# Airy Optics ® Polaris-M

## Polaris-M Polarization Ray Tracing Software Capabilities

**Description**: Airy Optic's premier optical analysis product is built for the design and analysis of general optical systems with emphasis on polarization modeling and analysis. The **Polaris-M** polarization ray tracing engine will refract, reflect, and total internally reflect rays using 3-D polarization ray tracing matrices through complex assemblies of spherical, aspheric, and freeform lenses, anisotropic crystals, diffraction gratings, anisotropic multilayer films, liquid crystal cells, and elements with stress birefringence. **Polaris-M** calculates polarization dependent amplitudes, polarization states, optical path lengths, wavefronts, polarization point spread functions, and optical transfer functions. Includes large collection of Jones and Mueller matrices and functions. Renders polarization ellipses and Poincaré spheres in 3D.

**Applications**: Imaging systems, illumination systems, monochromators, realistic polarization elements, liquid crystal systems, etc.

**Surface types:** Plane, sphere, conic, freeform, user defined, spline, CAD import, or generated from point cloud. General aperture shapes from arbitrary Boolean functions.

**Material types and libraries:** Includes refractive index libraries of isotropic materials, metals, commercial glass catalogs, common thin film materials, and crystals (uniaxial, biaxial, and optically active materials). User defined materials and dispersion equations can be added.

**Coatings:** Multilayer isotropic, ideal coatings (non-polarizing), Jones matrix, multilayer anisotropic, isotropic gratings, (anisotropic gratings, available as an add-on). Can operate using tabulated coating data (s and p-amplitude or intensity and phase imported from ellipsometry or polarimetry data).

**Ray trace forms:** Sequential, non sequential, automated ray doubling, beam dividing at beamsplitters and interfaces. Coherent ray trace with optical path lengths and **E**-fields. 3-D polarization ray tracing matrices at all ray intercepts and accumulated through the system. Incoherent ray trace with Mueller matrices for all ray intercepts.

4961 E. Oakmont Dr., Tucson, AZ 85718 303 518 2637 khawkins@airyoptics.com

**Anisotropic ray trace:** For reflection, refraction, and TIR, calculates wave vectors, Poynting vectors (ray directions), **E**, **D**, **H** and refractive index for each mode (uniaxial: ordinary and extraordinary; biaxial: high and low index), amplitude coefficients (Fresnel coefficients), ray intercepts and optical path lengths. 3-D polarization ray tracing matrices and Mueller matrices at all ray intercepts. Automated ray doubling. Combination of exiting modes into combined wavefronts. User defined criteria to kill rays.

**Stress birefringence analysis:** Stress defined by closed form analytic expressions or data imported from MoldFlow® and Timon3D® CAD programs. Effect of stress birefringence on wavefronts, interferograms, and point spread functions can be calculated. Multiple stressed elements can be included within larger optical systems.

**RCWA:** *Rigorous coupled wave analysis* of diffraction gratings formed from isotropic materials. Calculates amplitude coefficients, phases, and diffraction efficiencies for each diffraction order and integrates these within the ray trace. Also runs as a standalone RCWA analysis package. RCWA with *anisotropic* materials available as an add-on to **Polaris-M**, or separately as **AiryAnisoRCWA**.

**Polarization Matrix Packages:** Extensive Jones matrix and Mueller matrix functions, Jones/Mueller/3D matrix interconversions, matrix data reductions into retardance, diattenuation, and depolarization, matrix root decompositions, degree of polarization maps, and more.

**Graphics:** Optical systems, ray paths, polarization states, Jones pupils, Mueller matrix pupils, polarization point spread functions and polarization optical transfer functions.

**Mathematica:** Requires Wolfram Research's *Mathematica*®. All quantities can be further manipulated within *Mathematica* for flexible operation.

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