Chip-Scale Low-Noise Optoelectronic Synthesizer (COES) for the EHF-Band

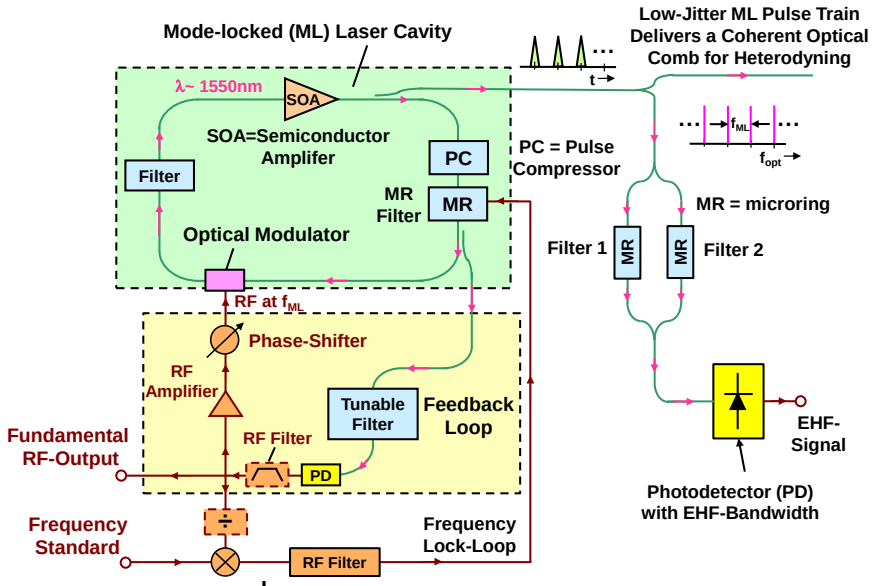
PI: P. D. Dapkus
University of Southern California (USC)

Co-I: W. Ng (USC)
H. Hashemi (USC)

Collaborator: Y. Shi (Boeing Space & Missile Systems, the Boeing Company)

Research Objective:

- Develop a chip-scale optoelectronic synthesizer that can generate EHF-signals (30-300 GHz) with *low phase-noise and SWaP* for space-applications in telecommunication, navigation and remote sensing
- Leverage the broadband capability of photonics to obtain, from *one low-noise chip-source*, coherent comb-lines that can be agilely filtered to deliver frequency-precise RF-signals covering the *entire* EHF-band
- Entry TRL is 1-2, Exit at TRL 3



Approach:

- Form an integrated Mode-Locked Laser that can provide a high-Q resonator, thus allowing the direct generation of an EHF-fundamental with *Ultra-Low* Noise attributes
- Generate low-jitter, short optical pulses to obtain comb-lines that can be heterodyned in pairs to deliver higher (harmonic) EHF-frequencies of high spectral purity
- Adopt fabrication processes supported by Process-Design-Kits (PDKs) to form Photonic Integrated Circuits that can be reconfigured in design to serve the multiple needs of NASA
- Achieve *absolute* frequency stability via use of a frequency-lock-loop formed using integrated optics components

Potential Impact:

Development of a *common,* System-on-a-Chip solution to EHF-signal generation that can enhance the capacity of satellite communication, provide navigation precision and versatility in remote sensing

- Adoption of an integrated photonics solution allows us to achieve an ultra-wide bandwidth, accompanied by low SWaP derived from waveguide-dimensions that scale with wavelength
- Development of a versatile chip that not only delivers EHF-signals as harmonics of an ultra-low noise fundamental, but also short pulses for low-jitter clock distribution
- Adoption of foundry-supported fabrication technologies allow the COES synthesizer to be transitioned readily to higher TRL levels