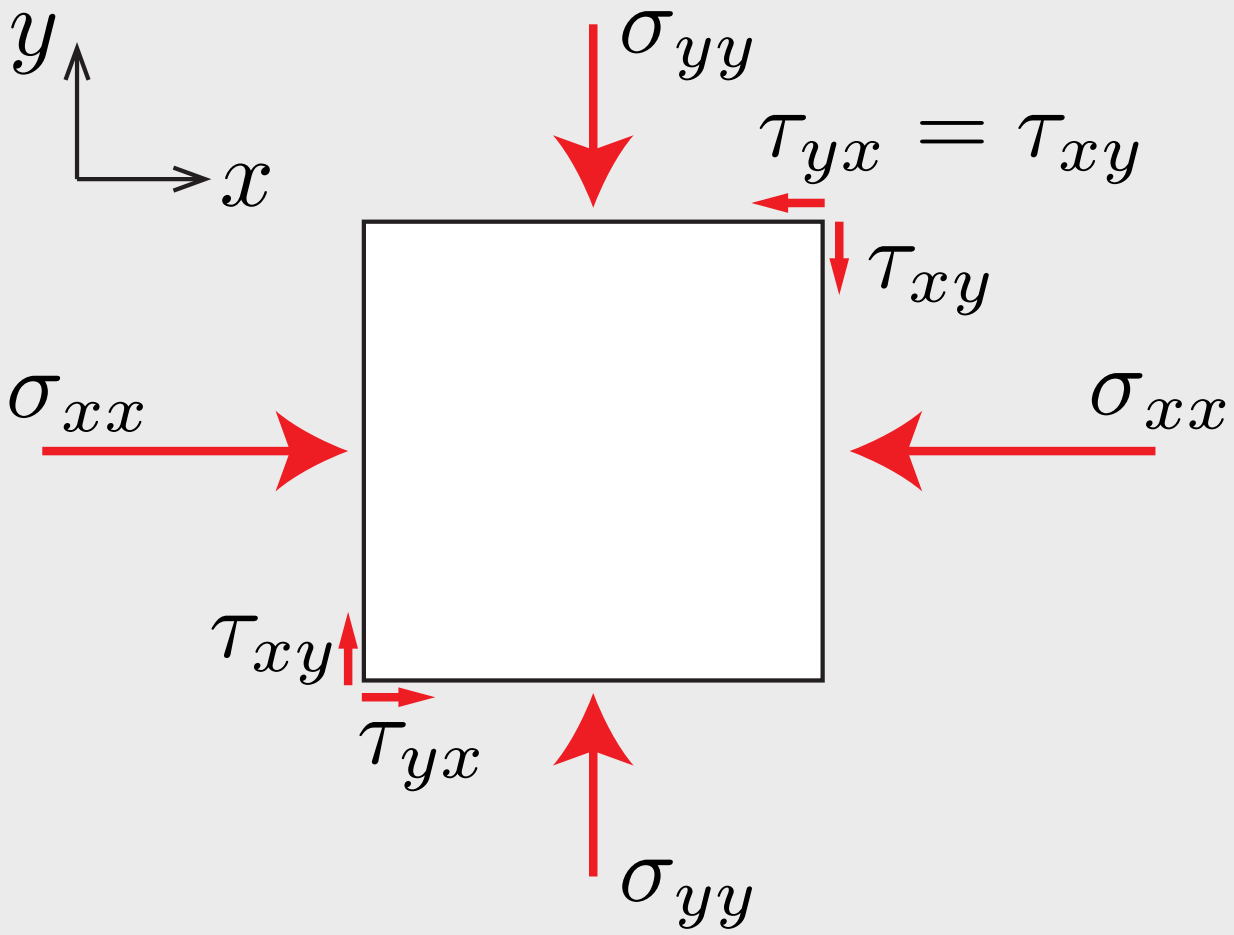
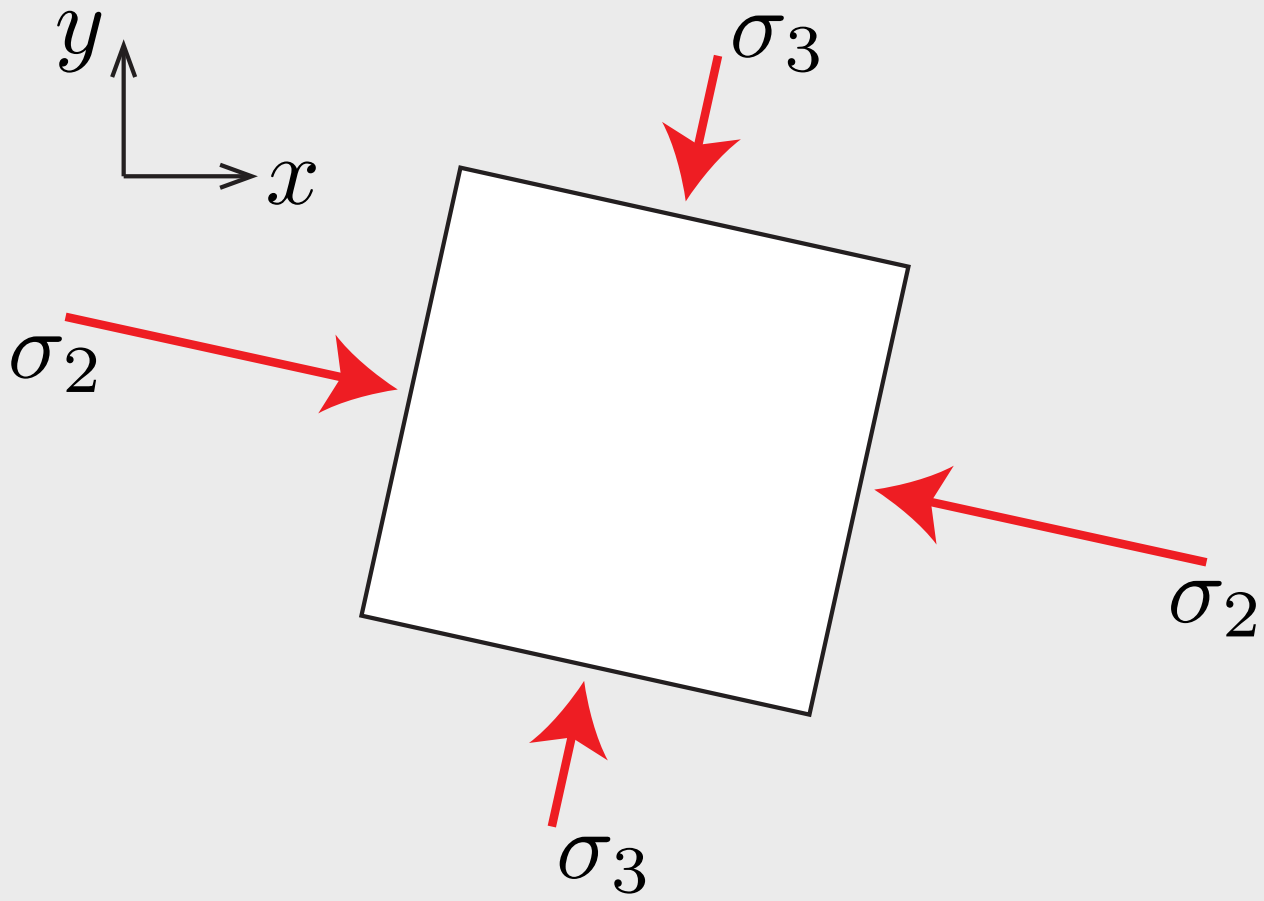
Source mechanisms

Nori Nakata
Stanford University

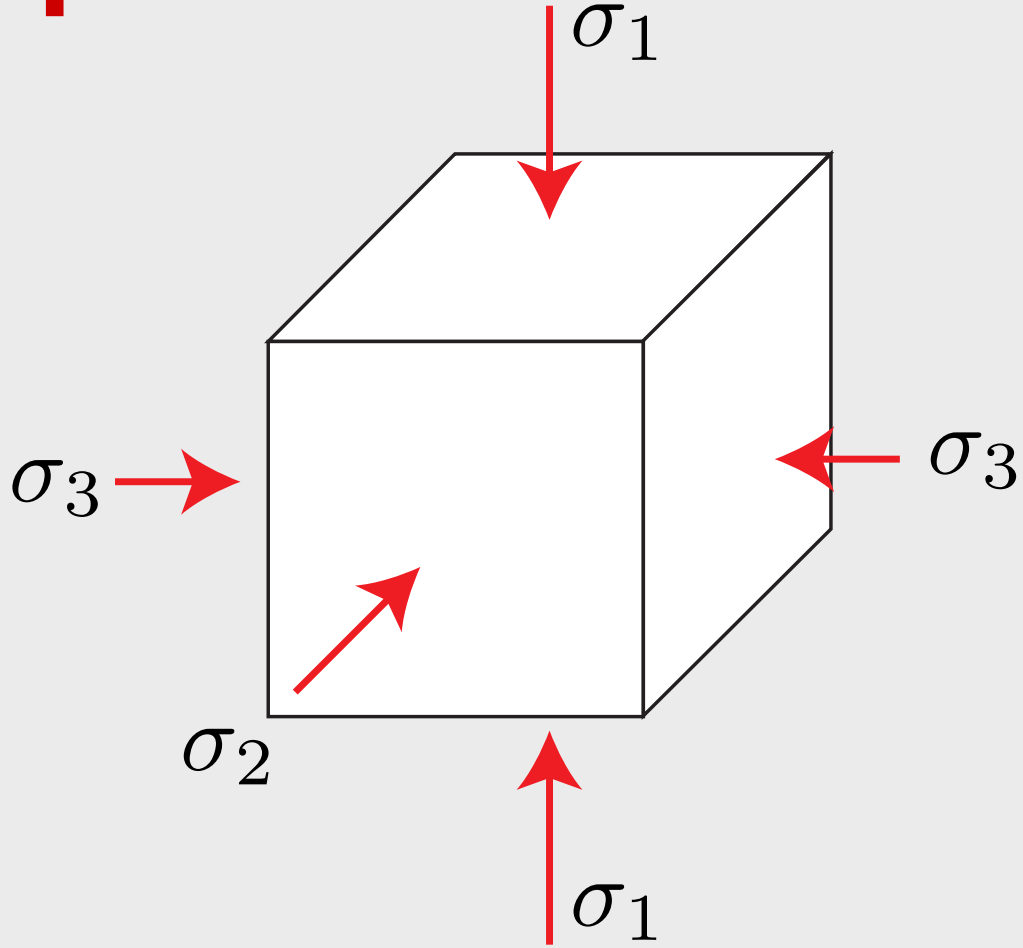
Stress orientation



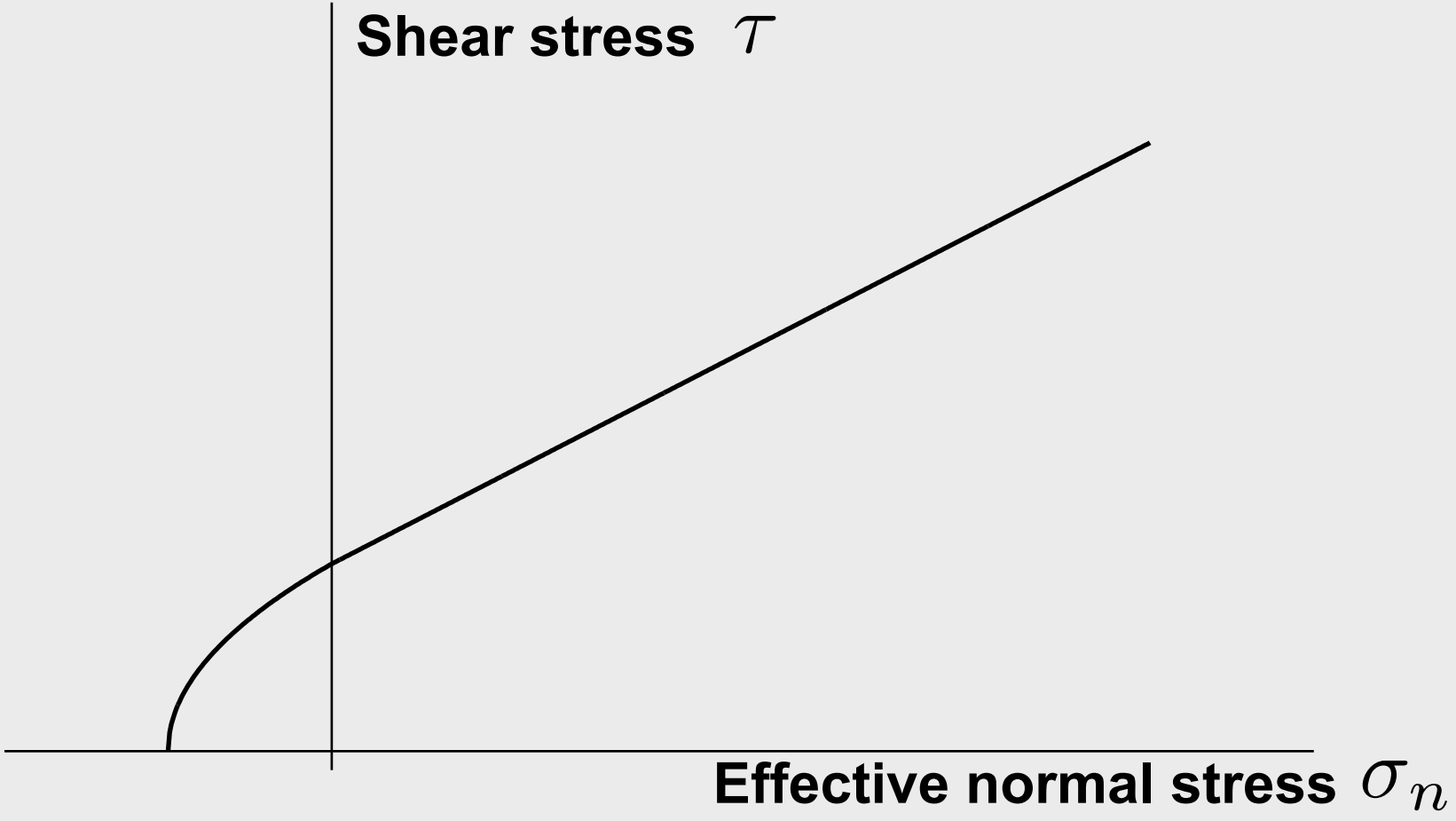
Principle stress orientation



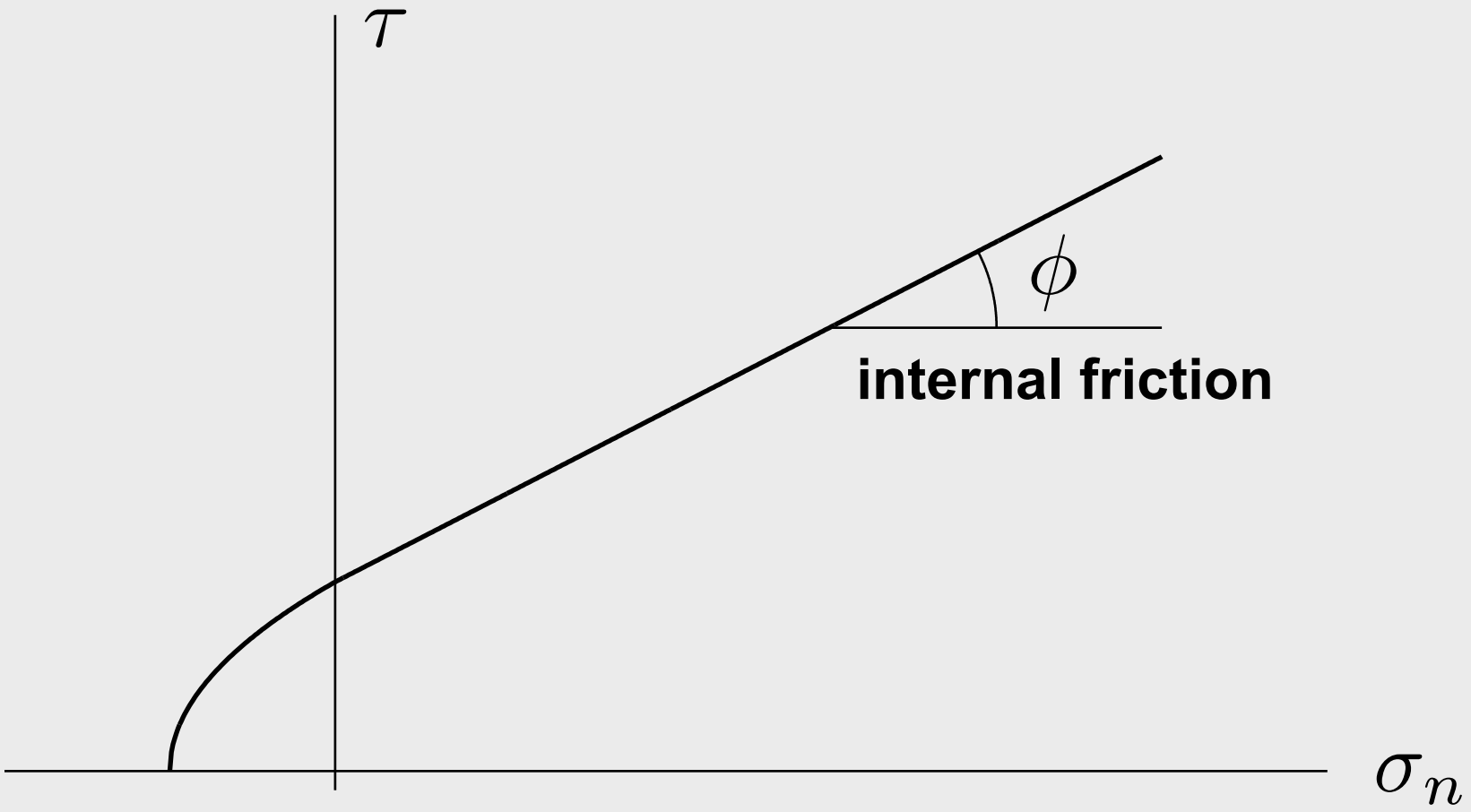
Principle stress orientation



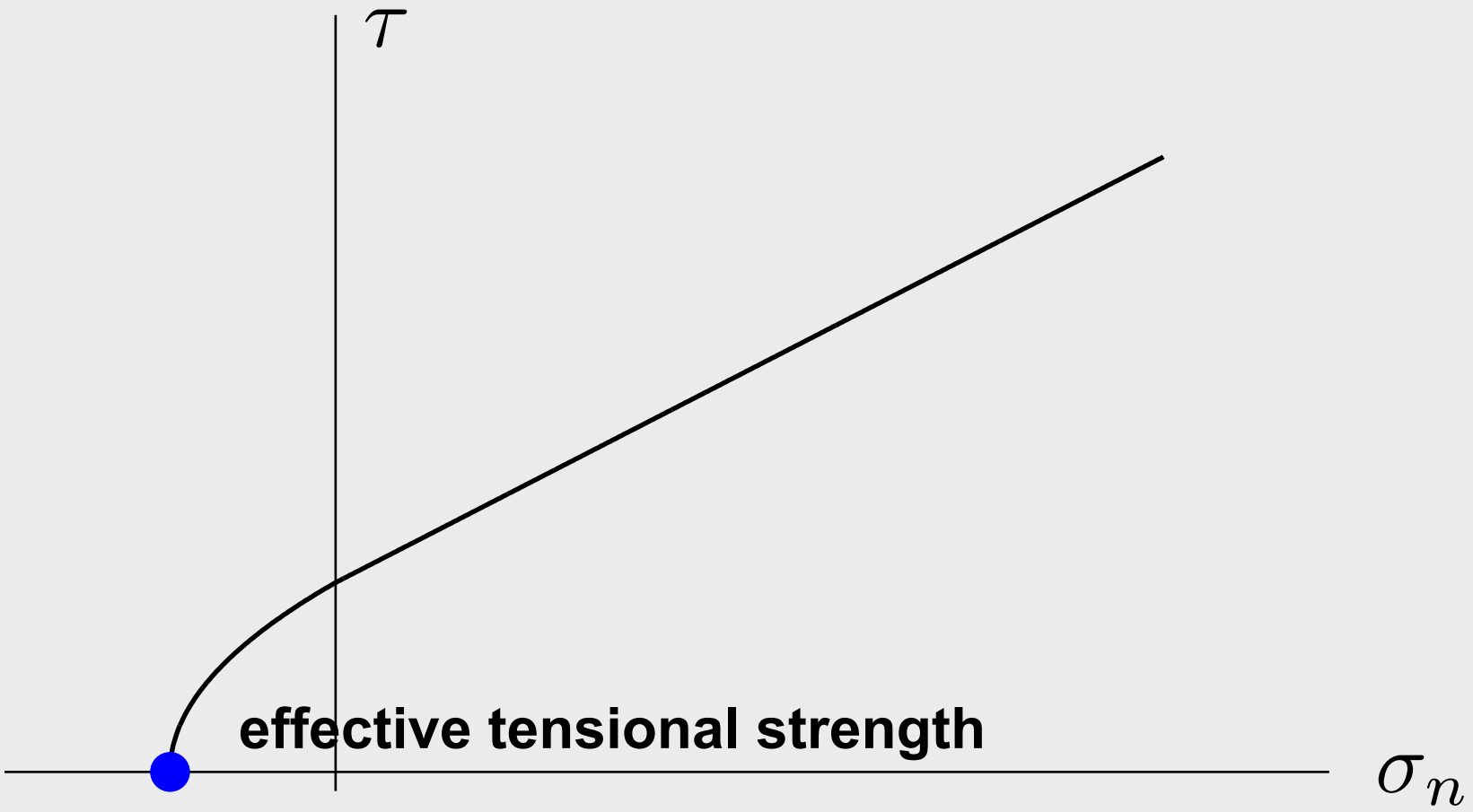
Coulomb/Griffith failure criteria



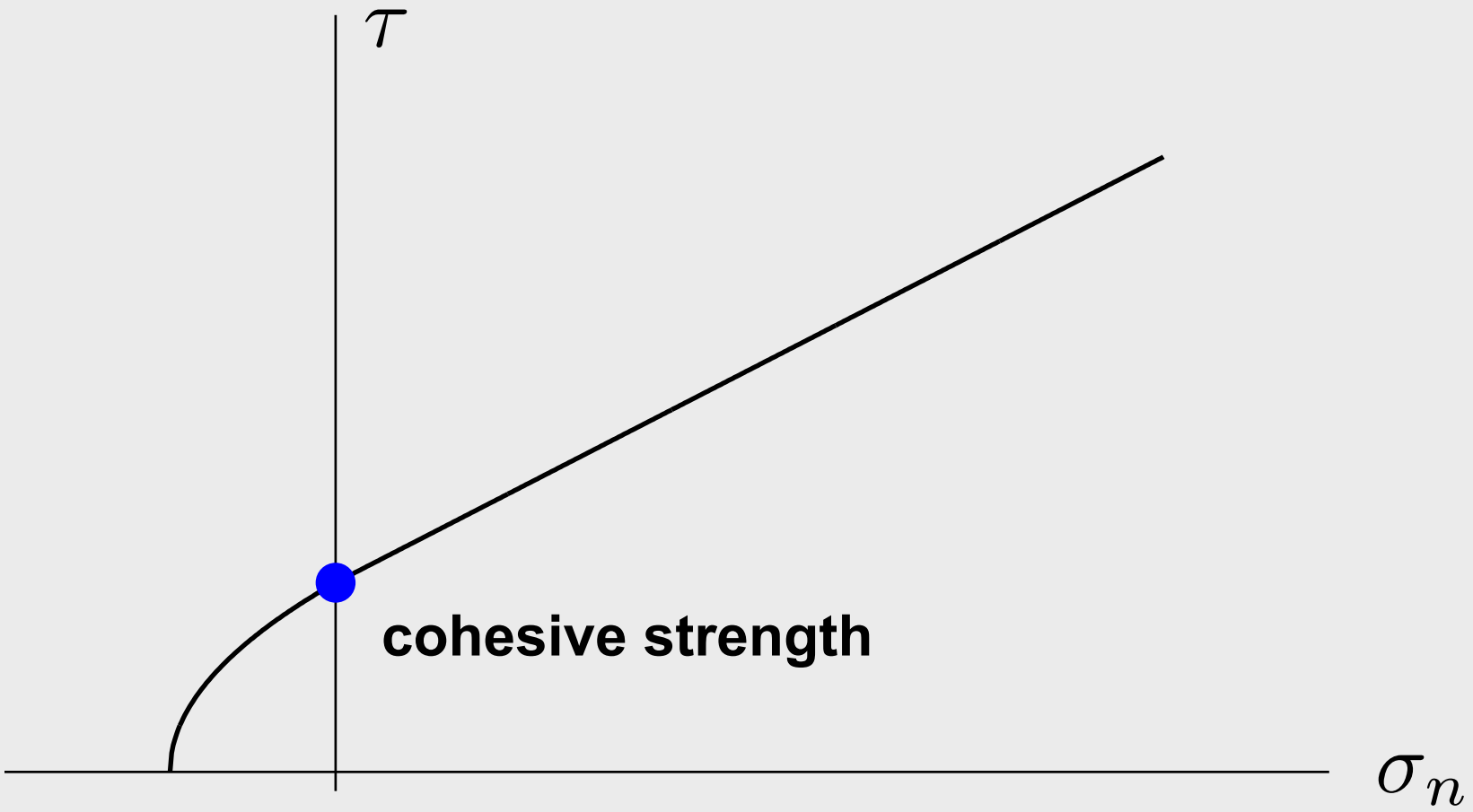
Coulomb/Griffith failure criteria



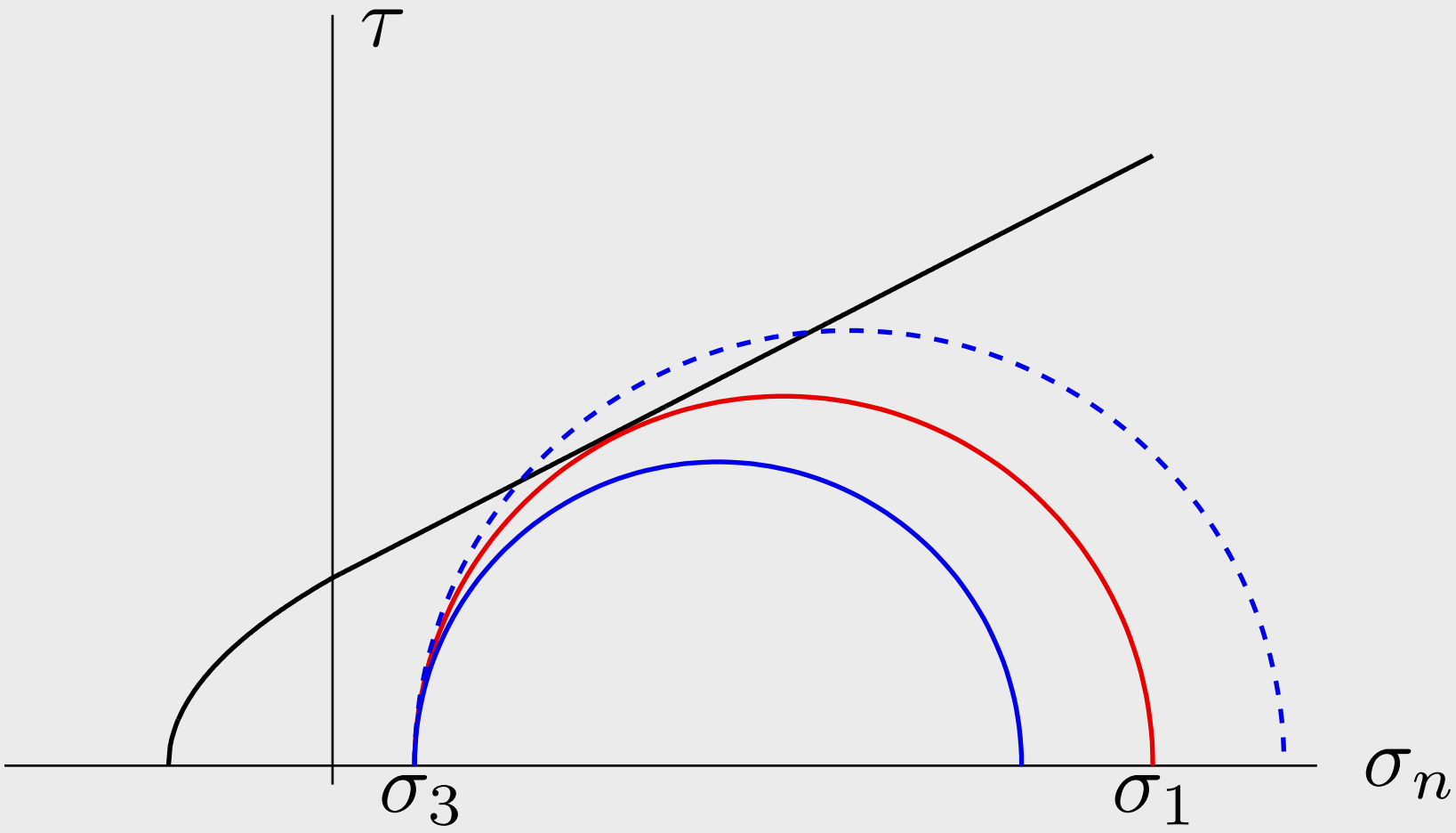
Coulomb/Griffith failure criteria



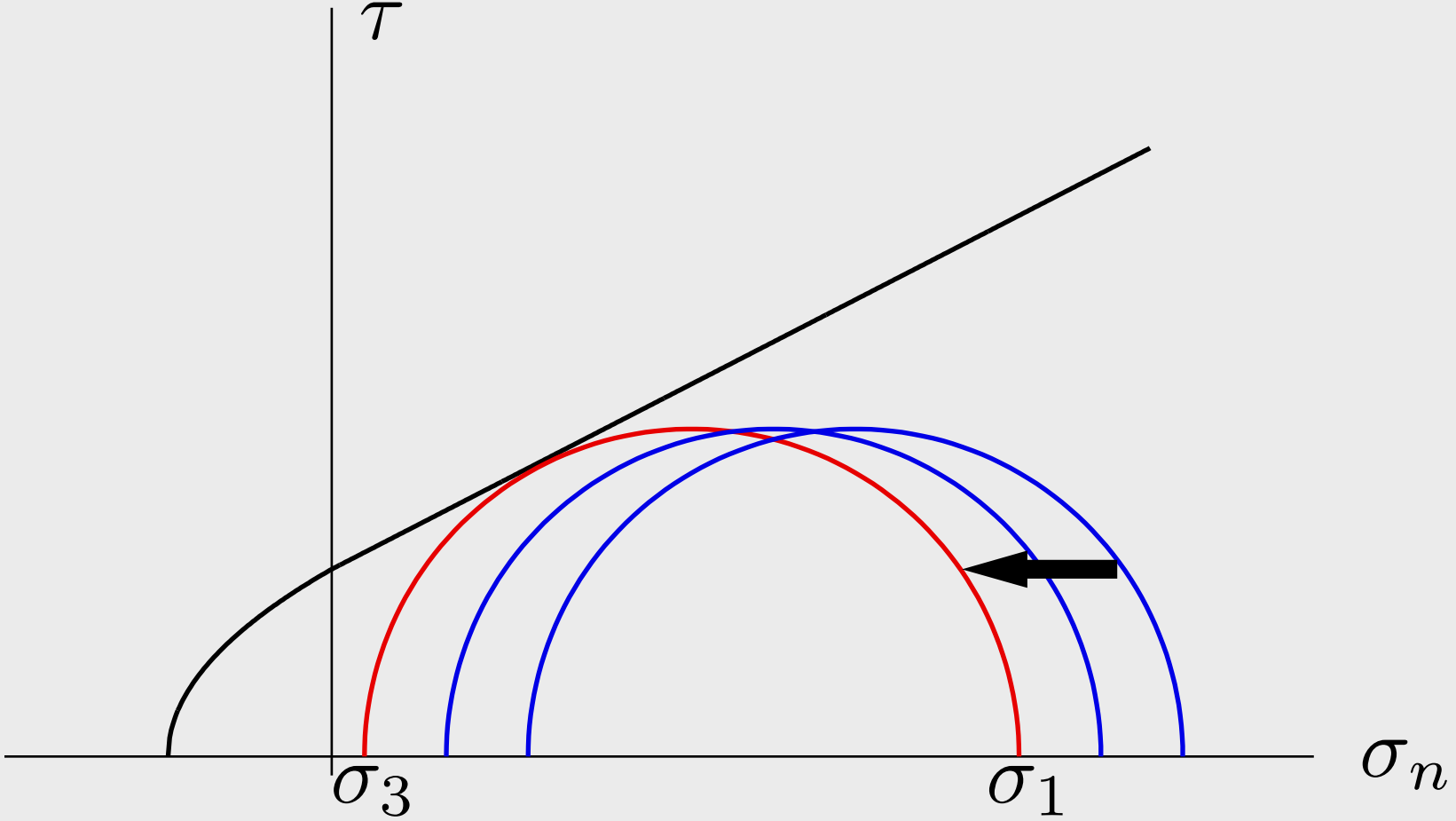
Coulomb/Griffith failure criteria



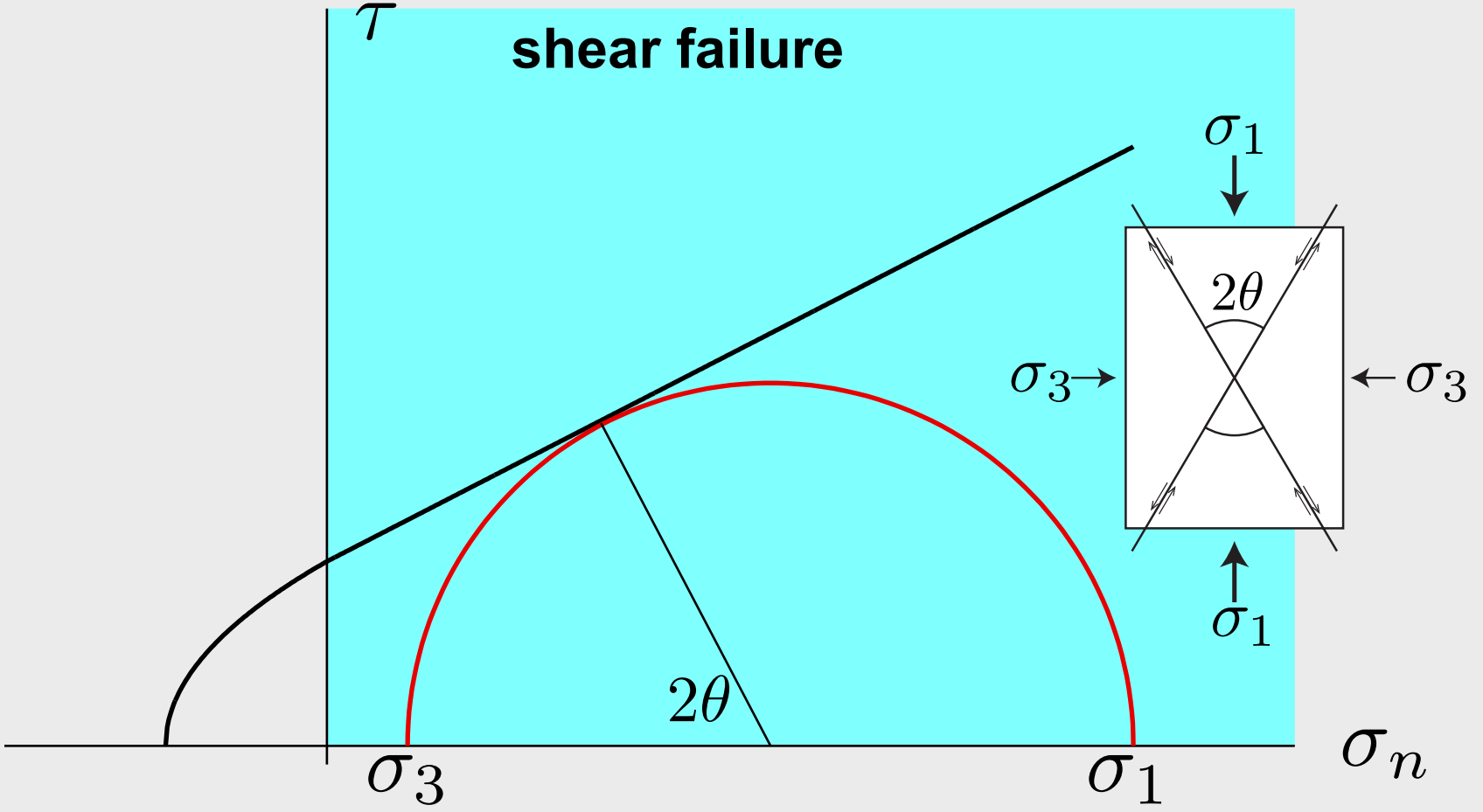
Mohr circle



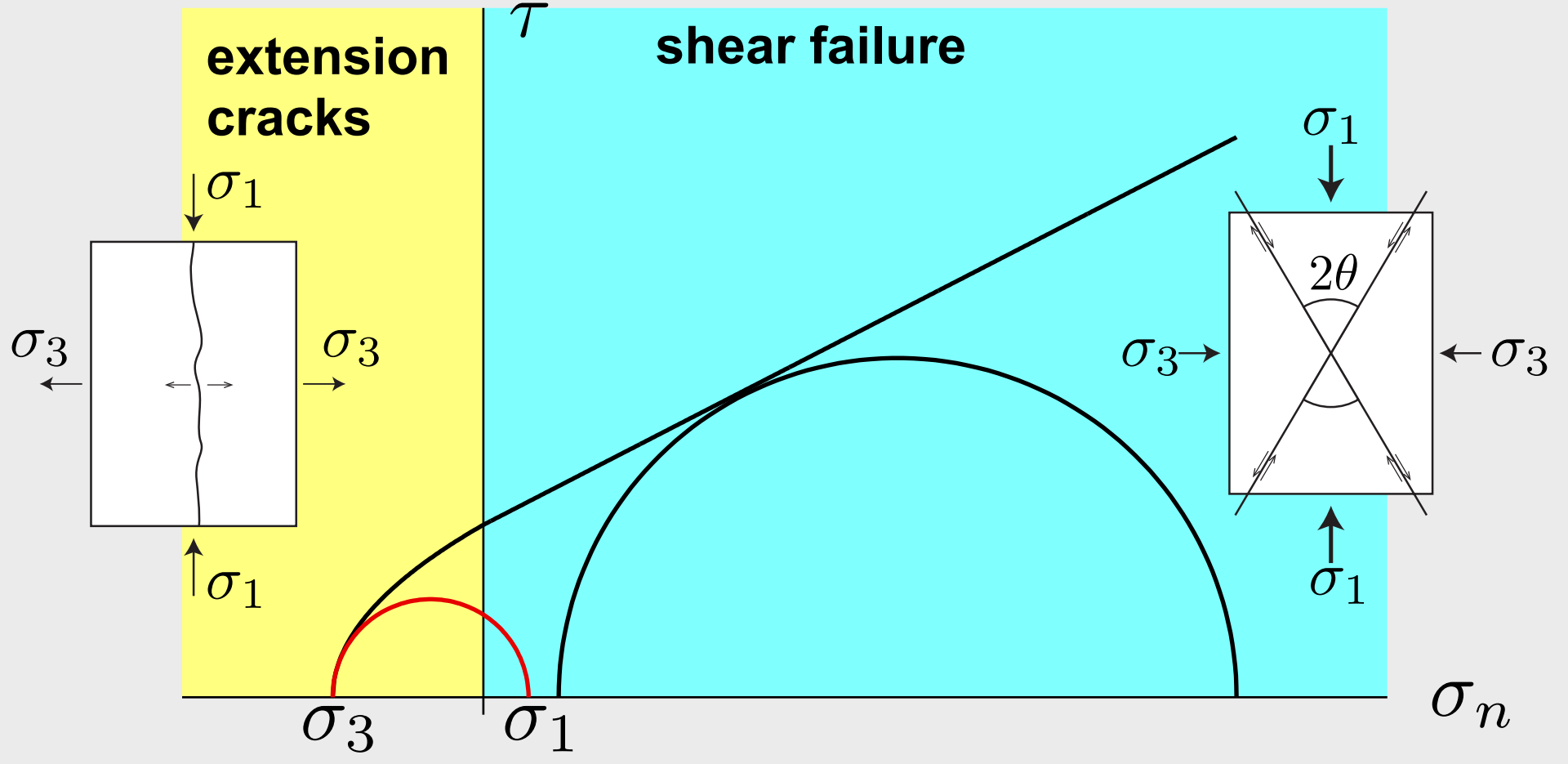
Changing pore pressure



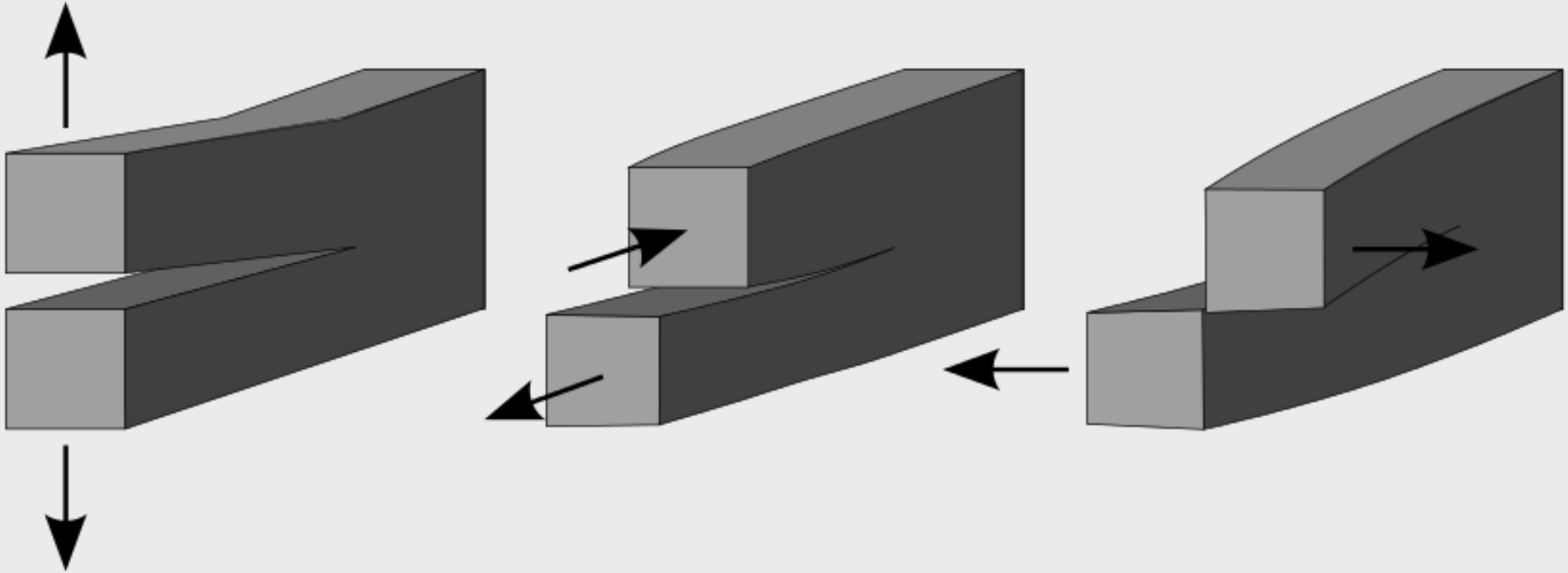
Failure


τ
shear failure
σ_1
2θ
σ_3
σ_3
σ_1
2θ
σ_3
σ_1
σ_n

Failure


extension cracks
shear failure
τ
σ_1
σ_3
σ_3
σ_1
2θ
σ_1
σ_3
σ_3
σ_1
σ_3
σ_1
σ_n

Fracture mechanisms



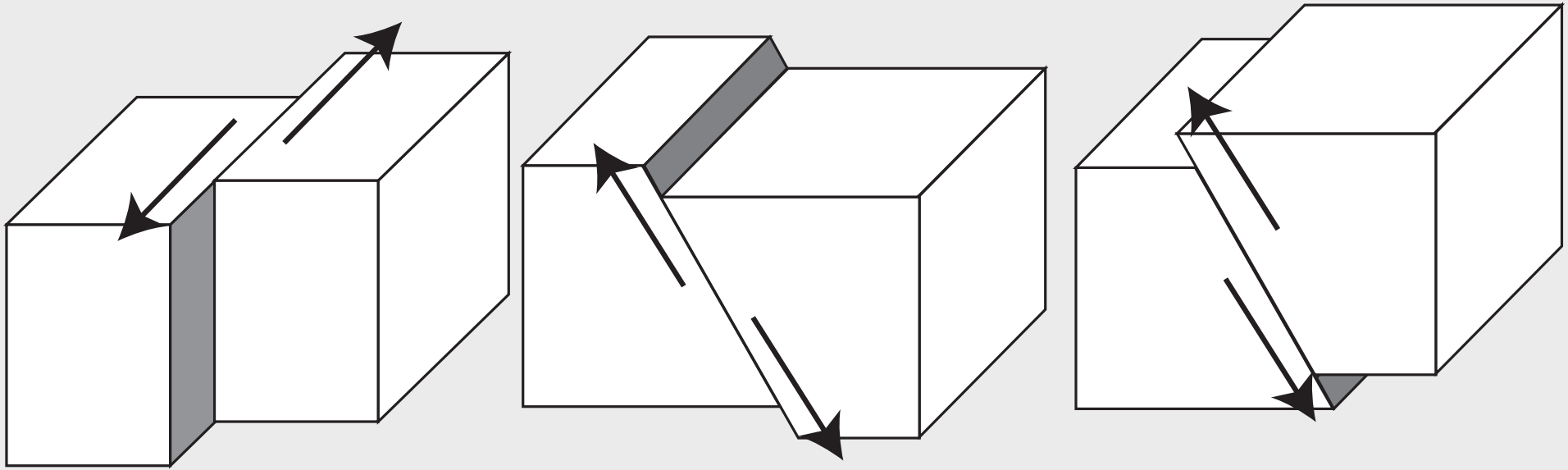
Mode I
Opening

Mode II
Shearing

Mode III
Tearing

Scholz, 2002; wikipedia

Faulting

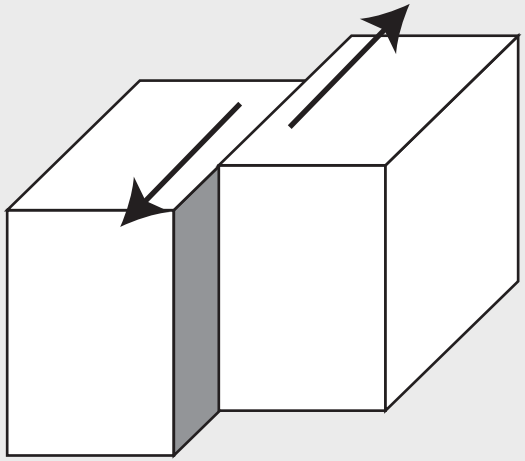


Strike slip

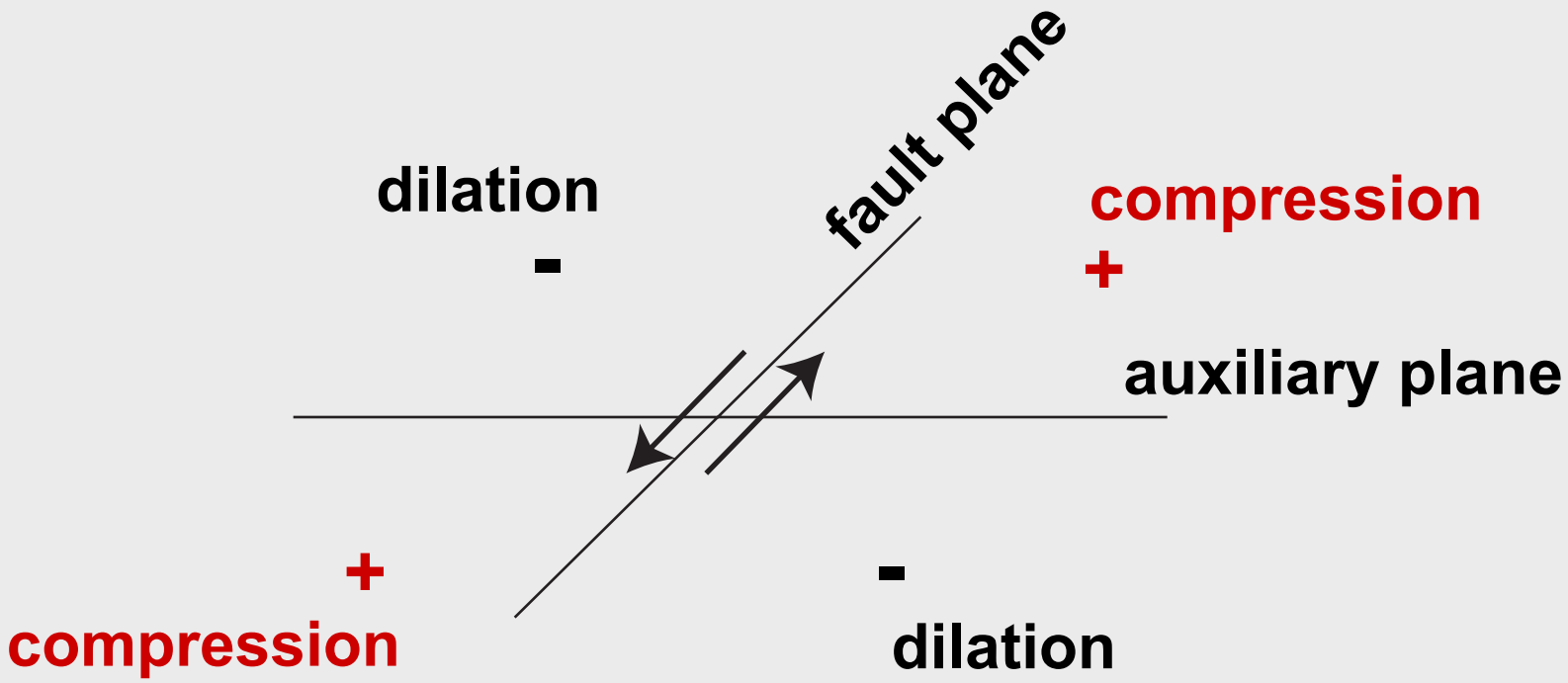
Normal

Reverse

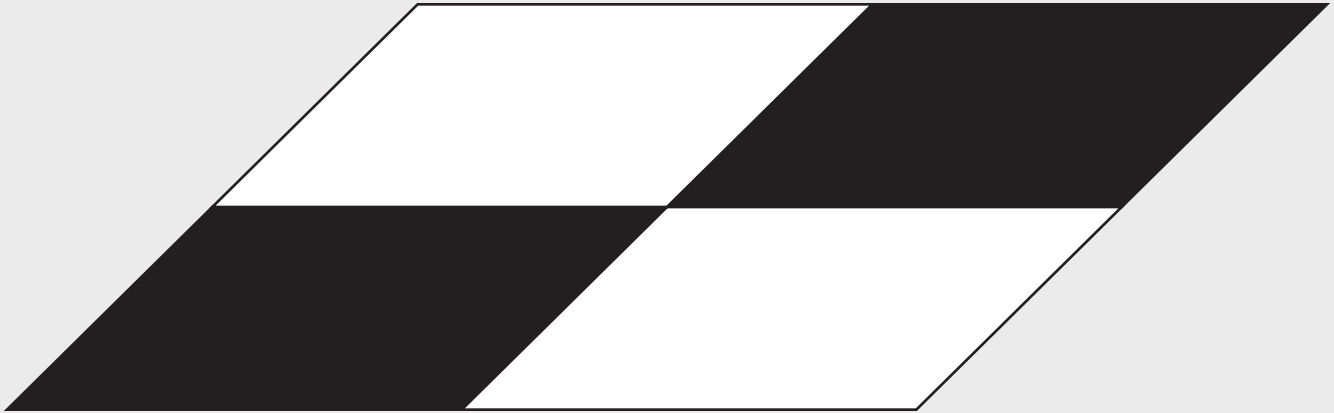
Faulting



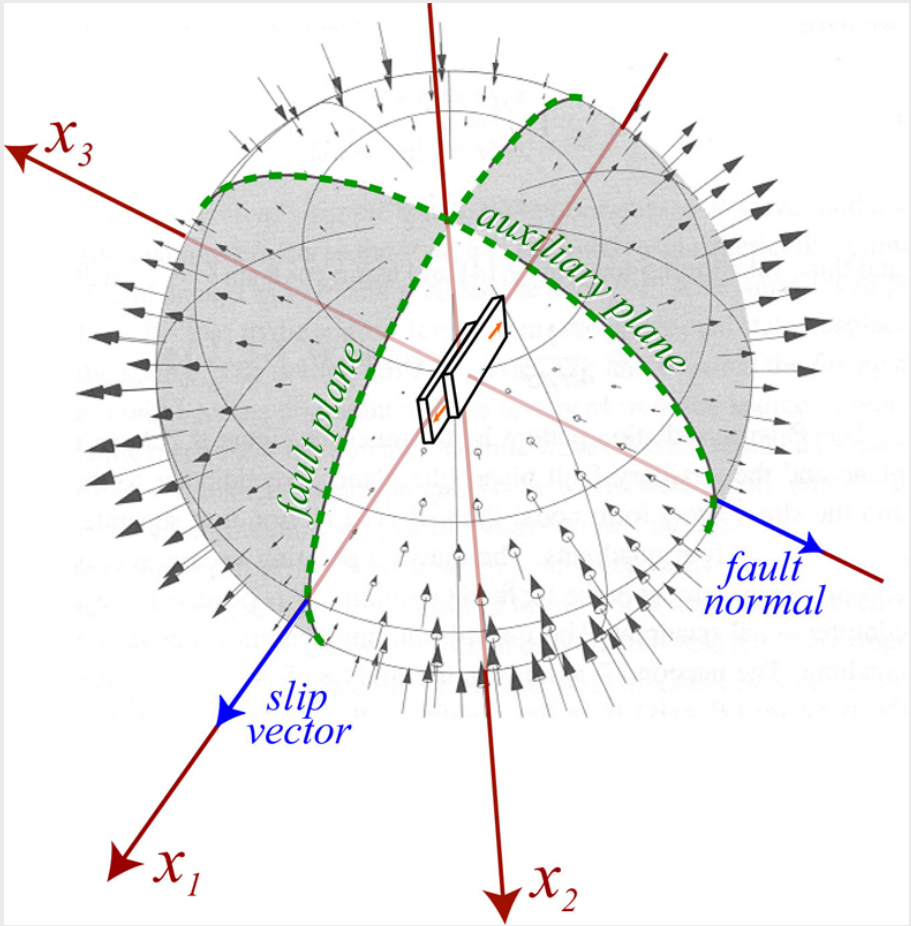
Faulting


fault plane
dilation
-
compression
+
auxiliary plane
+
compression
-
dilation

Faulting



Seismic wave



Ed Garnero

Seismic wave

$$\mathcal{L}\mathbf{u}(\boldsymbol{x}) = \mathbf{F}(\boldsymbol{x})$$

$\mathbf{u}$ Displacement

$\mathbf{F}$ Force (related to stress)

$\mathcal{L}$ Wave-propagation operator
(e.g., $\nabla^2 + \omega^2 / v_p^2$)

Seismic wave

wave propagation

mechanics

$$\mathcal{L}\mathbf{u}(\boldsymbol{x}) = \mathbf{F}(\boldsymbol{x})$$

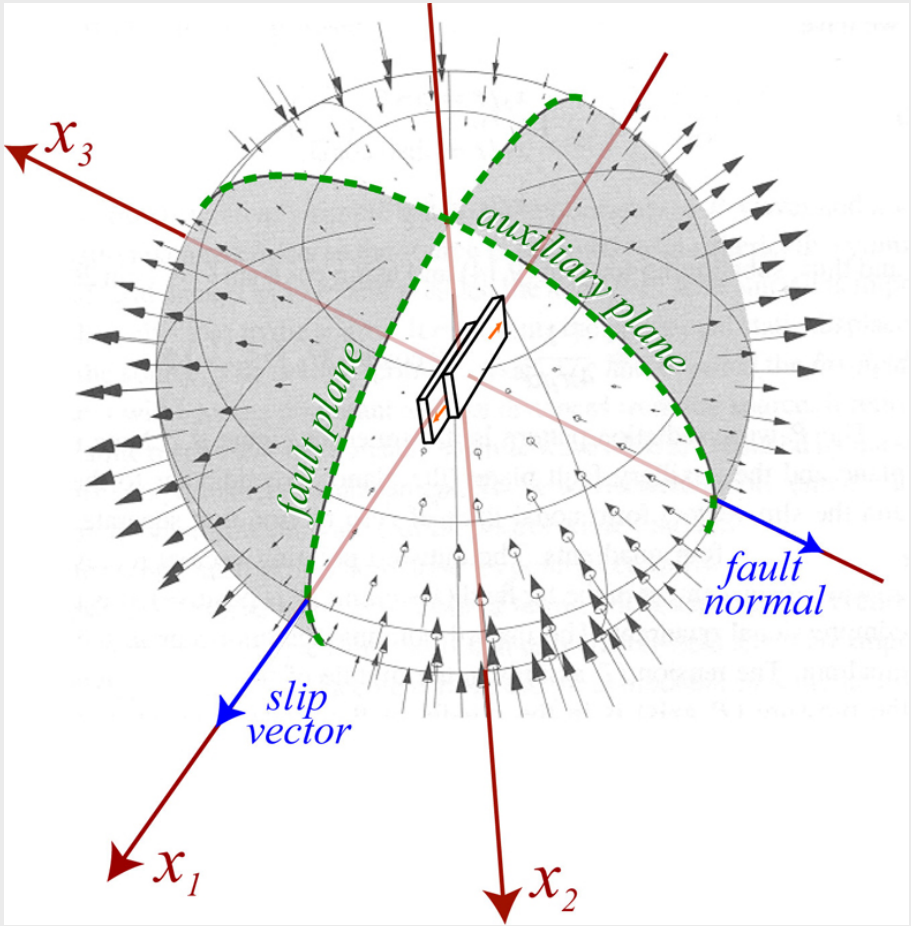
data

$\mathbf{u}$ Displacement

$\mathbf{F}$ Force (related to stress)

$\mathcal{L}$ Wave-propagation operator
(e.g., $\nabla^2 + \omega^2 / v_p^2$)

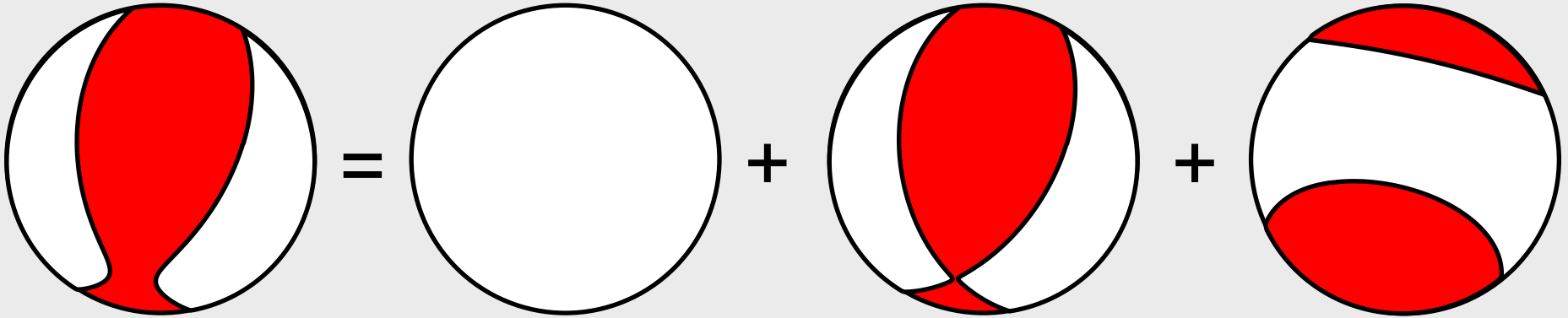
Seismic wave



Ed Garnero

Moment tensor

$$\mathbf{M} = \mathbf{M}^{\mathrm{ISO}} + \mathbf{M}^{\mathrm{DC}} + \mathbf{M}^{\mathrm{CLVD}}$$



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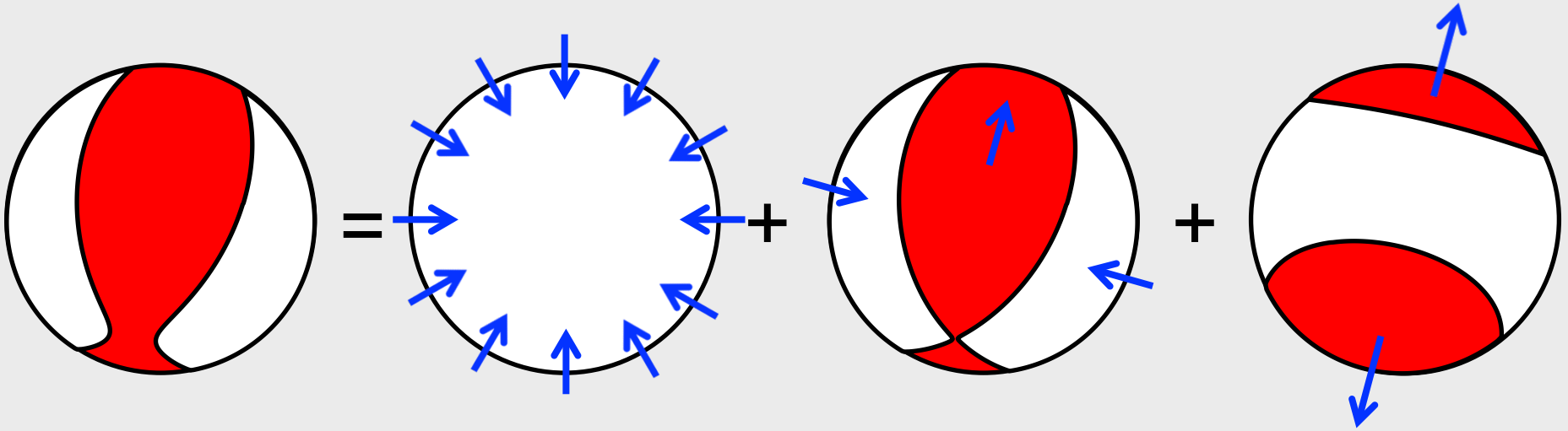
$$\mathbf{M} = \mathbf{M}^{\mathrm{ISO}} + \mathbf{M}^{\mathrm{DC}} + \mathbf{M}^{\mathrm{CLVD}}$$



Moment tensor

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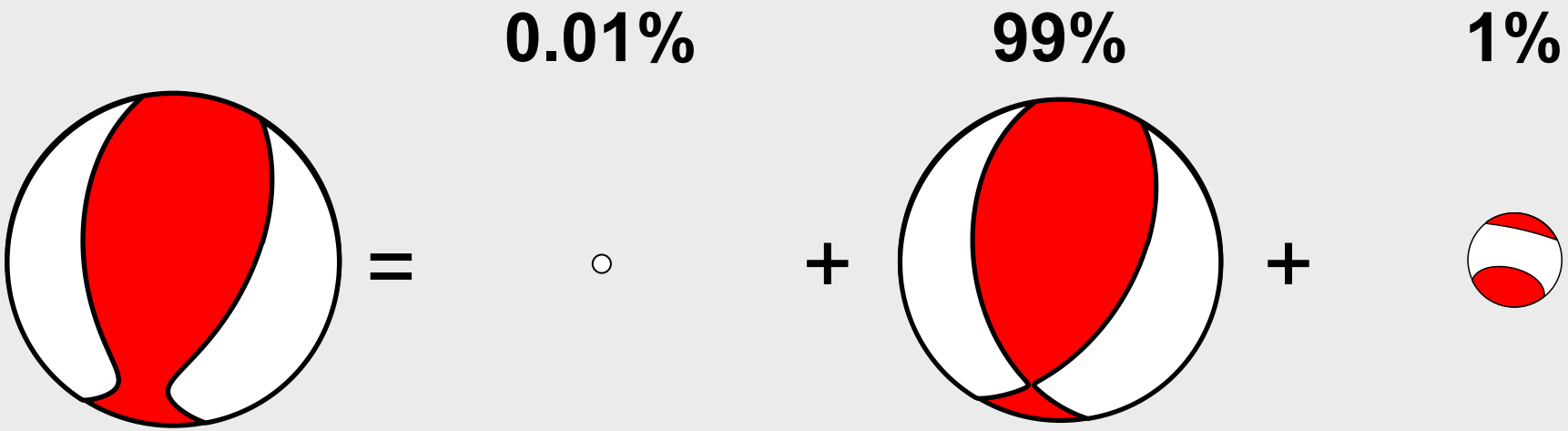
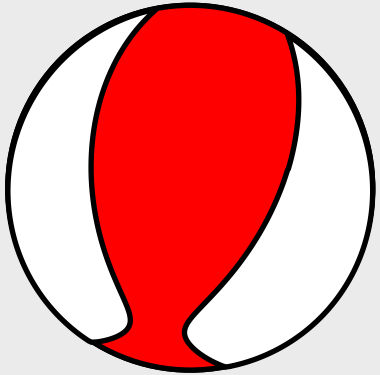
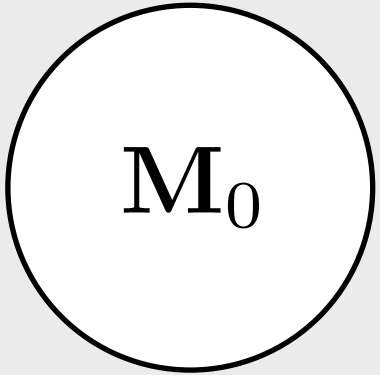




Magnitude

$$\mathbf{M}_w = \frac{2}{3}(\log_{10} \mathbf{M}_0 - 9.1)$$



Magnitude

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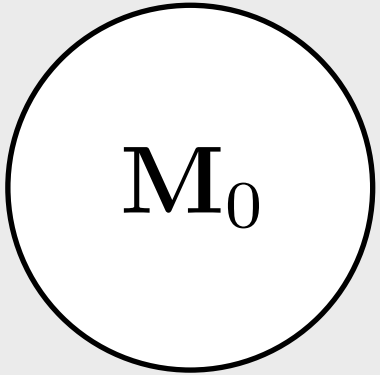
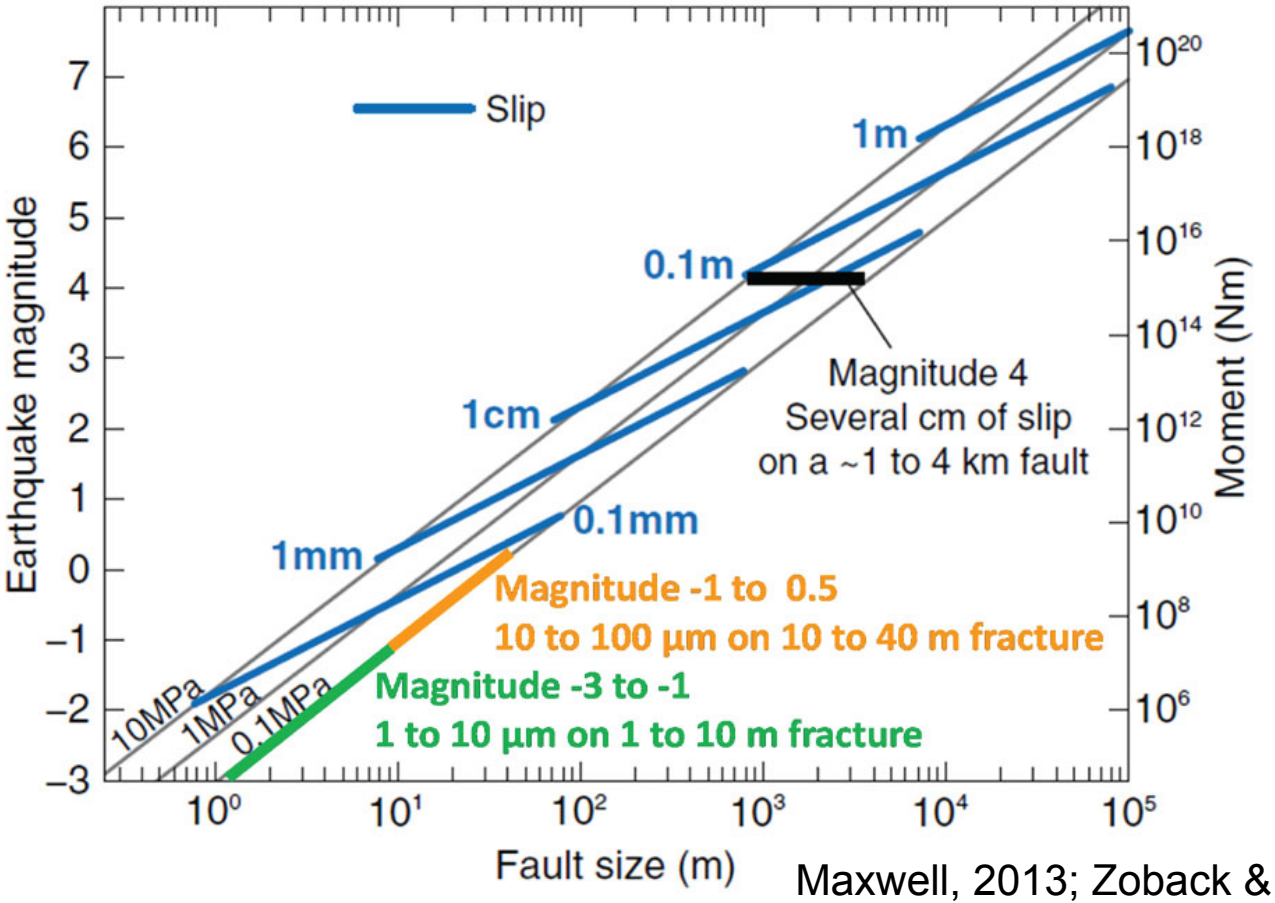


$$\mathbf{M}_w \to \mathbf{M}_w + 1$$

$$\Vert$$

$$\mathbf{M}_0 \to 32\mathbf{M}_0$$

Magnitude - scale



Maxwell, 2013; Zoback & Gorelick, 2012