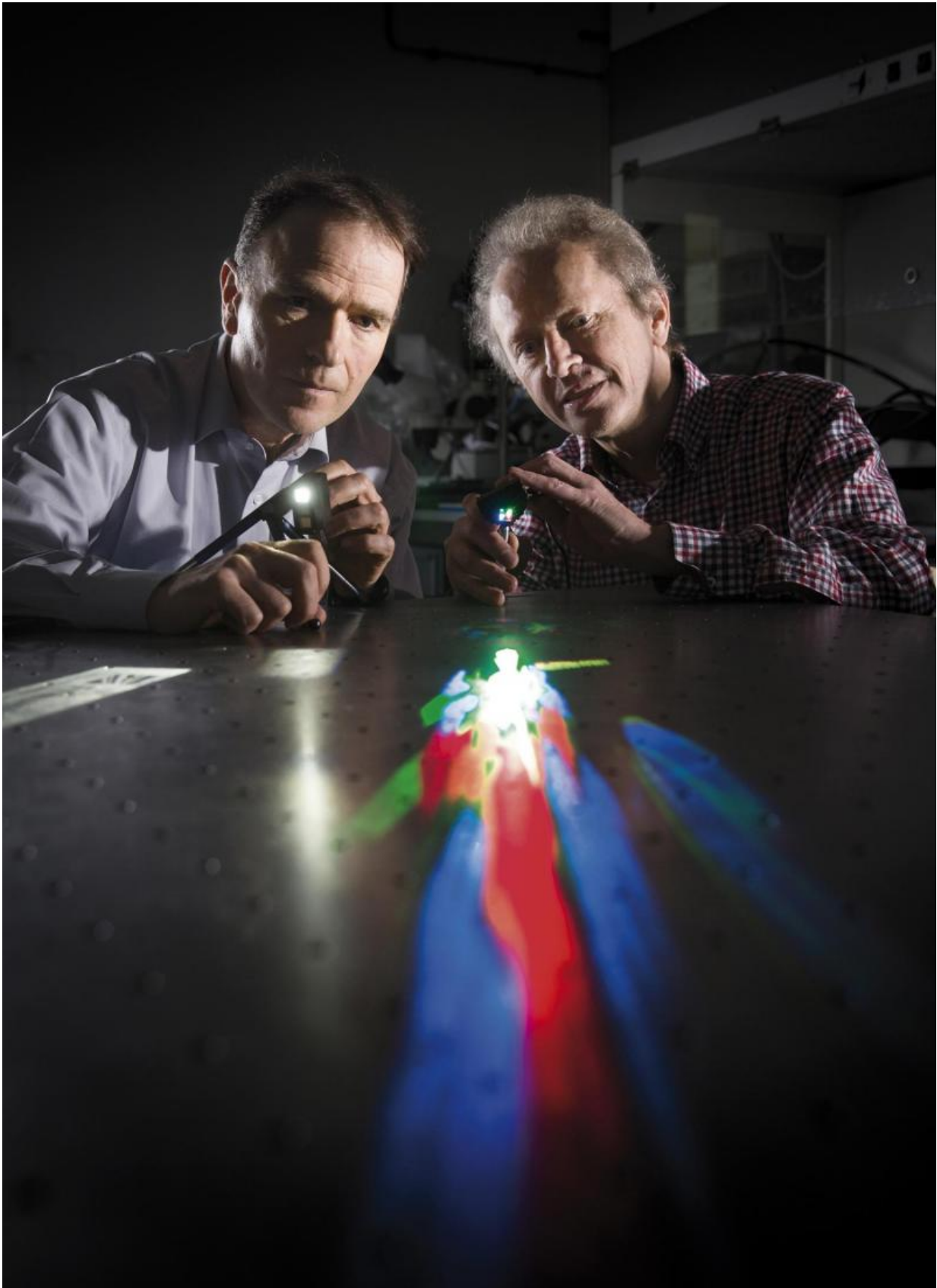


Little projectors that pack a big punch

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The array projector developed by Peter Dannberg, Peter Schreiber (from the left) and Marcel Sieler (not shown) projects an extremely bright image in spite of its minimal size. Credit: Dirk Mahler/Fraunhofer

An image projected on a slanted or curved surface appears distorted and can appear out of focus in some areas. A high-intensity mini-projector about the size of a Euro cent coin from the Fraunhofer IOF in Jena, Germany can now correct for this effect. The projector's secret: Hundreds of tiny lenses inspired by the model of an insect's compound eye.

It took only a few years for Fraunhofer researchers to develop a miniature projector, from concept to series production. Compared to conventional models with one channel projecting one image, the LED array projector from the Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena creates a bright and crisp image by overlaying hundreds of channels on one another, exact down to the pixel. "Our array projector can represent sharply focused and undistorted images on almost any curved or slanted surface. At the same time, we've succeeded in redefining the typical scaling rules of classic projection systems and consequently we've created extremely compact projectors," explains Dr. Peter Schreiber, responsible for micro-optical illumination systems at the IOF.

Array projector rolls out a carpet of light for the BMW 7 series

As more and more technology is built into cars, these properties are particularly interesting to the automotive industry: Individual components have to be small and very thrifty when it comes to energy

consumption. This also applies to illumination, both in and on the vehicle. The LED array projector masters these challenges. "The technical advantages, particularly in automotive applications, include for example the small dimensions and ruggedness of the microoptics," points out Marcel Sieler, former project manager at the IOF. Sieler was among those responsible for realizing the projector on an industrial basis, which has been featured in 7 series BMWs since mid-2015, creating a light carpet about four meters in length along the side of the car, illuminating obstacles and irregularities on the ground. "This is the world's first implementation of a complex microoptics module in a series-production car," says Dr. Peter Dannberg, who developed the projector's manufacturing process. The light module is built into the BMW below the door and not in the door, as is the case with other manufacturers. Here the BMW is taking advantage of another special feature of the Fraunhofer development: "An array projector is capable of projecting bright and sharply focused images without slanted optical elements, even at very small angles of incidence," says Peter Schreiber.

The IOF illumination system consists of an array of several micro-projectors. Each projector consists of a micro-lens for illumination and a second lens for projection, with a slide between them. An array projector arranges hundreds of such micro-projectors together. "Array projection overlays the individual images of the micro-optical projectors so that they form a bright complete image on the screen and ensure even illumination at the same time," Sieler explains. The projected image is made brighter by simply increasing the number of the deployed "projectorlets". This means the array projector size only needs to increase in terms of surface area, while the thickness of only about three millimeters remains the same. A conventional system on the other hand would have to increase its overall volume in order to increase light flow.

Also suitable for use in data glasses and measurement

technologies

Peter Schreiber also sees potential in additional applications: "We're thinking about whether the array projector might be suitable for use in ultra-compact data glasses or as a spotlight with special light distribution. I also see the possibility of generating efficient and highly dynamic light patterns in measurement technologies."

Peter Schreiber, Marcel Sieler and Peter Dannberg have received this year's Joseph-von-Fraunhofer prize for their work on the development of the LED array projector. Among other things the jury based its decision on "the development of another German automotive engineering component that will help position German manufacturers as premium vendors."

Provided by Fraunhofer-Gesellschaft

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