

Modeling photo-polarimetric response in Comet C/1975 V1 (West)

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The photo-polarimetric properties of Comet C/1975 V1 (West) were measured over a wide range of phase angles α . The phase function in the visible was observed at $\alpha = 30 - 146^\circ$ in [1]; whereas, the degree of linear polarization was investigated with a narrow-band green filter ($\lambda = 0.53 \mu\text{m}$) at $\alpha = 14 - 98^\circ$ [2]. We model these measurements using the discrete-dipole approximation (DDA) [e.g., 3] and the so-called *agglomerated debris particles* (e.g., [4]). We take into account the size polydispersity of the agglomerated debris particles, mimicking what was measured *in situ* for comets [5]; namely, it is assumed that the model particles obey a power-law size distribution r^{-a} with the index $a = 1.5 - 2$.

We have investigated a wide range of refractive indices m and found that a homogeneous ensemble of the *agglomerated debris particles* with a single value of m cannot reproduce the polarimetric response in Comet C/1975 V1 (West). However, a two-component mixture of weakly and highly absorbing agglomerated debris particles can satisfactorily reproduce the observations. Fig. 1 shows results of our modeling (dashed and solid lines) versus measurements (dots). The dashed line presents results for a mixture of particles having 26% (by volume) of $m = 1.5 + 0i$ and 74% of $m = 2.43 + 0.59i$. The solid line corresponds to a mixture of 24% of $m = 1.6 + 0.0005i$ and 76% of $m = 2.43 + 0.59i$. The refractive indices $\text{Re}(m) = 1.5 - 1.6$ and $\text{Im}(m) \approx 0$ are representative of Mg-rich silicates; whereas, the case $m = 2.43 + 0.59i$ corresponds to amorphous carbon. Both materials are abundant species in comets. Furthermore, the ratio of weakly and highly absorbing particles being about 1:3 is consistent with *in situ* findings in Comet 1P/Halley [6].

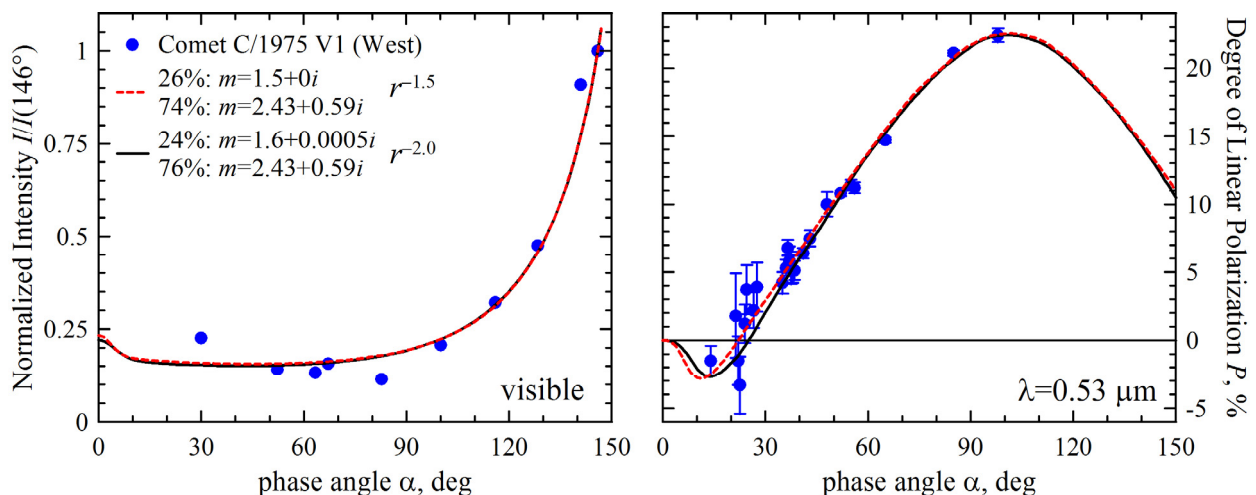


Fig. 1: Modeling (lines) vs. photometric (left) and polarimetric observations (right) of Comet West

References: [1] Kiselev & Chernova, 1978. Sov. Astron. 22, 607; [2] Ney & Merrill, 1976. Science 194, 1051; [3] Zubko et al., 2010. Appl. Opt. 49, 1267. [4] Zubko et al., 2009. J. Quant. Spectr. Rad. Trans. 110, 1741; [5] Price et al., 2010. Meteor. Planet. Sci. 45, 1409; [6] Fomenkova et al., 1992. Science 258, 266.