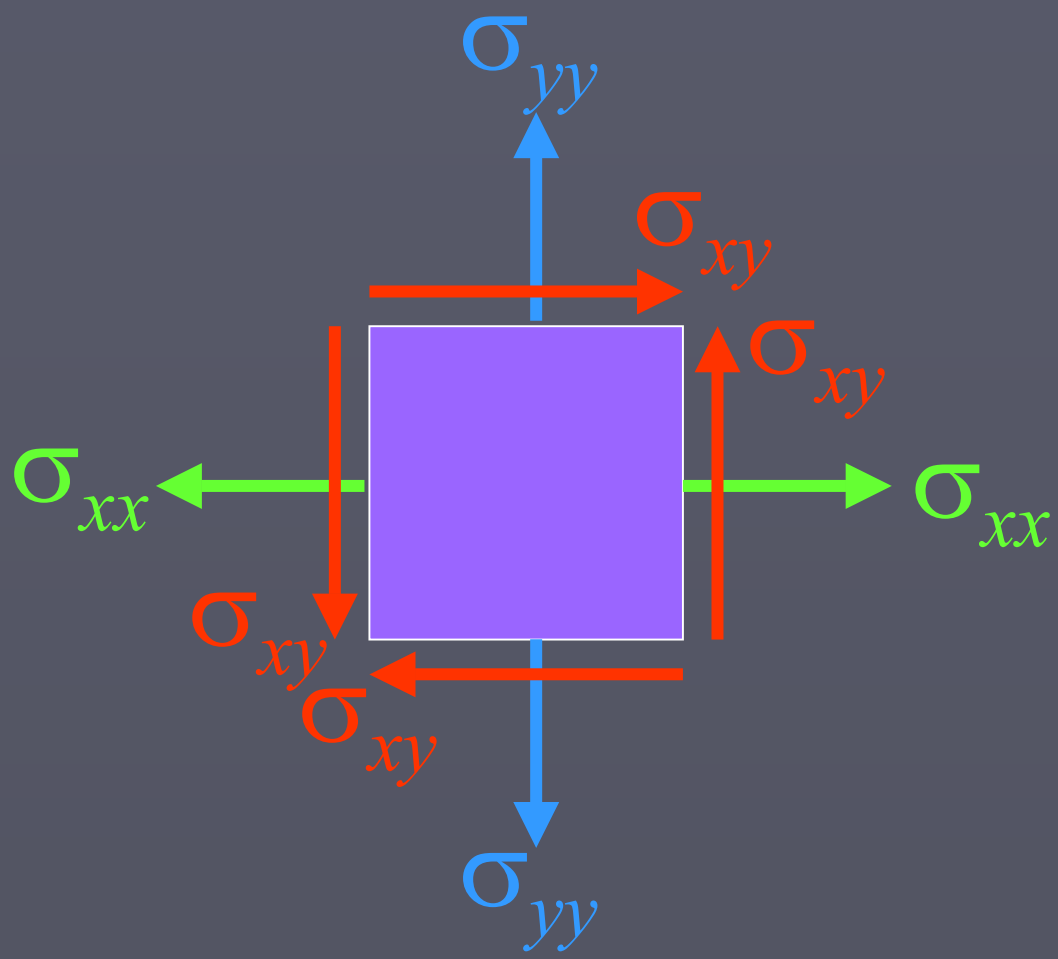
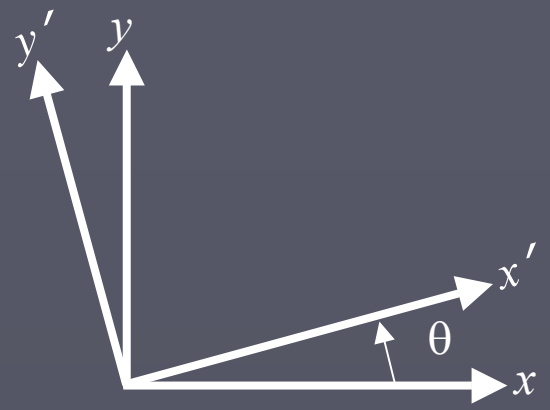
The Mohr Circle

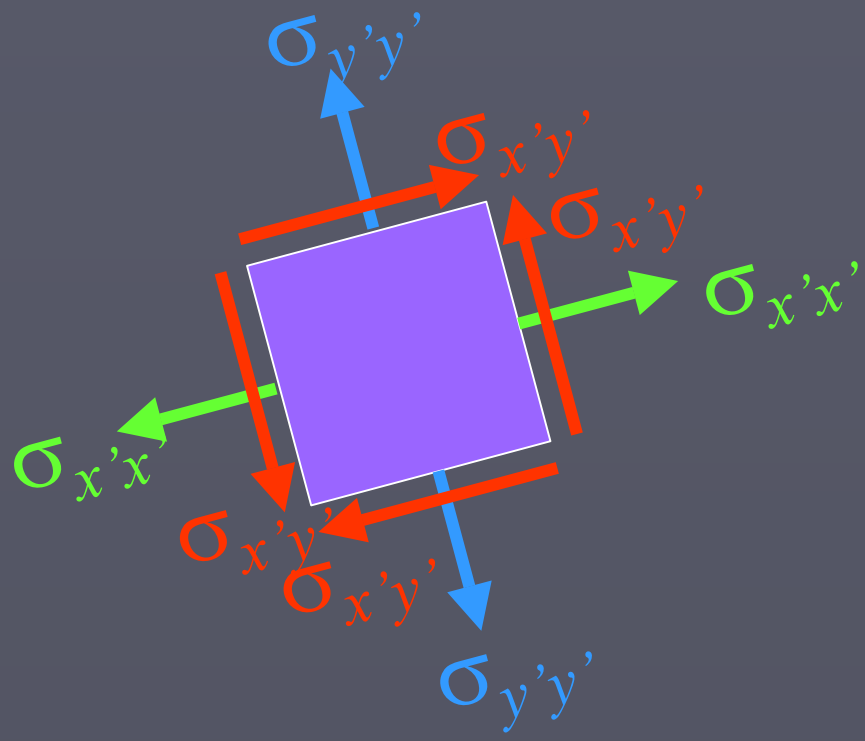
Given


σ_{yy}
σ_{xy}
σ_{xy}
σ_{xx}
σ_{xx}
σ_{xy}
σ_{xy}
σ_{yy}

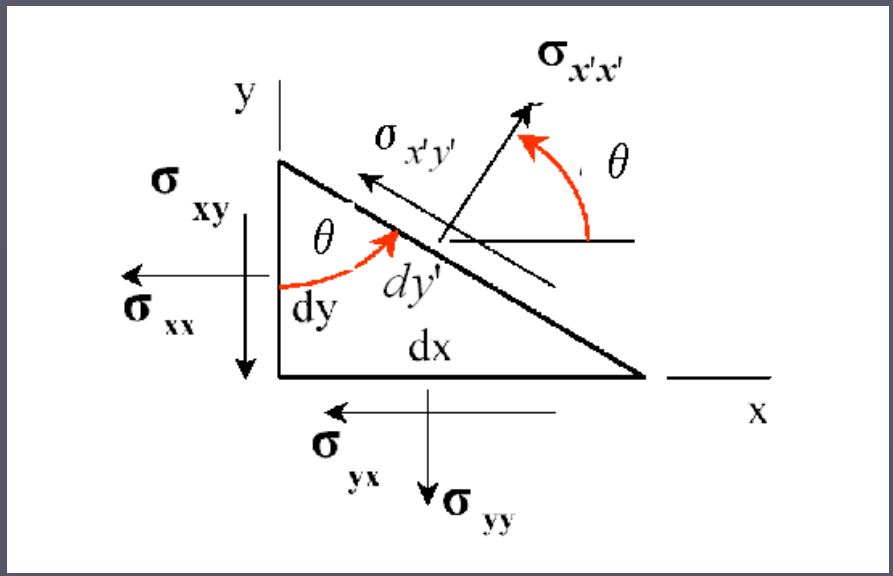
Question is:

Compute the stress in x'y'





Derived in Class

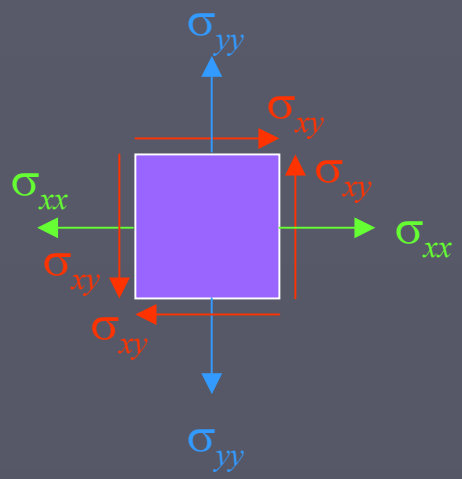


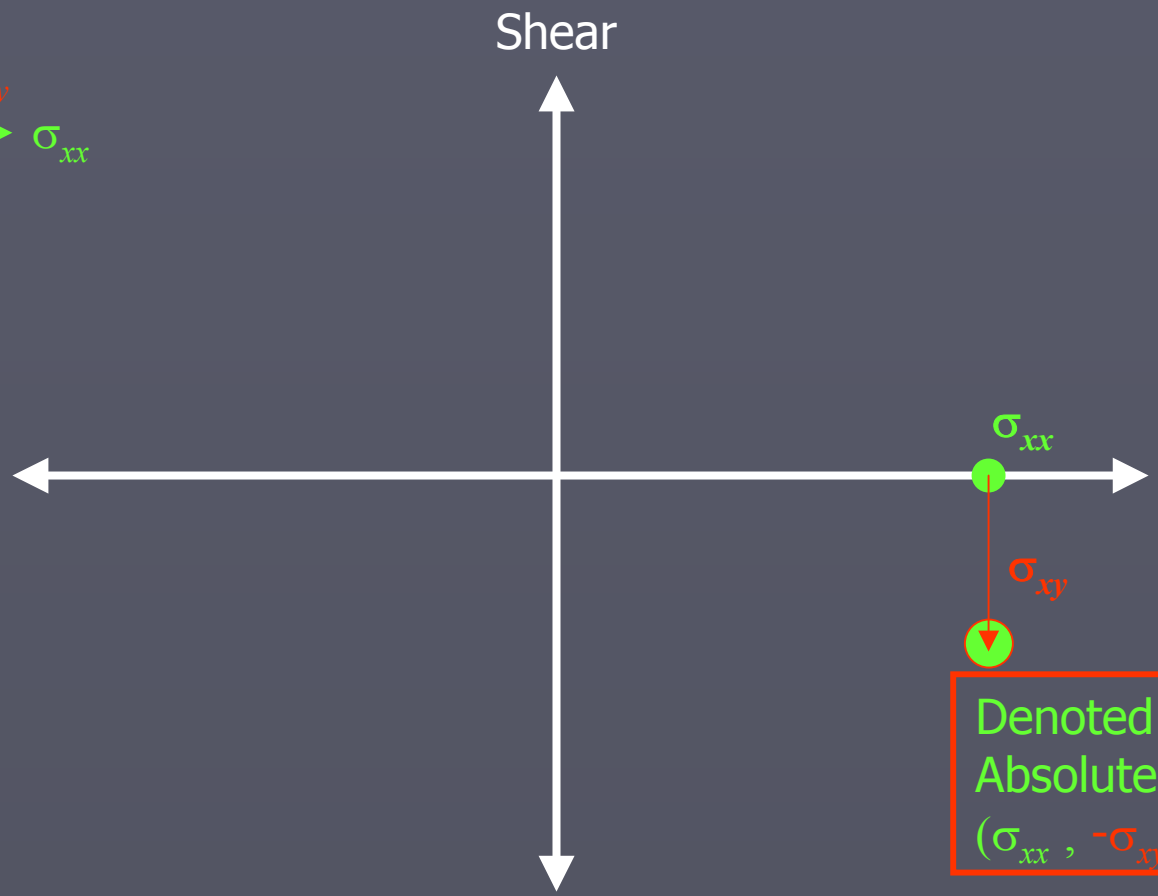
$$\sigma_{x'x'} = \frac{\sigma_{xx} + \sigma_{yy}}{2} + \frac{\sigma_{xx} - \sigma_{yy}}{2}\cos 2\theta + \sigma_{xy}\sin 2\theta$$

$$\sigma_{y'y'} = \frac{\sigma_{xx} + \sigma_{yy}}{2} - \frac{\sigma_{xx} - \sigma_{yy}}{2}\cos 2\theta - \sigma_{xy}\sin 2\theta$$

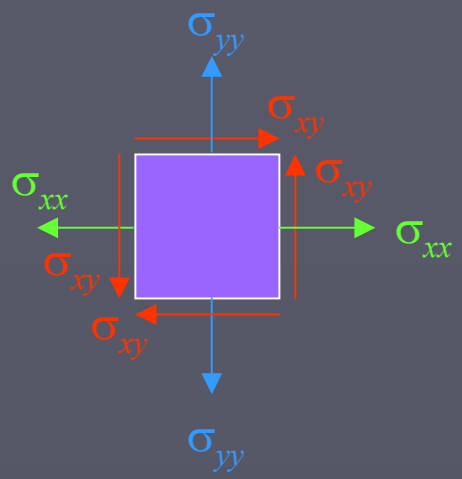
$$\sigma_{x'y'} = \frac{\sigma_{xx} - \sigma_{yy}}{2}\sin 2\theta + \sigma_{xy}\cos 2\theta$$

Draw Axes and $(\sigma_{xx}\ ,\ -\sigma_{xy})$

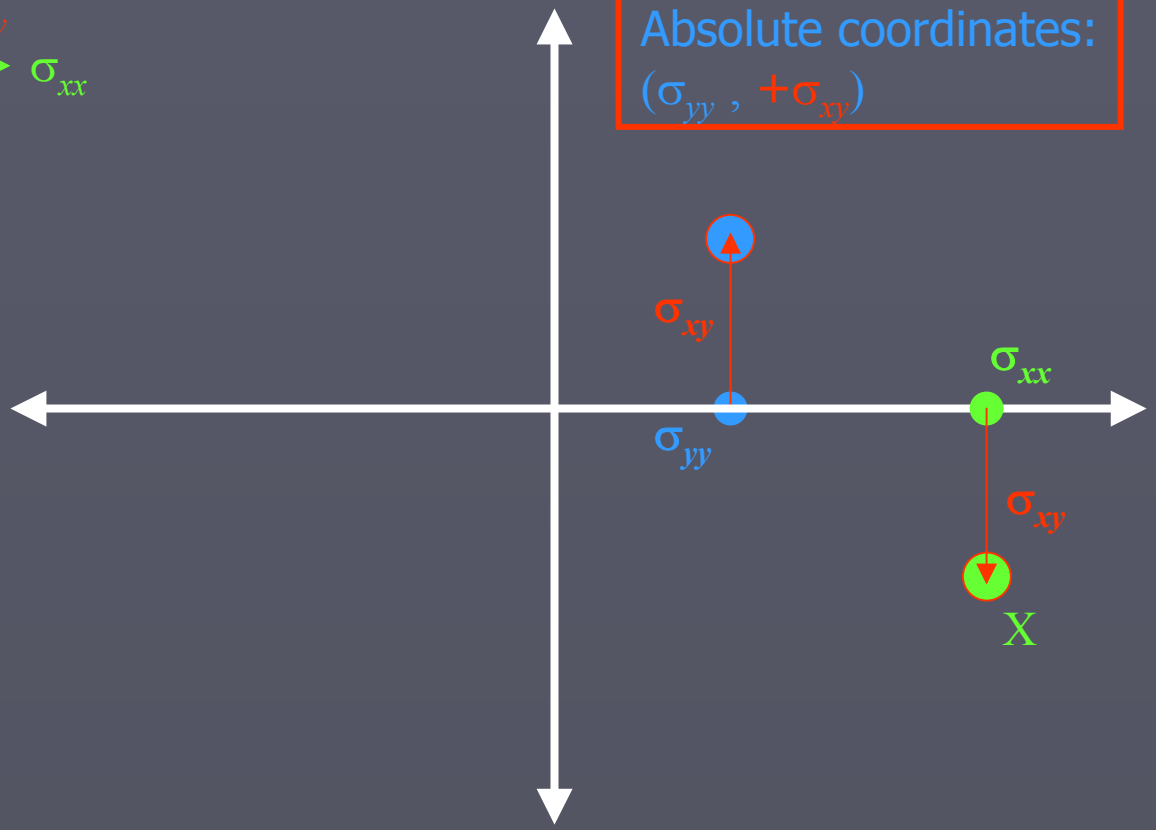




Draw (σ_{yy} , $+\sigma_{xy}$)

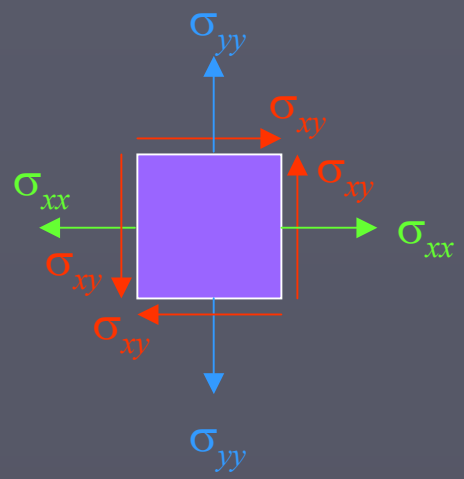


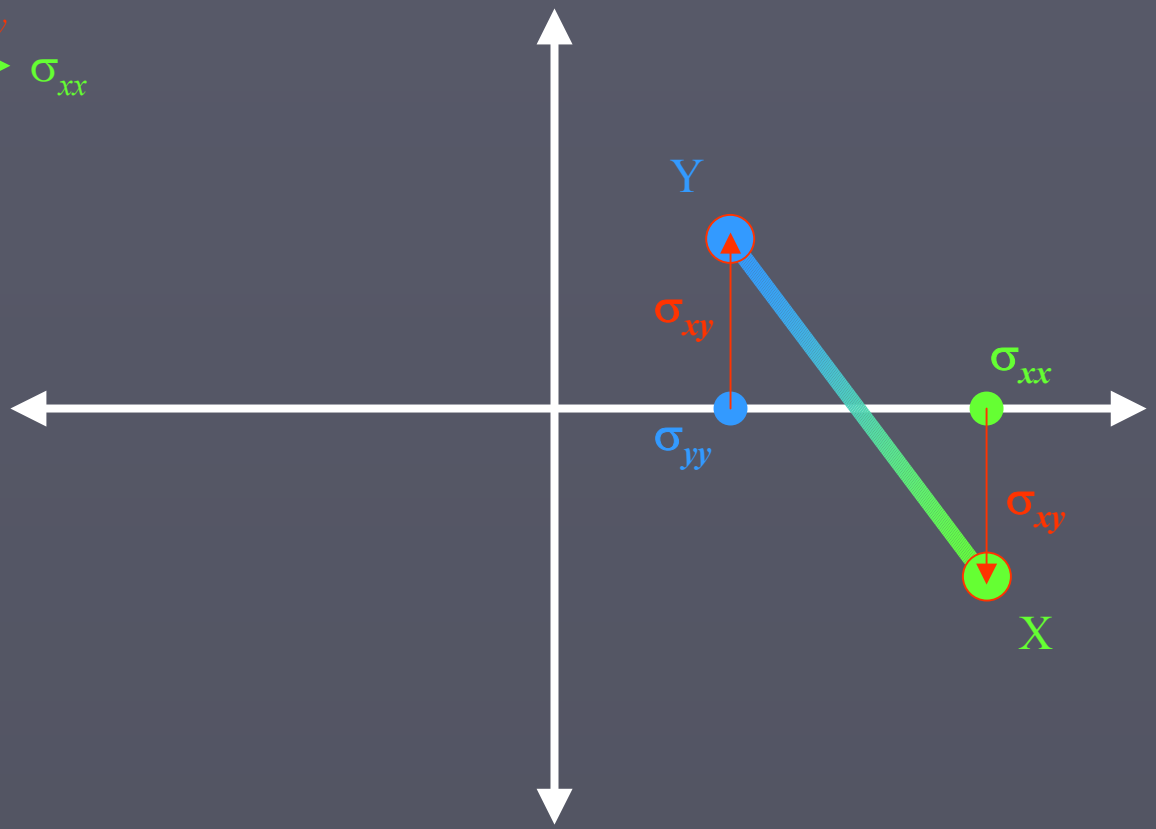
Denoted Y end.
Absolute coordinates:
(σ_{yy} , $+\sigma_{xy}$)



Positive
σ_{xx} ,σ_{yy}

XY: The State of Stress

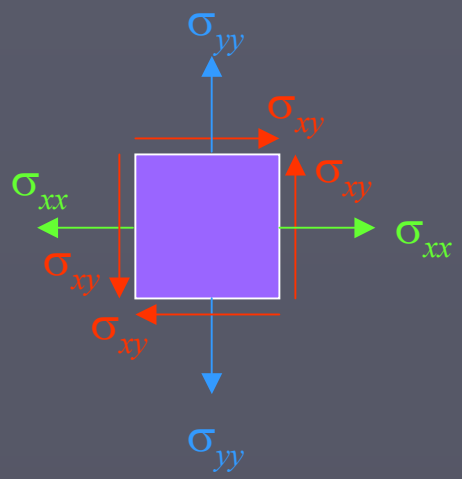


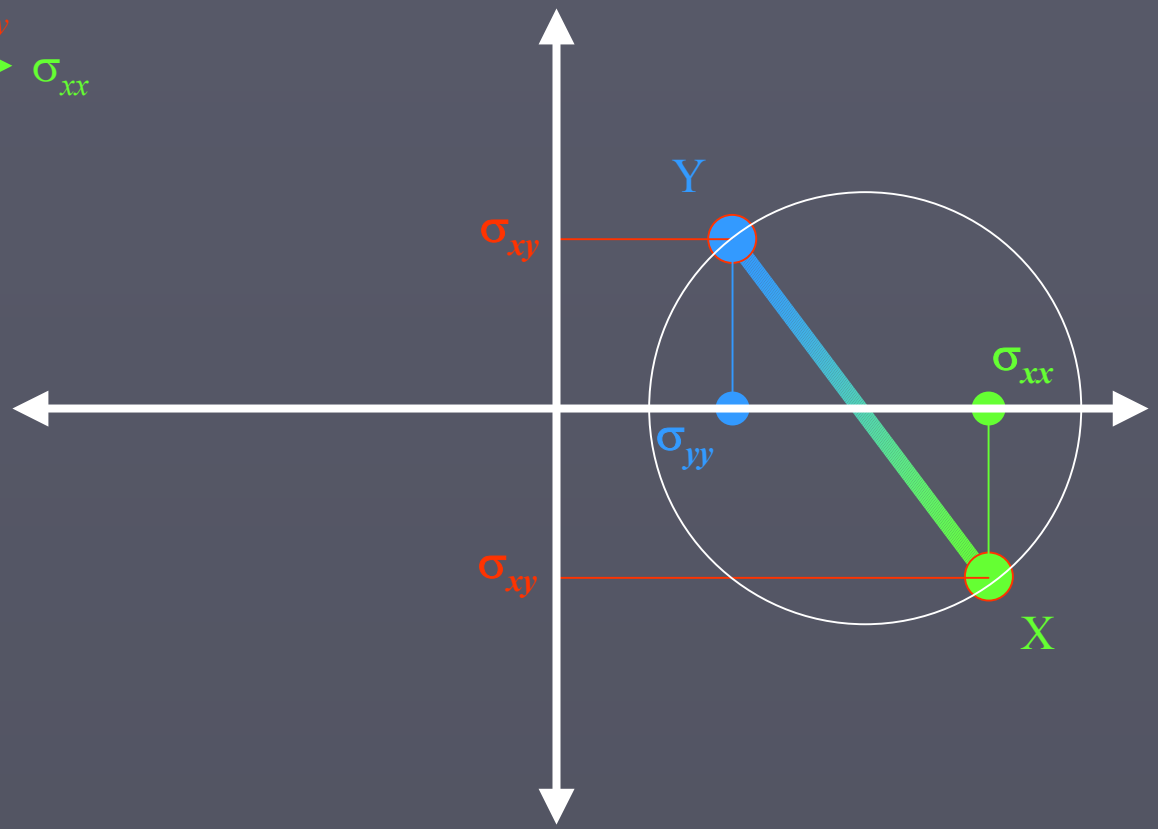


Positive

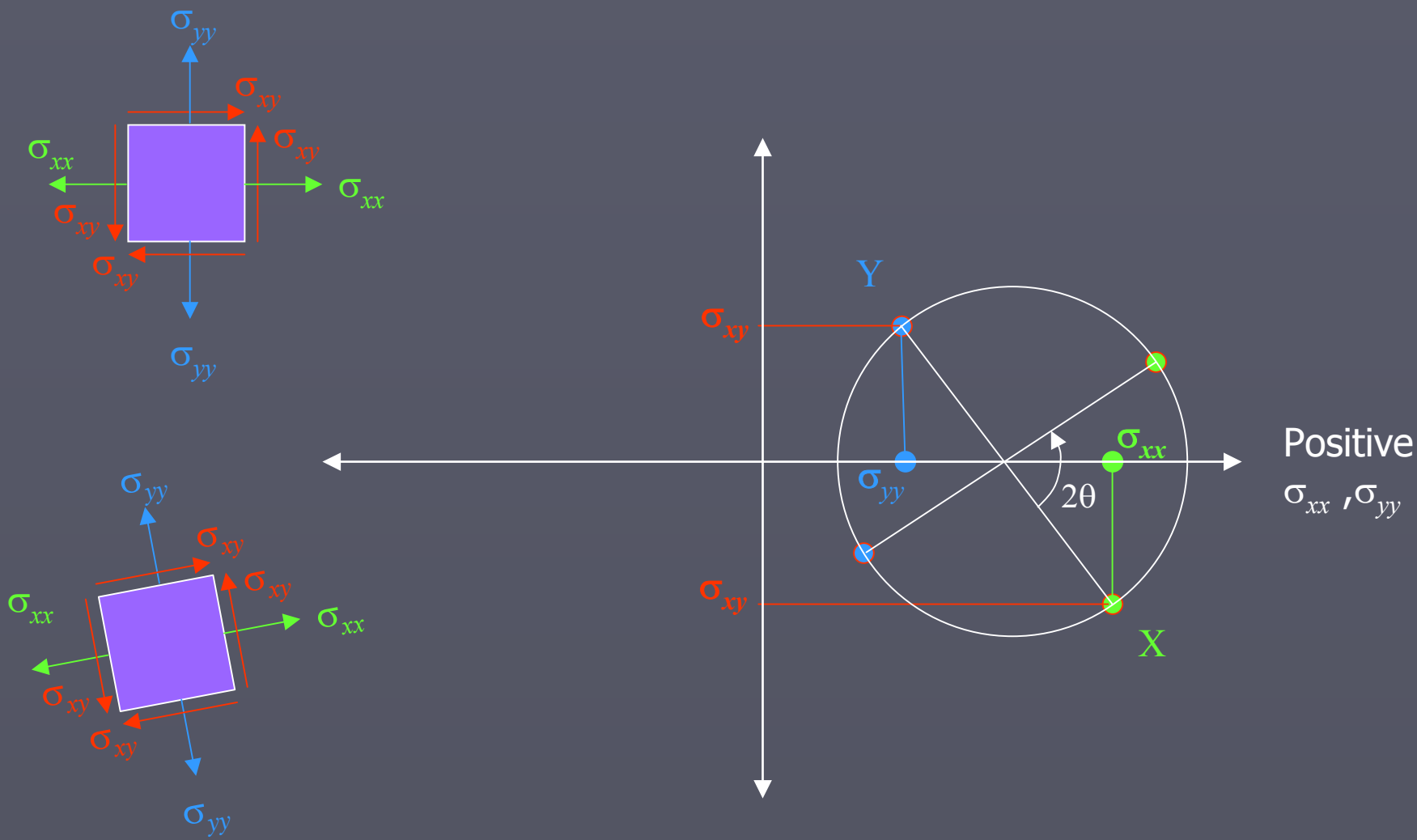
σ_{xx} , σ_{yy}

Mohr's Circle

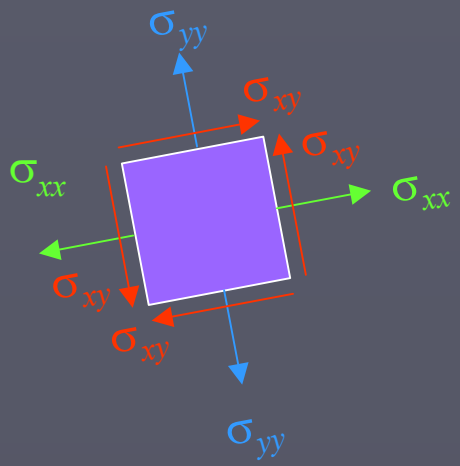


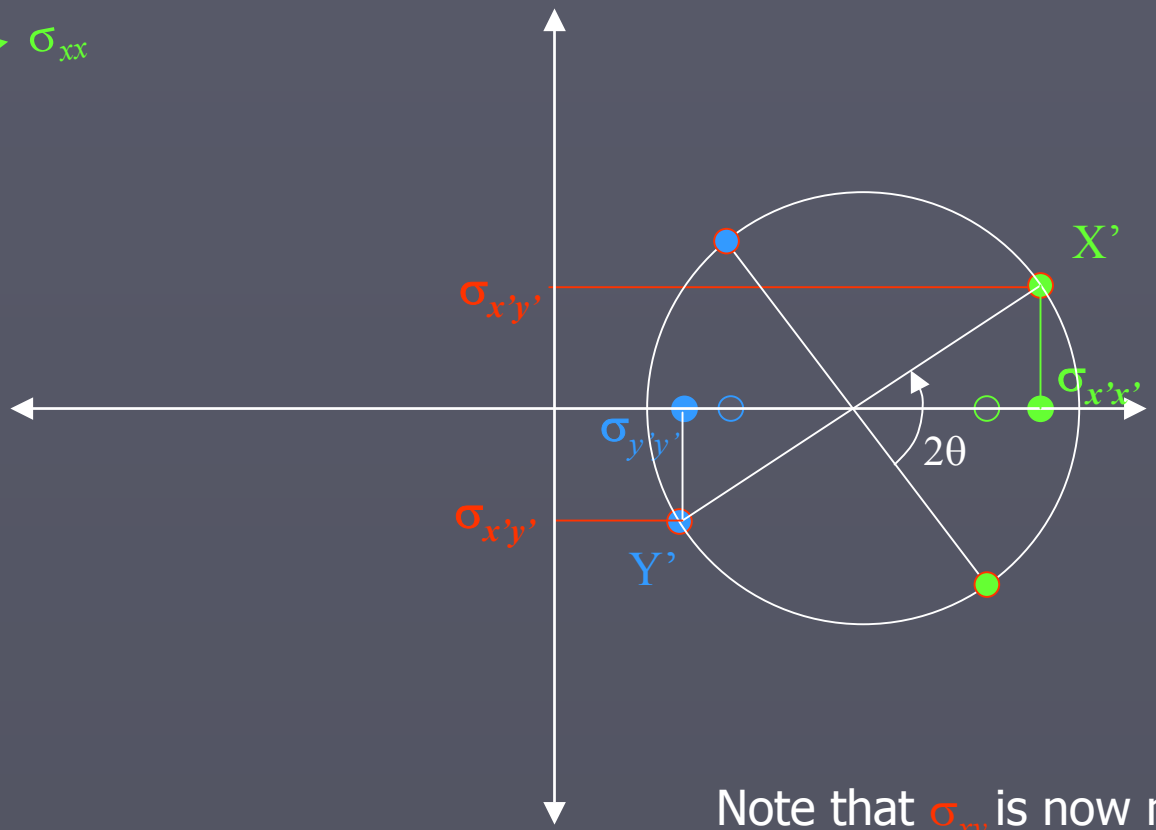


Rotated Axes



Rotated Axes

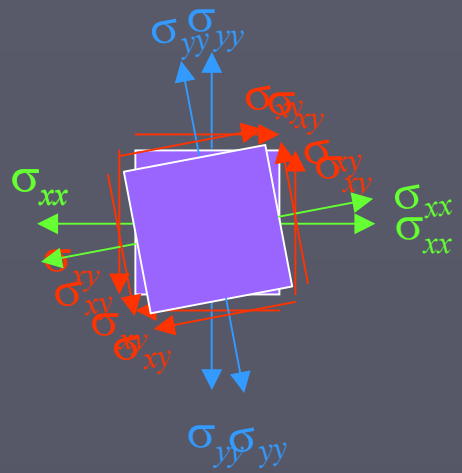


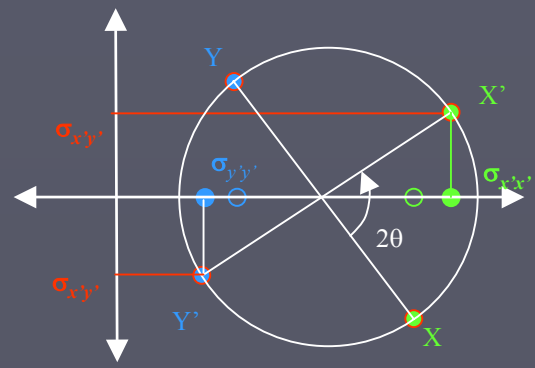


Positive
σ_{xx} ,σ_{yy}

Note that σ_{xy} is now negative because X' is above the x axis

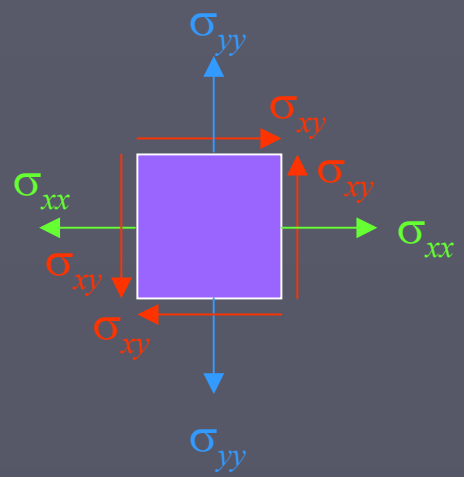
Some points that you should be careful about…

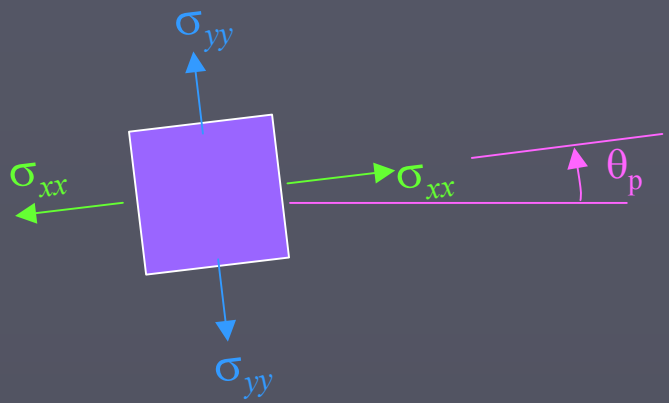


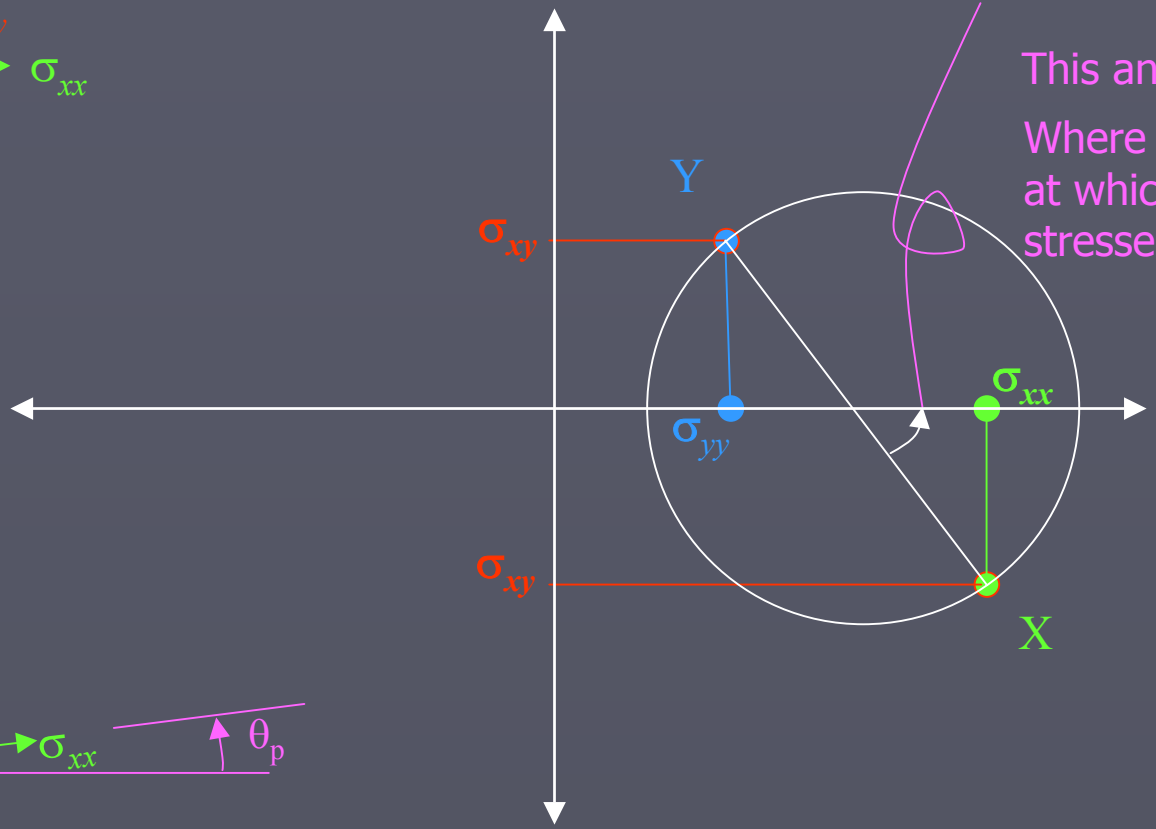


- XY is tilted the Mohr Circle by an angle determined by σ_{xx}, σ_{yy} and σ_{xy}.
  - XY is horizontal if and only if σ_{xy} is 0.
  - XY is vertical if and only if $\sigma_{xx} = \sigma_{yy}$.
- X'Y' is at an angle 2θ to XY.
  (It may look from the picture that it is at an angle θ from the horizontal. That is a coincidence.)

Principal Stresses







What is this angle?

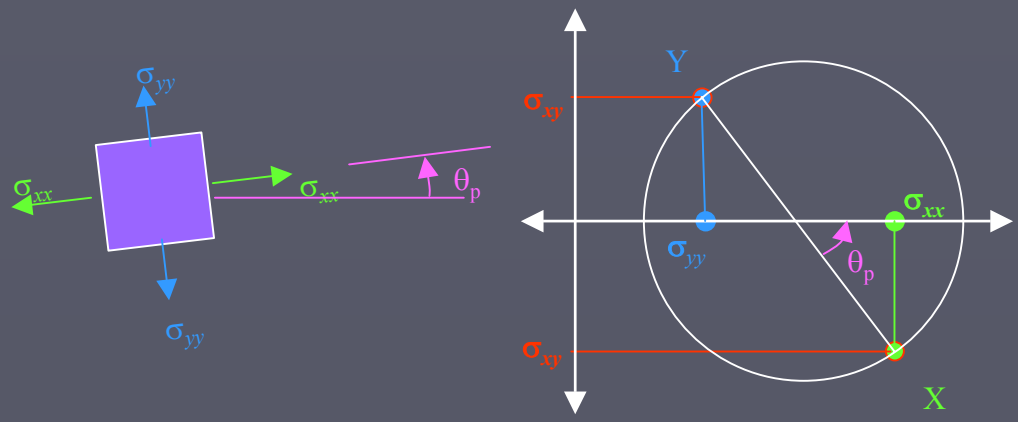
This angle is $2\theta_p$.

Where θ_p is the angle at which principal stresses are achieved.

Positive

σ_{xx} , σ_{yy}

Some comments about principal stresses



- Principal stresses occur when shear stresses vanish
- One of the principal stresses is the maximum stress possible
- The other principal stress is the minimum stress possible

Today

- We have just closed the book on stresses
- Now we will do strains
- Strains are very similar to stresses