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CRYOPLASMA IN HELIUM INDUCED BY CORONA DISCHARGE

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Fluorescence spectroscopy is a powerful tool to obtain information on microscopic processes in non-equilibrium discharge plasma (corona) in dense media such as high pressure supercritical gas and even liquids. Spectroscopic observations of the light emitted by ionized gases can be used to determine structural information of the local environment of the emitting atoms or molecules. An ionization zone near a tip electrode is the source of light emitted by the corona.

A cryoplasma has been realized in laboratory conditions using corona discharge in gaseous and liquid Helium at cryogenic temperatures of the matter, $T_g < 100$ K. Experiments were carried out at a number of fixed temperatures 300 K down to 4.2 K under high pressures 0.1÷10 MPa. The conditions covered a wide region of thermodynamic states of the matter such as from a gas with density of 10^{20} cm^{-3} up to liquid Helium with density of $2*10^{22}$ cm^{-3}.

Our analysis showed that conventional impact pressure broadening theory is inadequate for the description of the observed widths and shifts. The impact theory predicts broadening and shifts of atomic lines that are small due to the low temperature of the medium. In contrast, static (statistical) distortion of lines is important. The long-range He*-He repulsive potential has been used for calculation of the line shape within the framework of the static approximation theory. It is shown that atomic lines have asymmetric profile in the case of dense gas. A symmetric Gauss-like profile has been observed for lines in liquid He. Such a line shape is the result of creation of a micro-cavity around the excited atoms.