

2009 - Anno galileiano

Lezioni galileiane
Dipartimento Interateneo di Fisica - Bari

Prof. D. Di Bari - Prof. S. Pascazio

Lezione 1

20 marzo: 17:00-18:00, Aula B
S. Pascazio: "Il pendolo di Galileo"
18:00-18:30 Q & A

Lezione 2

27 marzo: 17:00-18:00, Aula B
D. Di Bari: "Interpretando si sbaglia! Il radiometro di Crookes"
18:00-18:30 Q & A

Lezione 3

17 aprile: 17:00-18:00, Aula B
S. Pascazio: "River meandering: le anse dei fiumi"
18:00-18:30 Q & A

24 aprile

D. Di Bari: "I motori: dai pi

Lezione 5

15 maggio: 17:00-18:00, Aula B
S. Pascazio: "I Principi fondamentali nella Scienza"
18:00-18:30 Q & A

Lezione 6

22 maggio: 17:00-18:00, Aula B
D. Di Bari: "Galileo: l'idea del metodo sperimentale"
18:00-18:30 Q & A

*Tutti gli studenti interessati (anche gli studenti di liceo)
sono cordialmente invitati*

Galileo Galilei

*Le lezioni avranno un taglio molto elementare
per stimolare la curiosità dei più e dei meno giovani!*

Cambio data!
Giovedì 21

<http://www.ba.infn.it/~pascazio/>

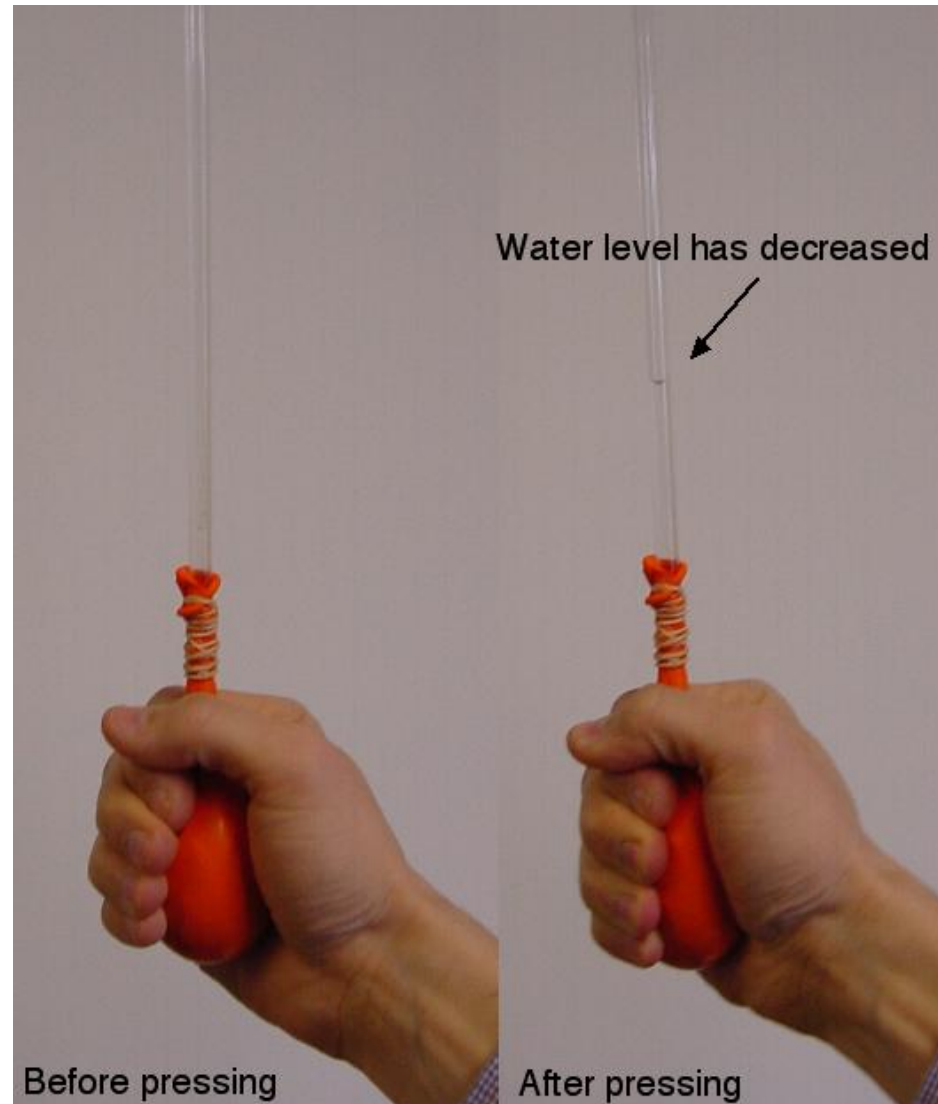
I Principi fondamentali nella Scienza

- Termodinamica
- Principio di sovrapposizione (EM e MQ)
- Teorie di gauge

Reynolds' dilatancy

is the observed tendency of a compacted granular material to dilate (expand in volume) as it is sheared. This occurs because the grains in a compacted state are interlocking and therefore do not have the freedom to move around one another. When stressed, a lever motion occurs between neighboring grains, which produces a bulk expansion of the material. On the other hand, when a granular material starts in a very loose state it may initially compact instead of dilating under shear. Reynolds' dilatancy is a common feature of the soils and sands studied by geotechnical engineers, and is a part of the broader topic of soil mechanics. It was first described scientifically by Osborne Reynolds (1842–1912) in 1885 and 1886.

Reynolds' dilatancy



Le formule

“Promessa” di non utilizzarle, ma...

“La filosofia è scritta in questo grandissimo libro che continuamente ci sta aperto innanzi a gli occhi (io dico l’universo), ma non si può intendere se prima non s’impara a intender la lingua, e conoscer i caratteri, ne’ quali è scritto. Egli è scritto in lingua matematica, e i caratteri son triangoli, cerchi, ed altre figure geometriche, senza i quali mezzi è impossibile a intenderne umanamente parola; senza questi è un aggirarsi vanamente per un oscuro laberinto.”

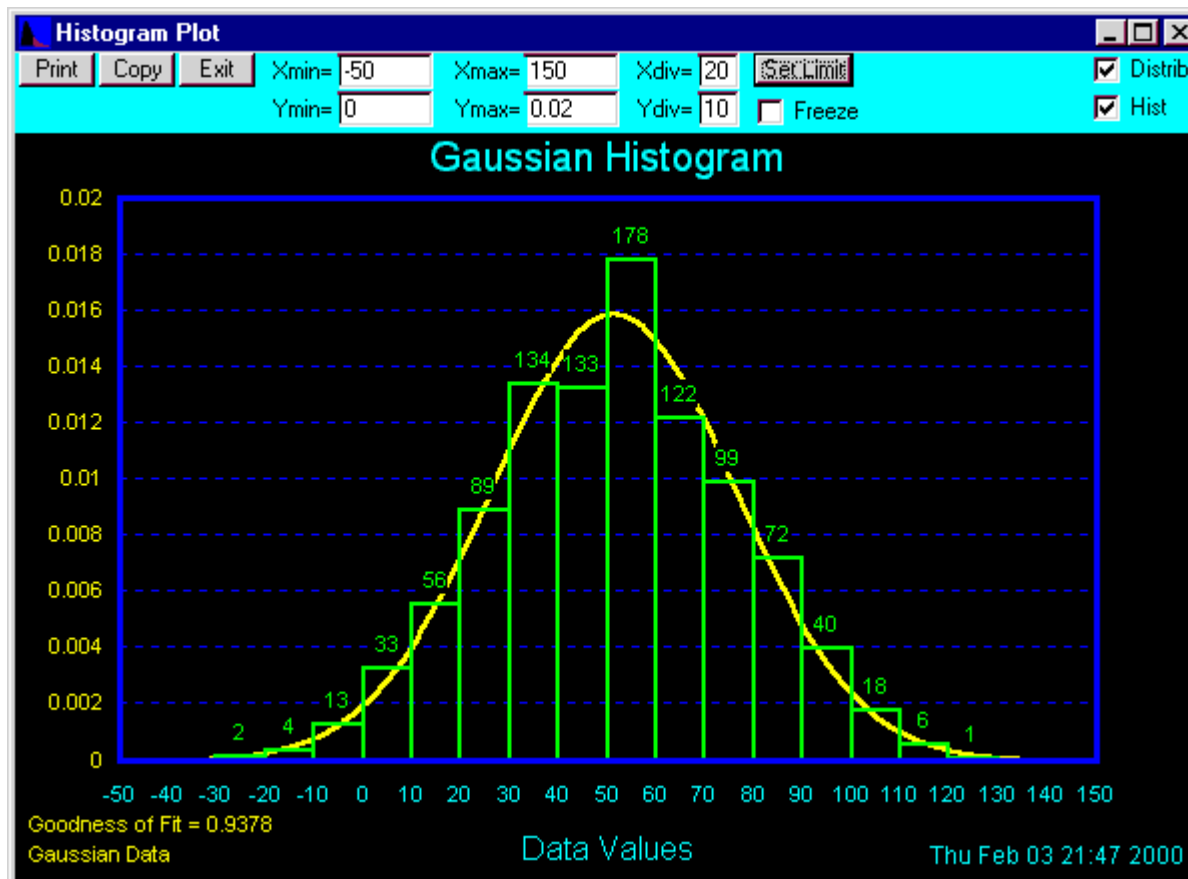
Galileo Galilei, Il saggiatore, 1623

Wigner, Faddeev, Lévy-Leblond

- **Wigner** nel 1960 pubblica un articolo (poi divenuto celeberrimo) intitolato "The Unreasonable Effectiveness of Mathematics in the Natural Sciences" (Communications in Pure and Applied Mathematics, vol. XIII, pp. 1-14, February 1960)
- Parla di **Galileo** e del metodo sperimentale

There is a story about two friends, who were classmates in high school, talking about their jobs. One of them became a statistician and was working on population trends. He showed a reprint to his former classmate. The reprint started, as usual, with the Gaussian distribution and the statistician explained to his former classmate the meaning of the symbols for the actual population, for the average population, and so on. His classmate was a bit incredulous and was not quite sure whether the statistician was pulling his leg. "How can you know that?" was his query. "And what is this symbol here?" "Oh," said the statistician, "this is pi." "What is that?" "The ratio of the circumference of the circle to its diameter." "Well, now you are pushing your joke too far," said the classmate, "surely the population has nothing to do with the circumference of the circle."

Naturally, we are inclined to smile about the simplicity of the classmate's approach. Nevertheless, when I heard this story, I had to admit to an eerie feeling because, surely, the reaction of the classmate betrayed only plain common sense. I was even more confused when, not many days later, someone came to me and expressed his bewilderment [1 The remark to be quoted was made by F. Werner when he was a student in Princeton.] with the fact that we make a rather narrow selection when choosing the data on which we test our theories. "How do we know that, if we made a theory which focuses its attention on phenomena we disregard and disregards some of the phenomena now commanding our attention, that we could not build another theory which has little in common with the present one but which, nevertheless, explains just as many phenomena as the present theory?" It has to be admitted that we have no definite evidence that there is no such theory.



$$P(x) = \frac{1}{\sigma \sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

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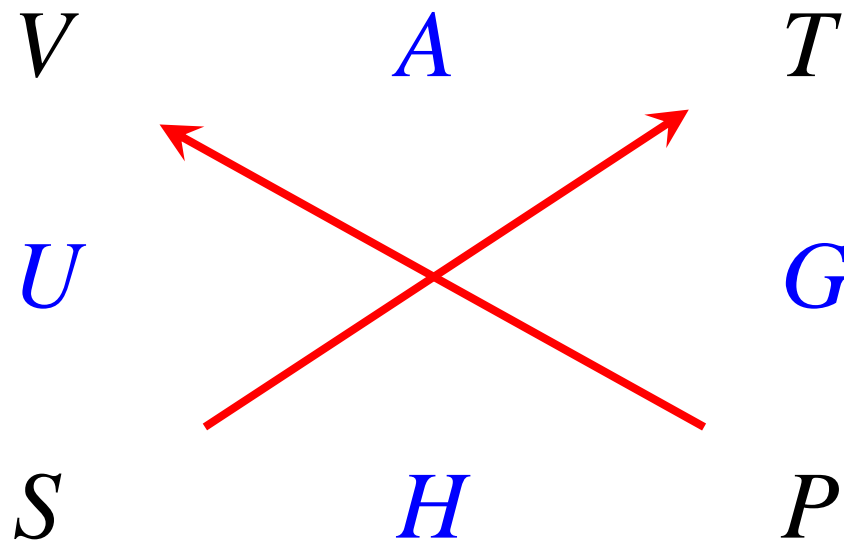
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- **Faddeev** pubblica un articolo intitolato “On the relation between mathematics and physics” (ho un vecchio preprint)
- Faddeev parla di unificazione (il sogno di **Einstein**) e si chiede come mai lo sviluppo di una scienza così “astratta” come la matematica “guadagni” applicazioni in fisica.
- Nella discussione che segue intervengono **Yang** e **Chern**. Yang gli chiede di pubblicare le sue idee.

- **Lévy-Leblond** pubblica un articolo intitolato “Why does physics need mathematics” (in *The scientific Enterprise*, 1992, Kluwer Academic Publishers)
- parla di Galileo e dell’ “architetto” dell’universo.

Le 8 relazioni di Maxwell (TD!)



A, U, G, H “potenziali termodinamici”

V, T, S, P “variabili”

Per esempio, $A=A(V,T)$ e $dA=-PdV-SdT$

Quantità termodinamiche

$$c = \frac{T}{N} \left(\frac{\partial S}{\partial T} \right) \quad \text{calore specifico}$$

$$\beta = -\frac{1}{V} \left(\frac{\partial V}{\partial p} \right) \quad \text{compressibilità}$$

$$\alpha = \frac{1}{V} \left(\frac{\partial V}{\partial T} \right) \quad \text{coefficiente di espansione termica}$$

intervengono fattori “umani” che ci portano a fare ipotesi “fisiche”

Principio di sovrapposizione: Elettromagnetismo e Meccanica Quantistica

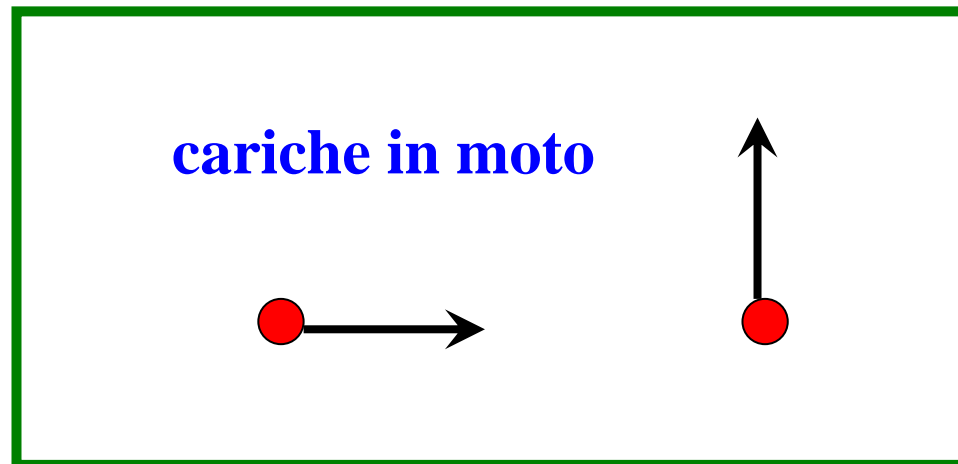
- Si possono sovrapporre campi elettrici e magnetici, perché le equazioni di Maxwell, che governano le leggi elettromagnetiche, sono *lineari*. Cioè, se E ed E' sono soluzioni, lo è anche $E+E'$

- Il principio di sovrapposizione non esiste in meccanica classica a livello degli stati, ma è valido per le equazioni del moto (se lineari)
- fecondo
- misterioso: “sommare due stati”
- significato di “**stato**” di un sistema fisico

Teorie di gauge

$$\vec{p} \implies \vec{p} - \frac{e}{c} \vec{A}$$

accoppiamento minimale (minimal coupling)



Grazie ed arrivederci alla prossima
ed ultima Lezione!