



Low Loss Optical Waveguides for Astronomical Heterodyne Imaging

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Program: FY22 R&TD Topics
Strategic Focus Area: Nano- and Micro- Devices/Systems

Objectives:

- Develop low-loss GaAs photonic waveguides operating at long-Infrared portion of the optical spectrum (10 μm).
- Couple Quantum Well Infrared (QWIP) detectors with the waveguides
 - Improve QWIP detection efficiency
 - Enhance scalability for linear detector arrays

Background:

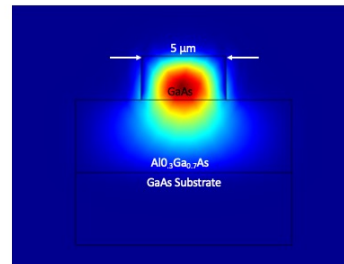
- High angular resolution imaging requires multi-telescope interferometers
 - Not possible to build single telescopes
 - Heterodyning astronomical signals with a local oscillator in the mid-infrared portion of the spectrum, allows observation of stellar sizes, shapes and asymmetries with high angular resolution.
 - Infrared Spatial Interferometer on Mount Wilson is a heterodyne interferometer limited by the signal-to-noise ratio due in part to the single local oscillator
- Optical frequency combs when used as the Local Oscillators (LOs) in these heterodyne systems offer game-changing wide bandwidth and radical simplification of the required infrastructure.

Approach and results:

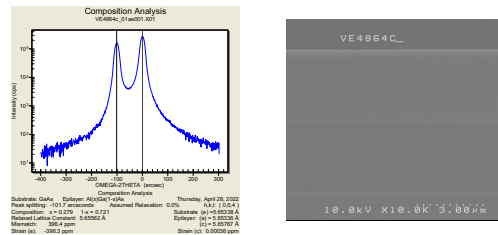
AlGaAs/GaAs photonics

- Platform is compatible with QWIP technology
 - Allows for eterogenous integration
- III/IV is mature and allows for easy processing

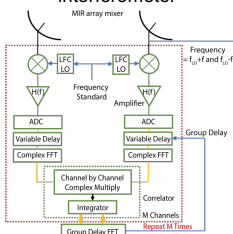
Simulated TE mode profile of a GaAs/AlGaAs heterostructure



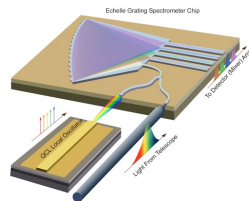
X-ray (left) and SEM image of cross section (right) of the grown GaAs/AlGaAs heterostructure



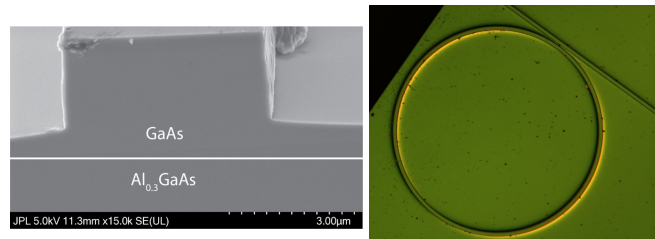
M-element long-baseline frequency comb-based interferometer



Comb enabled Heterodyne analyzer



SEM image of the fabricated waveguides (left) and optical image of the fabricated photonic chips



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