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A Novel Dense Fiber Array for Astronomical Spectroscopy

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With a Phase I Small Business Innovation Research (SBIR) grant from the National Science Foundation (NSF) we are building a high-density fiberscope. We propose a novel method for constructing a fiberscope for measuring the spectra of a large number of distant, celestial objects. Our design will provide a tenfold increase in the rate of red-shift measurements for cosmological surveys. We solder cylindrical, piezo-electric actuators to a rigid base, arranging them on a 5-mm grid. We glue a steel mast to each actuator. At the tip of each mast is an optical fiber. We bend each actuator by up to 6 mrad in two directions by applying ±250 V to its four electrodes. The tip of a 300-mm mast moves in a 3.8-mm square and locates the optical fiber with a precision of 10 μm rms. The positioner is mechanically simple but electrically complex. There are no moving parts other than the bending of the tube, but every tube requires its own amplifiers, converters, and control logic. Our miniaturized actuator electronics fit in the 5-mm square cross-section beneath each fiber. The positioner provides continuous adjustment of each fiber at a cost of only 10 mW per actuator. By making fibers available on a 5-mm pitch, our positioner makes it possible to place 50,000 fibers on a 1.3-m diameter focal plane, or 1,000 fibers in an 18-cm diameter. We are building a 16-fiber prototype now, and in the next two years we propose to build a 500-fiber fully-functional fiberscope for a collaborating telescope.

In-person or Virtual?

In-person

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