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Organizing The Subject of The Spectral Series of The Hydrogen Atom on The Base of New Pedagogical Technologies

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Abstract: This article talks about teaching the topics of Bohr's postulates, spectral series in the hydrogen atom, Balmer's formula, Balmer's generalized formula, Rydberg-Ritz's combinatorial principle based on modern pedagogical technologies.

Key words: Boron postulates, Hydrogen atom, spectral series, Balmer's formula, Balmer's generalized formula, combinatorial principle, modern pedagogical technology.

Atomning planetar modeliga duch kelgan qiyinchilikni 1913 yili N.Bor atomning yangi modeli bilan bartaraf qildi. Atomning Bor modeli ham planetar bo'lib, lekin avvalgiga nisbatan quyidagi 4 qo'shimchalar kiritiladi:

1. Kulon va markazga intilma kuchlar ta`sirida vodorod atomida elektron proton atrofida tekis aylana bo'ylab harakat qiladi.
2. Elektronning impul`s momenti butun songa teng va u $h/2\pi = \hbar$ ni ruxsat etilgan orbitalar son ko'paytmasiga teng bo'ladi, ya`ni

$$L = m\upsilon r = n\frac{h}{2\pi} = n\hbar, \qquad n = 1,2,3....$$

h -Plank doimiysi, $\hbar$ = 1,05 · 10^{-34} J · s.

3. Elektron ruxsat etilgan atom orbitasi bo'yicha harakat qilganda, o'zidan yorug'lik chiqarmaydi.

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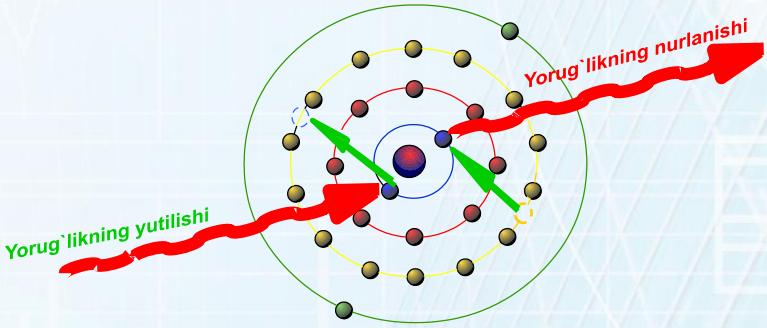
4. Elektron energiyasi E_n orbitadan energiyasi undan kichik bo'lgan E_m orbitaga o'tganda o'zidan nur chiqaradi, uning chastotasi quyidagicha aniqlanadi.

$$\nu = \frac{E_n - E_m}{h}$$



1-rasm.

Masalan, 1-rasmda elektron n = 3 orbitadan n = 1 orbitaga o'tganda (AB o'tish) ν chastotali $\nu = \frac{E_3 - E_1}{h}$ bo'lgan foton tarqatadi.

Bu nurlanish spektrining (diskretligini) tushuntiradi. Vodorod atomning spektrlari 2-rasmda keltirilgan. Ushbu rasmda Layman (n = 1), Bal`mer (n = 1), Breket (n = 3) va Pashen (n = 4) seriyalari keltirilgan. Balmer seriyasida n = 2 orbitaga undan yuqori joylashgan orbitalardan elektronlar o'tganda Bal`mer seriyasi hosil bo'ladi. Agarda elektron n = 3 orbitadan n = 4 orbitaga o'tsa, chastotasi $\nu = \frac{E_4 - E_3}{h}$ bo'lgan fotonni yutadi. Bunda yutulish spektri hosil bo'ladi.

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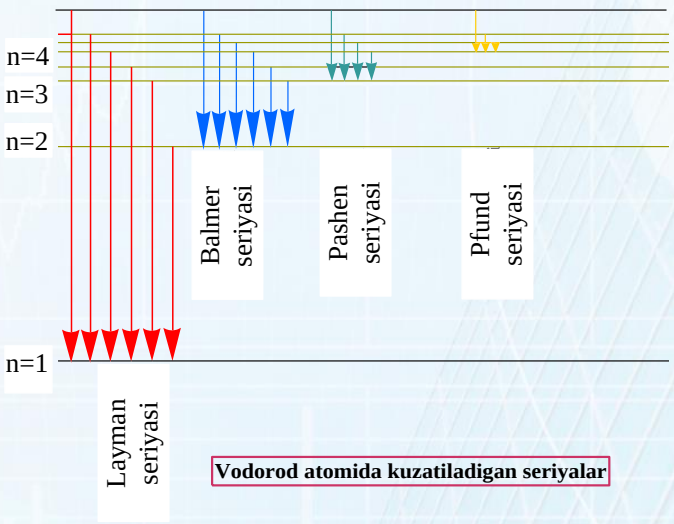

2-rasm.

Borning birinchi postulati asosida vodorod atomining to'la energiyasini aniqlash mumkin. Yadro atrofida elektron aylana bo'ylab harakat qilganligi tufayli, unga bir vaqtning o'zida ikkita kuch ta`sir etadi.

$$\frac{mv^2}{r} = -\frac{Ze^2}{4\pi\varepsilon_0 r^2} \quad (3)$$

Vodorod atomi uchun Z = 1.

r - elektron orbitasining radiusi.

(3)-ifodadan $\upsilon^2 = \frac{e^2}{4\pi\varepsilon_0 rm}$ aniqlab, uni elektronning kinetik energiya qiymatiga qo'yamiz.

$$E_k = \frac{m\upsilon^2}{2} = \frac{m}{2}\cdot\frac{e^2}{4\pi\varepsilon_0 rm} = \frac{1}{8\pi\varepsilon_0}\cdot\frac{e^2}{r} \quad (4)$$

Vodorod atomining potensial energiyasi

$$E_n = -\frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{r} \quad (5)$$

"-" ishora elektron va proton orasida tortishish kuchi borligini bildiradi. Sistemaning to'la energiyasi potensial va kinetik energiyalar yig'indisiga teng.

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$$E = E_n + E_k = -\frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{r} + \frac{1}{8\pi\varepsilon_0}\cdot\frac{e^2}{r} = -\frac{1}{8\pi\varepsilon_0}\cdot\frac{e^2}{r} \quad (6)$$

r-orbita radiusini aniqlash uchun (1) ifodadan $\upsilon = \frac{n\hbar}{mr}$ topib, elektron kinetik energiyasidagi tezlikning o'rniga qo'yamiz, (4) ifodadan

$\frac{1}{2}m\left(\frac{n\hbar}{mr}\right)^2 = \frac{1}{8\pi\varepsilon_0}\frac{e^2}{r}$, bundan

$$\frac{m}{2}\frac{n^2\hbar^2}{m^2r^2} = \frac{1}{8\pi\varepsilon_0}\frac{e^2}{r} \rightarrow r = r_n = \frac{4\pi\varepsilon_0 n^2\hbar^2}{me^2}, n = 1,2,3,... \quad (7)$$

Borning uchinchi postulatiga asosan, elektron nurlanmasdan harakat qiluvchi orbitani, stasionar holat deyiladi. n = 1 holatni asosiy yoki normal holat deyiladi. Bu holatda sistema eng kichik energiyaga teng bo'ladi. n = 2, 3, 4, holatlar uyg'ongan holatlar bo'lib, bu holatlardagi atom katta energiyaga ega. Asosiy holatga, ya`ni n = 1 mos keluvchi radius – Bor radiusi deyiladi.
Uning ifodasi

$$r_1 = \frac{4\pi\varepsilon_0\hbar^2}{me^2} \quad (8)$$

$\varepsilon_0 = 8{,}854\cdot10^{-12}\,F/m$-elektr doimiysi, $e = 1{,}602\cdot10^{-19}\,Kl$ -elektron zaryadi, $m_0 = 9{,}1095\cdot10^{-31}\,kg$ - elektronning tinchlikdagi massasi, $\hbar = 1{,}05\cdot10^{-34}\,J\cdot s$, bu kattaliklarni (8) ifodaga qo'ying, u holda $r_1 = 0{,}53\cdot10^{-8}m = 0{,}53A^0$ bo'ladi. Bu boshqa usullar bilan olingan natijalarga mos keladi.
(8) ifodani (6) ifodaga qo'ysak,

$E_1 = -\frac{me^4}{32\pi^2\varepsilon_0{}^2\hbar^2}$ (9) ifoda hosil bo'ladi. "-" ishora bog'langan sistema ekanligidan dalolat beradi. Kattaliklarning son qiymatlarini (9) ifodaga qo'yib hisoblasak n = 1 bo'lganda, ya`ni atomning asosiy holatidagi energiya qiymati topiladi u $E_1 = -13{,}6eV$. Energiya atom fizikasida elektronovol`t da (eV) hisoblanadi. Atom va yadro fizikasida energiya birligi sifatida elektronovol`tdan foydalanishadi

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$1eV = 1e \cdot 1V = 1{,}6 \cdot 10^{-19} Kl \cdot 1V = 1{,}6 \cdot 10^{-19} J$.

Elektronning anod bilan o'zaro ta`sir kattaligi uning zaryad va potensiallar farqi kattaliklariga bog'liq. Shu sababdan potensiallar farqi 1V ga teng elektr maydonida elektronning tezlanish bilan harakat qilishiga 1 elektronovol`t deyiladi.

Uyg'ongan energiya – elektron asosiy holatdan birorta yuqori holatga o'tish uchun sarflanadigan energiya. Masalan, vodorod atomi uchun n = 2 holat uchun energiya $E_2 = -3{,}40eV - (-13{,}6eV) = 10{,}2eV$ ga teng.

Ionlashtirish energiyasi-asosiy holatdagi elektronni atomdan ajratish uchun sarflangan energiya. Vodorod atomi uchun $E_{ion} = 13{,}6eV$.

Bog'lanish energiyasi – uyg'ongan holatdagi elektronni atomdan ajratish uchun sarflash energiyasi. Masalan, vodorod atomi uchun n =2 holatda bog'lanish energiyasi $E_{bog'} = 3{,}40eV$ ga teng. Agarda atom asosiy holatda joylashgan bo'lsa, ionlashtirish va bog'lanish energiyalari bir-biriga teng. Asosiy holatda turgan vodorod atomining bog'lanish energiyasi 13,6 eV ga teng.

Bal'mer seriyasi. Shveytsariyalik fizik I.Bal'mer 1885 yilda vodorod atomining ko'zga ko'rinuvchi qismidagi spektral chiziqlarning taqsimoti (chastotasi) uchun quyidagi

$$\nu = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right) \qquad (n = 3,4,5,....) \qquad (9)$$

formulani topdi. Bu yerda $R = 3{,}29 \cdot 10^{15} c^{-1}$–Ridberg doimiysi. Agar $\nu = \frac{c}{\lambda}$ ekanligini nazarda tutsak, Bal'mer formulasini quyidagi ko'rinishda yozish mumkin:

$$\frac{1}{\lambda} = \frac{R}{c}\left(\frac{1}{2^2} - \frac{1}{n^2}\right) = R'\left(\frac{1}{2^2} - \frac{1}{n^2}\right) \qquad (n = 3,4,5,....) \qquad (10)$$

$R' = \frac{R}{c} = 1{,}10 \cdot 10^7 м^{-1}$ ga ham Ridberg doimiysi deyiladi.

n ning turli qiymatlariga qarab chiziqlar guruhi hosil bo'ladi va ularga Bal'mer seriyasi deyiladi. 5–rasmda Bal'mer seriyasi ko'rsatilgan bo'lib,

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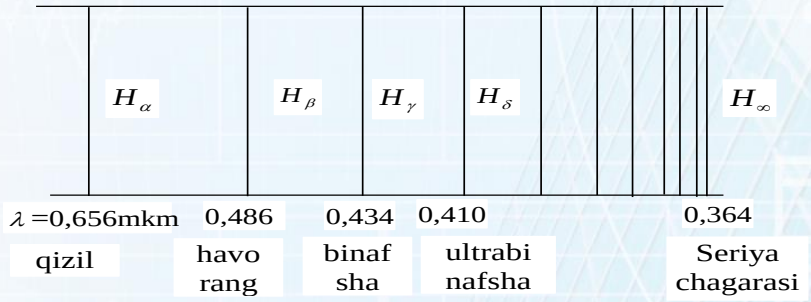
$H_\alpha, H_\beta, H_\gamma, H_\delta$ lar bilan ko'zga ko'rinuvchi chiziqlar belgilangan bo'lsa, H_∞ ga Bal'mer seriyasining eng so'nggi chizig'i mos keladi.



Bu seriyalarni Bal'merning umumlashgan formulasi orqali aniqlanadi:

$$\nu = R\left(\frac{1}{m^2} - \frac{1}{n^2}\right) \quad (11)$$ To'lqin uzunligi bo'yicha $$\frac{1}{\lambda} = \mathrm{R}'\left(\frac{1}{\mathrm{m}^2} - \frac{1}{\mathrm{n}^2}\right) \quad (12)$$

bu erda m har bir seriya uchun o'zgarmas $m = 1, 2, 3, 4, \ldots$. qiymatlarni qabul qilib, chiziqlar guruhi qanday seriya ekanligini ifodalaydi, n butun qiymatlarni ($m+1$ dan boshlab) qabul qilib, seriyadagi chiziqlarni ko'rsatadi. Vodorod atomi spektridagi mavjud 6ta seriyalarni quyidagi jadval yordamida ifodalash mumkin:

Seriyalar	m	n
Layman	1	2, 3, 4, ...
Bal'mer	2	3, 4, 5, ...
Pashen	3	4, 5, 6, ...
Breket	4	5, 6, 7, ...
Pfund	5	6, 7, 8, ...
Xemfri	6	7, 8, 9, ...

(12) ifodada quyidagicha belgilash kiritamiz: $T(m) = \frac{R'}{m^2}$, $T(n) = \frac{R'}{n^2}$. Bu kattaliklarni spektral termlar yoki termlar deyiladi. Ular orqali (12)ni quyidagicha yozish mumkin:

$$\frac{1}{\lambda} = T(m) - T(n) \quad (13)$$

Bu formula Ridberg –Ritsning kompinatsion prinsipi ifodasi deyiladi. Bu prinsip quyidagicha ta`riflanadi: *agar bitta seriyaning ikkita spectral chizig'ining to'lqin sonlari ma'lum bo'lsa, ularning ayirmasi ham boshqa seriyaning uchinshi spectral chizig'i to'lqin sonini berib, bu to'lqin soni ana shu atomga tegishli bo'ladi*.

Mashg'ulot yakuni bo'yisha nazorat savollar:

1. Rezerfod modelining kamchiligi nimada ekan?
2. Bor postulatlarini ayting.
3. Vodorod atomida nurlanish spektrlari qanday hosil bo'ladi?
4. Balmer formulasini yozing.
5. Qanday spektral seriyalar mavjud?
6. Balmerning umumlashgan formulasini ayting.
7. Ridberg –Ritsning kombinatsion prinsipi qanday?

References

1. Qosimjon o'g'li, Qurbonaliyev Qobiljon, Xusanov Omonjon Numonjon o'g'li, and Abdurafiqov Hayotjon Xislatjon o'g'li. "METHODOLOGY OF ORGANIZING PRACTICAL COURSES ON PARTICLE PHYSICS IN PEDAGOGICAL INSTITUTIONS OF HIGHER EDUCATION." Galaxy International Interdisciplinary Research Journal 10.12 (2022): 1030-1032.
2. Qosimjon o'g'li, Qurbonaliyev Qobiljon, Xusanov Omonjon, and Abdurafiqov Hayotjon. "METHODOLOGY OF DISCUSSION OF FUNDAMENTAL FEATURES OF ELEMENTARY PARTICS IN PEDAGOGICAL EDUCATIONAL INSTITUTIONS." Galaxy International Interdisciplinary Research Journal 10.12 (2022): 1038-1041.
3. Насриддинов, К. Р., and А. М. Мадалиев. "ЭЛЕМЕНТАР ЗАРРАЛАР ФИЗИКАСИНИНГ СЎНГГИ ЮТУҚЛАРИ ВА УЛАРНИ ПЕДАГОГИКА ОЛИЙ ТАЪЛИМ МУАССАСАЛАРИДА ЎҚИТИЛИШ ҲОЛАТИ." Academic research in educational sciences 2.CSPI conference 3 (2021): 597-602.
4. Maxammadjonovich, Madaliyev Akmaljon. "LATEST ACHIEVEMENTS IN THE FIELD OF PARTICLE PHYSICS AND ITS TEACHING IN PEDAGOGICAL

HIGHER EDUCATION IN THE ENVIRONMENT OF INFORMATION TECHNOLOGIES." Berlin Studies Transnational Journal of Science and Humanities 2.1.5 Pedagogical sciences (2022).

5. Makhammadjonovich, Madaliyev Akmaljon. "IMPROVING THE METHODOLOGY OF ORGANIZING PRACTICAL CLASSES OF THE ELEMENTARY PARTICLE PHYSICS DEPARTMENT OF GENERAL PHYSICS." Journal of Modern Educational Achievements 9.9 (2023): 58-62.
6. Maxammadjonovich, Madaliyev Akmaljon. "LATEST ACHIEVEMENTS OF ELEMENTARY PARTICLE PHYSICS AND THE STATE OF ITS TEACHING IN PEDAGOGICAL UNIVERSITIES."
7. Мадалиев, А. М. "РАЗВИТИЕ ТВОРЧЕСКОГО МЫШЛЕНИЯ СТУДЕНТОВ НА ПРАКТИЧЕСКИХ ЗАНЯТИЯХ ПО ФИЗИКЕ ЭЛЕМЕНТАРНЫХ ЧАСТИЦ." ПРИОРИТЕТНЫЕ НАПРАВЛЕНИЯ РАЗВИТИЯ НАУКИ И ОБРАЗОВАНИЯ. 2021.
8. Makhammadjonovich, Madaliyev Akmaljon. "A SCIENTIFIC-METHODICAL APPROACH TO PROCESSES INVOLVING" FUNDAMENTAL"," STRANGE" AND" CHARMING" PARTICLES DURING PRACTICAL TRAINING." Galaxy International Interdisciplinary Research Journal 10.12 (2022): 1-7.
9. Nasriddinov, K. R., and A. M. Madaliyev. "Amaliy mashg'ulotlarda zarralar fizikasi bo'limini o'zlashtirish samaradorligini oshirish yo'llari." Academic research in educational sciences 2.3 (2021): 42-46.
10. Nasriddinov, K. R., and A. M. Madaliyev. "Features of modern research, directions of development and its role in the formation of worldview." International scientific conference" Tendentsii razvitiya physical condensed medium".-Fergana. 2021.
11. Nasriddinov, K. R. "Madaliyev AM Zamonaviy tadqiqotlarning xususiyatlari, taraqqiyot yo'nalishlari va dunyoqarash shakllanishidagi o'rni. Международной научной конференции" Тенденции развития физики конденсированных сред"." (2021): 500-504.

12. Nasriddinov, K. R., and A. M. Madaliyev. "Practical in training particles physics department appropriation efficiency increase ways." Academic research in educational sciences 2 (2021): 42-46.
13. Nasriddinov, K. R., and A. M. Madaliyev. "Ways to improve the efficiency of mastering the particle physics section in practical training." Academic research in educational sciences 2.3 (2021): 42-46.
14. Nasriddinov, K. R., and A. M. Madaliyev. "Umumiy fizika. Elementar zarralar fizikasi asoslari." Toshkent, Ishonchli hamkor.-2021.-128 b.
15. Nasriddinov, K. R., and A. M. Madaliyev. "Umumiy fizika. Elementar zarralar fizikasi asoslari. O'quv qo'llanma." Chirchiq: Ishonchli hamkor.–2021 118 (2021).
16. Makhammadjonovich, Madaliyev Akmaljon. "METHODOLOGY FOR SOLVING PROBLEMS ON FUNDAMENTAL INTERACTIONS BETWEEN PARTICLES IN PRACTICAL LESSONS IN GENERAL PHYSICS." Galaxy International Interdisciplinary Research Journal 10.12 (2022): 1033-1037.