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Identifying Observable Infrared Signatures of Nanosilicate Dust Grains in the Interstellar Medium

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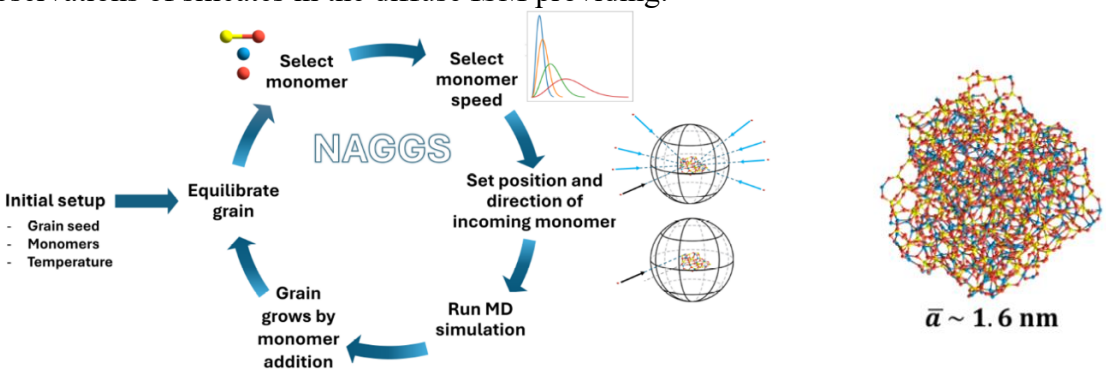
Collisional processing of dust in the interstellar medium (ISM) massively favours higher populations of smaller grains. Even if such species account for a relatively small fraction of the total silicate dust grain mass in the ISM, nano-sized grains could potentially dominate dust populations by number. Indirect evidence for a large population of nanosilicate grains comes from their potential as carriers of the anomalous microwave emission.[1] However, more direct spectroscopic evidence is lacking.

Employing our new NAGGS (Nucleated Atomistic Grain Growth Simulator)[2] approach we have prepared a large set of atomistically detailed nanosilicates with sizes up to 4-5 nm diameter. Previously, we showed that ultrasmall nanosilicates with diameters less than 1 nm have specific infrared (IR) features that should be discernible with the James Webb Space Telescope (JWST)[3]. By analysing the accurately calculated IR spectra of different populations of nanosilicates we show how these molecular IR features evolve with increasing size. We find that nanosilicates have a signature IR spectrum which in consistent with recent JWST observations of silicates in the diffuse ISM providing.[4]



Left: Workflow of the NAGGS code. Right: an example NAGGS-prepared nanosilicate grain.

References:
[1] Macià Escatllar, A.; Bromley, S. T. Assessing the viability of silicate nanoclusters as carriers of the anomalous microwave emission: a quantum mechanical study, A&A 2020, 634, A77.
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[3] Zeegers, S. T.; Mariñoso Guiu, J.; Kemper, F.; J. Marshall, J. P.; Bromley, S. T. Predicting observable infrared signatures of nanosilicates in the diffuse interstellar medium, Faraday Discuss. 2023, 245, 609.
[4] Zeegers, S. T.; *et al* Investigating Silicate, Carbon, and Water in the Diffuse Interstellar Medium: The First Shots from WISCI ApJ, 2025, 987, 25.