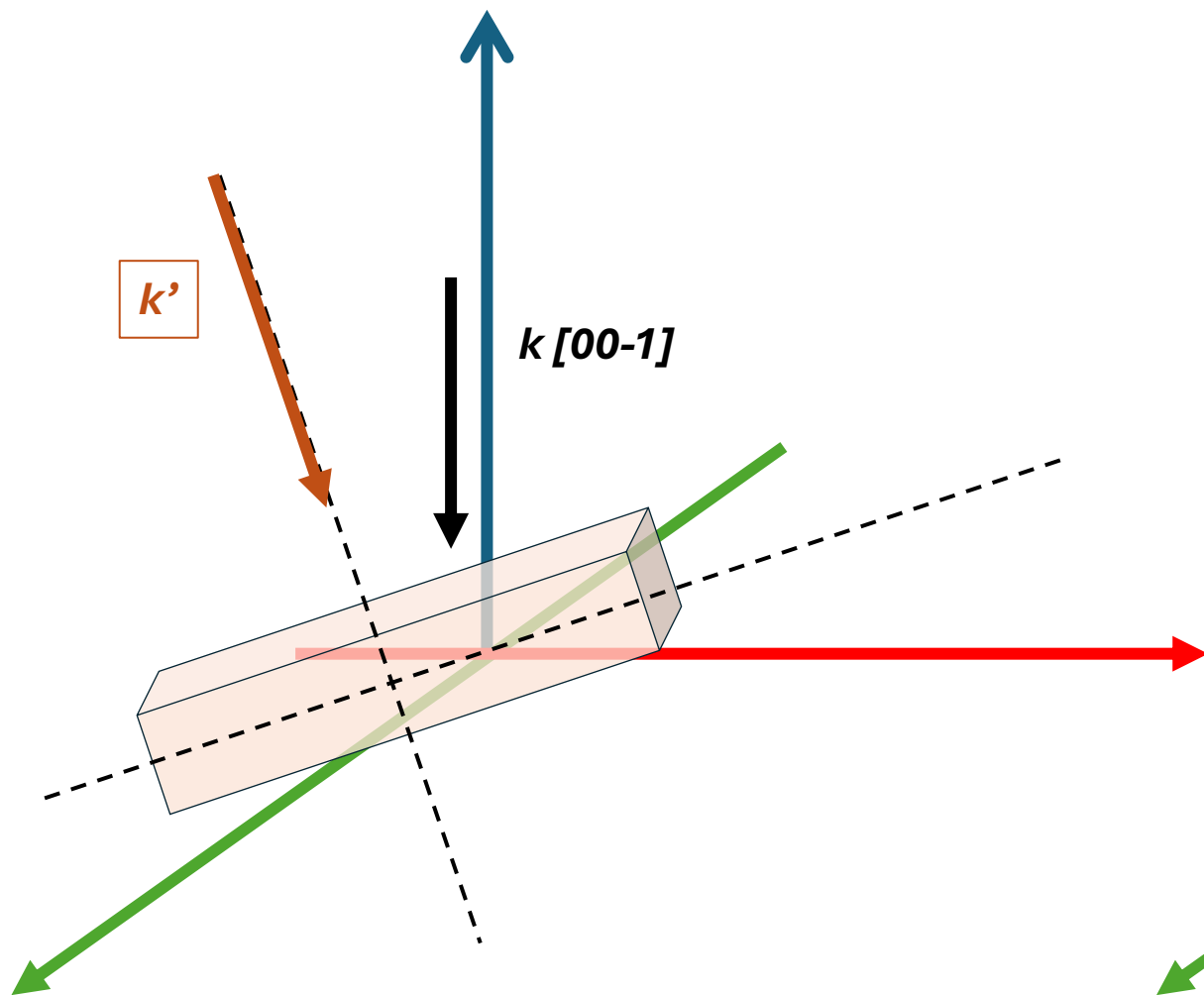


# Matrix rotation for crispy

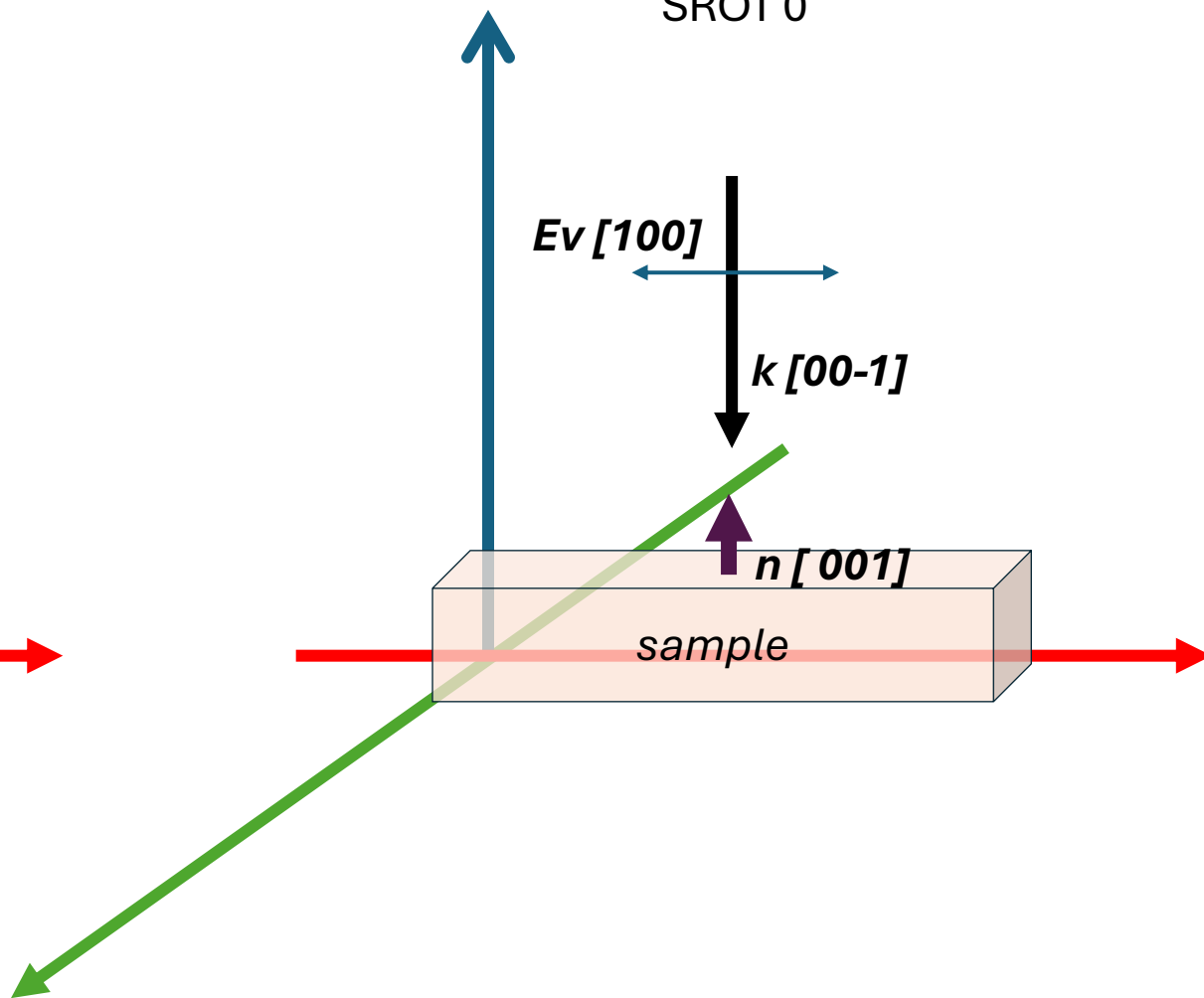
+ visualisation

Simple fast python script from ewa

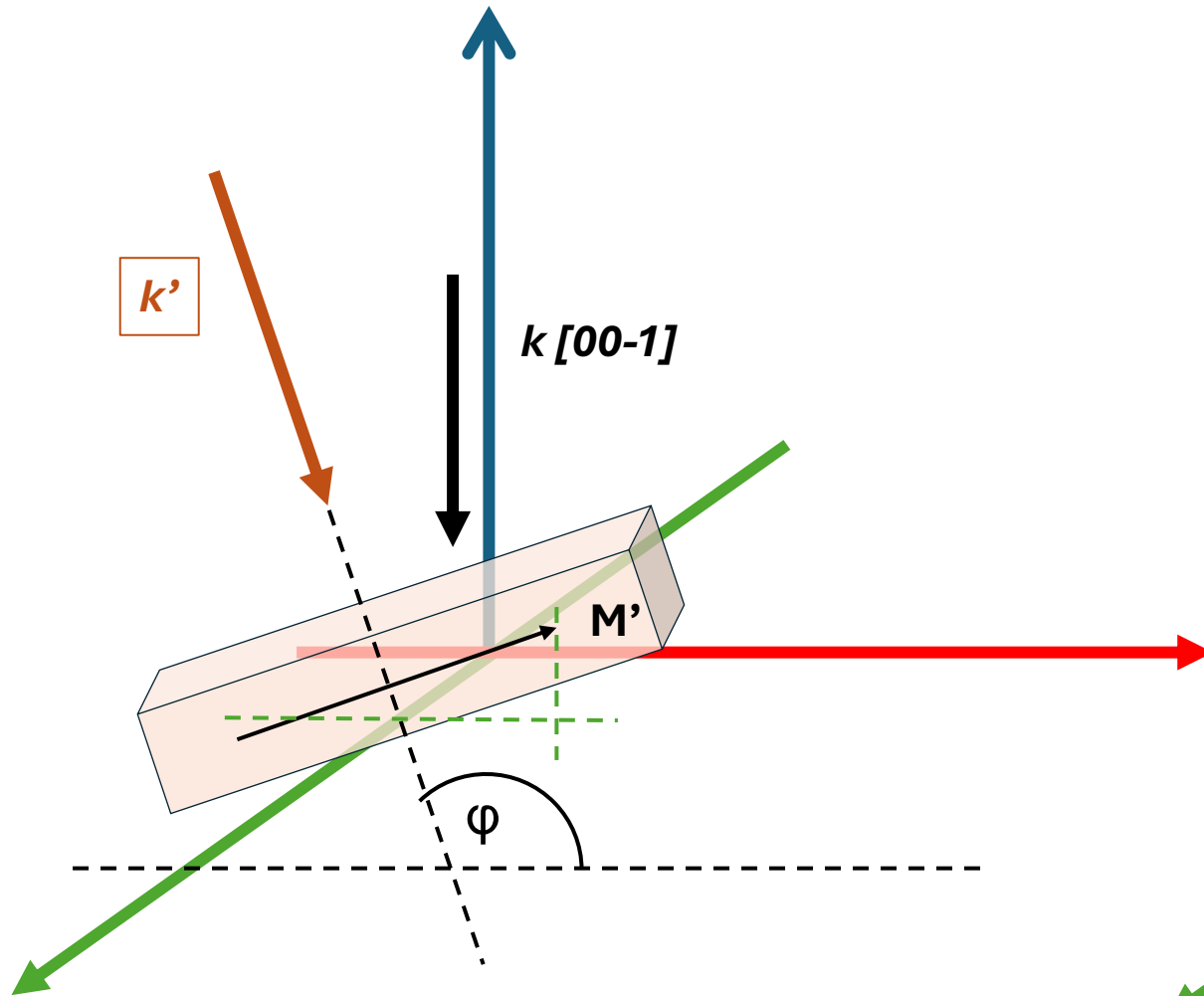
SROT  $\neq 0$



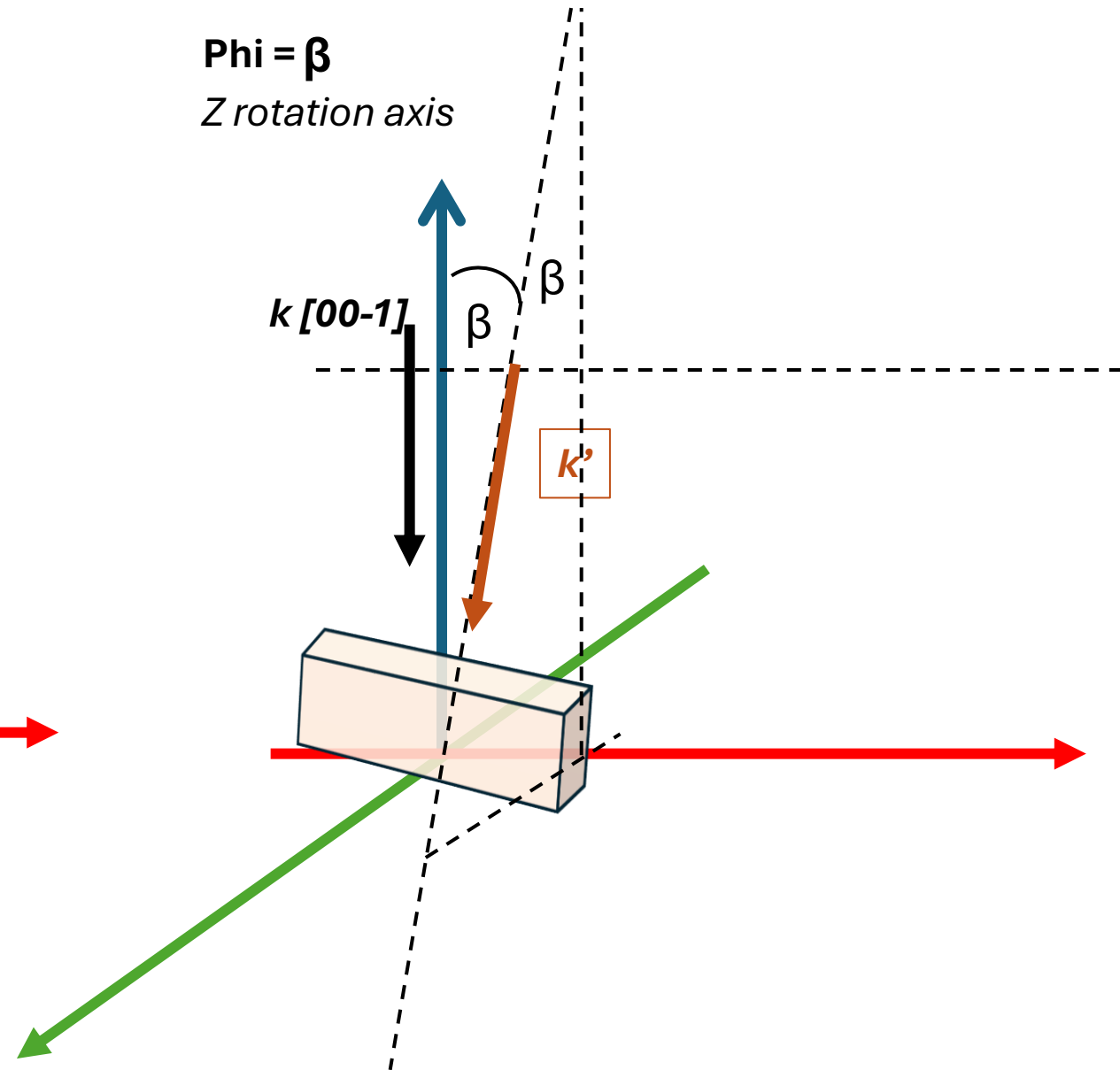
SROT 0



**SROT =  $\varphi$**   
*Y rotation axis*



**Phi =  $\beta$**   
*Z rotation axis*



$$R = R_z(\alpha) R_y(\beta) R_x(\gamma) = \begin{matrix} & \text{yaw} & \\ \begin{bmatrix} \cos \alpha & -\sin \alpha & 0 \\ \sin \alpha & \cos \alpha & 0 \\ 0 & 0 & 1 \end{bmatrix} & \begin{matrix} \text{pitch} \\ \begin{bmatrix} \cos \beta & 0 & \sin \beta \\ 0 & 1 & 0 \\ -\sin \beta & 0 & \cos \beta \end{bmatrix} & \begin{matrix} \text{roll} \\ \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \gamma & -\sin \gamma \\ 0 & \sin \gamma & \cos \gamma \end{bmatrix} \end{matrix} \end{matrix}$$

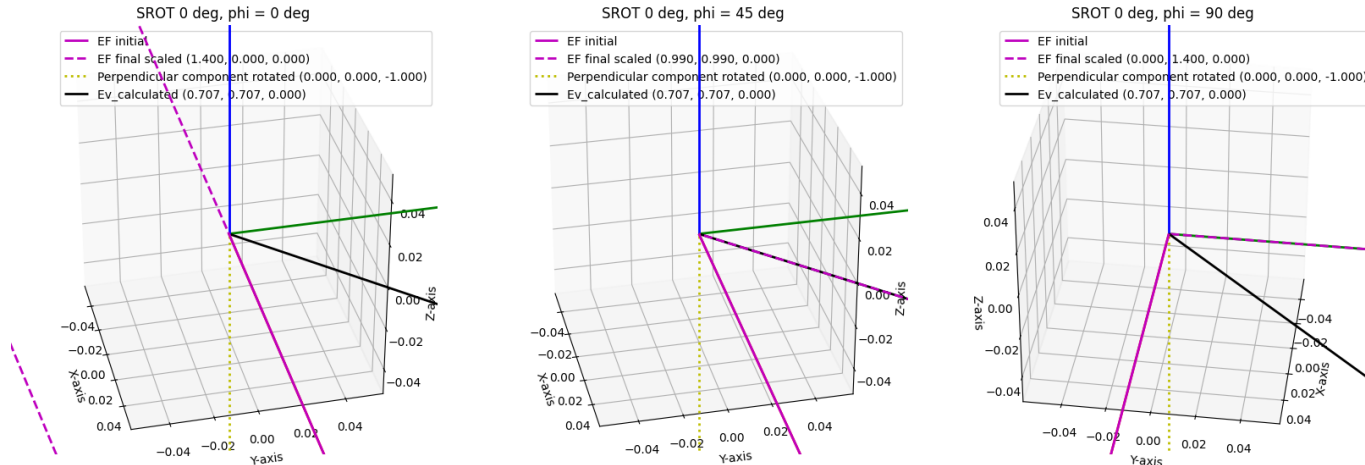
**SROT rotation matrix**

**Phi rotation matrix**

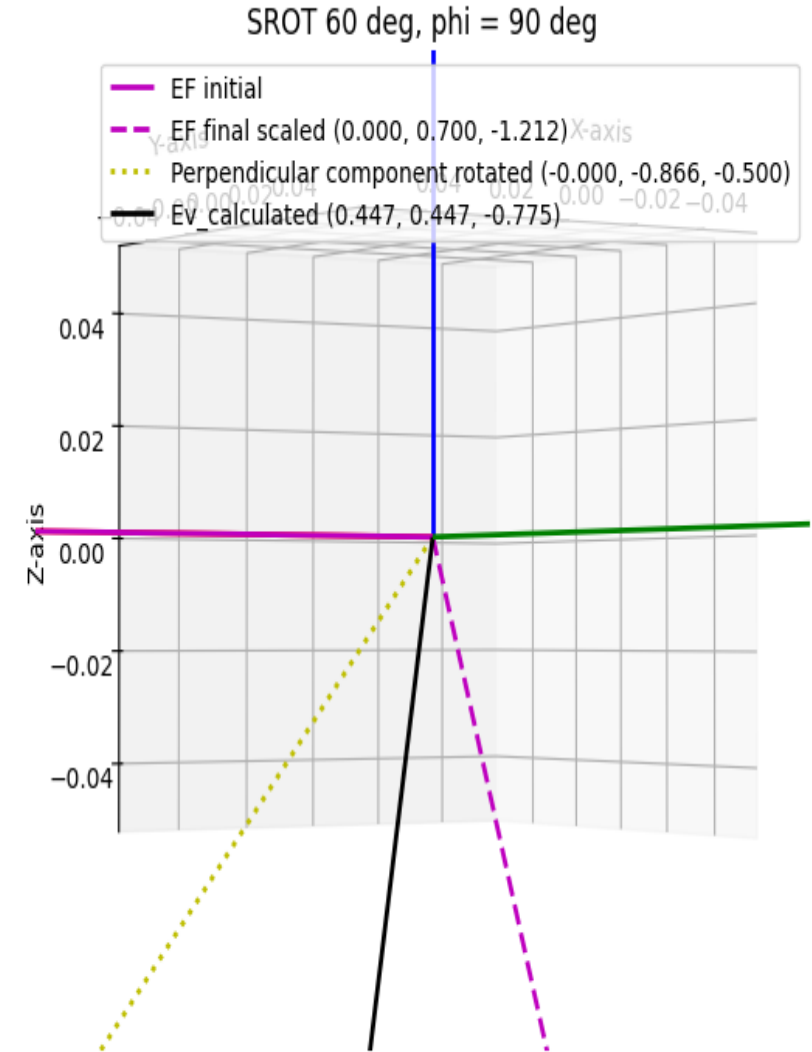
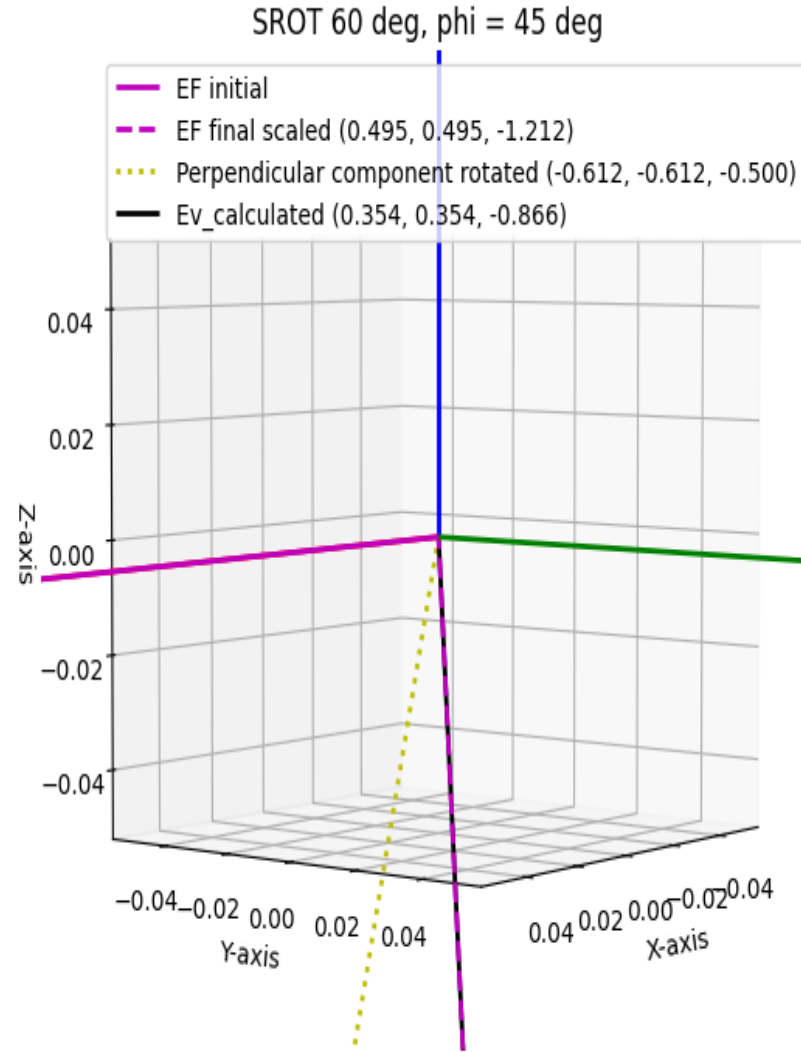
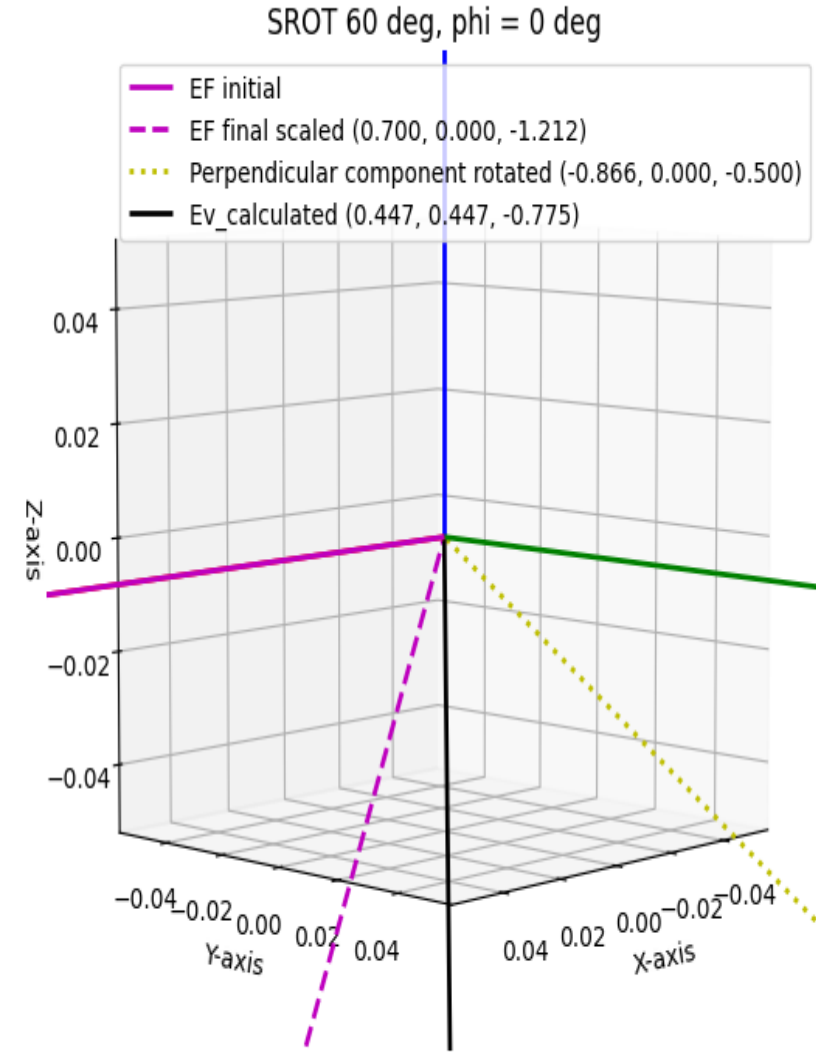
We want to transform M via rotation matrices:

$$M' = R(\varphi)R(\beta) M$$

So for the EF SROT 0 deg, phi 0, 45, 90 deg we may obtain rotated EF:



Exemplary srot 60, phi 0, M [100]



Projection of  $\mathbf{k}$  [00-1] onto **rotated EF**

Extraction of **perpendicular k** from the projection  
(vector subtraction simply)

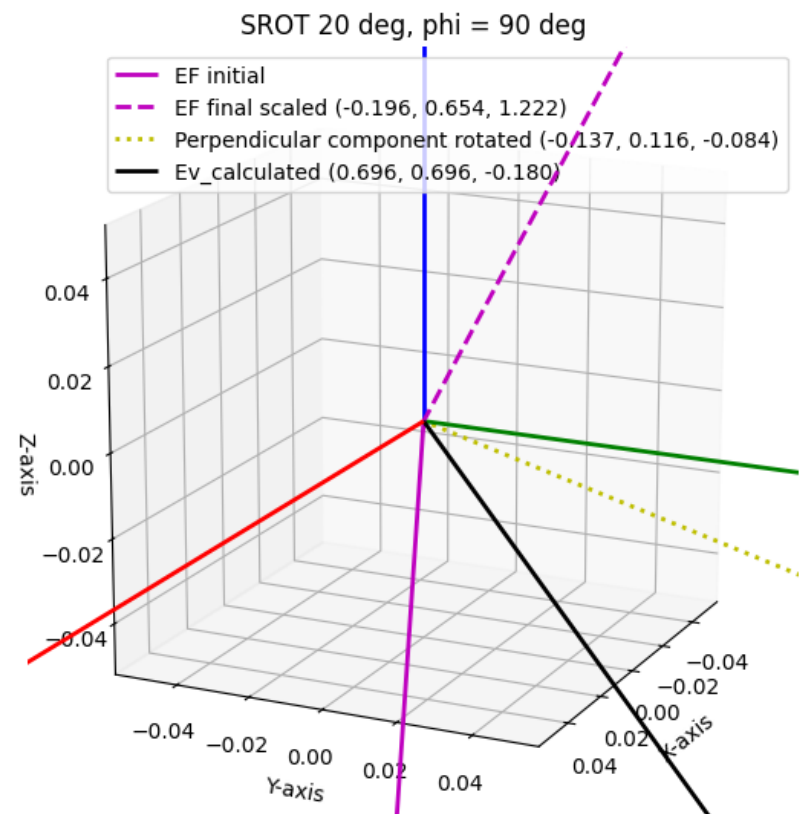
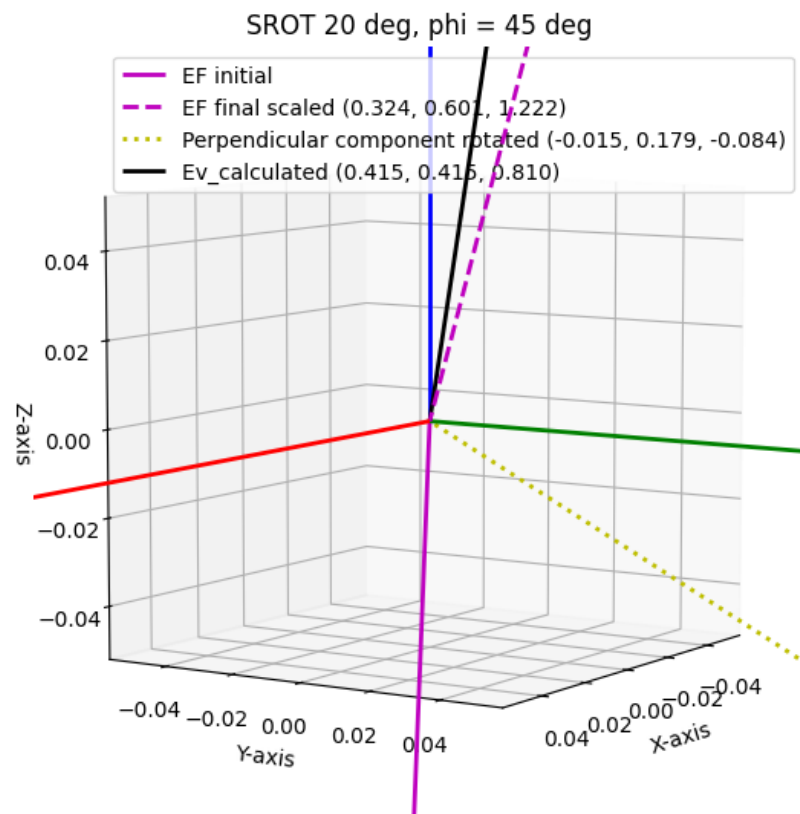
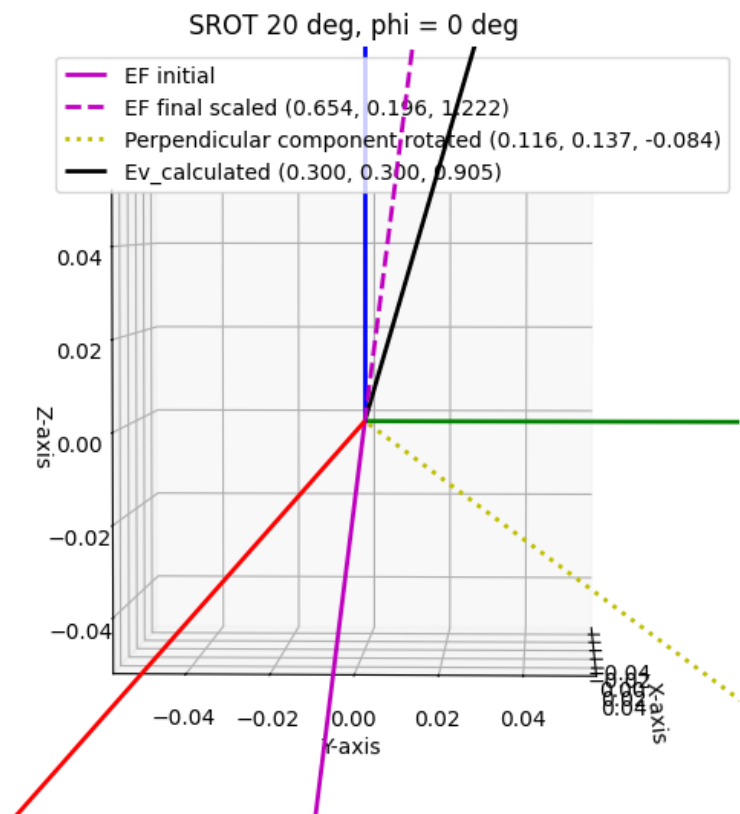
**Perpendicular k is the k vector used in crispy**

$$proj_k M = \frac{\mathbf{M} \cdot \mathbf{k}}{|\mathbf{k}|^2} \cdot \mathbf{k} \longrightarrow \mathbf{k}_{\perp} = R(\varphi)R(\beta)\mathbf{k} - proj_k M$$

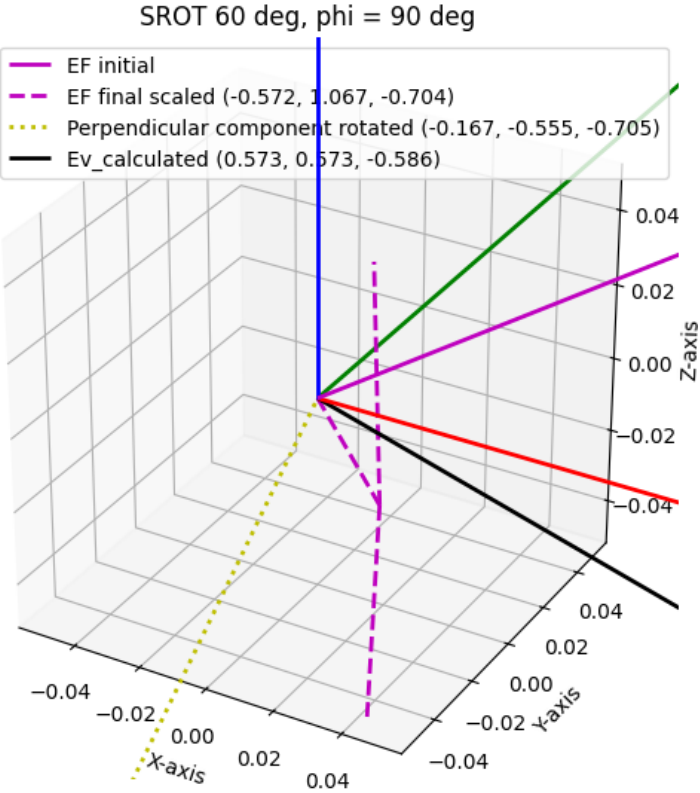
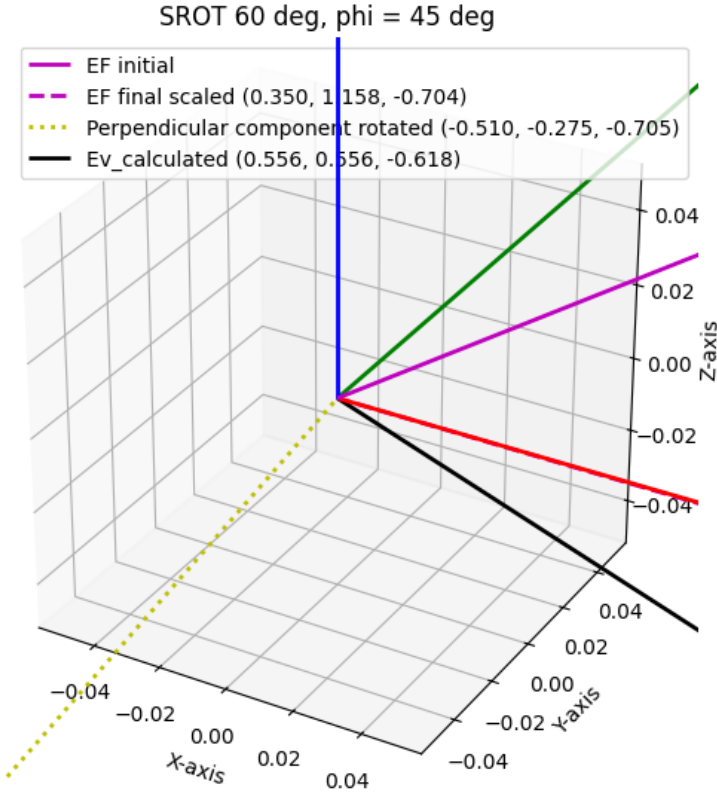
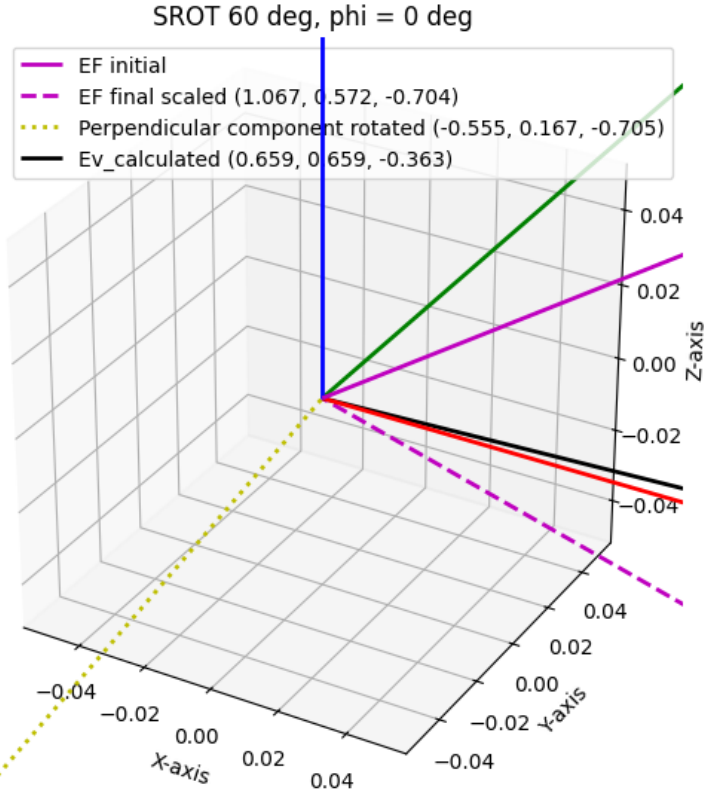
Ev calc: obviously from the vector multiplication, **BUT the cross product of z & k' is an expression not holding true when z of M is not equal to 0**, as we need to be perpendiculary oriented in regards to sample's Surface (x, y)

$$\hat{u} \text{ is } [1, -1, 0], \quad \widehat{E_v} = \mathbf{k}_{\perp} \times \hat{u}$$

# M(117) + SROT 20:



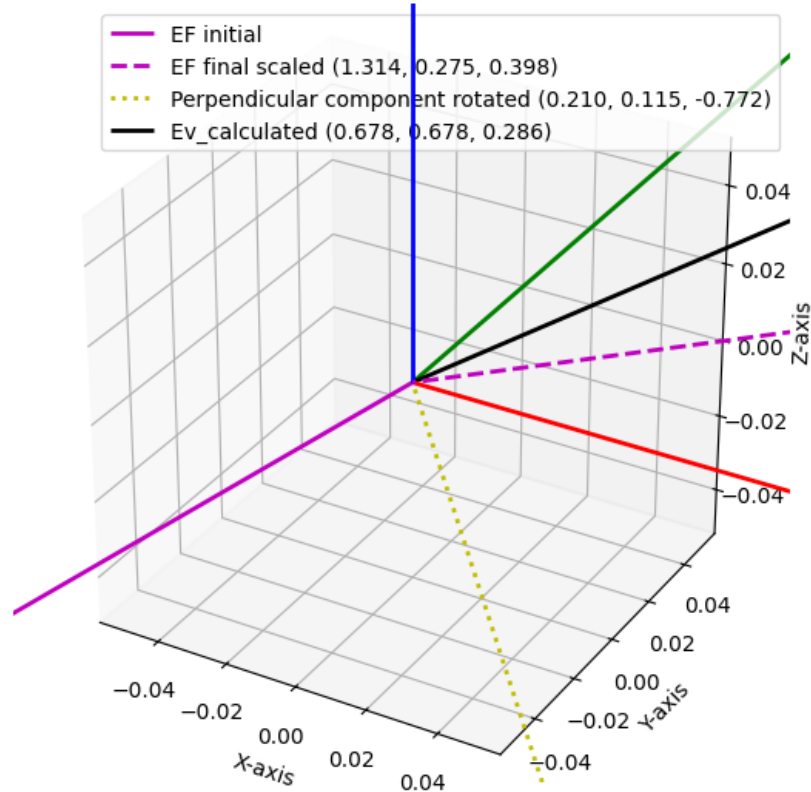
M(211):



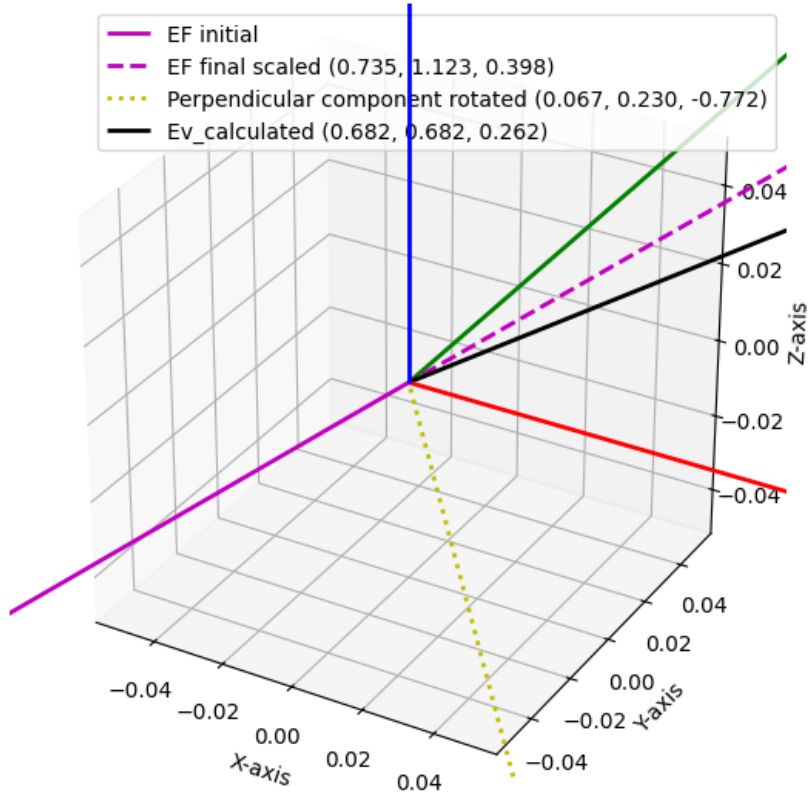


M(413):

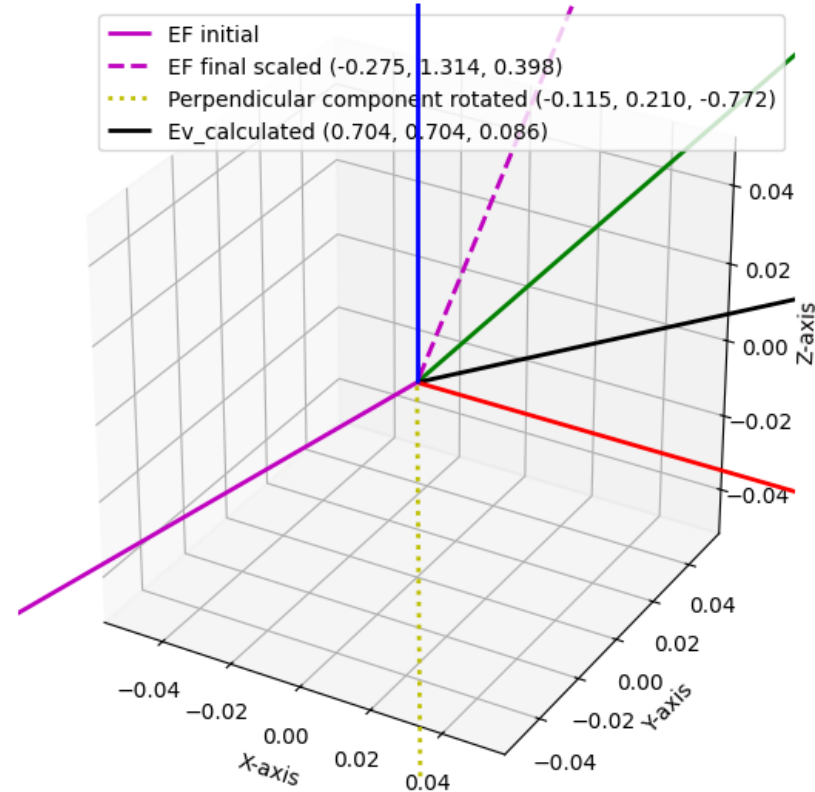
SROT 20 deg, phi = 0 deg



SROT 20 deg, phi = 45 deg

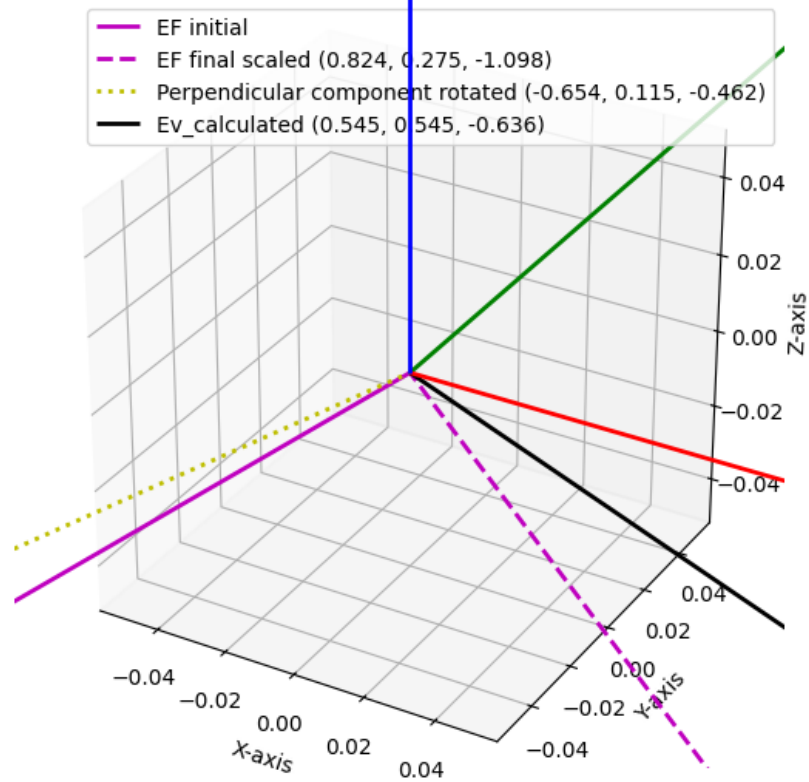


SROT 20 deg, phi = 90 deg

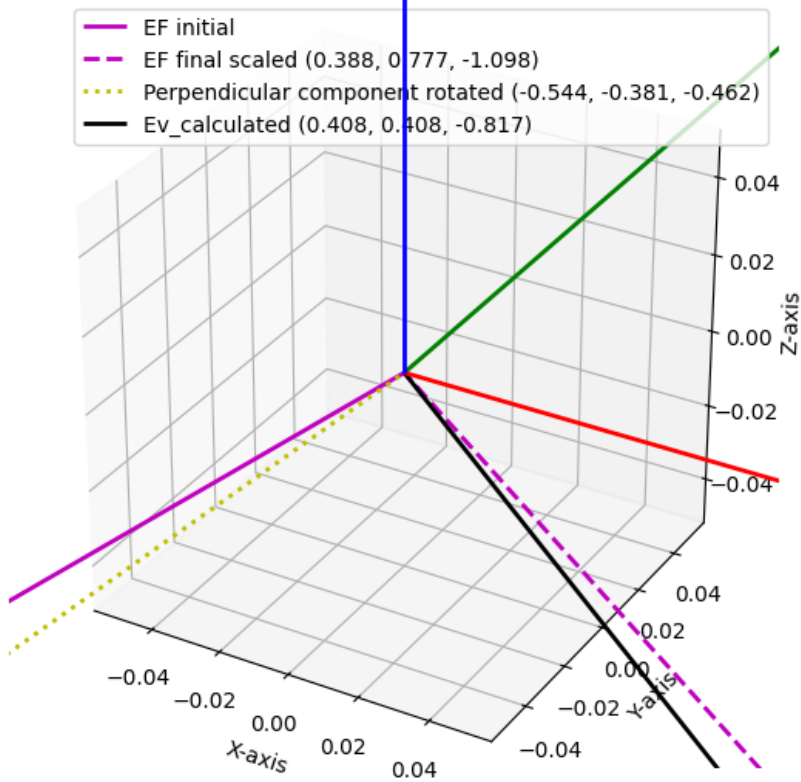


M(413):

SROT 90 deg, phi = 0 deg



SROT 90 deg, phi = 45 deg



SROT 90 deg, phi = 90 deg

