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SINGULAR APPROACH IN ANALYSIS OF MUELLER MATRIX IMAGES

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According to mathematical approach singularity of a complex matrix element d_{ik} is determined by the following terms

$$\begin{cases} (\operatorname{Re} d_{ik})^2 + (\operatorname{Im} d_{ik})^2 = 0, \\ tg\left[\operatorname{Im}(d_{ik}) / \operatorname{Re}(d_{ik})\right] = \infty. \end{cases} \tag{1}$$

It follows from (1) that singularities of matrix elements d_{ik} are caused by certain (characteristic) values of orientation r^* and phase d^* parameters of the BT liquid crystals' nets

$$\begin{cases} r^* = 0^0 \pm 45^0; 90^0; \\ d^* = 0^{\circ}, \quad 90^{\circ}, \quad 180^{\circ}. \end{cases} \tag{2}$$

On the other hand, relations (2) are the necessary terms for forming polarization singular states of the laser beam (S- ($d = 0^{\circ}, 180^{\circ}$) and C- ($d = \pm 90^{\circ}$) points) by optically coaxial birefringent crystal. It follows from the above mentioned that there is a direct theoretical interconnection between singularities of the Jones matrix elements of the biological liguid crystal and polarization singularities in its laser image.

It is easy to show that the singular value of the Jones matrix are corresponding to characteristic value of the Mueller matrix:

- the values $M_{44} = 0$ and $V_4 = \pm 1$ determine the complete set of ±C-points ($d = \pm 90^{\circ}$);
- the complete set of S-points ($d = 0^{\circ}$) of the laser image is caused by the terms $M_{22} = M_{33} = M_{44} = 1$ and $V_4 = 0$.

In addition to the above mentioned, the Mueller-matrix analysis enables to perform the sampling of polarization singularities of the laser image, formed by biological liquid crystals with orthogonally oriented ($d = 0^{\circ}$, 90° и $d = 45^{\circ}$, 135°) optical axes to:

- “orthogonal” $\pm C$ -points $\begin{cases} M_{33} = 0, M_{34,43} = \pm 1 \quad - \quad \pm C - (r = 0^{\circ}, 90^{\circ}), \\ M_{22} = 0, M_{24,42} = \pm 1 \quad - \quad \pm C - (r = 45^{\circ}, 135^{\circ}). \end{cases}$
- “orthogonal” $S_{0;90}$ - and $S_{45;135}$ - points $\begin{cases} M_{24,42} = 0 \quad - \quad S_{0^{\circ},90^{\circ}} - (r = 0^{\circ}, 90^{\circ}), \\ M_{34,43} = 0 \quad - \quad S_{45^{\circ},135^{\circ}} - (r = 45^{\circ}, 135^{\circ}). \end{cases}$