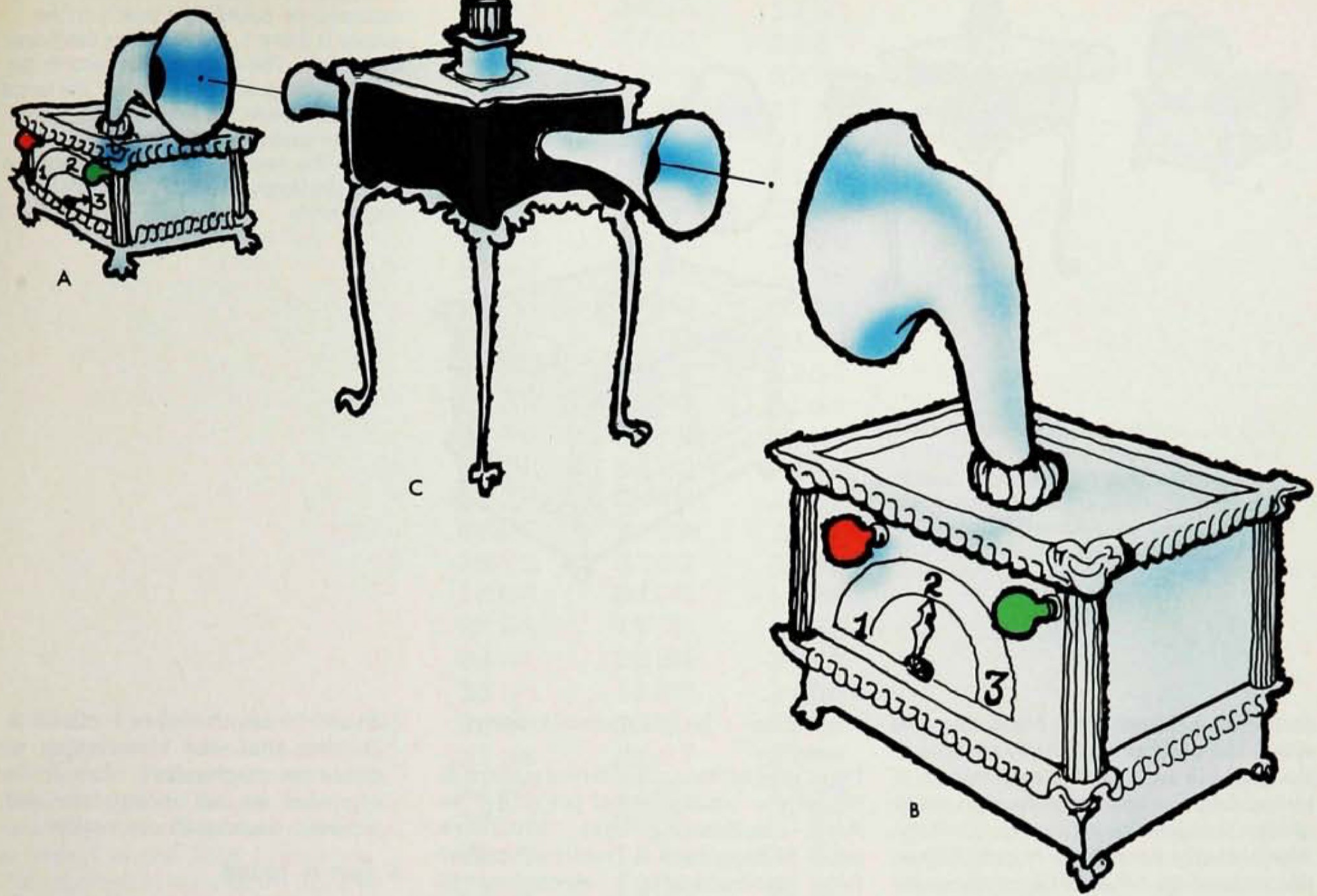
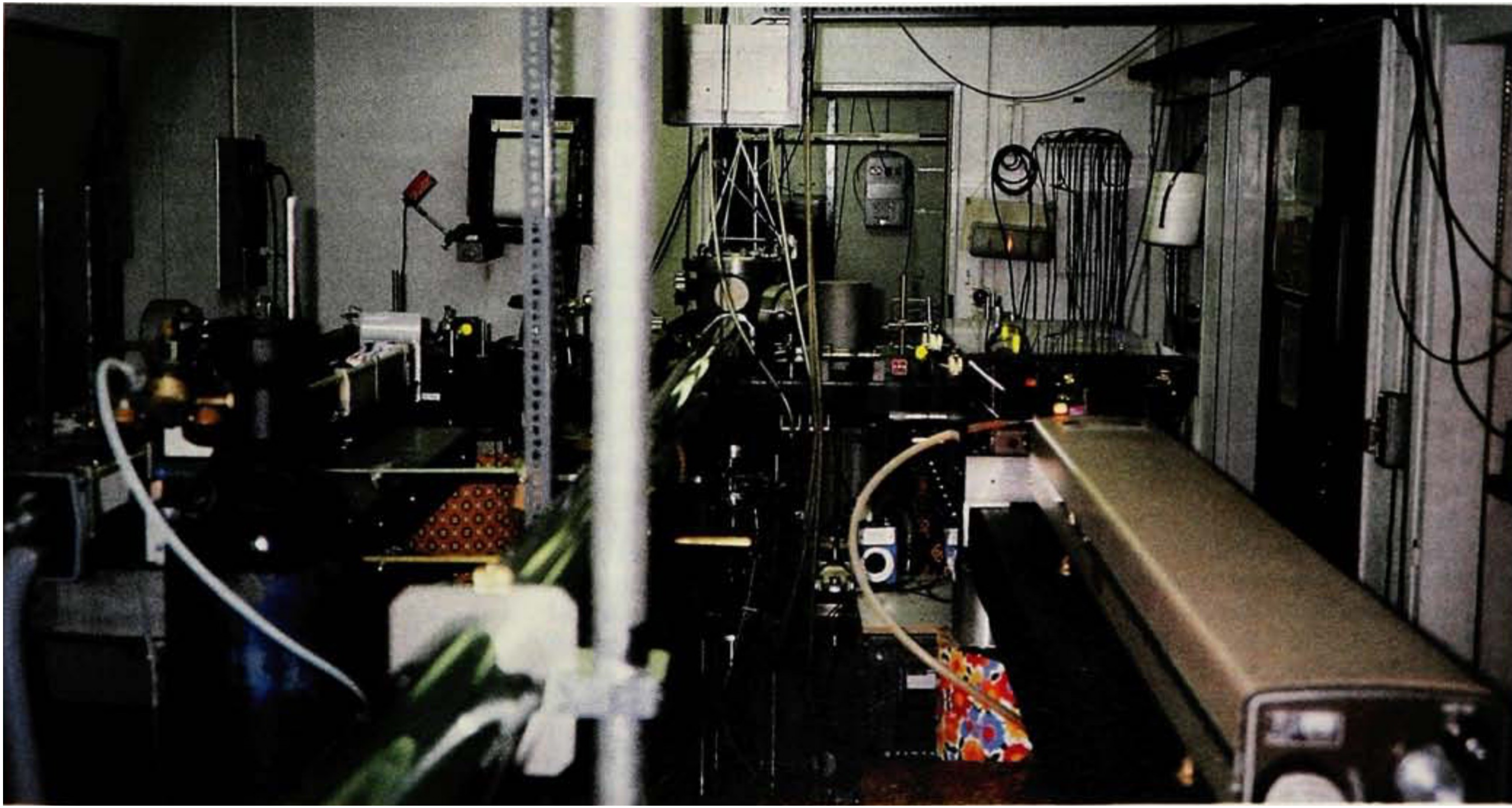
Is the moon there when nobody looks?

N. David Mermin


A
C
B
1
2
3



Three Observable "Color Properties"

$$C_1 \text{ (1-color)} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \qquad |R_1\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \qquad |G_1\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

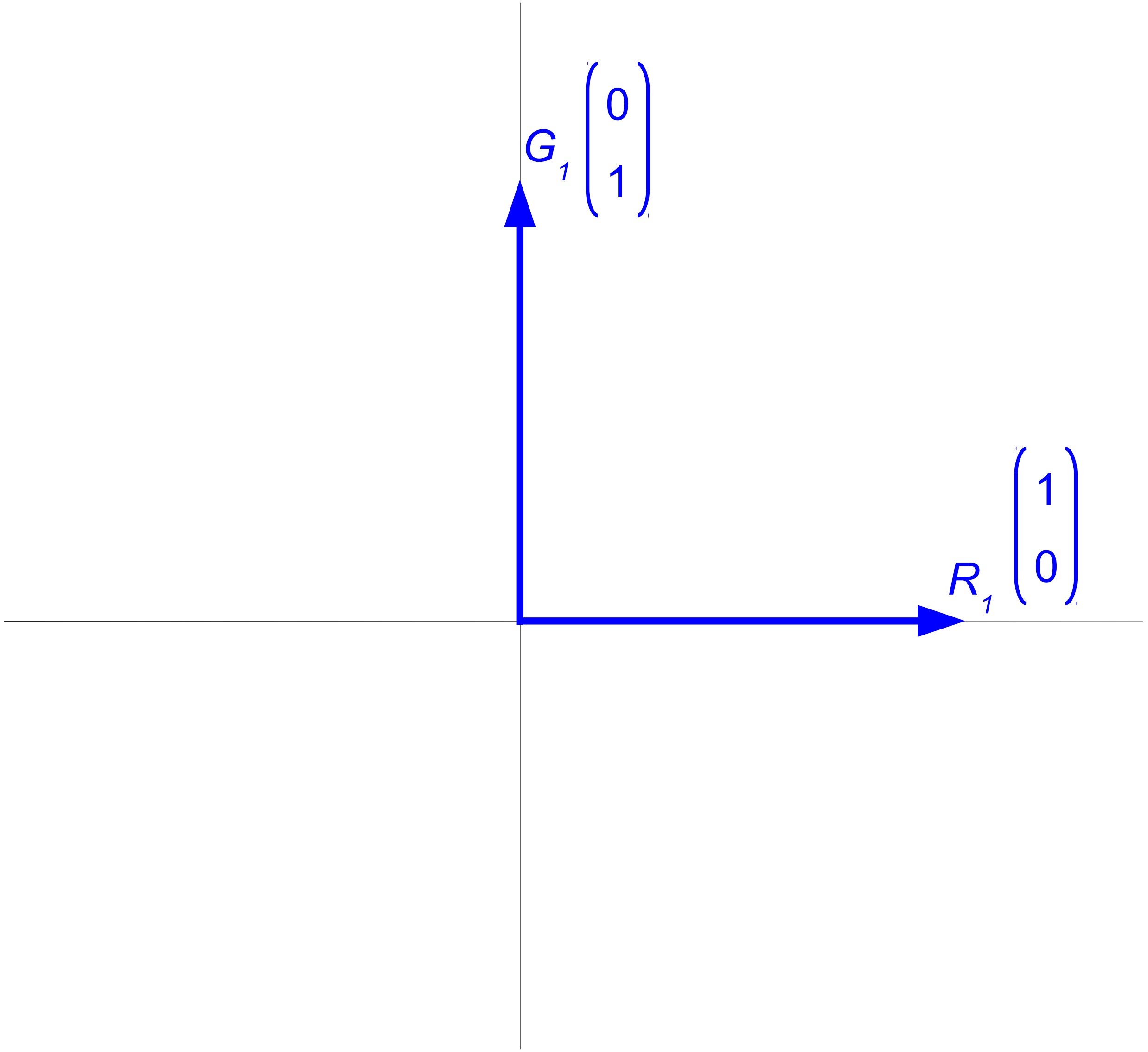
$$C_2 \text{ (2-color)} = \begin{bmatrix} -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2} \end{bmatrix} = \begin{bmatrix} -0.5 & 0.866 \\ 0.866 & 0.5 \end{bmatrix} \qquad |R_2\rangle = \begin{bmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{bmatrix} \qquad |G_2\rangle = \begin{bmatrix} -\frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{bmatrix}$$

$$C_3 \text{ (3-color)} = \begin{bmatrix} -\frac{1}{2} & -\frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{bmatrix} = \begin{bmatrix} -0.5 & -0.866 \\ -0.866 & 0.5 \end{bmatrix} \qquad |R_3\rangle = \begin{bmatrix} -\frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{bmatrix} \qquad |G_3\rangle = \begin{bmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{bmatrix}$$

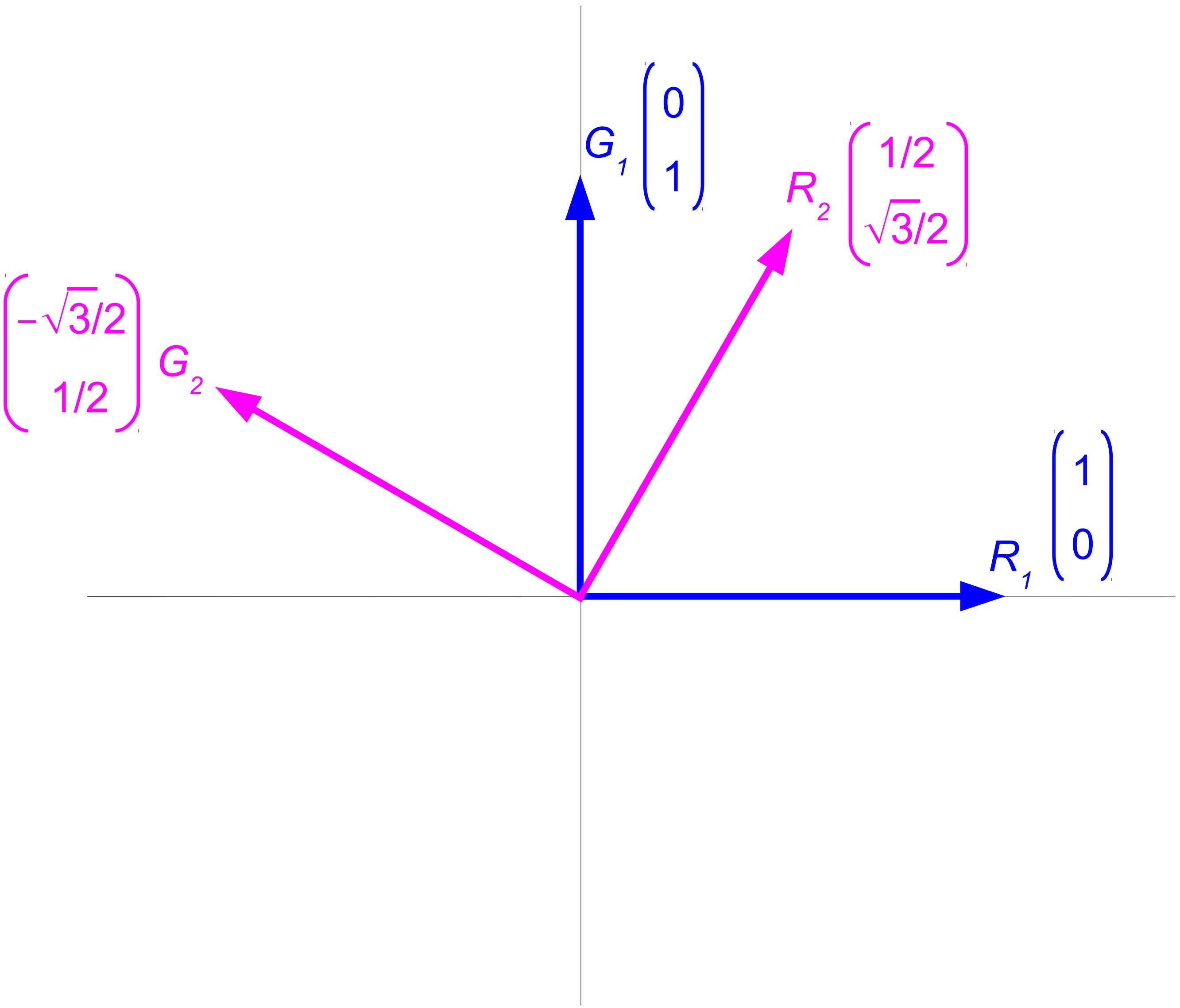
Eigenvalues: +1 (red) –1 (green)

Eigenvectors

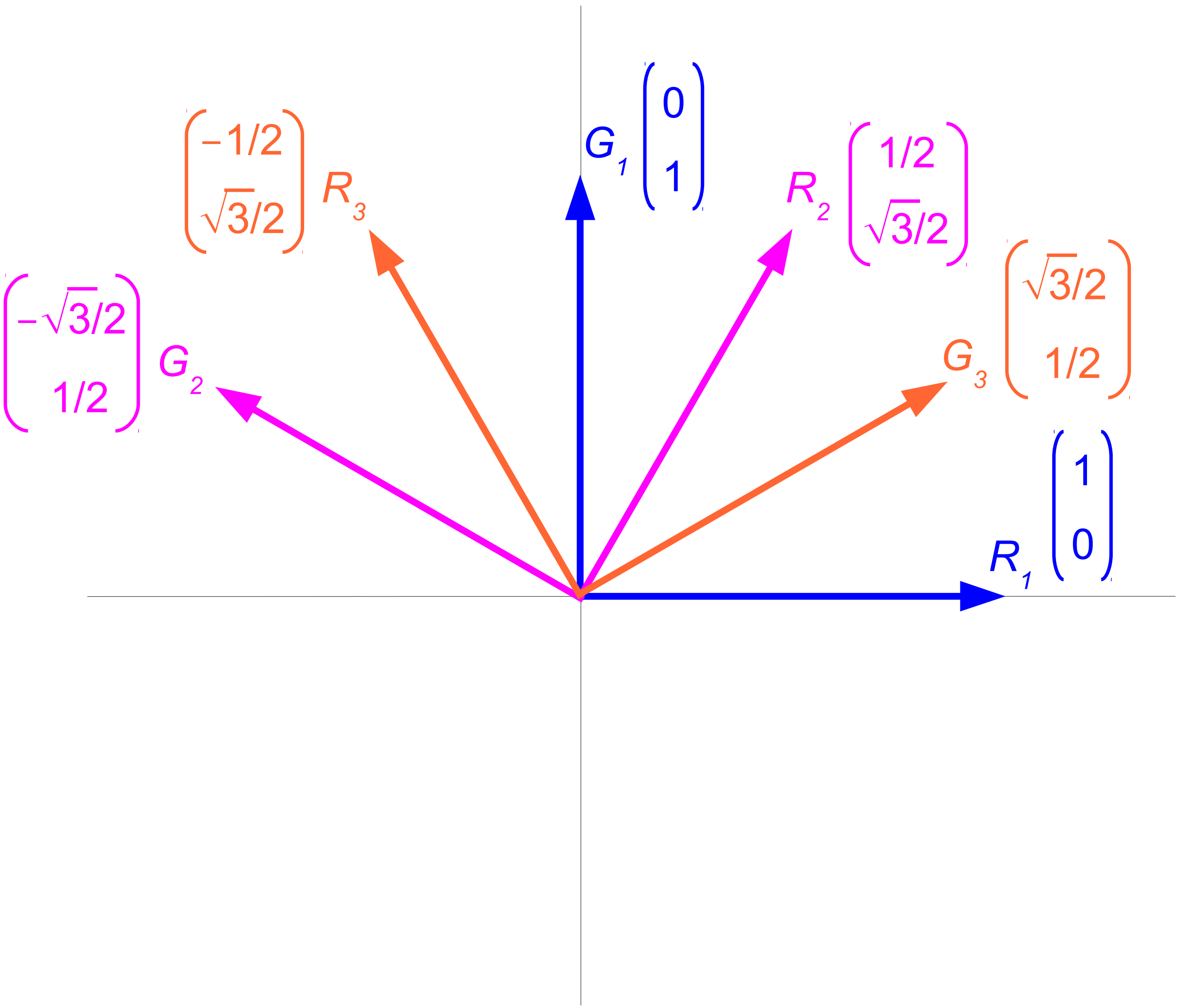
Eigenvectors of the observable C_1



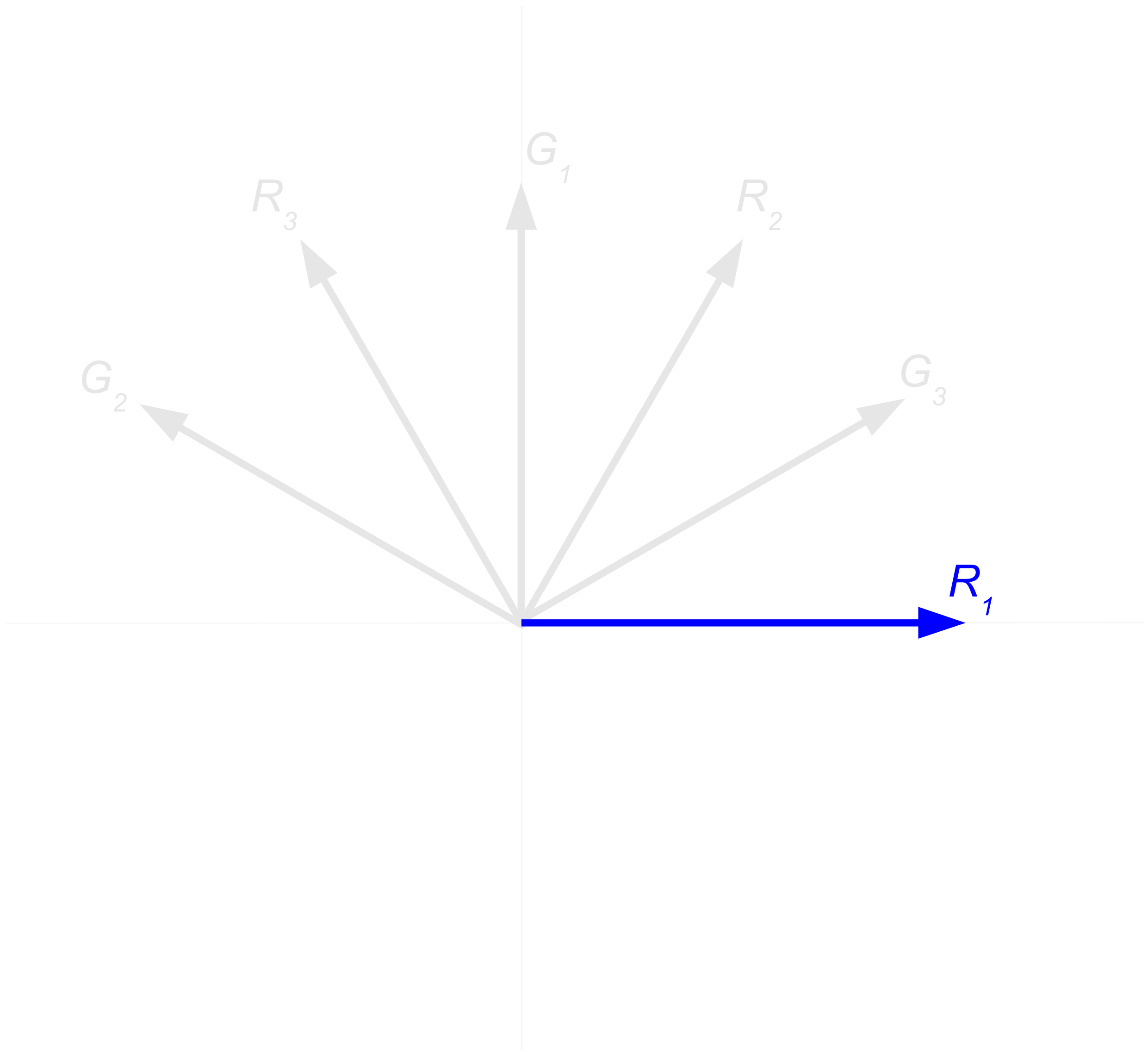
Eigenvectors of the observables C_1, C_2



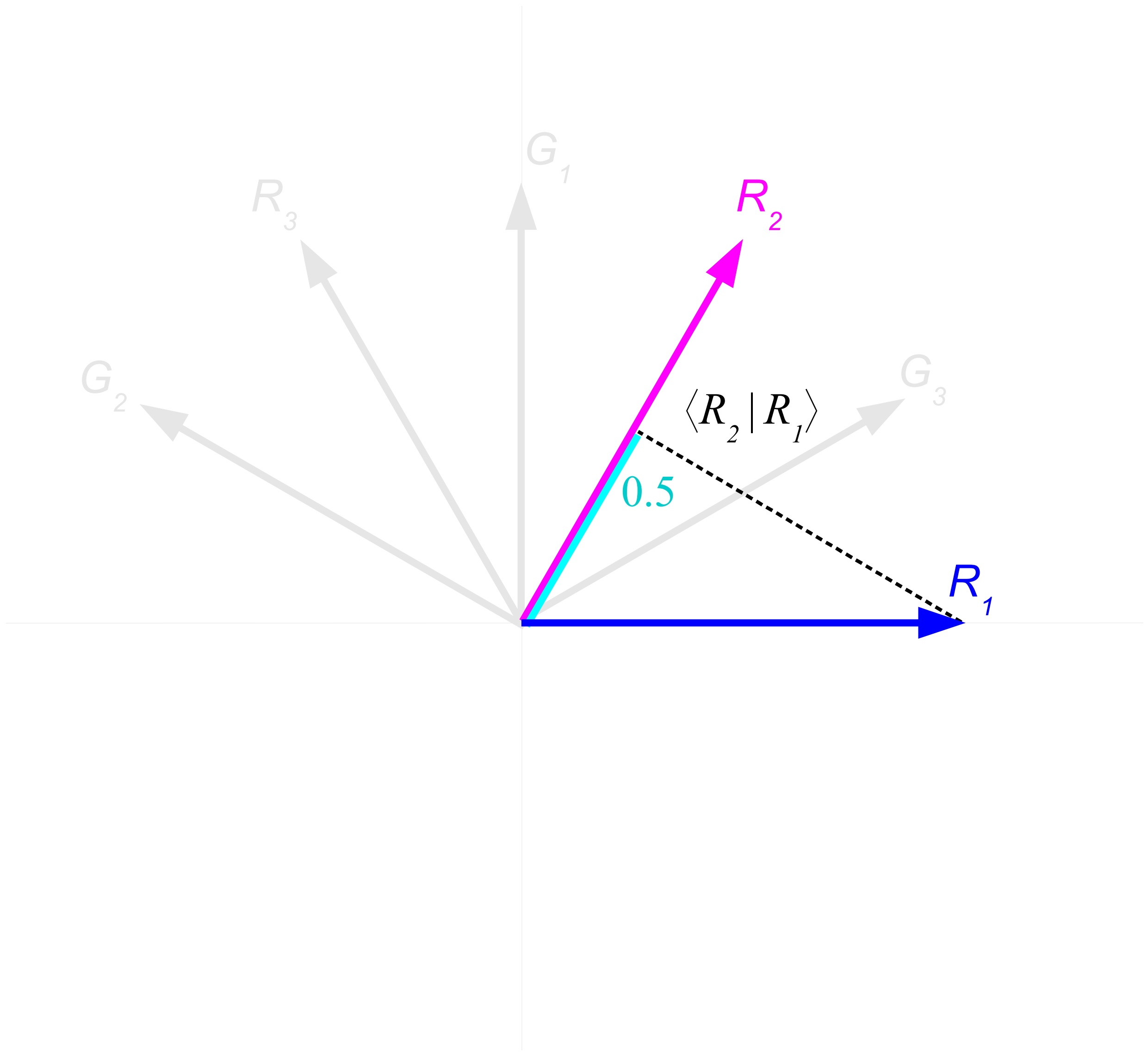
Eigenvectors of the observables C_1, C_2, C_3



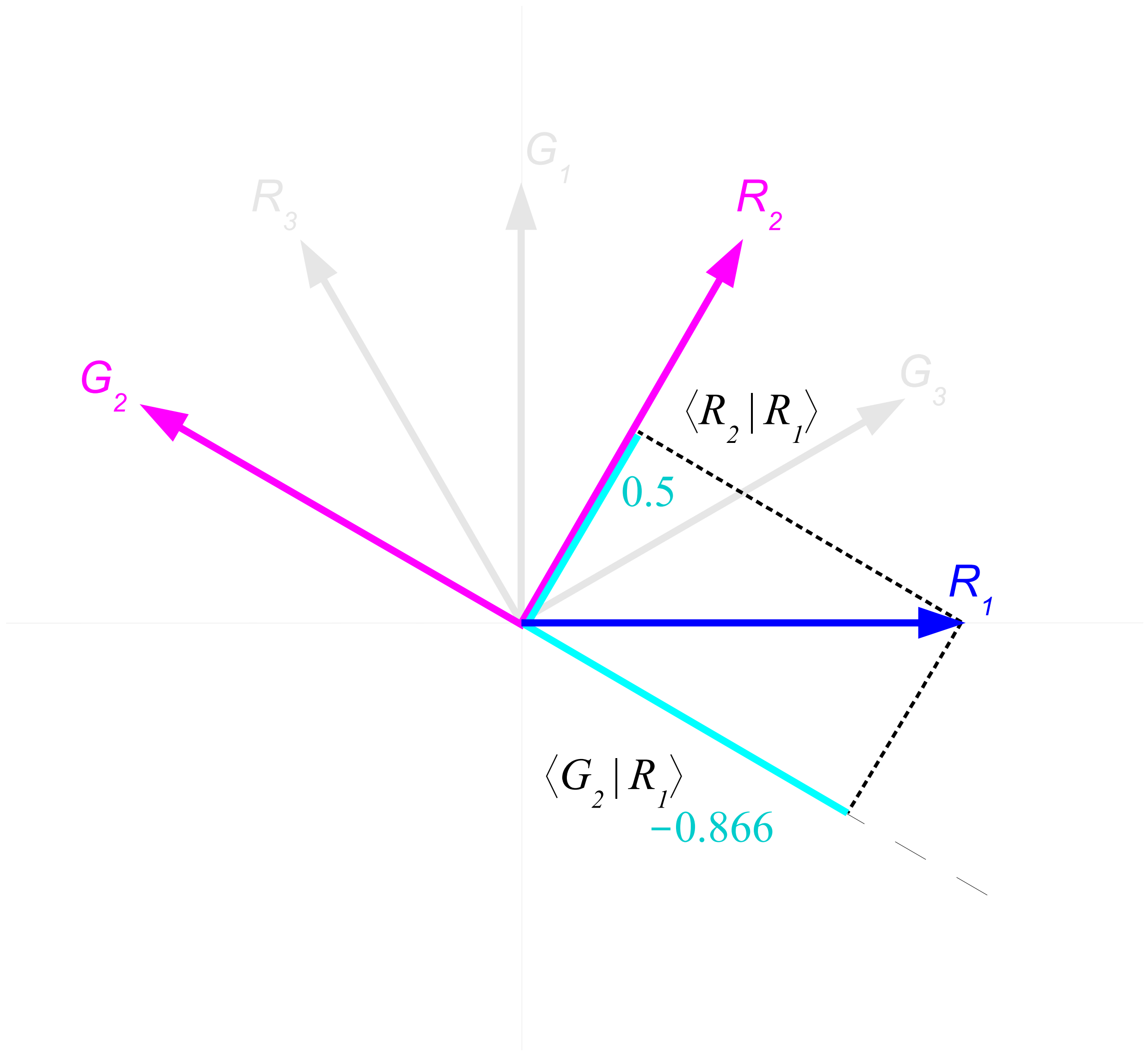
Suppose the particle's 1-color is RED and we measure its **2-color**



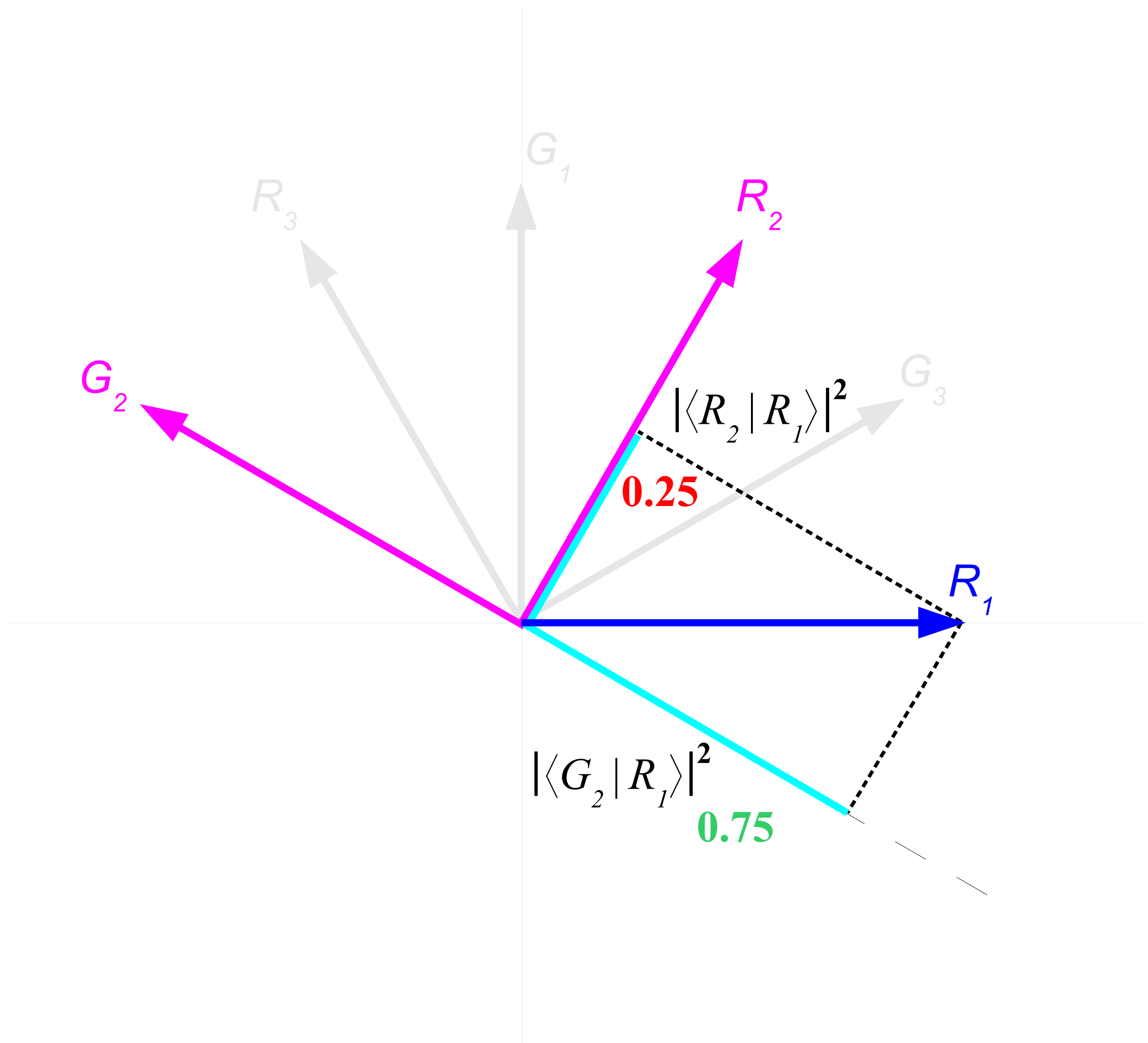
Projecting R_1 onto the eigenvectors of C_2 (2-color)



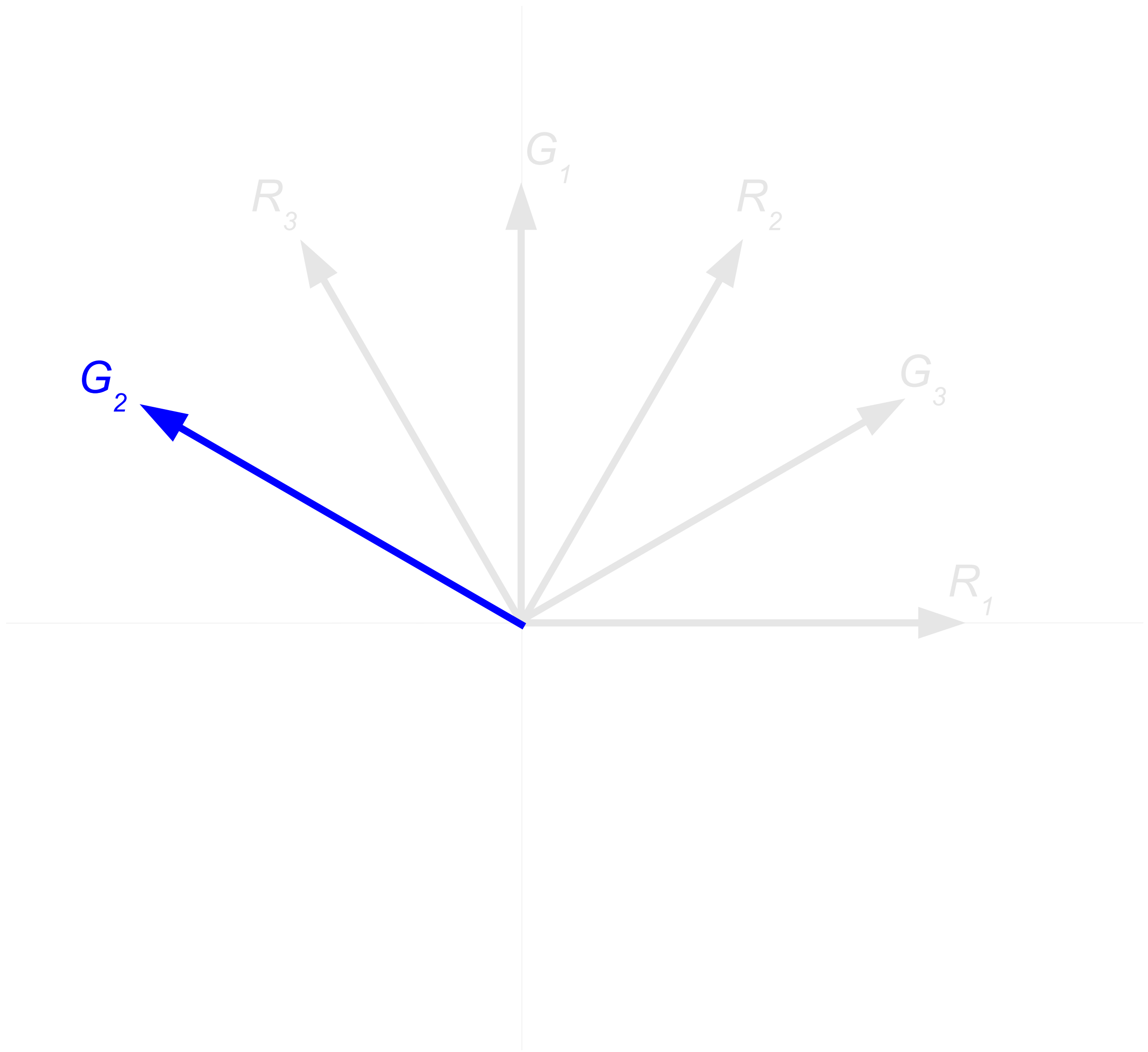
Projecting R_1 onto the eigenvectors of C_2 (2-color)



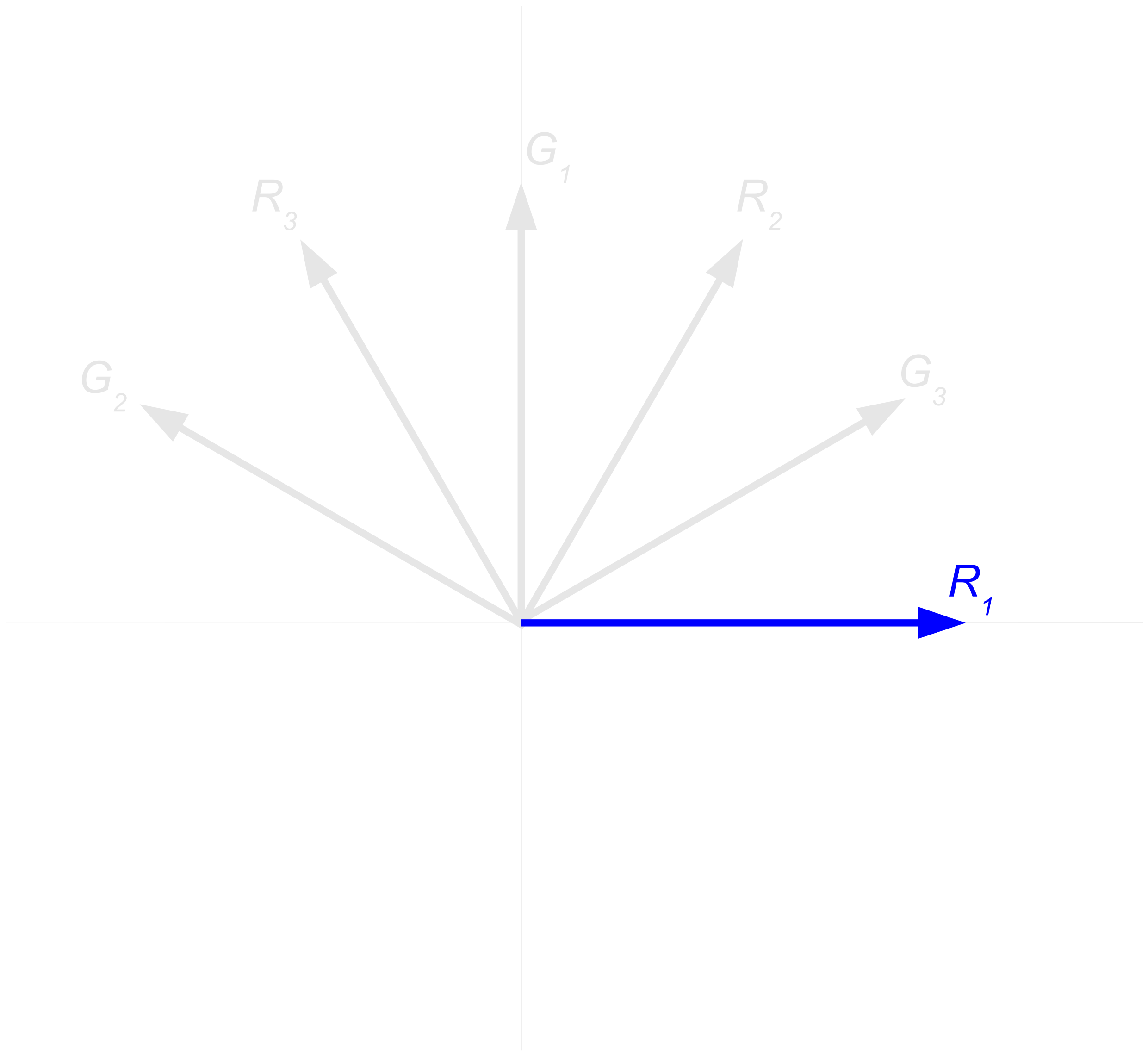
Squaring the magnitude gives the probability



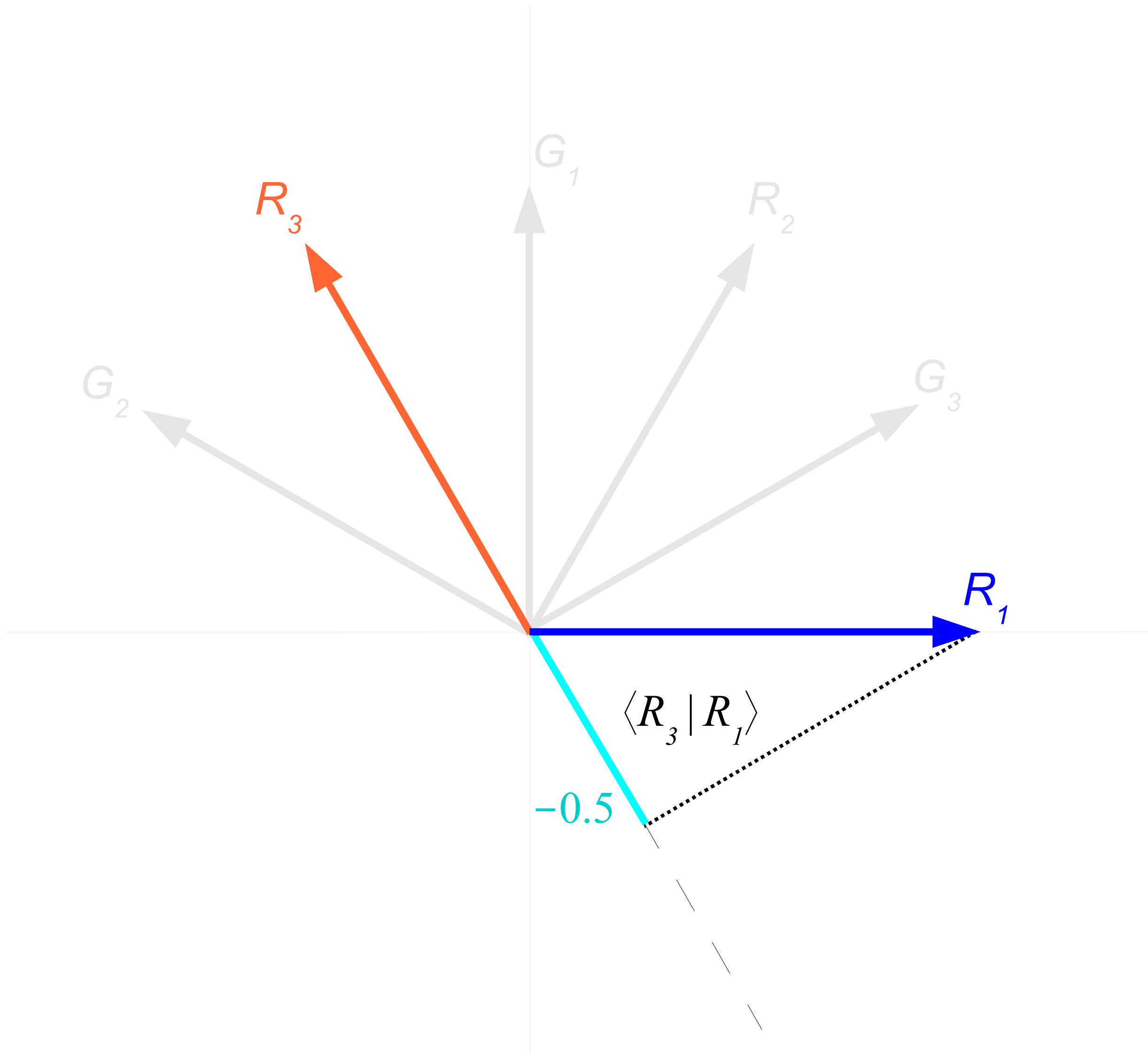
The 2-color becomes GREEN with 75% probability



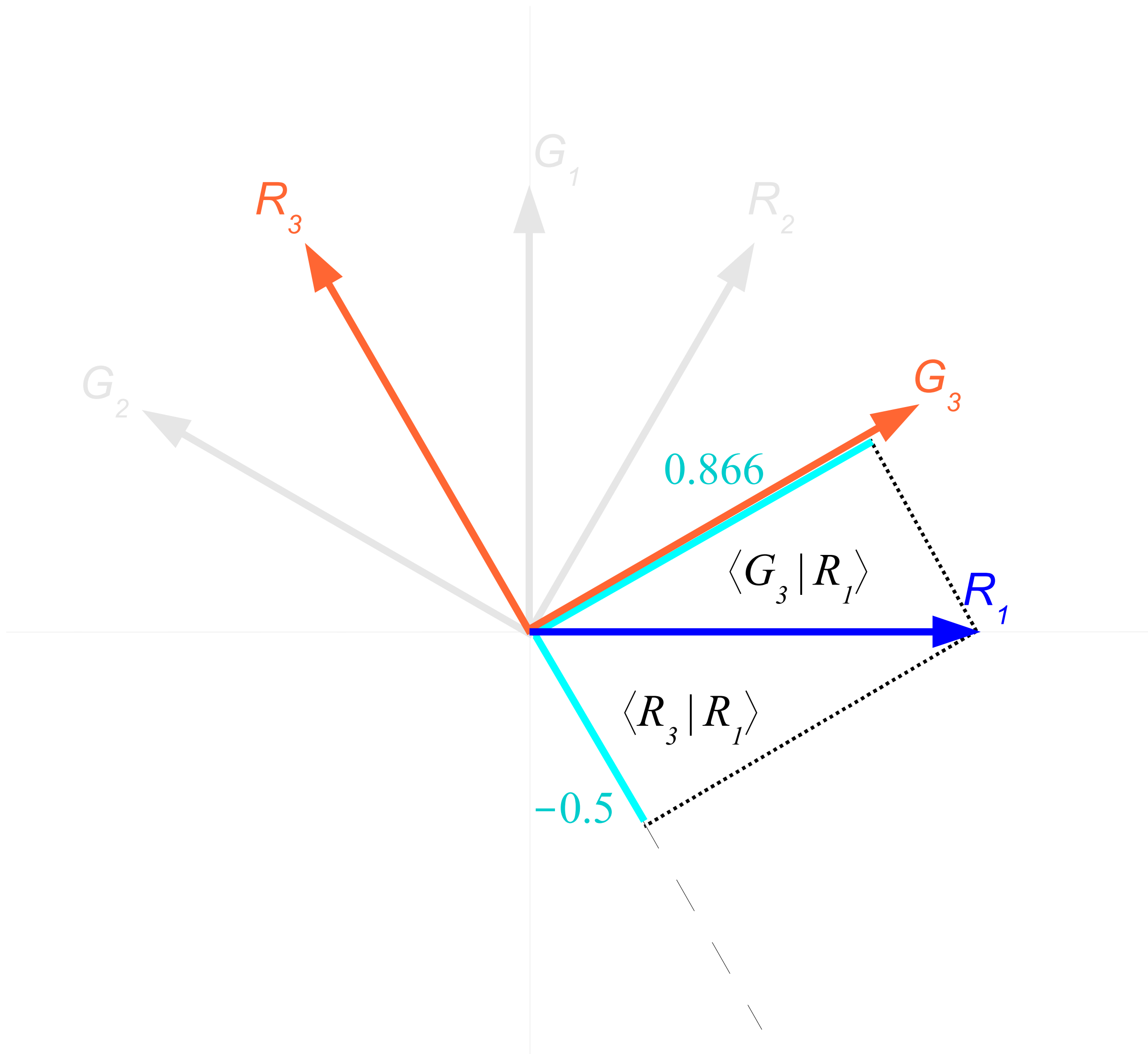
Suppose the particle's 1-color is RED and we measure its **3-color**



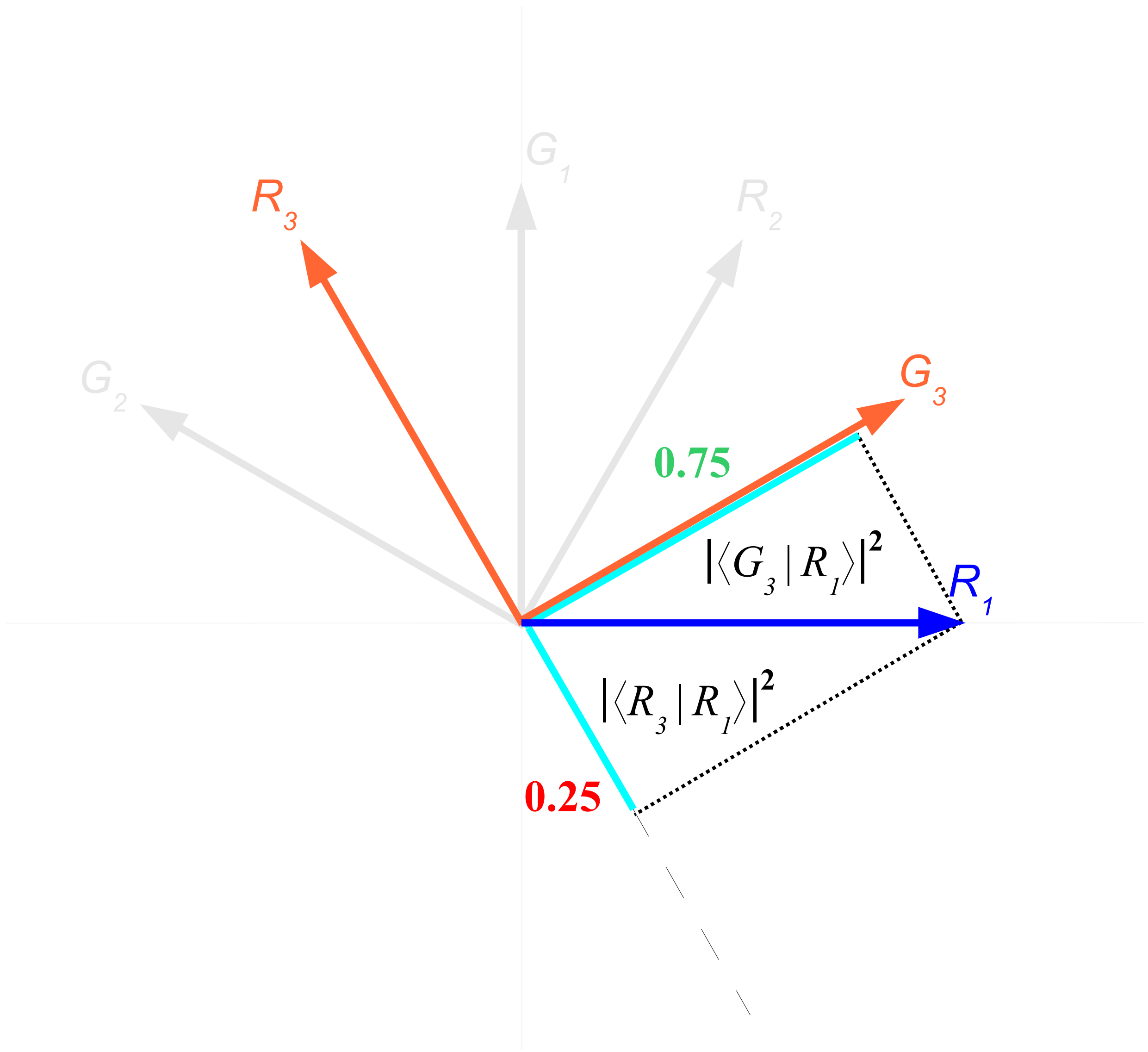
Projecting R_1 onto the eigenvectors of C_3 (3-color)



Projecting R_1 onto the eigenvectors of C_3 (3-color)



Squaring the magnitude gives the probability



The 3-color becomes RED with 25% probability