CLAIMS

1. A target irradiation system ~~(1)~~, comprising at least:

– a particle accelerator ~~(10)~~ configured at least to emit an irradiation beam ~~(11)~~ along an axis,

– ~~a~~one target holder mounting ~~(20),~~ positioned outside the particle accelerator facing the irradiation beam ~~(11),~~ comprising at least ~~one port (21)~~two ports configured to receive a target holder ~~(22)~~ configured to receive a target that is to ~~irradiate~~be irradiated, and

– a radiation protection chamber ~~(30)~~ surrounding the target holder mounting ~~(20),~~ the particle accelerator ~~(10)~~ being positioned outside the chamber ~~(30),~~

~~characterized in that~~ wherein the target holder mounting ~~(20)~~ is fixed relative to the particle accelerator ~~(10)~~ and ~~in that~~ the ~~port (21) is~~at least two ports are axially offset relative to the axis of the irradiation beam ~~(11),~~ and ~~in that~~wherein the system ~~(1)~~ comprises a deflection device ~~(40),~~ positioned in the radiation protection chamber ~~(30)~~ and configured to deviate the irradiation beam ~~(11)~~ towards the port ~~(21)~~ of the target holder ~~(22)~~ in which the target to irradiate is inserted~~.~~

~~2. A system according to claim 1, characterized in that~~, and wherein the radiation protection chamber ~~(30)~~ comprises an alternating arrangement of at least one layer comprising a dense material ~~(31)~~ and at least one layer comprising a hydrogen-rich material ~~(32)~~ comprising a neutron poison, the radiation protection chamber having a wall thickness less than 100 cm.

~~3.~~2. A system according to claim ~~2, characterized in that a~~1, wherein an innermost layer of radiation protection of the radiation protection chamber ~~near an inside surface of the chamber~~ is a layer of dense material ~~(31).~~.

~~4.~~3. A system according to ~~any one~~either of claims ~~2~~1 or ~~3, characterized in that~~2, wherein the hydrogen-rich material ~~(32)~~ is polyethylene ~~(PE)~~ with a boron filler as neutron poison in an amount of approximately 5% to 7% (atomic).

~~5.~~4. A system according to any one of claims ~~2~~1 to ~~4, characterized in that~~3, wherein the dense material is tungsten and/or lead.

~~6.~~5. A system according to any one of claims 1 to ~~5, characterized in that~~4, wherein the radiation protection chamber ~~(30)~~ further comprises an additional radiation protection part ~~(33)~~ which surrounds the target holders mounted on the target holder mounting, within a wall of the radiation protection chamber.

~~7.~~6. A system according to claim ~~6, characterized in that~~5, wherein the radiation protection additional part ~~(33)~~ is of dense material.

~~8.~~7. A system according to claim ~~3~~2 and either one of claims ~~6~~5 or ~~7, characterized in that~~6, wherein the radiation protection chamber comprises a wall which comprises an additional thickness ~~(34)~~ of hydrogen-rich material positioned between the radiation protection additional part ~~(33)~~ of the target holders and the innermost layer of dense material ~~(31).~~.

~~9.~~8. A system according to claim ~~8, characterized in that~~7, wherein the radiation protection additional part ~~(33)~~ is of tungsten ~~(W)~~ and is of thickness comprised between approximately 5- cm and approximately 15- cm and in that the wall of the radiation protection chamber ~~(30)~~ next comprises:

– ~~The~~the additional thickness ~~(34)~~ 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~~the innermost layer of dense material ~~(31)~~ of a thickness comprised between approximately 3 cm and approximately 8 cm, and is of tungsten ~~(W);~~;

– ~~A~~a next layer of hydrogen-rich material ~~(32)~~ of a thickness comprised between approximately 25 cm and approximately 40 cm, and is of PE having 5 % boron filler;

– ~~A~~a following layer of dense material ~~(31)~~ of a thickness comprised between approximately 2 cm and approximately 8 cm, and is of lead ~~(Pb);~~; and

~~–~~ ~~An~~an outermost layer ~~(32)~~ of hydrogen-rich material of a thickness comprised between approximately 15 cm and approximately 30 cm, and is of PE having 5% boron filler.

~~10.~~9. A system according to any one of claims 1 to ~~9, characterized in that~~8, wherein the deflection device ~~40)~~ is configured to emit a magnetic field having a value between 1 and 2 Tesla ~~(T),~~, for example the magnetic field is of the order of 1.4 Tesla.

~~11.~~10. A system according to any one of claims 1 to ~~10, characterized in that~~9, wherein the deflection device ~~(40)~~ comprises at least one electromagnetic quadrupole positioned on a path of the irradiation beam.

~~12.~~11. A system according to any one of claims 1 to ~~11, characterized in that~~10, wherein the deflection device ~~(40)~~ is composed of a dense material, for example copper and/or iron in particular.

~~13.~~12. A system according to any one of claims 1 to ~~12, characterized in that~~11, wherein the ports ~~(21)~~ are disposed in a same plane.

~~14.~~13. A system according to claim ~~13, characterized in that~~12, wherein the plane in which the ports ~~(21)~~ are disposed is a horizontal plane.

~~15.~~14. A system according to any one of claims 1 to ~~12, characterized in that~~11, wherein the ports ~~(21)~~ are disposed in a volume.

~~16.~~15. A system according to any one of claims 1 to ~~15, characterized in that~~14, wherein the system comprises a device for adjusting the position of the irradiation beam ~~(51)~~ and a device for adjusting the focus of the irradiation beam ~~(52),~~ and in that the position adjusting device ~~(51)~~ and the focus adjusting device ~~(52)~~ are positioned upstream of the deflection device ~~(40).~~.

~~17.~~16. A system according to claim ~~16, characterized in that~~15, wherein the deflection device ~~(40)~~ differs from the position adjusting device ~~(51).~~.

~~18.~~17. A system according to ~~any~~either one of claims ~~16~~15 or ~~17, characterized in that~~16, wherein the position adjusting device ~~(51)~~ and the focus adjusting device ~~(52)~~ are positioned outside the radiation protection chamber ~~(30).~~.

~~19.~~18. A system according to ~~any~~either one of claims ~~16~~15 or ~~17, characterized in that~~16, wherein the position adjusting device ~~(51)~~ and the focus adjusting device ~~(52)~~ are positioned at least partly inside the radiation protection chamber, or even at least partly within the wall of the radiation protection chamber.

~~20.~~19. A system according to any one of claims ~~16~~15 to ~~19, characterized in that~~18, wherein the position adjusting device ~~(51)~~ and the focus adjusting device ~~(52)~~ are for example conjointly formed by a pair of electromagnetic quadrupoles.

~~21.~~20. A system according to any one of claims ~~16~~15 to ~~20, characterized in that~~19, wherein it comprises an automatic module ~~(60)~~ comprising a control module ~~(61)~~ and a command unit ~~(62),~~ the control unit ~~(61)~~ being configured to integrate information and measurements concerning the position and the focus of the irradiation beam ~~(11)~~ and to send instructions to the command unit ~~(62),~~ and the command unit ~~(62)~~ being configured to actuate the position adjusting device ~~(51)~~ and/or the focus adjusting device ~~(52)~~ and/or the deflection device ~~(40)~~ in order to optimize an interaction between the irradiation beam ~~(11)~~ and the target to irradiate.

~~22.~~21. A target holder assembly having a reference direction in which it is adapted to be subjected to an irradiation beam, comprising:

~~a~~one target holder mounting, adapted to be positioned facing opposite said direction, comprising at least ~~one port~~two ports configured to receive a target holder configured to receive a target that is to ~~irradiate~~be irradiated, and

– a radiation protection chamber surrounding the target holder mounting and being passed through by said direction,

~~the assembly being characterized in that~~wherein the target holder mounting is fixed relative to said direction and ~~in that~~ the ~~port is~~at least two ports are axially offset relative to that direction, and ~~in that~~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.