

## ANALISI DIMENSIONALE

$$[ \dots ] \rightarrow [\Delta x] = L \quad [\Delta t] = T \quad [v] = L/T$$

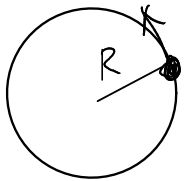
- 1) membri di un'uguaglianza omogenei tra loro
- 2) Somma e differenza tra grandezze omogenee tra loro

$$[v] = [v_c]$$

### verifica di equazioni

$$x = \frac{1}{2} g t^2 + x_i \rightarrow [x] = \left[ \frac{1}{2} g t^2 \right] + [x_i] = \frac{L}{T^2} T^2 + L = L + L$$

### determinazione di leggi di scala



$v$  velocità  
 $R$  raggio

$$a_c = ?$$

$$[a_c] = \frac{L}{T^2} = \left( \frac{L}{T} \right)^2 \frac{1}{L} = [v^2] \cdot \frac{1}{[R]} = \left[ \frac{v^2}{R} \right]$$

$$[R] = L$$

$$[v] = \frac{L}{T}$$

$$a_c \sim \frac{v^2}{R}$$

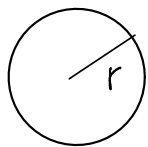
$$a_c = \frac{v^2}{R} !$$

↑  
relazione esatta

## PROBLEMI ALLA FERMI

sfera di raggio  $r \rightarrow V = \frac{4}{3}\pi r^3 \quad S = 4\pi r^2$

1) massa della terra



$$M = \rho V = \frac{4}{3}\pi \rho r^3 \approx 4 \times 10^4 \frac{\text{kg}}{\text{m}^3} \times (6 \times 10^6 \text{ m})^3 = 4 \times 6^3 \times 10^4 \times 10^{18} \frac{\text{kg}}{\text{m}^3} \cdot \text{m}^3$$

$r \approx 6 \times 10^3 \text{ km}$

$$\approx \underbrace{4 \times 2 \times 10^2}_{8} \times 10^{22} \text{ kg} \approx 10^{25} \text{ kg}$$

2) numero di capelli



superficie  $S = 2\pi r^2 = 2\pi \left(\frac{D}{2}\right)^2 = \frac{2\pi D^2}{4} = \frac{\pi D^2}{2}$

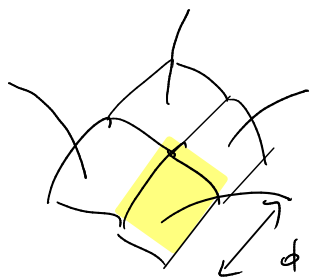
$D \approx 10^{-1} \text{ m} = 10 \text{ cm}$

distanza tra capelli  $d \approx 10^{-3} \text{ m} = 1 \text{ mm}$

densità superficiale di capelli  $\sigma \approx 1 \text{ mm}^{-2} = 1 \frac{1}{\text{mm}^2} = 10^6 \text{ m}^{-2}$

numero di capelli  $N$

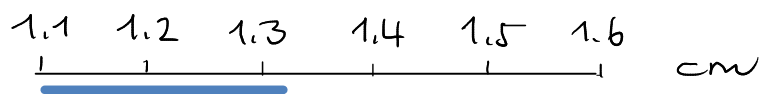
$$N = S \cdot \sigma = \frac{\pi D^2}{2} \cdot \sigma \approx (10^{-1})^2 \text{ m}^2 \times 10^{-6} \text{ m}^{-2} = 10^{-2} \times 10^6 \approx 10^4$$



# INCERTEZZE SPERIMENTALI.

Il valore vero di una grandezza fisica non esiste

1) risoluzione dello strumento / sensibilità



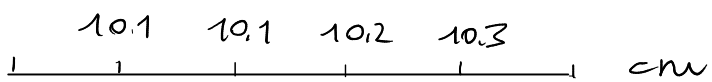
$$1.3 \text{ cm} < x < 1.4 \text{ cm}$$

$\Delta x \equiv$  metà della graduazione  
↓

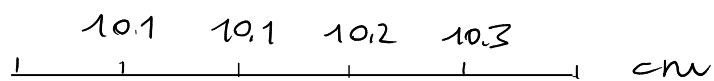
$$x = (1.35 \pm 0.05) \text{ cm}$$

$$[ x = (1.3 \pm 0.1) \text{ cm} ]$$

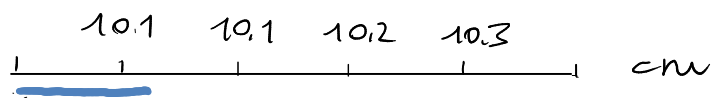
2) incertezze statistiche



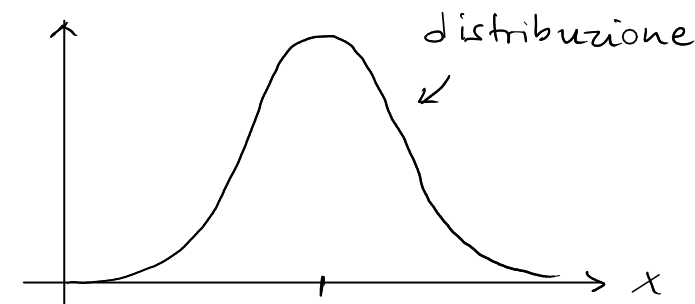
$$x = (10.15 \pm 0.05) \text{ cm}$$



$$x = (10.25 \pm 0.05) \text{ cm}$$



$$x = (10.15 \pm 0.05) \text{ cm}$$



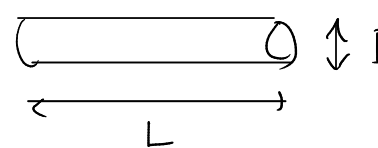
3) errori sistematici

Incertezza assoluta:  $\Delta x > 0$

Incertezza relativa o percentuale:  $\frac{\Delta x}{|x|} \rightarrow \frac{0.05}{1.35} \approx 4\%$

## CIFRE SIGNIFICATIVE

Esempio: volume di gessetto cilindrico  $V = S \cdot L = \frac{\pi D^2}{4} \cdot L$


$$D = (1,35 \pm 0,05) \text{ cm} \quad L = (5,15 \pm 0,05) \text{ cm}$$

$$\begin{aligned} A &= 1,43188 \text{ cm}^2 \\ V &= A \cdot L = 7,37169 \text{ cm}^3 \end{aligned} \left. \right\} \rightarrow \text{quante cifre devo riportare?}$$

$$D = (1,35 \pm 0,05) \text{ cm} = (0,0135 \pm 0,0005) \text{ m} = (1,35000 \pm 0,05) \text{ cm}$$

↑                      ↑                      ↑

significative        non significative        non significative

$$D = 1,35000 \text{ cm} \quad 300000 \text{ km} = 3,0000 \times 10^5 \text{ km}$$

1)  $x \rightarrow$  mi fermo all'ordine di grandezza dell'incertezza

2)  $\Delta x \rightarrow$  1 cifra significativa  $(1,35 \pm 0,05) \text{ cm}$  però  $(1,350 \pm 0,012) \text{ cm}$