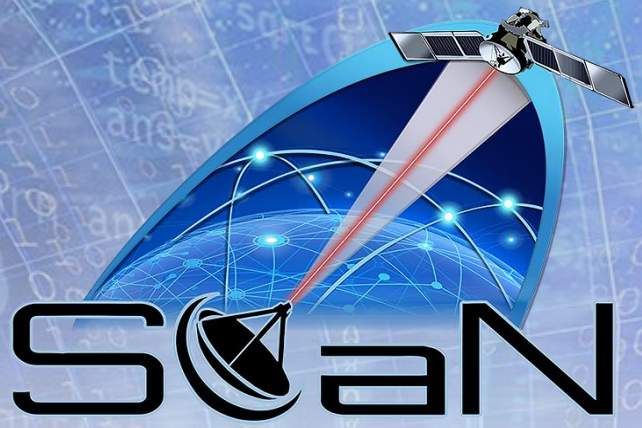
National Aeronautics and Space Administration



Modeling Electro-Optic Frequency Comb Generation as a Pump Source for Quantum Communications

Intern: Conner Stevons
Mentor: Brian Vyhnalek

Glenn Research Center

Summer 2021

My Journey to NASA

Conner Stevons

University of Michigan

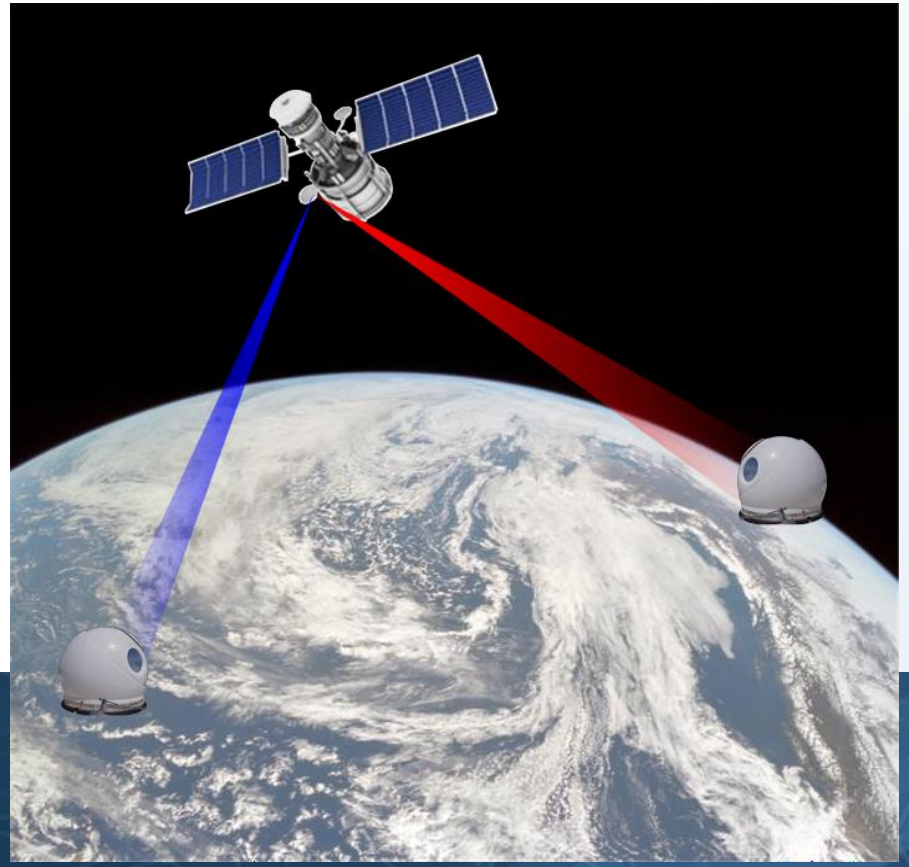
Masters in Electrical Engineering – Optics & Photonics

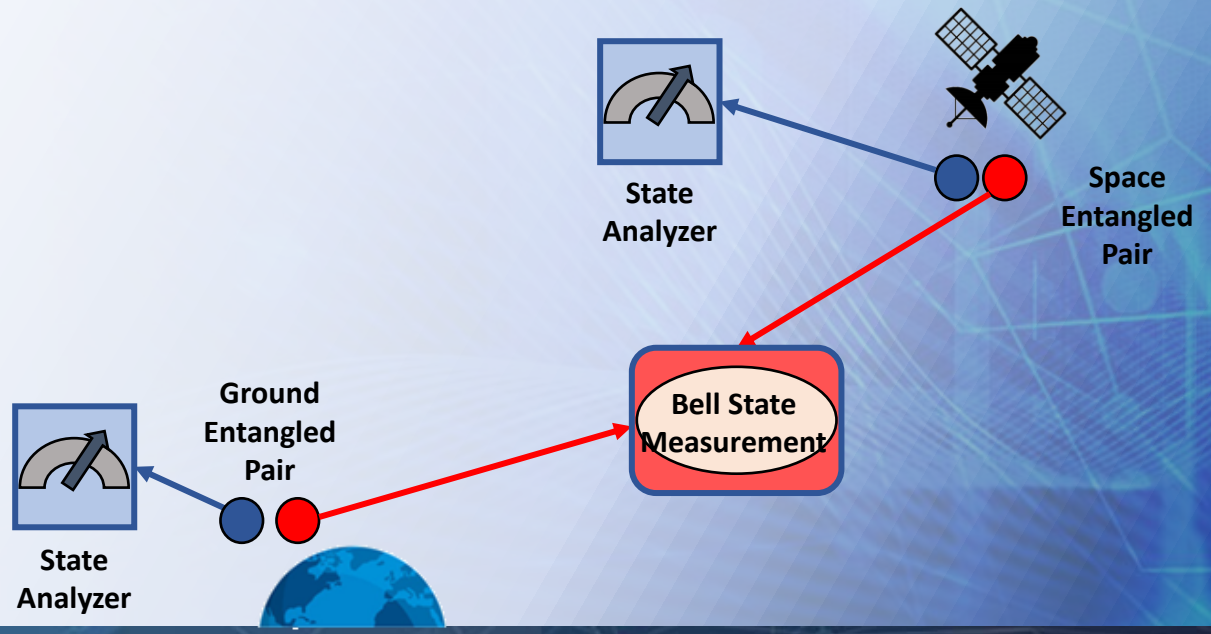
(December 2021)

Returning intern (2nd summer)

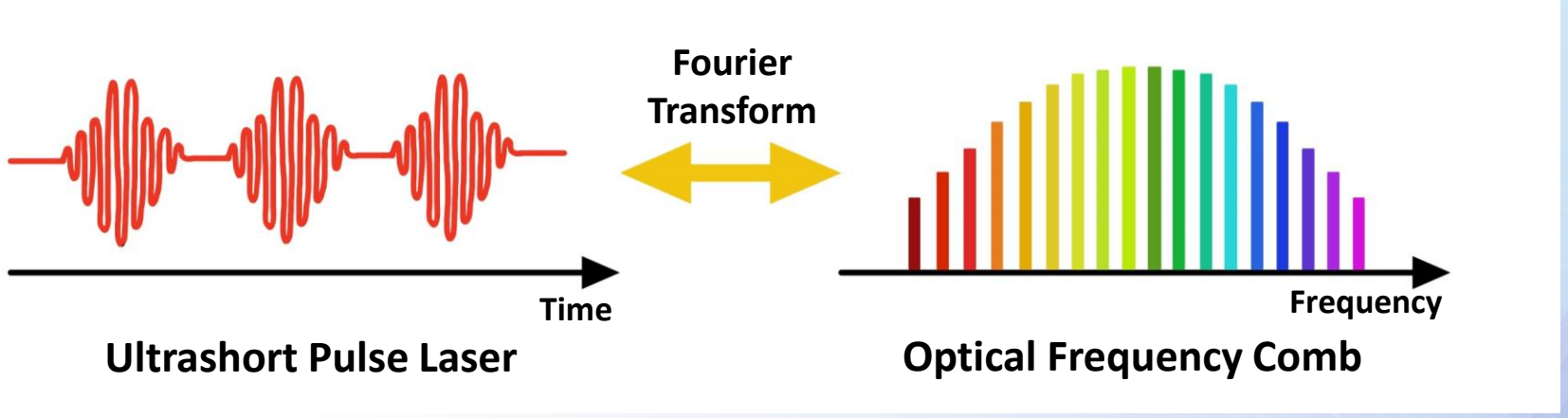
Space-Based Quantum Network

- ***Next frontier of space communications***
- ***Implementation of entanglement swapping***
- ***Notable requirement: High-rate of photonic entanglement***

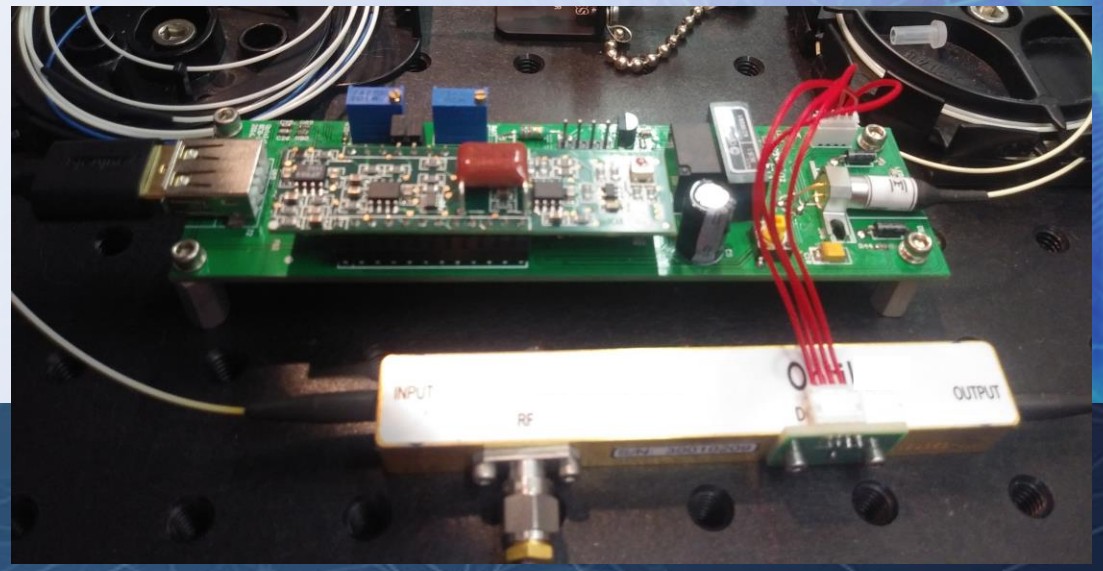




Source Solution: Optical Frequency Combs

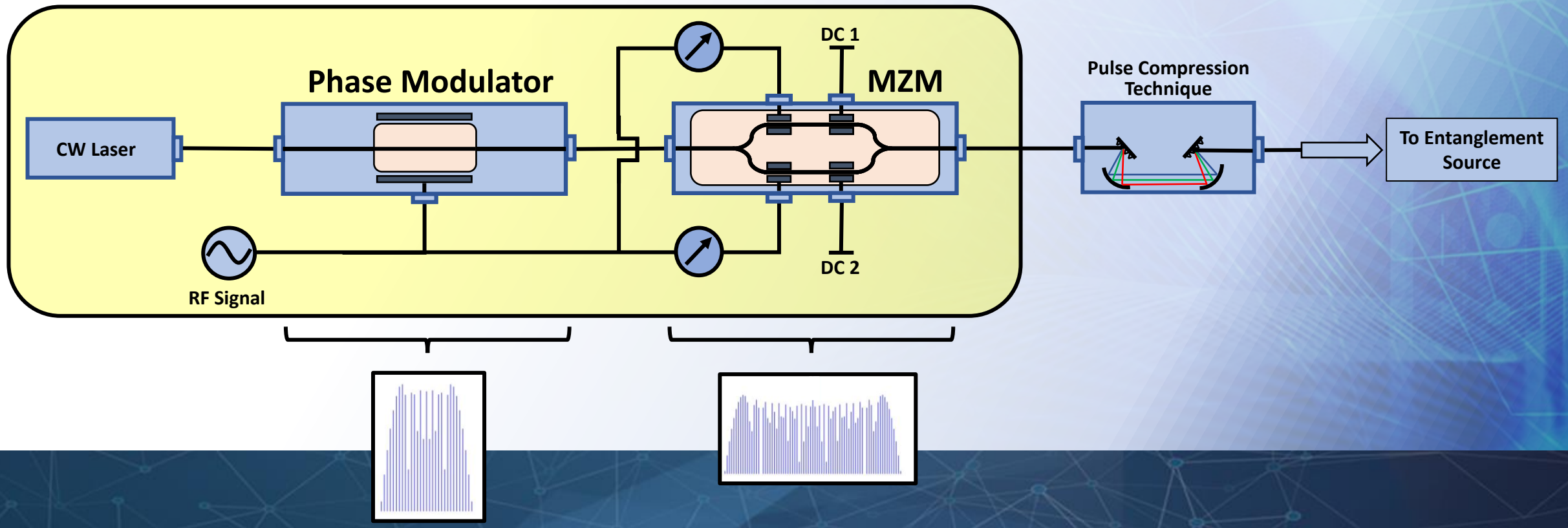


- **Modulate a CW laser to create frequency comb**
  - > Spacing of peaks dependent on RF modulation signal
- **Using electro-optic modulators**
  - > Meets broad set of reqs. for various entanglement sources



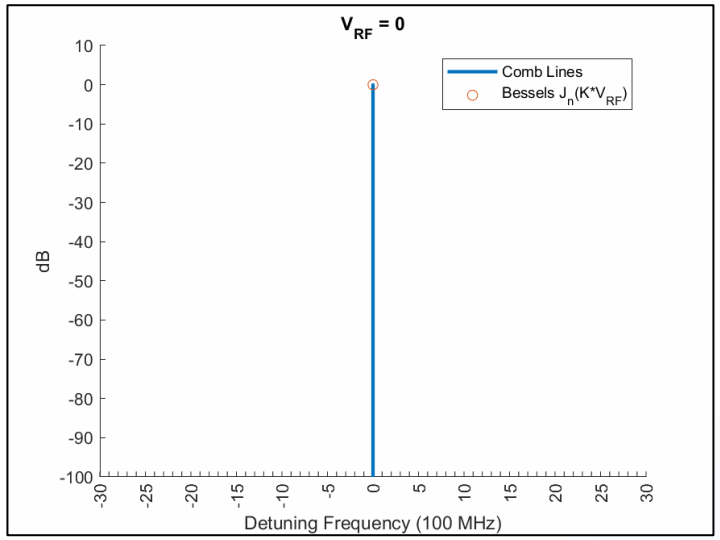
Project Details

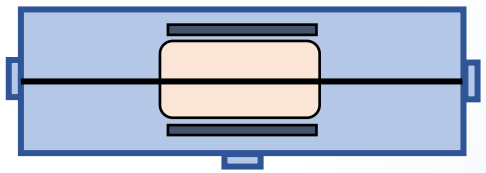
- **Model a Phase Modulator**
- ***Model a Mach Zehnder Modulator (MZM)***
- ***Tune parameters to manipulate the OFCs***



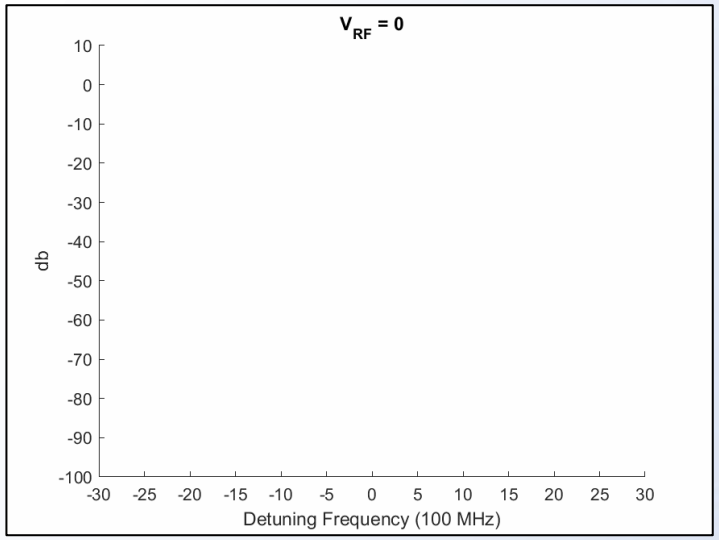
OFC Models

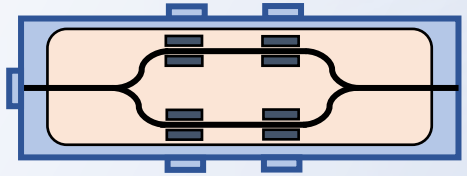
Phase Modulator
Increasing RF Voltage



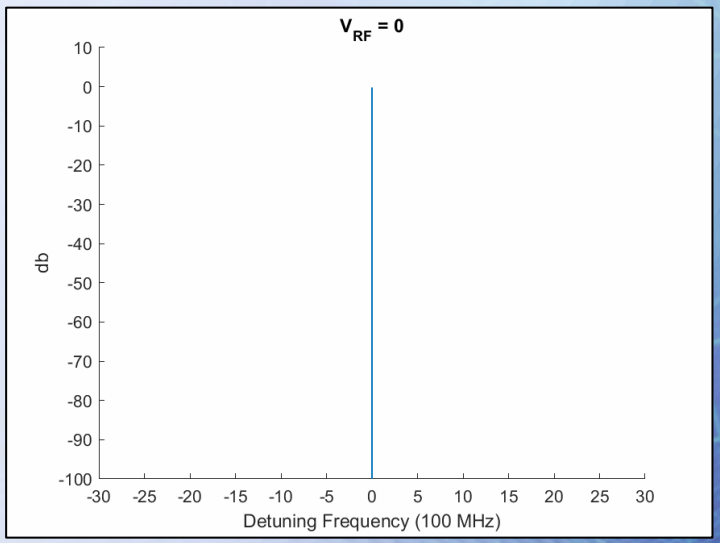


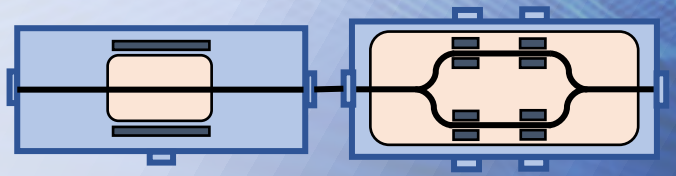
MZM
Increasing RF Voltage





PM and MZM
Increasing RF Voltage





NASA Project Impact

- **Provide simulation tool to compare with future experimental setups**
  - > *Covid-19 restrictions = limited lab time*
- **Conveniently visualize effects of tuning parameters**
- ***Adjustable model = Versatility with entanglement source***

GRC-2016-CN-00015 Photo by Marsheba Bond

The lab team, pictured left to right, is Roger Tokars, Bertram Floyd, John Pouch and Jeff Wilson observing entangled photon source in Glenn's Quantum Optics Laboratory.

Bond, Marsheba. Glenn's Quantum Optics Laboratory. NASA Aerospace Frontiers, Vol. 19, Issue 1, January 2017.

Questions?

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