Claims

1. Method for imaging and/or spectroscopy using an interferometer setup, comprising the steps

i) generation of a first signal field s_1 and a first idler field i_1, by pumping a first non-linear medium with a pump beam, such that the two fields are correlated,

ii) illumination of an object with the first idler i_1 field, respectively by transmission and/or reflection,

iii) generation of a second signal field s_2 and a second idler field i_2,

- by pumping a spatial separate second non-linear medium with the pump beam, or
- by pumping the first non-linear medium a second time with the pump beam,

such that the two fields are correlated,

iv) combination of the first i_1 and second i_2 idler fields, such that the two fields are indistinguishable, and

combination of the first s_1 and second s_2 signal fields, such that the two fields interfere,

v) first measurement of an interfered signal field s_{12} by a detection means,

vi) one or more additional measurements of the interfered signal field s_{12} by the detection means,

wherein for each additional measurement in step vi) a different phase shift α is generated in the interferometer setup, and

wherein the first measurement in step v) and the one or more additional measurements in step vi) are all carried out within a stability time of the interferometer setup,

vii) calculation of a phase function Φ out of the measurements from step v) and step vi) in order to get an image and/or a spectrum of the object.

2. The method according to claim 1,
wherein the phase shift α is created in at least one of
- the first signal field s_1
- the second signal field s_2
- the first idler field i_1
- the second idler field i_2
- the pump beam in front of the first non-linear medium, preferably in the first pump beam
- the pump beam in front of the second non-linear medium, preferably in the second pump beam
- between the first and second signal fields i_1 and i_2
- between the first signal and idler fields s_1 and i_1,
- between the first and the second pump beams, and
- the interfered signal field s_{12}.

3. The method according to one of claims 1 or 2,
wherein the phase shift α is created by
- changing the path length of one or more field/s, and/or
- changing the wavelength of the first and/or second pump beam, and/or
- by thermal effects, and/or
- by spatial displacement or change of the optical path length in one or both interferometer arms.

4. The method according to one of claims 1 to 3,
wherein the phase shifts can be introduced by a translation of a mirror and/or a translation of an optical surface and/or a translation of a dichroic mirror, respectively movable by a piezo element, and/or by a fiber expander, and/or by tilting a plane-parallel plate, and/or by an optical frequency difference between two beams, preferably two pump beams

and/or by the change of the polarization by an EOM and/or wave plates and/or a polarizing beam splitter and/or a polarizer, and/or by tilting a plane-parallel plate, and or by a rotation or movement of a birefringent plate.

5. The method according to one of claims 1 to 4, wherein a phase of the interferometer setup in step v) is unknown and/or arbitrary.

6. The method according to one of claims 1 to 5, wherein in step i) and/or step iii) the signal and idler fields are separated by a separation means in or behind the crystal or are separated due to the generation of the signal and idler fields in the non-linear medium, respectively separated due to the generation of the fields in a BBO crystal.

7. The method according to one of claims 1 to 6, wherein in step v) and/or vi) a constructive and a destructive interference is measured, respectively by a first and second detection means behind two output arms of an interference means, respectively a 50/50 beam splitter, respectively wherein the 50/50 beam splitter is the signal combining means

8. The method according to one of claims 1 to 7, wherein in step v) and/or vi) one detection means is used, wherein for each measurement a phase shift α is generated, or two or more detection means are used, wherein for each additional detection means the same or a separate phase shift α is generated.

9. Apparatus for imaging and/or spectroscopy comprises a pump source to generate a pump beam, and

a first signal s_1 and idler i_1 field generation means pumped by the pump beam, and

a second signal s_2 and idler i_2 field generation means pumped by the pump beam,

wherein the first and the second field generation means are

- two spatial separated non-linear media pumped by the pump beam, or
- one non-linear medium, pumped by the pump beam a first time to generate a first signal s_1 and idler i_1 field and pumped a second time to generate a second signal s_2 and idler i_2 field, and

an object to be measured which is illuminated, respectively by transmission or reflection, by the first idler field i_1, and

a signal combining means to overlap the first signal s_1 and second signal s_2 fields, such that the two fields interfere, and

an idler combining means to overlap the first idler i_1 and second idler i_2 fields, such that the two fields are indistinguishable, and

a detection means to detect the intensity and/or phase of the interfered signal field,

characterized in that,

a phase shifter is arranged in the first signal s_1 field, and/or in the second signal s_2 field, and/or in the pump beam, and/or in the indistinguishable first and second signal fields s_1 and s_2, wherein the phase shifter is adapted to introduce a phase shift α in the apparatus during the measurement in order to get an image and/or a spectrum of the object.

10. Apparatus according to claim 9,

wherein the phase shifts can be introduced by a movable mirror and/or a movable optical surface and/or a movable dichroic mirror, respectively movable by a piezo element, and/or by a fiber expander, and/or by a tiltable plane-parallel plate, and/or by an optical frequency difference between two beams, preferably two pump beams and/or by the change of the

polarization by an EOM and/or wave plates and/or a polarizing beam splitter and/or a polarizer, and/or by a tiltable plane-parallel plate, and/or by a rotatable or moveable birefringent plate.

11. Apparatus according to claim 9,
wherein a separation means and the signal combining means are arranged in a Mach-Zehnder interferometer configuration or a laser Fizeau interferometer configuration, or a Michelson-interferometer configuration.

12. Apparatus according to claim 11,
wherein the phase shift α is created within the interferometer.

13. Apparatus according to one of claims 9 to 12,
wherein the apparatus comprises a control device adapted to provide one of the methods according to claims 1 – 8 , wherein the control device is connected to the phase shifter and to the detection means.

14. Computer device with a microprocessor with a non-volatile memory,
wherein the non-volatile memory comprises an executable program adapted to provide one of the methods according to claims 1 – 8, preferably wherein the computer device is the control device.