

FIRST-PIC: Update on status and current state of technology

The Fibred Imager for a Single Telescope (FIRST) instrument is a visible light spectro-interferometer installed at the Subaru telescope. It recombines the sub-apertures of the telescope's pupil to detect and spectrally characterize faint star companions. The upgrade to a photonic integrated circuit (PIC), referred to as FIRST-PIC, will provide a stable, compact, and scalable replacement to the bulk optic system currently installed, with future iterations to replace the remaining required fibre optic components. A full upgrade will allow for higher sensitivity and increase the number of available targets, potentially enabling the direct imaging of brown dwarfs and exoplanets.

Previous generations of FIRST-PIC used low-index contrast technologies to combine five sub-apertures. These PICs had a total loss >70% with some exhibiting high cross talk and polarisation sensitivities. A high index contrast technology, fabricated by LioniX International, was optioned for the next generation PIC that should be low loss without any cross talk or polarisation issues. It will also be smaller, confined within a 10x10mm footprint, than the previous PICs. In this talk we will discuss the fundamental building blocks, such as splitters and combiners, for both technologies, specifically discussing the loss and consistency over a broad wavelength range, including injection from fibre optics, crossed waveguide, radial and junction bend losses, and transmission of the waveguides themselves.

Given the widespread integration of PICs in telescopes globally, progress in this technology promises collective advancements across all related fields.