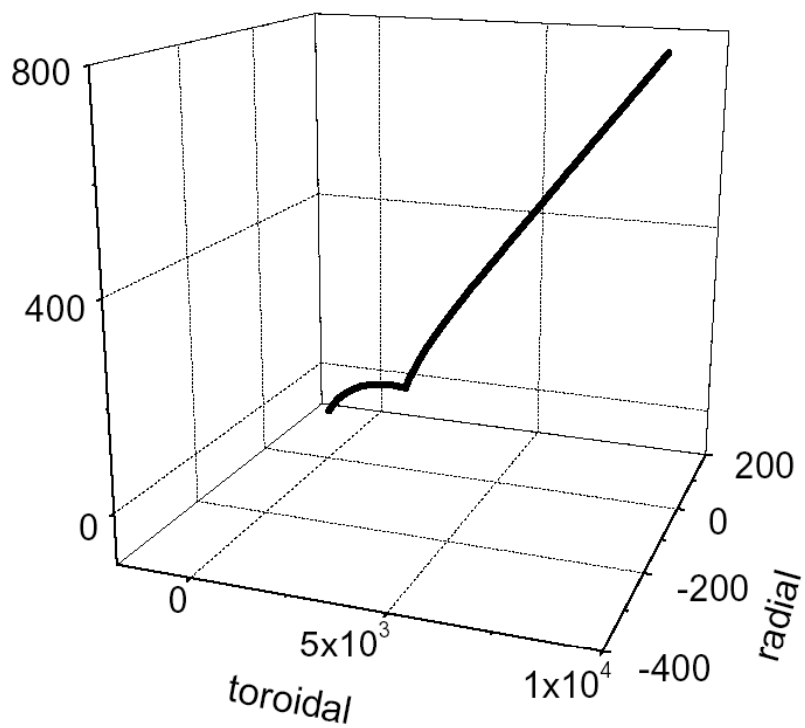


Skinner et al., (NSTX) Rev. Scientific Instr., 2004

- So far an impact of dust on the performance of current fusion devices is not clear
- However, in burning plasma experiments an existence of significant amount of mobile dust particles poses intolerable threat since dust contains radioactive material and tritium
- **Therefore, dust physics must be addressed and learned in current tokamaks!**

- Theory (Krasheninnikov, et al., PoP **11** (2004) 3141; EPS-2004) shows that:
- Due to acceleration by plasma flows, dust particles can have a very high speed, $10^3 - 10^4$ cm/s

- Interactions of dust particles with surface inhomogeneities (including micro-roughness as well as corners, etc.) or plasma turbulence can cause dust particles to fly through SOL plasma toward tokamak core



- It is feasible that dust formation in and transport from divertor region play an important role in core plasma contamination in current experiments
- However, even then, dust particle density around separatrix is $\sim 3\times10^{-2}$ cm$^{-3}$, which makes it difficult to diagnose
- Preliminary comparison of theoretical results on dust dynamics with experimental data of dust particle images in infrared radiation from MAST shows qualitative agreement

**In the proposed research we suggest:**

i) develop comprehensive physical model and numerical 3D code to study dust dynamics in edge of the NSTX

ii) apply this code to analyze IR images of dust from the NSTX

iii) comparing simulations of 3D trajectory and the brightness of dust particles in the NSTX edge plasma with experimental observations of dust images will allow to infer distribution of dust particle parameters and asses dust composition and the mechanism of generation

iv) some characteristics of edge plasma turbulence can be assessed from a small scale fluctuations of dust trajectory

- Our physical model and 3D code describing dust dynamics will, in particular, include:

  i) heating and erosion/deposition of dust particle due to plasma-dust interactions

  ii) model for sheath plasma region and plasma-dust interactions in this region accounting for the corrugation of wall surface which is important for dust dynamics

  iii) in order to stay consistent to experimental conditions of wall corrugation we will use experimental data for that, where possible

iv) we also will use experimental data and the UEDGE assessment for plasma flows (including diamagnetic one) and electric field in edge region to calculate forces imposed by plasma onto dust particle

v) we also incorporate physical model describing an impact of intermittent edge plasma transport on both dust dynamics, heating, and erosion/deposition

- In addition we will assess the role of collective phenomena associated with the dust for the conditions of edge plasma in fusion devices.