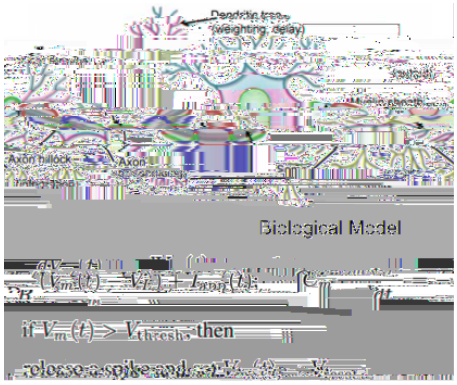
[Invited Talk]

(a)



(b)

Figure 2: (a) A circuit diagram of the proposed device.

Figure 4: A schematic of an integrated excitable laser fully integrated into a hybrid silicon/III-V platform. This device can interface with a passive SOI network. Only one photodetector (PD) is shown.

ogous to the neural axon hillock. We chose to implement this model using a hybrid silicon evanescent DFB laser [5], shown in Figure 4.

Much of the energy cost of electronic conversion in optical systems comes from the need for high-speed clocked transistor circuitry and the need to demultiplex wavelength-division multiplexed (WDM) channels before conversion. In our case, electronic conversion does not have the goal of signal regeneration, but instead of exploiting electronic physics for intermediate analog processing. The use of passive integrated electrical wires does not sacrifice bandwidth or sensitivity in this device. Pulse reshaping is not required due to the clean pulse generation of

picosecond computational domain that impacts application areas where both complexity and speed are paramount.

In this scheme, a group of nodes (a node is illustrated in Figure 4) shares a common medium in which the output of every node is assigned a unique transmission wavelength and made available to every other node (Figure 6). Each node has a tunable spectral filter bank at its front-end. By tuning continuously between the ON/OFF resonant states, each filter drops a portion of its corresponding wavelength channel, thereby applying a coefficient of transmission analogous to a neural weight. The filters of a given receiver operate in parallel, allowing it to receive multiple inputs simultaneously. An interconnectivity pattern is determined by the local states of filters and not a state of the transmission medium between nodes. Routing in this network is transparent, massively parallel, and switchless, making it ideal to support asynchronous signals of a neural character.

3.2. Silicon Photonic Integration

Since routing is already performed by filters at the front end of each laser neuron described in the previous sec-