Taichi: A large-scale diffractive hybrid photonic AI chiplet

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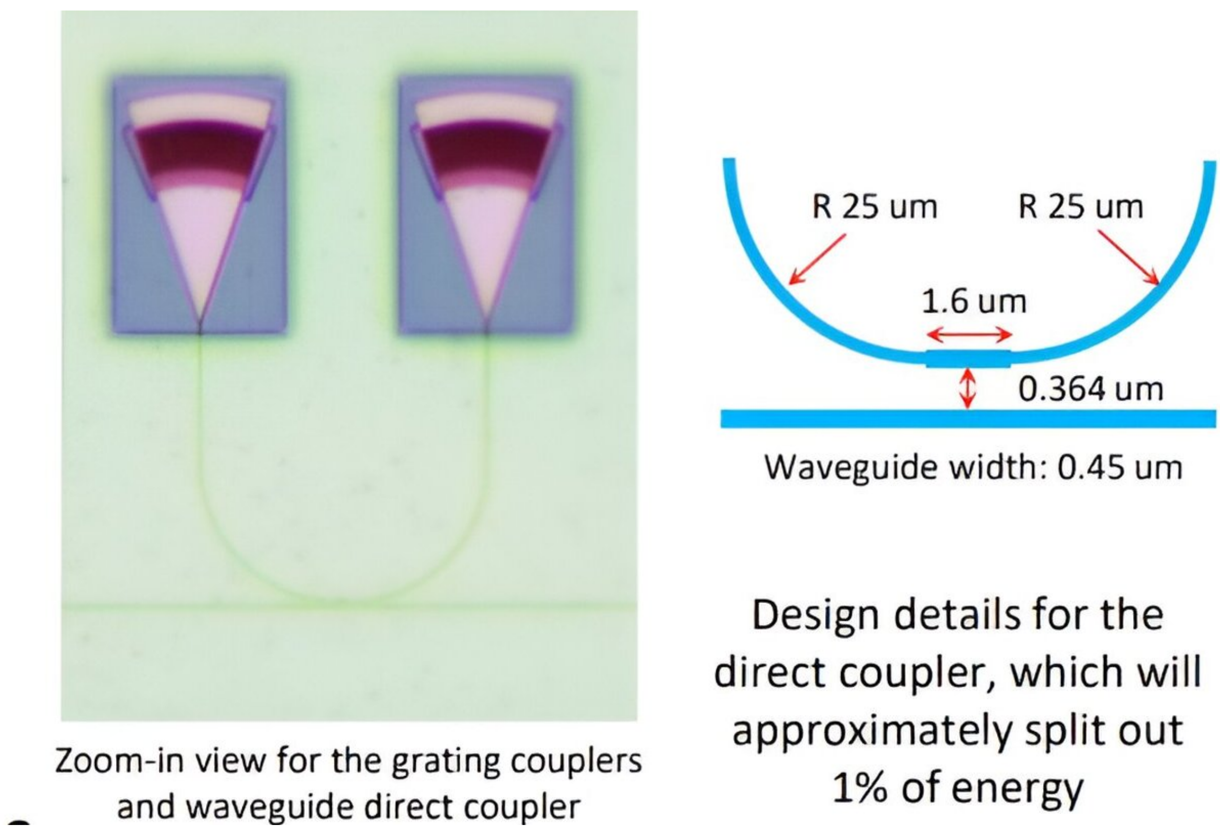

Device details for Taichi chiplets. a, The microscopy image for grating couplers and direct couplers in the chip design. b, The detailed sizes for the direct coupler. We decided these parameters with FTDT simulations. c, The microscopy image for the edge coupler we used for laser input. d, The microscopy image for the phase shifters. Credit: *Science* (2024). DOI:

10.1126/science.adl1203

A combined team of engineers from Tsinghua University and the Beijing National Research Center for Information Science and Technology, both in China, has developed a large-scale diffractive hybrid photonic AI chiplet for use in high-efficiency artificial general intelligence applications. Their paper is published in the journal *Science*.

As software AI applications have become mainstream over the past several years, computer engineers have been hard at work looking for ways to build hardware that either supports AI software more efficiently or that carries out AI computing directly.

In this new study, the team in China focused on the latter, seeking to find ways to conduct AI processing more quickly and efficiently. To that end, they have created a chiplet—an integrated circuit that carries out clearly defined subsets of functionality that are typically used with other chiplets to carry out tasks that comprise packages based on light rather than electricity.

At the heart of the new research is the goal of building an artificial general intelligence (AGI) model. Such a model would, in theory, be composed of a variety of chiplets, including those like Taichi, that together would form a neural-network based computer with artificial intelligence capabilities that match or surpass those of the human brain.

One of the main hurdles in creating such a model is the computing power requirements. Currently, graphics processing units are the main components of such systems, but more powerful technology is needed for an AI system to match the intelligence capabilities of humans. The team in China suggests that the answer is to use light instead of electricity for processing—the resulting computer would use much less electricity and be able to carry out calculations more quickly.

The researchers note that Taichi was designed and built much like other light-based chiplets—the difference is that it can be scaled up far more easily, allowing for many of them to be used together to create an AGI.

In testing their design, the team found it capable of achieving a network scale of 13.96 million artificial neurons, which is far better than the 1.47 million reported by other chiplet makers.

More information: Zhihao Xu et al, Large-scale photonic chiplet Taichi empowers 160-TOPS/W artificial general intelligence, *Science* (2024). DOI: 10.1126/science.adl1203