UAB
Universitat Autònoma de Barcelona

Technology Offer

# Static Complete Fast time Polarimeter

## THE INVENTION

**We present a complete polarimeter composed by two biaxial crystals. This design corresponds to a static polarimeter (without mechanical movements or electrical signal addressing). Only one division of amplitude is required to completely characterize any state of polarization, incliuding partially polarized and unpolarized states.**

## Innovative aspects and advantatges

> Static polarimeter
> Large data redundancy
> Fast time measurements
> Complete polarimetric measurements
> Easy extendible to any wavelength such as the infrared.
> Just one division of amplitude is required

## IP Rights

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## Scientific Team

Optics Research Group - UAB


## Summary

Polarimeters are the basic devices to measure the polarization of the light (Stokes polarimeters) or characterizing the polarimetric properties of a polarizing sample (Mueller polarimeters) from radiometric measurements.

This polarimetric information is crucial in a large number of applications such as:

> Biomedicine
> Material modelling and characterization
> Remote sensing
> Astronomy
> Art
> Among others


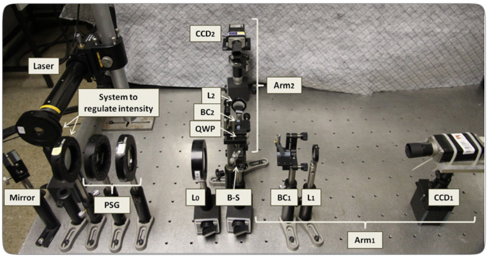


*Fig. 1 Implemented Stokes polarimeter based on two biaxial crystals.*

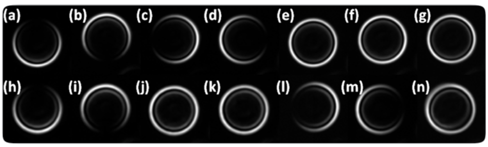


*Fig. 2 Experimental images acquired by cameras of arm 1 (a-g) and arm 2 (h-n) when illuminating with linearly polarized light at 0° (a,h), at 90° (b,i), at 45° (c,j), at 135° (d,k), with circularly polarized light right handed (e,l) and left handed (f,m) and with unpolarized light (g,n).*


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## The Invention

We present a novel concept to measure states of polarization based on the mapping that conical refraction (CR) phenomenon produces between the polarization of the input beam and the transverse intensity distribution along the light ring of the output beam.

This concept is materialized into the design of a new division of amplitude polarimeter based on two biaxial crystals.

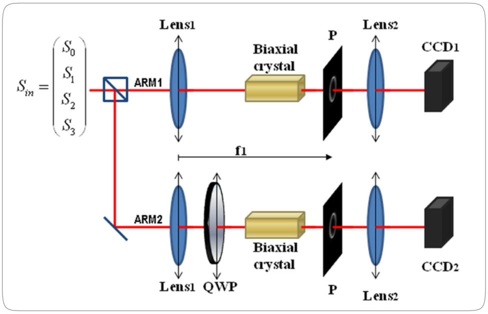


*Fig. 3 Proposed setup of the polarimeter based on two biaxial crystals. The incident light beam is divided in two arms for being separately analyzed. In arm 2, there is an additional quarter waveplate (QWP).*

By using this alternative, not only the benefits of amplitude division polarimeters are present but also, just one amplitude division is needed to implement a complete polarimeter. We are able to distinguish each state of polarization, including unpolarized light beams.

The polarimeter is complete since the PAs (Polarizing Analyzers) represented upon the sphere are enclosing a certain volume.

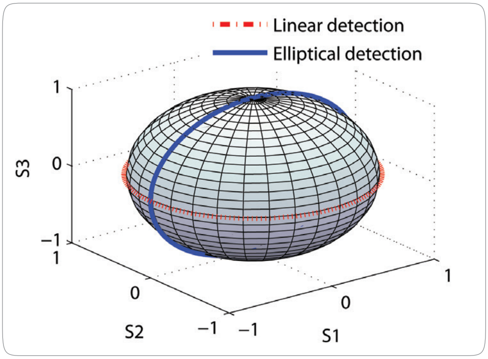


*Fig. 4 PAs represented upon the Poincaré sphere. Red line corresponds to the linear detection arm and blue line to the elliptical detection arm (assuming that the QWP is at 0º).*

Quality indicators used : Condition Number (CN), Equally Weighted Variance (EWV).

The CN calculated for our PAs arrangement is equal to 2.00, value very close to the theoretical minimum 1.73 for polarimeters.

Unlike CN , the EWV indicator is able to account for the benefits of data redundancy. As the design of the CR polarimeter proposed includes a CCD camera, it is able to instantaneously increase the data redundancy in the system just by increasing the number of PAs selected at the ring distribution, being this number only limited by the pixel geometry. In contrast to other polarimeter architectures, this appealing feature of the CR polarimeter allows us to instantaneously decrease, to certain extent, and without an increase of the measuring-time, the final Stokes variances, being the EWV a useful indicator to show such enhancement.

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