CLAIMS

1. Device (1) for providing a radiation treatment to a patient, the device (1) comprising :

- an electron source (2) for providing a beam of electrons, and
- a linear accelerator (3) for accelerating said beam until a predetermined energy, the accelerated beam being composed of a plurality of trains of electrons bunches, and
- a beam delivery module (4) for delivering the plurality of trains of electrons bunches from said linear accelerator (3) toward the patient to treat a target volume (5) with a radiation dose,

characterized in that the device (1) further comprises intensity modulation means (9) configured to modulate the distribution of the radiation dose in the target volume (5) according to a predetermined modulation pattern matching the target volume (5),

the intensity modulation means (8) are configured to adjust the position, the total charge and energy of each electrons bunch within a train and between trains of electrons bunches, and to separate the trains of electrons bunches depending on the charge and/or energy of each train,

the modulation pattern comprising several subsections and each subsection comprising trains of electron bunches with a determined charge and energy to irradiate a corresponding portion of the target volume (5) so that the intensity modulation means (9) allow to set the radiation dose received by each portion of the target volume (5),

the modulation pattern is determined to match the dimensions of a target volume (5) of at least about 50 cm^3, and/or a target volume (5) located at least about 5 cm deep in the tissue of the patient with said radiation dose,

the device (1) being further characterized in that the radiation dose distributed by said intensity modulation means (8) named entire radiation dose is at least about 20 Gy, the radiation dose being delivered during an overall treatment time less than about 50 ms.

2. Device (1) according to claim 1, wherein the intensity modulation means (8) are configured to further adjust arrival angle, projected size each electrons bunch within a train and between trains of electrons bunches.

3. Device according to any one of claims 1 to 2, wherein the entire radiation dose is of at least 30 Gy, preferably of at least 35 Gy, preferably of at least 40 Gy.

4. Device (1) according to any one of claims 1 to 3, wherein each portion receives a radiation dose up to the entire radiation dose.

5. Device (1) according to claims any one of claims 1 to 4, wherein each portion receives at least one train of electrons bunches.

6. Device (1) according to claims any one of claims 1 to 5, wherein the intensity modulation means (8) comprises charge variation means to set the charge of each train independently and direct each train to a predetermined subsection of the pattern to reach a corresponding portion of the target volume (8) which modulates the distribution of radiation dose in the target volume (8).

7. Device (1) according to claims any one of claims 1 to 6, wherein the intensity modulation means (8) comprises energy variation means to set the energy of each train independently and direct each train to a predetermined subsection of the pattern to reach a corresponding portion of the target volume (5) which modulates the distribution of radiation dose along the direction of the accelerated beam through the target volume (5).

8. Device (1) according to the preceding claim, wherein each train has an energy which differs from about 1 % to about 5 %.

9. Device (1) according to any one of claims 1 to 8, wherein the accelerated electron beam is separated into a plurality of beam lines (6,7) by separating means (8), each beam lines (6,7) being separated by a determined angle, and subsequently focusing each of said beam lines (6,7) toward the patient to arrive in an overall time of less than 50 ms on the target volume (5), each beam line (6,7) further comprising independent intensity modulation means (8).

10. Device (1) according to the preceding claim, wherein each beam line (6,7) has an energy with differs from about 10 % to about 40 %.

11. Device (1) according to any one of claims 1 to 10, wherein the intensity modulation means (8) comprise deflecting means (13) for deflecting each train of electrons bunches position transversely relative to the accelerated beam direction,

said deflecting means (13) having a deflecting speed faster than the interspacing time between two subsequent trains.

12. Device (1) according to the preceding claim, wherein the deflecting means (13) comprise magnet, for instance dipole magnets quadrupole magnet with time varying magnetic fields, or dipole coils, or fast ramping magnets or magnets capable of fast field-ramping.

13. Device (1) according to any one of claims 11 to 12, wherein the deflecting means (13) comprise a radio frequency deflector.

14. Device (1) according to any one of claims 1 to 13, wherein the energy variation means are set for implementing predetermined energy variations between each train of electrons bunches, said energy variation means being preferably operated from the linear accelerator (3).

15. Device (1) according to the preceding claim, wherein the energy variation means are operated by controlling the amplitude and the phase of the radiofrequency pulses of the linear accelerator (3).

16. Device (1) according to any one of claims 1 to 15, wherein the intensity modulation means (8) comprise a combination of charge variation means, energy variation means deflection means (13) and multiple beam lines (6,7).

17. Device (1) according to any one of claims 1 to 16, wherein the accelerated electron beam having a predetermined energy between about 30 MeV and about 250 MeV, preferably between about 50 MeV and about 250 MeV, more preferably between about 50 MeV and about 150 MeV.