Radiative transfer simulations for in-situ diagnostic of reactive, particle growing plasmas

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When considering particles produced in reactive plasmas, their refractive index and grain size often need to be known, e.g. to study the basic physics of the nanodusty plasmas [1]. Both can be constrained in-situ by polarimetry, i.e. analysing the polarization state of scattered light. This approach has the advantage of temporal resolution and real-time measurements, but is often limited by the assumption of single scattering and thus to optically thin dust clouds. However, 3D polarized radiative transfer simulations, enable the analysis of both single point and imaging polarimetry to constrain the properties of dense particle clouds.

We designed an in-situ diagnostics strategy for the investigation of the particle growth process based on radiative transfer simulations. For the first time, this strategy allowed us to analyse the polarization measured during a growth experiment in a reactive argon-acetylene plasma for particle radii up to 280 nm (Fig. 1). However, we could show that characteristic asymmetries in the spatially resolved Stokes parameters resulting from the anisotropic scattering of polarized laser light provide additional constraints for the analysis of particle properties, i.e., the refractive index and grain size, at any time during the growth process.

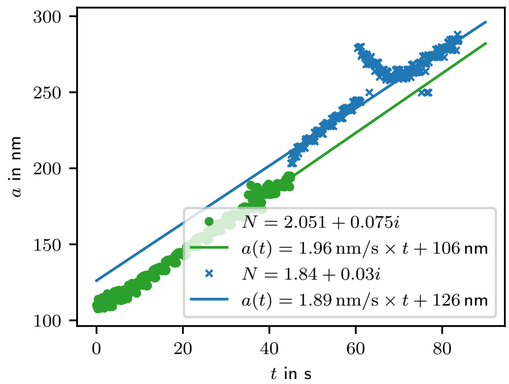

Figure 1: *Particle radius as a function of time, derived with the help of radiative transfer simulations [2].*

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References

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