Welcome to 3.091

3.091 Periodic Table Quiz

September 18, 2003

Name _____

Grade _____/10

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															

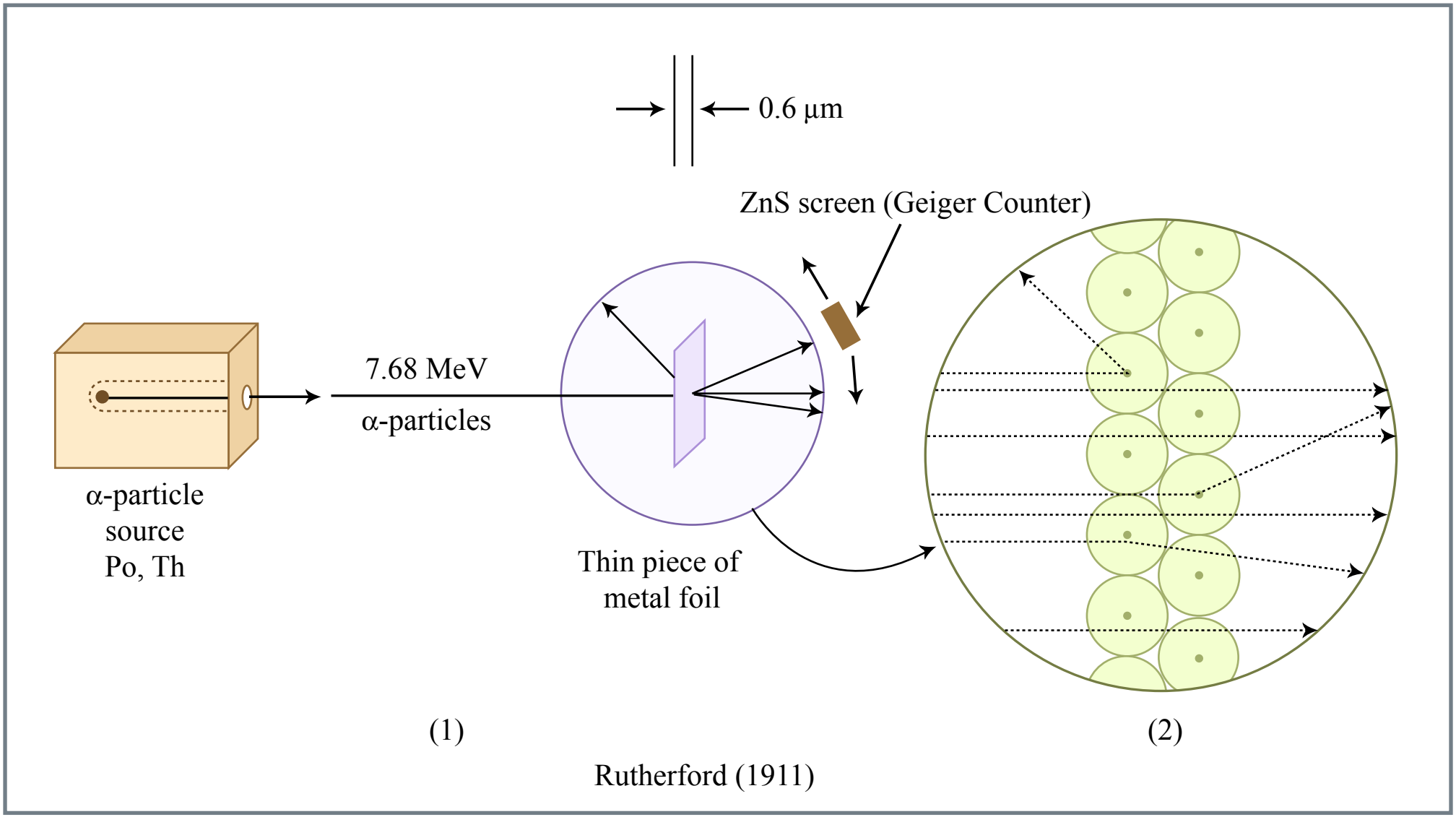

Figure by MIT OCW.

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:

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

   $c = \nu\lambda$

	Quantity	Symbol	
1	Speed of light in vacuum	c	
2	Permeability of vacuum	μ_0	
3	Permittivity of vacuum	$\epsilon_0 = 1/\mu_0 c^2$	8
4	Newtonian constant of gravitation	G	
5	Planck constant	h	6
6	h-bar	$\hbar = h/2\pi$	1.
7	Elementary charge	e	1.
8	Electron mass	m_e	9
9	Proton mass	m_p	1
10	Neutron mass	m_n	1.
11	Avagadro constant	N_A, L	6
12	Atomic mass constant	m_u	1.
13	Molar gas constant	R	
14	Boltzmann constant	$k = R/N_A$	1
15	Molar volume (ideal gas), STP	V_m	
16	Faraday constant	$F = N_A e$	
17	Magnetic flux quantum	$\Phi_0 = h/2e$	2.0
18	Bohr magneton	$\mu_B = e\hbar/2m_e$	9.
19	Nuclear magneton	$\mu_N = e\hbar/2m_p$	5

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18	Bohr magneton	$\mu_B = e\hbar/2m_e$	$9.274\,015\,4(31) \times 10^{-24}$	J T^{-1}	0.
19	Nuclear magneton	$\mu_N = e\hbar/2m_p$	$5.050\,786\,6(17) \times 10^{-27}$	J T^{-1}	0.
20	Fine structure constant	$\alpha = \mu_0 ce^2/2h$	$7.297\,353\,08(33) \times 10^{-3}$		0.
21	Inverse fine structure constant	$1/\alpha$	137.035 989 5(61)		0.
22	Rydberg constant	$R_\infty = m_e c\alpha^2/2h$	10 973 731.534(13)	m^{-1}	0.
23	Rydberg constant in eV	$R_\infty hc/\{e\}$	13.605 698 1(40)	eV	0.
24	Bohr radius	$a_0 = \alpha/4\pi R_\infty$	$0.529\,177\,249(24) \times 10^{-10}$	m	0.
25	Quantum of circulation	$h/2m_e$	$3.636\,948\,07(33) \times 10^{-4}$	m^2 s^{-1}	0.
26	Electron specific charge	$-e/m_e$	$-1.758\,819\,62(53) \times 10^{11}$	C kg^{-1}	0.
27	Electron Compton wavelength	$\lambda_C = h/m_e c$	$2.426\,310\,58(22) \times 10^{-12}$	m	0.
28	Electron classical radius	$r_e = \alpha^2 a_0$	$2.817\,940\,92(38) \times 10^{-15}$	m	0.
29	Electron magnetic moment	μ_e	$928.477\,01(31) \times 10^{-26}$	J T^{-1}	0.
30	Electron mag. moment anomaly	$a_e = \mu_e/\mu_B - 1$	$1.159\,652\,193(10) \times 10^{-3}$		0.
31	Electron g-factor	$g_e = 2(1 + a_e)$	2.002 319 304 386(20)		0.
32	Muon mass	m_μ	$1.883\,532\,7(11) \times 10^{-28}$	kg	0.
33	Muon magnetic moment	μ_μ	$4.490\,451\,4(15) \times 10^{-26}$	J T^{-1}	0.
34	Muon mag. moment anomaly	$a_\mu = [\mu_\mu/(e\hbar/2m_\mu)] - 1$	$1.165\,923\,0(84) \times 10^{-3}$		7.
35	Muon g-factor	$g_\mu = 2(1 + a_\mu)$	2.002 331 846(17)		0.
36	Proton magnetic moment	μ_p	$1.410\,607\,61(47) \times 10^{-26}$	J T^{-1}	0.
37	Proton gyromagnetic ratio	γ_p	$26\,752.212\,8(81) \times 10^4$	T^{-1} s^{-1}	0.
38	Neutron magnetic moment	μ_n	$0.966\,237\,07(40) \times 10^{-26}$	J T^{-1}	0.
39	Stefan-Boltzmann constant	$\sigma = (\pi^2/60)k^4/\hbar^3 c^2$	$5.670\,51(19) \times 10^{-8}$	W m^{-2} K^{-4}	34
40	First radiation constant	$c_1 = 2\pi hc^2$	$3.741\,774\,9(22) \times 10^{-16}$	W m^2	0.
41	Second radiation constant	$c_2 = hc/k$	0.014 387 69(12)	m K	8.
42	Electron volt	eV $= (e/\mathrm{C})$J $= \{e\}$J	$1.602\,177\,33(49) \times 10^{-19}$	J	0.
43	Atomic mass unit	u	$1.660\,540\,2(10) \times 10^{-27}$	kg	0.
44	Standard atmosphere	atm	101 325	Pa	ex
45	Standard acceleration of gravity	g_n	9.806 65	m s^{-2}	ex

Notation: $1.602\,177\,33(49) \times 10^{-19}$ C means $(1.602\,177\,33 \pm 0.000\,000\,49) \times 10^{-19}$ C

C = A s F = (C/V) = m^{-2} kg^{-1} s^4 A^2 Pa = N m^{-2} = m^{-1} kg s−2 T = kg s^{-2} A^{-1} W = J s^{-1} =
Wb = V s = m^2 kg s^{-2} A^{-1} F m^{-1} = (C/V) m^{-1} = m^{-3} kg^{-1} s^4 A^2 T s = kg s^{-1} A^{-1} J T^{-1} = m^2 A

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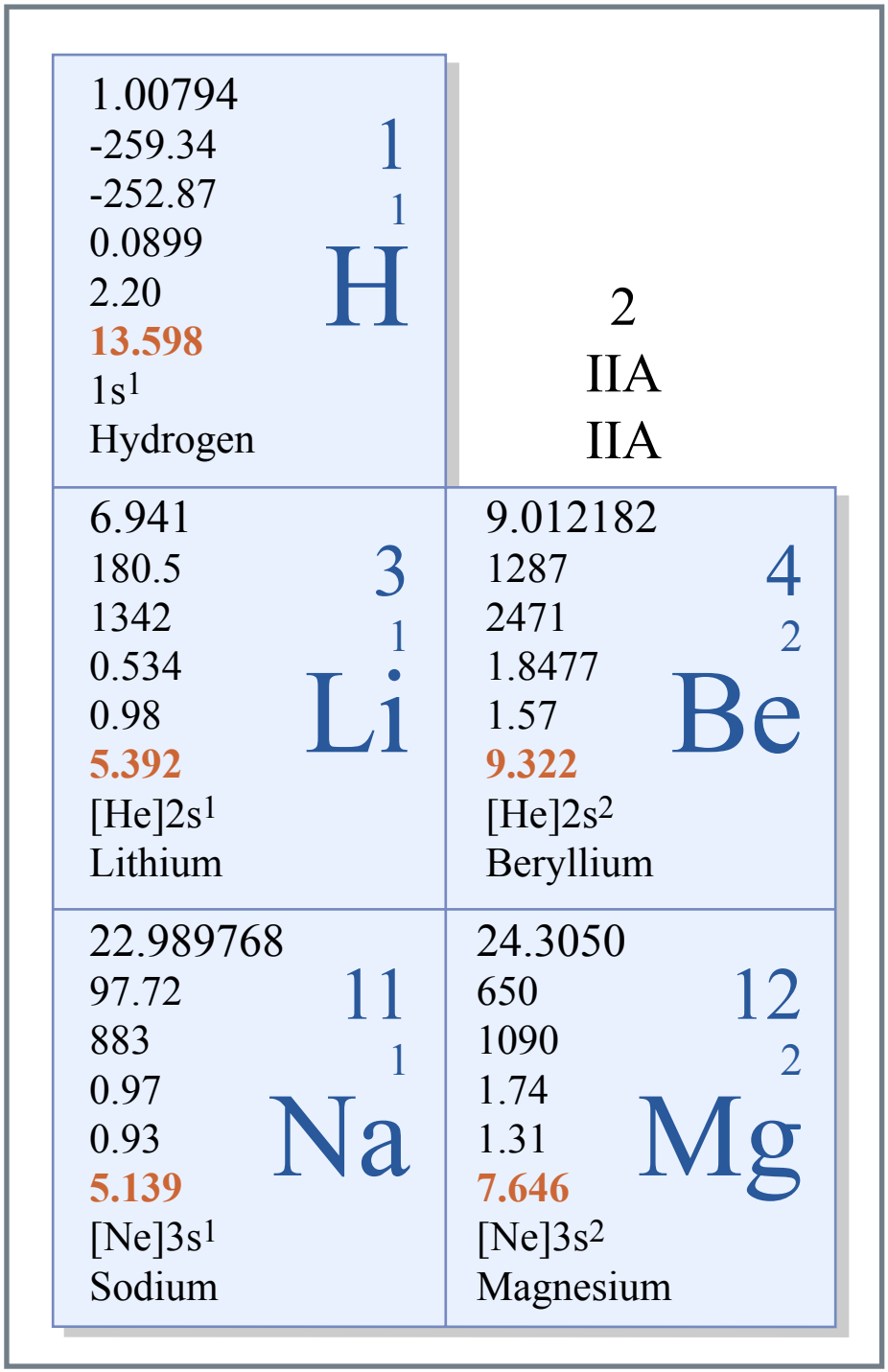

Figure by MIT OCW.

Prism Spectrograph A.A. Ångström (1853)

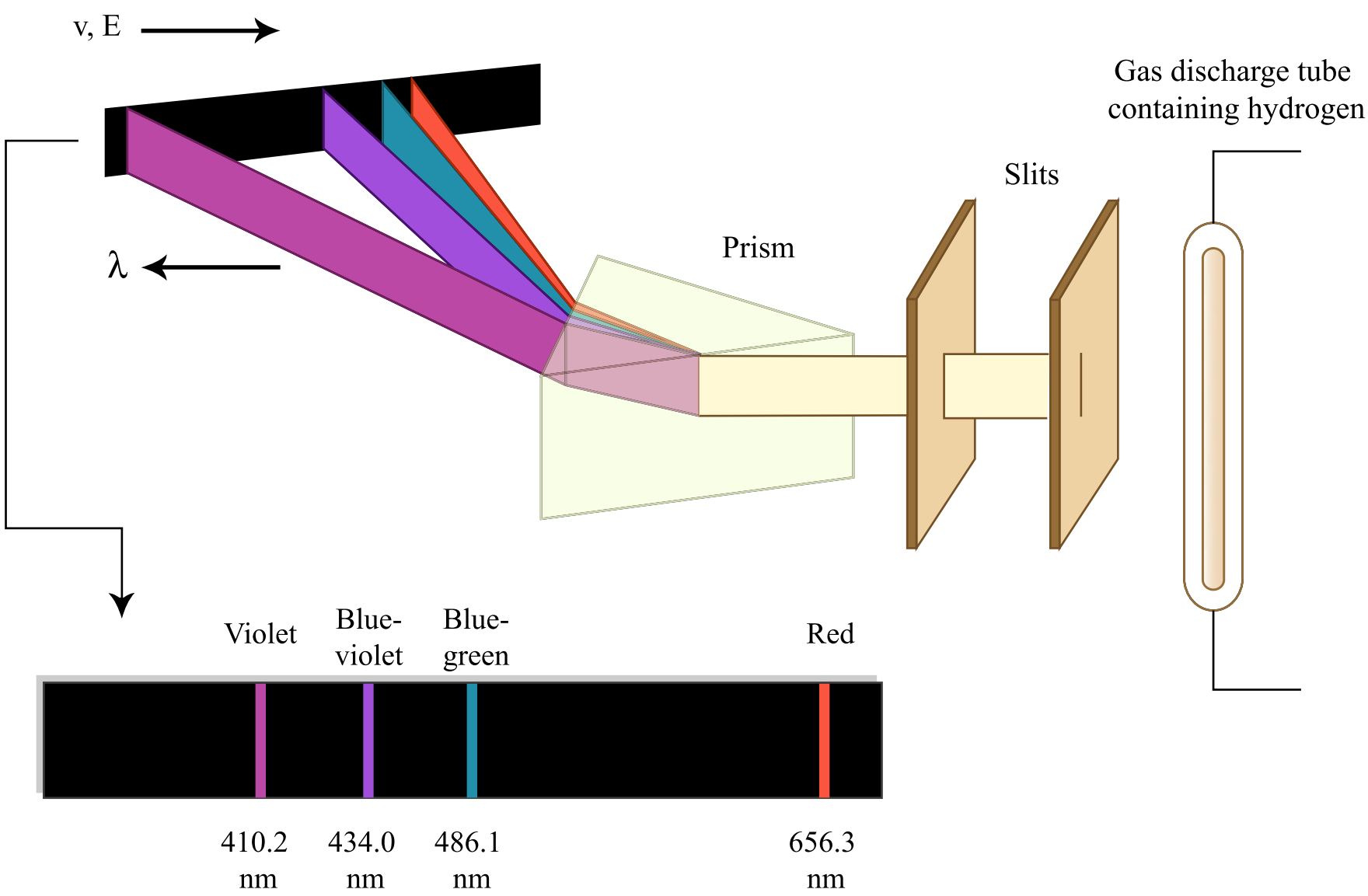

Figure by MIT OCW.

Cecilia Payne (1900-1979)

1st woman graduate student in Astronomy at Harvard

1st Ph.D. in Astronomy at Harvard

1st woman to receive tenure at Harvard

1st woman to chair the Faculty of Arts and Sciences at Harvard

awarded tenure in 1938 but denied a professorship for 18 years

forced to recant her findings that the sun is not dominantly iron but rather hydrogen

theysaidironagaien

theysaid**iron**agaien

t**h**e**y**sai**d**i**ro**na**g**ai**en**

t**h**e**y**sai**d**i**ro**na**g**ai**en**

h y d ro g en

“The enormous abundance [of hydrogen]…
is almost certainly not real.”

- Cecilia Payne, Ph.D. Thesis, Harvard College

Image removed due to copyright concerns.

painting by Patricia Watwood hangs in the faculty room
of University Hall, Harvard U.