Euler angles

(see chapter 4 of Goldstein)

\[
\begin{align*}
\theta &= \Theta \cos \Psi \\
\phi &= \Theta \sin \Psi \\
\psi &= (0, 0, \Psi)
\end{align*}
\]

We start with \( x_1, x_2, x_3 \) coinciding with \( x'y'z' \)

i) Rotate \( x_1 \) axis by \( \phi \) about \( z \)

ii) Rotate \( x_2 \) axis by \( \theta \) about new \( x'_1 \)

iii) Rotate \( x'_1 \) by \( \psi \) about \( x'_3 \)

We now express \( \mathbf{R} \) in \( x_1 x_2 x_3 \) frame in the Euler angles.

We first express \( \theta, \phi, \psi \) into \( x_1 x_2 x_3 \) components:

\[
\begin{align*}
\mathbf{R} &= \begin{pmatrix}
\cos \theta & -\sin \theta & 0 \\
\sin \theta \cos \phi & \cos \theta \cos \phi & -\sin \phi \\
\sin \theta \sin \phi & \cos \theta \sin \phi & \cos \phi
\end{pmatrix}
\end{align*}
\]

The line of nodes moves in negative direction along the axis before rotating by \( \Psi \).

\( z \parallel x'_2 \)