CLAIMS

1. A pseudotyped retrovirus-like particle or retroviral vector comprising:

a) at least one cell targeting fusion protein comprising (i) a protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family and (ii) at least one cell targeting domain selected from the group consisting of a DARPin, ScFv, targeting peptide and their cominations,

b) at least one modulating fusion protein comprising (i) a protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family or a transmembrane domain and (ii) at least one functional domain chosen from a cytokine, growth factor, hormone, neurotransmitter, apoptosis ligand, or a combination thereof, and

c) at least one glycoprotein comprising at least one modification by comparison to the sequence of the envelope glycoprotein F of a virus of the Paramyxoviridae family,

wherein at least one of said cell targeting fusion protein or said modulating fusion protein comprises a protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family,

wherein each protein protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family in (a) and (b) independently:

(i) comprises at least one modification by comparison to the sequence of the envelope glycoprotein G or H of a virus of the Paramyxoviridae family;

(ii) lacks at least one part of the cytoplasmic region of said envelope glycoprotein G or H; and

(iii) has at least 80% sequence identity to SEQ ID NO: 9 or SEQ ID NO: 10.

2. The pseudotyped retrovirus-like particle or retroviral vector according to claim 1, wherein said virus of the Paramyxoviridae family is a virus of the *Morbillivirus* genus or of the *Henipavirus* genus.

3. The pseudotyped retrovirus-like particle or retroviral vector according to claim 1 or claim 2, wherein the protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family lacks at least 10 amino acids, at least 15 amino acids, at least 18 amino acids, or at least 20 amino acids in the cytoplasmic region.

4. The pseudotyped retrovirus-like particle or retroviral vector according to claim 3, wherein the envelope glycoprotein G is a Nipah virus (NiV) envelope glycoprotein G or the envelope glycoprotein H is a measles virus (MeV) envelope glycoprotein H.

5. The pseudotyped retrovirus-like particle or retroviral vector of any one of claims 1 to 4, wherein the glycoprotein G is derived from Nipah virus envelope glycoprotein G and lacks at least 25 amino acids or at least 30 amino acids in the cytoplasmic domain, preferably wherein the protein derived from Nipah virus envelope glycoprotein G lacks 34 amino acids.,

6. The pseudotyped retroviral vector or retroviral vector according to any of claims 1-5, wherein the glycoprotein G is a truncated Nipah virus (Niv) glycoprotein that lacks amino acids 2-34 of SEQ ID NO: 9 (GcΔ34).

7. The pseudotyped retrovirus-like particle or retroviral vector according to claims 1 to 6, wherein said protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family is at least partially unable to bind at least one natural receptor of said envelope glycoprotein G or H.

8. The pseudotyped retrovirus-like particle or retroviral vector according to claim 7, wherein the protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family is derived from the NiV envelope glycoprotein G and is at least partially unable to bind to Ephrin-B2 receptor and/or Ephrin-B3 receptor, preferably both Ephrin-B2 receptor and Ephrin-B3 receptor.

9. The pseudotyped retrovirus-like particle or retroviral vector according to claim 8, wherein the protein is derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family is derived from the NiV envelope glycoprotein G and comprises at least two or at least three point mutations by comparison to SEQ ID NO: 9, wherein said point mutations are selected in the group consisting of E501A, W504A, Q530A and E533A, preferably wherein the point mutations comprise E501A, W504A, Q530A and E533A and lead to the inability to bind Ephrin-B2 receptor and Ephrin-B3 receptor.

10. The pseudotyped retrovirus-like particle or retroviral vector according to any of claims 1-9, wherein the glycoprotein is a Nipah virus envelope glycoprotein F or is a measles virus envelope glycoprotein F.

11. The pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1-10, wherein the glycoprotein derived from an envelope F comprisesing at least one modification by comparison to the sequence of the envelope glycoprotein F of a virus of the Paramyxoviridae family lacks at least 10 amino acids, at least 15 amino acids, at least 20 amino acids, at least 25 amino acids or at least 30 amino acids in the cytoplasmic region of said glycoprotein F.

12. The pseudotyped retrovirus-like particle or retroviral vector according to claim 10, wherein:

the glycoprotein comprising at least one modification by comparison to the sequence of the envelope glycoprotein F of a virus of the Paramyxoviridae family is a measles virus envelope glycoprotein F that lacks 30 amino acids in the cytoplasmic domain; or

the glycoprotein comprising at least one modification by comparison to the sequence of the envelope glycoprotein F of a virus of the Paramyxoviridae family is a Nipah virus envelope F that lacks 22 amino acids in the cytoplasmic domain.

13. The pseudotyped retroviral vector according to any one of claims 1-11, wherein the glycoprotein F is a truncated envelope glycoprotein F that lacks amino acids 523-546 of SEQ ID NO:11 (FcΔ22).

14. The pseudotyped retrovirus-like particle or retroviral vector according to any of claims 1 to 13, wherein the protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family comprises a protein having at least 85%, 90%, 95%, 96%, 97%, 98% or 99% sequence identity to SEQ ID NO: 9, or the protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family comprises a protein having at least 85%, 90%, 95%, 96%, 97%, 98% or 99% sequence identity to SEQ ID NO: 10

15. The pseudotyped retrovirus-like particle or retroviral vector of any of claims 1 to 14, wherein the glycoprotein comprising at least one modification by comparison to the sequence of the envelope glycoprotein F of a virus of the Paramyxoviridae family comprises a protein having at least 80%, 85%, 90%, 95%, 96%, 97%, 98% or 99% sequence identity to SEQ ID NO: 11, or wherein the glycoprotein comprising at least one modification by comparison to the sequence of the envelope glycoprotein F of a virus of the Paramyxoviridae family comprises a protein having at least 80%, 85%, 90%, 95%, 96%, 97%, 98% or 99% sequence identity to SEQ ID NO: 12

16. The pseudotyped retrovirus-like particle or retroviral vector of any one of claims 1-15, which comprises a gene encoding a chimeric antigen receptor.

17. The pseudotyped retrovirus-like particle or retroviral vector of claim 16, wherein the encoded chimeric antigen receptor is specific for CD19.

18. The pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 17, wherein the at least one cell targeting domain binds a target cell selected from a hematopoietic cell, stromal cell, liver cell, muscle cell, or cell of the nervous system.

19. The pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 18, wherein the at least one cell targeting domain is specific for CD3, CD8, CD4, a cancer cell marker, CD11b, CD19, CD62L, CD56, Glut-1 (glucose transporter), CD22, CD20, CCR5 or CXCR4.

20. The pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 19, wherein the at least one cell targeting domain is specific for CD3 or CD8.

21. The pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 20, wherein the at least one cell targeting domain comprises an anti-CD8 scFv and the anti-CD8 scFv targeting domain comprises the variable heavy (VH) and variable light (VL) chain of the scFv set forth in the sequence of SEQ ID NO:4.

22. The pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 21, wherein the at least one cell targeting domain comprises an anti-CD8 scFv and the anti-CD8 scFv targeting domain comprises the scFv set forth in the sequence of SEQ ID NO:4

23. The pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 22, wherein the cytokine is selected from the group consisting of interleukin (IL), a tumor necrosis factor (TNF) or an interferon.

24. The pseudotyped retrovirus-like particle or retroviral vector of claim 23, wherein the interleukin is IL-2, IL-7, IL-15 or IL-21.

25. The pseudotyped retrovirus-like particle or retroviral vector of any of claims 1 to 24, wherein the modulating fusion protein comprises IL-7.

26. A nucleic acid comprising a sequence encoding a cell targeting fusion protein and a sequence encoding a modulating fusion protein, wherein:

(a) said cell targeting fusion protein comprises (i) a protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family and (ii) at least one cell targeting domain selected from the group consisting of a DARPin, ScFv, targeting peptide and their combinations, and

(b) said modulating fusion protein comprises (i) a protein comprising at least one modification by comparison to the sequence of the envelope glycoprotein G or H of a virus of the Paramyxoviridae family or a transmembrane domain and (ii) at least one functional domain chosen from a cytokine, growth factor, hormone, neurotransmitter, apoptosis ligand, or a combination thereof,

wherein each protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family in (a) and (b) independently:

(i) comprises at least one modification by comparison to the sequence of the envelope glycoprotein G or H of a virus of the Paramyxoviridae family;

(ii) lacks at least one part of the cytoplasmic region of said envelope glycoprotein G or H; and

(iii) has at least 80% sequence identity to SEQ ID NO: 9 or SEQ ID NO: 10.

27. The nucleic acid according to claim 26, wherein said virus of the Paramyxoviridae family is a henipavirus.

28. The nucleic acid according to claim 27, wherein the virus of the Henipavirus genus is Nipah virus, Cedar virus, or Hendra virus.

29. The nucleic acid according to any one of claims 26 to 28, wherein said nucleic acid comprises a sequence selected from the group consisting of SEQ ID NO: 1, SEQ ID NO: 3, SEQ ID NO: 5, SEQ ID NO: 7 and SEQ ID NO: 13 and/or comprises a sequence encoding a sequence selected in the group consisting of sequences SEQ ID NO: 2, SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 8 and SEQ ID NO: 14.

30. A vector comprising the nucleic acid according to any of claims 26 to 29.

31. A method for producing a pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 25, wherein said method comprises co-transfecting a packaging cell line with:

(a) at least one nucleic acid encoding a cell targeting fusion protein, said cell targeting fusion protein comprising (i) a protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family or a transmembrane domain and (ii) at least one cell targeting domain selected from the group consisting of a DARPin, ScFv, targeting peptide and their combinations,

(b) at least one nucleic acid encoding a modulating fusion protein, said modulating fusion protein comprising (i) a protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family or a transmembrane domain and (ii) at least one functional domain chosen from a cytokine, growth factor, hormone, neurotransmitter, apoptosis ligand, or a combination thereof,

(c) at least one nucleic acid encoding a glycoprotein comprising at laeast one modification by comparison to the sequence of the envelope glycoprotein F of a virus of the Paramyxoviridae family, and

(d) at least one vector comprising a nucleic acid encoding core proteins from said retrovirus,

wherein each protein derived from an envelope glycoprotein G or H of a virus of the Paramyxoviridae family in (a) and (b) independently:

(i) comprises at least one modification by comparison to the sequence of the envelope glycoprotein G or H of a virus of the Paramyxoviridae family;

(ii) lacks at least one part of the cytoplasmic region of said envelope glycoprotein G or H; and

(iii) has at least 80% sequence identity to SEQ ID NO: 9 or SEQ ID NO: 10.

32. An in vitro or ex vivo use of a pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 25 to selectively modulate the activity of target cells and optionally selectively transduce said target cells.

33. An in vitro or ex vivo method for selectively modulating the activity of target cells and/or selectively transducing target cells, wherein said method comprises contacting a pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 1 to 25 with cells comprising said target cells.

34. A pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 16 to 25 for use in immune therapy, gene therapy and/or vaccination.

35. Use of a pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 16 to 25 in the manufacture of a medicament, for use in immune therapy, gene therapy and/or vaccination

36. A pseudotyped retrovirus-like particle or retroviral vector or a fusion protein according to any one of claims 16 to 25 for use in the prevention and/or treatment of an immune disease, cancer, genetic disease, allergic disease, inflammatory disease, infectious disease, metabolic disease, neurological disease, muscular disease and their combinations.

37 . Use of a pseudotyped retrovirus-like particle or retroviral vector according to any one of claims 16 to 25 in the manufacture of a medicament, for the prevention and/or treatment of an immune disease, cancer, genetic disease, allergic disease, inflammatory disease, infectious disease, metabolic disease, neurological disease, muscular disease and their combinations.