

# HYBRID GUIDED-WAVE AND FREE-SPACE SYSTEM FOR BROADBAND INTEGRATED LIGHT DELIVERY

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## BRIEF DESCRIPTION

Photonic integrated circuits (PICs) have emerged as an encouraging platform for many fields due to their compact size, phase stability, and can be mass produced in semiconductor foundries at low cost. As such, PIC enabled waveguide-to-free-space beam delivery has been demonstrated towards ion trap quantum computing, atomic clocks, optical tweezers, and more. Grating couplers are commonly used, as through careful design, they can generate diffraction-limited focused spots into free space from a waveguide input. However, they suffer from many drawbacks – they have a narrow optical bandwidth, limited efficiency, are sensitive to light polarization and the emission angle is sensitive to fabrication variation.

Quantum systems require stable delivery of multiple wavelengths, often spanning the near ultraviolet (NUV), visible, and near infrared (NIR) spectrum, to multiple locations tens to hundreds of micrometers above the PIC. This requirement exacerbates the pitfalls of grating couplers; their single-wavelength operation necessitates multiple gratings per unit cell. With more gratings to fabricate, fabrication variance takes a greater toll on device performance. UC Berkeley researchers have devised a new approach and device to deliver light from in-plane waveguides to out-of-plane free space beams in a low-loss, broadband manner. In particular, this device is used for controlling qubits in a trapped ion quantum computer, but in general the system is suitable for other integrated beam delivery applications.

## PATENT STATUS

Patent Pending

## SUGGESTED USES

Trapped ion quantum computing and quantum systems

## ADVANTAGES

This system greatly simplifies the challenge of free-space beam alignment, stabilization, and scalability issues.

## RELATED MATERIALS

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

► [Compact Ion Gun for Ion Trap Surface Treatment in Quantum Information Processing Architectures](#)

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## OTHER INFORMATION

### KEYWORDS

trapped ion quantum computer

### CATEGORIZED AS

- » **Optics and Photonics**
  - » All Optics and Photonics
- » **Computer**
  - » Hardware
  - » Other

### RELATED CASES

2023-155-0

