CLAIMS

1. A target irradiation system, comprising at least:
   - a particle accelerator configured at least to emit an irradiation beam along an axis,
   - one target holder mounting, positioned outside the particle accelerator facing the irradiation beam, comprising at least two ports configured to receive a target holder configured to receive a target that is to be irradiated, and
   - a radiation protection chamber surrounding the target holder mounting, the particle accelerator being positioned outside the chamber,

   wherein the target holder mounting is fixed relative to the particle accelerator and the at least two ports are axially offset relative to the axis of the irradiation beam, and wherein the system comprises a deflection device, positioned in the radiation protection chamber and configured to deviate the irradiation beam towards the port of the target holder in which the target to irradiate is inserted, and wherein the radiation protection chamber comprises an alternating arrangement of at least one layer comprising a dense material and at least one layer comprising a hydrogen-rich material comprising a neutron poison, the radiation protection chamber having a wall thickness less than 100 cm.

2. A system according to claim 1, wherein an innermost layer of radiation protection of the radiation protection chamber is a layer of dense material.

3. A system according to either of claims 1 or 2, wherein the hydrogen-rich material is polyethylene with a boron filler as neutron poison in an amount of approximately 5% to 7% (atomic).

4. A system according to any one of claims 1 to 3, wherein the dense material is tungsten and/or lead.

5. A system according to any one of claims 1 to 4, wherein the radiation protection chamber further comprises an additional radiation protection part which surrounds the target holders mounted on the target holder mounting, within a wall of the radiation protection chamber.

6. A system according to claim 5, wherein the radiation protection additional part is of dense material.

7. A system according to claim 2 and either one of claims 5 or 6, wherein the radiation protection chamber comprises a wall which comprises an additional thickness of hydrogen-rich material positioned between the radiation protection additional part of the target holders and the innermost layer of dense material.

8. A system according to claim 7, wherein the radiation protection additional part is of tungsten and is of thickness comprised between approximately 5 cm and approximately 15 cm and in that the wall of the radiation protection chamber next comprises:
   - the additional thickness of hydrogen-rich material of a thickness comprised between approximately 5 cm and approximately 15 cm, and is of PE having 5 % boron filler;
   - the innermost layer of dense material of a thickness comprised between approximately 3 cm and approximately 8 cm, and is of tungsten;
   - a next layer of hydrogen-rich material of a thickness comprised between approximately 25 cm and approximately 40 cm, and is of PE having 5 % boron filler;
   - a following layer of dense material of a thickness comprised between approximately 2 cm and approximately 8 cm, and is of lead; and
   - an outermost layer of hydrogen-rich material of a thickness comprised between approximately 15 cm and approximately 30 cm, and is of PE having 5% boron filler.

9. A system according to any one of claims 1 to 8, wherein the deflection device is configured to emit a magnetic field having a value between 1 and 2 Tesla, for example the magnetic field is of the order of 1.4 Tesla.

10. A system according to any one of claims 1 to 9, wherein the deflection device comprises at least one electromagnetic quadrupole positioned on a path of the irradiation beam.

11. A system according to any one of claims 1 to 10, wherein the deflection device is composed of a dense material, for example copper and/or iron in particular.

12. A system according to any one of claims 1 to 11, wherein the ports are disposed in a same plane.

13. A system according to claim 12, wherein the plane in which the ports are disposed is a horizontal plane.

14. A system according to any one of claims 1 to 11, wherein the ports are disposed in a volume.

15. A system according to any one of claims 1 to 14, wherein the system comprises a device for adjusting the position of the irradiation beam and a device for adjusting the focus of the irradiation beam, and in that the position adjusting device and the focus adjusting device are positioned upstream of the deflection device.

16. A system according to claim 15, wherein the deflection device differs from the position adjusting device.

17. A system according to either one of claims 15 or 16, wherein the position adjusting device and the focus adjusting device are positioned outside the radiation protection chamber.

18. A system according to either one of claims 15 or 16, wherein the position adjusting device and the focus adjusting device are positioned at least

partly inside the radiation protection chamber, or even at least partly within the wall of the radiation protection chamber.

19. A system according to any one of claims 15 to 18, wherein the position adjusting device and the focus adjusting device are for example conjointly formed by a pair of electromagnetic quadrupoles.

20. A system according to any one of claims 15 to 19, wherein it comprises an automatic module comprising a control module and a command unit, the control unit being configured to integrate information and measurements concerning the position and the focus of the irradiation beam and to send instructions to the command unit, and the command unit being configured to actuate the position adjusting device and/or the focus adjusting device and/or the deflection device in order to optimize an interaction between the irradiation beam and the target to irradiate.

21. A target holder assembly having a reference direction in which it is adapted to be subjected to an irradiation beam, comprising:
    - one target holder mounting, adapted to be positioned facing opposite said direction, comprising at least two ports configured to receive a target holder configured to receive a target that is to be irradiated, and
    - a radiation protection chamber surrounding the target holder mounting and being passed through by said direction,

    wherein the target holder mounting is fixed relative to said direction and the at least two ports are axially offset relative to that direction, and wherein the system comprises a deflection device, positioned in the radiation protection chamber and configured to deviate an irradiation beam received in said direction towards the port of the target holder in which the target to irradiate is inserted, and wherein the radiation protection chamber comprises an alternating arrangement of at least one layer comprising a dense material and at least one layer comprising a hydrogen-rich material comprising a neutron poison, the radiation protection chamber having a wall thickness less than 100 cm.