Maria Goeppert Mayer

1906 - 1972

Contribution to Science

The Nuclear Shell Model: The model proposes that within the nucleus of a molecule, there there are a series of shells where neutrons and protons are rotating around a different orbit. Depending on the isotope number, these neutrons/protons will move in a certain direction. For more stable isotopes, the neutrons/protons will move in the same direction as this requires less energy while unstable isotopes will move in the opposite direction.

Research Paper: The Shell Model

Mayer, M. G. The Shell Model. *Science* 1964, *145* (3636), 999-1006

Fun Fact

During her university years in Göttingen, Germany to be a physicist, Mayer attended a Quantum Mechanics seminar alongside Robert Oppenheimer. Oppenheimer would constantly interrupt the class to ask questions/make comments to the point where Mayer asked other students to sign a petition in order to shut Oppenheimer up.

Table 1. Magic number nuclides.

2	8	20	28	50	82	126
			Protons			
He^{4}	O^{16}	Ca^{40}	Ni^{58}	Sn^{112}	Pb^{204}	
	O^{17}	Ca^{42}	Ni^{60}	Sn^{114}	Pb^{206}	
	O^{18}	Ca^{43}	Ni^{61}	Sn^{115}	Pb^{207}	
		Ca^{44}	Ni^{62}	Sn^{116}	Pb^{208}	
		Ca^{46}	Ni^{64}	Sn^{117}		
		Ca^{48}		Sn^{118}		
				Sn^{119}		
				Sn^{120}		
				Sn^{122}		
				Sn^{124}		
			Neutrons			
He^{4}	N^{15}	S^{36}	Ca^{48}	Kr^{86}	Xe^{140}	Pb^{208}
	O^{16}	Cl^{37}	Ti^{50}	Rb^{87}	Ba^{138}	Bi^{209}
		A^{38}	V^{51}	Sr^{88}	La^{139}	
		K^{39}	Cr^{52}	Y^{89}	Ce^{140}	
		Ca^{40}	Fe^{54}	Zr^{90}	Pr^{141}	
				Mo^{92}	Nd^{142}	
					Sm^{144}	

- Table from research paper. Depicts the "magic numbers" of neutrons or protons that an isotope needs to be stable. The numbers mentioned above were proven to have consistently stable isotopes regardless of the molecule. These "magic numbers" were what led Mayer to want to explore more as to why these numbers of neutrons/protons did not produce decaying isotopes as other versions did.

What If the Magic Numbers were never discovered?

The tale begins on an Earth different from ours. On Earth-13,579, nothing is even and everything is odd. People are born with odd features(one eye or three hands) and instead what would be the year 1948 for us would be the year 959 for them. It was during this time, on March 15, 959, that Maria Goeppert Mayer looks upon her uneven classroom as she prepares her first lecture on nuclei of the day. On our Earth, MG Mayer was notorious for holding a piece of chalk on one hand and a cigarette on another in order for her to remain calm during a lecture. On E-13,579 however, MG Mayer only had one hand and as a result had to swap between chalk and cigarette as she lectured the class. Because there were no even numbers, the idea of magic numbers never came to be and as result, MG Mayer was still contemplating the reason as to why certain isotopes were more stable than others. It was during this lecture period however, that an idea would form within the esteemed professor. AS her one eye dotted around the room, she began to become increasingly nervous from all of the attention being directed to her. Leaving the chalk on the desk next to her, she picks up the cigarette to help distract her. But, due to her rapid movements, she misplaced the chalk and it falls towards her feet. Not noticing this, MG Mayer takes a step after inhaling the cigarette and slips on the chalk she once had grasped. Frantically, she manages to catch herself with her third foot, but not before causing the smoke from her cigarette to reach the front row of her students. They each begin to stand up and move towards her direction to avoid the smoke rather than the stairs that were located on each row. MG Mayer noticed this and asked why the students would move towards her. All of the students responded with the same answer of walking towards her was much easier to walk to an empty side of the room rather than an occupied side. MG Mayer then proceeded to look at her drawn image of what an atom looked like with the atomic orbital theory. Suddenly, as if a train had hit her, Mayer dropped on the floor and all the students looked at her in shock. She proceeded to run out of the classroom and went to the nearby laboratory to test a theory of hers. Sure enough, when comparing different isotopes of calcium, the more stable were the isotopes with a smaller number(because there were no even numbers, on this Earth, the more stable isotopes were the ones with less neutrons/protons). She conducted more lab tests and eventually wrote a paper describing the relationship about how larger numbers would cause these protons/neutrons to become crowded and that they must be separated in order for an isotope to be stable. She called it the separate shell model and the rest is history. She earned her nobel peace prize and in this Earth, she was the third women to win it.