Polarization of dust and molecular bands in comets: effects of mutual contamination

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The spectra of comets are composed of emission lines of atoms, ions, and neutral molecules as well as of a continuum produced by the solar light scattered by dust particles in the coma or tail. Öhman (1941) revealed that there are two different types of polarization behavior in comets. The polarization of continuum was explained by the scattering of sunlight on dust particles, while the polarization in molecular emissions is due to the resonance fluorescence mechanism. Polarimetry of the continuum is a recognized tool for the study of physical properties of dust particles and light scattering mechanisms in comets. However, there are still unsolved problems in the interpretation of the available data. In particular, there are different approaches to explain the observed differences in the maximum polarization of comets. On one hand the observed dispersion of $P_{\max}$ results from different physical properties in cometary dust. On the other hand this difference can be explained by the gas contamination of the continuum polarization. Less attention has been paid to polarimetry of cometary molecular emissions. However, the linear and circular polarimetry of molecular bands can be used to clarify the mechanism of the fluorescence polarization of different emissions and as a diagnostic of the presence or absence of a magnetic field in comets. In addition, since the molecular emissions are observed in the continuum background, there is an effect of continuum contamination of the polarization in molecular emissions. As a result, the observed polarization of the light emitted from molecules is higher than theoretical values for the resonance fluorescence mechanism. It is shown that the effects of mutual gas and dust contamination on the observed polarization of the continuum and molecular emissions depend on the dust-to-gas ratio in different comets.