



A REVIEW OF HADRONIC CHEMISTRY AND ITS APPLICATION IN THE DEVELOPMENT OF NEW MAGNECULAR FUEL

V. M. Tangde¹, I. B. Das Sarma² and S. G. Rawat³

¹Department of Chemistry, Rashtrasant Tukadoji Maharaj Nagpur
University, Nagpur – 440 033, India

²Department of Applied Chemistry, Jhulelal Institute of Technology,
Lonara, Koradi Road, Nagpur

³Department of Applied Chemistry, Priyadarshini College of Engineering,
Hingna Road, Nagpur
Email: vijaytn6@gmail.com

Abstract

The discipline, today known as Quantum Chemistry for atomic and subatomic level interactions has no doubt made a significant historical contributions to the society. Despite of its significant achievements, quantum chemistry is also known for its widespread denial of insufficiencies. An Italian-American Scientist *Professor Ruggero Maria Santilli* during his more than five decades of dedicated and sustained research has denounced the fact that quantum chemistry is mostly based on mere nomenclatures without any quantitative scientific contents. Professor R M Santilli first formulated the iso-, geno- and hyper- mathematics¹⁻⁴ that helped in understanding numerous diversified problems and removing inadequacies in most of the established and celebrated theories of 20th century physics and chemistry. This involves the isotopic, genotopic, etc. lifting of Lie algebra that generated Lie admissible mathematics to properly describe irreversible processes. The studies on Hadronic Mechanics in general and chemistry in particular based on Santilli's mathematics³⁻⁵ for the first time have removed the very fundamental limitations of quantum chemistry^{2, 6-8}. In the present discussion, we propose to present the review on the conceptual foundations of Hadronic Chemistry that imparts the completeness to the Quantum Mechanics and Chemistry via an addition of effects at distances of the order of 1 fm (only) and the industrial applications of Hadronic Chemistry in formulating the basically new chemical species of Magnecule^{8, 12-14}.

Keywords: *Hadronic Mechanics, Quantum Chemistry, Magnecules, Fuels.*

Introduction:

In the late seventeenth century, Issac Newton discovered classical mechanics, the laws of motion of macroscopic objects. In the early



twentieth century, physicists found that classical mechanics does not correctly describe the behaviour of very small particles. Such particles are described by a set of laws called *quantum mechanics*. *Quantum mechanics* is the science of motion of micro (atomic and subatomic) particles. Its study is of great importance in chemistry because physicochemical properties of atoms and molecules, their structures, spectral behaviour and even reactions may be interpreted in terms of the motion of micro particles like electron and protons. Despite undeniable achievements, quantum chemical models of molecular structures have very fundamental insufficiencies. For example, Quantum mechanics and chemistry cannot characterize an attractive force among neutral atoms of a Hydrogen molecule.

Quantum mechanics and chemistry cannot explain why the Hydrogen and water molecules admit only two H-atoms and not three or more. Characteristics like binding energy, electric and magnetic dipole and multi-pole moments (and sometimes even their signs) of Hydrogen and other molecules have not been represented accurately. So called more accurate representations of binding energies are achieved by the “screening of the Coulomb potential” via the use of an arbitrary multiplicative function of completely unknown physical or chemical origin,

$$V(r) = \frac{e^2}{r} \rightarrow V'(r) = f(r) \frac{e^2}{r}$$

However, such a screening occurs with the evident loss of quantized orbits (since the latter are solely admitted by the Coulomb potential), the evident loss of the fundamental Galilean symmetry (and consequential inapplicability of the imprimitivity theorem for a consistent quantization), and other basic insufficiencies. The basic axioms of quantum mechanics and chemistry are known to be reversible over time, while most chemical reactions are known to be irreversible, thus creating the problem of constructing covering theories based on irreversible axioms and so on.



More so, quantum mechanics and chemistry are structurally linear theories, thus necessitating the representation of complex multi-body systems via the factorization of the total wave function into its individual components which requires the adoption of superposition principle as a prerequisite for consistency in the representation of composite systems. However, composite systems like the water molecule are nonlinear, thus implying the inapplicability of the superposition principle, with consequential inappropriateness of formulating a consistent factorization thus confirming the inability of quantum mechanics and chemistry as the final theories to represent complex structures. Additionally, the synthesis of the water molecule from its constituents is a structurally irreversible process, while quantum mechanics and chemistry are reversible theories, thus admitting the possibility of spontaneous decay of water molecule into its atomic constituents which turns out as a serious drawback of said theories. Besides all these limitations, quantum mechanics and chemistry admit an additional and rather crucial, inherent limitation, that of divergent or of poorly convergent perturbation series. In fact, the representation of the main features of the water molecule and other complex structures require Gaussian and other methods, all based on expansions whose calculations require the assistance of computers due to their complexities. The insufficiency here referred to is given by the fact that the physical and chemical values of final results under divergent or poorly convergent perturbation series is clearly questionable. Additionally, the time required for basic calculations using big computers is generally excessive, thus implying clear axiomatic limitations from the divergent or poorly convergent character of the series.

Hadronic Chemistry:

To overcome the above said insufficiency there evolved Hadronic Chemistry. The Italian-American scientist Ruggero Maria Santilli has

achieved a milestone in formulating a new mathematics (hereon referred to as Santilli's Mathematics) that streamlined various branches of physics including quantum mechanics. To remove these fallacies Santilli has formulated new mathematics and hadronic mechanics. Hadronic mechanics is characterized by novel *iso*-, *geno*- and *hyper* mathematics for the representation of reversible, irreversible and multi valued system respectively with Hamiltonian and non-Hamiltonian effects. Accordingly, the hadronic mechanics has three corresponding branches, *isomechanics*, *genomechanics* and *hyper mechanics and their isoduals*. Hadronic chemistry is applicable at distances of about 1 fm (10^{-13} cm) or less. As it is well known that, all fundamental particles with finite mass have wave packets of the order of 1 fm hence the process of molecular binding is a case of interior interactions of these wave packets^{8, 12, 15, 16}.

Isochemical Model:

Santilli and Shillady^{6, 7} developed an isochemical model of valence bond considering deep overlapping of the wave packets of the bond forming valence electrons and obviously the interactions at 1 fm level of considerations having the property nonlocal, non-linear, non-potential, non-Hamiltonian and hence non-unitary transformations.

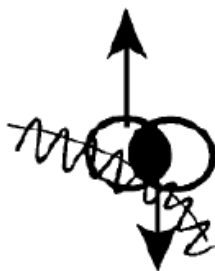


Figure 1: A schematic view of the the deep overlapping of the wavepackets of valence electrons in singlet coupling resulting in conditions which are known to be *non-linear*, *non-local*, and *non-potential* (due to the zero-range, contact character of the interactions), thus not being representable via a Hamiltonian (*non-Hamiltonian structure*). As a

result, the ultimate nature of valence bonds is outside any representational capability of quantum chemistry. Santilli has build hadronic chemistry for the specific scope of representing the conditions herein considered of the bonding of valence electrons (see the monograph *Hadronic Mathematics, Mechanics and Chemistry* Volume V⁸)

The deep overlapped singlet state of electrons is termed by Santilli as *isoelectronium* because the energetic description of it requires his *isomathematics*³⁻⁵. Its pictorial representation for hydrogen molecule is depicted in Figure 2 below. This branch is known as hadronic chemistry².

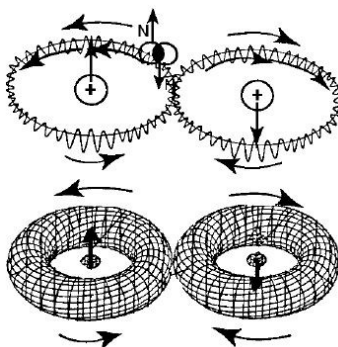


Figure 2: A view of isochemical model of the hydrogen molecule at absolute zero degrees temperature without any rotational degree of freedom, with the Santilli-Shillady strong valence bond between the valence electrons pair into isoelectronium quasiparticle. Note the oo-shape orbital of the isoelectronium, the only one allowing a representation of the diamagnetic character since, under an external strong magnetic field the two H atoms acquire parallel but opposite magnetic polarities with null value at sufficient distance. source: New Science for a New Era²

The isochemical model has provided for the first time in the history, the exact representation of molecular binding energies from first axiomatic



principles without ad hoc adulteration; Gave an explanation for why Hydrogen molecule have only two Hydrogen atoms; Provided reconstruction of the superposition principle at the isotopic level, thus permitting an axiomatically consistent study of composite systems under non-linear, non-local and non-Hamiltonian interactions; and most of all Reduced the computer time by at least 1000-fold by using the isounit to compute isoelectronium energy much much bigger than one and, consequently, the isotopic element is much smaller than one, this then turns all slow convergent series into a strong (fast) convergent form^{2, 6-8}. The model as shown in Figure 2 represents motion of isoelectronium in an oo-shaped orbit and this fact lucidly help in describing the magneuclear bonding discussed in next section.

Magnecules:

The energy requirement of the mankind has been fulfilled by the conventional source of energy i.e. molecular combustion of fossil fuels, hydrogen or nuclear fission. However, combustion of fossil fuel generates large amount of green house gas like CO₂ and hydrogen combustion depletes atmospheric O₂ by forming H₂O. Also, most of the environmental pollution caused by fossil fuel is due to chunks of un-combusted fuel that may be carcinogenic primarily because consisting of incomplete combustion of fuel. Therefore the current day demand is clean energy source that is cheap and abundant. The fuels developed should be such that can be used in existing engines without any or major modifications. This requirement has been fulfilled by changing the approach from quantum mechanics to hadronic mechanics to hadronic chemistry. Italian-American physicist Professor R. M. Santilli^{1,3,4,6-8} developed a new novel fuel characterized by hadronic mechanics/chemistry known as MAGNECULES^{8, 12-14,17}.

Magnecules are novel chemical species having at least one magneuclear bond. Principle of synthesis of magnecules is similar to the magnetization

of a ferromagnet where the orbits of unbounded electrons are polarized. The atoms are held together by magnetic fields originating due to toroidal polarization of the atomic electron orbits. The rotation of the electrons within the toroid creates the magnetic field which is absent for the same atom with conventional spherical distribution of electron orbitals. When two such polarized atoms are sufficiently close to each other and in north-south north-south alignment, the resulting total force between the two atoms is attractive. The polarization is brought about by high magnetic field which is obtained as in the case of high voltage DC arc. Thus, Santilli Magnecules in gases, liquids, and solids consist of stable clusters composed of conventional molecules, and/or individual atoms bonded together by opposing magnetic polarities of toroidal polarizations of the orbits of at least the peripheral atomic electrons when exposed to sufficiently strong external magnetic fields, as well as the polarization of the intrinsic magnetic moments of nuclei and electrons. A population of magnecules constitutes a chemical species when essentially pure, i.e., when molecules or other species are contained in very small percentages in a directly identifiable form.

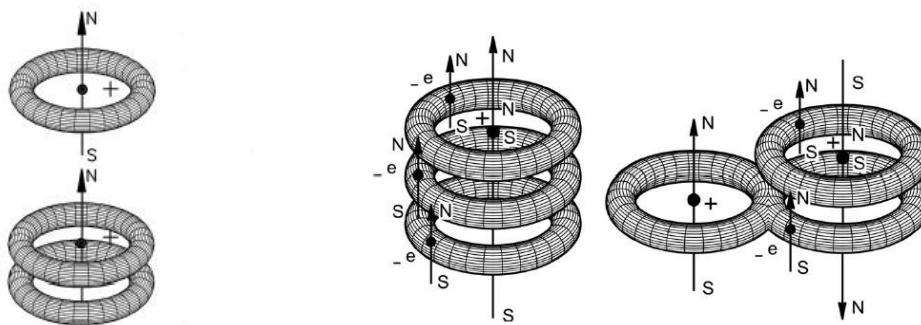


Figure 3: A schematic view of the simplest possible multiatomic magnecular bonds Rendering *magnecule* comprising two identical or different atoms whose bond is entirely of *magnecular* character, namely, originating from opposing polarities North-South-North-South of the



toroidal distributions of orbital, as well as the polarization of nuclear and electron magnetic moments. source: New Science for a New Era².

Magnecules are of the following types-

Elementary when composed only of two molecules, e.g.: {H – H} × {H – H}; and so on where ‘–’ denotes conventional valence bond and ‘×’ denotes magnecular bond

Magneplexes when entirely composed of several identical molecules e.g.: {H – O – H} × {H – O – H} × {H – O – H} × {H – O – H} × {H – O – H} × ...; and so on

Magneclusters when composed of several different molecules e.g.: {H – H} × {C – O} × {O – C – O} × {C = O} × {H – H} × ...; and so on

Magnecules are also classified as-

Isomagnecules when having all single-valued characteristics and being reversible in time, namely, when they are characterized by isochemistry,

Genomagnecules when having all single-valued characteristics and being irreversible in time, namely, when they are characterized by genochemistry; and

Hypermagnecules when having at least one multi-valued characteristic and being irreversible in time, namely, when they are characterized by hyperchemistry.

Santilli magnecules are characterized by following characteristics, namely:

- i. Large atomic weights which are ten times or more than the conventional molecules.
- ii. Large peaks in macroscopic percentages in mass spectra, which do not belong to conventional molecules.



- iii. These peaks show same infra-red and ultra-violet signature as expected from the conventional molecules and/or radicals constituting the magnecule.
- iv. Said infrared and ultraviolet signatures are generally altered with respect to the conventional versions.
- v. Magnecules have an anomalous adhesion to other substances.
- vi. They can break down into fragments under high energetic collisions, with subsequent recombination with other fragments and/or conventional molecules.
- vii. They can build up or lose individual atoms, radicals or molecules during collision.
- viii. They have an anomalous penetration through other substances indicating a reduction of the average size of conventional molecules as expected under magnetic polarizations.
- ix. Gas magnecules show an anomalous solubility in liquids due to new magnetic bonds between gas and liquid molecules caused by magnetic induction.
- x. Magnecules can be formed by molecules of immiscible liquids.
- xi. A gas with magnecular structure does not follow the perfect gas law.
- xii. Substances with magnecular structure have anomalous physical characteristics, as compared to the conventional molecules.
- xiii. Magnecules release more energy in thermochemical reactions than that released by the same reactions among unpolarized molecular constituents.

All the above characteristic features disappear when the magnecules are brought to a sufficiently high temperature (Curie Magnecular Temperature), which varies from species to species. The property of magnecules to undergo magnecular combustion with high energy output which is attributed to weak magnecular bond¹⁴. This is exploited for the industrial development of novel clean fuels such as magnegas.



Consider the case of combustion of molecular hydrogen and oxygen to produce H_2O . The dissociation of H_2 and O_2 molecules consume 163.7 kcal/mol and thereafter the atom recombination to produce H_2O releases 221.25 kcal/mol hence the net release of energy is 57 kcal/mol. However, in case of magneuclear hydrogen $\{H \times H\}$ and atomic oxygen O combustion (even if on considering $H \times H$ bond dissociation energy arbitrarily to be zero) the energy output is predicted to be approximately three times the value predicted by molecular structures with the same atomic constituents and combustion temperature².

Recently, two different experimental confirmations have been reported of the new chemical species of Magnecules - MagneHydrogen¹⁴ with 99% Hydrogen content, and also having a multiple of the specific weight of conventional molecular Hydrogen. A number of features of the new species MH are pointed out therein, such as the increased energy content and the lack of seepage through the walls of a container. These features appear to be relevant for the Hydrogen industry.

Conclusion:

The molecular structure study based on the bonding of a pair of valence electrons from different atoms into a singlet quasi-particle (*isoelectronium*) in Hadronic Chemistry has provided a route to overcome the 20th century insufficiencies in quantum chemistry, namely:

1. Exact representation of molecular binding energies from first axiomatic principles without ad hoc adulterations.
2. An explanation, why hydrogen molecule has only two hydrogen atoms.
3. The major achievement of this isochemistry is that, absolute value of the isounit is much bigger than one and the isotopic element is much smaller than one turning all slow convergent series into strongly (fast) convergent form. Therefore the variational calculations for isochemical model of hydrogen and water



molecules turned out to require a computer time at least 1000 shorter folds than the conventional calculations.

Also, Hadronic Chemistry has application in the development of novel magneuclear fuel which shows clean combustion. The magneuclear combustion can be considered superior to molecular combustion due to:

1. Comparatively weak bond of magnecules.
2. Its stored magnetostatic energy, and
3. Highly ordered structure.

They also have promising application as fuel additive for improving combustion of existing fossil fuel due to their high miscibility, higher combustion rate and thermal output. The magnecules might be acting as detonator to the conventional fuel molecules resulting in near complete combustion of the latter. Thus, they hold promising applications as sustainable energy requirements.

References:

- R. M. Santilli, (2001). Foundations of Hadronic Chemistry, Kluwer Academic Publisher, Dordrecht.
<http://www.santilli-foundation.org/docs/santilli-113.pdf>
- I. Gandzha and J. Kadisvily, (2001). New Science for a New Era, Sankata Printing Press, Nepal,.
<http://www.santilli-foundation.org/docs/RMS.pdf>
- R. M. Santilli, (2007). Hadronic Mathematics, Mechanics and Chemistry: Limitations of Einstein's Special and General Relativities, Quantum Mechanics and Quantum Chemistry, Volume I, International Academic Press, U.S.A..
- R. M. Santilli, (2007). Hadronic Mathematics, Mechanics and Chemistry: Iso-, Geno-, Hyper-Formulations for Matter and Their Isoduals for Antimatter, Volume III, International Academic Press, U.S.A.



- C. Corda, (2012). Numerical Analysis and Applied Mathematics ICNAAM AIP Conf. Proc. 1479, 1013 (2012); doi:10.1063/1.4756316.
<http://www.santilli-foundation.org/docs/Corda-2012.pdf>
- R. M. Santilli and D. D. Shillady, (1999). International Journal of Hydrogen Energy, 24, 943-956.
<http://www.santilli-foundation.org/docs/Santilli-135.pdf>
- R. M. Santilli and D. D. Shillady, (2000). International Journal of Hydrogen Energy, 25, 173-183.
<http://www.santilli-foundation.org/docs/Santilli-39.pdf>
- R. M. Santilli, (2008). Hadronic Mathematics, Mechanics and Chemistry: Experimental Verifications, Theoretical Advances and Industrial Applications in Chemistry, Volume V, International Academic Press, U.S.A.
- Raul Pérez-Enriquez, Jose Luis Marin and Raul Riera, (2007). Progress in Physics, 2, 34-41.
- A. K. Aringazin and M. G. Kucherenko, (2000). Hadronic J., 23, 1.
- A. K. Aringazin, (2000). Hadronic J. 23, 57.
- R. M. Santilli, (1998). Hadronic J., 21, 789.
<http://www.santilli-foundation.org/docs/Santilli-43.pdf>
- R. M. Santilli, (2005). The New Fuel with Magneuclear Structure, International Academic Press, U.S.A.
- Y. Yang, J. V. Kadeisvili, and S. Marton, (2013). Int. J. Hydrogen Ener., 38, 5003.
- V. M. Tangde, (2012). Hadronic Chemistry Applied to Hydrogen and Water Molecules, AIP Conf. Proc., 1479 1033-36.
- V. M. Tangde, (2013). Elementary and Brief Introduction to Hadronic Chemistry, AIP Conf. Proc., 1558 652-656.
- I. B. Das Sarma, (2013). Santilli's New Fuels as Sources of Clean Combustion, AIP Conf Proc., 1558, 680-684.