# LIMITS OF BACKREFLECTION MUELLER MATRIX POLARIMETRY: LESSONS FROM QUASI TRANSPARENT TISSUES

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Transmission and backreflection are the two main modalities in biomedical Mueller matrix polarimetry, but they are often treated as equivalent. Transmission, commonly used for ex vivo tissues like histological sections, involves straightforward light–tissue interactions, allowing clear measurements of birefringence and depolarization. Backreflection, required for in vivo imaging, involves complex multiple scattering and includes both diffuse and specular components. Specular highlights can distort the Mueller matrix, leading to overestimated retardance and polarization purity. We have developed methods [1] to reduce these highlights and improve measurement accuracy.

A curious example of the large discrepancy between transmission and reflection measurements is chicken breast tissue. Nearly transparent in the near-infrared and naturally birefringent, its muscle fibers show strong retardance in transmission. Yet in backreflection, the measured retardance (see Fig. 1) becomes nearly undetectable due to deep light penetration and the interplay of multiple scattering and multiple-order birefringence. This highlights that transmission-based interpretations cannot be directly translated to backreflection scenarios. Accurate analysis demands modality-specific models and correction strategies.

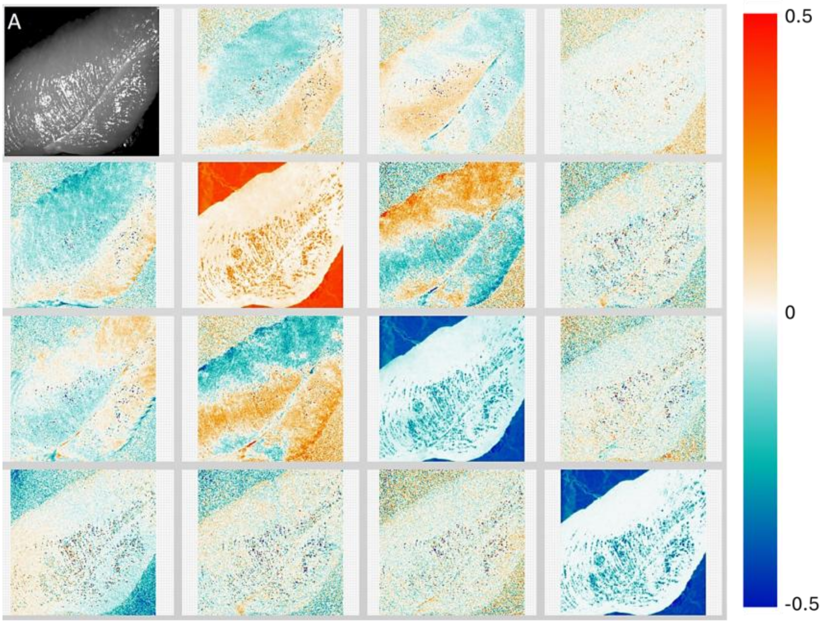


Fig. 1: Wide-field imaging in backreflection of chicken breast at 660 nm. This sample mostly behaves as a depolarizing diattenuator instead of a retarder

[1]. I. Pardo, S. Bian, E. Pascual, and O. Arteaga, “Method for reducing specular reflections in Mueller matrix imaging,” Opt. Express 33, 21183-21193 (2025)