Bem-vindos à SFI-5774
(Mec. Quântica Aplicada)

Prof. Sérgio R. Muniz
(srmuniz@ifsc.usp.br)

Laboratório de Tecnologias Quânticas
Sala #42 – Gr. de Óptica

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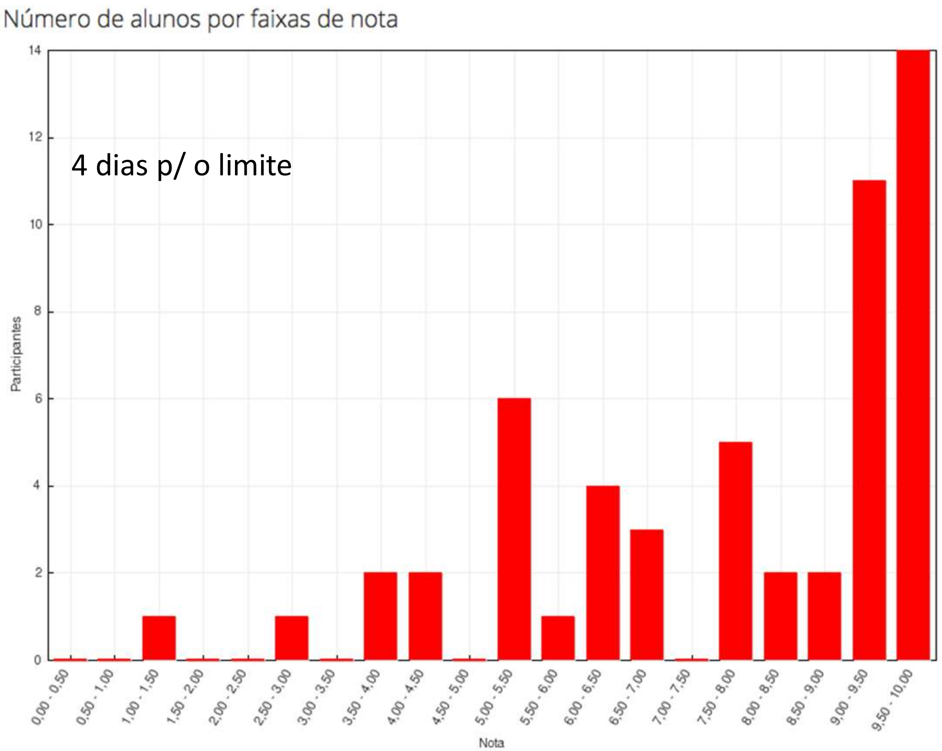
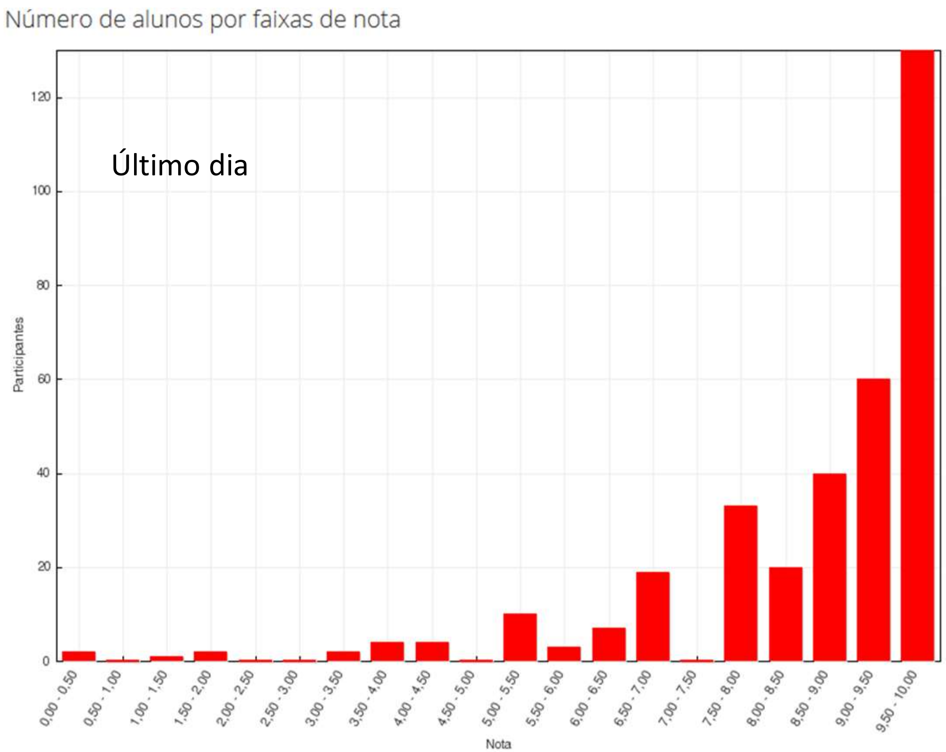
Análise de comportamento (preocupante)

Exemplo: evolução temporal do questionário online Pós-S2





Active learning increases student performance in science, engineering, and mathematics

Scott Freeman[a,1], Sarah L. Eddy[a], Miles McDonough[a], Michelle K. Smith[b], Nnadozie Okoroafor[a], Hannah Jordt[a], and Mary Pat Wenderoth[a]

[a]Department of Biology, University of Washington, Seattle, WA 98195; and [b]School of Biology and Ecology, University of Maine, Orono, ME 04469

Edited* by Bruce Alberts, University of California, San Francisco, CA, and approved April 15, 2014 (received for review October 8, 2013)

To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning. The effect sizes indicate that on average, student performance on examinations and concept inventories increased by 0.47 SDs under active learning ($n = 158$ studies), and that the odds ratio for failing was 1.95 under traditional lecturing ($n = 67$ studies). These results indicate that average examination scores improved by about 6% in active learning sections, and that students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning. Heterogeneity analyses indicated that both results hold across the STEM disciplines, that active learning increases scores on concept inventories more than on course examinations, and that active learning appears effective across all class sizes—although the

225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs. We followed guidelines for best practice in quantitative reviews (*SI Materials and Methods*), and evaluated student performance using two outcome variables: (*i*) scores on identical or formally equivalent examinations, concept inventories, or other assessments; or (*ii*) failure rates, usually measured as the percentage of students receiving a D or F grade or withdrawing from the course in question (DFW rate).

The analysis, then, focused on two related questions. Does active learning boost examination scores? Does it lower failure rates?

Results

The overall mean effect size for performance on identical or

8410–8415 | PNAS | June 10, 2014 | vol. 111 | no. 23 www.pnas.org/cgi/doi/10.1073/pnas.1319030111

COMMENTARY

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click for updates

COMMENTARY

Large-scale comparison of science teaching methods sends clear message

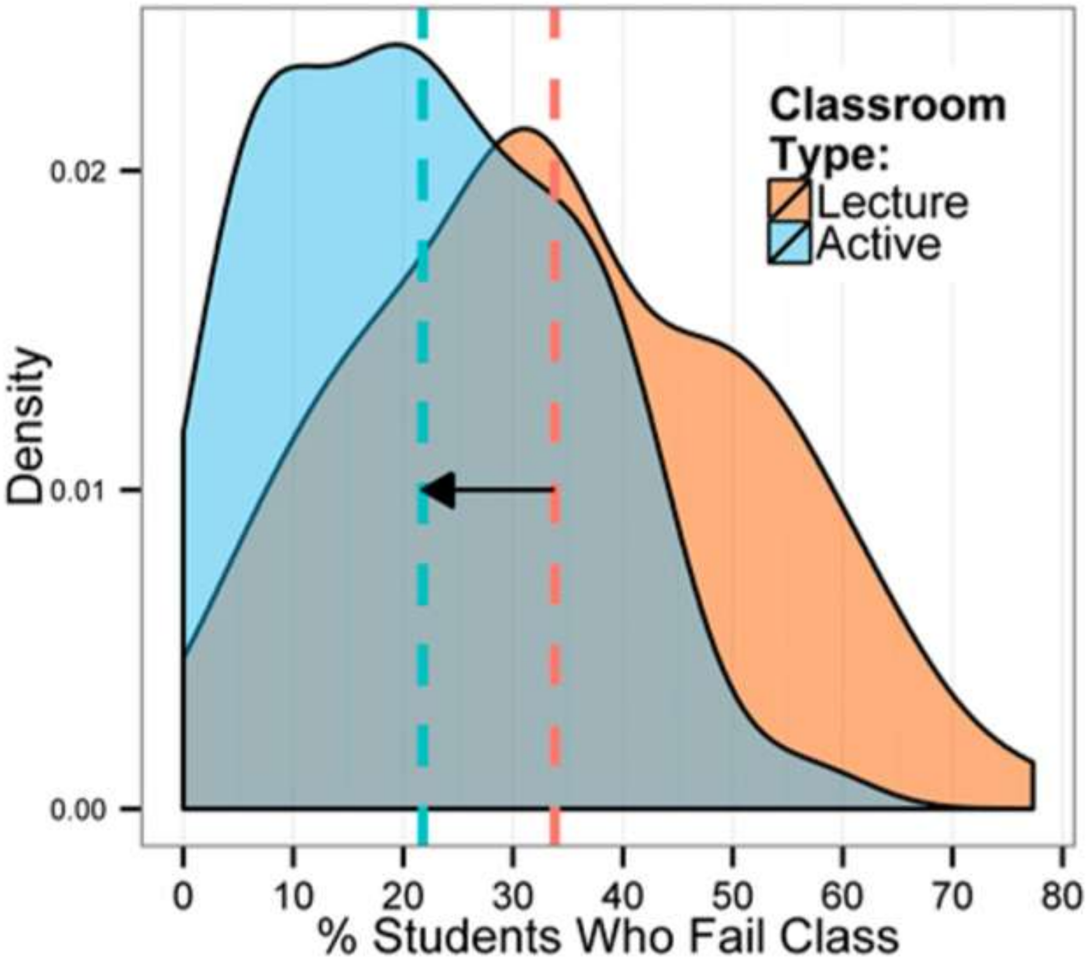
Carl E. Wieman[1]

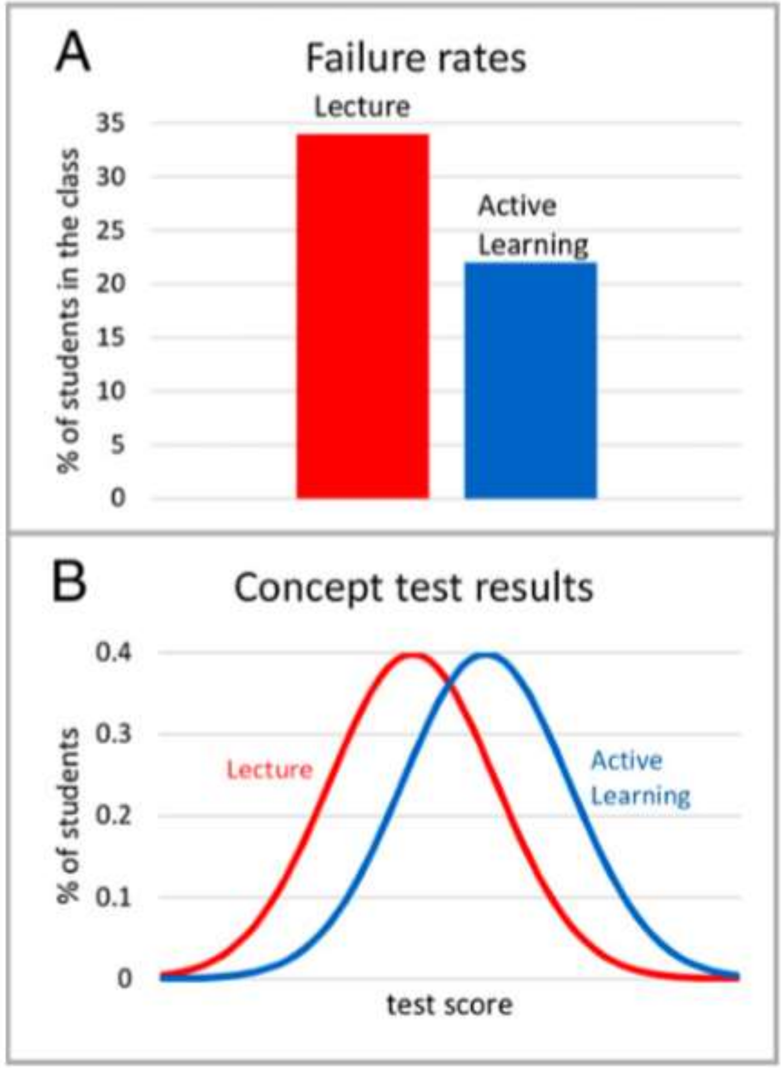
Department of Physics and Graduate School of Education, Stanford University, Stanford, CA 94305

Freeman et al. argue that it is no longer appropriate to use lecture teaching as the comparison standard.

www.pnas.org/cgi/doi/10.1073/pnas.1407304111

Probably the most striking result in ref. 3 is that the impact of active learning on educational outcomes is both large and consistent. The authors examined two outcome measures: the failure rate in courses and the performance on tests. They found the average failure rate decreased from 34% with traditional lecturing to 22% with active learning (Fig. 1*A*), whereas performance on identical or comparable tests increased by nearly half the SD of the test scores (an effect size of 0.47). These benefits of active learning were consistent across all of the different STEM disciplines and different levels of courses (introductory, advanced, majors, and nonmajors) and across different experimental methodologies.





www.pnas.org/cgi/doi/10.1073/pnas.1407304111

Objetivos didáticos

Plano de aulas

Mec. Quântica Aplicada (pós-grad/SFI5774)

[*S.R.Muniz - versão 1.0* @31/01/2020, *última atualização:* 10/03]

Conteúdo oficial (ementa)	Conteúdo complementar
1. Operadores em mecânica quântica. 2. Postulados da mecânica quântica e equação de Schroedinger. 3. Mecânica quântica matricial. 4. Movimento linear e oscilador harmônico. 5. Momento angular e átomo de hidrogênio. 6. Teoria de perturbação e método variacional. 7. Noções de simetrias e representação de grupos 8. Estruturas atômicas e moleculares. 9. Rotações e vibrações moleculares. 10. Transições eletrônicas moleculares. 11. Propriedades elétricas e ópticas de moléculas.	C1. Teoria de perturbação dependente do tempo C2. Quantização do campo E&M C3. Formalismo de segunda quantização C4. Partículas idênticas e estatística quântica * Bose-Einstein, Fermi-Dirac, supercondutores C5. Simetria e leis de conservação **Aulas práticas**: 1h/semana (**eventual, qdo necessário*) Aula prática, usando sala com computadores, para resolução de problemas com ferramentas computacionais. Permitirá explorar problemas mais interessantes e avançados. [Decidir horário/local]

Bibliografia
(sugerida)

(*) sugestões serão feitas ao longo do semestre, dependendo do assunto

- Molecular quantum mechanics – Peter ATKINS; Ronald FRIEDMAN
- Quantum chemistry – Ira LEVINE

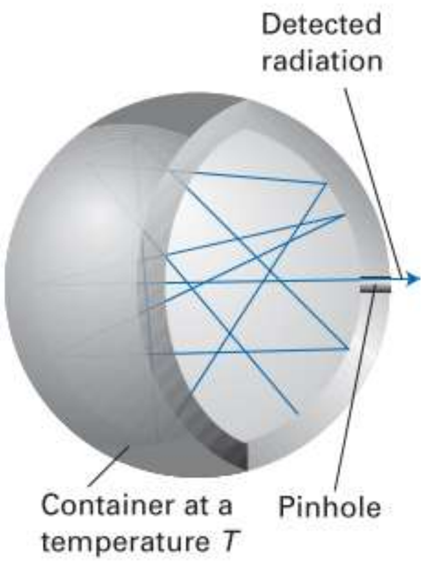
Bibliografia Complementar

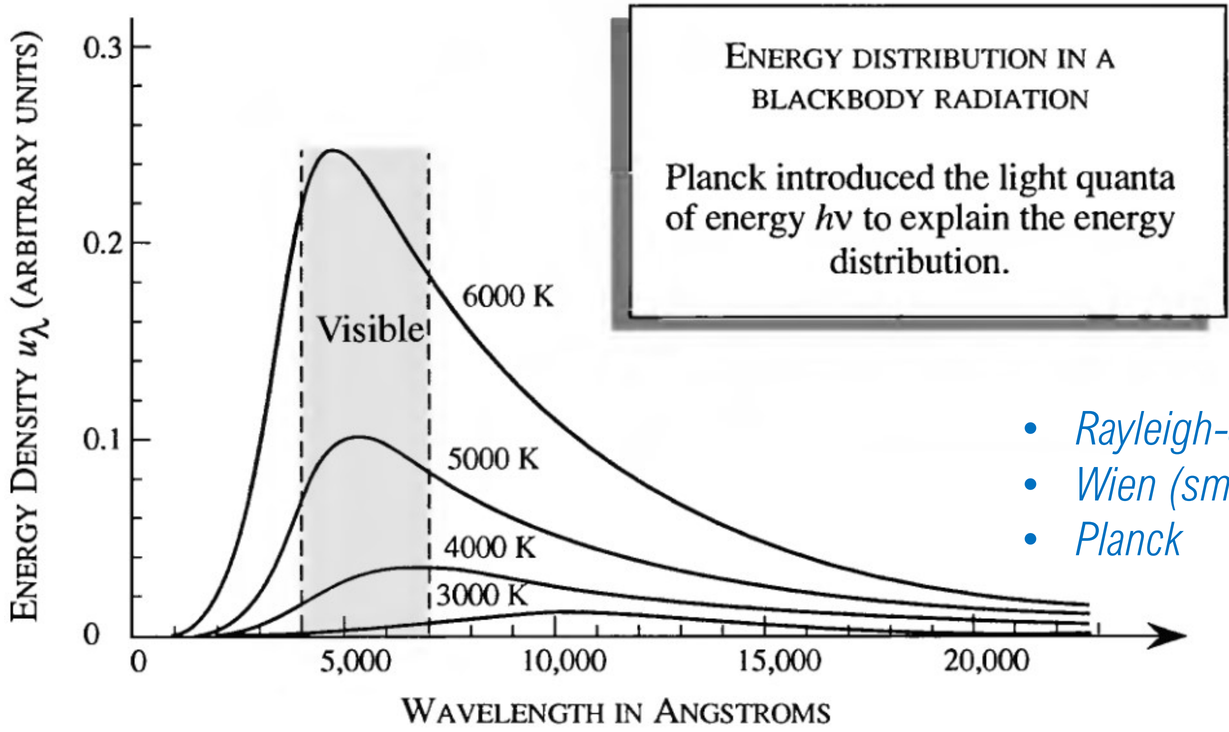
- Quantum Mechanics, Fundamentals & Applications to technology – Jasprit SINGH (Wiley)
- Mecânica Quântica – David GRIFFITHS (Pearson)
- Quatum Mechanics DeMystified – David McMahon (McGraw Hill)
- Thomas Engler (Quantum Chemistry)
  Atkins-dePaula-Friedman (Quanta, Físico-Química)
  R. Feynmann (Lectures & Stat. Mech)
  E. Merzbacher (Quantum Mechanics, 3 ed.)
- ...(+*outros*...)

Experimentos que desafiaram a Física Clássica (início do sec. XX)

"Some black clouds on sky..."

- Radiação de Corpo Negro



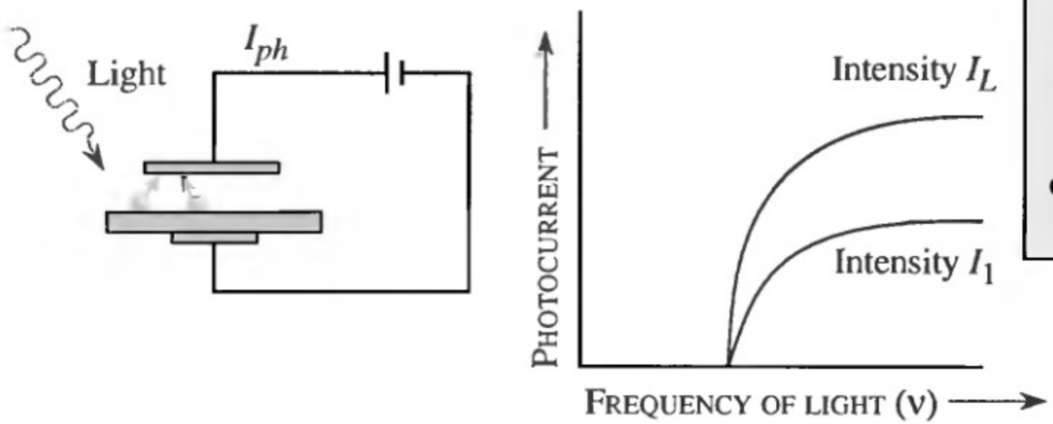


- *Rayleigh-Jeans (large-λ)*
- *Wien (small-λ)*
- *Planck*

Experimentos que desafiaram a Física Clássica (início do sec. XX)

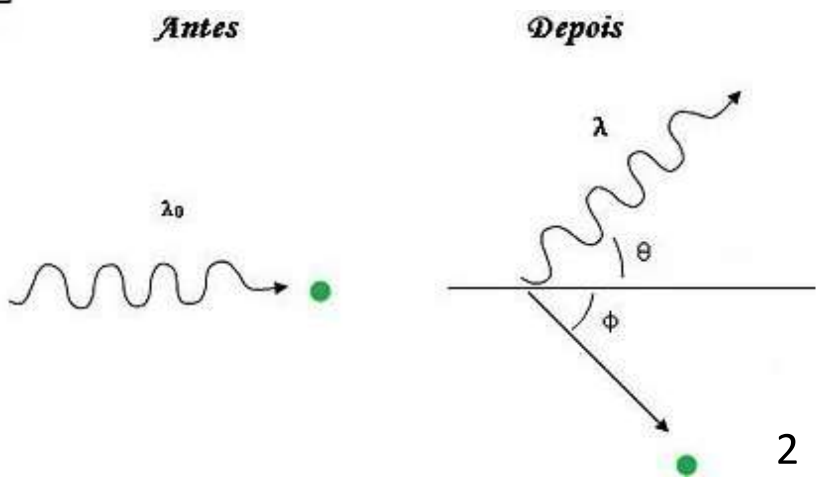
"Some black clouds on sky..."

- Efeitos fotoelelétrico & Compton: *fótons* (ondas como "partículas")



Einstein explained the photoelectric effect by treating light as made up of energy quantas with energy *hv*.

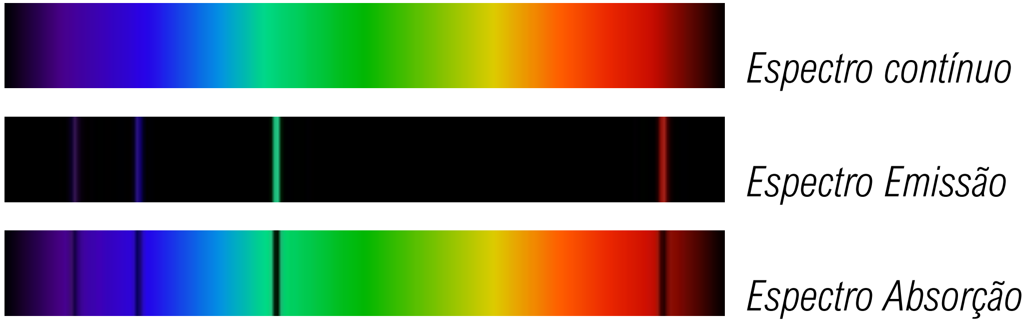
Efeito (espalhamento) Compton

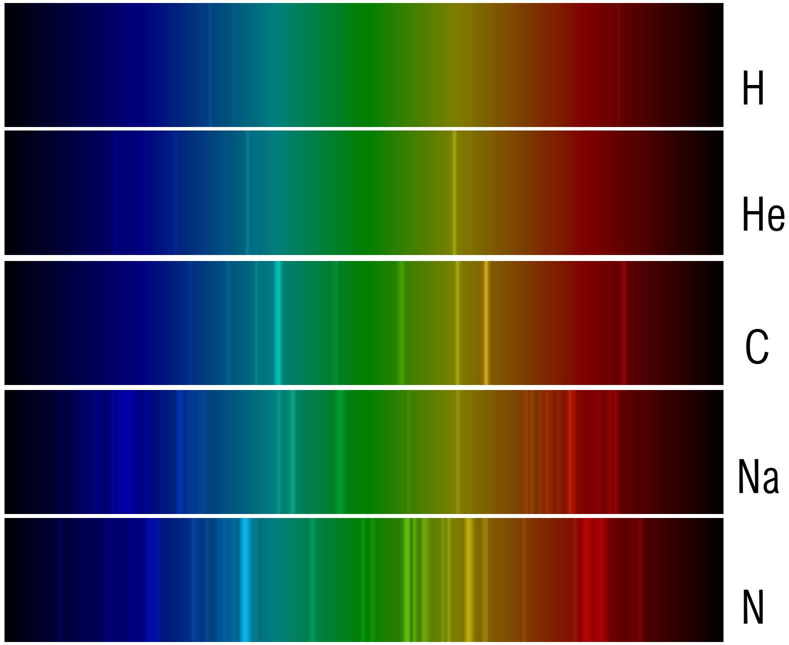


Experimentos que desafiaram a Física Clássica (início do sec. XX)

"Some black clouds on sky..."

- Espectro atômico: *Linhas espectrais* (níveis "quantizados")

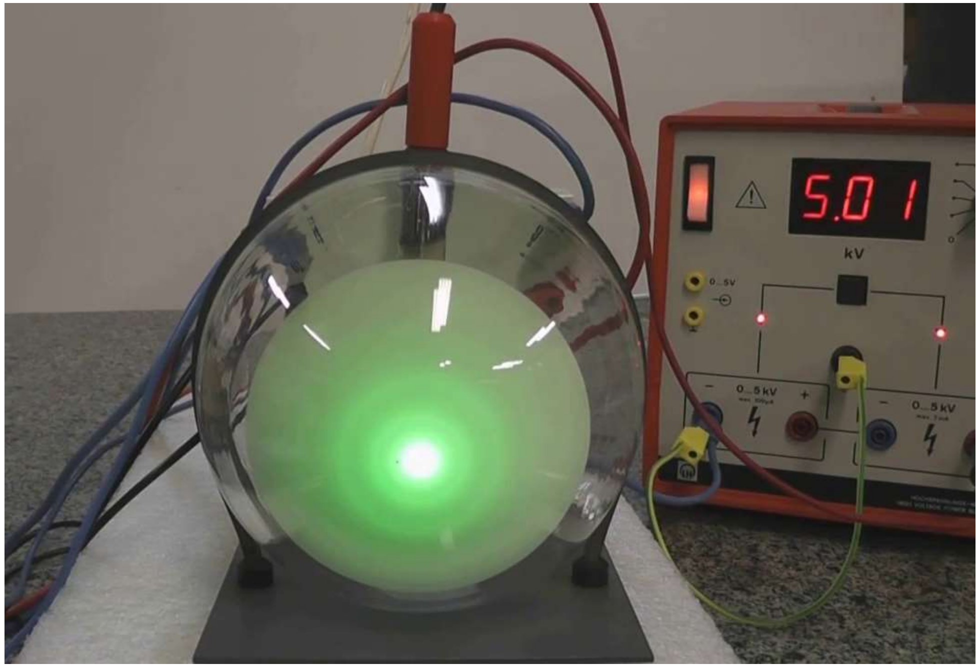




Experimentos que desafiaram a Física Clássica (início do sec. XX)

- **Difração de elétrons:** *partículas como ondas* (dualidade partícula-onda)

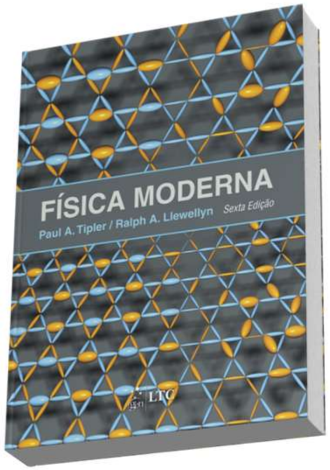
  Experimento de Davisson- Germer (1927)

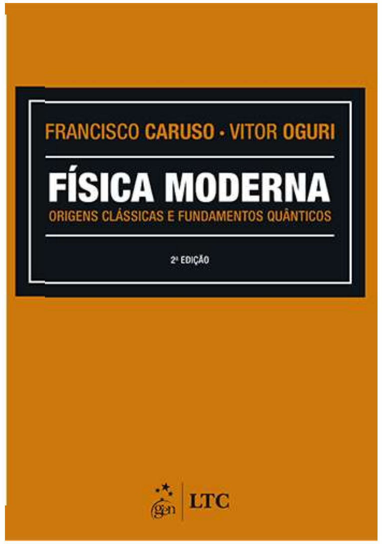


Experimentos que desafiaram a Física Clássica (início do sec. XX)

Leituras sugeridas:

- Atkins, Friedman, dePaula (vários títulos)
- P. Tipler – Física Moderna (ed. LTC)
- Caruso-Oguri – Física Moderna (ed. LTC)
- Eisenberg-Resnick – Física Quântica (ed. Campus)
- ...outros





Videoaulas:

- Curso de Física Moderna Prof. Bagnato (YouTube)
- ...outros

Transição conceitual Mec. Clássica p/ Mec. Quântica

(Evolução das ideias e conexões...)

Formalismos/formulações da Mec. Clássica:

- Mecânica Newtoniana
- Mecânica Lagrangeana
- Mecânica Hamiltoniana
  - ✓ Parênteses de Poisson >> Heisenberg
- Mecânica de Hamilton-Jacobi >> Schroedinger