Instabilities in Magnetized Nanodusty Plasmas

F. Greiner\textsuperscript{1}, N. Köhler\textsuperscript{1}, J. Carstensen\textsuperscript{2}, A. Piel\textsuperscript{1}

\textsuperscript{1} Christian-Albrechts-Universität zu Kiel, Germany
\textsuperscript{2} ABB Switzerland Ltd, CH-5405 Baden-Daettwil, Switzerland

Magnetized dusty plasmas are an interesting field of experimental dusty plasma physics. On the way to investigate interesting phenomena like dusty drift waves we face two main challenges: (i) the creation of dust clouds which are large enough to exhibit wave phenomena and (ii) the magnetization of the dust particles. Large dust clouds require weak gravitation, the magnetization of the dust requires a collision frequency of the dust which is at least comparable to its Larmor frequency. To this end, small dust particles with radii of 80 to 200 nm are used. The simplest way to put spherical, mono-disperse nanodust into the plasma, is to produce it in the (reactive) plasma itself. In our experiments, we use argon plasmas with a small admixture of acetylene. The production of large nano dust clouds is easily realized in a capacitively coupled parallel plate rf reactor. However, even for weak magnetic fields, the creation of nanodust clouds is not possible in a system containing argon and acetylene. Two effects have to be taken into account. Firstly, the magnetic field seems to interfere with the precursor production of the nanodust. Secondly, magnetized parallel plate reactors tend to build filamentary discharge channels, which disturb the development of stable nanodust clouds. To create a nanodust cloud at magnetic inductions of up to 500 mT we use specially tailored electrodes. The nanodust clouds produced with this electrode system are void-free and show spectacular instabilities: radial dust ejections (RDE). Such an eruptive event is shown in Fig. 1. Using the Imaging Mie method (I-Mie) \cite{1}, the spatial size of the nanodust particles can be visualised. The color-coding in Fig. 1 gives the particle size, blue corresponds to small particle radii ($\approx 80$ nm) and red corresponds to large particle radii ($\approx 200$ nm). It is seen, that the RDE is not a size depending phenomena.

\cite{1} Franko Greiner et al, Plasma Sources Sci. Technol. \textbf{21} 065005, 2012.

\begin{figure}
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\includegraphics[width=\textwidth]{Figure_1}
\caption{Radial dust ejection during a continuous particle growth process ($\Delta t = 5$ms). Color gives information about particle size.}
\end{figure}