nucleic acid or viral vector as disclosed herein. In one example, the host cell is a HEK293 or HEK293T cell.

In yet another aspect, the present disclosure refers to a pharmaceutical composition comprising a vector as described herein and a pharmaceutically acceptable carrier. Also provided are pharmaceutical compositions comprising a nucleic acid or vector described herein and a pharmaceutically acceptable carrier.

In a further aspect, the present disclosure refers to the vector as described herein for use in treating retinal disorders. In a further aspect, the present disclosure refers to use of a vector as described herein in the manufacture of a medicament for treating retinal disorders. In a further aspect, the present disclosure refers to use of a vector as described herein in the manufacture of a medicament for treating retinal disorders in a patient in need thereof, comprising that a therapeutically effective amount of the vector is to be administered to said patient.

The disclosure further provides methods of using the nucleic acids, vectors, optimized gene sequences, and/or expression constructs described herein in a method of preventing or treating retinal disorders. In one example, the nucleic acids, vectors, optimized gene sequences, and/or expression constructs described herein are used in the manufacture of a medicament for the treatment or prevention of retinal disorders. Also provided is a method of treating or preventing retinal disorders in a patient in need thereof, comprising administering a therapeutically effective amount of a vector disclosed herein. In one example, the retinal disorder is Achromatopsia. In some examples, the vector is administered to a patient by direct retinal, subretinal, or intravitreal injection.

Brief description of the Figures

Figure 1 shows the results of an *in vivo* reporter gene expression study in transgenic mice in order to assess the position effect of the Locus Control Region (LCR) on the green (M) opsin core promoter. Top left: The normal human red and green pigment gene array showing the locations of the LCR, transcription units, and exons. Lower left: Modified visual pigment gene

CLAIMS

1. A transcriptional control unit (TCU) of up to 2500 nucleotides in length comprising in a 5' to 3' direction:

(a) a Locus Control Region (LCR) comprising

(i) SEQ ID NO 1; or

(ii) a sequence having at least 90% sequence identity to said sequence (a)(i); and

(b) a promoter element comprising SEQ ID NO: 16 and

(i) at least the last 200 nucleotides of SEQ ID NO: 17; or

(ii) a sequence having at least 90% sequence identity to said sequence (b)(i);

said TCU exhibiting cone photoreceptor-specific promoter activity.

2. The TCU of claim 1, wherein (b) comprises:

(i) at least the last 500 nucleotides of SEQ ID NO: 17, or

(ii) a sequence having at least 90% sequence identity to said sequence (i);

said TCU exhibiting cone photoreceptor-specific promoter activity.

3. The TCU of any one of the preceding claims, wherein (b) comprises at least 200 nucleotides of SEQ ID NO: 3.

4. The TCU of any one of the preceding claims, wherein the TCU comprises:

(a) a LCR comprising SEQ ID NO: 1; and

(b) a promoter element comprising SEQ ID NO: 3.

5. The TCU of any one of the preceding claims, wherein (b) comprises a sequence of at least 10 contiguous nucleotides selected from nucleotides 1 to 35 of SEQ ID NO:3, or a sequence comprising at least 10 contiguous nucleotides selected from a sequence having at least 90% sequence identity to nucleotides 1 to 35 of SEQ ID NO:3.

6. The TCU according to any one of the preceding claims, wherein (b) comprises:

(i) SEQ ID NO: 3; or

(ii) a sequence having at least 90% sequence identity to said sequence (i);

said TCU exhibiting cone photoreceptor-specific promoter activity.

7. The TCU of claim 6, wherein the TCU comprises SEQ ID NO: 4.

8. The TCU of claim 6, wherein the TCU comprises SEQ ID NO:15.

9. The TCU of any one of claims 1 to 3, wherein the promoter element comprises SEQ ID NO: 5.

10. The TCU of claim 9, wherein the TCU comprises SEQ ID NO: 6.

11. An expression construct comprising the TCU of any one of the preceding claims, operably linked to a sequence to be expressed in a cone photoreceptor-specific manner.

12. The expression construct according to claim 11, wherein the operably linked sequence is *CNGA3, CNGB3, PDE6C, PDE6H, GNAT2, KCNV2* or *CACNA2D4*.

13. The expression construct according to claim 12, wherein the operably linked sequence comprises SEQ ID NO: 7, 8, 9, 10, 11, 12, 13 or 14, or that has at least 80% sequence identity to SEQ ID NO: 7, 8, 9, 10, 11, 12, 13 or 14 and has the ability to rescue cone photoreceptor function.

14. The expression construct according to claim 12 or 13, wherein the operably linked sequence has at least 80% sequence identity to SEQ ID NO: 8 and has the ability to rescue cone photoreceptor function.

15. The expression construct according to claim 14, wherein the operably linked sequence comprises SEQ ID NO: 8.

16. A vector comprising the TCU according to any one of claims 1 to 10 or an expression construct according to any one of claims 11 to 15.

17. The vector according to claim 16 which is a viral vector.

18. The vector according to claims 17, which is an adeno-associated virus (AAV) vector.

19. The vector according to claim 18, wherein the vector comprises an AAV genome or a derivative thereof.

20. The vector according to claim 19, wherein the vector comprises an AAV genome or a derivative thereof, and wherein the AAV capsid is derived from AAV8.

21. The vector according to claim 20, wherein the AAV capsid is derived from AAV8 and the expression construct is defined according to any one of claims 11 to 15.

22. The vector according to claim 21, wherein the operably linked sequence is *CNGA3*.

23. The vector according to any one of claims 19 to 22, wherein said derivative is a chimeric, shuffled or capsid modified derivative.

24. The vector according to any of claims 19 to 23, wherein said AAV genome is from a naturally derived serotype or isolate or clade of AAV.

25. The vector according to claim 24, wherein said AAV genome is from AAV serotype 2 (AAV2), AAV serotype 4 (AAV4), or AAV serotype 8 (AAV8) and/or wherein the capsid is derived from AAV8.

26. The vector according to claim 25, wherein the genome is derived from AAV2 and the capsid is derived from AAV8.

27. A host cell that contains a vector of any one of claims 16 to 26 or produces a viral vector of any one of claims 16 to 26.

28. The cell according to claim 27 that is a HEK293 or HEK293T cell.

29. A pharmaceutical composition comprising a vector of any one of claims 16 to 26 and a pharmaceutically acceptable carrier.

30. The vector according to any one of claims 16 to 26 for use in treating retinal disorders.

31. Use of a vector according to any one of claims 16 to 26 in the manufacture of a medicament for treating retinal disorders.

32. Use of a vector according to any one of claims 16 to 26 in the manufacture of a medicament for treating retinal disorders in a patient in need thereof, comprising that a therapeutically effective amount of the vector is to be administered to said patient.

33. The vector for use according to claim 30, or the use of claim 31 or 32, wherein the retinal disorder is Achromatopsia.

34. The vector for use according to claim 30 or 33, or the use of any one of claims 31 to 33, wherein the treatment is by administration of the vector according to any one of claims 16 to 26 to a patient by direct retinal, subretinal or intravitreal injection.

35. The vector for use, or use, according to claim 34, wherein said vector is to be administered directly into the retinal, subretinal space or intravitreal space.