Welcome to 3.091

Lecture 5

September 18, 2009

Electron Shell Model & Quantum Numbers

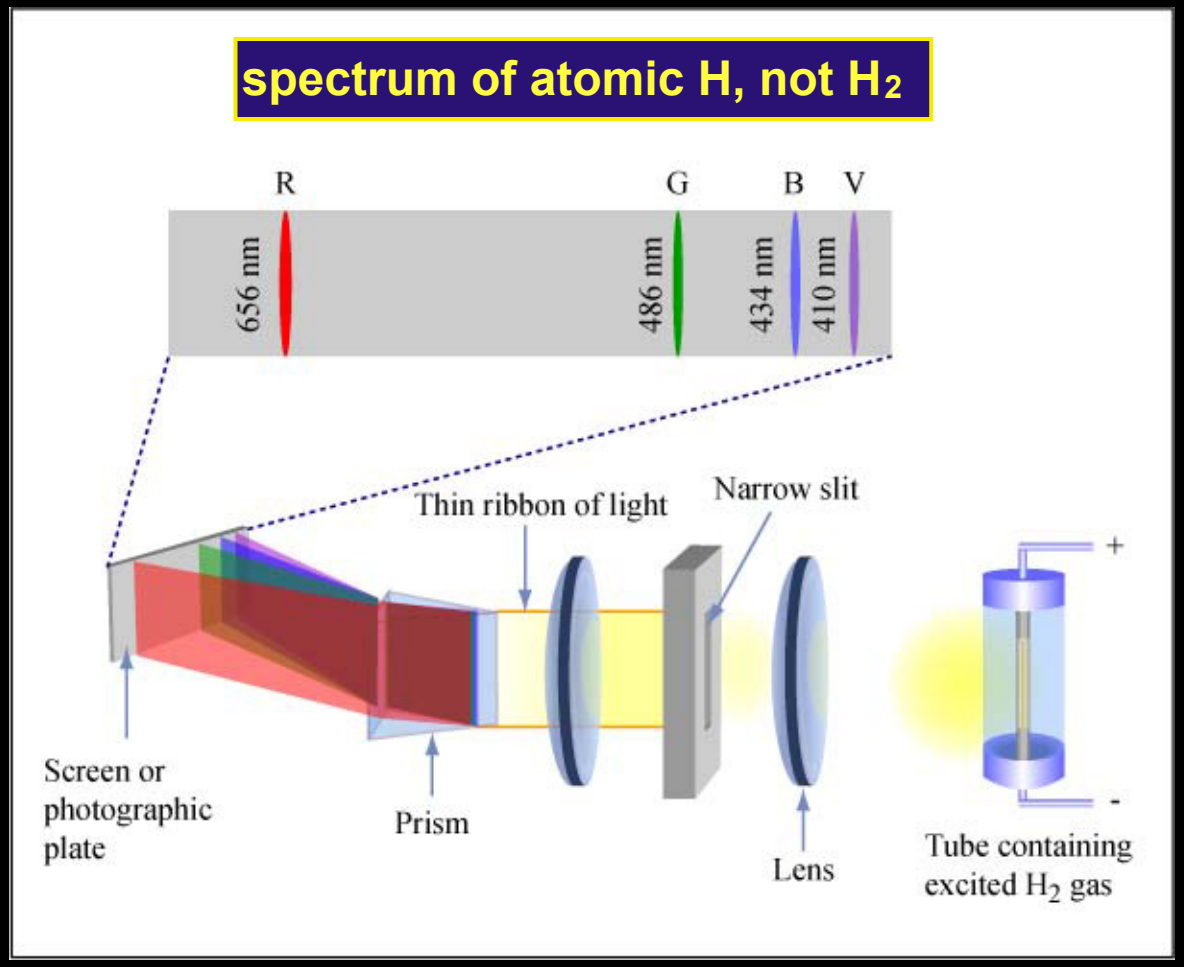
3.091 Periodic Table Quiz

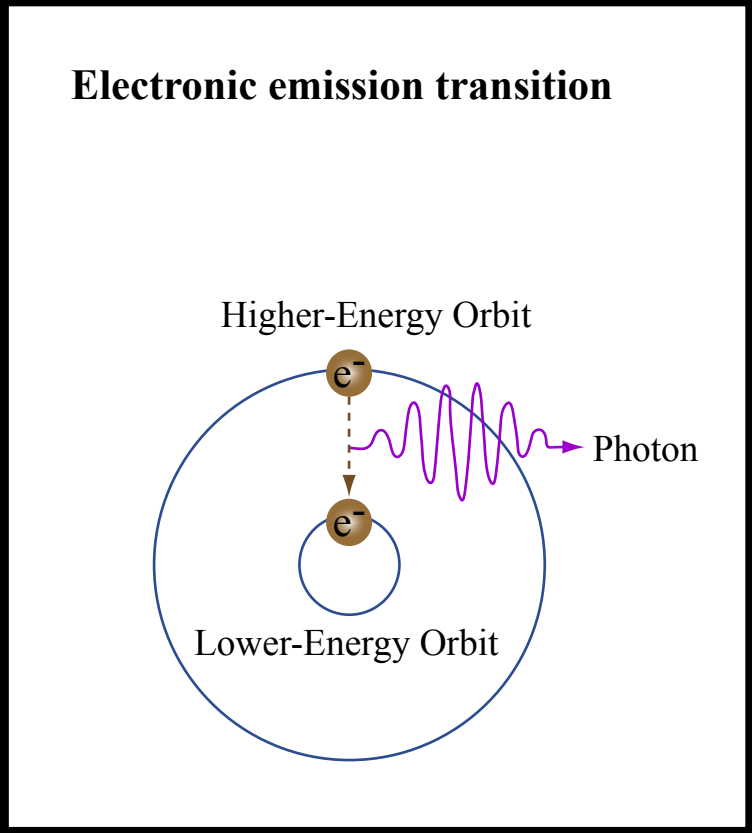
1																	2
3	4											5	6	7	8	9	10
11	12											13	14	15	16	17	18
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
87	88	89															

Name _____

Grade _____ /10

Prism Spectrograph A.A. Ångström (1853)





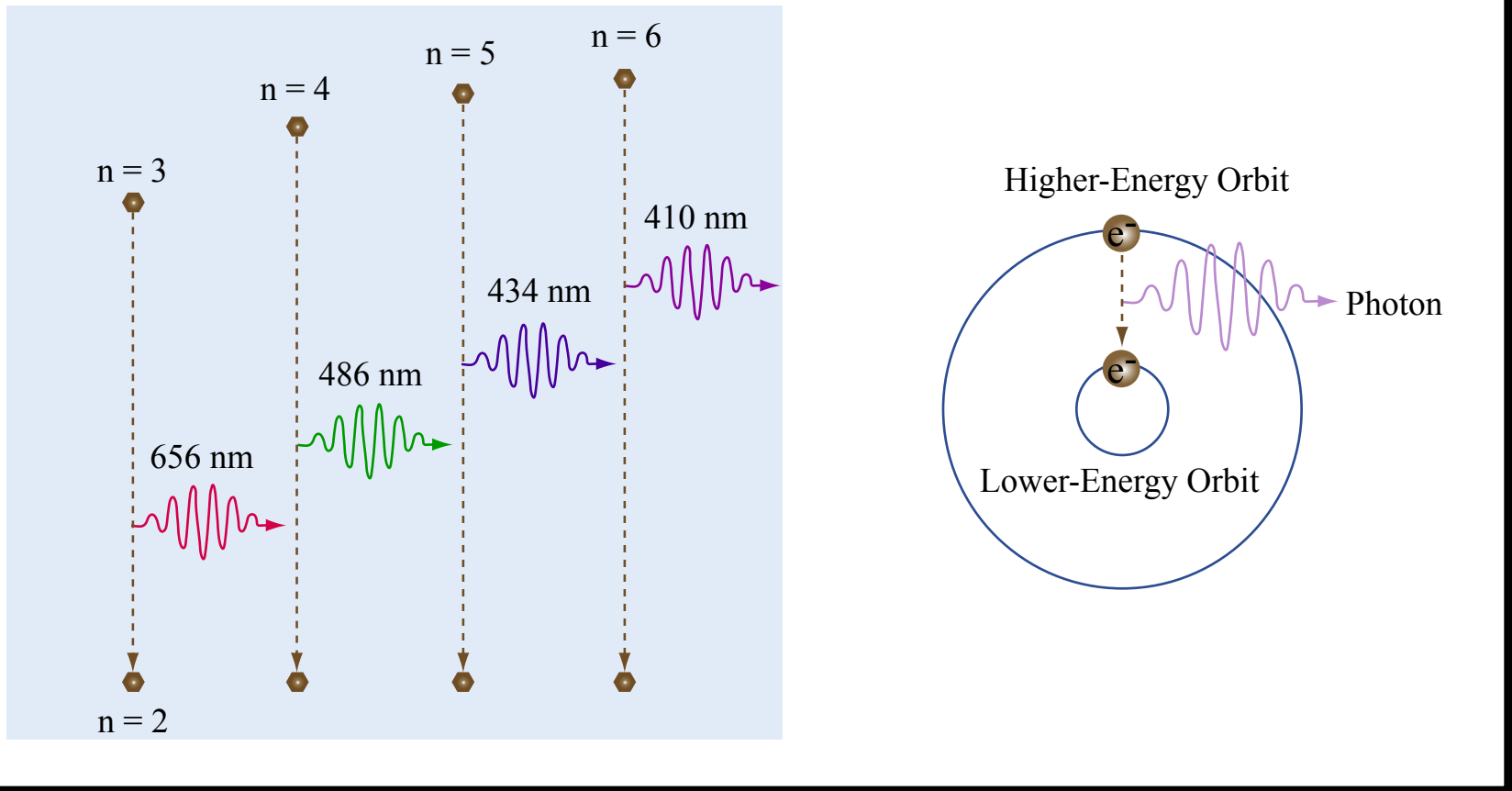
Bohr Postulates for the Hydrogen Atom

1. Rutherford atom is correct
2. Classical EM theory not applicable to orbiting e^-
3. Newtonian mechanics applicable to orbiting e^-
4. $E_{\text{electron}} = E_{\text{kinetic}} + E_{\text{potential}}$
5. e^- energy quantized through its angular momentum:

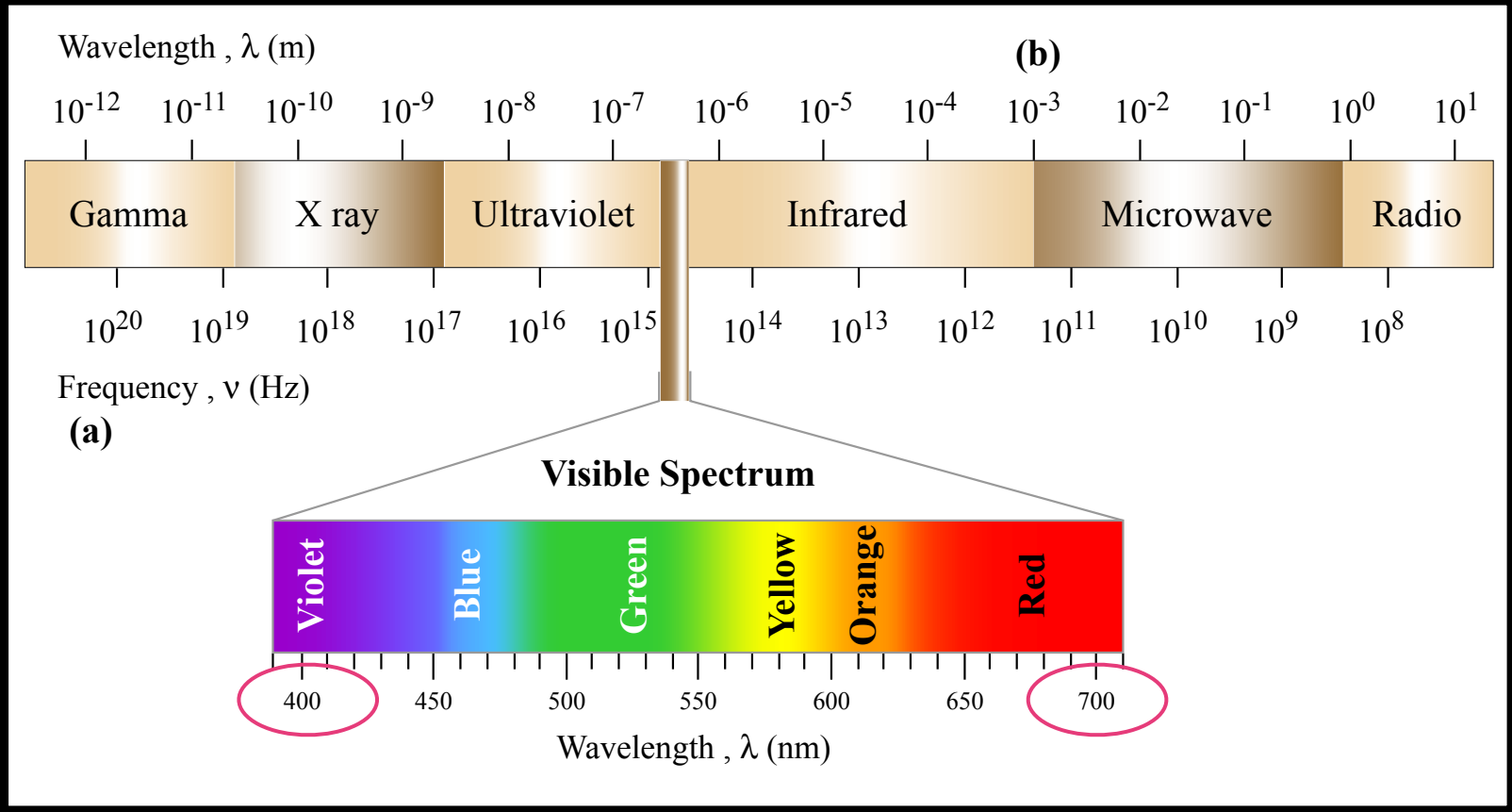
   $L = mvr = nh/2\pi, \quad n = 1, 2, 3, \ldots$
6. Planck-Einstein relation applies to e^- transitions:

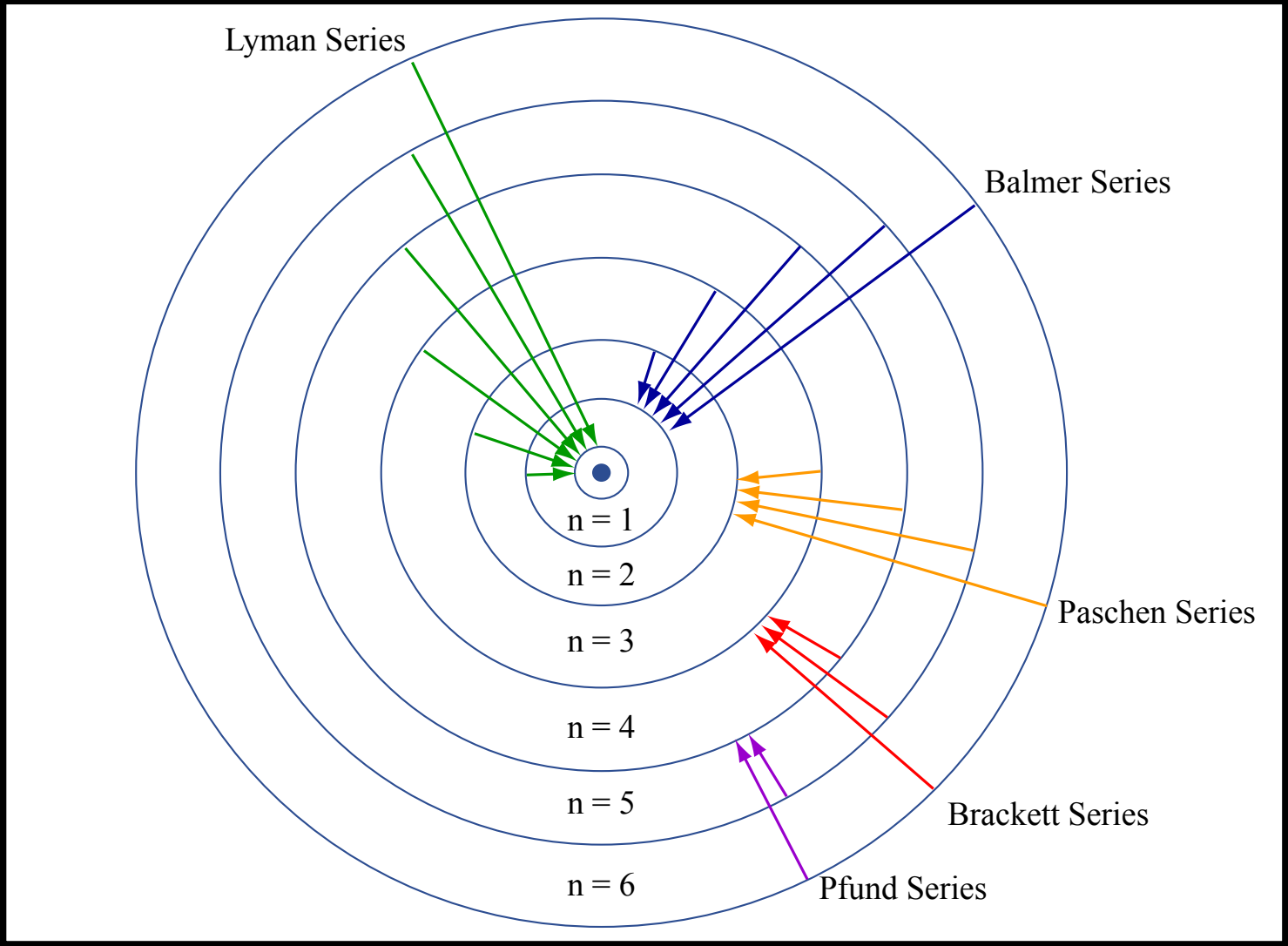
   $\Delta E = E_f - E_i = h\nu = hc/\lambda$

   $c = \nu\lambda$



← E, ν, $\bar{\nu}$ λ →





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The Nobel Prize in Physics 1925

"for their discovery of the laws governing the impact of an electron upon an atom"

Gustav Ludwig Hertz

- 1/2 of the prize Germany

Halle University
Halle, Germany

B. 1887
D. 1975

James Franck

- 1/2 of the prize Germany

Goettingen University
Goettingen, Germany

B. 1882
D. 1964

Prism Spectrograph A.A. Ångström (1853)

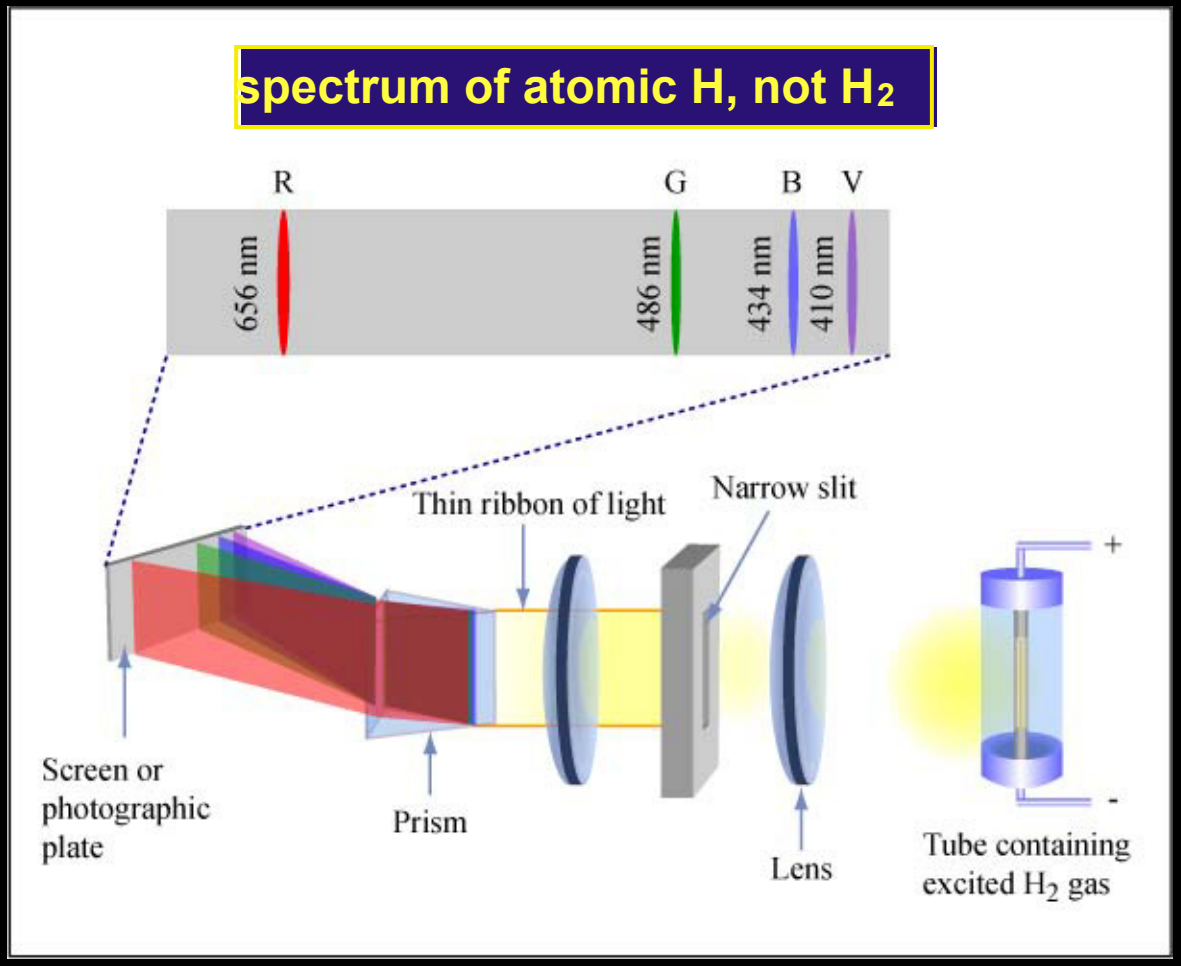


Image by MIT OpenCourseWare.

The Nobel Prize in Physics 1907

"for his optical precision instruments and the spectroscopic and metrological investigations carried out with their aid"

Albert Abraham Michelson

USA

University of Chicago
Chicago, lL, USA

b. 1852
(in Strelno, then Germany)
d. 1931

The Nobel Prize in Physics 1902

"in recognition of the extraordinary service they rendered by their researches into the influence of magnetism upon radiation phenomena"

Hendrik Antoon Lorentz

1/2 of the prize

the Netherlands

Leiden University
Leiden, the Netherlands

b. 1853
d. 1928

Pieter Zeeman

1/2 of the prize

the Netherlands

Amsterdam University
Amsterdam, the Netherlands

b. 1865
d. 1943

The Nobel Prize in Physics 1919

"for his discovery of the Doppler effect in canal rays and the splitting of spectral lines in electric fields"

Johannes Stark

Germany

Greifswald University
Greifswald, Germany

b. 1874
d. 1957

Image by MIT OpenCourseWare.

The Nobel Prize in Physics 1922

"for his services in the investigation of the structure of atoms and of the radiation emanating from them"

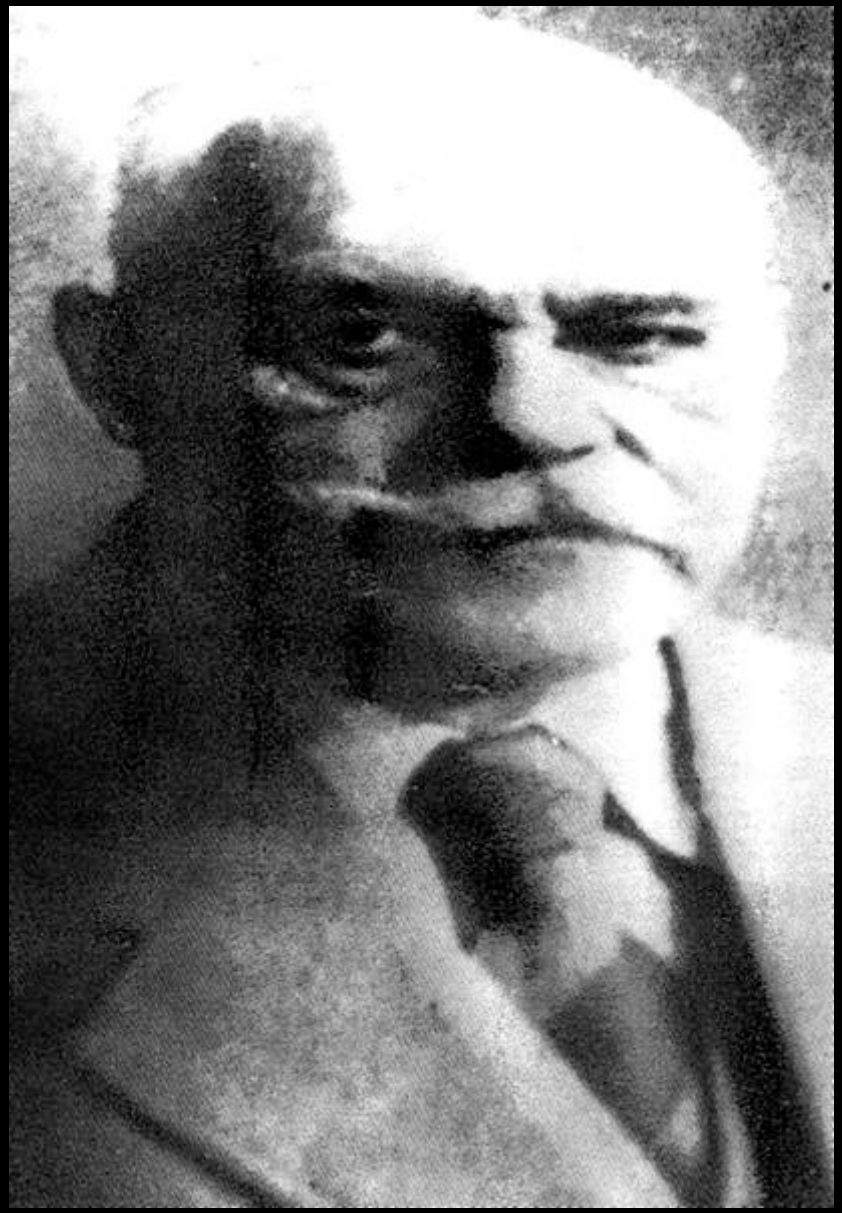
Niels Henrik David Bohr

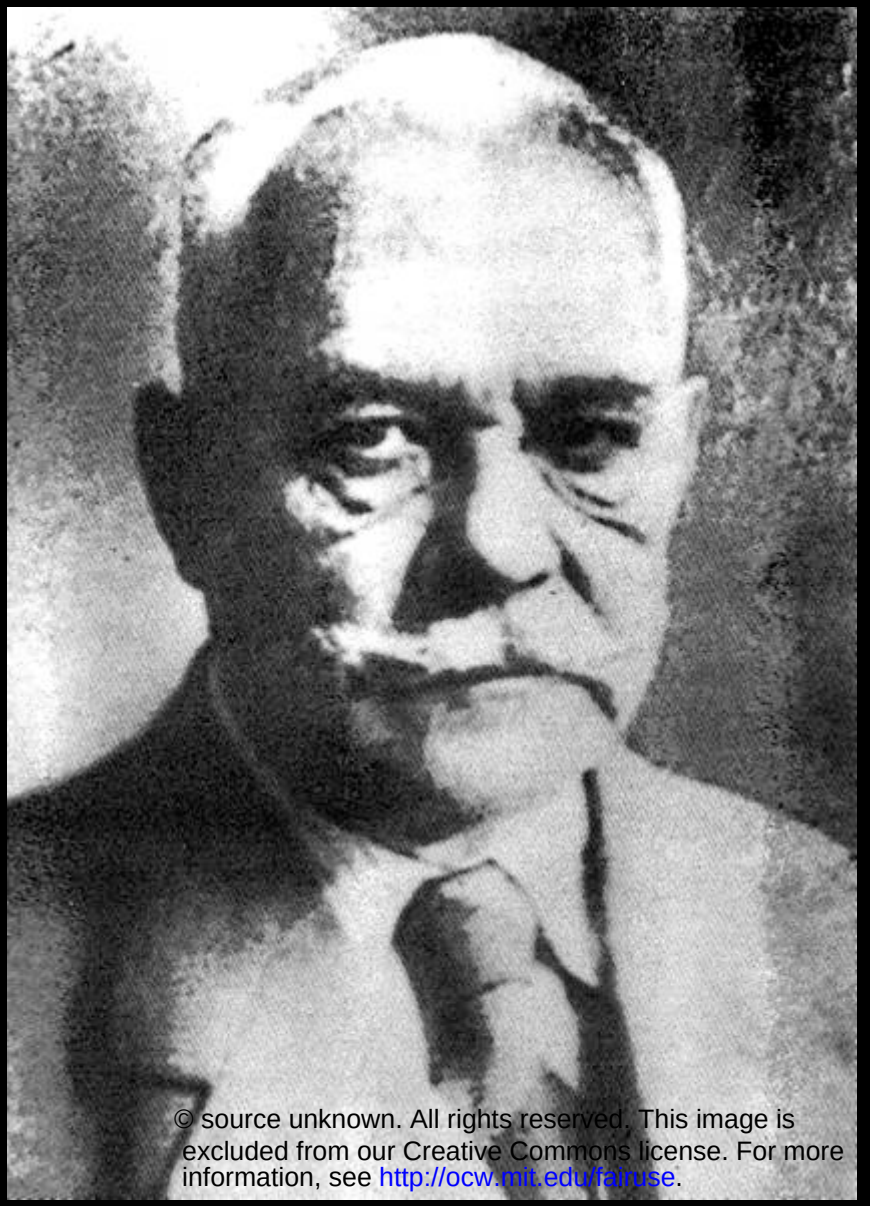
Denmark

Copenhagen University
Copenhagen, Denmark

b. 1885
d. 1962

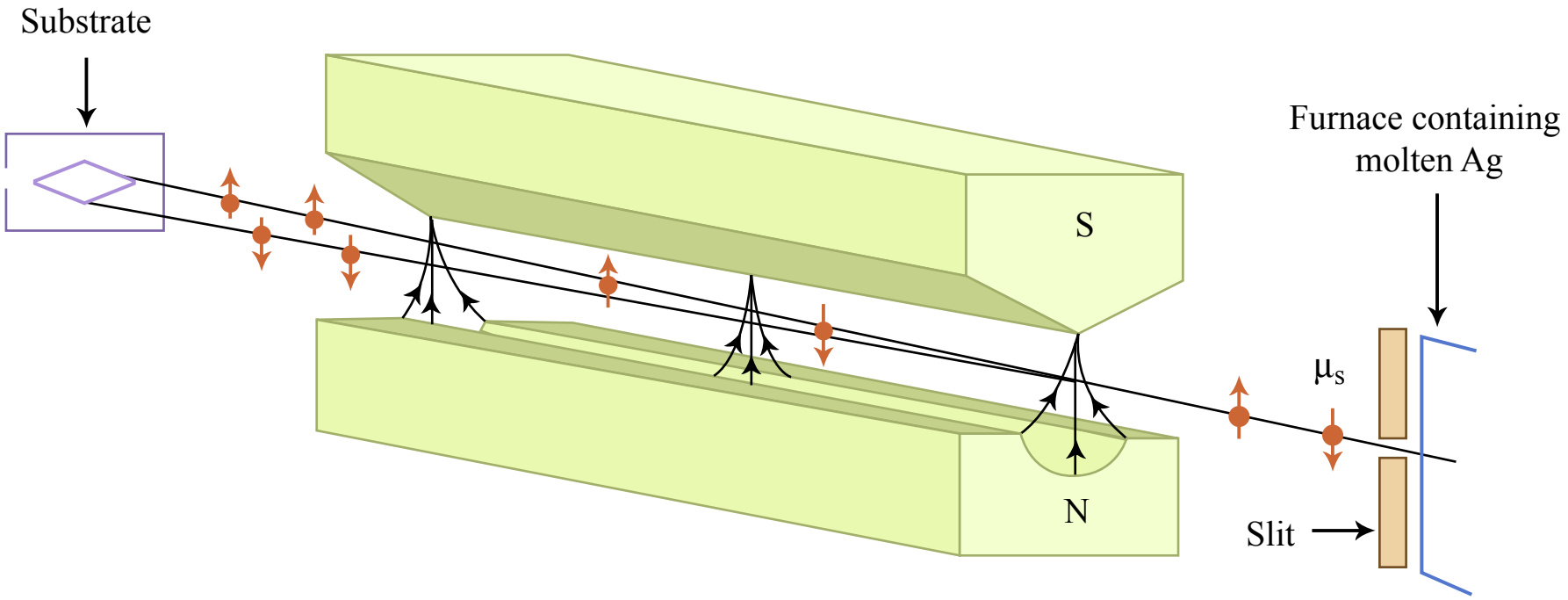
Image by MIT OpenCourseWare.

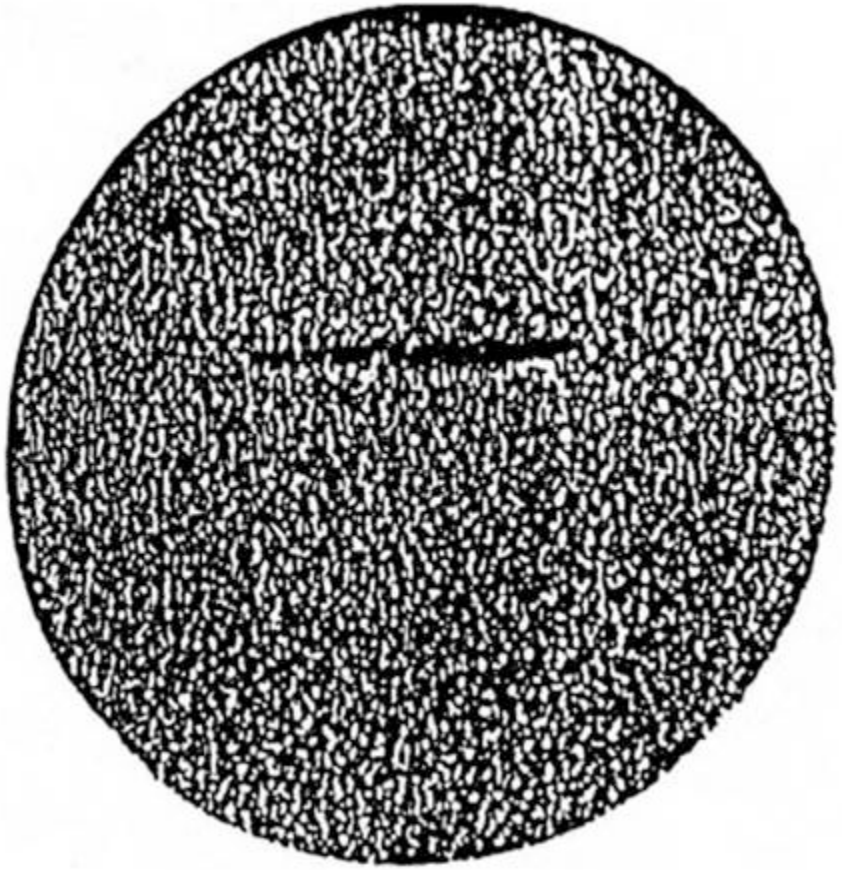


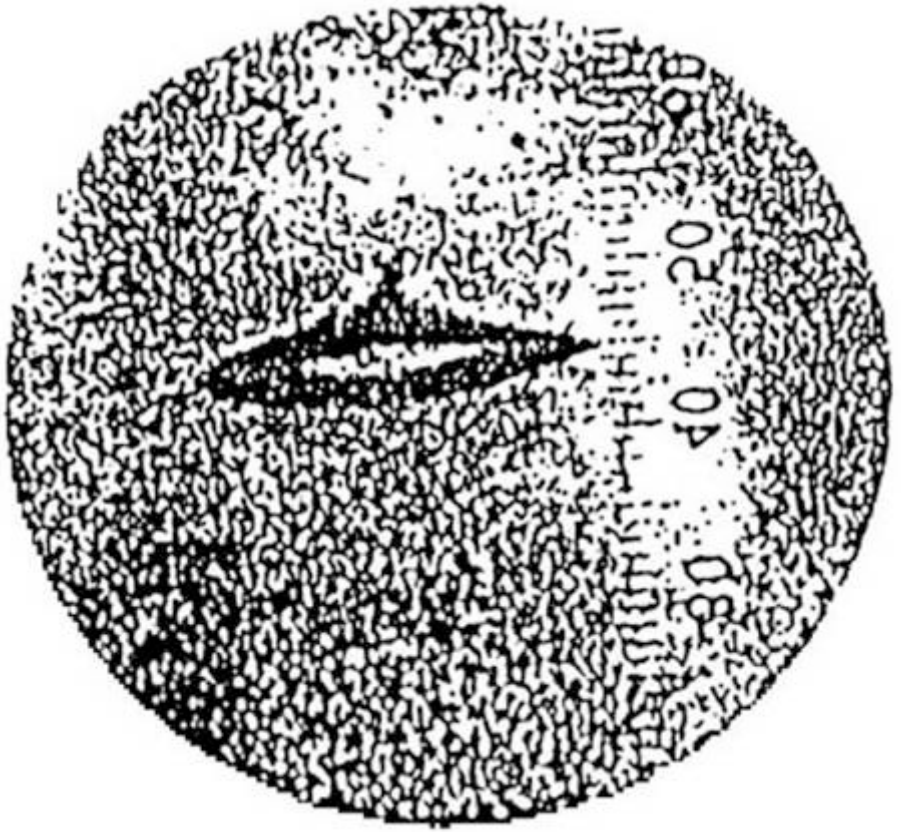


Arnold Sommerfeld on the occasion of his 80th birthday

Schematic representation of the Stern Gerlach experiment (1921).







no magnetic field

divergent magnetic field

Z odd

The Nobel Prize in Physics 1943

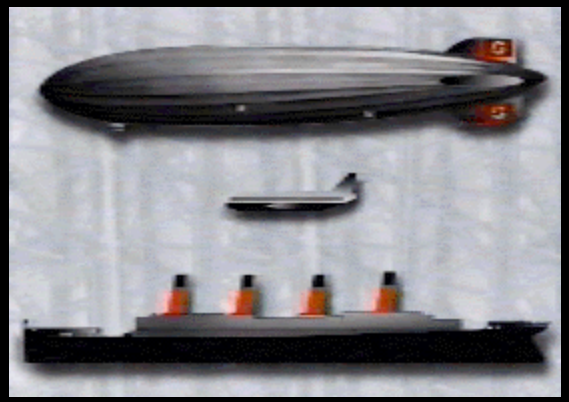
"for his contribution to the development of the molecular ray method and his discovery of the magnetic moment of the proton"

Otto Stern

USA

Carnegie Institute of Technology
Pittsburgh, PA, USA

b. 1888 (in Sorau, then Germany)
d. 1969



Hindenburg

B 747

Titanic

HYDROGEN IN TRANSPORTATION

* built in Germany by Zeppelin (LZ129)

* 135 ft in dia. × 804 ft long

* 7 million cu ft gas

* 112 tons useful lift

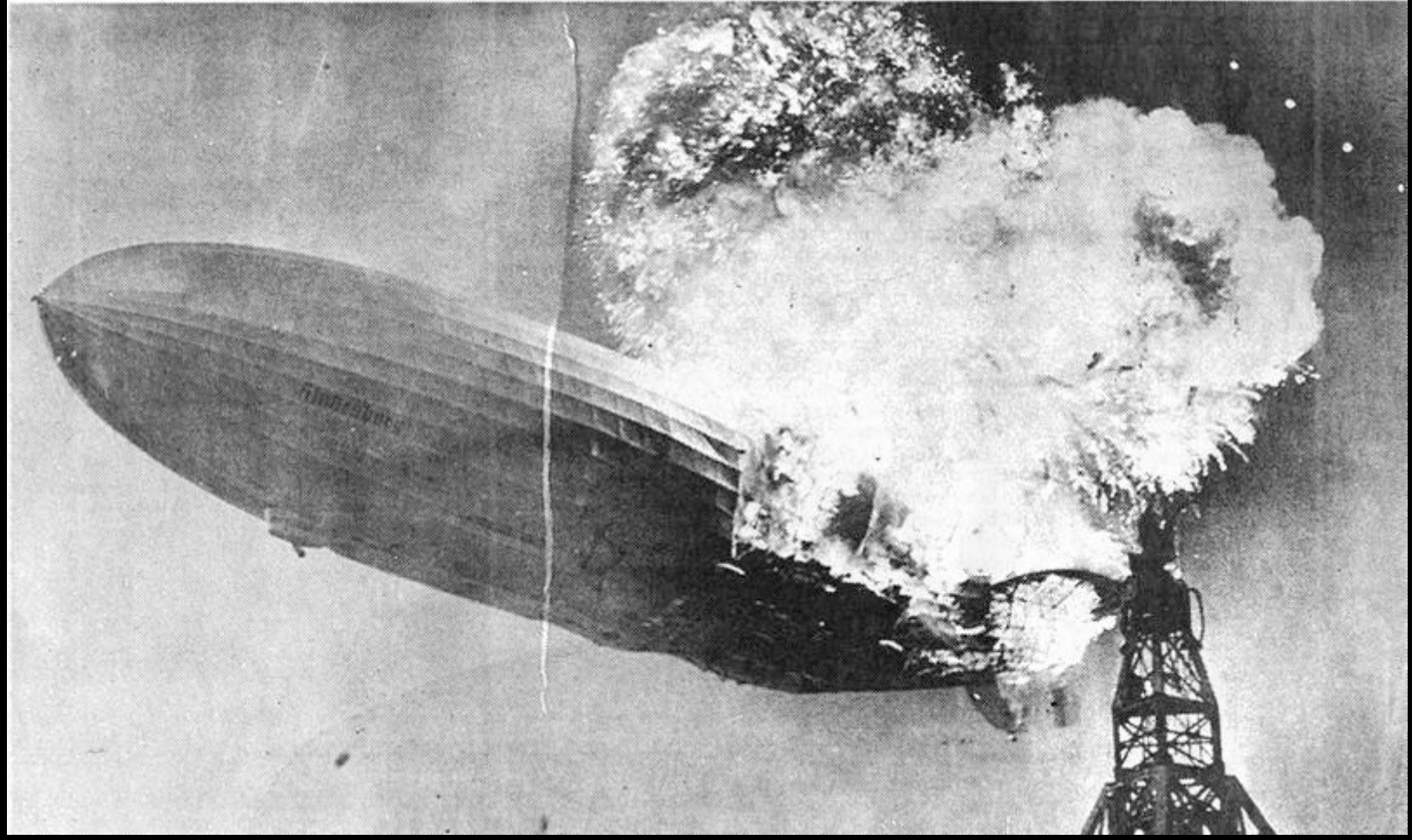
* Helium Control Act ☞ inflated with H_2

Hindenburg

* 10 transatlantic flights in 1936:
  1002 passengers

* cruising speed 78 mph

* May 6, 1937 arrival of first flight to US



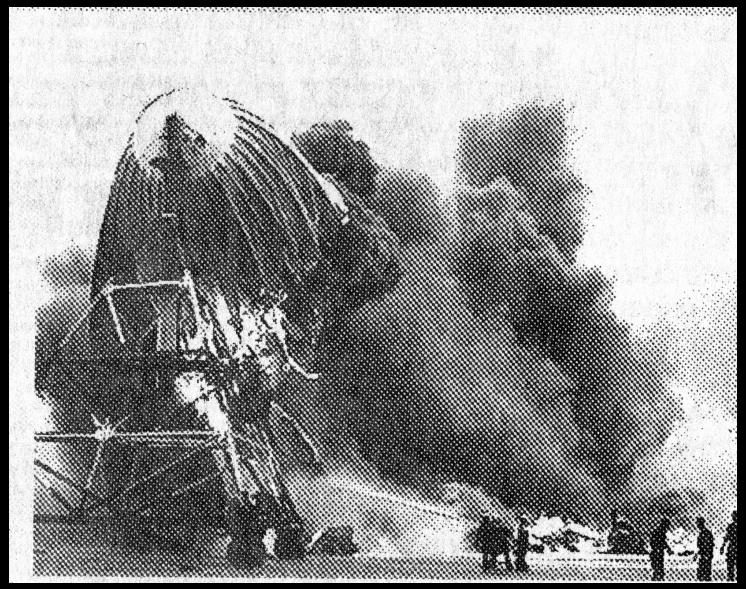
* while docking at Lakehurst, NJ

* 35 dead of 97 on board

* electrical discharge in vicinity of H_2 leak

* skin of resin (finished with lacquer dope)
  + aluminum powder
    + iron oxide on inside
  ☞ sheets of SOLID ROCKET MOTOR grains

* end of rigid airships in
  commercial air transportation



* US Navy airship filled with helium (1956)

* two-ply cotton envelope
  could not withstand gasoline fire

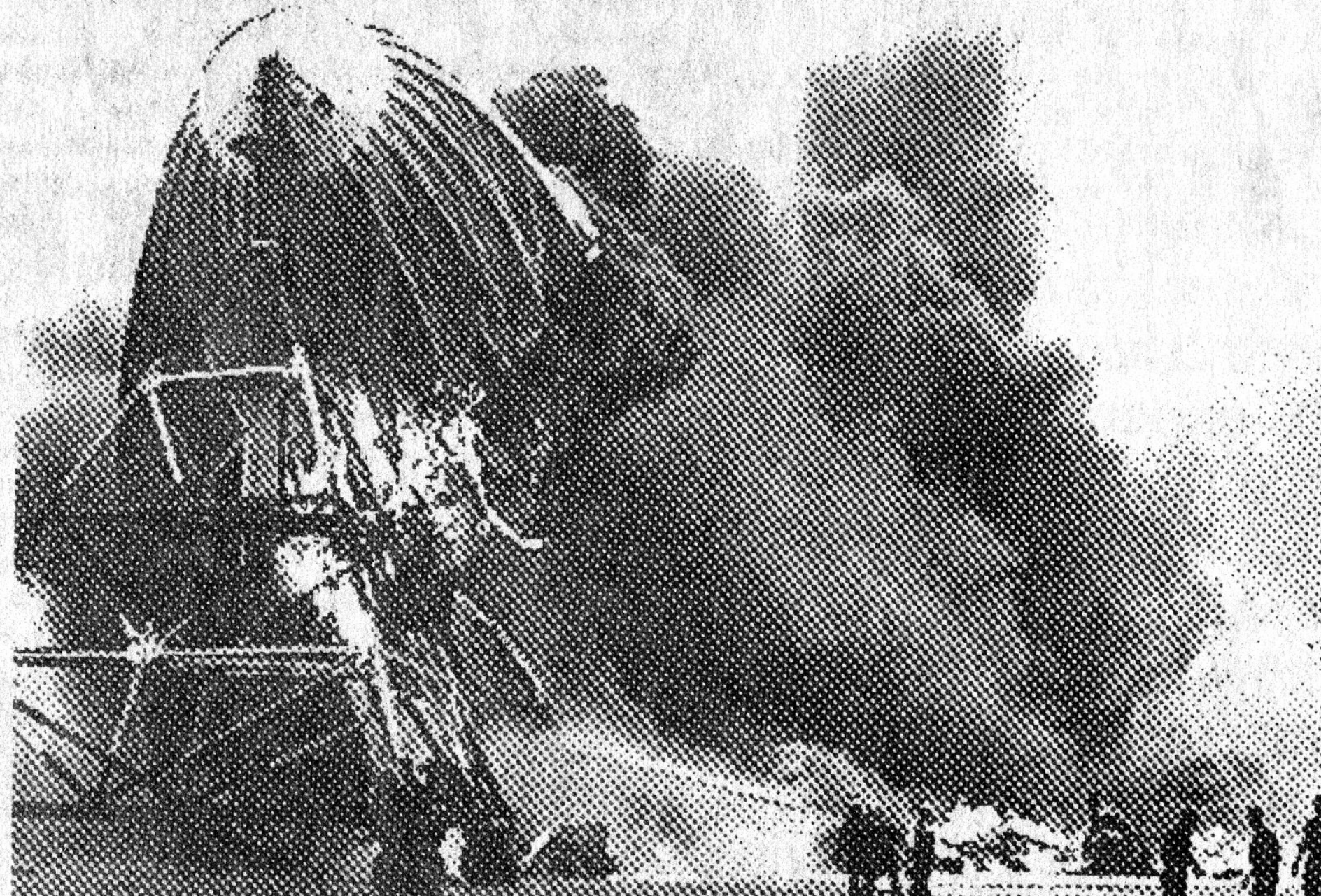
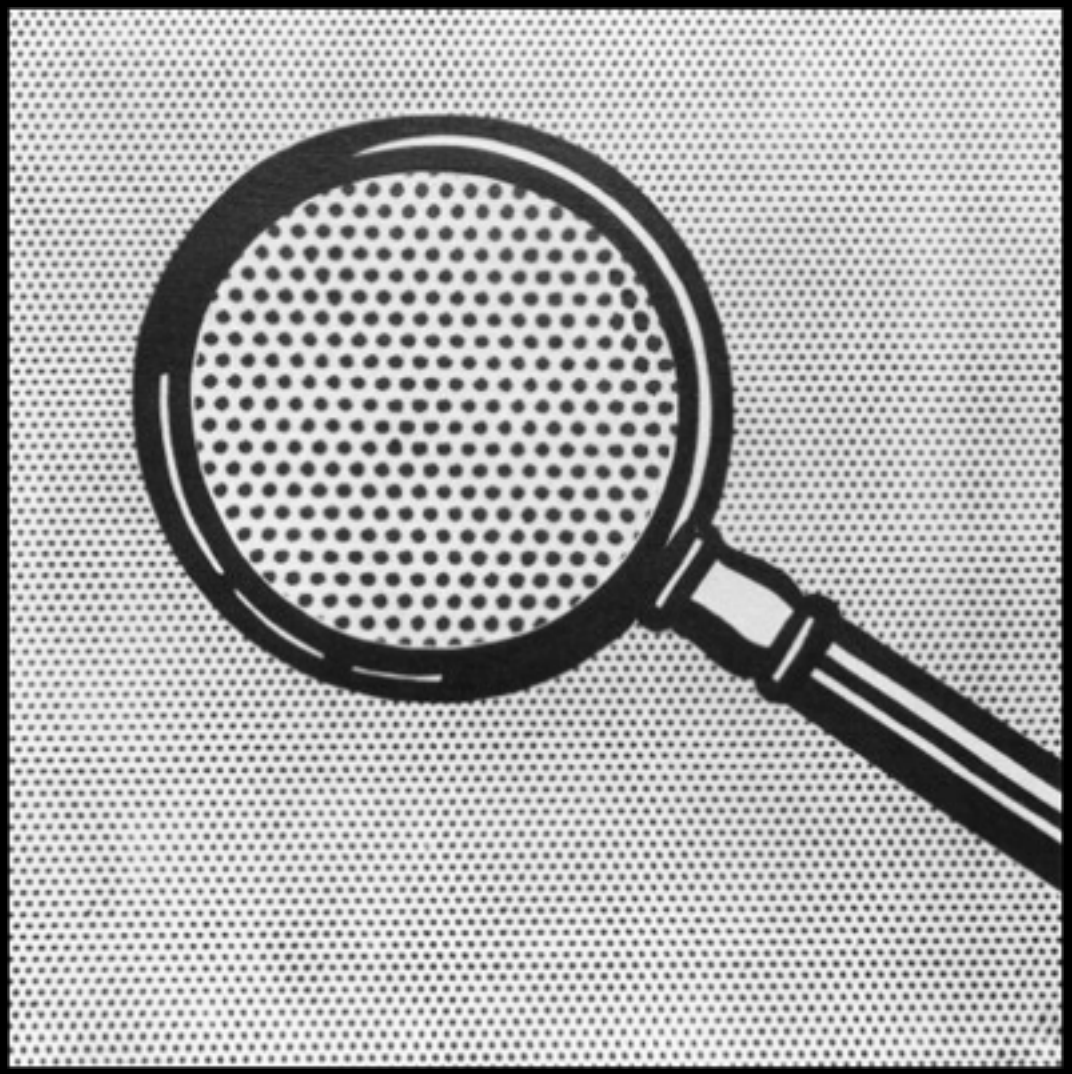


Photo courtesy of action datsun on Flickr.

Vicki!
I - I Thought I Heard
Your Voice!

Roy Lichtenstein (1964)

enamel on steel



Magnifying Glass

Roy Lichtenstein (1963)

oil on canvas

Photo courtesy of Kyle McDonald on Flickr.

3.091SC Introduction to Solid State Chemistry

Fall 2009