

Integrating Superconductivity in Cu Replace Lead Apatite by Nuclear Magnetic Moment Theory of RBL

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ABSTRACT

Recently, scientists proclaimed superconductivity under ambient conditions of room temperature and 1 atmosphere pressure in Cu partial substituted lead apatite: $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$. This paper highlights the application of RBL's stable isotope of positive and negative nuclear magnetic moments (NMMs) theory for explaining the heavy isotopic enrichment of this materials as $\{^{207}\text{Pb}_{(10-x)}^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6\}$, where $i = 17$ or 18 and the resulting superconductivity and novel room temperature atmospheric pressure superconductivity of this heavy isotopic enriched substance. On the basis of such analysis by RBL theory, the synthesis of high temperature, regular pressure superconductivity can be explained and this recent experimental observation of ambient pressure and temperature superconductivity in $^{207}\text{Pb}_{(10-x)}^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6$, where $i = 17$ or 18 , proves RBL's NMMs theory of high temperature superconductivity. After 1 month on July 22, 2023 of the archiving of such data for superconductivity $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ by Lee and coworkers, a huge experimental effort by hundreds of researchers around the world has attempted to replicate this room temperature, ambient pressure superconductivity in $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ without success. The resulting inability to replicate the ambient superconductivity and note of some fractional component in the mixture causing the ambient superconductivity is explained by RBL's theory as the fractional component may be clumped isotopes as in $\{^{207}\text{Pb}_{(10-x)}^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6\}$, where $i = 17$ or 18 , and RBL here notes the vapor deposition process alleged by Lee and coworkers for producing the superconductivity was previously predicted by RBL to cause isotopic fractionation during solid to liquid and liquid to gas and gas to solid physical changes.

Keywords: Nuclear magnetic moments, stable isotopes, superconductivity.

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1. INTRODUCTION

A recent declaration of room temperature, ambient pressure superconductivity was announced in partial Cu replaced Lead apatite ($\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$) [1]. Synthesis of LK-99 was reported in 1999 as $\text{Pb}(\text{PO}_4)_6$. Recently in 2022, the partial substitution of Cu for some of the Pb in these materials was observed to cause volume shrinkage and observation of ambient pressure and temperature superconductivity by drop in resistance and Meissner Effect [1]. Scientists have been attempting during the last 110 years to discover superconductors at room temperature and normal pressure of sea level, atmospheric pressure since Onnes discovered superconductivity in 1911 in Hg at atmospheric pressure and -270°C . A theory of superconductivity has also been sought during the last 110 years. In 2005, RBL by his relativistic spinrevorbital gave a theory of superconductivity on the basis of isotopes and nonzero nuclear magnetic moments (NMMs) [2]. Since Onnes, superconductors (like Nb, Pb, Sc, cuprates, iron arsenates and MgB_2) with higher critical temperatures have been discovered; but only recently have superconductors near room temperature been reported in hydrides with huge



external mechanical pressures. The aim for greater applications has been to thereby not only raise the temperature for superconductivity but also lower the extremely high pressures to normal pressure of the atmosphere at sea level. On July 22, 2023, such superconductivity at room temperature and normal pressure was reported in $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ [1].

In addition to materials for superconductivity under ambient conditions, the understanding and theory of superconductivity at high temperatures and lower atmospheric pressure have been sought. One of the first successful theories of superconductivity was given by Bardeen, Cooper, and Schrieffer during 1950s and it is called BCS theory of superconductivity [3]. But BCS theory was only successful in explaining superconductivity (type I) of the earliest superconductors like Hg, Pb, and Nb. With the discovery of type II superconductivity in cuprates during the 1980s [4], a new theory was needed; as BCS theory could not account for superconductivity in cuprates. Some important efforts for explaining type II superconductors were given by Anderson theory of fluctuating electronic orbitals [5] and Pines theory of fluctuating electron spin [6]. Later in 2004, RBL [2] introduced combined fluctuating spin and orbital and included nuclear spin (in particular nuclei of nonzero and negative NMMs) on the quantum fluctuations for causing superconductivity.

2. PROCEDURE

The synthesis and superconductivity properties of $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ is here explored by a method of applying RBL theory of clumping of positive and negative NMMs into covalent and metallic bonds during chemical reactions and the manifestations of quantum fluctuations down to nuclei leading to seeping of positive and negative NMMs from nuclei into surrounding electronic lattices for altering the electronic orbitals in materials (reactants, intermediates and the products they form) by such quantum fluctuations for causing quantum phenomena nonlocally for explaining formations of superconductivity and superconductivity itself. The theory of seeping NMMs by quantum fluctuations down to nuclei, nucleons and quarks by Little Effect is here applied to the syntheses of $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ from reactants PbO, PbSO_4 and CuP by Lee and co-workers [1] and the subsequent replication efforts of many laboratories around the world during the last month for explaining the differing products and properties of those products from the different syntheses. Moreover, the isotopic and non-zero NMM theory of RBL [2], [7]–[10] is applied to the vapor deposition process done by Lee and co-workers [11]. Such vapor deposition was not done replicating laboratories to explain why replicators were not successful. RBL theory is applied to the vapor deposition step of Lee and coworkers [11] on the synthesized PbS, CuS, $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$, and other components of the product mixture to give reasons why the produced $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ possesses the ambient superconductivity. The method here also provides a basis for considering various elements and their stable isotopes for finding new superconductors and relating superconductive properties to various elements based on the stable isotope distributions and isotopes of positive and negative NMMs.

3. RESULTS

3.1. Apply Isotope and NMM phenomena to $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$

Superconductivity is a quantum phenomenon. To raise critical temperature (T_c) and lower pressure, one has to cause quantum mechanics on macroscale at higher temperatures and lower pressure. Prior scientists have achieved quantum phenomena by lowering temperature like temperatures of liquid helium, where Onnes first discovered superconductivity. But during the last 24 years, RBL has proposed quantum phenomena can manifest at higher temperatures by increasing force density at higher temperatures by strong electric and/or magnetic fields either from internal fields or external fields [7]. RBL has reasoned mechanical pressures can cause materials to manifest internal strong electric and magnetic fields for transforming thermal energies to quantum energies for quantum phenomena at higher temperatures and even room temperature by not only large applied pressures but by strong internal electric and/or magnetic fields. But RBL has previously noted that the applied magnetic fields and electric fields cannot only come from applied external pressures, but RBL noted that internal pressures from nuclei for nuclear pressures can cause pressure and energy densities for superconductivity at higher temperatures. In addition to the high temperature and its prior proclivity to classical mechanics (and RBL resolving by high electric and magnetic fields), quantum mechanics has been restricted and discovered on submicroscopic scales. The challenge for superconductive technologies is macro-size materials. RBL has give resolution to this size effect by isotopes of nonzero NMMs of positive and negative chiralities so that the huge energy densities of nuclei can fractionally fission and fuse from nuclei into surrounding electronic shells for giving sufficient energy densities for quantum phenomena to exceed nanosize and the energy densities from quantum fluctuations down to

nuclei and release and seeping of relatively dense nuclear fields and NMMs from Avogadro's number of nuclei of positive and negative NMMs can cause the quantum phenomena and in this case the superconductivity to manifest on macroscale. By such seeping of both positive and negative NMMs into electronic lattices, the band structure is flattened over longer length scales by RBL theory. On the basis of these revelations from isotopes of non-zero NMMs of RBL during the last 24 years, the superconductivity, synthesis, and properties of $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ can be explained.

3.2. Understanding the Synthesis by RBL Isotope Theory

How does the the $\text{Pb}(\text{SO}_4)$ reacting with CuP manifest NMMs and encourage ^{17}O and/or ^{18}O ? The synthesis of the $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ can be explained by the prior theory of RBL that positive and negative NMMs of stable isotopes of ^{207}Pb , ^{31}P , ^{63}Cu , ^{65}Cu , ^{18}O and ^{17}O more stably clumping in covalent and metallic bonds during synthesis of $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ to form products like $\{^{207}\text{Pb}_{(10-x)}^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6\}$ (where $i = 17$ and/or 18) with clumped isotopes of nonzero NMMs. On basis of RBL theory, more stable ionic bond of all positive or all negative NMMs as created node between positive and positive NMMs and negative and negative NMMs. Thereby ionic substances drive to form covalent and metallic products by RBL chemistry when all positive or all negative ionic bonds for positive and negative NMMs in covalent and metallic bonds. Moreover, RBL asserts here that the vapor deposition of products by Lee and co-workers further by physical recrystallization separate compounds of differing heavy and light stable isotopes for forming components in a mixture on the glass substrate having clumped ^{207}Pb , ^{31}P , ^{63}Cu , ^{65}Cu , ^{18}O and ^{17}O to form enriched compound with heavy isotopes for manifesting the ambient superconductivity. The chemical reaction forms various compounds with various enrichments of these isotopes of Cu, Pb, P, O, and S. But RBL notes the subsequent heating, liquefaction, and vaporization separate compounds having different isotope enrichments and reprecipitate these compounds with isotopic enrichments to further manifest the ambient superconductivity due to the purifying the compounds with the properties heavy isotope composition [12].

Such theory is given as a basis for the synthesis for intrinsically enriching the product with ^{17}O under thermodynamic equilibrating conditions. Also such recent emphasis on vapor deposition during experiments, allows the separation of substances by isotopic abundances for causing superconductors and detecting superconductivity as induced by the isotopes by RBL's theory. By the theory of stable, isotopes of positive and negative (nonzero) nuclear magnetic moments (NMMs) can explain the synthesis of this $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ and other compounds in the product mixture with isotopic enrichments of heavier stable isotopes ^{207}Pb , ^{63}Cu , ^{65}Cu , ^{31}P , ^{18}O and ^{17}O of positive and negative NMMs under such high temperature conditions. The subsequent heating to liquid and gaseous states and redepositions from the vapor by Lee and co-workers [11] separated the formed compounds by their isotopic enrichments for components in the product mixture with more clumped isotopes for the ambient superconductivity. Such intrinsic clumpings of positive and negative NMMs in covalent and metallic bonds have been shown to enrich ^{18}O (of spin = 1 and 0.205% relative abundance) ^{17}O (of -1.89 NMM and 0.038% relative abundance [RA]) replacing ^{16}O (of zero [0] NMM and 99.8% RA) in bonds with ^{31}P (of + NMMs and 100% RA) and ^{63}C and ^{65}Cu (of + 2.22 and 2.38 NMMs and combined {69.2% + 30.8%} 100% RA) and ^{207}Pb (of + 0.582 NMMs and 22.1% RA). In the $\text{Pb}(\text{SO}_4)\text{O}$, the ^{32}S has null (0) NMM and by RBL's theory the ^{32}S preferentially binds the ^{16}O to form $^{32}\text{S}^{16}\text{O}_2$ (g) for further explaining the ^{17}O and/or ^{18}O enrichments in the $[^{207}\text{Pb}_{(10-x)}^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6]$ (where $i = 17$ and/or 18). The gaseous $^{32}\text{S}^{16}\text{O}_2$ (g) vaporizes away, leaving solid $[^{207}\text{Pb}_{(10-x)}^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6]$ (where $i = 17$ and/or 18). The remaining ^{17}O and ^{18}O enrich in the $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ with ^{31}P , ^{63}Cu , ^{65}Cu and ^{207}Pb to form this compound $[^{207}\text{Pb}_{(10-x)}^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6]$ (where $i = 17$ and/or 18) on the basis of RBL theory of positive and negative NMMs enriching in covalent and metallic bonds.

Compounds of varying isotopic clumping form, but the heating and redeposition as done by Lee and coworkers [11] isotopically fractionate the various compounds of varying isotopic compositions and clumpings for depositing array pure compounds of differing isotopic compositions. Among these isotopically separated compounds by the vapor deposition, one superconducts at higher temperatures and lower pressures and some even superconducts at ambient temperature and pressure by RBL's theory. The subsequent replication efforts failed as these scientists did not isotopically purify [11] their product mixture by vapor deposition techniques actually originally done by Lee and co-workers to produce the ambient superconducting component of the mixtures. Such NMM effects on the chemical reactions by RBL [2], [7]–[10] explain the $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ discovered by Lee *et al.* [1] and its isotopic enrichment as described here by RBL's theory [2], [7]–[10] for the formation of stable isotopically clumped $^{207}\text{Pb}_{(10-x)}^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6$ (where $i = 17$ and/or 18) with the alleged normal atmospheric pressure and room temperature superconductivity due to the positive and negative NMMs in this compound enriched with ^{17}O and/or ^{18}O . Such ambient superconductivity had never been observed

before the discovery of superconductivity in mercury (Hg) at temperature below $-269\text{ }^{\circ}\text{C}$ (4.2 K) at atmospheric pressures by Kamerlingh Onnes in 1911.

RBL previously propose ^{29}Si for gettering ^{17}O [12] and afterward, both Lee and coworkers [11] and Iris [13] demonstrated Si enhanced superconductivity in [11], [13]. RBL's theory [2], [7]–[10] explains such role of Si as Si has ^{29}Si with its negative NMMs and ^{29}Si binds more weakly to ^{17}O and/or ^{18}O of negative NMMs relative to ^{33}S (and its positive NMM) binding ^{17}O and/or ^{18}O . Therefore ^{29}Si more easily releases captures ^{17}O and/or ^{18}O than $(^{33}\text{S}^{4-})^{2-}$ ($\iota = 17$ and/or 18) and it more easily releases ^{17}O (or ^{18}O) than ^{33}S (of positive NMM) by RBL's theory. It is on this basis of RBL's theory [12] that the Si in Iris [13] and Lee *et al.* [11] subsequently observed Si assisting superconductivity of $\{\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6\}$.

RBL theory of such positive and negative NMMs effects on chemical reactions and isotopic enrichments are described in the previous archived paper on Aug 14, 2021 [8]. Also in 2018, RBL archived part of his book [10], where he gave a general theory of chemistry of enriching these stable isotopes of positive and negative NMMs (^{63}Cu , ^{65}Cu , ^{33}S , ^{31}P , ^{17}O , and ^{18}O) for enriching in chemical bonds and manifesting superconductivity. On page 4, in 2021, RBL disclosed a general theoretical framework explaining this superconductivity as observed by Sukbae Lee *et al.* on July 22, 2023 [1], therein on page 4 in 2021 RBL [8] previously disclosed: "Such type I mix of positive and negative NMMs are proposed to manifest ... as by mix of ^{13}C , ^{15}N , ^{17}O , ^{18}O , ^{25}Mg , ^{33}S with normal ^1H , ^{14}N , ^{31}P for mix of positive and negative NMMs to alter enzymatics and motions and chemical changes ... by altering the effects of all positive NMMs of ^1H , ^{14}N , and ^{31}P in normal biomolecules (1,2). The type II mix of positive and negative NMMs are of heterogeneous mix ... Such type II heterogeneous mixture in single nanodomain effects also explain the superconducting properties in nano-size".

But if it is still hard to believe RBL's theory of positive and negative NMMs enriching in materials due to forming stronger covalent bonds by Little Effect and ferrochemistry of the NMMs of different chiralities and nuclear spins for ^{17}O (or ^{18}O) enriching in $^{31}\text{PO}_4^{3-}$ structures as in apatite, then more evidence is given. I gave direct observation of the enrichment in phosphates of ^{17}O (or ^{18}O) in reference [14] under thermodynamic equilibrating conditions. Here is a second fact that substantiates RBL's theory and discover; as in 2020 researchers reported data of ^{17}O enriching in zeolite structures having Si-O-Si and Si-O-Al bonds in frame workers. To really drive home the factual basis of RBL's theory, the Si-O-Al was observed to enrich more in ^{17}O than Si-O-Si sites. Such greater enrichment of Si-O-Al with ^{17}O follows directly from RBL's NMM driven enrichment. By RBL, NMM driven enrichment; Si has fewer isotopes of nonzero NMM as its stable isotope ^{29}Si has negative (-0.555) NMM at only 4.68% relative abundance. This lower relative abundance of ^{29}Si accounts for lower ^{17}O enrichment in Si-O-Si sites due to the low relative abundance of ^{29}Si and its negative NMM. But the Al in Si-O-Al has ^{27}Al , and ^{27}Al has a large positive NMM of $+3.64$ and 100% relative abundance. Thereby due to ^{27}Al 's huge $+$ NMM, ^{27}Al pulls in ^{17}O of negative NMMs by RBL theory to explain the data and the data prove RBL's theory [2], [7]–[10] in ref [15]. On the basis of this, it follows if Si is added to the Lee process [11] then it should on the basis of Little archive [12] in July 2023 enrich the apatite with ^{17}O (and/or ^{18}O) to improve the superconductivity of the $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$. In 2023, RBL further noted in 2021 the importance of ungerade orbital symmetry for superconductivity [16]. Such ungerade orbital symmetry is manifested by Pb, P and O in the Cu substituted lead apatite, but the Cu ions give proximity to s orbitals. It is important to note that RBL archived [12] this NMM enrichment of ^{17}O (and/or ^{18}O) by ^{29}Si also in July 2023 and this role of ^{29}Si was predicted by RBL in July 2023 prior to Iris Alexander [13] and then Lee and Co-workers [11] mentioning Si subsequently in Aug 2023. Also as for the prior Dec 2019 paper [8], this paper was submitted to JACS [15] where they observed ^{17}O enrichment in zeolite. But before the submission of this paper in Dec 2019, RBL had archived [13] the phenomena in many papers and publications. For instance, in Nov 2019 [8] before this JACS paper [15], RBL was archived on page 4 [8].

In Nov 2019, RBL archived in reference [8]: "The fractional, reversible fission and fusing of nuclear (NMM) alter surrounding atomic orbitals and such altered atomic orbital alter molecular orbitals and alter chemical dynamics, catalysis, and enzymatics by the Little Effect: "spins alter orbitals during chemical reactions and orbitals altering spins". The Little Effect not only involves e^- spins altering orbitals but nuclear spins also alter orbitals for Little Effect as manifested by these nonzero NMMs of nonprimordial isotopes relative to more null NMMs of primordial isotopes. For instance, the fractional, reversible fission and fusing of the nonprimordial isotopes in enzymes can alter the stereochemistry of the substrate as the enzyme catalyzes the chemical transformation of the substrate. For instance, ^{14}N and ^{15}N nuclei motions have different chiralities as ^{14}N has positive NMM and ^{15}N has negative NMM; so changing ^{14}N to ^{15}N by this prior theory (1–3) would cause the fractional fission field of ^{15}N (relative to native ^{14}N in the enzyme) to alter the chirality of wavefunctions from the enzymatic catalyzing transition state of the substrate relative to such fission fields from primordial ^{14}N ." [9]. "Also such single domains of all positive NMMs manifest in normal

cells of living organisms for exhibiting energetic and motional dissipative orders on nanoscales for normal operations of biochemical molecules for media for life (1,2). The functions of molecules like proteins, ATP and DNA and RNA can be reasoned by such dissipative phenomena of their all positive NMMs in ^1H , ^{14}N and ^{31}P . But single domains composed of mixed + NMMs and – NMMs have yet different but distinct and novel properties of two general types. Unlike the dissipative properties of all + and/or all negative NMMs, the mix of + and – NMMs cause dissipative to \rightarrow quantizing phenomena and transforming disorder to order for novel energy accumulation, transport, catalysis, enzymatics, optics, thermodynamics, magnetics, transmutations and biology (1,2). Type I mix of positive and negative NMMs are of homogeneous mix of the + and – NMMs more may locally accumulate the many fractional, reversible fissioned and fused NMMs into chemical for altering chemical bonds and catalyzing chemical changes, even enzymatics of biomolecules. Such type I mix of positive and negative NMMs are proposed to manifest in some regions in cancer cells as by mix of ^{13}C , ^{15}N , ^{17}O , ^{25}Mg , and ^{33}S with normal ^1H , ^{14}N , and ^{31}P for mix of positive and negative NMMs to alter enzymatics and motions and chemical changes of proteins, nucleic acids, sugars, fats, and other biomolecules by altering the effects of all positive NMMs of ^1H , ^{14}N , and ^{31}P in normal biomolecules (1,2). The type II mix of positive and negative NMMs are of heterogeneous mix as the positive NMMs are separated in subdomain from negative NMMs for positive NMMs and negative NMMs subdomains within the nano domain for heterogeneous mix of positive and negative NMMs. Such type II heterogeneous mixture in single nanodomain effects also explain the superconducting properties in nano-size silver particles within nano-size gold matrix (of Thapa and Pandey, 2018) as the silver has all negative NMMs and the gold has all positive NMMs.” These are details of RBL disclosing his discovered inventive effects of nonzero NMMs on chemical reaction dynamics, catalysis and enzymatics. Such NMM effects are here applied to $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ synthesis to explain why the $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ is enriched with ^{17}O and/or ^{18}O of negative NMM and/or spin = 1, respectively, due to the presence of other isotopes of ^{31}P , ^{207}Pb , ^{63}Cu , ^{65}Cu , ^{33}S , and ^{29}Si of positive NMMs.

In addition to the chemistry of forming isotopic enriched compounds, RBL also previously predicted and discovered isotopic enrichment of the compounds by physical changes. Describe the isotopic NMMs affecting the melting point, boiling point, nature of liquid and sublimation and deposition of compound as previous published by RBL [8]. So RBL not only accounted previously for the chemistry and isotopic enrichment during the chemistry but RBL also accounted and previously published the enrichment by physical vaporizing, liquefying and depositing solidifying and separations isotopically during such. It is important to note that here as this prior disclosure of RBL of physical processes altering stable isotopes distributions by their nonzero NMMs explains why the vapor deposition of Lee and coworkers [11] was necessary to produce the superconducting apatite. The vapor deposition by Little theory separates compounds by characteristic clumping of stable isotopes so certain isotopic compounds were separated and deposited together to produce macroscopic superconductor at ambient. Thereby RBL theory further explains the original work of Lee *et al.* [1] and why other scientists who did not vapor deposit have not been able to replicate Lee *et al.* [1].

3.3. Understanding the Superconductivity by RBL Theory of Superconductivity

How does the ^{17}O and/or ^{18}O in the resulting $\text{Cu Pb}(\text{PO}_4)$ cause the superconductivity? Such apatite is related to cuprates as both cuprates and apatite have chemical structures of anionic complexations of oxygen's by centers having positive NMMs by Cu and P (phosphorus) with surrounding cations. RBL had previously published in a respected journal that ^{17}O in cuprates due to negative NMM as “the needles in the haystack” for superconductivity in cuprates [7]. Now researchers in Korea as led by Sukbae Lee (CEO of the Quantum Energy Research Centre (Q-Centre) at Korea University) have experimentally discovered room temperature and ambient pressure superconductivity in apatite by replacing lead cations by copper cations [1]. Such proves RBL theory of superconductivity and material conditions for ambient superconductivity as it has been measured that apatite rocks are inherently enriched in heavy isotopes of ^{18}O and ^{17}O . These facts has been recently published [12]. Please see facts in ref [12]. RBL notes whereas Pb has one stable isotope of positive NMM, Cu has all its stable isotopes of ^{63}Cu and ^{65}Cu of positive NMMs. This is why replacing some Pb with Cu causes superconductivity. The negative NMM of ^{17}O and perhaps induced negative NMM in ^{18}O and positive NMMs of ^{63}Cu and ^{65}Cu in this Cu substituted apatite manifest the positive and negative NMMs for phenomena of nuclear pressures for superconductivity by RBL's theory [2], [7]–[10]!

4. DISCUSSION

RBL related the superconductivity in the recently discovered superconductors: N: LuH to LaH, CSH, SH, Cuprates, and Arsenates [17]. But now how does $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ relate to these prior

superconductors? RBL NMM theory can relate the $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ to the other superconductors. The superconductivity in the $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ is related to other superconductor by the isotope effect by nuclear magnetic moments (NMMs) as discovered by RBL. The ^{17}O (and/or ^{18}O) is intrinsically enriched in $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$. RBL has previously noted ^{17}O is intrinsically doped in cuprates. The $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ superconductivity is thereby related to cuprate superconductivity by both having enriched ^{17}O (of negative NMMs) and the 100% P by relative abundance enrich the ^{17}O (and/or ^{18}O) in $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ for $\{^{207}\text{Pb}_{(10-x)}\ ^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6\}$ (where $i = 17$ and/or 18), just as ^{63}Cu and ^{65}Cu of positive NMMs enrich ^{17}O (and/or ^{18}O) in cuprates. The $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ is further related to the other superconductors by periodic table as the ^{31}P with 100% + NMMs (binds the ^{17}O and/or ^{18}O) is above ^{75}As . And the stable isotope ^{75}As in iron arsenate has 100% positive NMMs. The same physical phenomena of positive and negative NMMs in cuprates and iron arsenates between ^{63}Cu (and ^{65}Cu) and ^{17}O (and/or ^{18}O) and ^{75}As and ^{17}O (and/or ^{18}O) manifest between ^{31}P and ^{17}O (and/or ^{18}O) to explain the superconductivity in the new $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$.

In prior papers RBL [12] related superconductivity in cuprates and iron arsenates (and therefore now $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$) to superconductivity in Hg and Nb and Sc and also to superconductivity in H_2S and LaH_{10} under high pressure. Therein RBL noted the internal pressure of the positive and negative ions in cuprates and iron arsenates (and now Cu-Pb(PO_4)) for causing the Cooper pairs to superconduct in the QF released by the positive and negative NMMs. But in Hg and Nb the metals are less bound and the phonons can more easily disrupt the cooper pairs in the Hg and Nb as the positive and negative NMMs in the Nb and Hg and Sc cannot bind the $e^- e^-$ Cooper pairs as well as in the ionic structures in cuprates and iron arsenates. In more recent years scientists have discovered high pressures induce superconductivity in some materials. RBL's theory can explain such mechanical pressure as it externally pushes the positive and negative NMMs together in collisions to induce fractional reversible fission to seep NMMs into surrounding electronic lattices to induce superconductivity. The temperature is chaotic and disrupt. The NMMs organize the disorder and temperature with flattening of bands over larger spacetime by more release of + and - NMMs. Pressure causes more frequent collisions to release more NMMs and order NMMs by pressure. So ions can pressurize to release NMMs for QF. So ions in cuprates cause internal pressure for superconductivity by collisions of NMMs. External pressure can also raise T_c to release NMM to order QF.

5. CONCLUSION

RBL Theory of NMMs causes the synthesis and the resulting superconductive properties of $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$. Ambient superconductivity has been attempted for many years. High temperature superconductivity has not been understood in theory for many years. RBL in 2005, gave a theory for superconductivity on the basis of nuclear magnetic moments (NMMs). RBL's theory of NMMs introduced chemistry and physics for forming and manifesting superconductivity, respectively. This work applies RBL's theory to the recent $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ and is found able to explain the ^{17}O (and/or ^{18}O) enrichment in formation of $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ as due to the prevalence of stable isotopes in the reactants of positive NMMs: ^{31}P , ^{33}S , ^{63}Cu , ^{65}Cu , and ^{207}Pb . Such positive NMMs of these stable isotopes favor covalently bonding ^{17}O (and/or ^{18}O) over ^{16}O during the kinetic controlling conditions of $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ synthesis. This favors clumping of heavier isotopes of nonzero NMMs for superconducting components in the mix such as $\{^{207}\text{Pb}_{(10-x)}\ ^{63}\text{Cu}_x(^{31}\text{P}^i\text{O}_4)_6\}$, where $i = 17$ and/or 18 . The recently noted superionicity is also explained in $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ product mixture due to these nonzero NMMs. Superconductivity is explained by the + and - NMMs by RBL's theory (causing fractional fission and fusing of NMMs from nuclei to alter surrounding electronic orbitals for extended flat band production) in certain components of the product mixture due to clumping of positive and negative NMMs in these superconducting components of the product mixture. RBL's theory also explains other aspects of the $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ superconductivity such as the role of silicon to the superconductivity as RBL previously noted ^{29}Si and its negative NMM may favor altered bonding to ^{17}O (and/or ^{18}O) and increased release of ^{17}O (and/or ^{18}O) to ^{31}P during the synthesis relative to positive NMM of ^{33}S hindering the release of its ^{17}O (and/or ^{18}O) to ^{31}P . Because of positive NMM of ^{33}S and induced negative NMMs of ^{32}S , sulfur impurity in the product Cu replaced lead apatite may increase ^{17}O and ^{18}O enrichment for increasing superconductivity of the Cu replaced lead apatite. RBL's theory also explains the recent inability of scientists around the world to replicate $\text{Pb}_{(10-x)}\text{Cu}_x(\text{PO}_4)_6$ as the original report of Lee and coworkers [1] reported the additional step of evaporating the product mixture and re-depositing the vapor on a glass slide. The theory of RBL explains why the vapor deposition from the initial product mixture isolates the superconducting phase as the physical process of melting, vaporizing, and re-depositing the product material has been previously proposed by RBL [12] to cause enrichment and separation of compounds by their differing stable isotopic enrichments and clumpings.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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