Mohr-Plane Construction
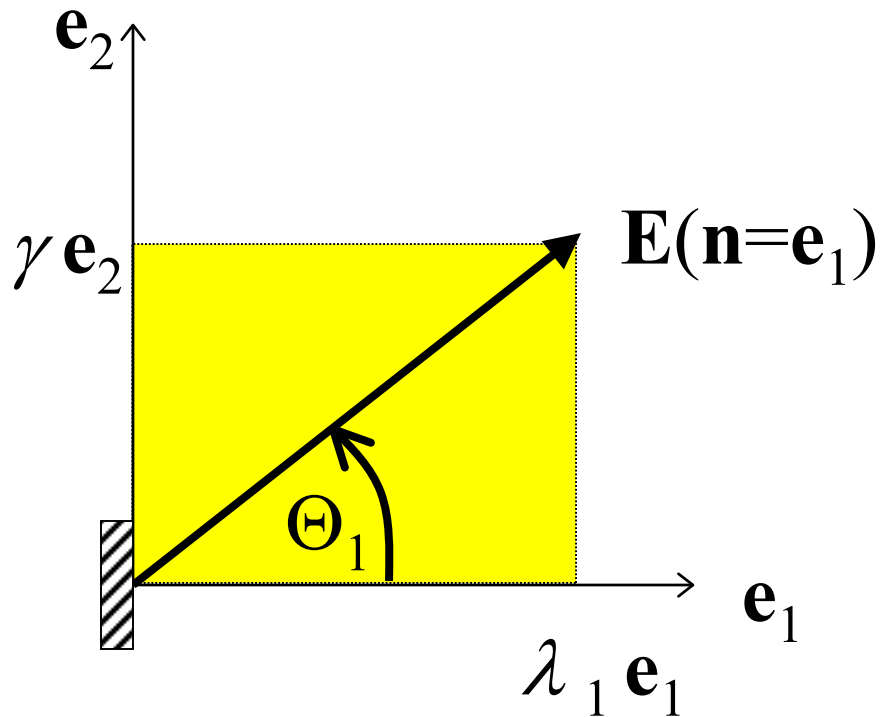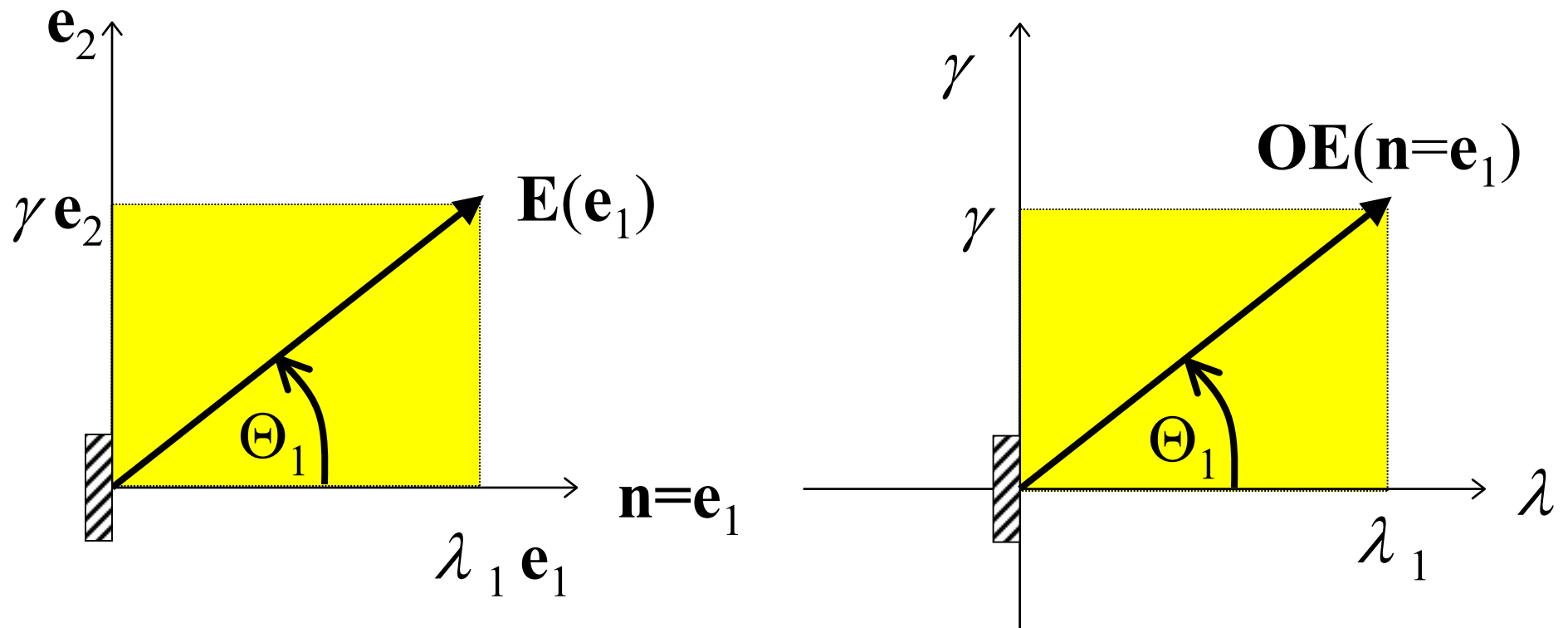

- Starting Point:
  - Strain vector in material plane (=measurement plane)

$$E(e_1) = \lambda_1 e_1 + \gamma \, e_2$$

$\lambda_1 = \varepsilon_{11}$ (rel. length variation)
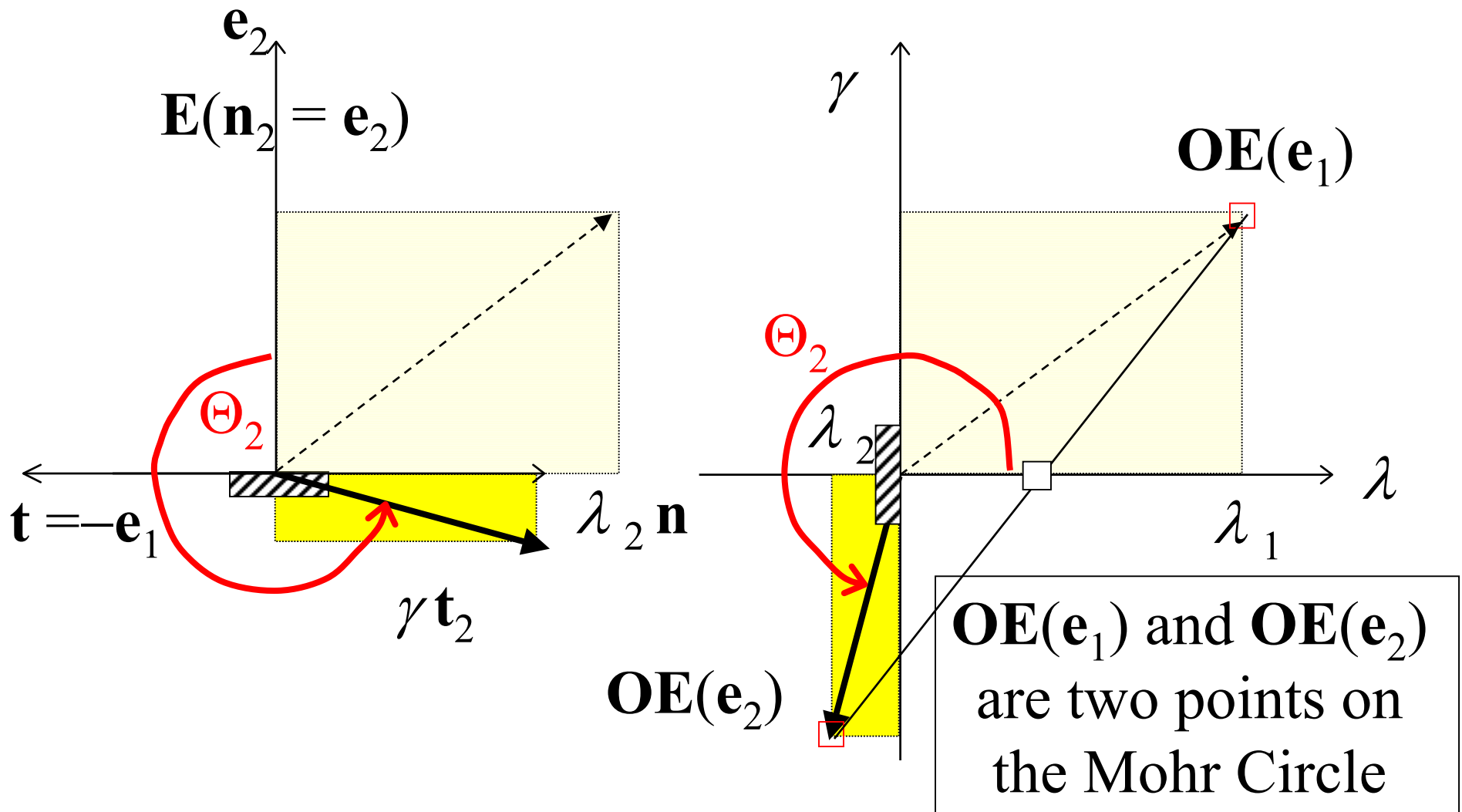
$\gamma = \varepsilon_{12}$ (distortion)

2. Strain Vector in Mohr Plane

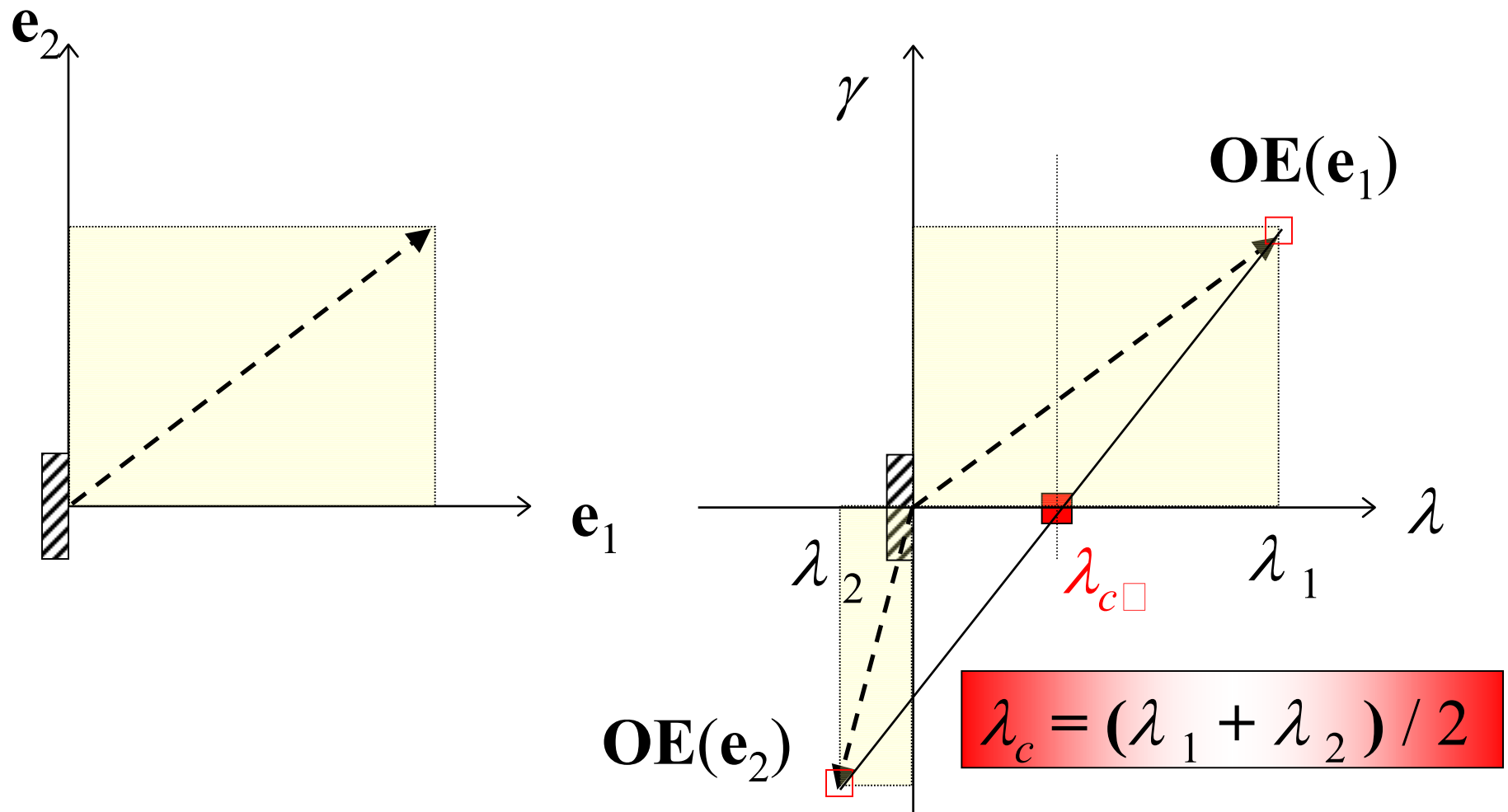Same Angle Θ_1 in both planes

3. 2nd Strain Vector

$\mathbf{e}_2$

$\mathbf{E}(\mathbf{n}_2 = \mathbf{e}_2)$

Θ_2

$\mathbf{t} = -\mathbf{e}_1$

$\lambda_2 \mathbf{n}$

$\gamma \mathbf{t}_2$

γ

$\mathbf{OE}(\mathbf{e}_1)$

Θ_2

λ_2

λ

λ_1

$\mathbf{OE}(\mathbf{e}_2)$

$\mathbf{OE}(\mathbf{e}_1)$ and $\mathbf{OE}(\mathbf{e}_2)$ are two points on the Mohr Circle

4. Center of Mohr Circle

$\mathbf{e}_2$

$\mathbf{e}_1$

γ

$\mathbf{OE(e}_1)$

$\mathbf{OE(e}_2)$

λ_2

λ_c

λ_1

λ

$$\lambda_c = (\lambda_1 + \lambda_2) / 2$$

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5. Mohr Circle
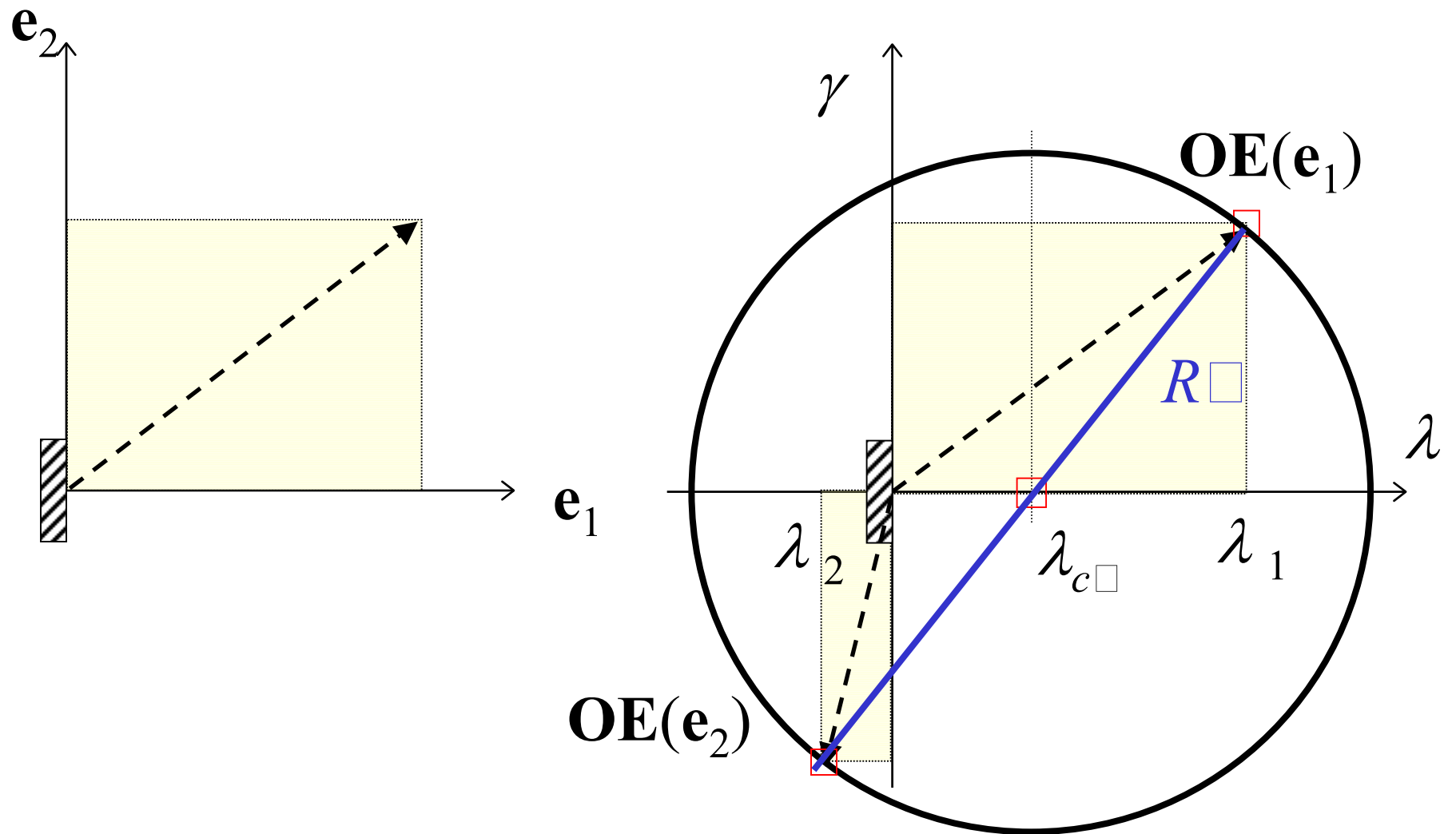
6. Principal Strains

$$\lambda_{I,II} = \lambda_c \pm R$$
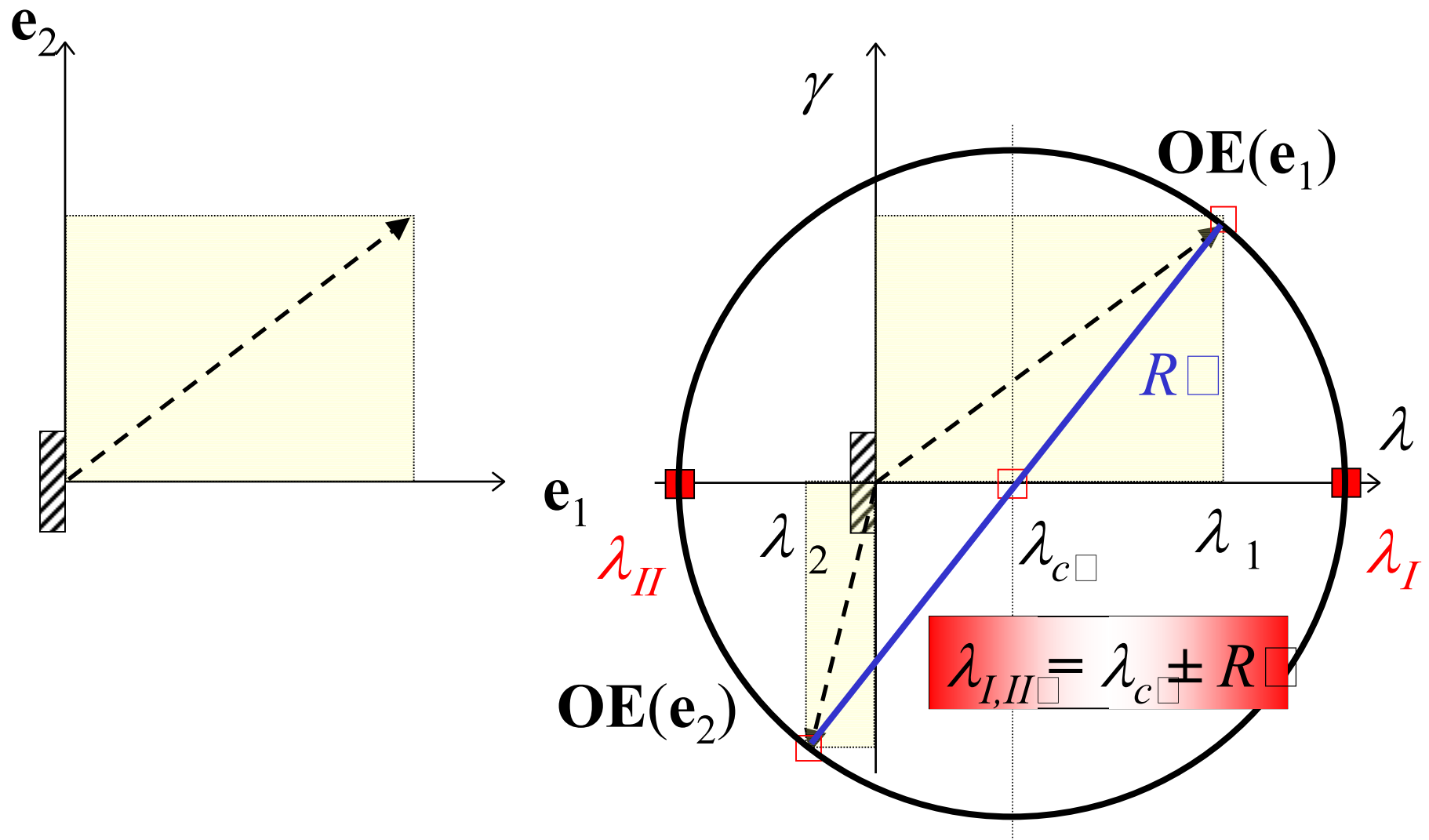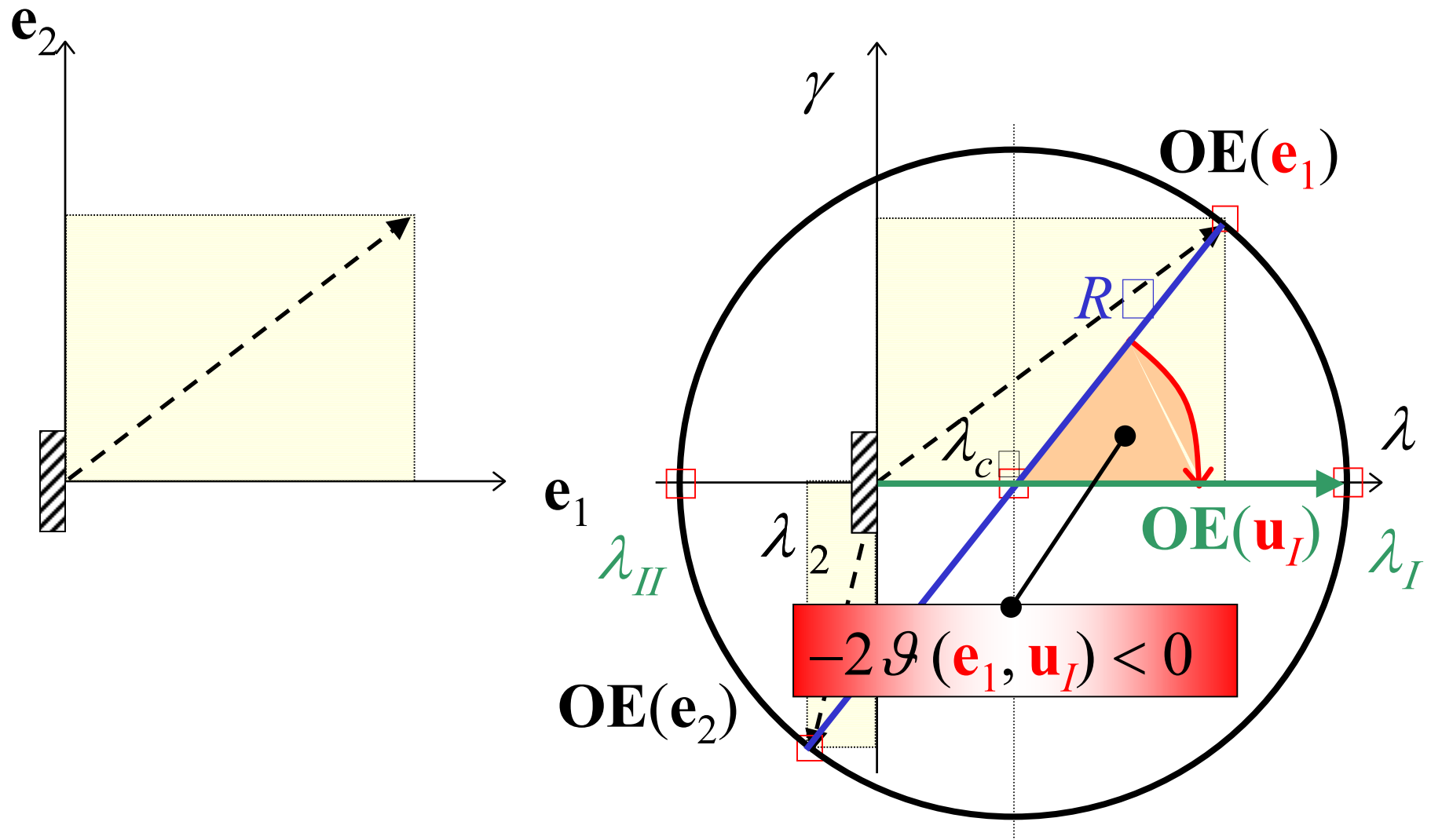
7. Principal Strain Vector in M-Plane
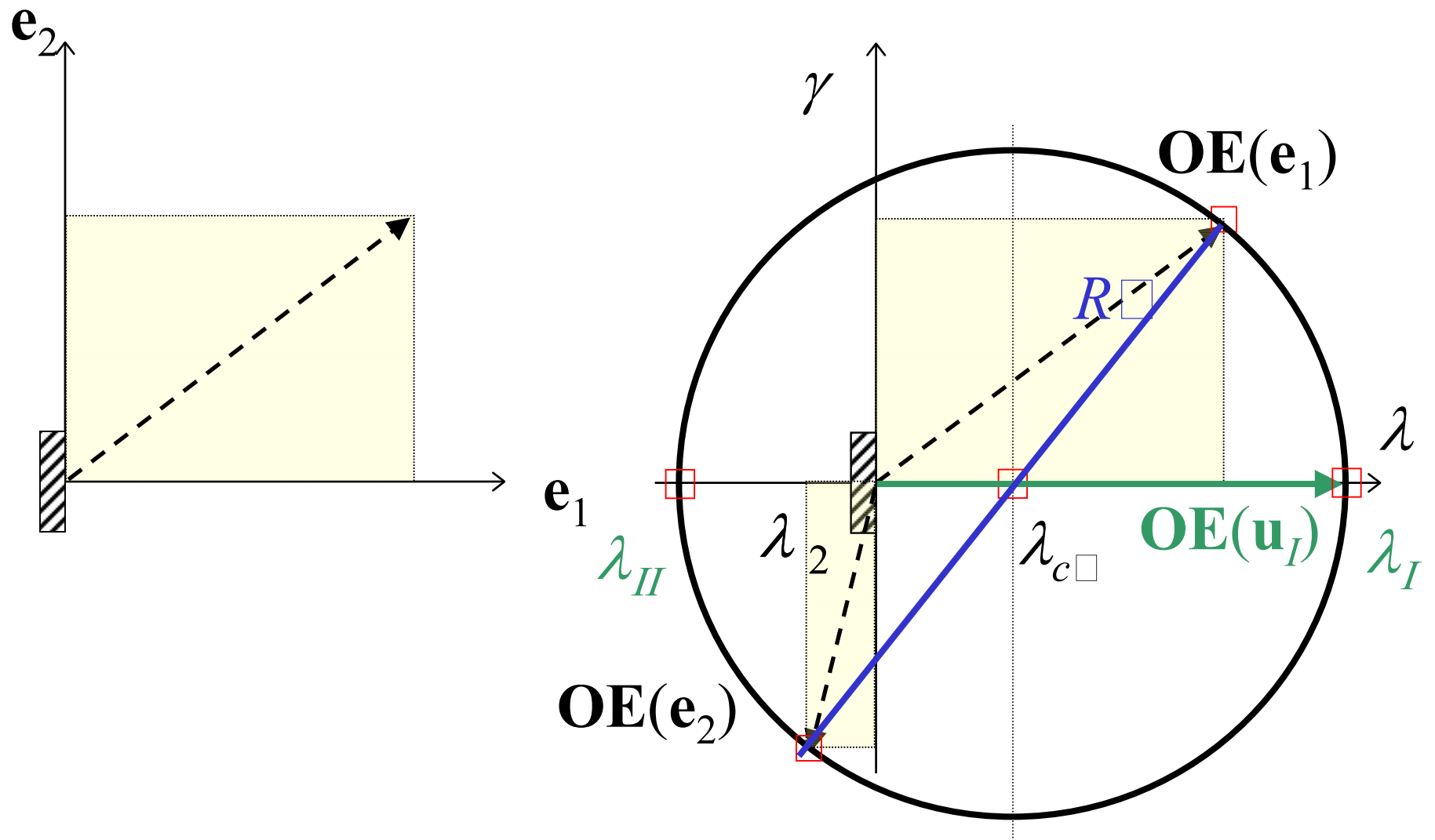
8. Direction of Principal Axis in M-Plane

9. Return to P-Plane

(Change in Sign !)

$\mathbf{e}_2$

$\mathbf{e}_1$

γ

$\mathbf{OE}(\mathbf{e}_1)$

R

λ_c

λ

$\mathbf{OE}(\mathbf{u}_I)$

λ_{II}

λ_2

λ_I

$\vartheta(\mathbf{e}_1, \mathbf{u}_I) > 0$

$-2\,\vartheta(\mathbf{e}_1, \mathbf{u}_I) < 0$
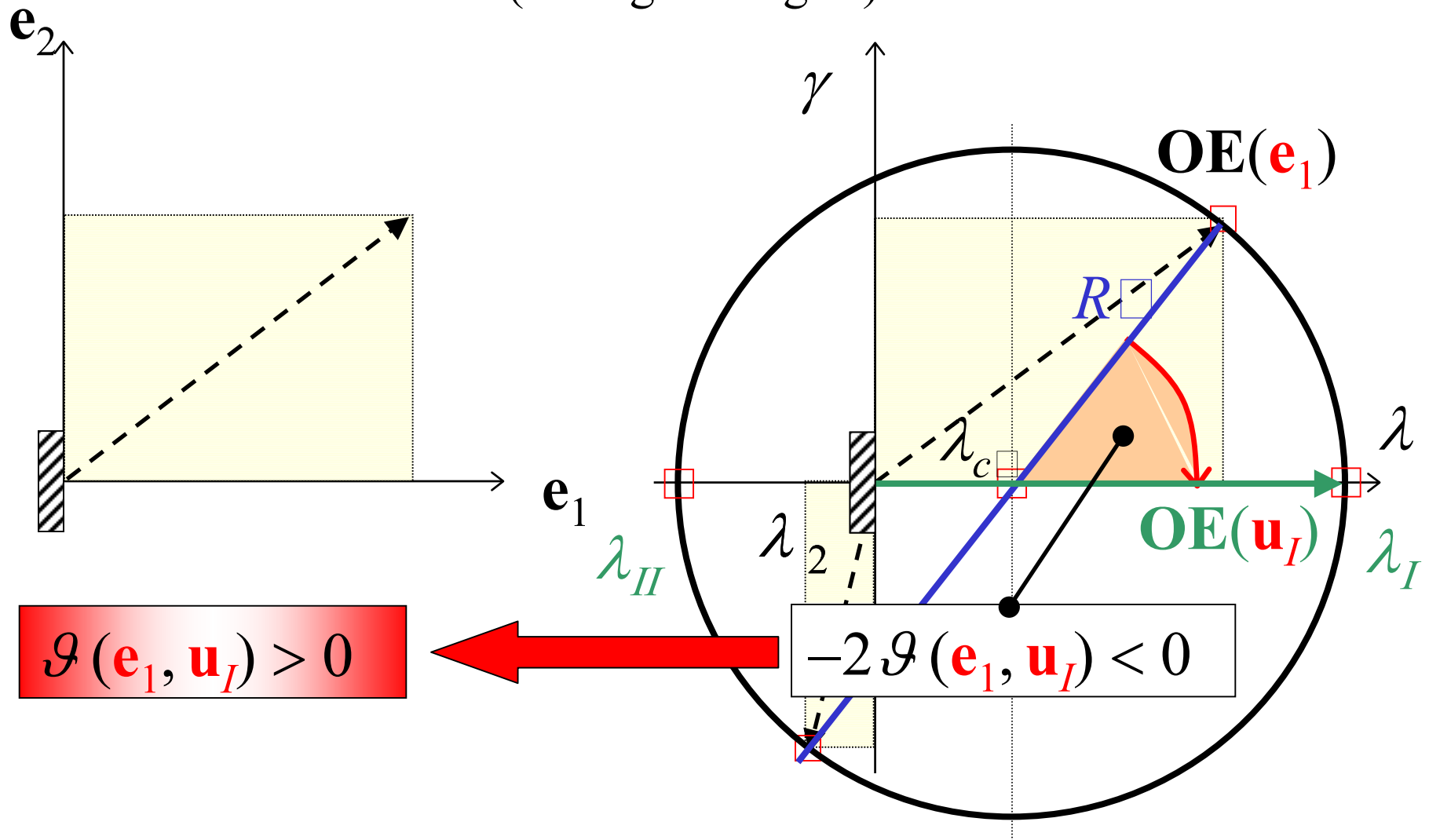
10. Principal Direction in P-Plane

$$\vartheta\left(\mathbf{e}_1, \mathbf{u}_I\right) > 0$$

$$-2\,\vartheta\left(\mathbf{e}_1, \mathbf{u}_I\right) < 0$$
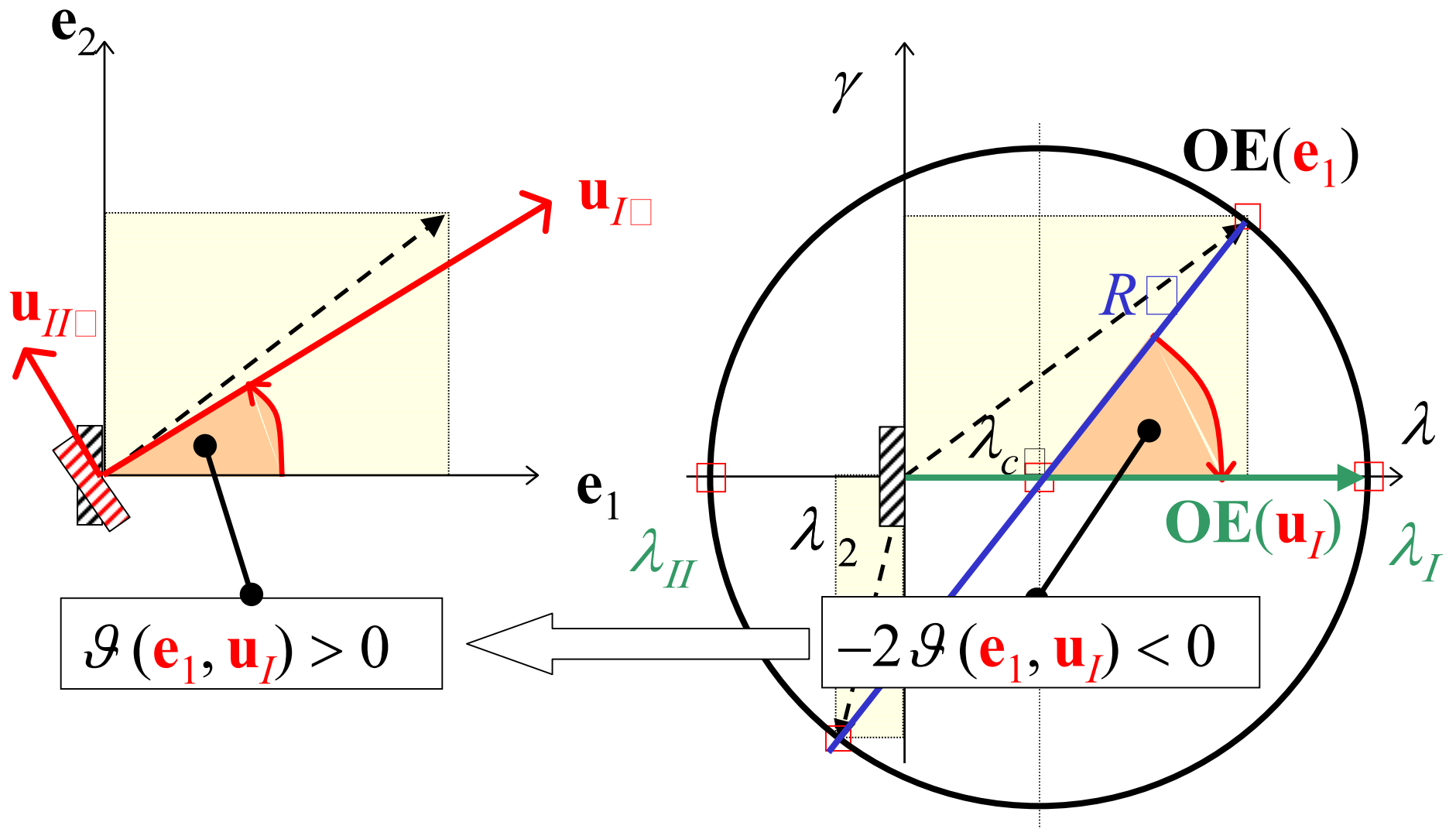
11. Principal Strain Vector in P-Plane

$$\vartheta\left(\mathbf{e}_1, \mathbf{u}_I\right) > 0$$

$$-2\,\vartheta\left(\mathbf{e}_1, \mathbf{u}_I\right) < 0$$