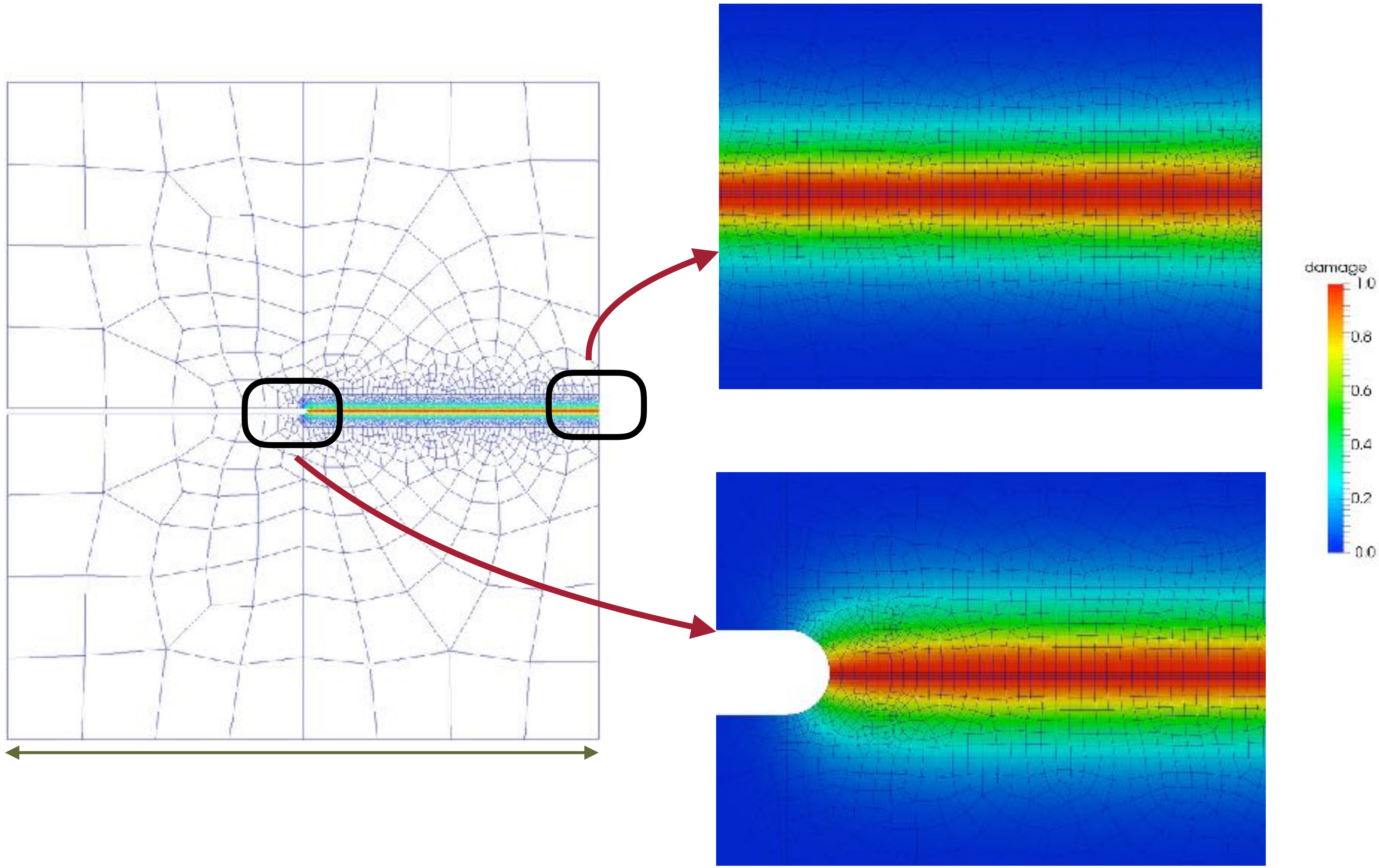
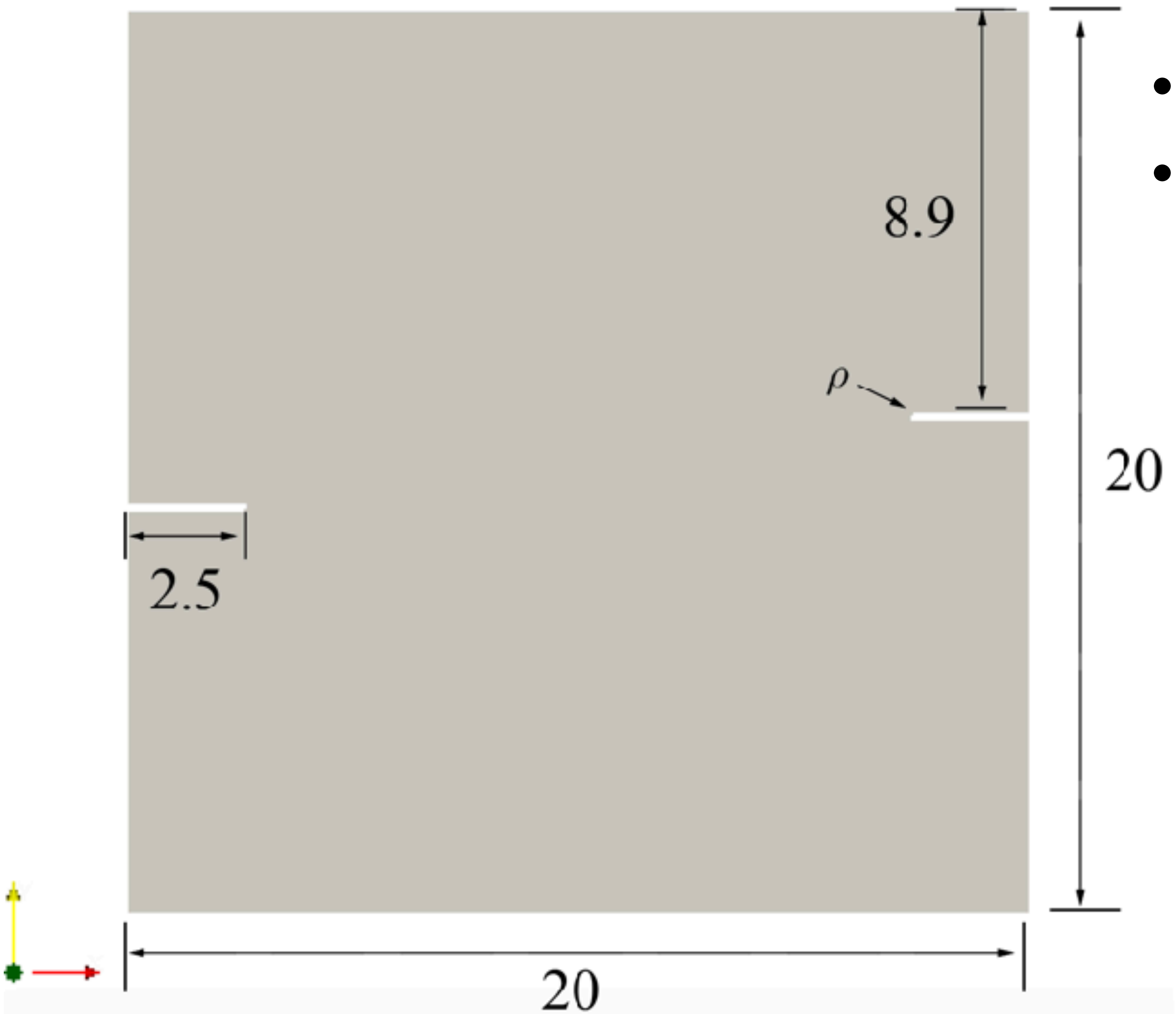
Mesh for single-edge-notch simulations

$h_e \lesssim \ell/10$



Asymmetric double-notch-tension of an elastomeric sheet

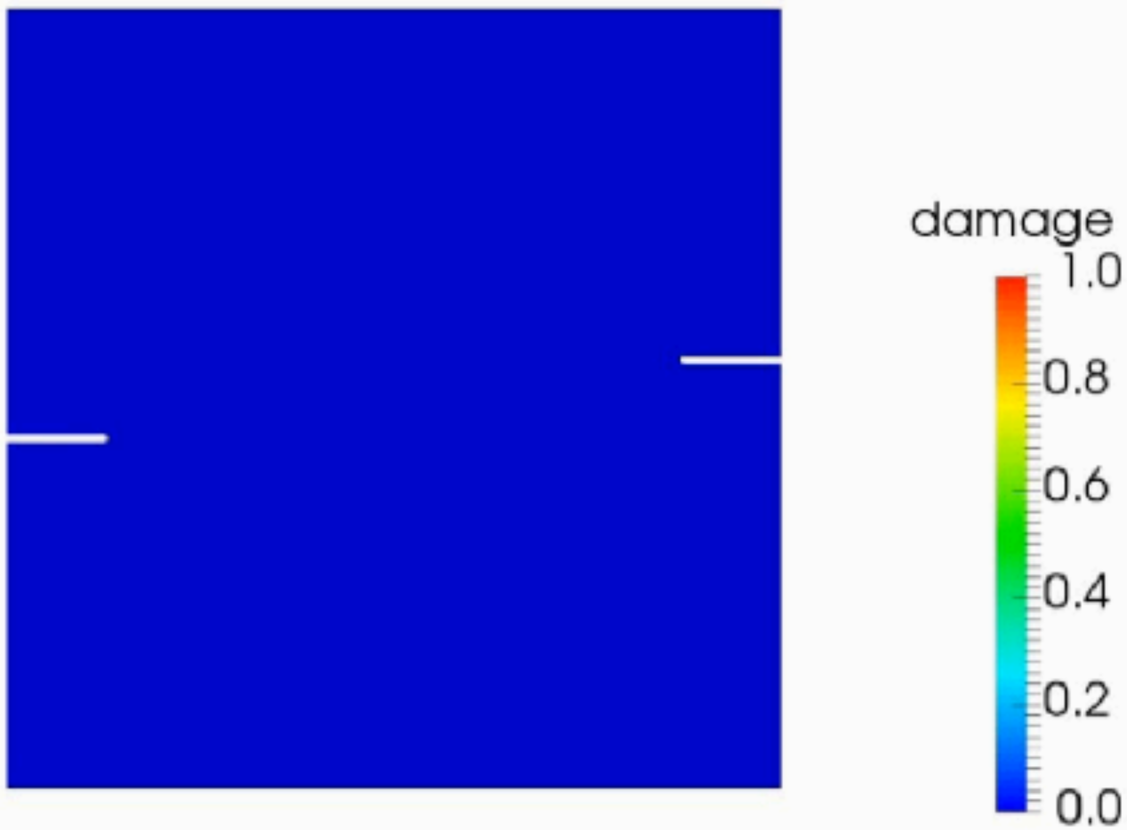


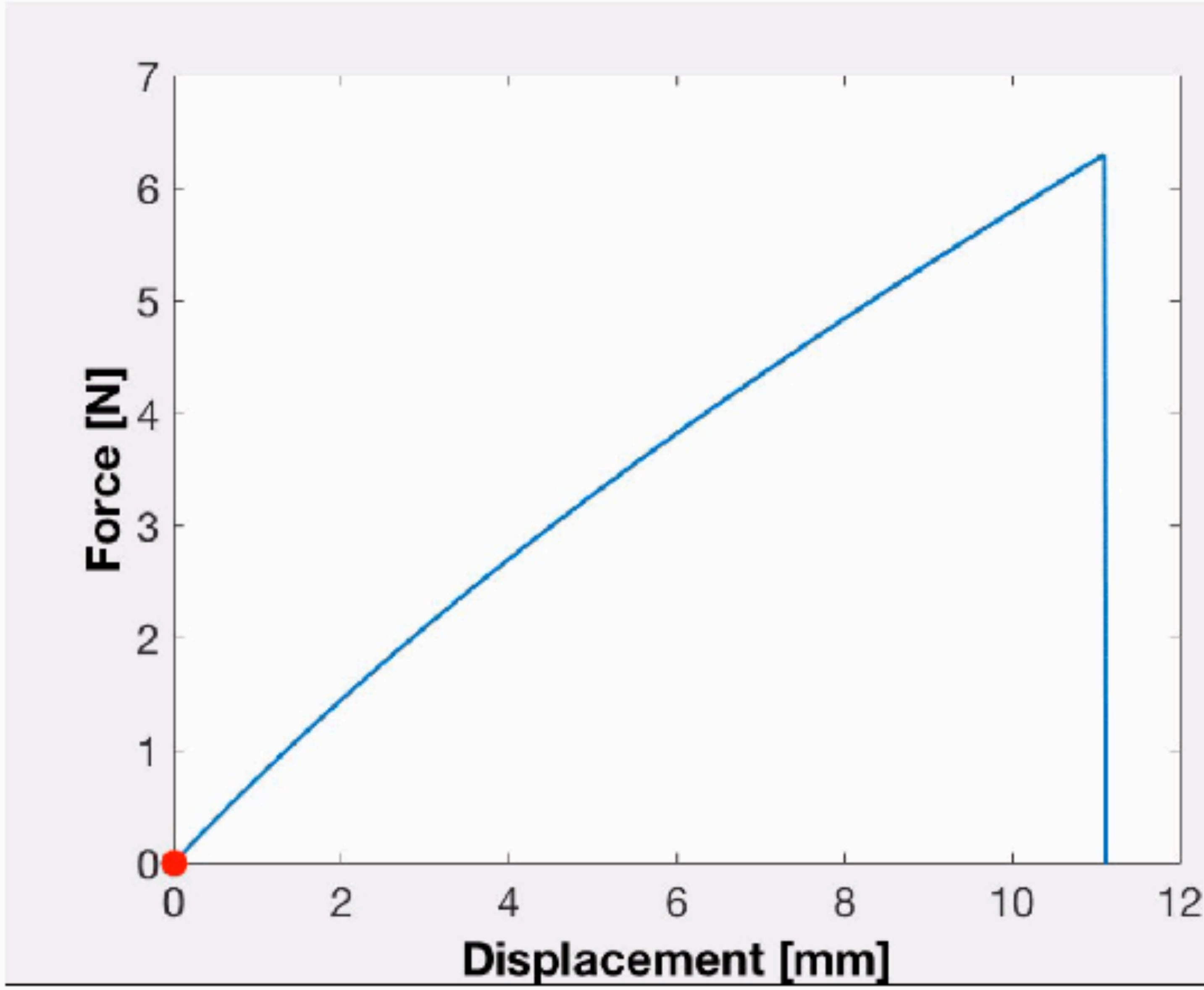
- Thickness: 1mm; $\rho = 0.1\,\mathrm{mm}$
- Stretch rate $1 \times 10^{-3}/s$

Dimensions in mm

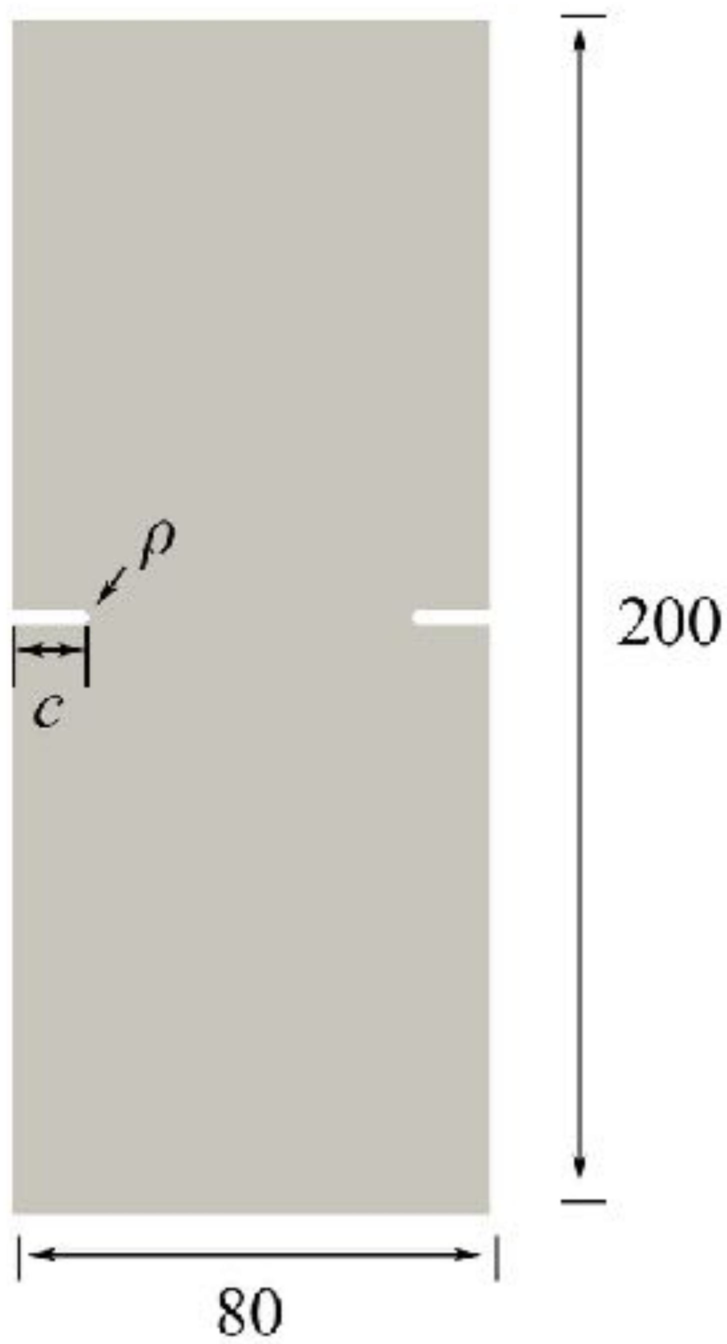
Asymmetric double-notch-tension of an elastomeric sheet

Contours of damage





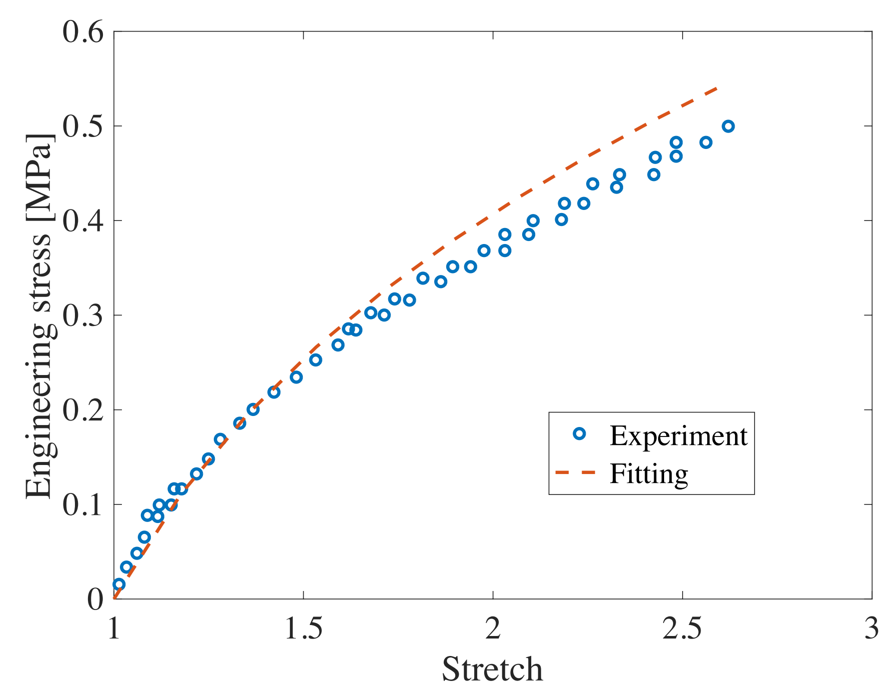
Double-edge-notched specimen in tension; plane stress



Dimensions in mm

- Thickness: 3 mm; $\rho = 1\,\text{mm}$
- Stretch rate $1 \times 10^{-3}/\text{s}$
- Notch length $c = 12, 16, 20, 24, 28\,\text{mm}$

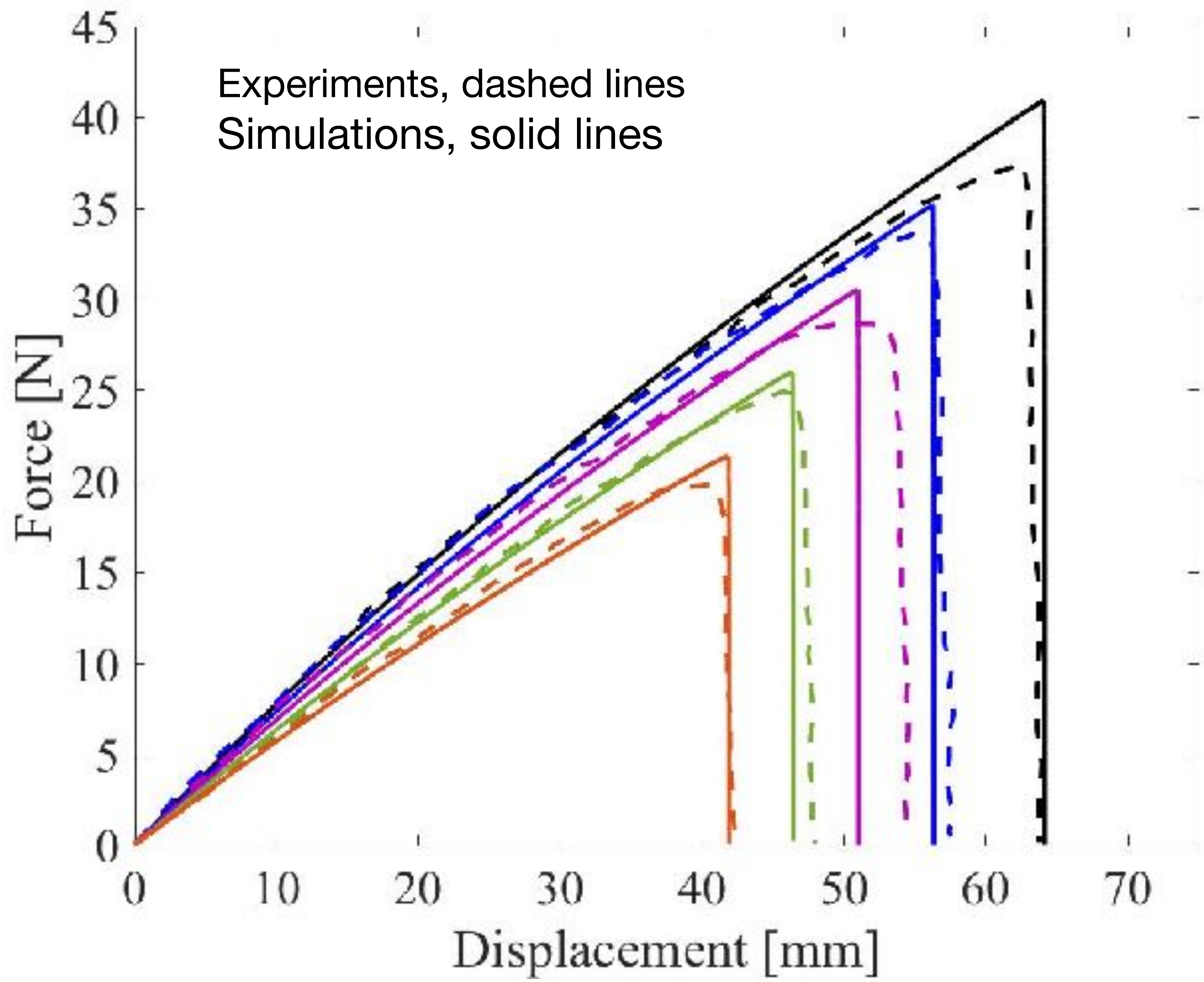
Hocine et.al. *IJF*, 117(1), 1-23, 2002

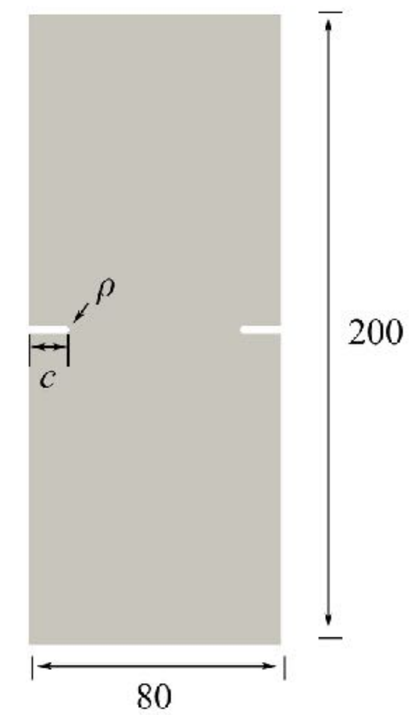


Material parameters

$G = Nk_B\vartheta$	n	$\bar{E}_b = NnE_b$	K	$\varepsilon^f_{\mathrm{R}} = Nn\varepsilon^f_b$	ℓ	ζ
0.268 MPa	1000	15 MPa	2.68 MPa	$0.235\,\text{MJ}/\text{m}^3$	$1000\,\mu\text{m}$	10 kPa·s

Experiments of Hocine et al. 2002 on symmetric double-notched sheet specimens



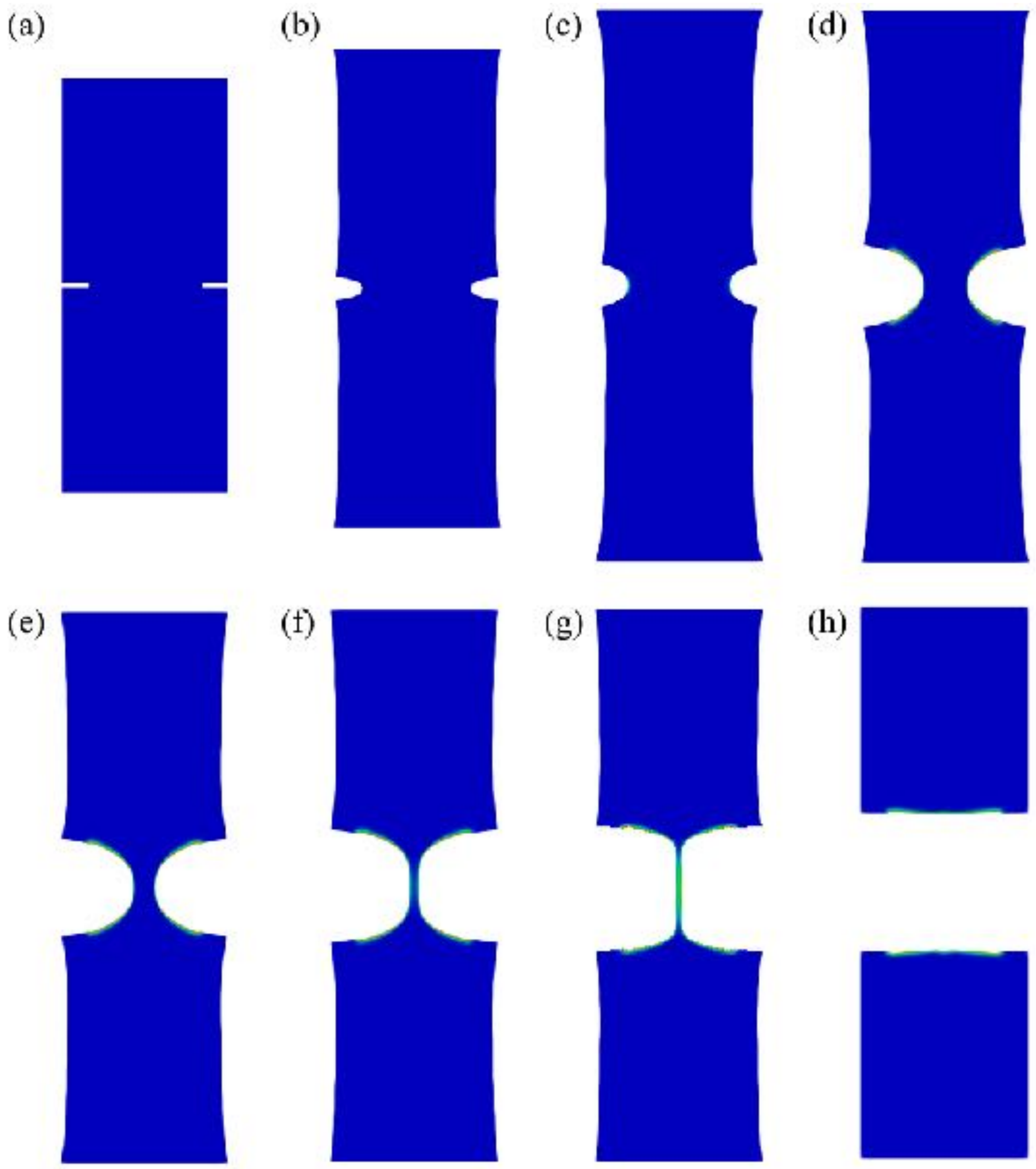


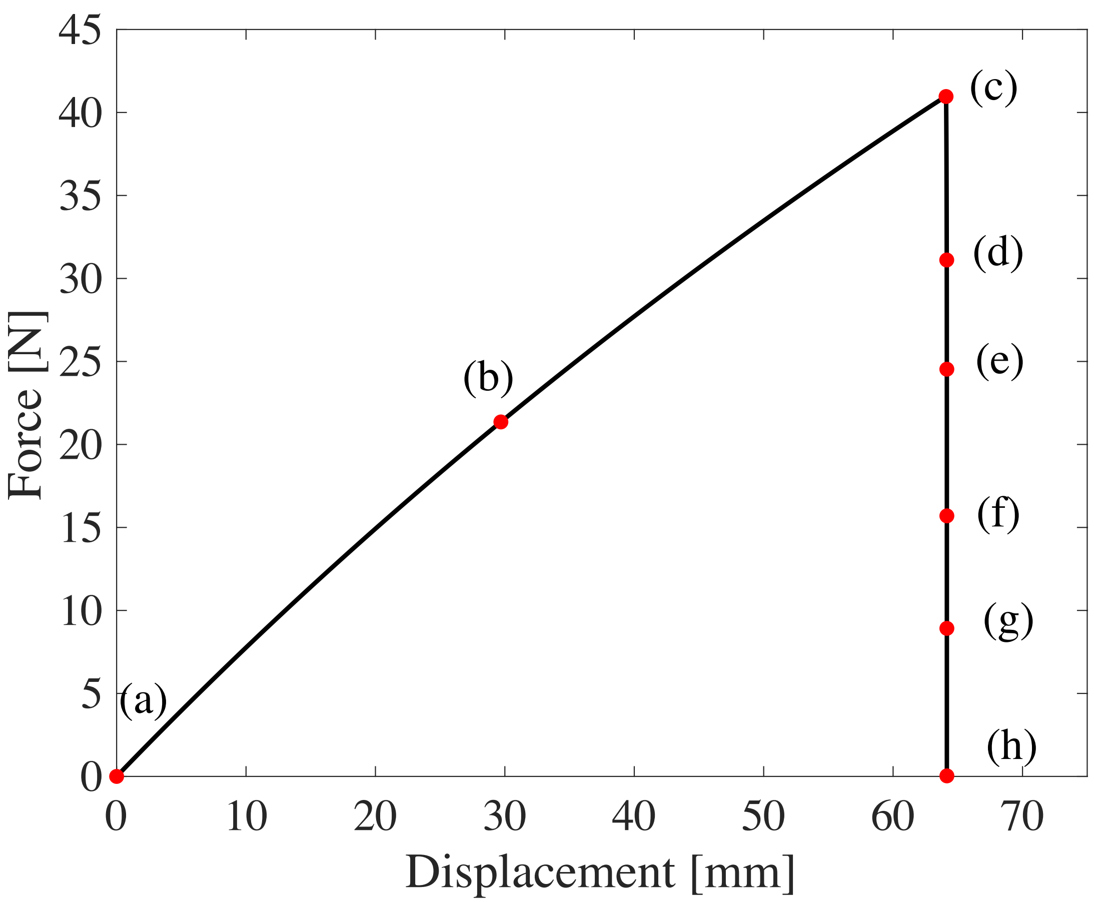
$c = 12, 16, 20, 24, 28\,\mathrm{mm}$

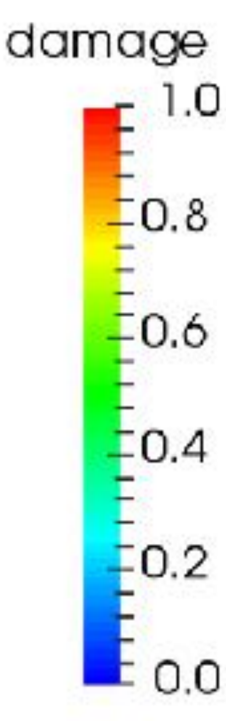
Material parameters

$G_0 = Nk_B\vartheta$	n	$\bar{E}_b = NnE_b$	K	$\varepsilon^f_{\mathrm{R}} = Nn\varepsilon^f_b$	ℓ	ζ
0.268 MPa	1000	15 MPa	2.68 MPa	$0.235\,\mathrm{MJ/m^3}$	$1000\,\mu\mathrm{m}$	$10\,\mathrm{kPa{\cdot}s}$

Double-edge-notched specimen in tension

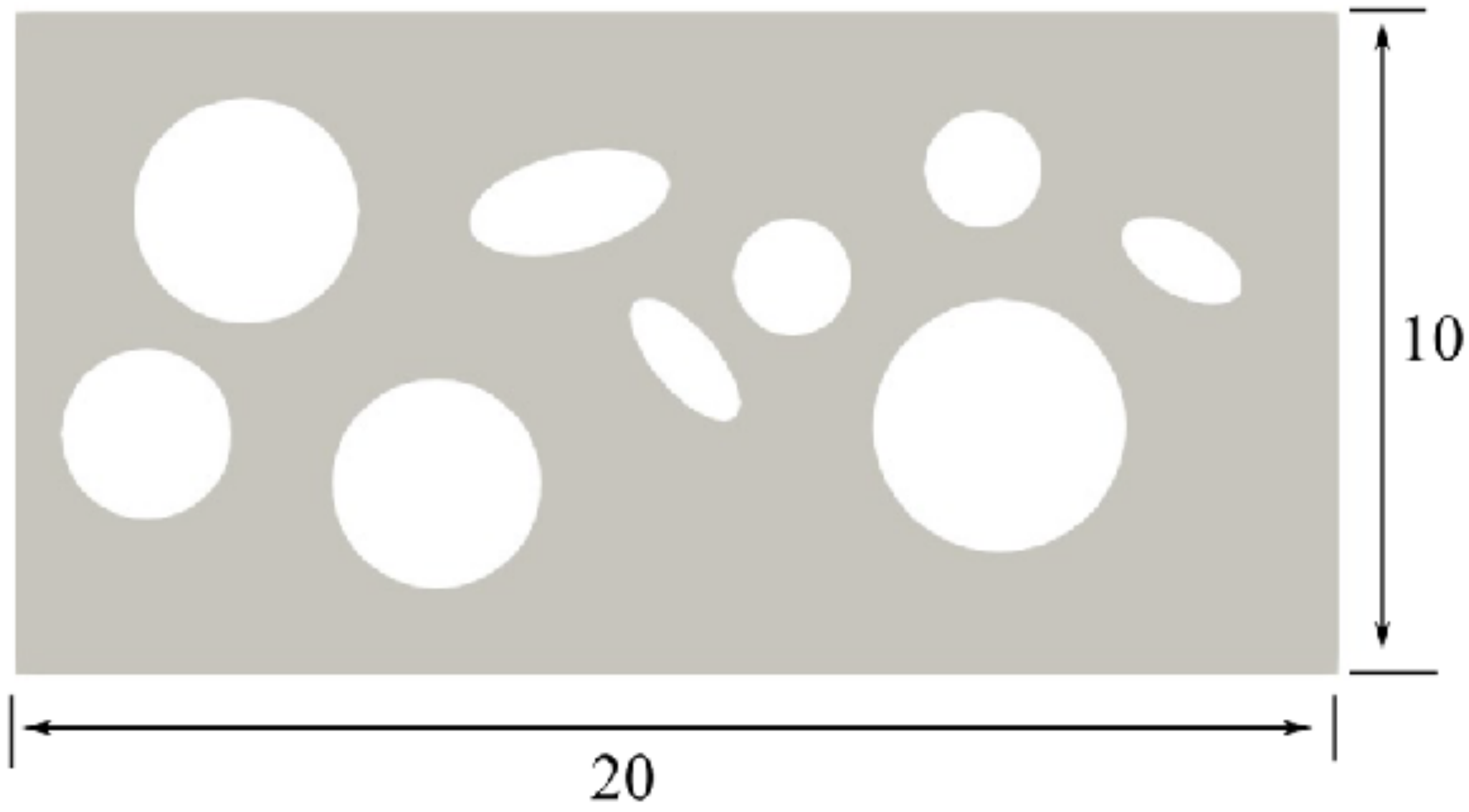






$c = 12$ mm

Fracture of an elastomeric sheet with holes

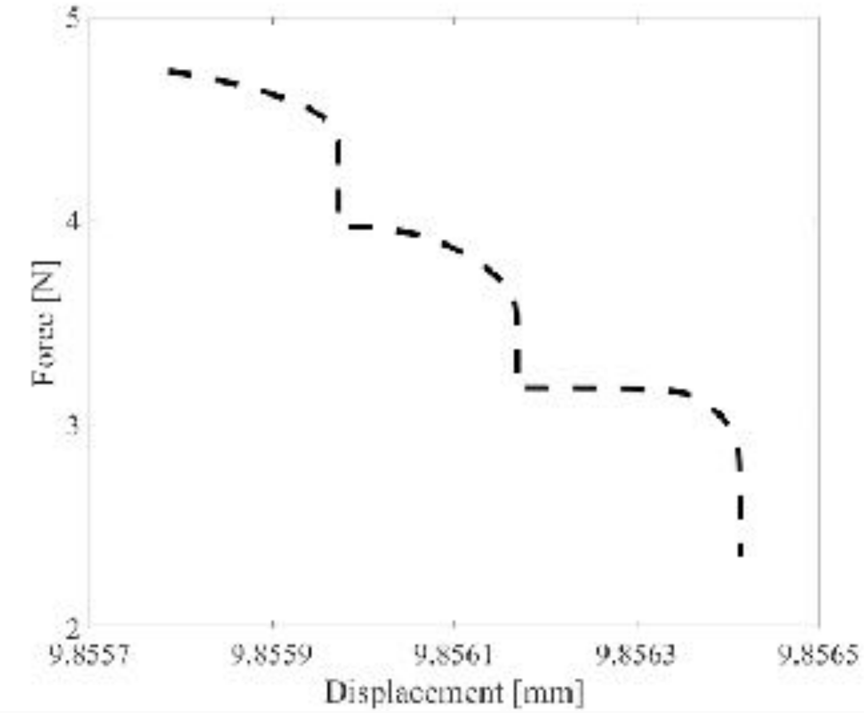


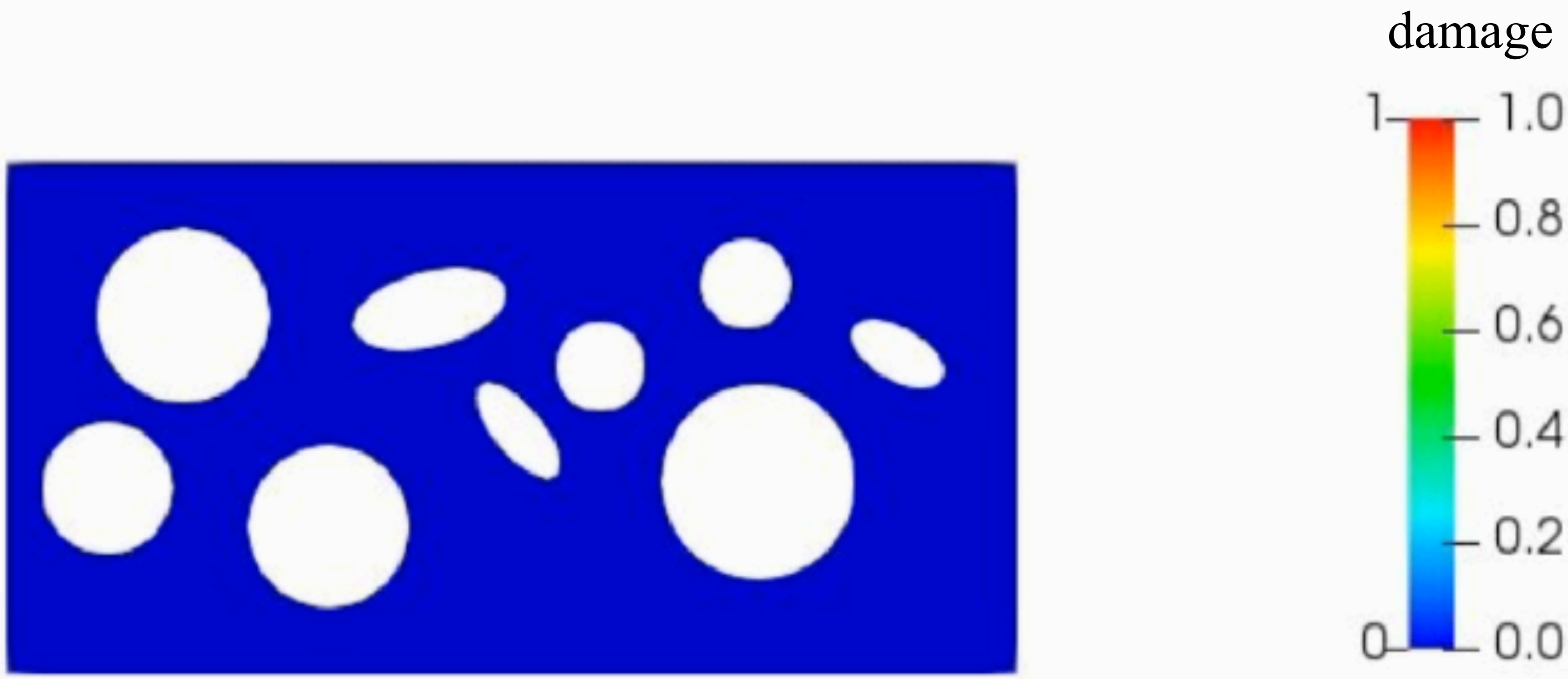
Dimensions in mm

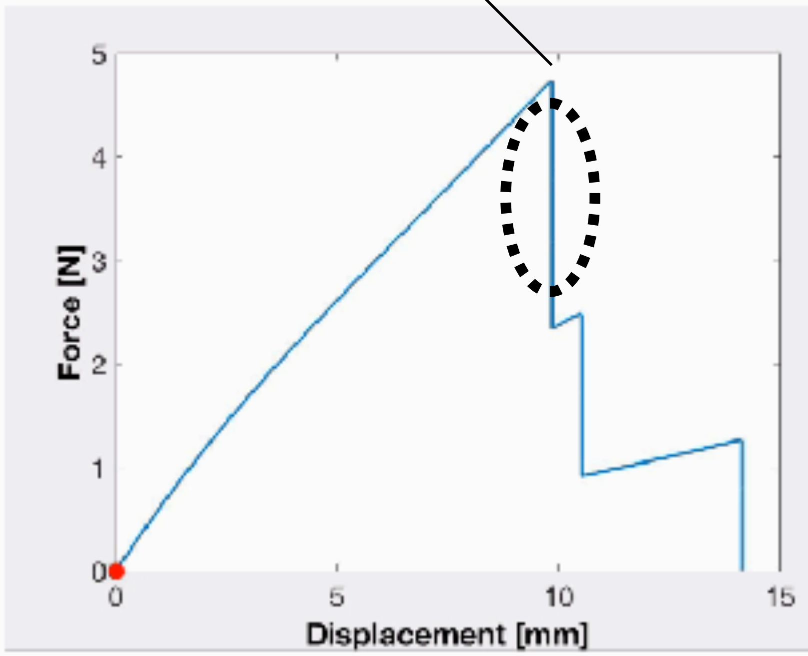
- Thickness: 1mm;
- Stretch rate $1 \times 10^{-3}/s$

Fracture of an elastomeric sheet with holes

Contours of damage







Concluding remarks

- A thermodynamically-consistent theory for deformation and fracture of elastomers and elastomeric gels has been formulated.
- The key idea is
  - to introduce an energetic part to the free-energy of the polymer due to bond-stretching, and
  - to damage this using a gradient-damage or phase-field theory.
- There are many more things to be done:
  - Full 3-D simulations
  - Modeling cavitation
  - Accounting for additional microscopic dissipation mechanisms — e.g., viscoelasticity, Mullins effect, etc.