CLAIMS

1. A composition comprising ^{11}B and ^{10}B isotopes for use in a diagnostic method or simultaneous diagnostic and treatment of tumors by energetic protons and proton boron fusion and simultaneous prompt gamma-ray imaging.

2. The composition for use according to claim 1, comprising 10%-50% of ^{10}B and 90%-50% of ^{11}B.

3. The composition for use according to claim 1, comprising 0.1%-20% of ^{10}B and 99.9%-80% of ^{11}B.

4. The composition according to anyone of preceding claims, wherein the ^{10}B or ^{11}B is comprised in at least one of the following compositions: boronophenylalanine, sodium borocaptate, dodecaborate cluster lipids and cholesterol derivatives, $Na_2B_{10}H_{10}$, cholesteryl ester mimics, boronated DNA metallo-intercalators, transferrin-polyethylene glycol liposomes, boron-containing unnatural amino acids, dodecahydro-closo-dodecaborate clusters, carboranyl nucleosides, carboranyl porphyrins, carboranyl porphyrazines, boronated cyclic peptides, boronated antibodies, boron-containing nanoparticles, boron carbide particles, boron containing immunoliposomes and liposomes, boronated EGF and anti-EGFR and VEGFR MoAbs and boron nitride nanotubes.

5. A device for simultaneous prompt gamma-ray imaging and treatment and/or calibration, comprising a source of energetic protons forming a proton beam, at least one treatment station **(104)**, at least one transport line **(103)** for delivering the proton beam to the at least one treatment station **(104)**, said transport line **(104)** having an output tube **(400)** adapted for collimation and/or direction and/or focusing of the proton beam, and a system for real-time imaging comprising at least two gamma-ray detectors **(603,604)**.

6. The device according to claim 5, wherein said source of energetic protons is a laser driven accelerator of protons.

7. The device according to claim 5 or 6, wherein the source of energetic protons comprises an accelerator system **(101)**, said accelerator system being preferably tunable in energy from 0.1 MeV to 400 MeV.

8. The device according to claim 5 to 7, wherein the treatment station **(104)** comprises a positioning system **(700)** for adjusting the spatial position of any of the components of the device.

9. The device according to any one of claims 5 to 8, wherein the gamma-ray detectors **(603,604)** are adapted to detect one or more peaks selected from peaks having the energy 429 keV, 718 keV and 1430 keV, and preferably also 3 MeV, 4.82 MeV, 5.91 MeV, 6.02 MeV and 6.5 MeV.

10. The device according to any one of claims 5 to 9, further comprising at least one gamma-ray detector **(501 or 502)** for spectral analysis.

11. The device according to any one of claims 5 to 10, further comprising a bed **(800)** for fixing an irradiated object **(200)** or a patient, preferably said bed **(800)** is located in the center of the positioning system **(700)**.

12. The device according to any one of claims 5 to 11, further comprising at least one control unit for controlling the proton beam energy and targeting and/or positioning of individual components of the device and/or treatment regimen, preferably the control unit comprises a feedback loop for controlling the operation of the device based on the prompt gamma-ray imaging outputs.

13. A system for simultaneous prompt gamma-ray imaging and treatment and/or calibration, comprising the device according to any one of claims 5 to 12, and a composition according to any one of claims 1 to 4.

14. The system according to claim 13, wherein the mixture comprises 0.1%-50% of ^{10}B and 99.9%-50% of ^{11}B.

15. The system according to claim 13 or 14, wherein the concentration of boron composition comprising $^{10}B/^{11}B$ is ranging from 10 to 10^4 ppm.

16. A system for prompt gamma-ray imaging and/or calibration, comprising a source of energetic protons forming a proton beam, at least one diagnostic station (104), at least one transport line (103) for delivering the proton beam to the at least one treatment station (104), said transport line (104) having an output tube (400) adapted for collimation and/or direction and/or focusing of the proton beam, and a system for real-time imaging comprising at least two gamma-ray detectors (603,604), and a composition comprising a ^{10}B and/or ^{11}B isotope, wherein said composition comprising 10%-50% of ^{10}B and 90%-50% of ^{11}B.

17. A method for calibration of the device according to any one of claims 5 to 12 or the system according to any one of claims 13 to 15 or the system according to claim 16, said method comprising the steps of

- introducing a composition comprising a mixture of ^{10}B and ^{11}B into a target region within a water phantom,
- targeting an energetic proton beam to the target region, thereby initiating interaction of the protons with both the ^{11}B and ^{10}B nuclei in the target region
- detecting prompt gamma-rays produced by the interaction of the protons with boron nuclei,
- using data obtained from said detection of prompt gamma-rays for adjusting the proton beam source to a position most suitable for irradiation.

18. A method for irradiation of tumors using the device according to any one of claims 5 to 12 or the system according to any one of claims 13 to 15 or the system according to claim 16, said method comprising the steps of

- introducing a composition comprising a mixture of ^{10}B and ^{11}B into a target region which is the tumor,
- targeting an energetic proton beam to the target region, thereby initiating interaction of the protons with both the ^{11}B and ^{10}B nuclei in the target region,

- detecting prompt gamma-rays produced by the interaction of the protons with boron nuclei,
- using data obtained from said detection of prompt gamma-rays for controlling and/or adjusting the treatment regimen.