CLAIMS

1. An integrated circuit spectrometer comprising:

a photonic circuit comprising:

an optical input port for receiving light from a light source; and

a filter array of microring resonators in optical communication with the optical input port, each microring resonator being characterized by a different series of resonance wavelengths;

a plurality of detectors, each of which is associated with one of said microring resonators to detect photons from an output of the microring resonator; and

at least one processor configured to reconstruct, from signals received at the plurality of detectors, an input spectrum of light received at the optical input port using an artificial neural network, the artificial neural network comprising:

an input layer having a number of neurons equal to a number of detectors of the plurality of detectors;

an output layer having a number of neurons equal to a number of wavelength points in the input spectrum such that the number of neurons in the output layer is greater than the number of neurons in the input layer;

a plurality of hidden layers; and

a plurality of batch normalization layers such that each hidden layer of the plurality of hidden layers feeds into a respective batch normalization layer of the plurality of batch normalization layers.

2. An integrated circuit spectrometer according to claim 1, wherein the microring resonators are arranged in parallel.

3. An integrated circuit spectrometer according to claim 2, wherein the microring resonators are optically coupled to the optical input port via a beam splitter that is arranged to split input light equally among the microring resonators.

4. An integrated circuit spectrometer according to claim 1, wherein the photonic circuit, the detectors, and the at least one processor are on a single substrate.

5. An integrated circuit spectrometer according to claim 1, wherein the detectors form a detector array.

6. An integrated circuit spectrometer according to claim 5, wherein the detector array is a MCT, InSb, InAs, PbS, PbSe, InGaAs, Si or Ge photodetector array.

7. An integrated circuit spectrometer according to claim 1, wherein the detectors are thermal detectors selected from thermopile detectors, microbolometers, or pyrodetectors with absorbers having an absorption spectrum that covers the resonance wavelengths of the resonators.

8. An integrated circuit spectrometer according to claim 1, wherein outputs of respective batch normalization layers feed into respective layers that transform the outputs according to a leaky ReLU activation function.

9. An integrated circuit spectrometer according to claim 1, wherein the artificial neural network comprises a ReLU layer after an output layer, for constraining the output layer.

10. A method of spectrometry, comprising, by at least one processor:

receiving signals from a plurality of detectors, wherein each detector is arranged to receive optical signals produced by one of a plurality of microring resonators on receiving light having an input spectrum, each microring resonator being characterized by a different series of resonance wavelengths; and

reconstructing the input spectrum from said signals received from the plurality of detectors using an artificial neural network, the artificial neural network comprising:

an input layer having a number of neurons equal to a number of detectors of the plurality of detectors;

an output layer having a number of neurons equal to a number of wavelength points in the input spectrum such that the number of neurons in the output layer is greater than the number of neurons in the input layer;

a plurality of hidden layers; and

a plurality of batch normalization layers such that each hidden layer of the plurality of hidden layers feeds into a respective batch normalization layer of the plurality of batch normalization layers.

11. A method according to claim 10, wherein outputs of respective batch normalization layers feed into respective layers that transform the outputs according to a leaky ReLU activation function.

12. A method according to claim 10, wherein the artificial neural network comprises a ReLU layer after an output layer, for constraining the output layer.