

Technology Offer

High-Precision Rotation Holder for Optical Components

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Abstract

The invention presents a high-precision rotation holder designed for optical components such as polarization filters. This innovative device features a rotor with an axial hollow shaft and an air-bearing system for frictionless rotation. Driven by an airflow turbine, the holder incorporates an angle encoder for precise measurement of the rotational position. Key applications include polarimetry in the terahertz spectrum, enabling advanced analysis of electromagnetic radiation. The invention ensures higher rotational speeds, reduced vibrations, and reliable operation even in strong magnetic fields, addressing limitations of conventional systems.

Background

Traditional systems for polarimetry in the terahertz range often employ mechanical setups prone to vibrations, limited speed, and inaccurate angle detection. Existing technologies like belt-driven rotors or static polarimeters lack sufficient reproducibility and precision, especially under the influence of magnetic fields or at high speeds. A demand exists for a robust and accurate rotation system that maintains performance in challenging experimental conditions.

Technology

This invention features a high-precision rotation holder combining an air-bearing-supported rotor and an air-driven turbine system (Fig. 1). The rotor, equipped with a hollow shaft, securely holds an optical element, ensuring precise alignment along its rotation axis. Unlike conventional mechanical systems, the air-bearing design minimizes friction and vibrations, enabling ultra-smooth and precise movement.

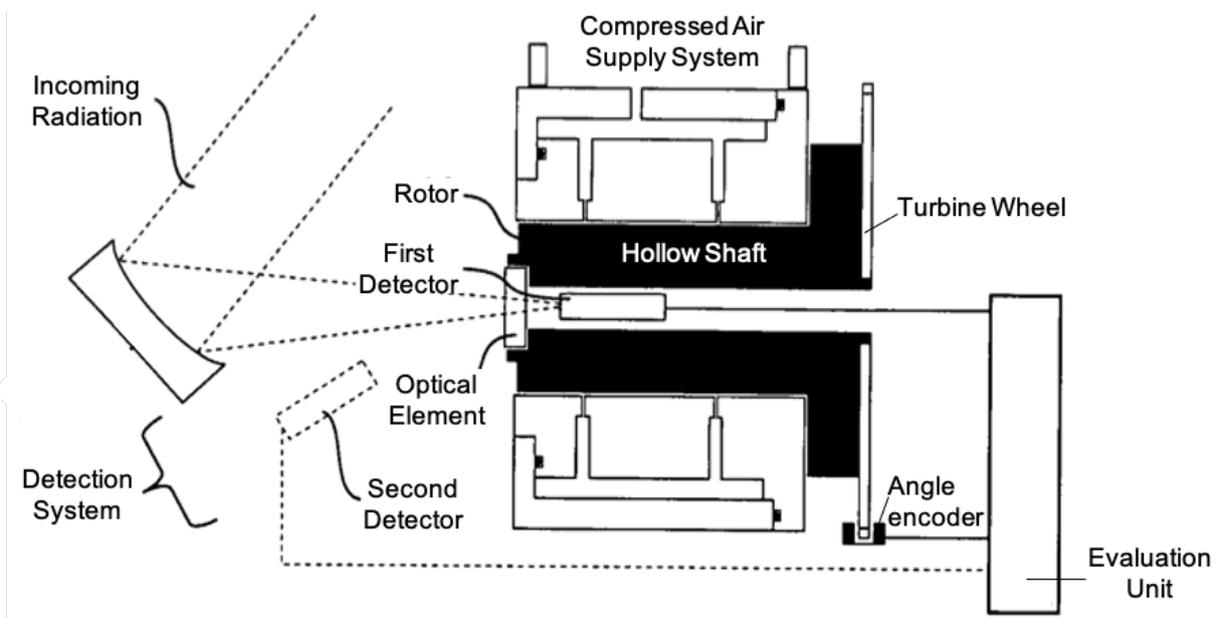


Figure 1: Schematic of the high-precision rotation holder integrated into a polarimeter system. Key components include the rotor with a hollow shaft for mounting the optical element, a turbine wheel powered by a compressed air supply system for rotation, and an angle encoder for precise rotational position measurement. The setup illustrates the interaction of incoming radiation with the optical element and the detection system (first and second detectors).



A turbine wheel, powered by a compressed air supply, drives the rotor, allowing rotation speeds exceeding 12,000 rpm without mechanical wear. A high-resolution angle encoder continuously tracks the rotor's position, providing real-time angular data with sub-degree accuracy. This ensures highly reproducible optical measurements, even in environments with strong electromagnetic interference. The system is particularly suited for polarimetry, where precise rotational control of optical components significantly enhances measurement accuracy and reliability. This invention provides a robust and accurate rotation system that maintains performance in challenging experimental conditions.

Advantages

- **High Precision:** Sub-degree angle measurement via optical encoding.
- **High Speed:** Operational speeds over 12,000 rpm with stability.
- **Reduced Vibrations:** Air-bearing and dynamic balancing eliminate mechanical instability.
- **Magnetic Immunity:** Non-magnetic materials enable reliable use in electromagnetic fields.
- **Versatile Application:** Compatible with various optical components, including polarization filters and birefringent elements.

Potential applications

- Polarimetry in the terahertz spectrum for plasma diagnostics.
- Calibration of optical instruments, including polarimeters.
- Optical modulation in research and communication systems.
- Characterization of materials under stress-induced birefringence.
- High-speed rotation of custom optical elements in experimental setups.

Patent Information

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