



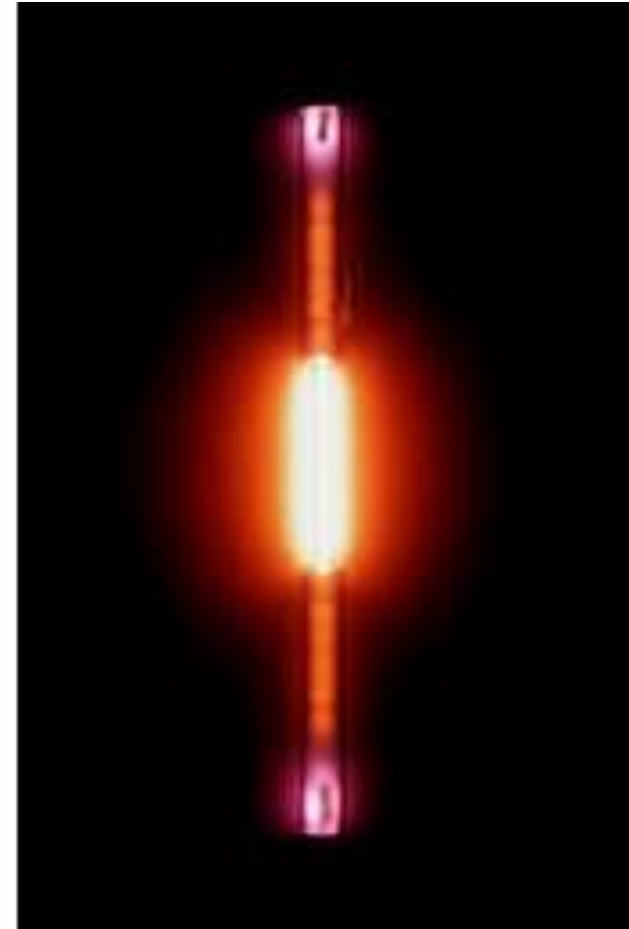
# ORBITS WITHIN THE NUCLEUS

BY PAUL VANRADEN

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# Orbits of the 2 **electrons** in Helium

- The 1<sup>st</sup> electron orbits around the nucleus (like a donut)
- The 2<sup>nd</sup> electron goes up and down (thru the donut hole)
- Planes of the nucleus and 1<sup>st</sup> electron orbit may be tipped at an angle, or conversely the 2<sup>nd</sup> orbit tipped vs the 1<sup>st</sup>
- Helium's nucleus must look like a donut



# Evidence for a hole in the nuclear center

- Source: [Shape of the atomic nucleus - Wikipedia](#):
  - “Nuclear charge densities for both He-3 and He-4, for example, indicate a **hole** or significant central depression within a radius of 0.8 fm.
  - Other light nuclides, including carbon-12 and oxygen-16, exhibit similar off-center charge density maxima.
  - A lower radial charge density within the nuclear core reflects a lower likelihood that scattering electrons will encounter a nucleon near the center of the nucleus compared to the surrounding nuclear structure.”
- My simulations of nuclear orbits began with a central orbit of 2 nucleons like a binary star

# MOTIVATION

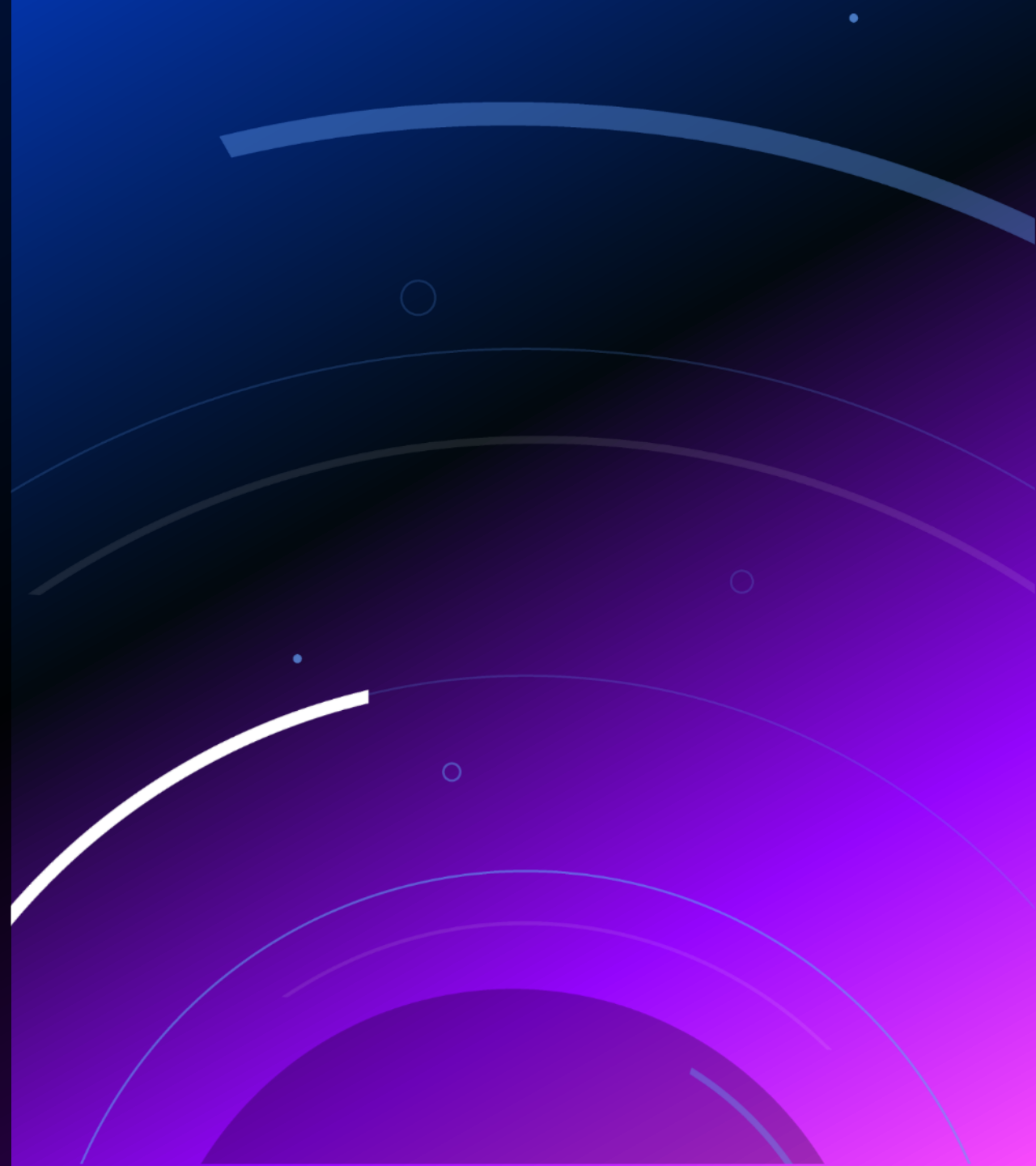
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Simulate the Helium nucleus with a hollow space in its center for 2<sup>nd</sup> electron orbit

Helium is a very stable atom: it does not react with itself or other elements

Helium's nucleus has weight of 4, explained by 4 bodies of equal mass

Nuclear orbits for helium and larger elements can be computed



# STABLE ORBITS IN HELIUM'S NUCLEUS

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Helium's nucleus may have a stable orbit with:

- 2 bodies in a clockwise inner orbit (like a binary star)

- 2 bodies in a counterclockwise outer orbit of twice the time length

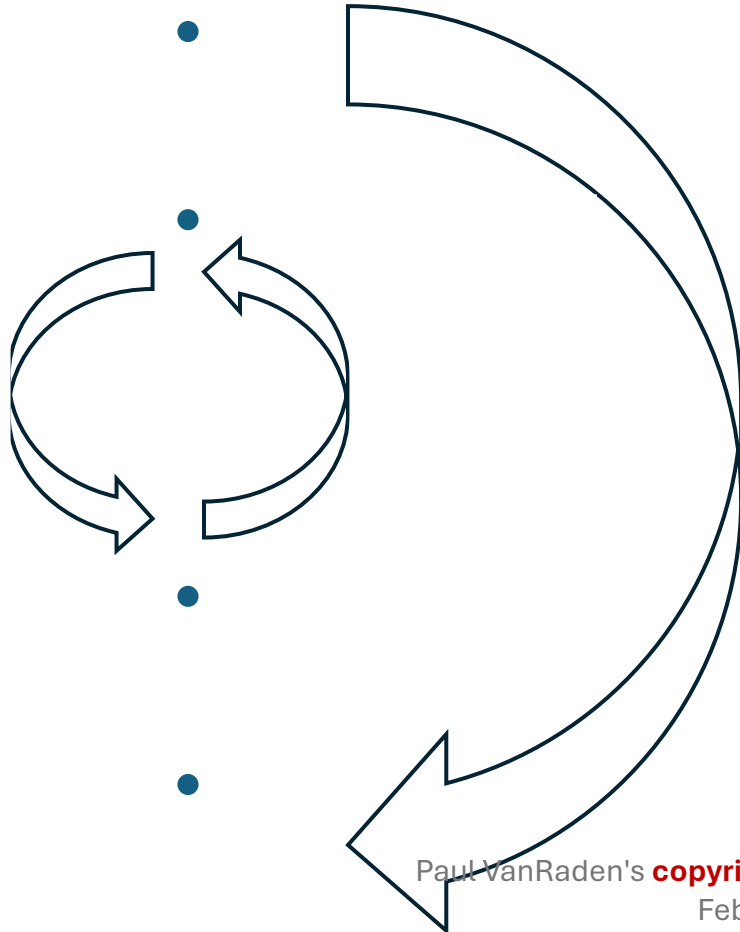
Bodies in the inner and outer orbits approach and pass each other at 6 equidistant points in the orbits, like a hexagon

They slightly accelerate and then decelerate each time they pass

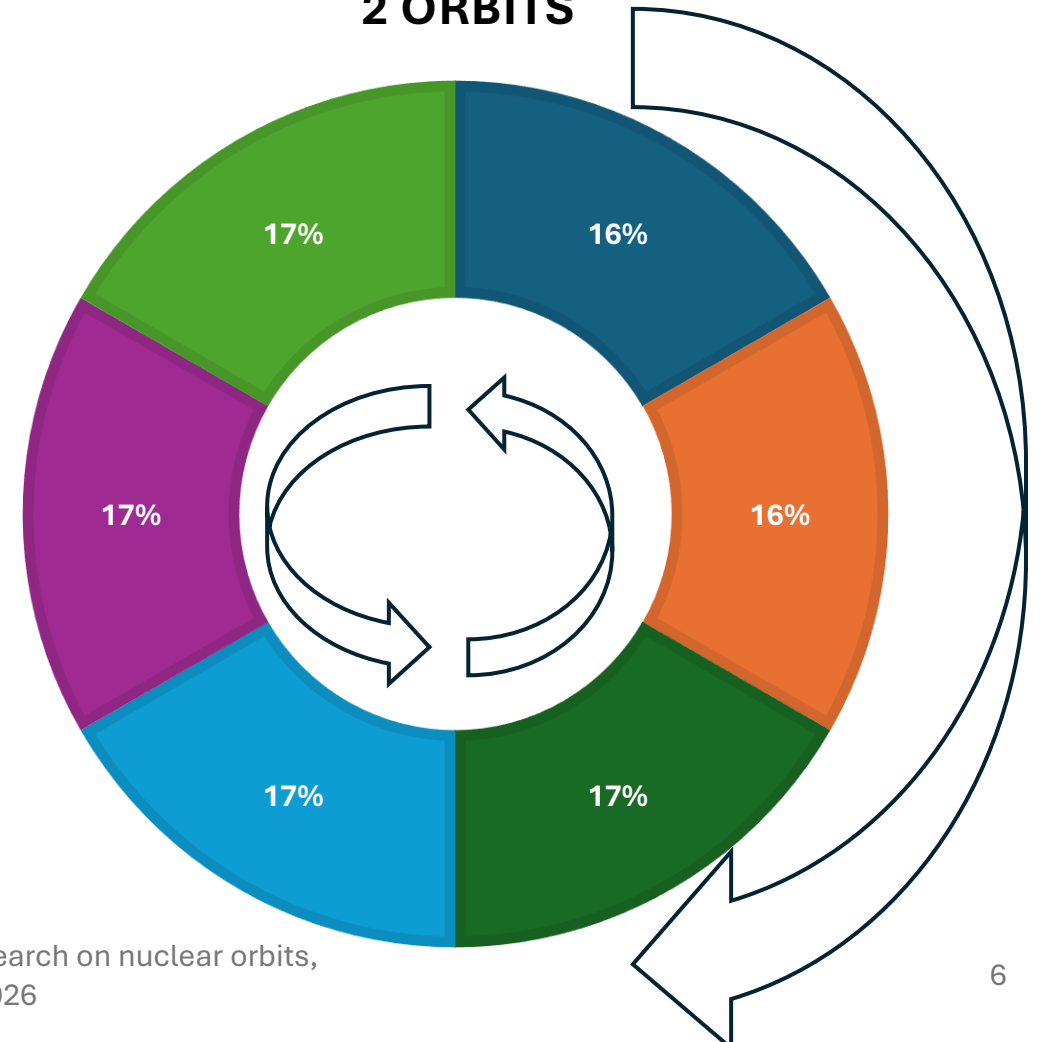
Harmonic orbits are more stable than discordant orbits

# Helium 4 orbit: starting positions of 4 bodies

Starting positions

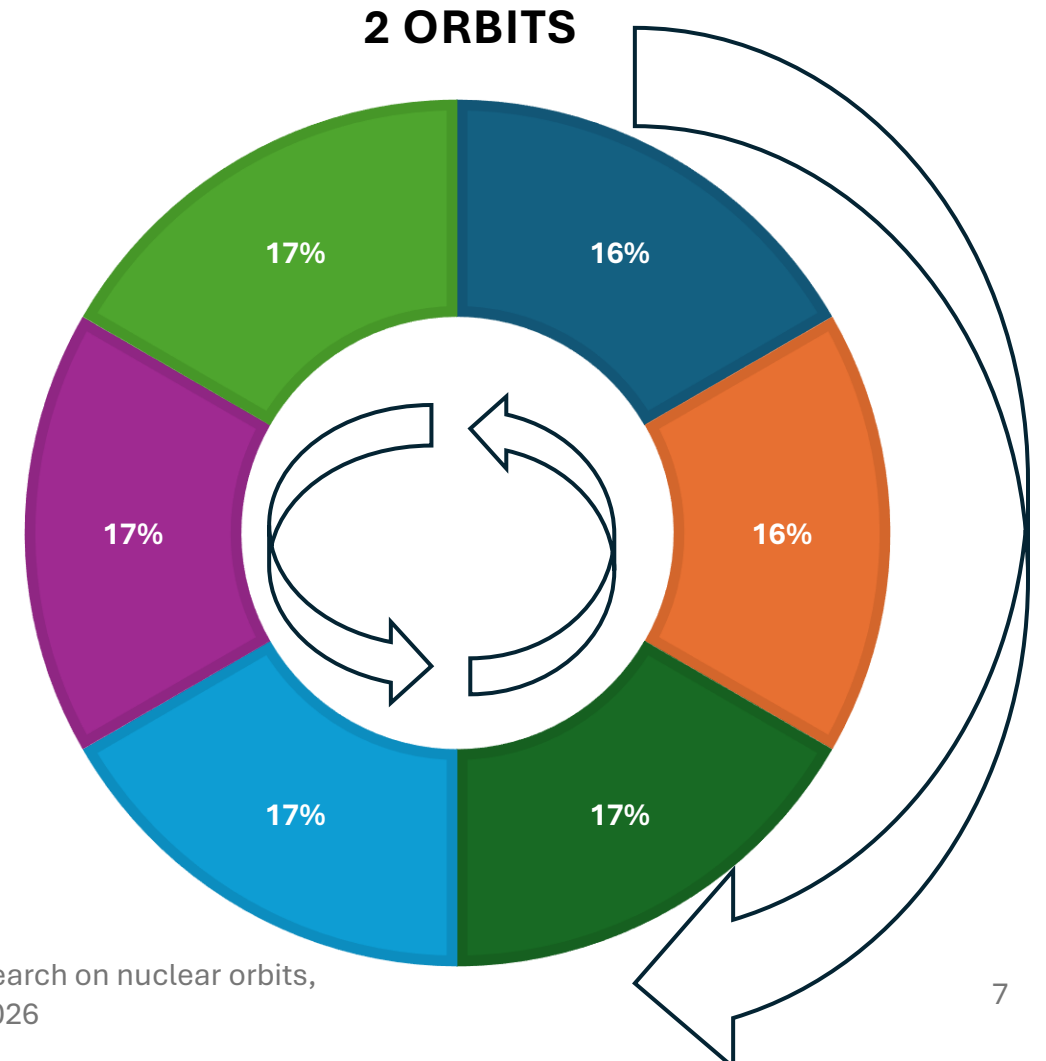


2 ORBITS



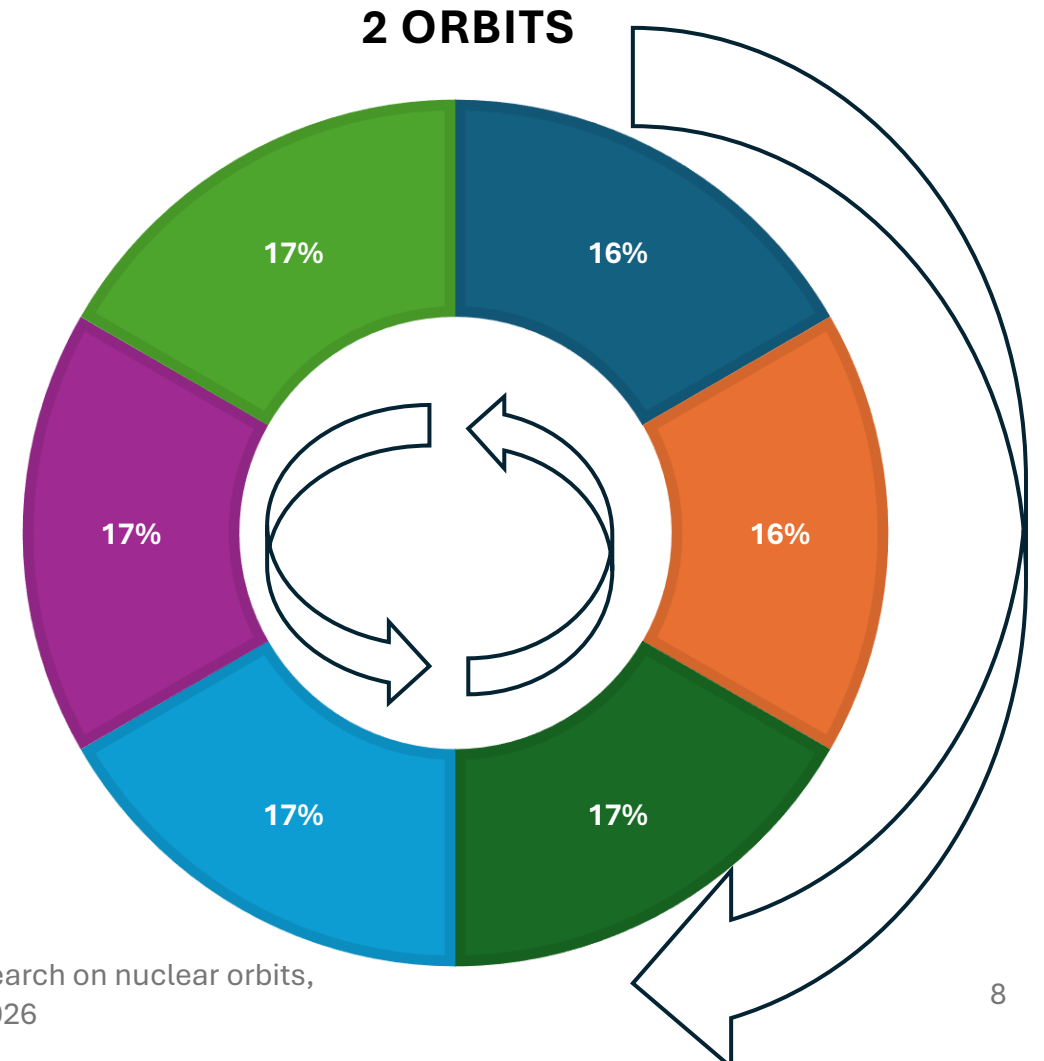
# Next position where all 4 bodies line up

1<sup>st</sup> meeting position



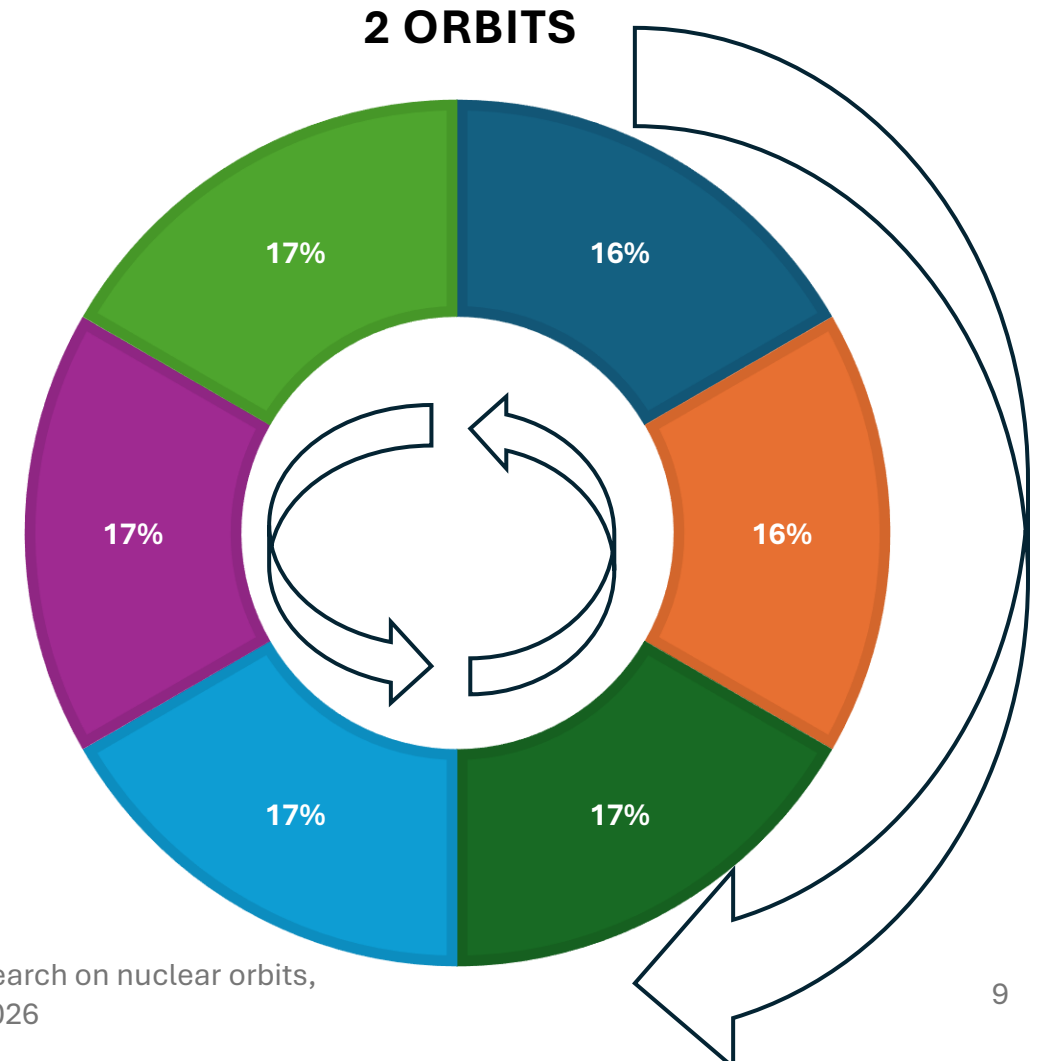
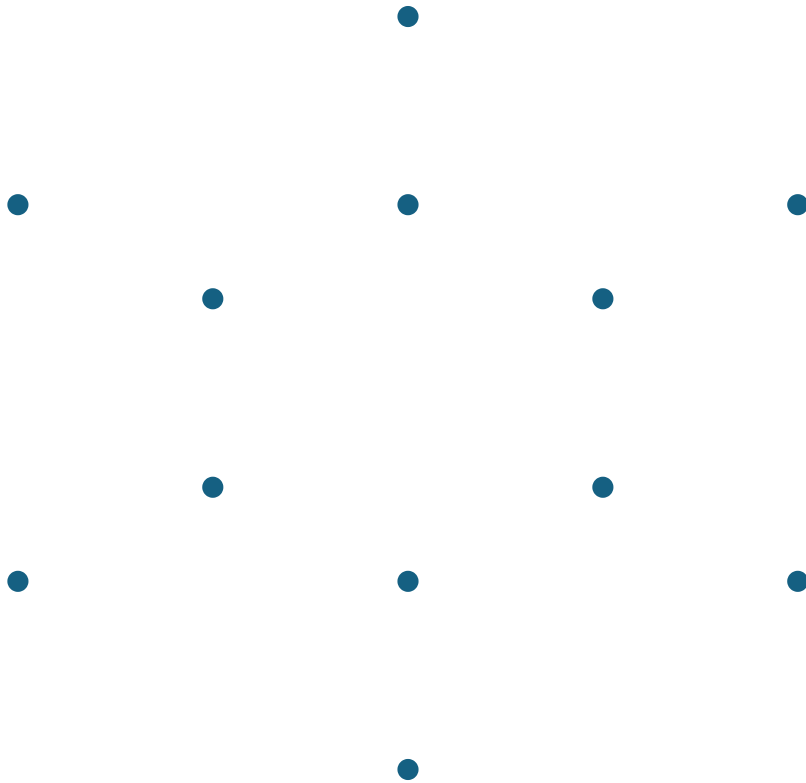
# Next position where all 4 bodies line up

2<sup>nd</sup> meeting position



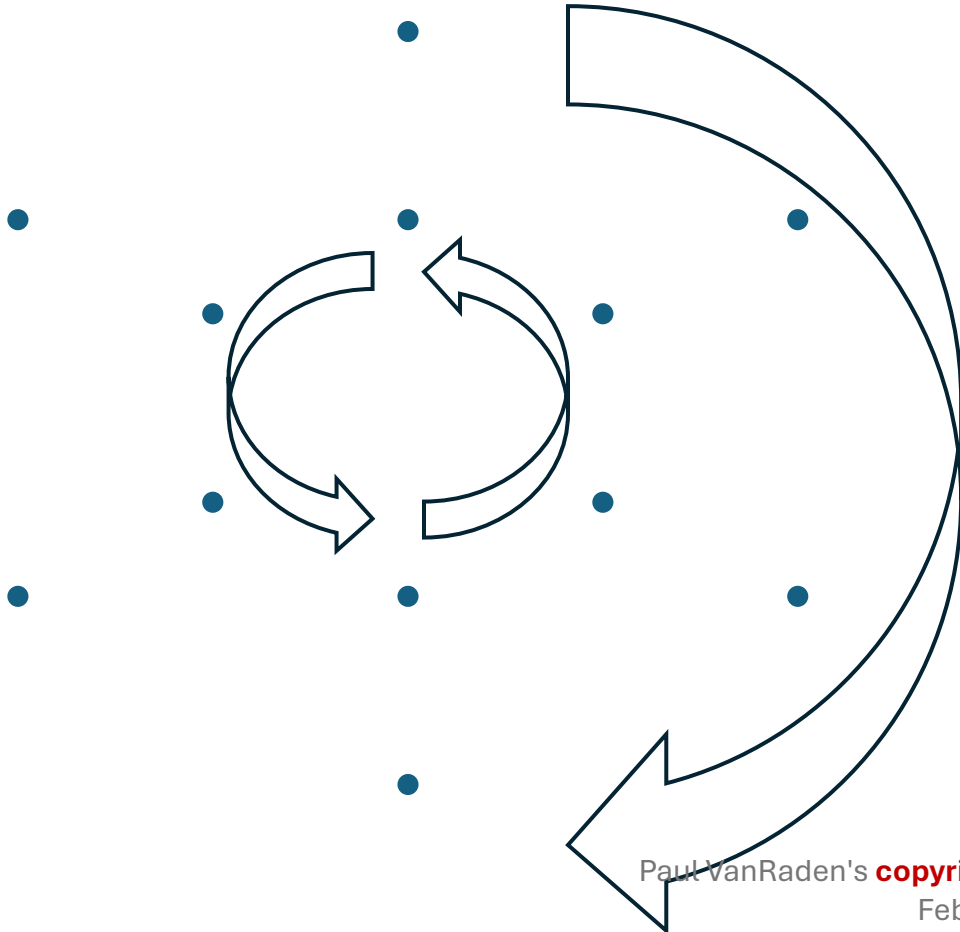
# Meeting positions: All 4 bodies lined up

All meeting positions

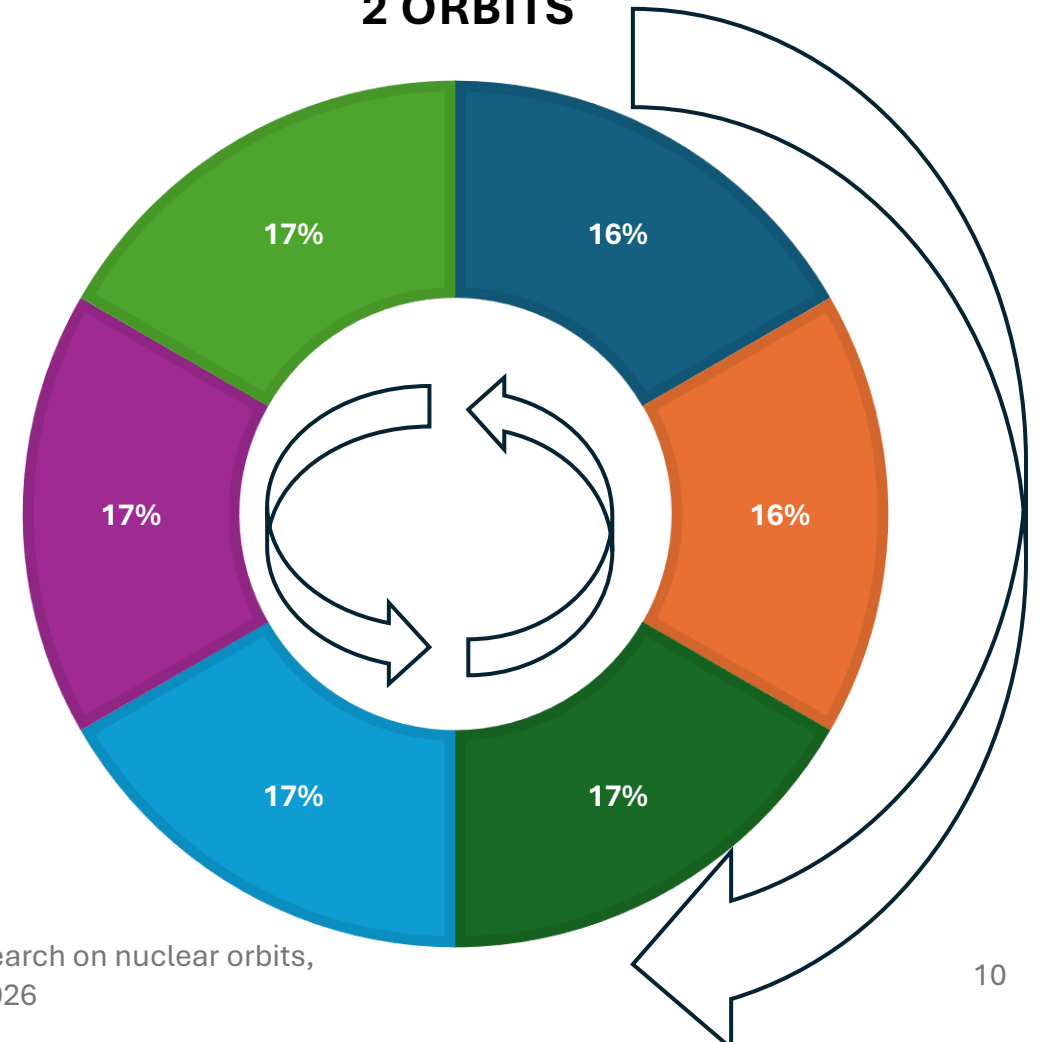


# Helium orbits continue for millions of years

Perpetual loop



2 ORBITS



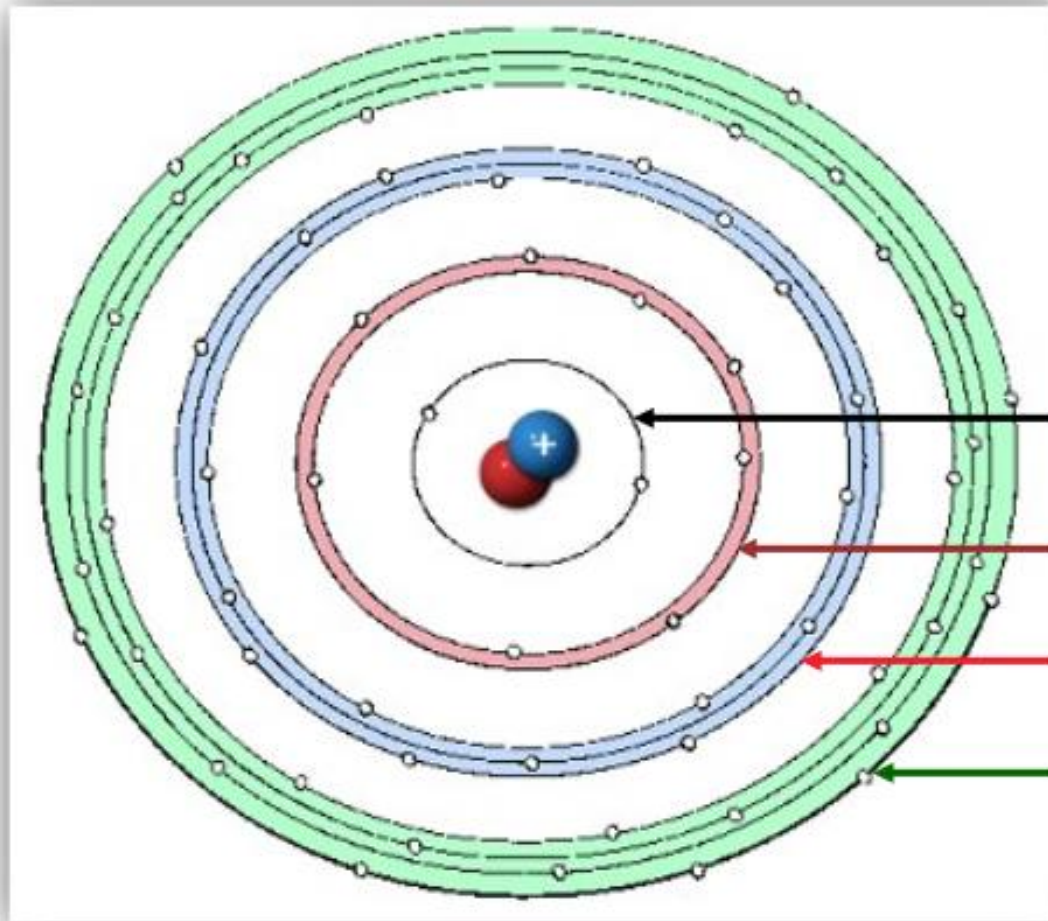
# PERIODIC TABLE OF ELEMENTS

1. H<sub>2</sub> and He have weights 2, 4
2. Ne has weight 20 after the nucleus adds 8 more pairs
3. Ar has weight 40 after the nucleus adds 8 more pairs
4. Bonds for elements C, N, and O often form hexagon patterns
5. Paired nuclear orbits can explain these patterns

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Period	1	2																	Noble gases	
Nonmetals	1																		2	
Metals	H																		He	
	3	4											5	6	7	8	9	10		
	Li	Be											B	C	N	O	F	Ne		
	11	12											13	14	15	16	17	18		
	Na	Mg											Al	Si	P	S	Cl	Ar		
	19	20											31	32	33	34	35	36		
	K	Ca											Ga	Ge	As	Se	Br	Kr		
	37	38											49	50	51	52	53	54		
	Rb	Sr											In	Sn	Sb	Te	I	Xe		
	55	56	La to Yb										81	82	83	84	85	86		
	Cs	Ba											Tl	Pb	Bi	Po	At	Rn		
	87	88	Ac to No										113	114	115	116	117	118		
	Fr	Ra											Nh	Fl	Mc	Lv	Ts	Og		
	s-block (plus He)		f-block	d-block								p-block (excluding He)								
			Lanthanides	57	58	59	60	61	62	63	64	65	66	67	68	69	70			
				La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb			
			Actinides	89	90	91	92	93	94	95	96	97	98	99	100	101	102			
				Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No			

# Current model of **electron** shells

From [Chemistry LibreTexts](#)



The shells are labelled from the nucleus outward

K shell - 2 electrons

L shell - 8 electrons

M shell - 18 electrons

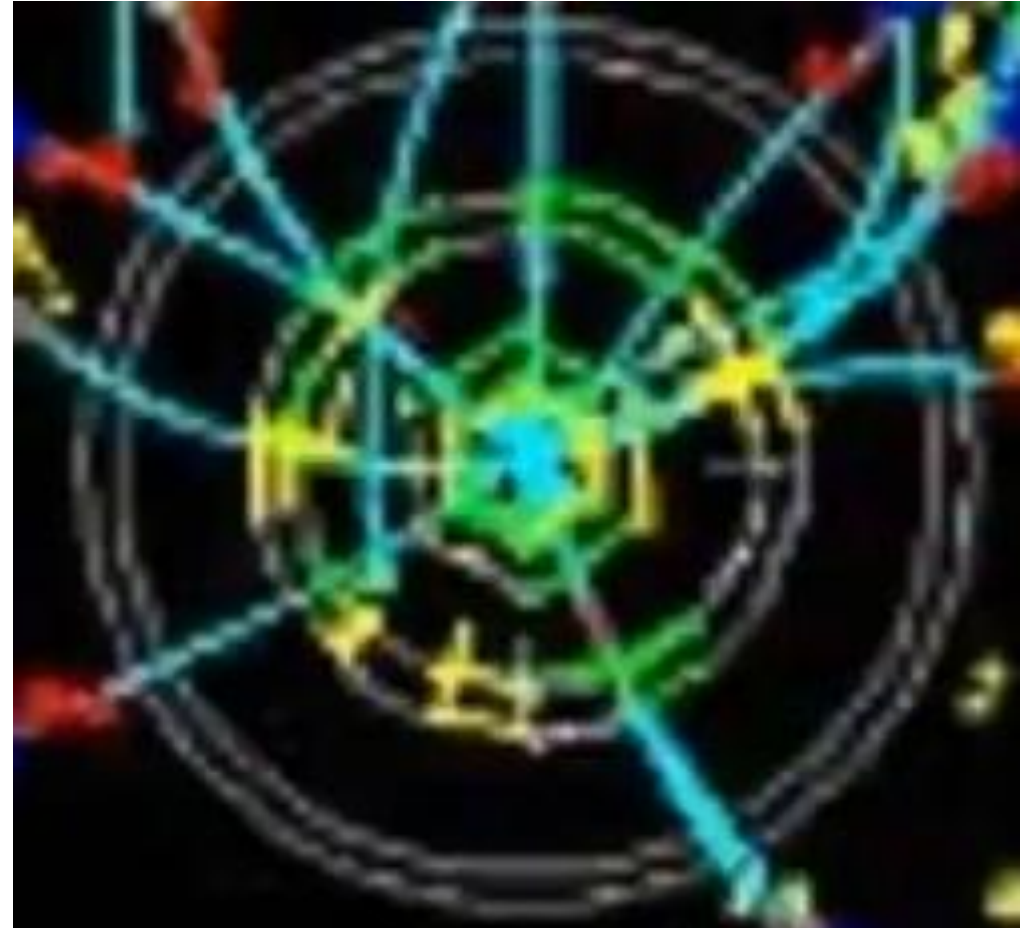
N shell - 32 electrons

# Nuclear vs. electron shells

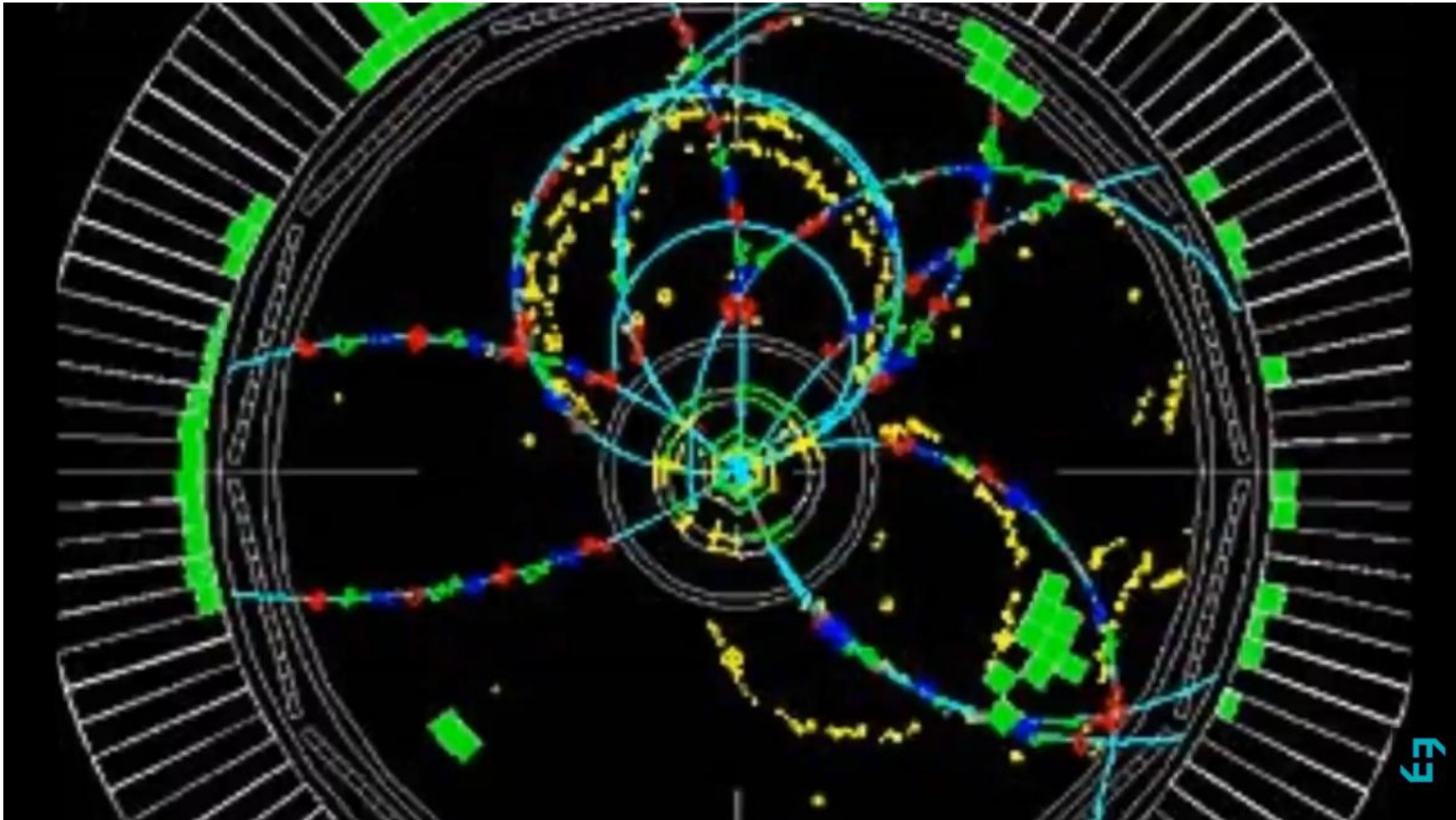
- The **electron** K shell really includes 2 different orbits:
  - 1 is circular with positive spin and 2 is linear thru the center of the nucleus.
  - Electrons in the L, M, and N outer shells are pairs with opposite spin.
- The **nuclear** shells have similar, opposite spin, paired orbits.
  - The shells may contain nucleon pairs with positive spin in the inner orbit and negative spin in a larger outer orbit.
  - The paired orbits may take the same time to complete 1 lap or take double the time to maintain harmony.

# Closeup of Feynman's picture from 1973

- The 2 central hexagon-shaped rings are the pair of 2-body orbits in helium's nucleus
- The 2 middle rings are the next pair of 8-body orbits in neon's nucleus
- The 2 outer rings are the next pair of 8-body orbits in argon's nucleus
- I had already used math to graph similar orbits by hand days before seeing this picture!



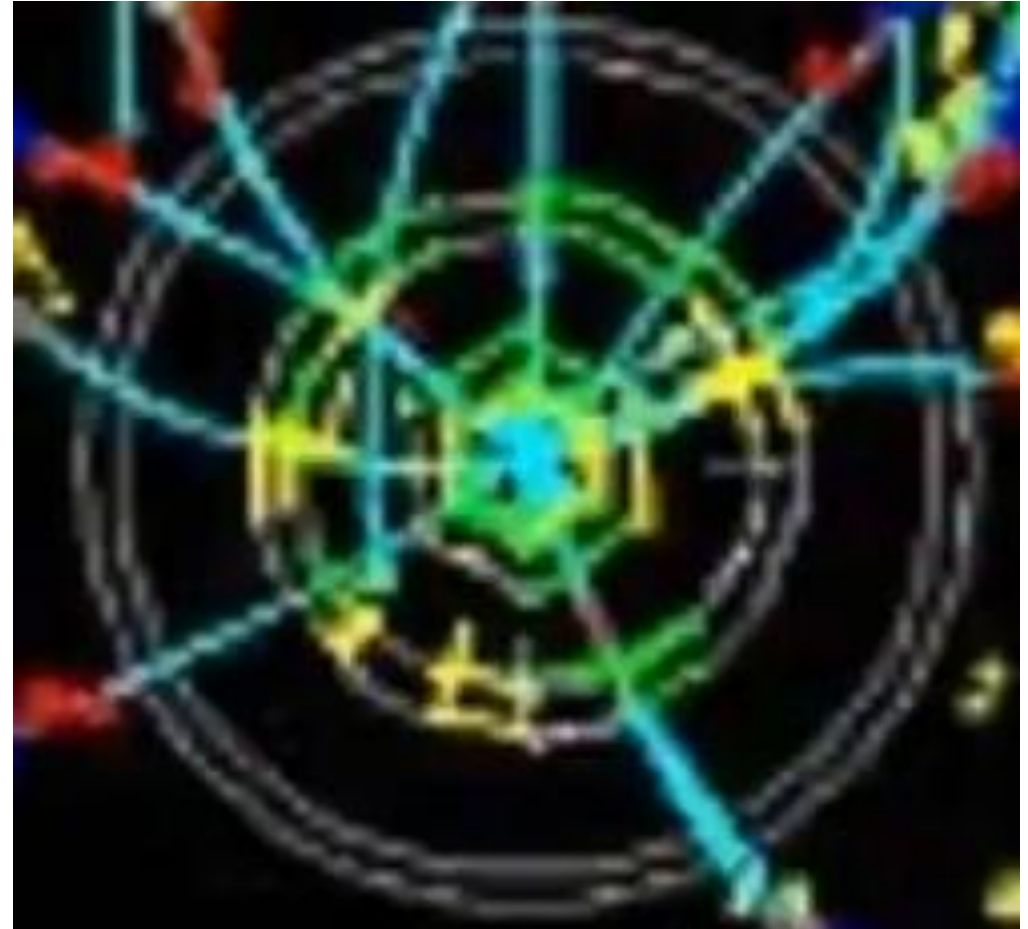
# 1973 lecture by Richard Feynman: Story of Particle Physics, *at minute 7:17 below*



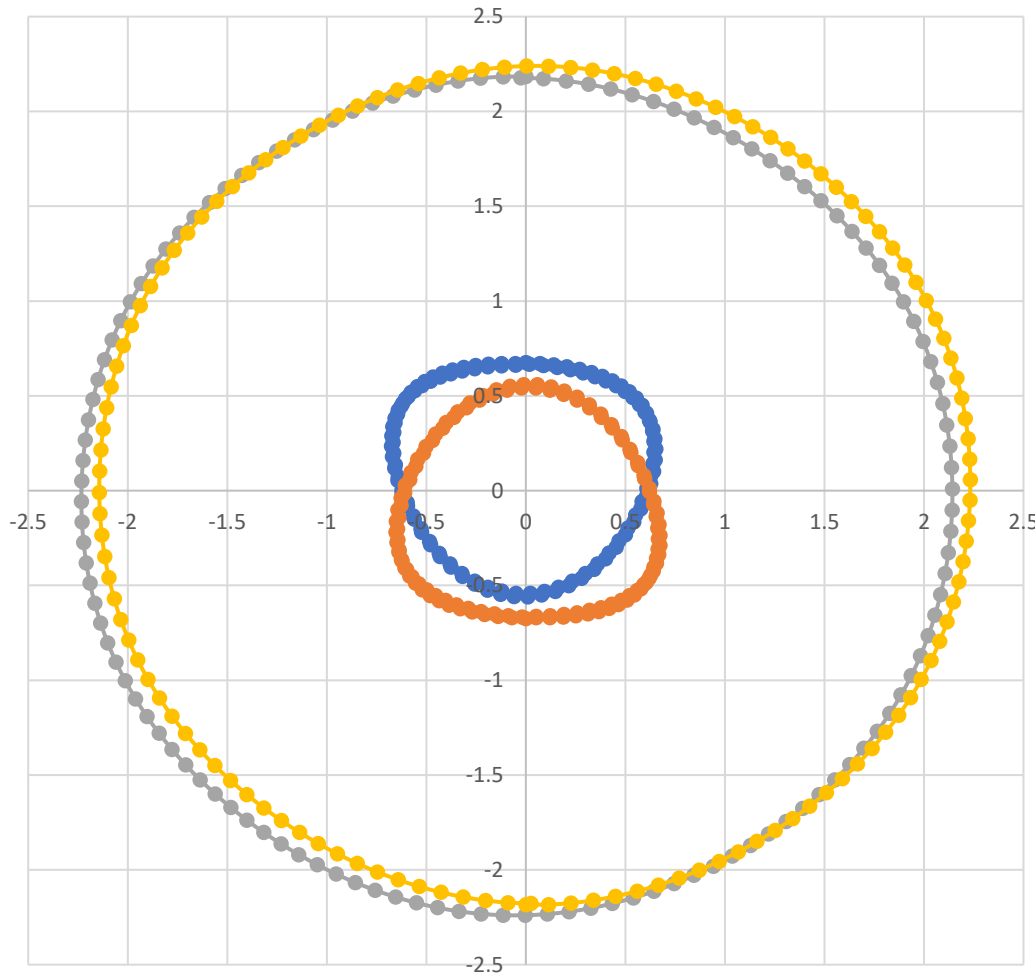
Paul VanRaden's **copyrighted** research on nuclear orbits,  
February 1, 2026

# Nuclear orbits

- Paired harmonic orbits of opposite spin can explain the nucleus.
- This 1973 image of the nucleus and more recent images show orbital rings.
- Scientists in nuclear physics have derived nuclear orbits to explain how the nucleons (protons and neutrons) interact.

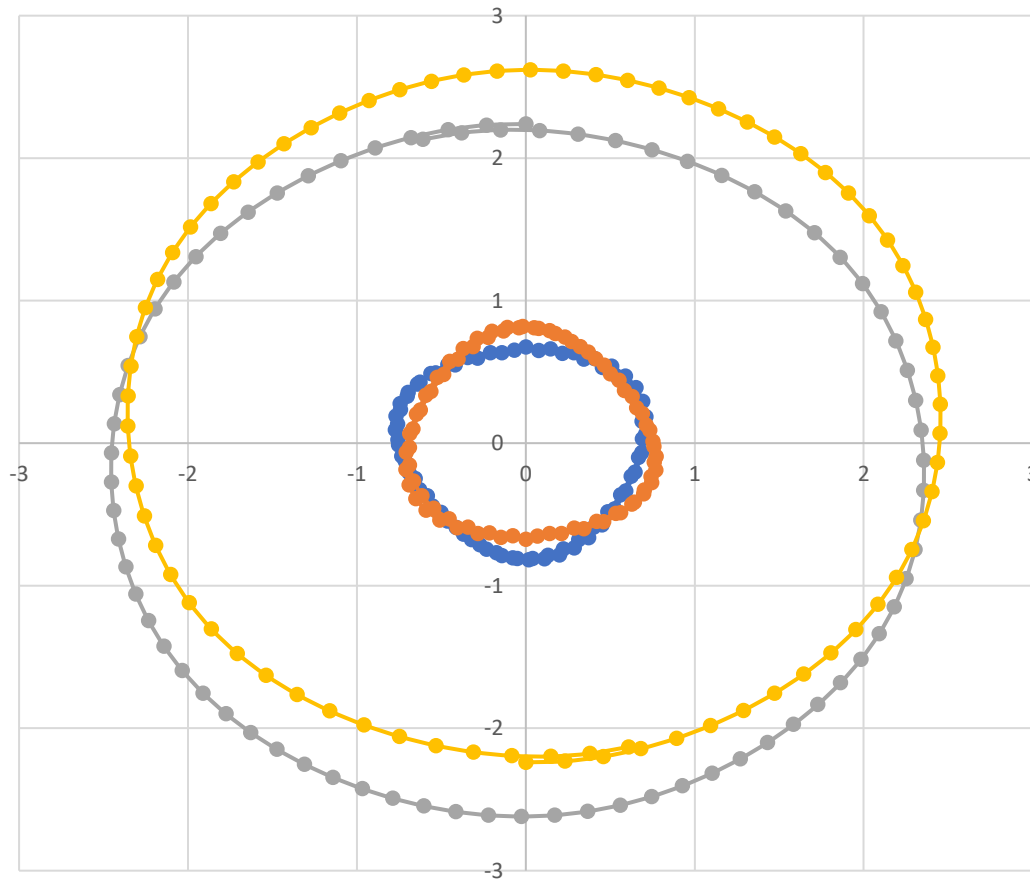


# Orbits in helium's nucleus



- Inner orbits of 2 nucleons are triangular and mirror images
- Outer orbits have slight hexagon shapes
- Inner 2 nucleons do 2 laps while outer 2 nucleons do 1 lap in opposite direction
- Computed using 1 simple force (no strong or weak nuclear forces)

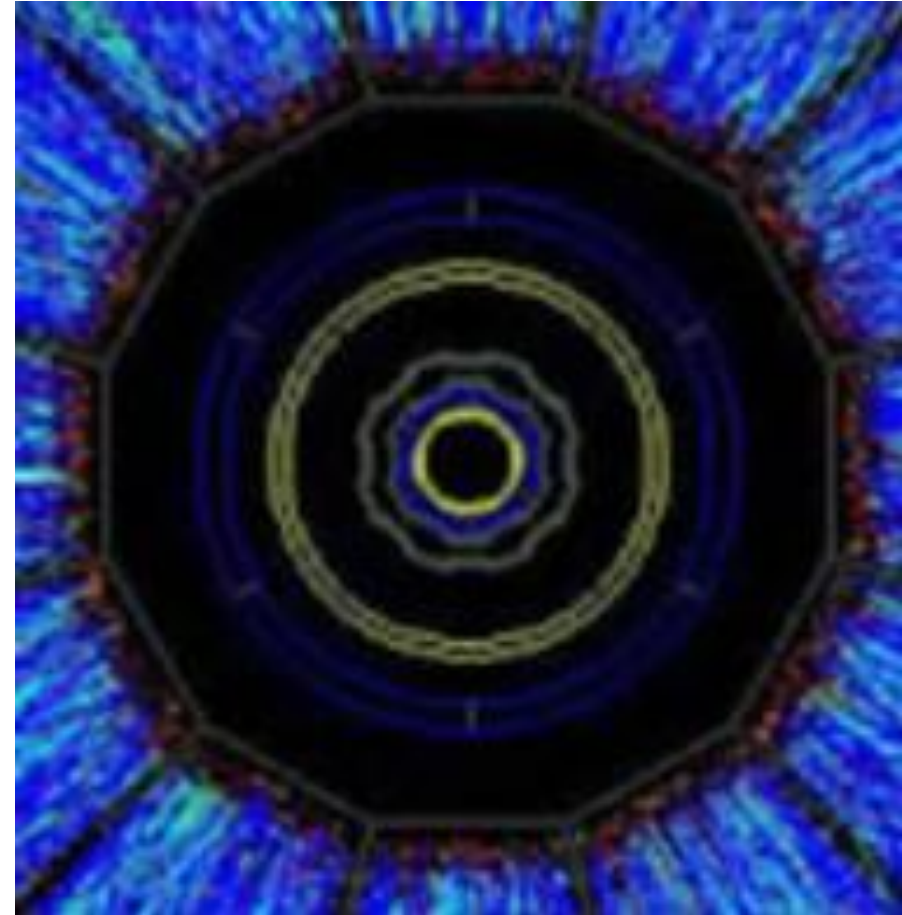
# Centered orbits to better show hex shape



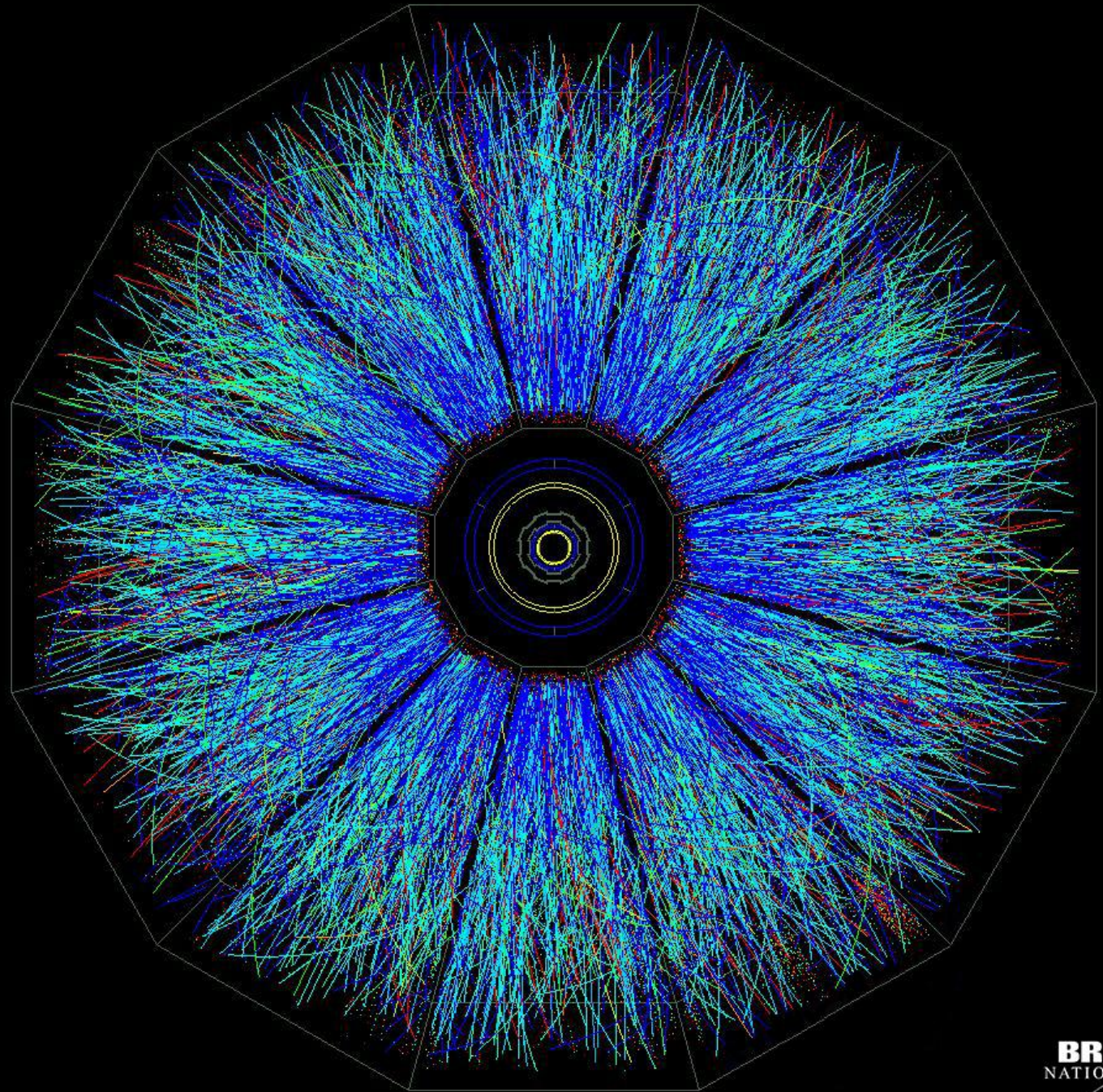
- This picture may look nicer but the orbits are less stable than previous
- Larger elements contain these same shaped inner orbit plus additional paired orbits with up to 8, 8, 18, 18, etc. nucleons analogous to the electron shells shown previously.

# Heavier atoms have more rings in nucleus

- Gold ion with additional rings
- 1<sup>st</sup> orbit has hexagon shape
- 2<sup>nd</sup> orbit has octagon shape
- 5<sup>th</sup> and 6<sup>th</sup> orbits are hexagons
- 7<sup>th</sup> orbit has 12 sides
- [Image from Brookhaven National Laboratory](https://www.flickr.com/photos/NationalLaboratory)
- <https://www.flickr.com/photos/11304375@N07/6799740261/>



Full view  
of gold  
ion  
including  
electron  
shells



# 2- or 3-dimensional nuclear orbits?

- Width of nucleus increases with cubed root of atomic number, implying 3-dimensional orbits or solid balls.
- Widths of the 2-dimensional (flat) nuclei that I simulated grow with the square root of mass or almost linearly with mass.
- 2-dimensional simulations seemed more consistent with actual images of atoms from particle colliders:
  - All nucleons were in the X-Y plane, like our sun and planets.
  - All elements above hydrogen have an open center, like binary stars, to let the second electron pass up and down in the Z direction.
  - Consistent with nucleon pairs having opposite spins.

# 3-dimensional simulations

- Used spherical instead of polar coordinates to better match published nucleus sizes.
- Helium orbits with 2 nucleons in the X-Y plane and the other 2 at the same distance from center but in the X-Z plane, rotated 90 degrees to be in perfect phase so they never collide when crossing the X axis.
- Two perpendicular nucleon orbits would still allow 4 holes thru the nucleus at 45-degree angles for electrons to pass.
- The next 2 nucleon orbits up to neon can have opposite spins and orbit time ratios of 1 : -2 as I previously tested to generate the hexagon-shaped orbits seen in nucleus images.
- Intersecting X-Y and X-Z orbits did not remain orthogonal. Those orbits were unstable and their spins in different directions interacted poorly.

# WHICH THEORY IS CORRECT?

PAIRED HARMONIC OPPOSITE ORBITS, YES!  
QUANTUM MECHANICS, NO!

Quantum mechanics theory offers no physical explanation of motion

Paired, harmonic, opposite-spin orbits seem more sensible

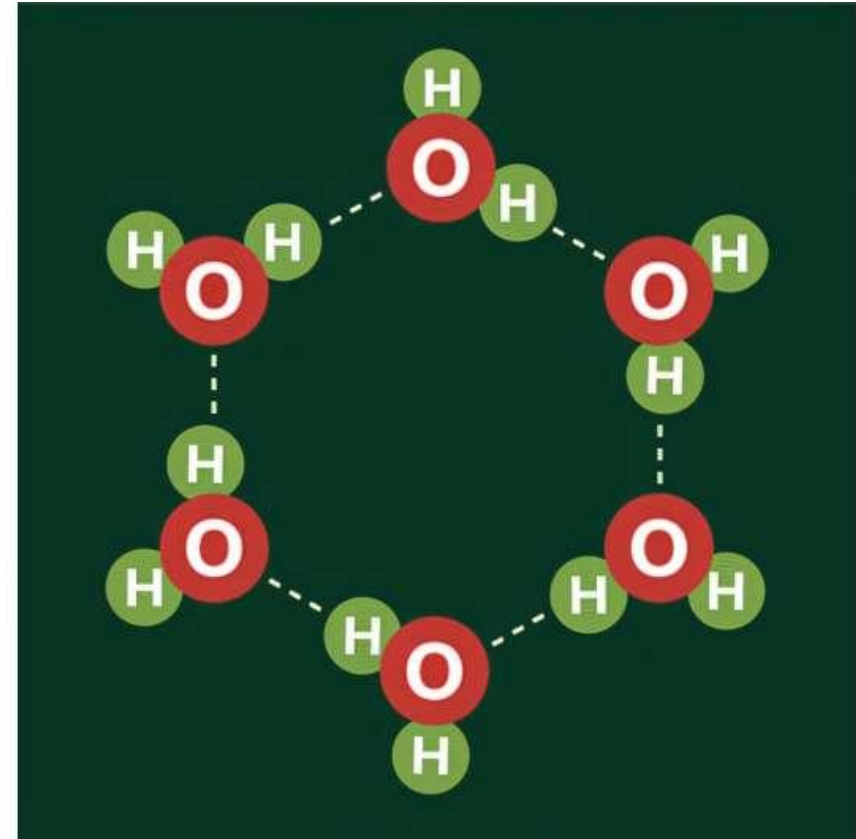
Their inner nuclear orbits are shaped like the hexagons common in chemical bonds among carbon, nitrogen, oxygen, and DNA

Even snowflakes are 6-sided hexagons

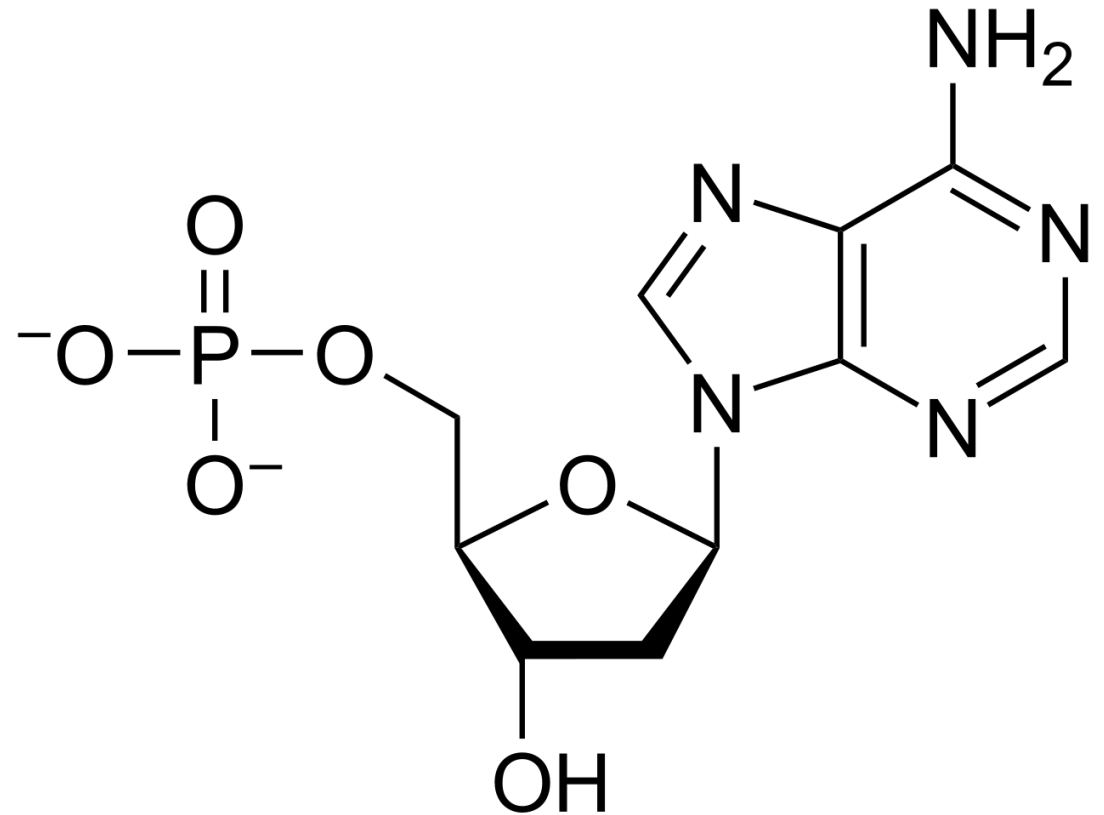
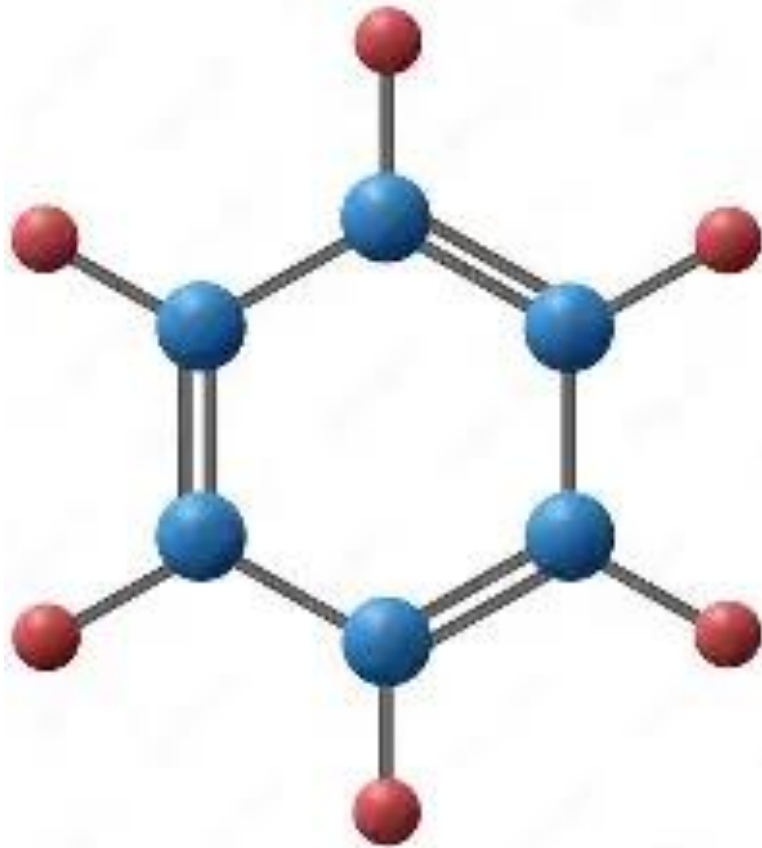


# 6 water molecules at center of snowflake

- Water is liquid  $\text{H}_2\text{O}$  but can freeze as its motion slows
- The  $\text{H}_2\text{O}$  molecule can form a 3<sup>rd</sup> 120-degree angle bond with another H from a nearby  $\text{H}_2\text{O}$  and that bond will stick.
- When 6 molecules by chance form a hexagon ring, all nearby  $\text{H}_2\text{O}$  can quickly join that 1<sup>st</sup> ring and make a snowflake



# Other 6-sided molecules: Benzene ( $C_6H_6$ ) and DNA nucleotides



# Carbon 12

Orbits 1 and 2 same as Helium

Orbit 3 has 4 bodies instead of 2

Opposite spin of orbit 2

Orbit 4 also has 4 bodies

Opposite spin of orbit 3

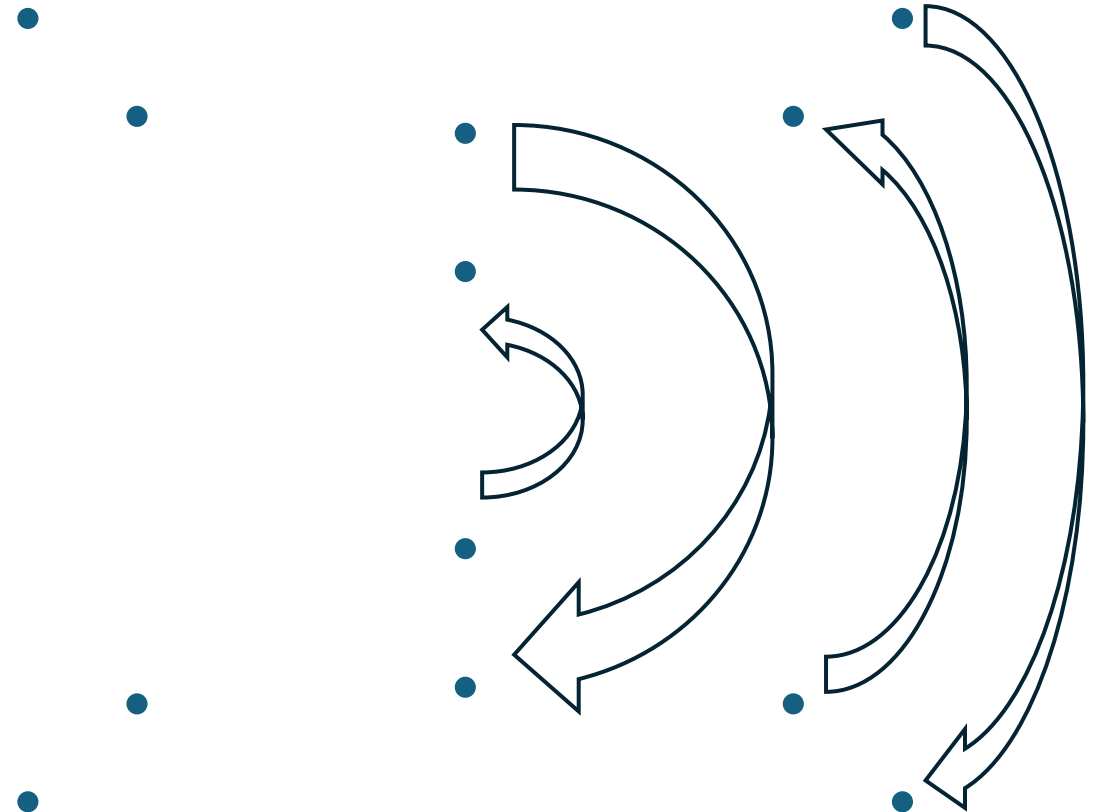
Total bodies = 12

Carbon 12 has weight of 12

Neon has 8 bodies instead of 4 in  
orbits 3 and 4

Neon has 20 bodies and weight 20

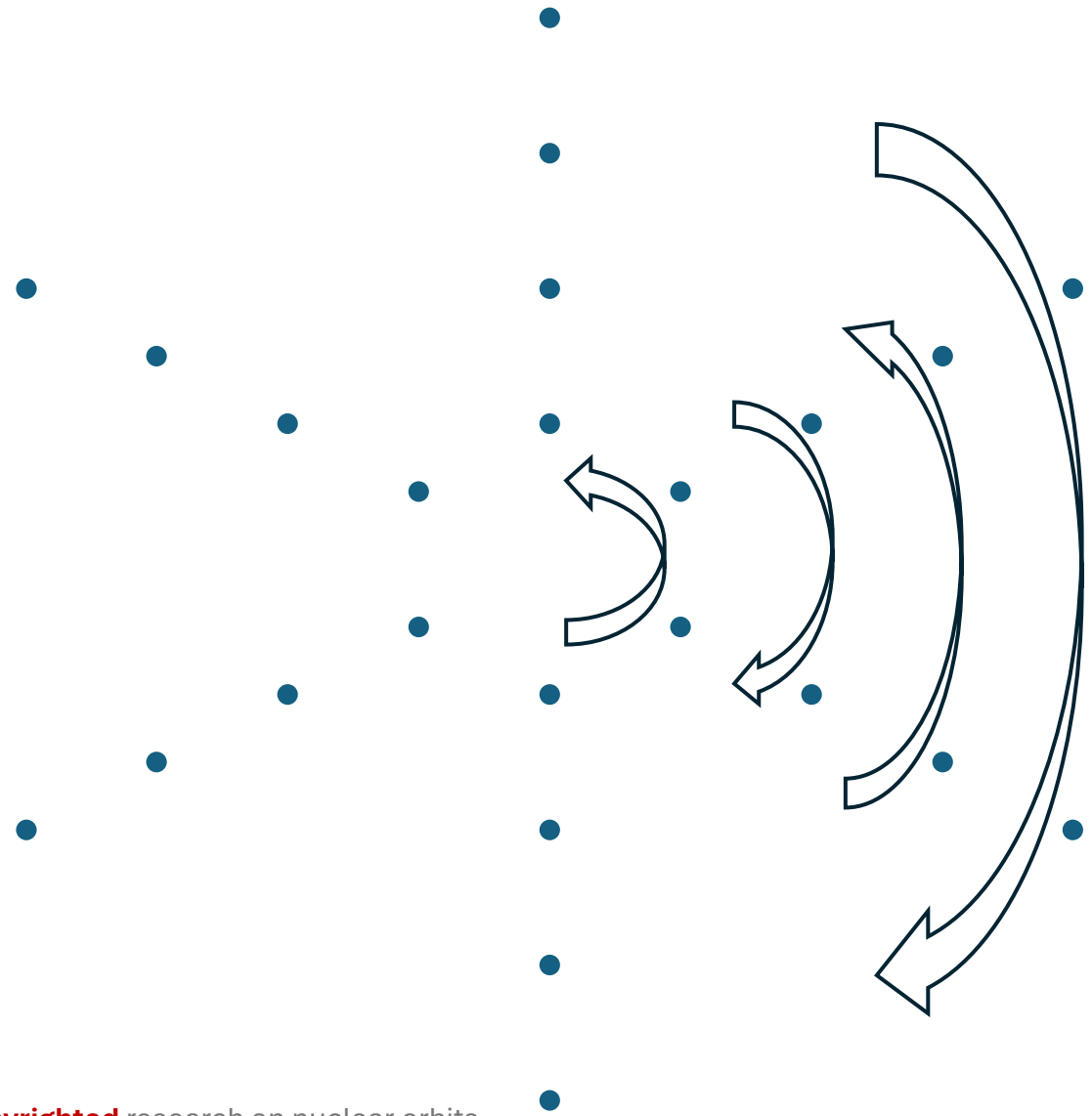
## Carbon nucleus starting points



# Carbon

The outer orbits meet the inner orbits at these points but not together. The outer orbits also meet each other at more points

Carbon nucleus **meeting** points

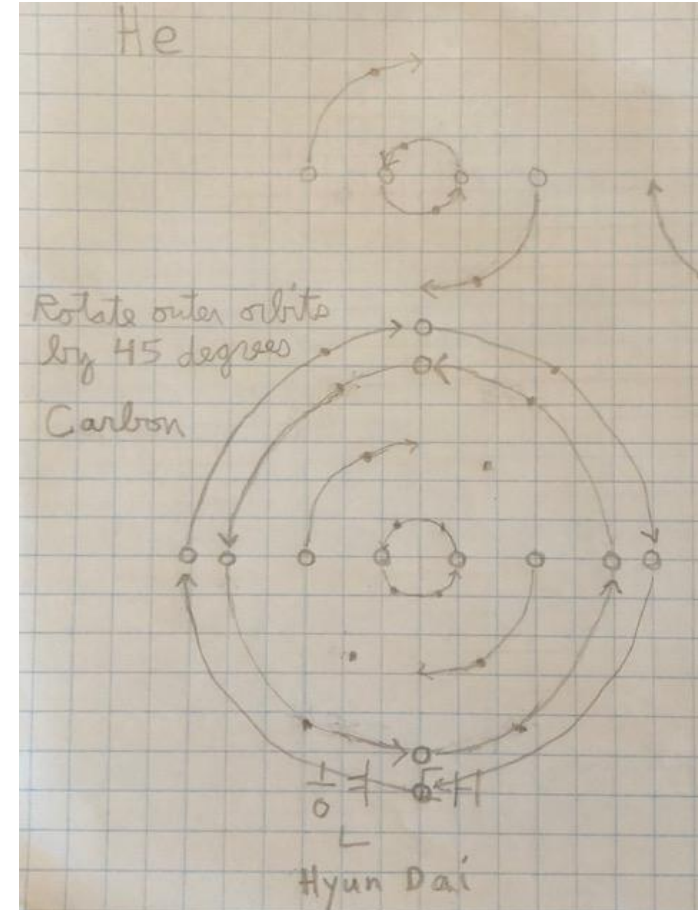


# Table of meeting points in degrees for each body

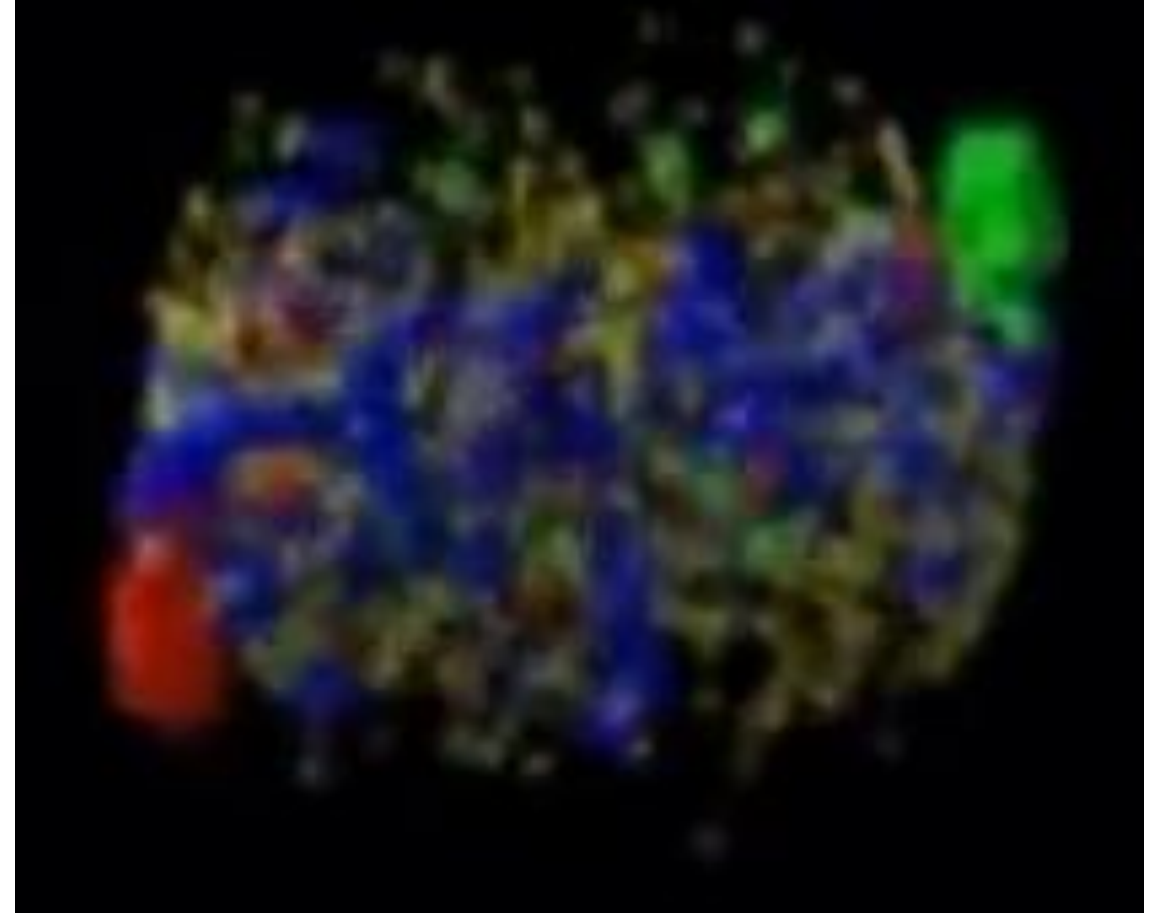
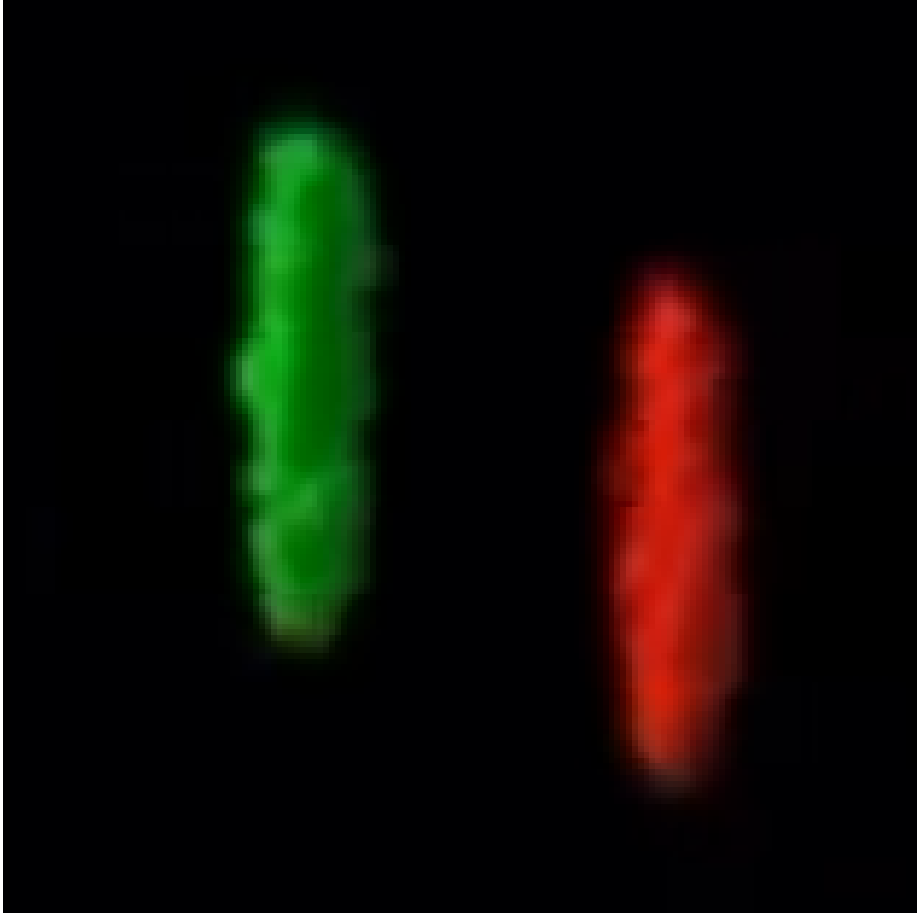
1	2	3	4	5	6	7	8	9	10	11	12	Bodies
Orbit 1		Orbit 2		Orbit 3			Orbit 4			Orbits		
+	+	-	-	+	+	+	+	-	-	-	-	Spins
360	360	180	180	120	120	120	120	120	120	120	120	Speed
<b>0</b>	<b>180</b>	<b>0</b>	<b>180</b>	<b>45</b>	<b>135</b>	<b>225</b>	<b>315</b>	<b>45</b>	<b>135</b>	<b>225</b>	<b>315</b>	<b>Start</b>
0	180	0	180	60	180	240	0	0	120	180	300	Meet
120	300	300	120	120	240	300	60	300	60	120	240	
240	60	240	60	180	300	0	120	240	0	60	180	
0	180	180	0	240	0	60	180	180	300	0	120	
120	300	120	300	300	60	120	240	120	240	300	60	
240	60	60	240	0	120	180	300	60	180	240	0	
0	180	0	180	60	180	240	0	0	120	180	300	

# My prior hand drawings for helium and carbon

- Helium showing the 1<sup>st</sup> set of meeting points
- Carbon showing the 2 extra rings of 4 extra masses and their meeting points
- I needed to rotate those orbits 45 degrees to get best timing
- We were debating how to say Hyundai and I had used Korean letters to explain that (sorry)

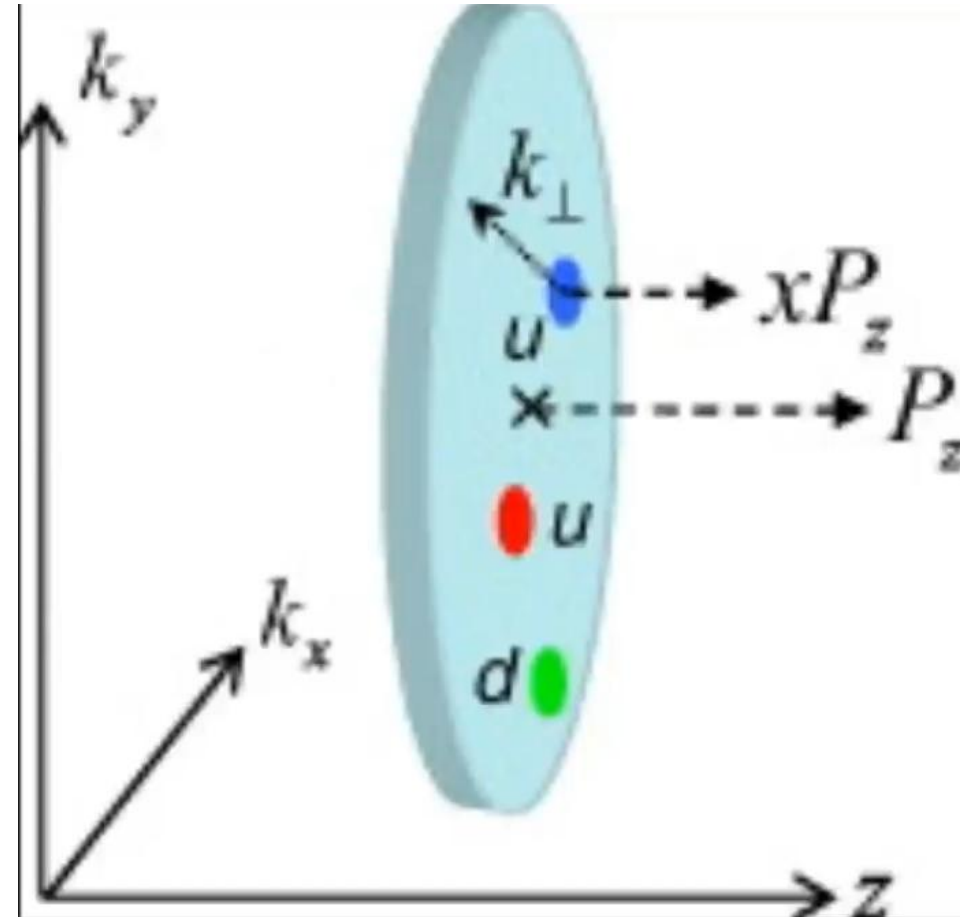


Feynman's particle collision [video](#) *from minute 11:33* shows 2 flat nuclei with evenly spread nucleons



# Another diagram from Feynman showing a flat nucleus *at minute 25:27 and minute 30:00*

- Strong and weak nuclear forces in past theory assumed protons and neutrons were in a stable, spherical center
- Instead they may orbit an empty center
- I tested orbital math applying only 1 common force of attraction between all nucleons



# Nucleons instead of protons and neutrons

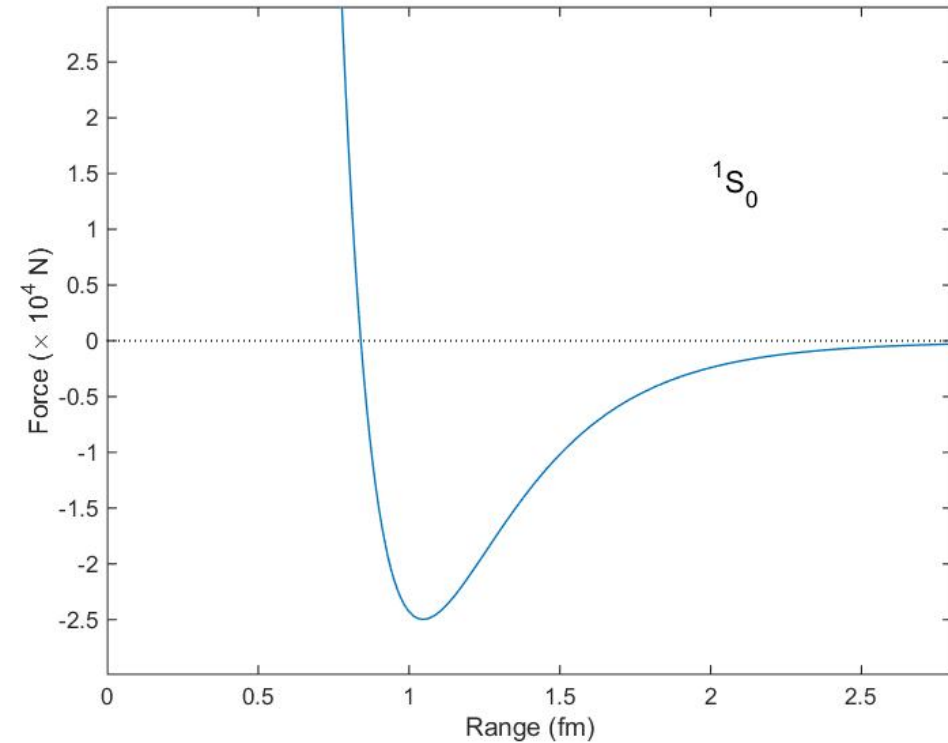
- Protons are hydrogen nucleus **with** an electron circling
  - They have a wavelength
- Neutrons are hydrogen nucleus **without** the electron circling
  - They have **no** wavelength.
- An analogy is Earth with a moon circling vs. Mars with no moon
  - Earth is like a proton
  - Mars is like a neutron
- Exact masses of protons, neutrons, and electrons might vary
- Average mass of helium exactly 4 times hydrogen because the sun constantly converts 4 hydrogen atoms into 1 helium atom

# Particle selection vs. natural selection

- Helium has a complex orbit that happens very rarely by chance
  - Deuterium, tritium, and less stable orbits do not last as long
  - But helium orbits can cycle for billions of years if left undisturbed
- Long DNA strands are complex and happen rarely by chance
  - Most living things die quickly compared to helium atoms
  - But DNA can make fresh copies of itself with some slight differences
  - Plants and animals can evolve for billions of years if left undisturbed
- The effects of gravity sort atoms and molecules by their masses
  - Metals in the core, Si on the shore, H<sub>2</sub>O in the sea, N<sub>2</sub> above me
- DNA replication sorts life by species

# Strong nuclear force attracts, then repulses, then nothing?

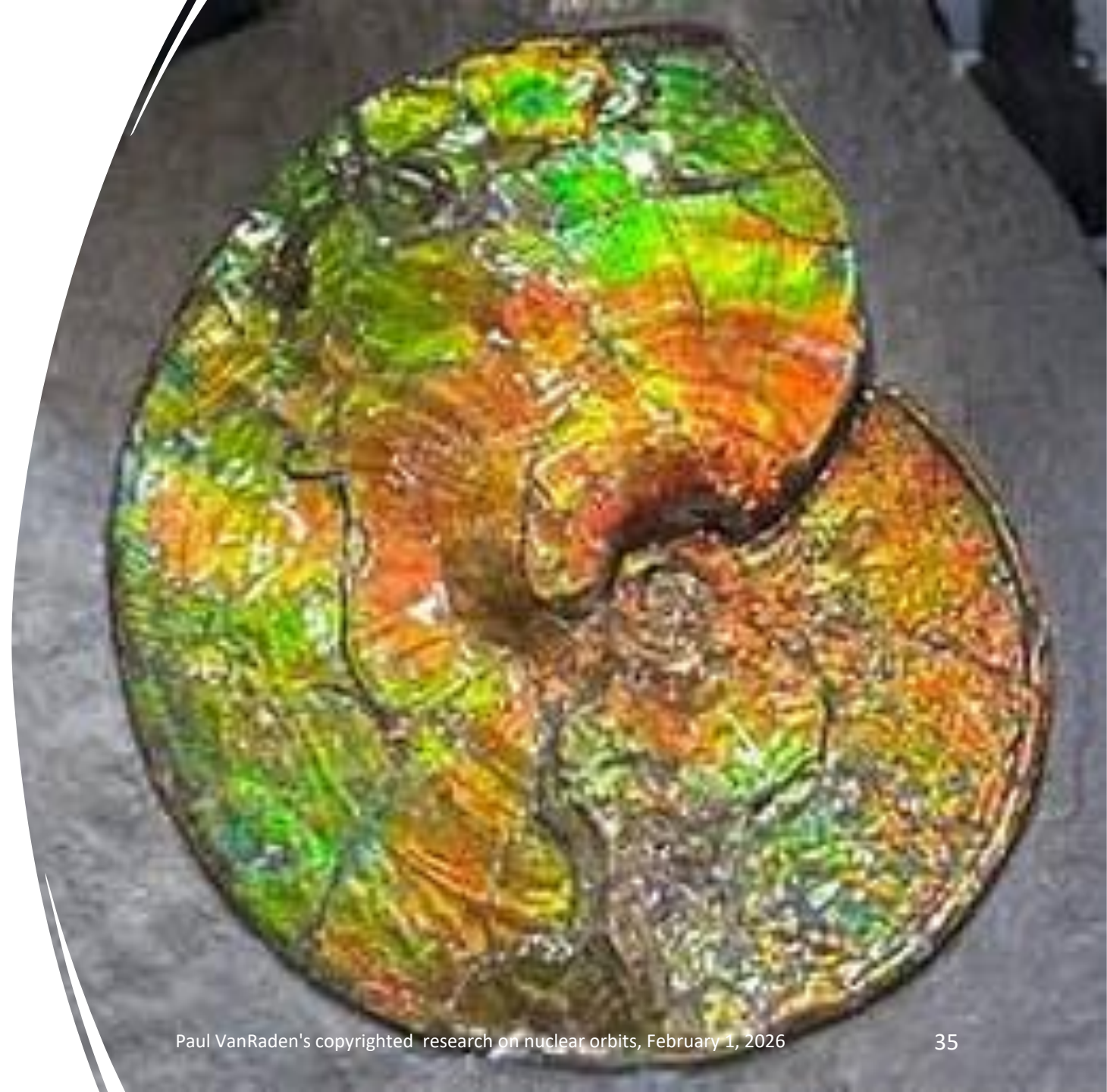
- [Strong Nuclear Force: Definition, Properties, and Examples](#)
- By Bdushaw - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=40780930>



# Helium

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- Helium ice is flexible
- “In supersolid helium, the particles forming the Bose-Einstein condensate are probably not the helium atoms but the lattice vacancies, he says.” [MosesChan, Penn State](#)
- Maybe not if Helium’s nucleus is a flat hexagon, like a 6-sided wheel.



# CONCLUSIONS

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- Harmonic inner and outer orbit pairs of opposite spin with time ratios of 1 to -2 generate stable, hexagon shaped paths of nucleon travel
- Nuclear orbits have the same patterns shown in the atomic table of elements
- Helium's nucleus has 2 protons in each of 2 orbits, while larger elements fill additional pairs of orbits that each contain 8 nucleons until Argon, then 18 nucleons per orbit after that

# Next steps

- Protons and neutrons do not differ
- They are like the 2 halves of a double star solar system
- Use term nucleon instead proton or neutron
- Nuclear orbits can be simulated directly
  - Computer programs from astronomy may work
  - I wrote my own Fortran code to verify that the orbits work as shown, based on SAS code I wrote to compute graph the moon's wobbly path around the sun for [my calendar](#)
- How and where to formally publish and present nuclear orbit results?
- I have no affiliation, no employees, no support, just me

# My previous simulations

- Simulated DNA genotypes with 50,000 genetic markers.
  - That simulation became my [most referenced paper](#).
  - 30 pairs of chromosomes, each containing different genotypes for thousands of bulls and cows.
  - Chromosomes are very long molecules averaging ~120,000 base pairs in humans or ~100,000 base pairs in cattle.
- Also simulated whole genome DNA sequence data.
  - 10x coverage for 10 bulls totaling 300 billion DNA bases.
  - Tested discovery of the 39 million DNA variants contained in the data.
  - Reported in [this 2019 paper](#).
- Atoms are only a little smaller than most molecules.

# My qualifications, or lack thereof

- I took General Chemistry 101 in spring semester 1979 and General Chemistry 103 in spring semester 1980 at University of Illinois, Urbana, and got A's in both.
- I got a PhD in animal breeding in 1986 from Iowa State University, Ames, but I never took Organic Chemistry because genetics was all about math, statistics, and economics, so I took those instead.
- I retired from the U.S. Department of Agriculture in 2025. My goal is to do important research that nobody else is doing.
- I have done particle physics research for 2 months.

# Other paired rings with opposite spins

- From 2018-2025 I lived 2 blocks outside the Capitol Beltway. It has a radius about 10 miles (16 km) around Washington, DC. The cars on its inner loop go clockwise and on its outer loop go counter-clockwise, driving past each other every hour, every day, every year, but few collide. Paired orbits with opposite spin seem almost magical, too good to be true, on the road and in the nucleus.
- Since May 2025, my 6 bike routes each include some circular streets. I bike 3 times per week and go clockwise for 2 weeks, then counter-clockwise for 2 weeks. My routes might mimic nuclear orbits but with a much wider radius and far fewer revolutions per week. I always pedal on the right side of the street and almost never collide with other bodies traveling in the opposite direction.

# Discussion of atoms I found on the internet

- [quantum mechanics - Why don't electrons crash into the nuclei they "orbit"? - Physics Stack Exchange](#)
- Final comment on Mar 5, 2014 at 23:31 from user41827:
  - “Let me clarify. What I am saying is that the answer will not be found by examining the quantum physics of the electrons. It is not the electrons that regulate this process. It is the quantum physics of the nucleus, which has been very much ignored in these previous answers”.
- Physics of the nucleus can be better explained by starting with orbits of nucleons like those of electrons, and user41827 deserves some credit for my ideas presented here.

# Acknowledgments

- Thank you to the audience who previewed these slides and asked interesting questions:
  - Dr. Mark VanRaden, Miriam McKenna, Deb Noordhoff, and Judy Winship
- Thank you to Dr. Tom Lawlor, Dr. Ignacy Misztal, and Dr. Derek Bickhart for useful comments and questions. In response I added further guesses about molecular bonding.
- [Review of Nuclear Orbits](#) documents the review process.
- Discussions with my next-door neighbor Dr. Atsutoshi Ikeda revealed that electron flow in superconducting alloys cannot yet be simulated by computer, which surprised me.

# History of Orbits and Atoms

- In ~250 BC, [Aristarchus of Samos](#) published that the earth and planets orbit the sun instead of everything else orbiting the earth.
- In 1543, just before he died and 30 years after he drafted his book, [Nicolaus Copernicus](#) published that the earth and planets orbit the sun instead of everything else orbiting the earth.
  - By 1600, about 15 astronomers had accepted the theory.
  - In 1633, [Galileo Galilei](#) was convicted of [heresy](#) for "following the position of Copernicus, which is contrary to the true sense and authority of Holy Scripture“, and was placed under [house arrest](#) for the rest of his life.
  - In 1687, [Isaac Newton](#) published how gravity can explain the orbits.
- In 1913, [Neils Bohr](#) published that [electrons circle a nucleus](#).

# Further reading - 1

- [Nuclear shell model - Wikipedia](#)
- [Molecular Orbitals - Chemistry LibreTexts](#)
- [Rotational model of the nucleus](#)
- McCarthy, J. S., I. Sick, and R. R. Whitney. 1977. Electromagnetic structure of the helium isotopes. Phys. Rev. C 15, 1396.  
<https://doi.org/10.1103/PhysRevC.15.1396>
- Otsuka T, Abe T, Yoshida T, Tsunoda Y, Shimizu N, Itagaki N, Utsuno Y, Vary J, Maris P, Ueno H. 2022. [α-Clustering in atomic nuclei from first principles with statistical learning and the Hoyle state character](#). Nat Commun. 13(1):2234. doi: 10.1038/s41467-022-29582-0

# Further reading - 2

- [Discovery Alert: Watch the Synchronized Dance of a 6-Planet System - NASA Science](#)
- [Saturn's Hexagon in Motion - NASA Science](#)
- “A stable geometric arrangement of the polygons can occur on any planet when a storm is surrounded by [a ring of winds turning in the opposite direction](#) to the storms itself.
- [A Proof of the Existence of the Figure-8 Orbit using Actions and the Shape Sphere | Henry Yip](#)
- [Fundamental, Identical Particles Don't Have The Same Masses As Each Other - Big Think](#)

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<https://paulvanraden.com/NuclearOrbits.htm>