Max-Planck-Innovation

Technology Offer

Device for deflecting a light and/or microwave beam with automatic beam tracking

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Abstract

This innovative device enables precise deflection of light/microwave beams with automatic beam tracking. Thanks to a specially developed hinge system with an integrated reflector, the beam can be guided reliably and with low loss to the desired target point despite the movement of the beam guide. This is particularly advantageous for applications in high-precision optics, sensor technology and plasma physics. The system is characterized by high stability and durability due to the use of low-wear bearing and guiding elements. The technology is ideal for use in vacuum chambers, laser systems, or other scientific and industrial applications where mobile but precise beam guidance is required.

Background

Conventional beam deflection systems often comprise fixed or moving mirrors that require manual or motorized adjustment. However, in many applications, especially in plasma physics or laser technology, the movement of beam sources or detectors poses a challenge to precise beam guidance. Conventional mechanical solutions are prone to wear and inaccuracy, especially when used for long periods or at high frequencies. This new technology overcomes these limitations by automatically adapting the deflection mirror to the movement of the beam delivery parts, ensuring continuously accurate beam delivery.

Technology

The novel device for deflecting a light or microwave beam contains two articulated mounting legs, to each of which movable beam guiding parts are attached (Fig. 1). A reflector/mirror, mounted on a movable coupling unit, automatically adjusts its alignment to changes in position of the beam guiding parts, thereby enabling the beam to track the movement of the beam guiding parts (Fig. 2). The mirror is moved using coupling arms that are coupled to the movable coupling unit via plain or roller bearings, thus ensuring precise, backlash-free alignment of the mirror. The reflective surface of the mirror is made of highly reflective materials and can optionally be tempered to minimize thermal influences. The mechanical coupling of the coupling arms to the coupling unit enables low-wear, movable beam guidance. The movable beam guide remains reliable and stable even after prolonged use.

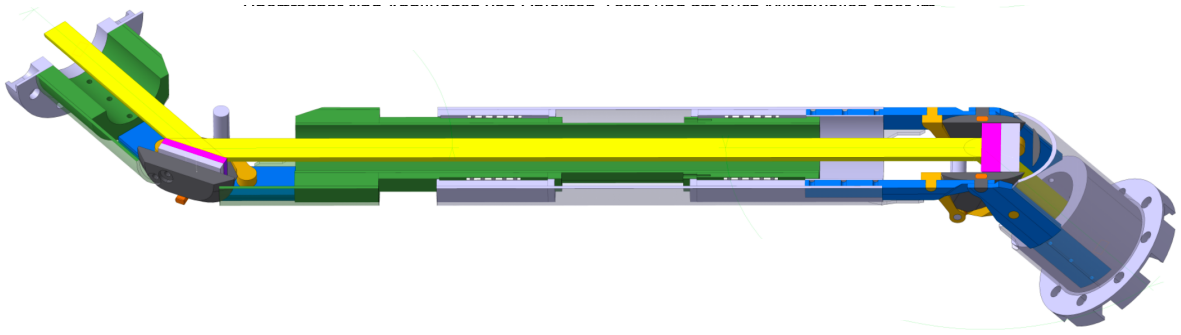

Figure 1: Schematic illustration of the movable beam guide with articulated mounting legs (colored blue), beam guiding parts (colored gray/green) and the movable coupling unit/joint (colored black). The yellow line shows the beam path, which is automatically tracked by precisely aligned mirrors (colored purple). The movable beam guide combines flexible joints with a rigid guide to provide low-loss deflection of the beam at different positions.

Max-Planck-Innovation GmbH
Arnulfstr. 58
80335 München
www.max-planck-innovation.de

Advantages

- **Automatic beam tracking:** No manual intervention required as the reflector automatically adjusts itself.
- **Durability & Low Maintenance:** Low-wear guides and high-quality materials reduce maintenance costs.
- **Versatile applications:** Usable for light and microwave beams in various technical and scientific environments.
- **Space saving & compact design:** Ideal for use in confined research and industrial environments.

Potential applications

- **Laser Systems & Optical Sensors:** Precise deflection of laser beams in measurement and processing systems.
- **Plasma Physics & Fusion Research:** Beam guidance into the vacuum vessel of a fusion reactor.
- **Medical laser surgery:** Beams guidance to different parts of a patient's body.
- **Radar & communications:** Deflection of microwave beams in antenna systems.
- **Automated manufacturing:** Optimization of beam delivery in precision manufacturing systems.

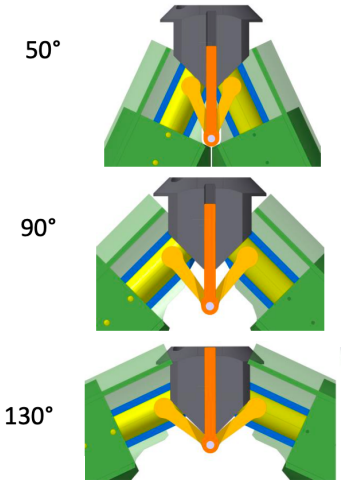

Figure 2: Reflector articulation shown with adjustable 2" mirror at different aperture angles (50°, 90°, 130°). Automatic beam tracking is achieved by mechanically coupling the coupling arms (colored orange) to the articulated mounting legs (colored blue) and the movable coupling unit/joint (colored black). The reflector/mirror is mounted on the movable coupling unit. At any aperture angle the incoming light is reflected into the outgoing arm of the beam guide.

Patent Application

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Contact

PD Dr. Wolfgang Tröger Senior Patent- & License Manager, Physicist
Phone: +49 (0)89 / 29 09 19 – 27
eMail: troeger@max-planck-innovation.de

Dr. Franz Gadelmeier Patent- & License Manager, Physicist
Phone: +49 (0)89 / 29 09 19 – 13
eMail: gadelmeier@max-planck-innovation.de