

CLAIMS

- 1- A demultiplexer for demultiplexing multiple wavelength streams comprising a separator for separating the multiple wavelength streams into a first stream of wavelengths output from a first output of the separator and a second stream of wavelengths output from a second output of the separator wherein the first output of the separator is coupled to a first input of a bi-directional multi-input port, multi-output port frequency demultiplexer and the second output of the separator is coupled to a second input of the bidirectional multi-input port, multi-output port frequency demultiplexer, and wherein the demultiplexer is comprised in a photonic integrated circuit.
- 2- The demultiplexer of claim 1 wherein the multi-input port, multi-output port frequency demultiplexer is an array waveguide grating or an echelle grating.
- 3- The demultiplexer of claim 1 or 2 wherein the separator comprises a delay filter and the multiple wavelength streams modulated with QPSK format..
- 4- The demultiplexer of claim 1 or 2 wherein the separator comprises a power splitter and a delay filter and the multiple wavelength streams are DQPSK-type stream.
- 5- The demultiplexer of claim 1 or 2 wherein the separator comprises a polarization splitter and the multiple wavelength streams are polarization multiplexed streams.
- 6- The demultiplexer of claim 1 or 2 wherein the separator is a combination of at least one power splitter, at least one delay filter and at least one polarization splitter and the multiple wavelength streams are polarization multiplexed DPQSK streams.

7- The demultiplexer of any one of the preceding claims wherein the input ports are located on opposite sides and symmetrical with respect to a longitudinal axis of the frequency demultiplexer.

5 8- The demultiplexer of any one of the preceding claims wherein the grating comprises at least a first output port located at an opposite side of the grating with respect to the side where the first group of single wavelengths is input in the grating, and at least a second output port located at an opposite side of the grating with respect to the side where the second group of single wavelengths is input in the grating.

10 9- A receiver for receiving WDM signals comprising a demultiplexer according to any one of claims 1 to 6

10- A method of demultiplexing multiple wavelength streams, the method comprising:

- inputting multiple wavelength streams into a separator;
 - 15 • separating, according to at least one predetermined separation criterion, the multiple wavelength streams into a first stream of wavelengths and a second stream of wavelengths;
 - inputting the first stream of wavelengths into a first input port of a bi-directional multi-input port, multi-output port frequency demultiplexer;
 - 20 • inputting the second stream of wavelengths into a second input of the bi-directional multi-input port, multi-output port frequency demultiplexer;
 - separating the first stream into a first group of single wavelengths;
 - 25 • separating the second stream into a second group of single wavelengths;
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- coupling the first group of single wavelengths to respective first output ports of the grating;
- coupling the second group of single wavelengths to respective second output ports of the grating; and

5 wherein the demultiplexer is comprised in a photonic integrated circuit.

11- The method of claim 10 wherein the first group of single wavelengths are coupled to respective output ports located at an opposite side of the grating with respect to the side where the first group of single wavelengths is input in the grating, and the second group of single wavelengths are coupled to respective
10 output ports located at an opposite side of the grating with respect to the side where the second group of single wavelengths is input in the grating.

The invention claimed is:

1. A demultiplexer for demultiplexing multiple wavelength streams, comprising:
 - a separator configured to separate the multiple wavelength streams into a first stream of wavelengths output from a first output of the separator and a second stream of wavelengths output from a second output of the separator, wherein
 - the first output of the separator is coupled to a first input of a bi-directional multi-input port, multi-output port frequency demultiplexer and the second output of the separator is coupled to a second input of the bi-directional multi-input port, multi-output port frequency demultiplexer,
 - the demultiplexer is in a photonic integrated circuit (IC), and
 - a grating includes at least a first output port located at an opposite side of a grating with respect to the side where the first group of single wavelengths is input in the grating, and at least a second output port located at an opposite side of the grating with respect to the side where the second group of single wavelengths is input in the grating.
2. A receiver for receiving WDM signals comprising a demultiplexer according to claim 1.
3. The demultiplexer of claim 1, wherein the bi-directional multi-input port, multi-output port frequency demultiplexer is configured to separately demultiplex the first and second streams of wavelengths in a same grating.
4. The demultiplexer of claim 1 wherein the bi-directional multi-input port, multi-output port frequency demultiplexer is an array waveguide grating or an echelle grating.
5. A demultiplexer for demultiplexing multiple wavelength streams, comprising:
 - a separator configured to separate the multiple wavelength streams into a first stream of wavelengths output from a first output of the separator and a second stream of wavelengths output from a second output of the separator, wherein
 - the first output of the separator is coupled to a first input of a bi-directional multi-input port, multi-output port frequency demultiplexer and the second output of the separator is coupled to a second input of the bi-directional multi-input port, multi-output port frequency demultiplexer,

the demultiplexer is in a photonic integrated circuit (IC),
and

the separator includes a delay filter and the multiple
wavelength streams modulated with QPSK format.

6. A demultiplexer for demultiplexing multiple wavelength
streams, comprising:

a separator configured to separate the multiple wavelength
streams into a first stream of wavelengths output from a
first output of the separator and a second stream of
wavelengths output from a second output of the separa-
tor, wherein

the first output of the separator is coupled to a first input
of a bi-directional multi-input port, multi-output port
frequency demultiplexer and the second output of the
separator is coupled to a second input of the bi-direc-
tional multi-input port, multi-output port frequency
demultiplexer,

the demultiplexer is in a photonic integrated circuit (IC),
and

the separator includes a power splitter and a delay filter
and the multiple wavelength streams are DQPSK-
type stream.

7. A demultiplexer for demultiplexing multiple wavelength
streams, comprising:

a separator configured to separate the multiple wavelength
streams into a first stream of wavelengths output from a
first output of the separator and a second stream of
wavelengths output from a second output of the separa-
tor, wherein

the first output of the separator is coupled to a first input
of a bi-directional multi-input port, multi-output port
frequency demultiplexer and the second output of the
separator is coupled to a second input of the bi-direc-
tional multi-input port, multi-output port frequency
demultiplexer,

the demultiplexer is in a photonic integrated circuit (IC),
and

the separator includes a polarization splitter and the
multiple wavelength streams are polarization multi-
plexed streams.

8. A demultiplexer for demultiplexing multiple wavelength streams, comprising:

- a separator configured to separate the multiple wavelength streams into a first stream of wavelengths output from a first output of the separator and a second stream of wavelengths output from a second output of the separator, wherein

- the first output of the separator is coupled to a first input of a bi-directional multi-input port, multi-output port frequency demultiplexer and the second output of the separator is coupled to a second input of the bi-directional multi-input port, multi-output port frequency demultiplexer,

- the demultiplexer is in a photonic integrated circuit (IC), and

- the separator is a combination of at least one power splitter, at least one delay filter and at least one polarization splitter and the multiple wavelength streams are polarization multiplexed DPQSK streams.

9. A demultiplexer for demultiplexing multiple wavelength streams, comprising:

- a separator configured to separate the multiple wavelength streams into a first stream of wavelengths output from a first output of the separator and a second stream of wavelengths output from a second output of the separator, wherein

- the first output of the separator is coupled to a first input of a bi-directional multi-input port, multi-output port frequency demultiplexer and the second output of the separator is coupled to a second input of the bi-directional multi-input port, multi-output port frequency demultiplexer,

- the demultiplexer is in a photonic integrated circuit (IC), and

- the input ports are located on opposite sides and symmetrical with respect to a longitudinal axis of the frequency demultiplexer.

10. A method of demultiplexing multiple wavelength streams, the method comprising:

- inputting multiple wavelength streams into a separator;
- separating, according to at least one predetermined separation criterion, the multiple wavelength streams into a first stream of wavelengths and a second stream of wavelengths;

- inputting the first stream of wavelengths into a first input port of a multi-input port, multi-output port frequency demultiplexer;

- inputting the second stream of wavelengths into a second input of the multi-input port, multi-output port frequency demultiplexer;

- separating the first stream into a first group of single wavelengths;

- separating the second stream into a second group of single wavelengths;

- coupling the first group of single wavelengths to respective first output ports of a grating; and

- coupling the second group of single wavelengths to respective second output ports of the grating, wherein the first group of single wavelengths are coupled to respective output ports located at an opposite side of the grating with respect to the side where the first group of single wavelengths is input in the grating, and the second group of single wavelengths are coupled to respective output ports located at an opposite side of the grating with respect to the side where the second group of single wavelengths is input in the grating.