

**Claims:**

1. A binding protein comprising an antigen binding domain, said antigen binding domain comprising a heavy chain CDR3 domain comprising the amino acid sequence of  
5 SEQ ID NO: 4, wherein said binding protein is capable of binding a TAT protein transduction domain.
2. The binding protein of claim 1, wherein said antigen binding domain further comprises a heavy chain CDR2 domain comprising the amino acid sequence of SEQ ID  
10 NO: 3.
3. The binding protein of claim 1 or 2, wherein said antigen binding domain further comprises a heavy chain CDR1 domain comprising the amino acid sequence of  
15 SEQ ID NO: 2.
4. The binding protein of any one of claims 1-3, wherein said antigen binding domain further comprises a light chain CDR3 domain comprising the amino acid sequence selected from the group consisting of SEQ ID NO: 8 and SEQ ID NO: 12.
- 20 5. The binding protein of any one of claims 1-4, wherein said antigen binding domain further comprises a light chain CDR2 domain comprising the amino acid sequence selected from the group consisting of SEQ ID NO: 7 and SEQ ID NO: 11.
- 25 6. The binding protein of any one of claims 1-5, wherein said antigen binding domain further comprises a light chain CDR1 domain comprising the amino acid sequence selected from the group consisting of SEQ ID NO: 6 and SEQ ID NO: 10.
7. A binding protein comprising an antigen binding domain, said antigen binding domain comprising:  
30 a heavy chain variable region comprising a CDR3 domain comprising the amino acid sequence set forth in SEQ ID NO: 4, a CDR2 domain comprising the amino acid sequence set forth in SEQ ID NO: 3, and a CDR1 domain comprising the amino acid sequence set forth in SEQ ID NO: 2; and

a light chain variable region comprising a CDR3 domain comprising the amino acid sequence set forth in SEQ ID NO: 8, a CDR2 domain comprising the amino acid sequence set forth in SEQ ID NO: 7, and a CDR1 domain comprising the amino acid sequence set forth in SEQ ID NO: 6; or a light chain variable region comprising a CDR3 domain comprising the amino acid sequence set forth in SEQ ID NO: 12, a CDR2 domain comprising the amino acid sequence set forth in SEQ ID NO: 11, and a CDR1 domain comprising the amino acid sequence set forth in SEQ ID NO: 10,

wherein said binding protein is capable of binding a TAT protein transduction domain.

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8. The binding protein of claim any one of claims 1-7, wherein said antigen binding domain comprises a heavy chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 1 or SEQ ID NO: 14.

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9. The binding protein of any one of claims 1-8, wherein said antigen binding domain comprises a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 5, a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 9, or a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 13.

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10. The binding protein of any one of claims 1-9, wherein said antigen binding domain comprises a heavy chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 1 and a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 5.

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11. The binding protein of any one of claims 1-9, wherein said antigen binding domain comprises a heavy chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 1 and a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 9.

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12. The binding protein of any one of claims 1-9, wherein said antigen binding domain comprises a heavy chain variable region comprising the amino acid sequence set

forth in SEQ ID NO: 1 and a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 13.

13. The binding protein of any one of claims 1-9, wherein said antigen binding  
5 domain comprises a heavy chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 14 and a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 5.

14. A binding protein comprising an antigen binding domain, said antigen  
10 binding domain comprising a heavy chain CDR3 domain comprising the amino acid sequence of SEQ ID NO: 18, wherein said binding protein is capable of binding a TAT protein transduction domain.

15. The binding protein of claim 14, wherein said antigen binding domain further  
15 comprises a heavy chain CDR2 domain comprising the amino acid sequence of SEQ ID NO: 17.

16. The binding protein of claim 14 or 15, wherein said antigen binding domain  
20 further comprises a heavy chain CDR1 domain comprising the amino acid sequence of SEQ ID NO: 16.

17. The binding protein of any one of claims 14-16, wherein said antigen binding  
domain further comprises a light chain CDR3 domain comprising the amino acid  
25 sequence of SEQ ID NO: 22.

18. The binding protein of any one of claims 14-17, wherein said antigen binding  
domain further comprises a light chain CDR2 domain comprising the amino acid  
sequence of SEQ ID NO: 21.

19. The binding protein of any one of claims 14-18, wherein said antigen binding  
30 domain further comprises a light chain CDR1 domain comprising the amino acid sequence of SEQ ID NO: 20.

20. A binding protein comprising an antigen binding domain, said antigen binding domain comprising:

5 a heavy chain variable region comprising a CDR3 domain comprising the amino acid sequence set forth in SEQ ID NO: 18, a CDR2 domain comprising the amino acid sequence set forth in SEQ ID NO: 17, and a CDR1 domain comprising the amino acid sequence set forth in SEQ ID NO: 16; and

10 a light chain variable region comprising a CDR3 domain comprising the amino acid sequence set forth in SEQ ID NO: 22, a CDR2 domain comprising the amino acid sequence set forth in SEQ ID NO: 21, and a CDR1 domain comprising the amino acid sequence set forth in SEQ ID NO: 20,

wherein said binding protein is capable of binding a TAT protein transduction domain.

15 21. The binding protein of claim any one of claims 14-20, wherein said antigen binding domain comprises a heavy chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 15.

20 22. The binding protein of any one of claims 14-21, wherein said antigen binding domain comprises a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 19.

25 23. The binding protein of any one of claims 14-22, wherein said antigen binding domain comprises a heavy chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 15 and a light chain variable region comprising the amino acid sequence set forth in SEQ ID NO: 19.

24. The binding protein of any one of claims 1-23, wherein the TAT protein transduction domain comprises the amino acid sequence of SEQ ID NO: 23.

30 25. The binding protein of any one of claims 1-23, wherein the TAT protein transduction domain consists essentially of the amino acid sequence of SEQ ID NO: 23.

26. The binding protein of any one of claims 1-25, wherein the TAT protein transduction domain is covalently linked to a cargo moiety.

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27. The binding protein of claim 26, wherein the cargo moiety is a polypeptide.

28. The binding protein of claim 26, wherein the cargo moiety is a frataxin polypeptide.

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29. The binding protein of claim 26, wherein the cargo moiety is an antibody.

30. The binding protein of claim 26, wherein the cargo moiety is a nucleic acid.

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31. The binding protein of claim 30, wherein the nucleic acid is an siRNA, shRNA, miRNA, phosphorothioate modified RNA, aptamer, phosphorodiamidate morpholino oligomer (PMO), or any combination thereof.

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32. The binding protein of claim 26, wherein the cargo moiety is a small molecule, a liposome enclosing protein, a radionuclide or radionuclide labeled compound, or any combination thereof.

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33. A binding protein comprising an antigen binding domain, wherein said binding protein is capable of binding to a TAT protein transduction domain that is covalently linked to a cargo moiety.

34. The binding protein of claim 33, wherein said antigen binding domain binds to an epitope comprising the amino acid residues of SEQ ID NO: 23.

35. The binding protein of claim 33, wherein the cargo moiety is a polypeptide.

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36. The binding protein of claim 33, wherein the cargo moiety is a frataxin polypeptide.

37. The binding protein of claim 33, wherein the cargo moiety is an antibody.

38. The binding protein of claim 33, wherein the cargo moiety is a nucleic acid.

39. The binding protein of claim 38, wherein the nucleic acid is an siRNA,  
5 shRNA, miRNA, phosphorothioate modified RNA, aptamer, phosphorodiamidate  
morpholino oligomer (PMO), or any combination thereof.

40. The binding protein of claim 33, wherein the cargo moiety is a small  
molecule, a liposome enclosing protein, a radionuclide or radionuclide labeled compound,  
10 or any combination thereof.

41. The binding protein of any one of claims 1-40, wherein said binding protein  
is an antibody.

42. An antibody construct comprising the binding protein of any one of claims 1-  
15 41, said antibody construct further comprising a linker polypeptide or an immunoglobulin  
constant domain.

43. The antibody construct according to claim 42, wherein said binding protein is  
20 selected from the group consisting of: an immunoglobulin molecule, a monoclonal  
antibody, a murine antibody, a chimeric antibody, a CDR-grafted antibody, a humanized  
antibody, a single domain antibody, a Fv, a disulfide linked Fv, a scFv, a diabody, a Fab,  
a Fab', a F(ab')<sub>2</sub>, a multispecific antibody, a dual specific antibody, and a bispecific  
antibody.

44. The antibody construct according to any one of claims 42 and 43, wherein  
25 said binding protein comprises a heavy chain immunoglobulin constant domain selected  
from the group consisting of: a IgM constant domain, a IgG<sub>4</sub> constant domain, a IgG<sub>1</sub>  
constant domain, a IgE constant domain, a IgG<sub>2</sub> constant domain, a IgG<sub>3</sub> constant domain  
30 and a IgA constant domain.

45. The antibody construct according to claim 44, wherein said binding protein  
comprises a IgG<sub>1</sub> constant domain.

46. The antibody construct according to claim 44, wherein said heavy chain immunoglobulin constant domain is not IgM.

5           47. An isolated nucleic acid encoding a binding protein amino acid sequence of any one of claims 1-41.

48. An isolated nucleic acid encoding an antibody construct amino acid sequence of any one of claims 42-46.

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49. A vector comprising an isolated nucleic acid according to claim 47 or 48.

50. The vector of claim 49 wherein said vector is selected from the group consisting of pcDNA, pTT, pTT3, pEFBOS, pBV, pJV, pBJ, pGEX, VSV, pBR322,  
15 pCMV-HA, pEN, YAC, BAC, Bacteriophage Lamda, Phagemid, pCAS9, pCEN6, pYES1L, p3HPRT1, pFN2A, pBC, pTZ, pGEM, pGEMK, pEX, pSAR, pCEP, Cosmids, pBluescript, pKJK, pFloxin, pCP, pHR, pUC, and pMAL.

51. A host cell comprising a vector according to claim 49 or 50.

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52. The host cell according to claim 51, wherein said host cell is a prokaryotic cell or a eukaryotic cell.

53. The host cell according to claim 51, wherein said prokaryotic host cell is E.  
25 Coli.

54. The host cell according to claim 51, wherein said eukaryotic cell is selected from the group consisting of a protist cell, an insect cell, an animal cell, a plant cell and a fungal cell.

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55. The host cell according to claim 51, wherein said animal cell is a mammalian cell or an avian cell.

56. The host cell according to claim 51, wherein said host cell is selected from the group consisting of a CHO cell, a COS cell, a yeast cell, an insect Sf9 cell, HEK-293 cell, ExpiCHO cell, Expi-293f cell, and *E.Coli* cell.

5 57. The host cell according to claim 56, wherein said yeast cell is *Saccharomyces cerevisiae*.

58. A method of producing an antibody, or antigen binding portion thereof, comprising culturing the host cell of any one of claims 51-57 in culture medium so that  
10 said isolated nucleic acid is expressed and said antibody is produced.

59. An antibody produced according to the method of claim 58.

60. A transgenic mouse comprising the host cell of any one of claims 51-57,  
15 wherein the mouse expresses a polypeptide encoded by the nucleic acid, or an antigen binding portion thereof, that binds to a TAT protein transduction domain.

61. A hybridoma that produces the antibody construct of any one of claims 42-46.

20 62. The binding protein of any one of claims 1-41, which is immobilized on a solid support.

63. The binding protein of claim 62, wherein the solid support is a plate, a bead, or a chromatography resin.

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64. The binding protein of claim 63, wherein the bead or chromatography resin comprises protein A agarose or protein G agarose.

65. The binding protein of any one of claims 1-41, which is conjugated to a  
30 detection molecule.

66. The binding protein of claim 65, wherein the detection molecule is horseradish peroxidase, sulfotag, alkaline phosphatase, cresol violet, quantum dots, FITC, an infrared molecule, a radiolabel, or an EPR spin tracer label.

5           67. A method for detecting and/or quantifying the level of a TAT fusion molecule in a sample, comprising contacting the sample with a binding protein of any one of claims 1-41 under conditions such that the binding protein binds to TAT protein transduction domain in the sample, to thereby detect and/or quantify the level of the TAT fusion molecule in the sample.

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68. The method of claim 67, wherein the sample is a biological sample.

69. The method of claim 68, wherein the biological sample is a liquid sample or a tissue sample.

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70. The method of claim 68, wherein the TAT fusion molecule comprises a TAT protein transduction domain covalently linked to a cargo moiety.

71. The method of claim 70, wherein the cargo moiety is a polypeptide.

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72. The method of claim 70, wherein the cargo moiety is a frataxin polypeptide.

73. The method of claim 70, wherein the cargo moiety is an antibody.

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74. The method of claim 70, wherein the cargo moiety is a nucleic acid.

75. The binding protein of claim 74, wherein the nucleic acid is an siRNA, shRNA, miRNA, phosphorothioate modified RNA, aptamer, phosphorodiamidate morpholino oligomer (PMO), or any combination thereof.

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76. The binding protein of claim 70, wherein the cargo moiety is a small molecule, a liposome enclosing protein, a radionuclide or radionuclide labeled compound, or any combination thereof.

77. The method of claim 67, further comprising assessing the stability of the TAT fusion molecule.

78. A method of isolating and/or purifying a TAT fusion molecule present in a mixture, wherein said TAT fusion molecule comprises a TAT protein transduction domain covalently linked to a cargo moiety, comprising (a) contacting said mixture comprising the TAT fusion molecule with the immobilized binding protein of any one of claims 62-64 under conditions such that the TAT fusion molecule binds to the immobilized binding protein; (b) eluting said TAT fusion molecule from the immobilized binding protein.

79. A kit for comprising at least one reagent specific for the detection of a level of a TAT protein transduction domain, wherein the detection reagent is a binding protein of any one of claims 1-41.

80. The kit of claim 79, wherein the TAT protein transduction domain is covalently linked to a cargo moiety.

81. The kit of claim 79 or 80, wherein the kit further comprises instructions for the detection, quantitation or characterization of the TAT protein transduction domain.

82. A method of inhibiting the translocation of a TAT fusion molecule across a cell membrane, comprising contacting the TAT fusion molecule with an antigen binding protein of any one of claims 1-41, thereby inhibiting translocation of the TAT fusion molecule across the cell membrane.

83. A method of inhibiting the activity of HIV-TAT protein in a subject, comprising administering to the subject an antigen binding protein of any one of claims 1-41, thereby inhibiting activity of the HIV-TAT protein in the subject.

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