Membrane Calculations

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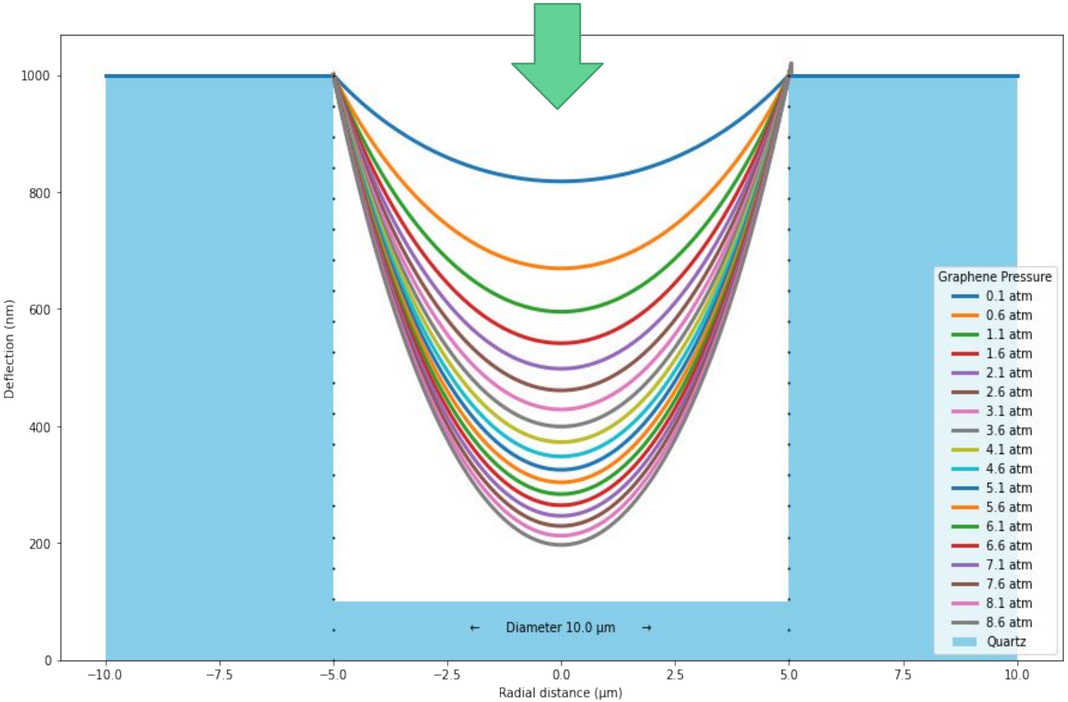
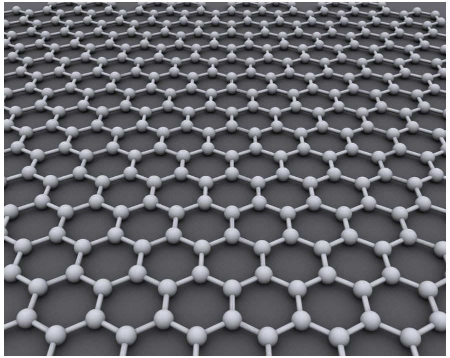
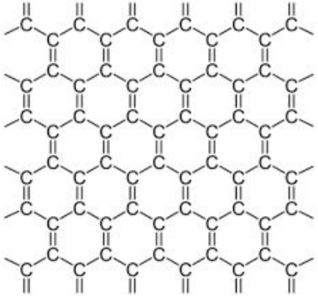




Graphene



- Single layer of C in a hexagonal lattice

Obtaining Vertical Deflection

$$h = \frac{a}{b_0}\left(\frac{Pa}{Et}\right)^{1/3}$$

P: Pressure

a: radius of the hole

Et : 2D Elastic modulus (Young's modulus × thickness)

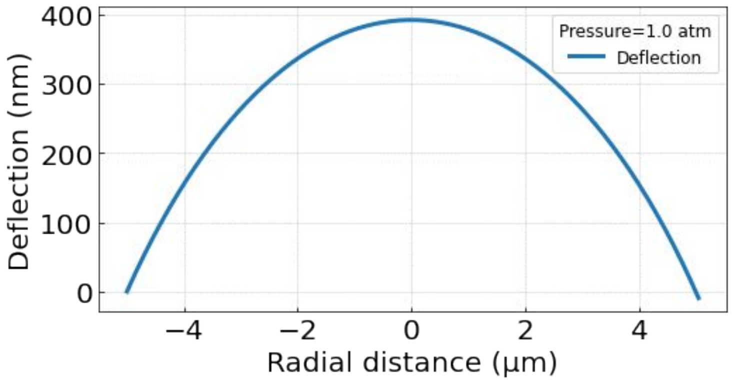
ν : Possion's ratio

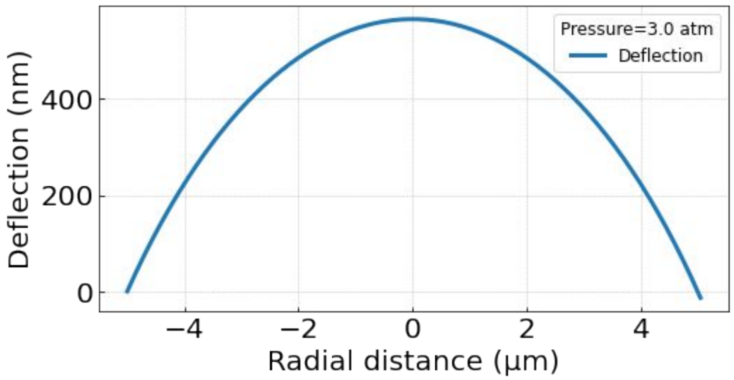
b_0 : ν dependent parameter

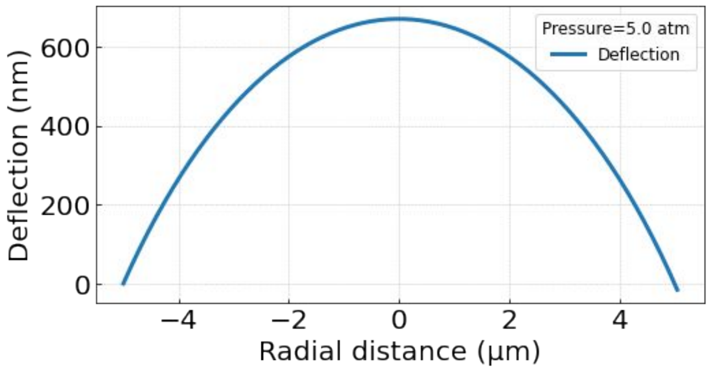
h = vertical deflection of the membrane

$$\begin{aligned} 0 = {} & (1-\nu)b_0 - (3-\nu)b_0^{-2} - (5-\nu)(2/3)b_0^{-5} - (7-\nu)(13/18)b_0^{-8} - (9-\nu)(17/18)b_0^{-11} - (11-\nu)(37/27)b_0^{-14} \\ & - (13-\nu)(1205/567)b_0^{-17} - (15-\nu)(219241/63504)b_0^{-20} - (17-\nu)(6634069/1143072)b_0^{-23} \\ & - (19-\nu)(51523763/5143824)b_0^{-26} - (21-\nu)(998796305/56582064)b_0^{-29} \end{aligned}$$

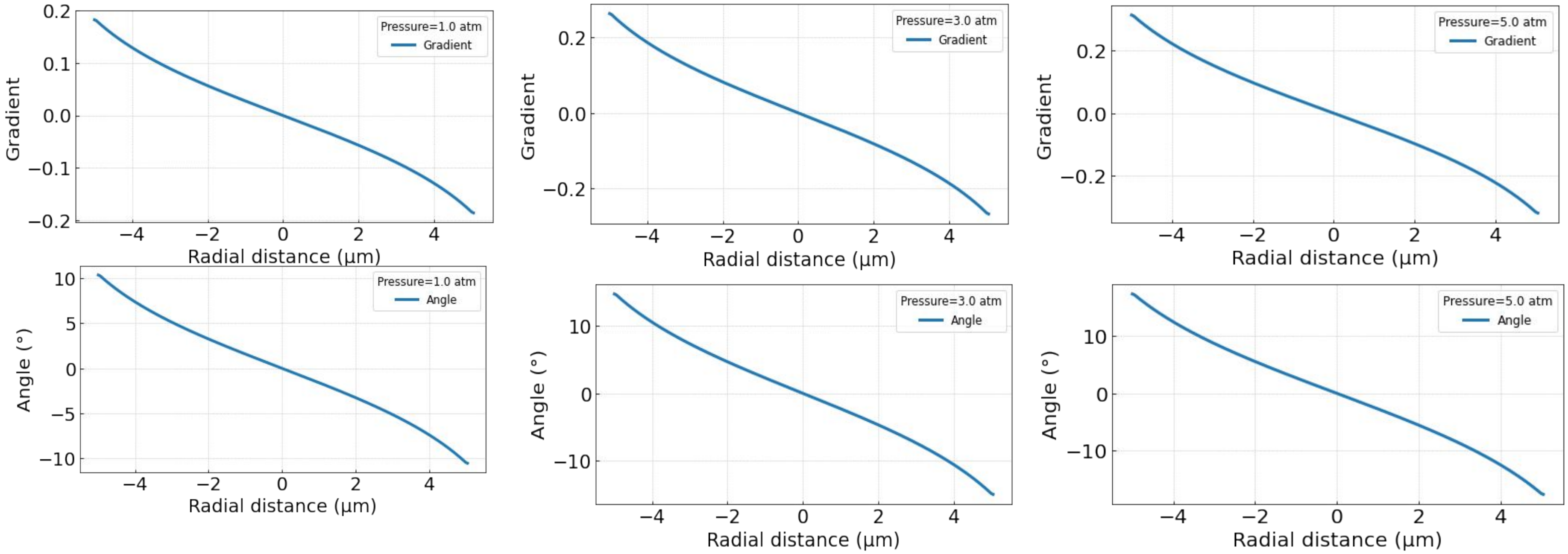
Pressure-Deflection (Diameter = 10µm)



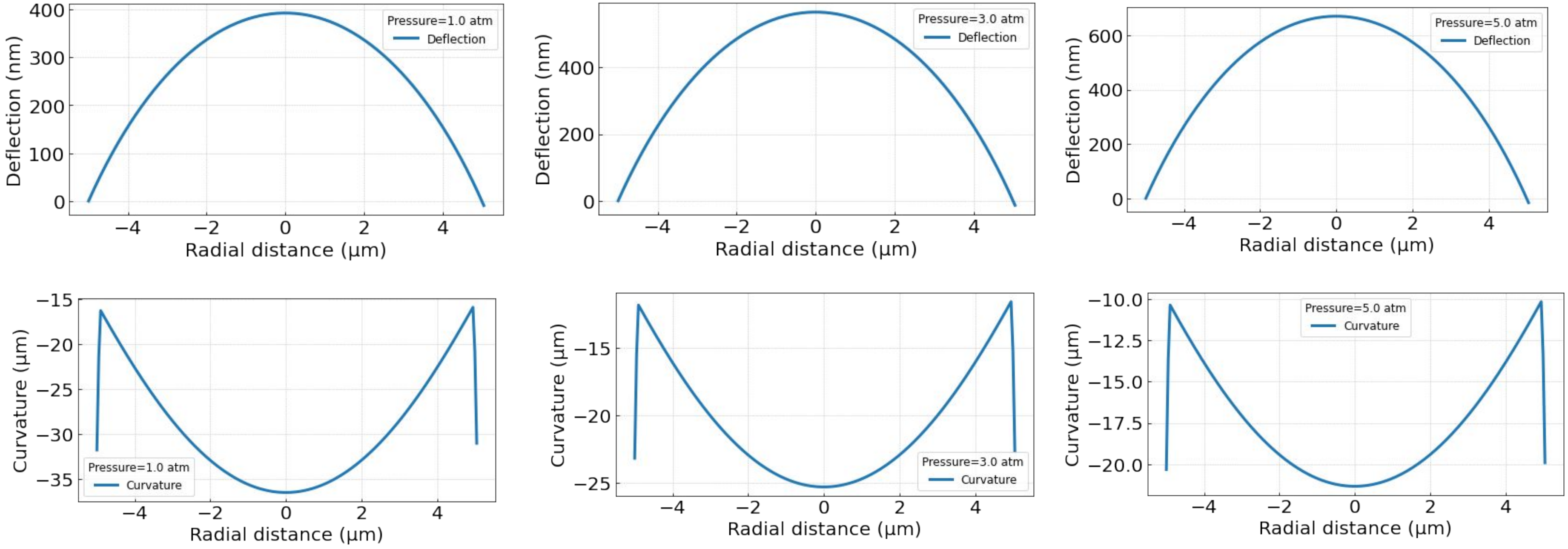




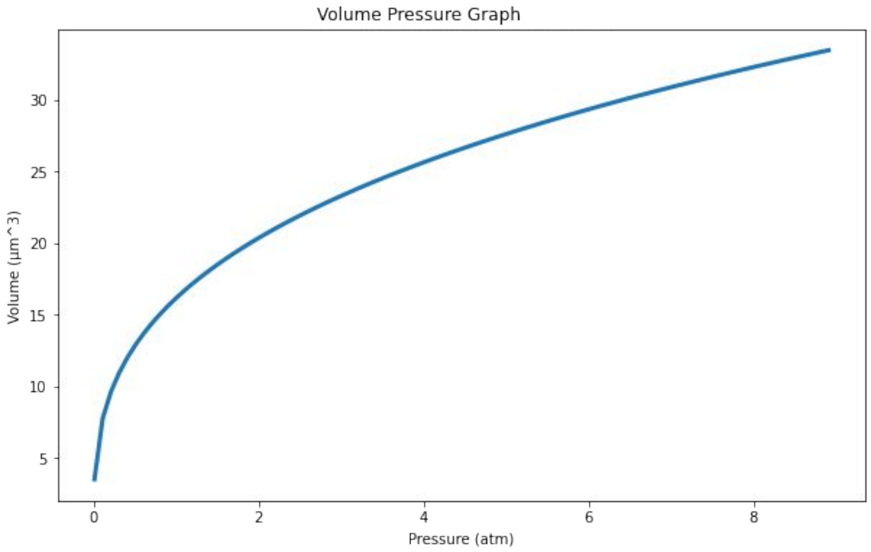
Gradient, Angle-Pressure (Diameter = 10µm)



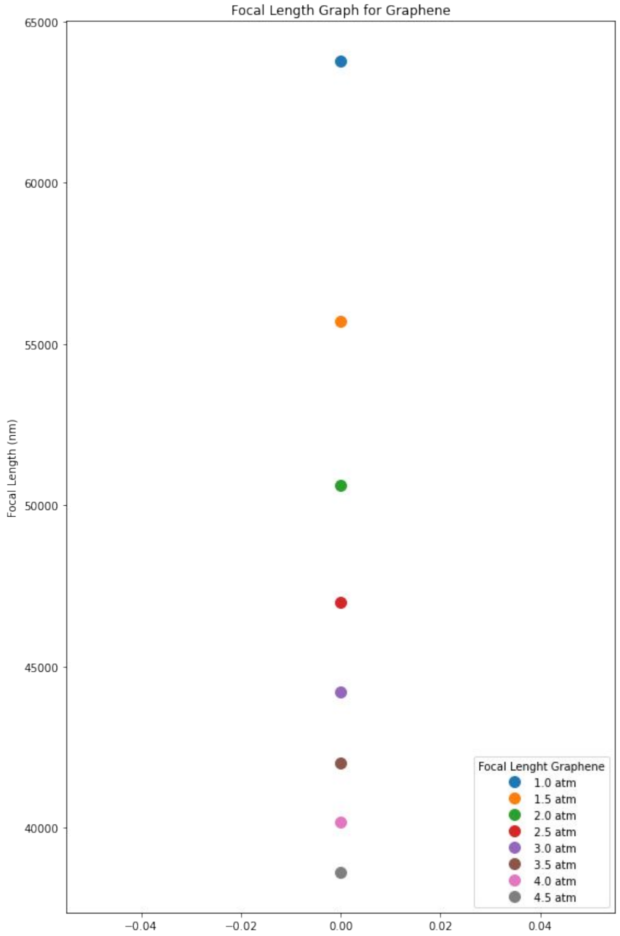
Radius of Curvature-Pressure (Diameter = 10µm)



Volume of the Bulge



10.1103/PhysRevLett.118.266101



Obtaining Focal Length

$$f = \frac{a^2}{4w_{max}}$$

Where a is the radius of the hole and $wmax$ is the maximum vertical deflection of the membrane.