

WHAT IS CLAIMED IS:

1. An adeno-associated virus 2 (AAV2) VP1 capsid protein comprising an amino acid sequence comprising SEQ ID NOs:82, 85, or 86 inserted between amino acids N587 and R588 of the AAV2 VP1 capsid protein, numbered relative to SEQ ID NO:110.
2. The AAV2 VP1 capsid protein of claim 1, the capsid protein further comprising an V708I amino acid substitution.
3. The AAV2 VP1 capsid protein of claim 1, the capsid protein further comprising one or more of an E12V, P29A, H38L, E36G, D41G, L59P, E67A, D69E, K105E, K137E, E147A, G163D, V182E, V182I, Q186R, S207G, N214D, N227D, M235L, F284Y, N335K, N382D, N408S, S423N, S492P, S492Y, N496D, N496Y, N587S, D594N, R585G, T567A, or S662C amino acid substitution.
4. An AAV2 VP1 capsid protein comprising an amino acid sequence comprising sequence LAxxDxTKxA (SEQ ID NO:106), wherein the amino acid sequence is inserted between amino acids N587 and R588 of the AAV2 VP1 capsid protein and wherein the AAV2 VP1 capsid protein comprises an N382D and an V708I amino acid substitution, numbered relative to SEQ ID NO:110.
5. The AAV2 VP1 capsid protein of claim 4, wherein the amino acid sequence that is inserted into the capsid protein comprises the sequence LADQDYTKTA (SEQ ID NO:85).
6. A viral particle comprising the viral capsid protein of claim 1 or 4.
7. The viral particle of claim 6, wherein the viral particle exhibits enhanced retrograde movement compared to a wild type viral particle.
8. The viral particle of claim 6, wherein the viral particle possesses retrograde transport capability.
9. A viral particle of claim 6, further comprising a payload.
10. The viral particle of claim 9, wherein the payload comprises a protein-coding gene or an inhibitory RNA nucleic acid.
11. The viral particle of claim 10, wherein the payload comprises an inhibitory RNA nucleic acid selected from the group consisting of an antisense oligonucleotide, an siRNA, and an RNAi.

12. The viral particle of claim 10, wherein the payload comprises a protein-coding gene encoding an optical reporter.
13. The viral particle of claim 10, wherein the payload comprises a protein-coding gene encoding a viral protein.
14. The viral particle of claim 10, wherein the payload comprises a protein-coding gene encoding a therapeutic protein.
15. The viral particle of claim 9, wherein the payload comprises a nucleic acid comprising a promoter sequence operably linked to a protein-coding gene.
16. The viral particle of claim 15, wherein the promoter is a neuron-specific promoter.
17. The viral particle of claim 15, wherein the promoter is selected from the group consisting of a synapsin-1, CMV, GFAP, CAG, CaMKII, MBP, EF1alpha, TRE, and mDlx promoter.
18. A method of delivering a payload to one or more neurons, the method comprising contacting one or more neurons with the viral particle of claim 6, wherein viral particle comprises a payload packaged therein.