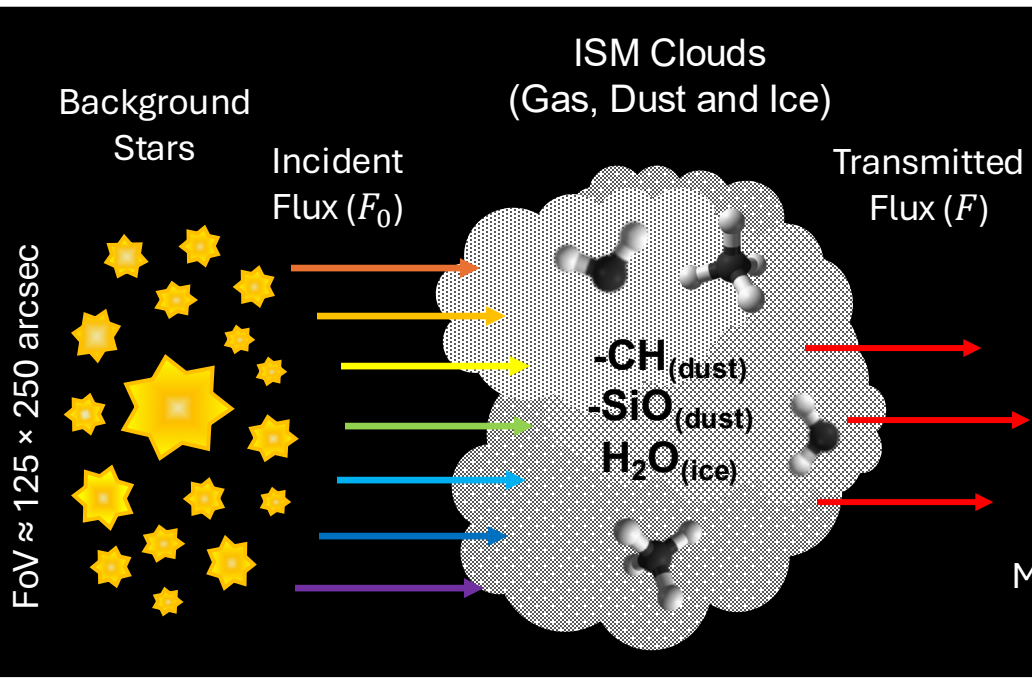
Photometric Mapping of Carbonaceous/Siliceous Dust and Water Ice in the ISM with JWST

STScI | SPACE TELESCOPE SCIENCE INSTITUTE

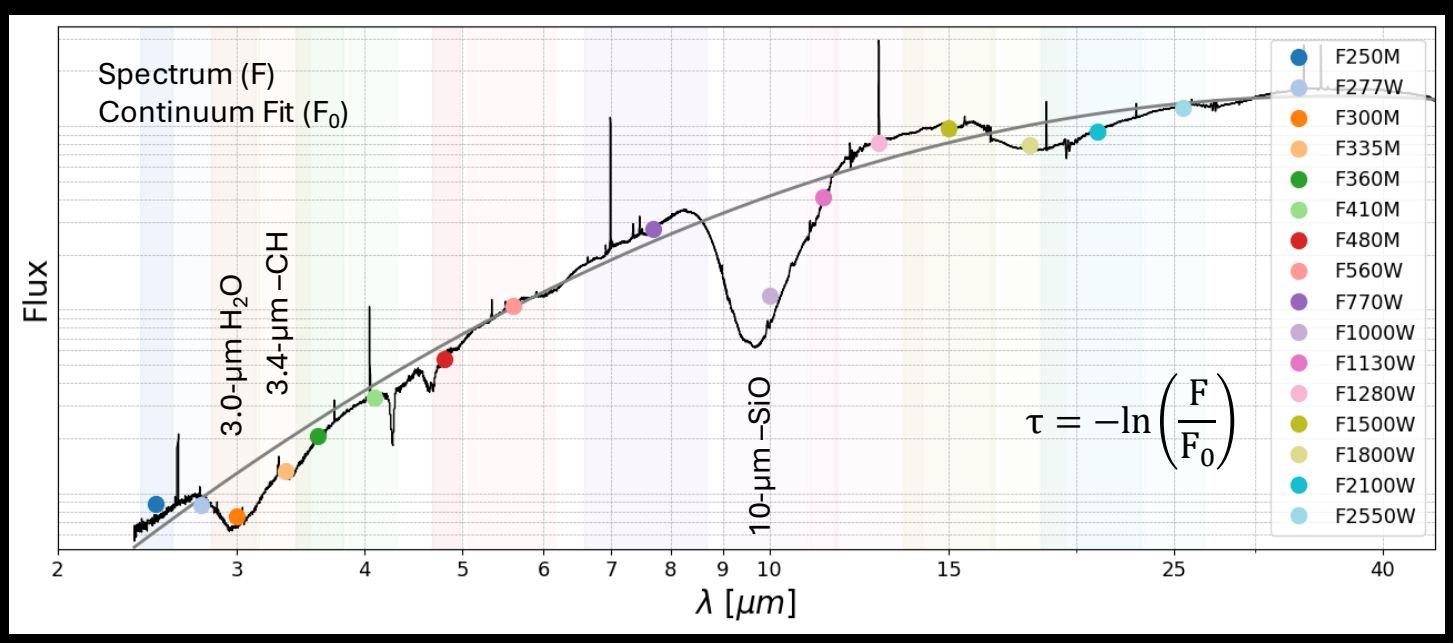
Burcu Günay, Karl D. Gordon, Joshua E. G. Peek, Marjorie Decleir, Dries Van De Putte, Kirill Tchernyshyov, and Michael G. Burton

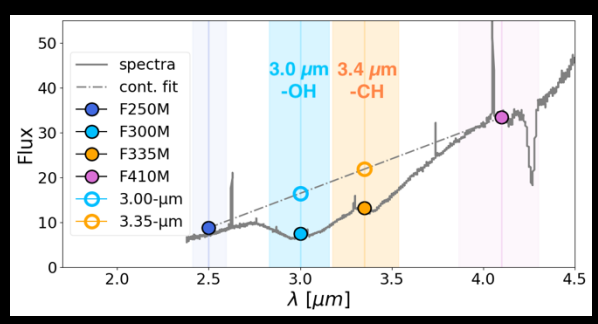
ARMAGH OBSERVATORY & PLANETARIUM

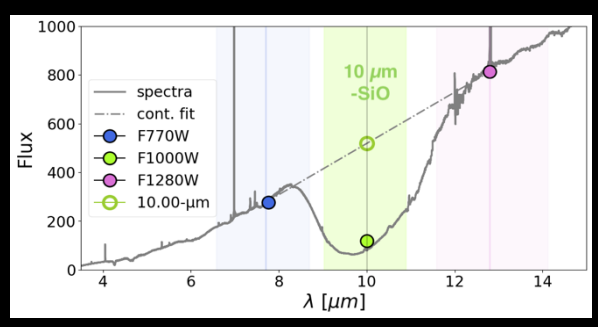
TÜBİTAK



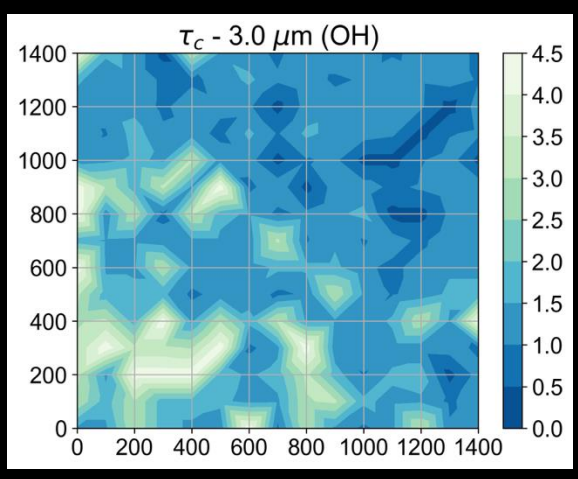
We present a photometric method for the JWST that employs NIRCam and MIRI imaging filters to map the spatial distribution of the major dust and ice components in the dense interstellar medium (ISM). The method relies on measuring the optical depths of the absorption features arising from –CH groups in carbonaceous dust, –SiO groups in silicate dust, and H_2O molecules in water ice. This method can be applied to multiple sources within the field of view (FoV) simultaneously at minimal observational cost.

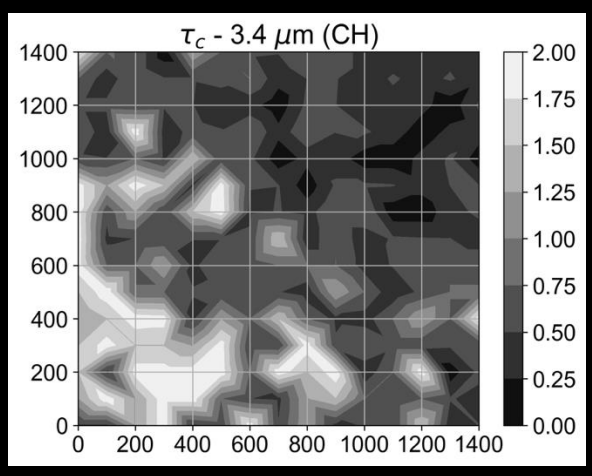


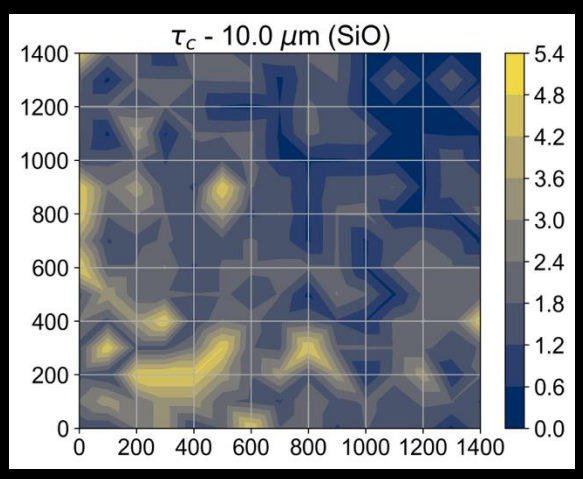




The methodology and optical depth measurements are illustrated using an example spectrum (Sagittarius A*). The photometric measurements provide spatially resolved information on the 3.0-μm water-ice –OH feature, 3.4-μm aliphatic hydrocarbon –CH feature, and 10-μm silicate –SiO feature, and provide statistical data sets on the dust and ice elemental abundances in the ISM.







We use a set of spectra of dense ISM sources from the literature to simulate a scene exhibiting an abundance gradient of water ice, aliphatic hydrocarbons, and silicates. The resulting optical depth maps demonstrate that the spatial distribution of absorbers (OH, CH, SiO) is recovered using the photometric method. After calibration based on spectral modeling, the calibrated optical depths (τ_c) are consistent with spectroscopic simulations, with residual discrepancies of ~15% for water ice, ~11% for aliphatic hydrocarbons, and ~5% for the silicate feature. The photometric method also produces results comparable to literature values derived from full spectra, with discrepancies of ~15–20% for the silicate feature and ~20–25% for water ice.

Scan Me

Photometric Mapping of Carbonaceous/Siliceous Dust and Water Ice in the ISM with JWST: Applications to the Dense Sightlines

Burcu Günay *et al* 2025 *AJ* 170 169

Burcu Günay
Armagh Observatory and Planetarium
for more info ->
burcu.gunay@armagh.ac.uk

Scan Me