Measurements & Uncertainties

errors

random → systematic

random
- readability
  of instrument

systematic
- instrument wrongly
  calibrated
- zero error (shows 2, should be 0)

when
error is
minimal → precise → accurate

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quantities

vectors
"numbers with direction"

scalars
"just number"

vectors		scalars
displacement	vs	distance
velocity	vs	speed
force		mass
E-field strength		area
...		...

resolving:

$\vec{A_V}$ $\vec{A}$

$A \cdot \sin(\theta)$

A

θ

$A \cdot \cos(\theta)$ $\vec{A_H}$
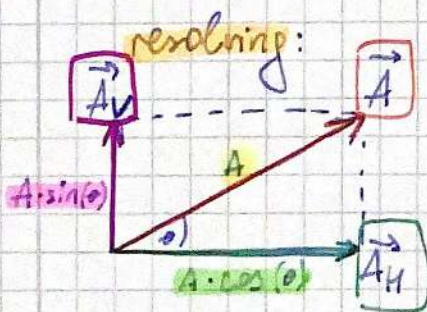
Measurements & Uncertainties II

$$2,056 \triangleq "2,055 - 2,057"$$

In calculations:

number of <u>significant figures</u> in output
must not <u>exceed</u> number of <u>significant figures</u>
<u>in least exact input</u>

relative $\begin{cases} \text{absolute uncertainty} \\ \text{fractional uncertainty} \\ \text{percentage uncertainty} \end{cases}$ $\quad \begin{array}{l} \pm 1m \\ \pm 0,01 \\ \pm 1\% \end{array}$

- multiplication/division → add percentage uncertainties
- powers → multiply percentage uncertainty with power
- addition/substraction → add absolute uncertainties