



Mechanical modes (Photo-elastic effect)

$$[\Delta\beta(\mathbf{r}; \vec{S})]_{ij} = p_{ijkl}(\mathbf{r})S_{kl}(\mathbf{r})$$

Photo-elastic effect is described in terms of the "impermeability tensor" β_{ij}

$$S_I = \begin{bmatrix} S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \\ S_6 \end{bmatrix} = \begin{bmatrix} S_{xx} \\ S_{yy} \\ S_{zz} \\ 2S_{yz} \\ 2S_{xz} \\ 2S_{xy} \end{bmatrix}$$

Voigt notation: Strain is a symmetric tensor

$$\Rightarrow \Delta\epsilon_{ij} = -\epsilon^2 \left(p_{ijrs} S_{rs} \right)$$

$$\Rightarrow \Delta\epsilon_I = -\epsilon^2 p_{IJ} S_J$$

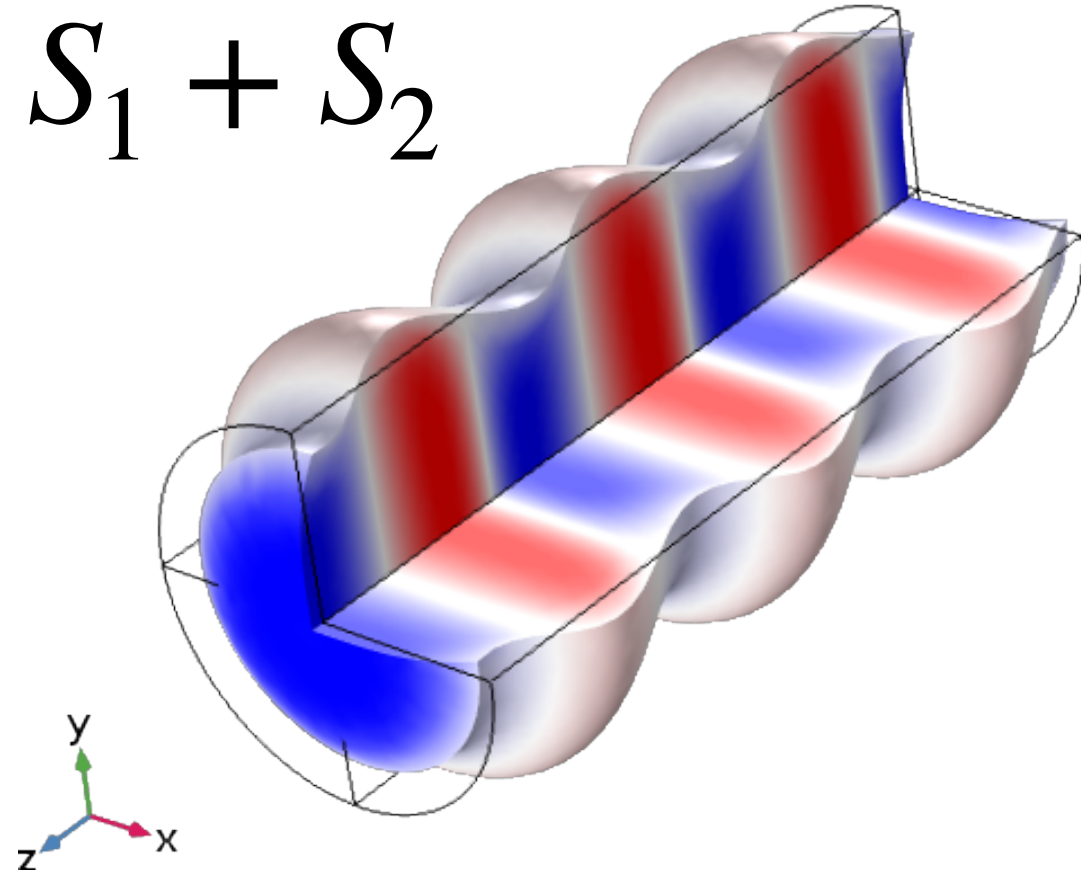
$$\Delta\epsilon_I = -\epsilon^2 \begin{bmatrix} p_{11} & p_{12} & p_{12} & 0 & 0 & 0 \\ p_{12} & p_{11} & p_{12} & 0 & 0 & 0 \\ p_{12} & p_{12} & p_{11} & 0 & 0 & 0 \\ 0 & 0 & 0 & p_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & p_{44} & 0 \\ 0 & 0 & 0 & 0 & 0 & p_{44} \end{bmatrix} \begin{bmatrix} S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \\ S_6 \end{bmatrix}$$



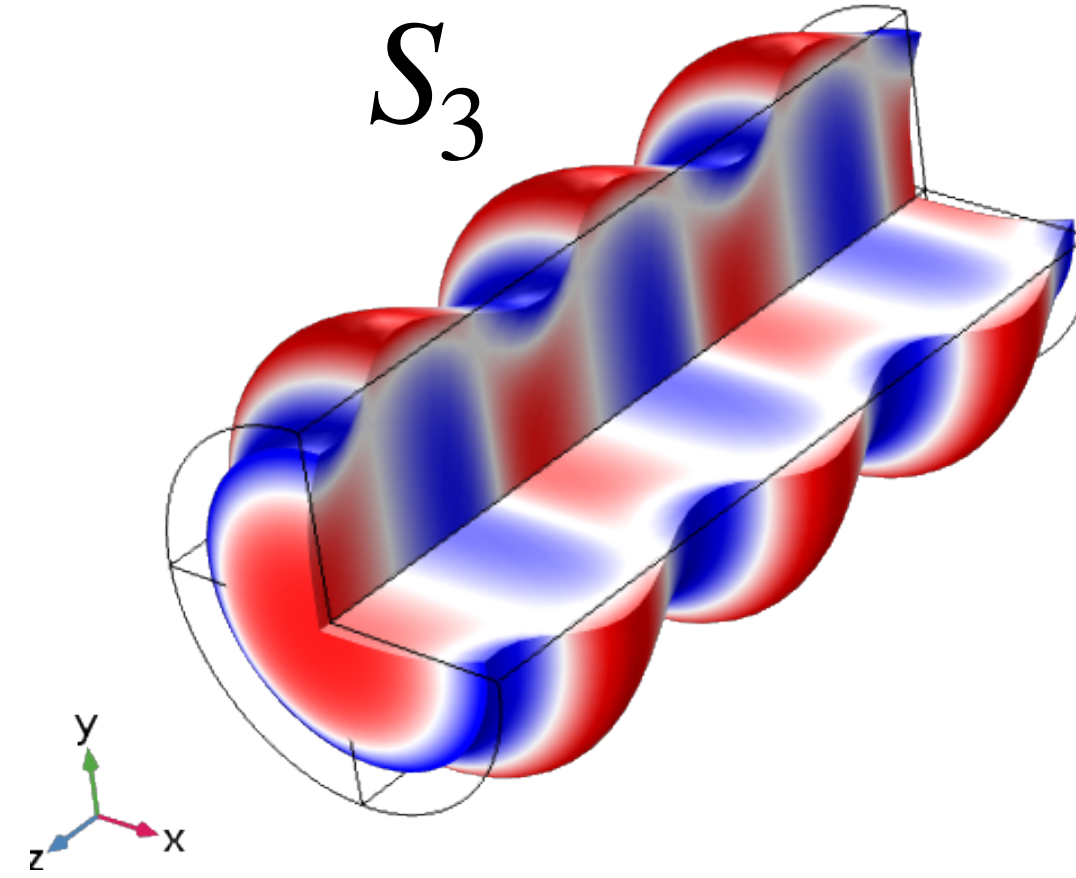
Mechanical modes (Photo-elastic effect)

Radial mode

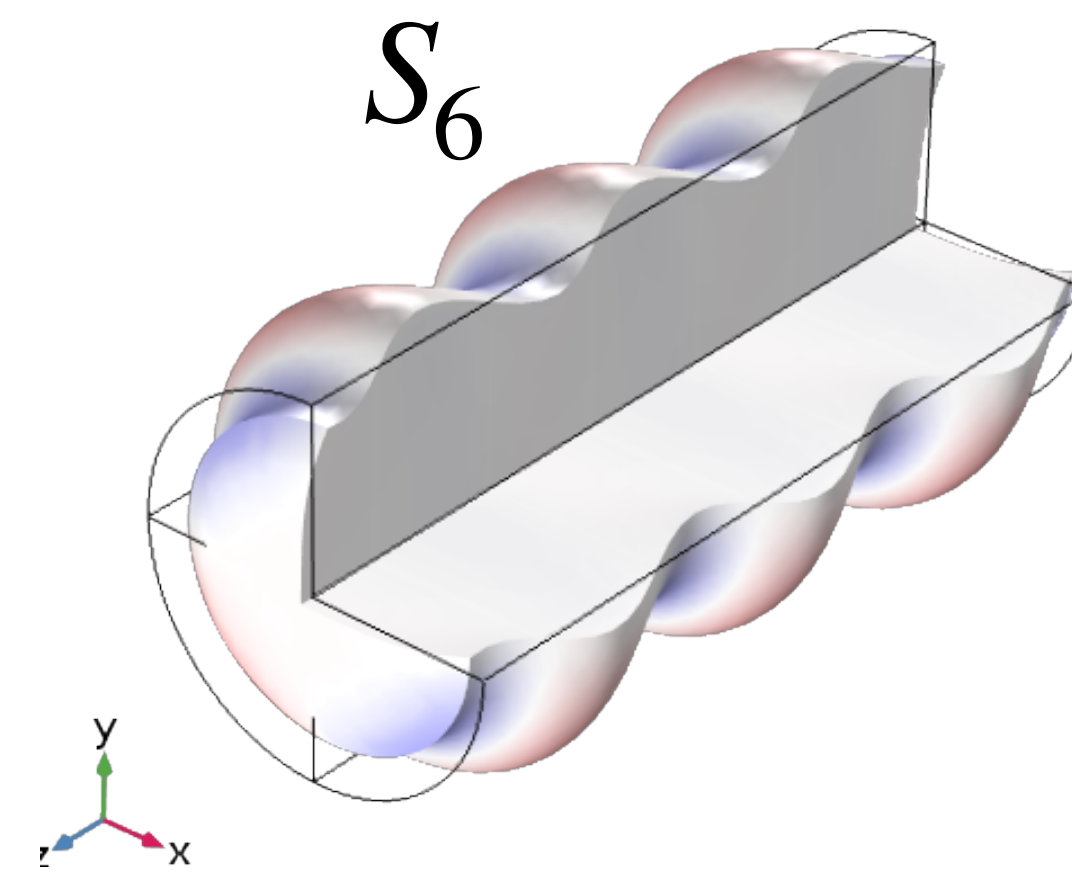
$S_1 + S_2$



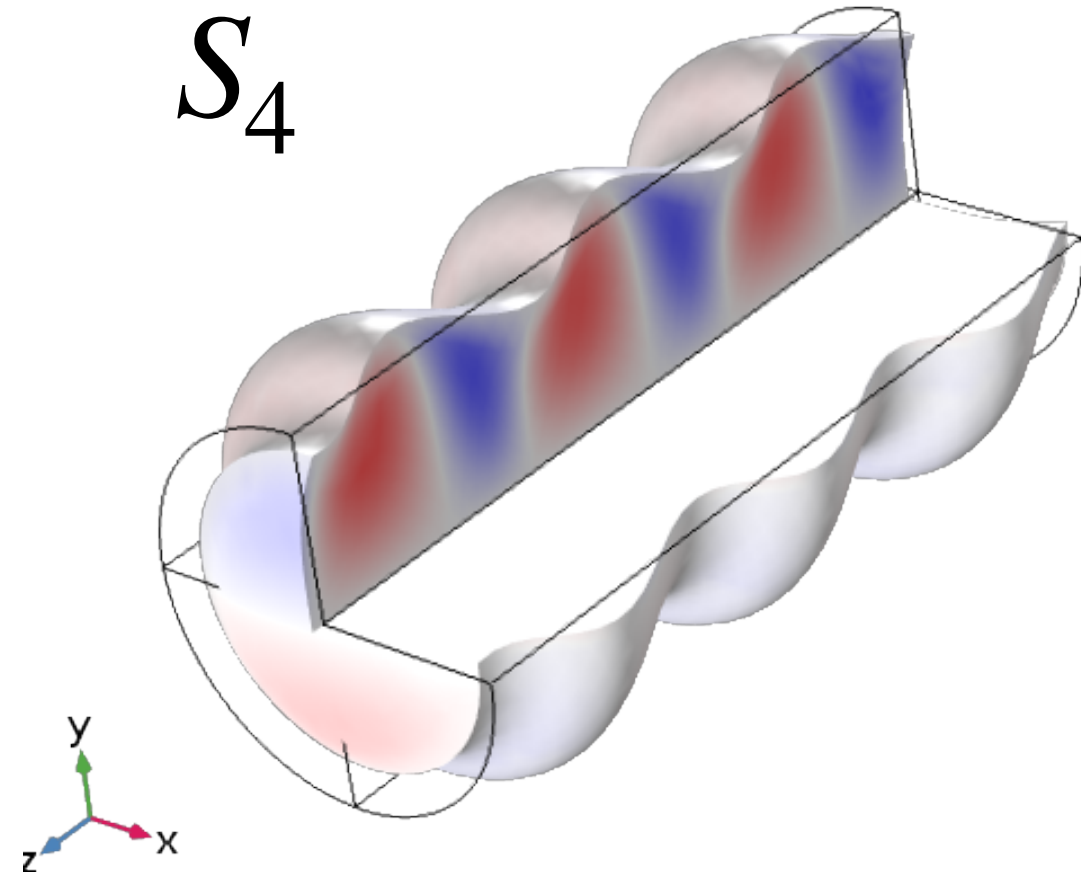
S_3



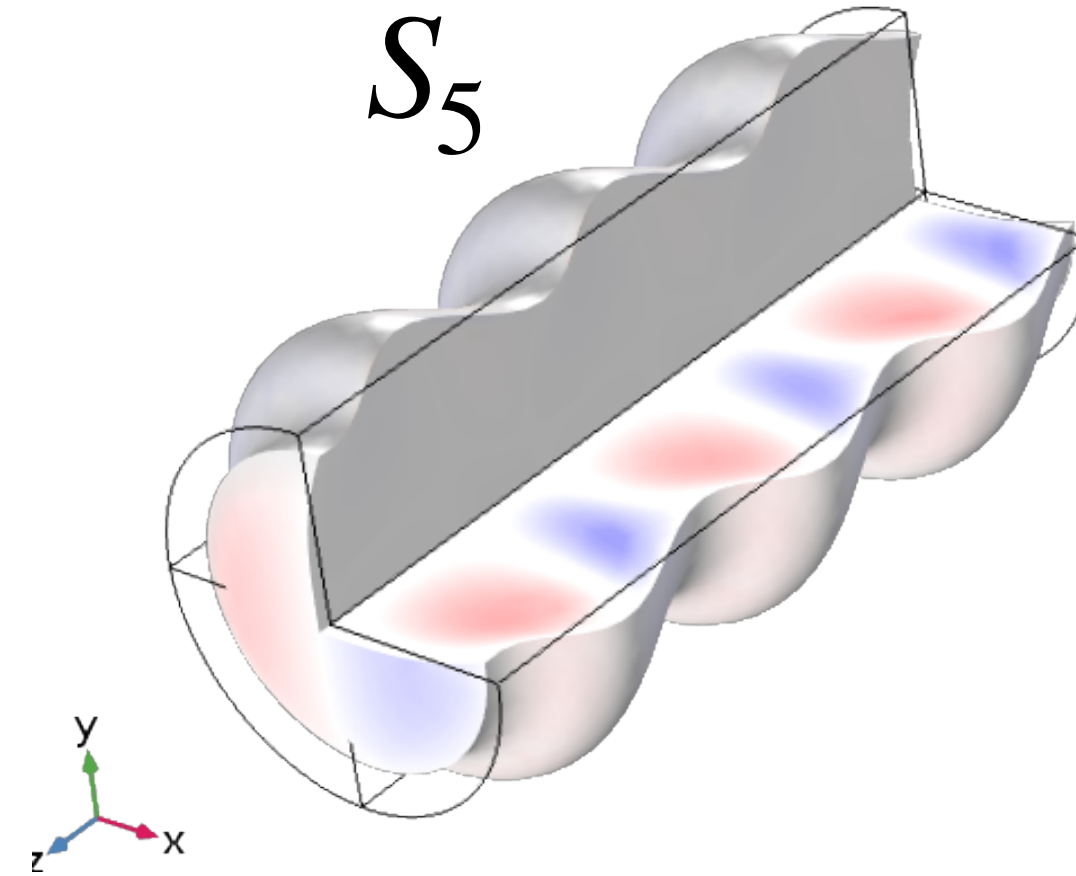
S_6



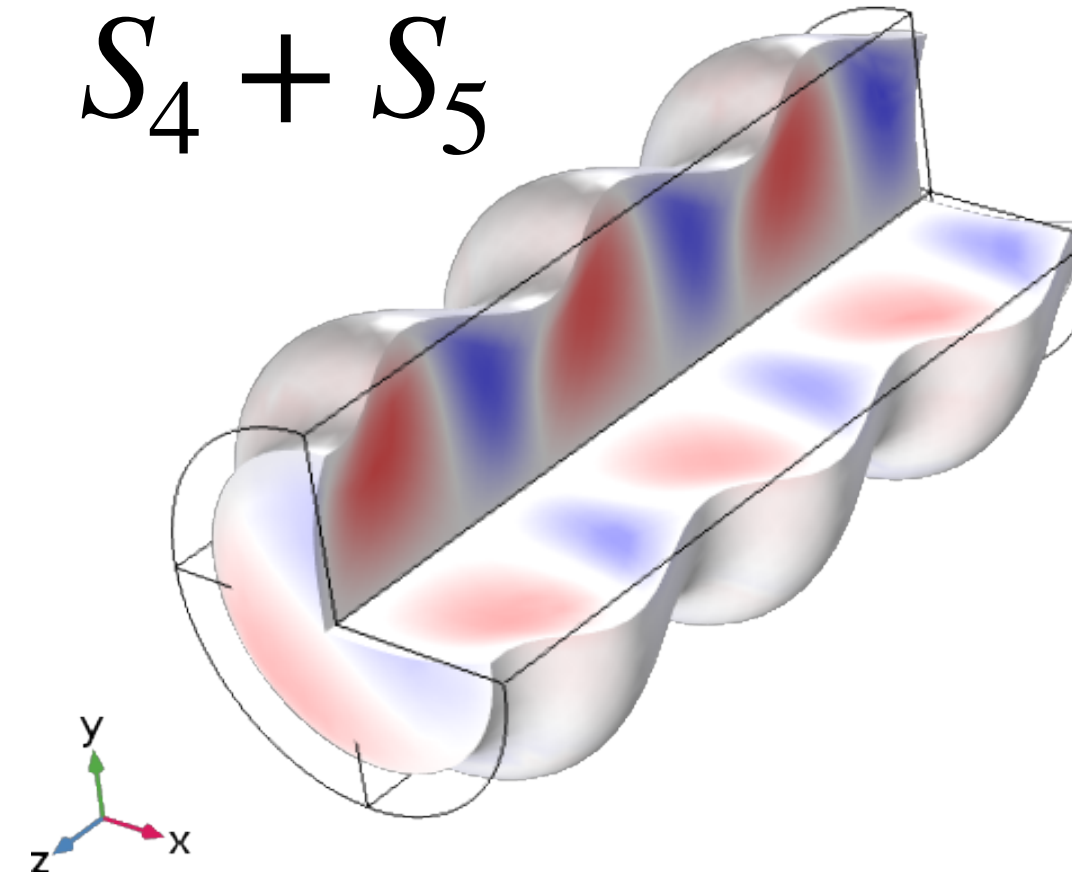
S_4



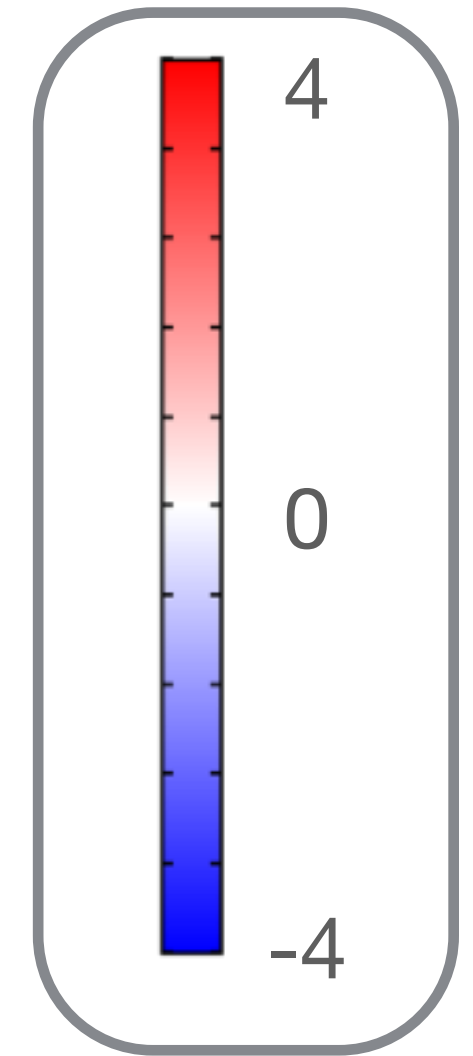
S_5



$S_4 + S_5$



Strain (μm^{-1})



$$\begin{bmatrix} S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \\ S_6 \end{bmatrix} = \begin{bmatrix} S_{xx} \\ S_{yy} \\ S_{zz} \\ 2S_{yz} \\ 2S_{xz} \\ 2S_{xy} \end{bmatrix}$$