Burst Mode Wavelength Stabilization

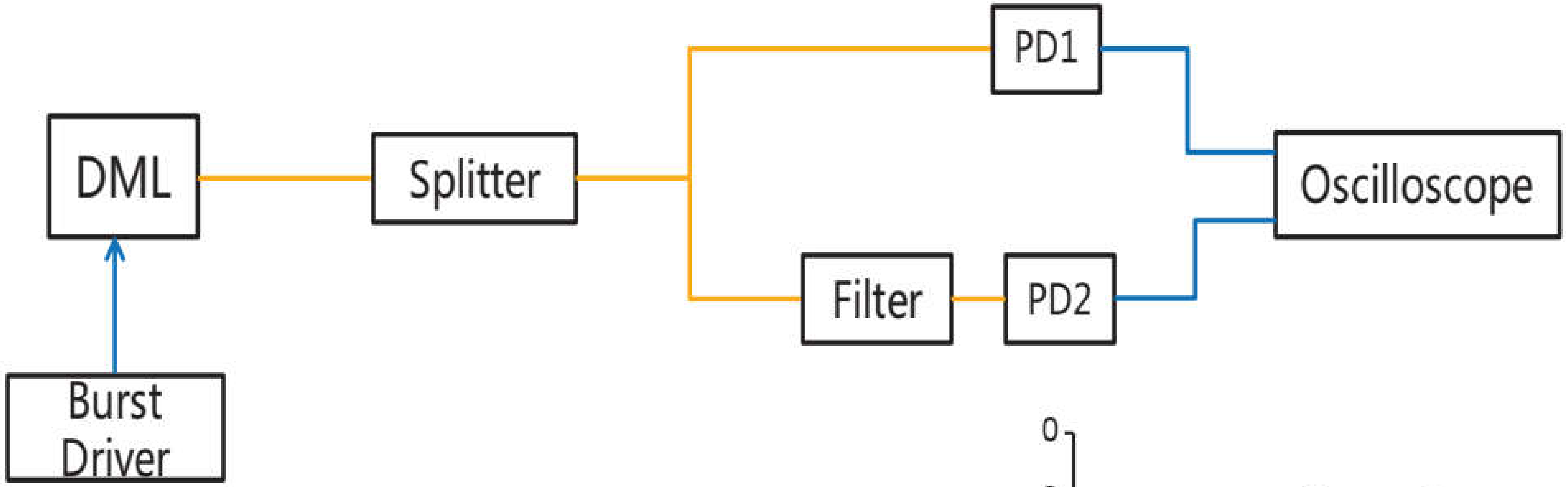
Xuming Wu, Dekun Liu, Huafeng Lin, Xiang Liu, Frank Effenberger

Jan 2019

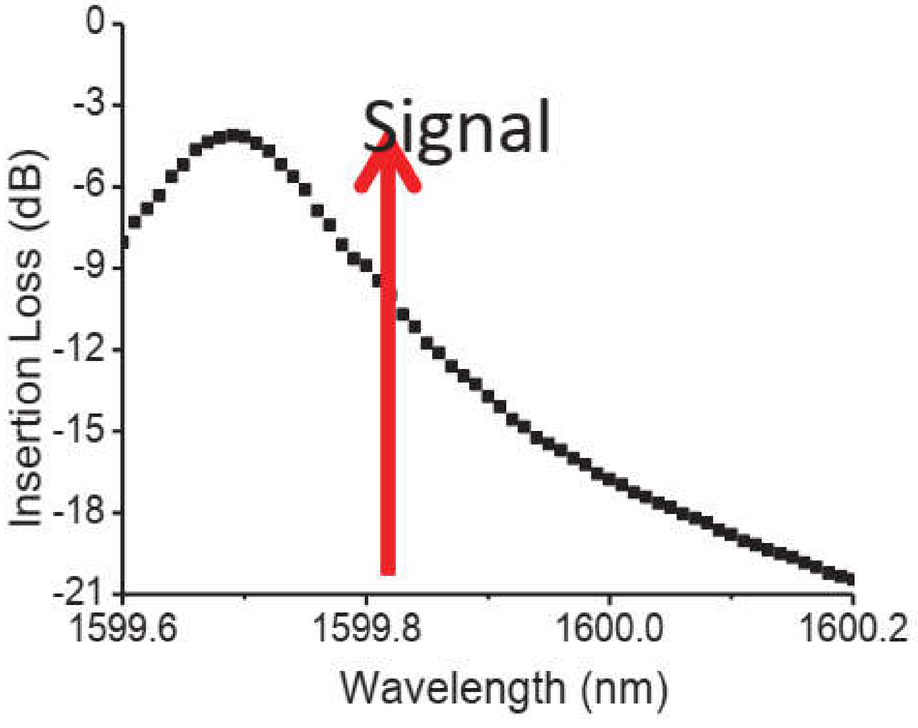
ONU must be tunable and TDMA

- In order for the ONU's transmissions to be conducted back to the OLT, it must transmit on the appropriate wavelength
- The ONU must also operate in burst mode, with relatively long periods of "off" (no light emission)
- When the transmitter turns on, it takes time to warm up
  - This is mostly a thermal issue
- Since laser wavelength is typically a function of temperature, this causes wavelength drift

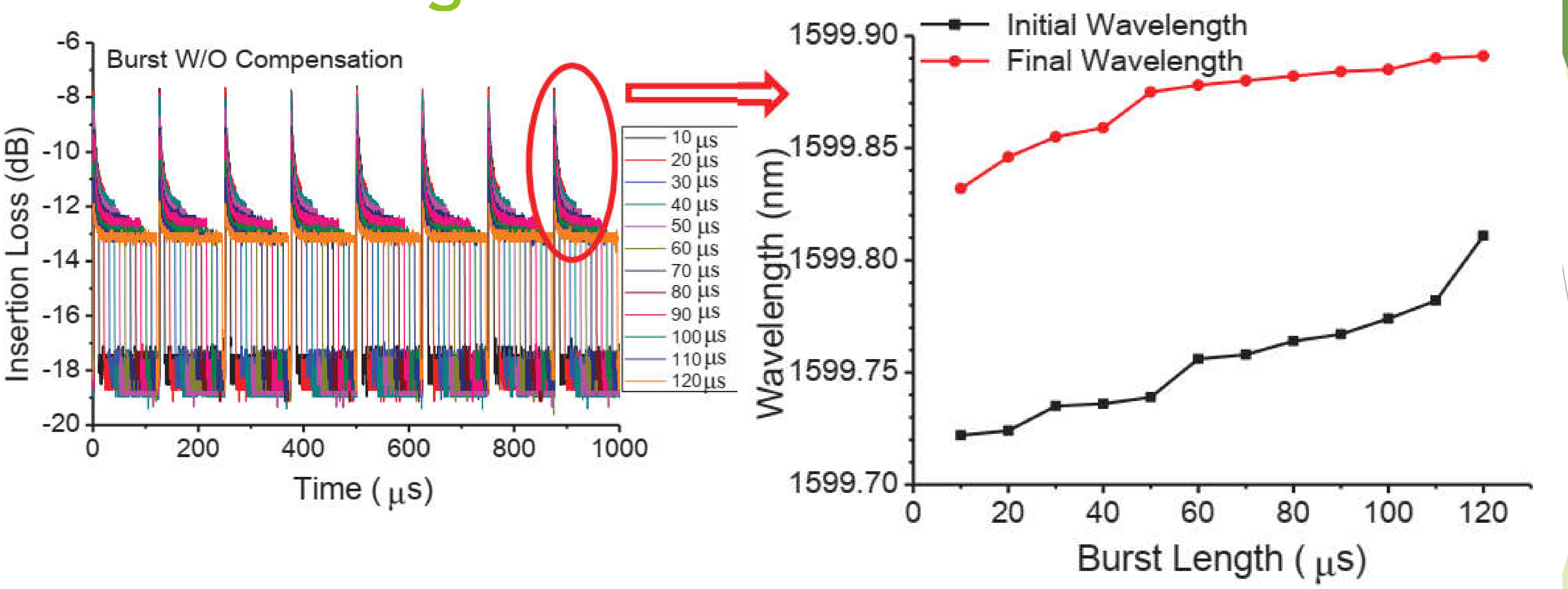
Measurement of instantaneous wavelength



- Use sharp optical filter to convert wavelength shift into amplitude shift
- The ratio of the PD currents is proportional to wavelength



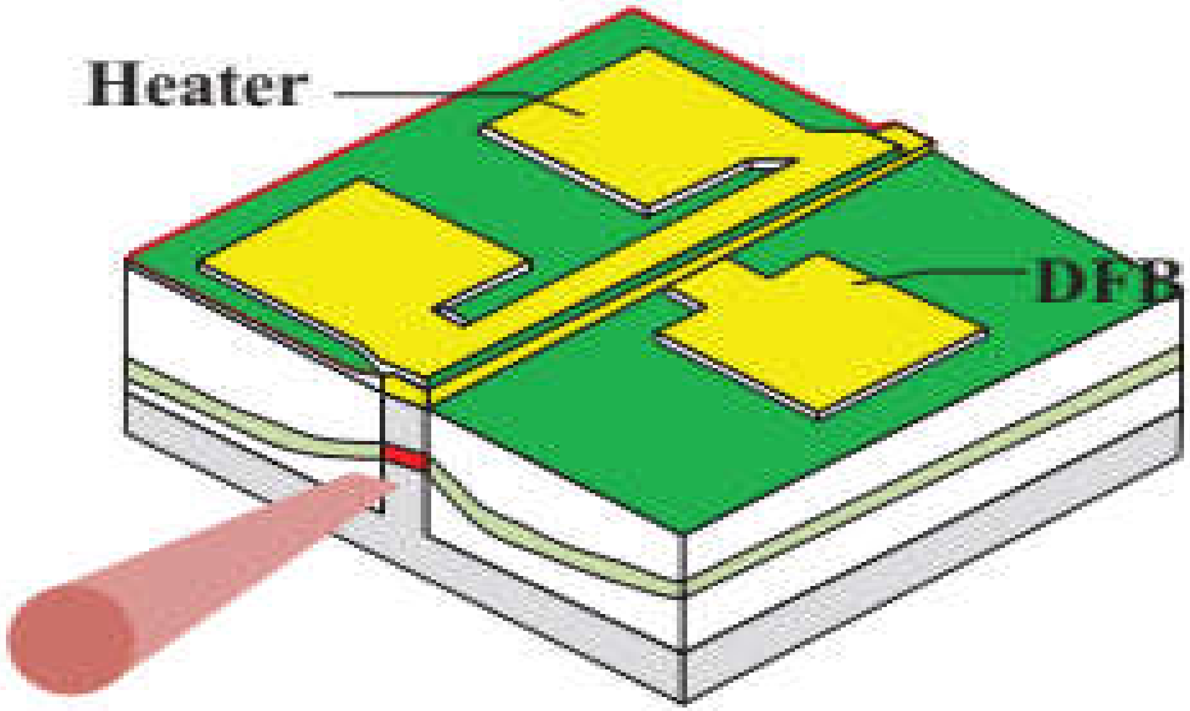
Result using conventional laser



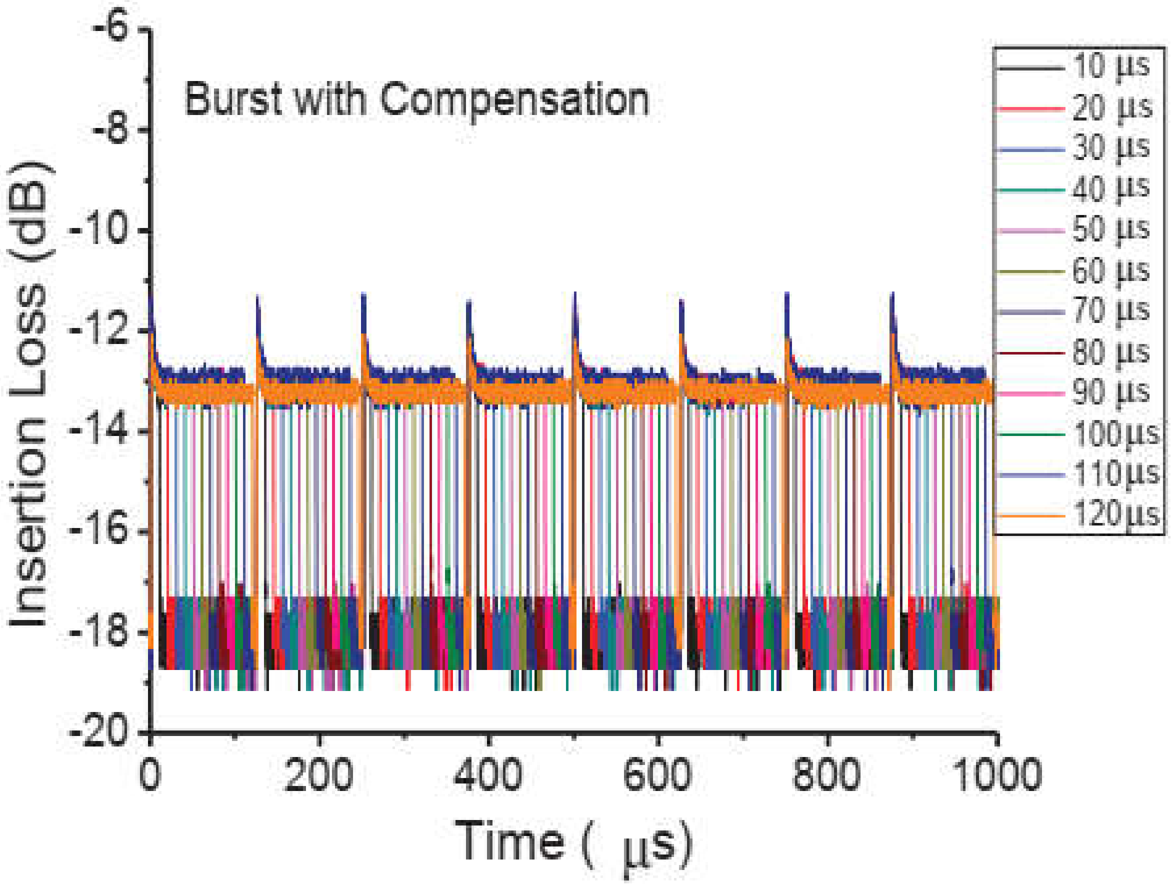
- Wavelength shift over burst on the order of 23 GHz
- The maximum spectral excursion is 40 GHz
- This presents a problem for maintaining channel

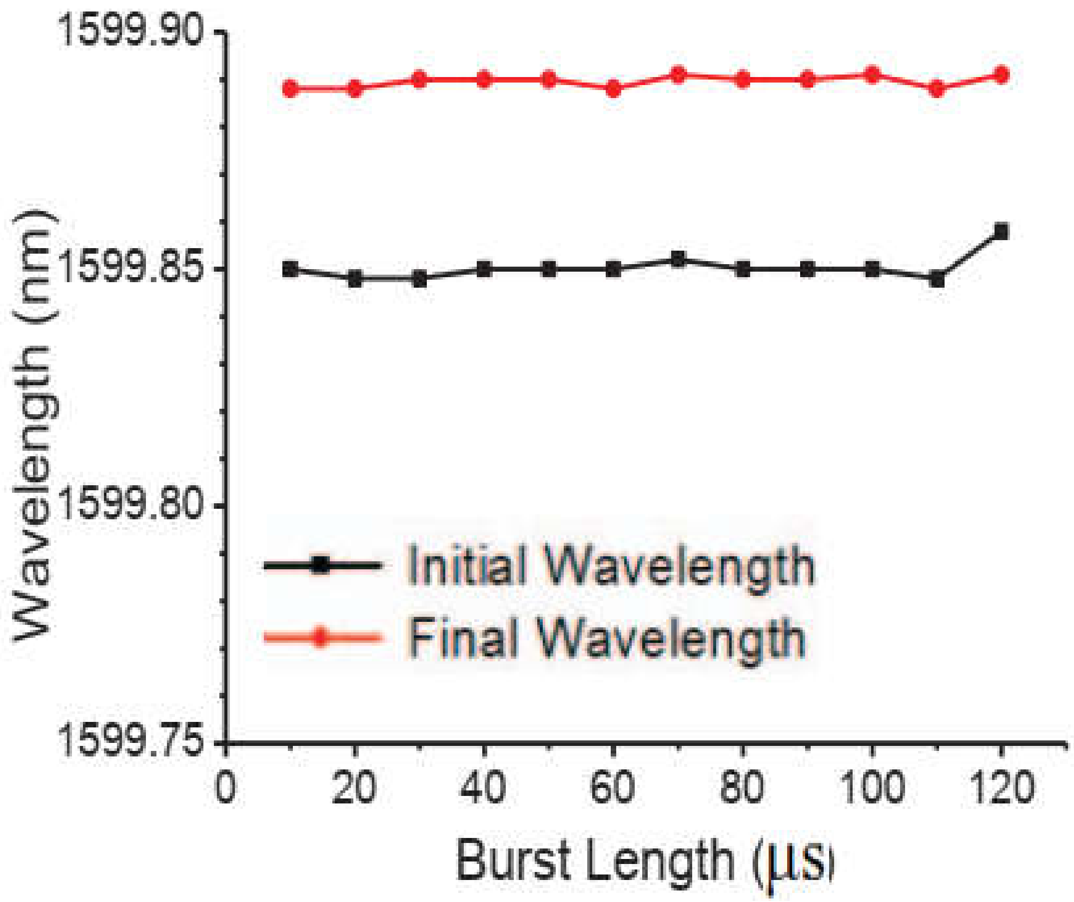
Stabilization with built-in heater

- Solution concept is to overlay a resistive heater over the active region of the laser
- Bias current goes either to the laser diode or the heater, so the net power dissipation remains constant



Laser with built-in heater





- Wavelength shift over burst is reduced to 5 GHz
- This is small enough to build a practical system

Conclusion

- TDMA PONs with tunable ONUs have the problem of burst mode wavelength drift
- The addition of a heater to the device is a viable solution for wavelength stabilization
  - The heater is driven opposite to the laser, thereby maintaining constant power to the device
  - This is very simple, but it does increase dissipation
- Alternatively, ‘counter tuning’ is another solution
  - The laser tuning control is intentionally perturbed to counteract the burst mode heating effect
  - This is more efficient, but requires a control circuit that accurately anticipates the wavelength shift