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Elementary and Brief Introduction to Hadronic Chemistry

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Quantum Chemistry

Based on the true axioms of **Quantum Mechanics** without ad hoc adulteration, quantum chemistry has proved majestic axiomatic consistency through out the 20^{th} century, and provided invariant results without any internal inconsistency.
Despite its axiomatic consistency and achievements throughout the 20^{th} century quantum chemistry still remains affected by number of basically unresolved limitations, insufficiencies, or sheer inconsistencies.

Revolutionary Claims of Quantum Mechanics/Chemistry

The claims of quantum Mechanics about the fundamental behavior of particle.

1. Particles act like waves.
   Particles can interfere with themselves.
2. There is a non-zero probability of finding a particle essentially anywhere in the universe.
3. Measurement is inherently probabilistic.
   No supplemental knowledge will make measurement deterministic.

Quantum Mechanics: Real Black Magic Calculus. - A. Einstein

Einstein was so shocked by these claims that he was convinced that quantum mechanics must be wrong

Albert Einstein, On Quantum Physics, Letter to Max Born, December 12, 1926

[a]Quantum mechanics is certainly imposing. But an inner voice tells me that it is not yet the real thing. Quantum theory says a lot, but does not really bring us any closer to the secret of the Old One. I, at any rate, am convinced that He (GOD) does not throw dice.

[a] J. Ankerberg and J. Weldon, *Encyclopedia of New Age Beliefs*, Harvest House, U. S. A., pp. 520, 1996.

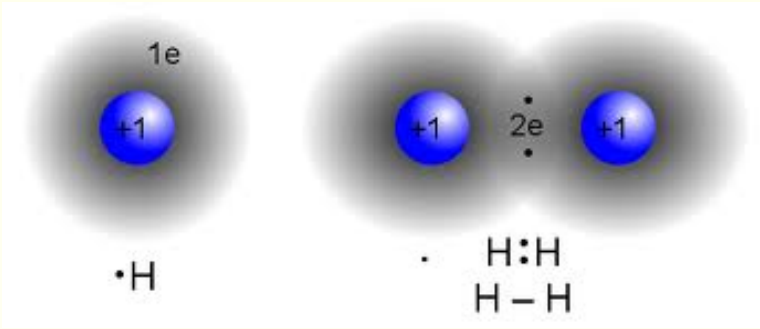
Niels Bohr
As quoted in Meeting the Universe Halfway (2007) by Karen Michelle Barad, p. 254, with a footnote citing The Philosophical Writings of Niels Bohr (1998).

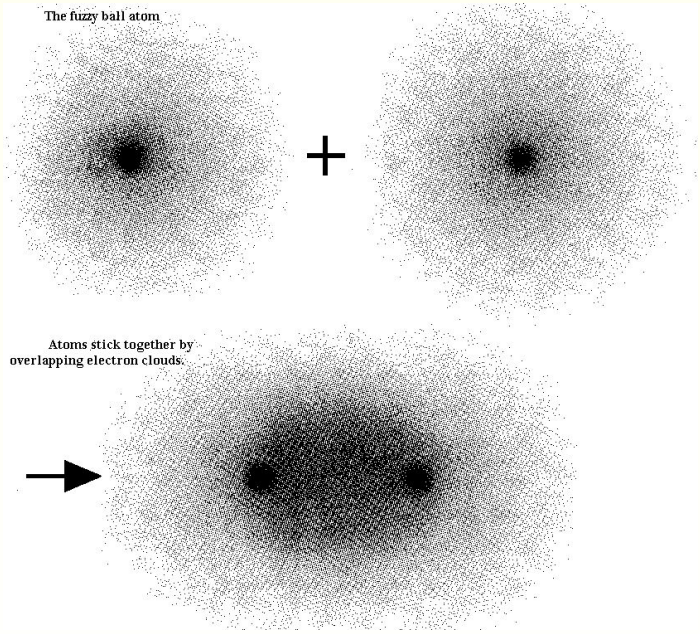
Anyone who is not shocked by quantum mechanics has not understood it.

With the advancement of experimental and technological efficiencies the increasing limitations of quantum mechanics and chemistry got surfaced out for example[a]-

[a] R. M. Santilli, *Foundations of Hadronic Chemistry*, Kluwer Academic Publisher, Dordrecht, 2001.

- It does not characterize an attractive force among neutral atoms of Hydrogen molecule.
- Why 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 of Hydrogen and other molecules have not been represented accurately.
- Larger percentage are missing in the representations of electric and magnetic moments, sometimes even have wrong signs.





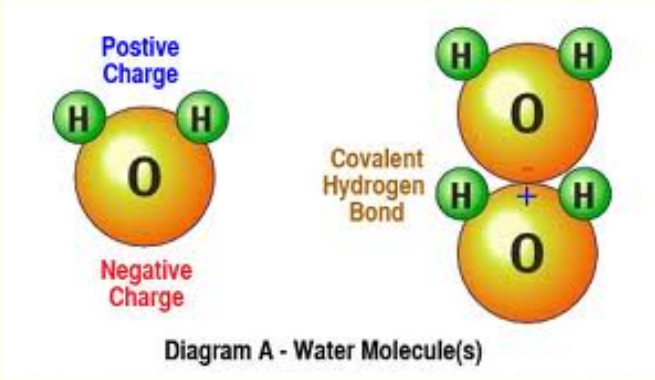
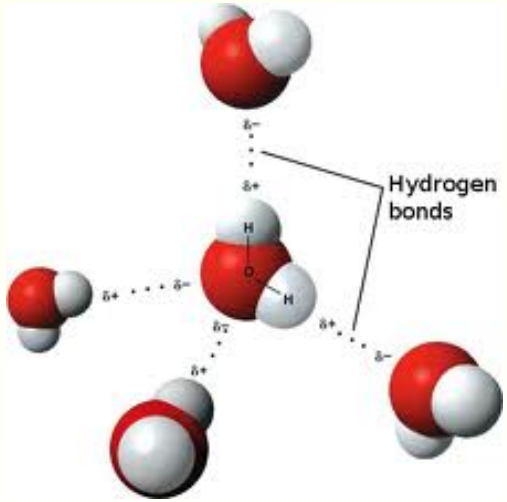


Diagram A - Water Molecule(s)



Use of Screened coulomb potential

- The basis of introduction of an arbitrary function to describe screening of coulomb potential between two electrons to arrive at a more accurate numerical representation of molecular binding energies and other data, as

The map from the Coulomb potential to its screened form requires a nonunitary transform,

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

$$UU^{\dagger} = f(r) \neq I.$$

adhoc modified law of such type do not admit stable orbit and the Bohr's orbit is impossible under such adulteration therefore, the screening of the Coulomb law causes major departure from the unitary structure of quantum mechanics which cannot be accepted.

Inability to deal with complex structures

- Quantum chemistry is structurally linear theory, thus representing complex multi body systems via the factorization of the total wave function into its individual components

$$\psi_{total} = \psi_1 \times \psi_2 \times \cdots \psi_n \tag{1}$$

this requires the adoption of the superposition principle as a prerequisite for its consistency. Multi-body systems like water molecules are nonlinear where superposition principle is inapplicable, with consequential impossibility of formulating a consistent factorization,

$$H(r, p, \psi, \cdots)\psi_{total} \neq H(r, p, \psi, \cdots)\psi_1 \times \psi_2 \times \cdots \psi_n \tag{2}$$

thus expresses the inability of quantum chemistry to rationally deal complex structures.

Possibility of spontaneous decay of water molecule
Reversibilty of Quantum Chemistry

- Synthesis of water molecule is structurally irreversible process whereas quantum chemistry is a reversible theory indicating the possibility of spontaneous decay too of water molecule

$$A > B \equiv B > A$$
$$H_2 + O \longrightarrow H_2O$$
$$H_2O \longrightarrow H_2 + O$$

Irreversibilty of Hadronic Chemistry

$$A > B \neq B > A$$

which became a serious drawback of the theory.

- Moreover, when passing to water molecules as a part of complex environments like liquid states or when at the foundation of life, quantum chemistry becomes simply beyond any level of acceptability.

Poor convergence of perturbative series

- Beside all these limitations quantum chemistry admits an additional rather crucial limitation given by poor convergence of the perturbation series. That is, water molecule and other complex structures require Gaussian and other methods, all based on expansions whose calculations require computer due to their complexities.
  The insufficiency here referred to is given by the fact that the time requested for basic calculations by large computers is generally excessive, thus implying an inherent lack of strong convergence of the perturbative series, with consequential debatable accuracy.

Development of new theory

For all these and other reasons, Santilli never accepted the quantum chemical notion of valence bond. For him it was merely a nomenclature without quantitative scientific content because to achieve the later a valence bond must verify the following *CONDITIONS*:

1. The force between a pair of valence electrons and its physical or chemical origin.
2. That the force must be attractive indeed.
3. The attractive force must verify the equivalence of molecular binding energy and other data.

Quantum chemistry could never verify the above conditions. On the contrary, according to quantum mechanics (chemistry), identical electrons repel each other, and certainly do not attract each other.
Therefore an idea of constructing a quantitative invariant representation of the deep overlapping of the wavepackets of valence electrons motivated **Professor Santilli** to construct hadronic covering of quantum chemistry capable of resolving all the issues of insufficiencies.
This covering is christened as **Hadronic Chemistry**.

Hadronic Chemistry

In **Hadronic Chemistry**[1,2] we study a completion of quantum mechanics and chemistry via the addition of effects at distances of the order of 1 fm (only) which are assumed to -

- **Nonlinear** - dependent on powers of the wave functions greater than one.
- **Nonlocal-integral** - dependent on integrals over the volume of wave-overlapping which, as such, cannot be reduced to a finite set isolated points.

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[1] R. M. Santilli, *Foundations of Hadronic Chemistry*, Kluwer Academic Publisher, Dordrecht, 2001.

[2] R. M. Santilli, *Hadronic Mathematics, Mechanics and ChemistryVolume V: Experimental verifications, Theoretical Advances and Industrial Applications in Chemistry*, International Academic Press, U.S.A., 2008.

- **Nonpotential** - consisting of contact interactions, that is, contact caused by the actual physical contact, with consequential zero range for which the notion of potential energy has no mathematical or physical state.
- **Non-Hamiltonian** - not representable via a Hamiltonian, thus requiring additional terms and consequently
- **Non-Unitary** - the time evolution violates unitary condition $U \times U^{\dagger} = U^{\dagger} \times U = I$.

Note that the condition of nonunitarity is necessary because, quantum chemistry would be fully within the basic axioms under unitary representations.

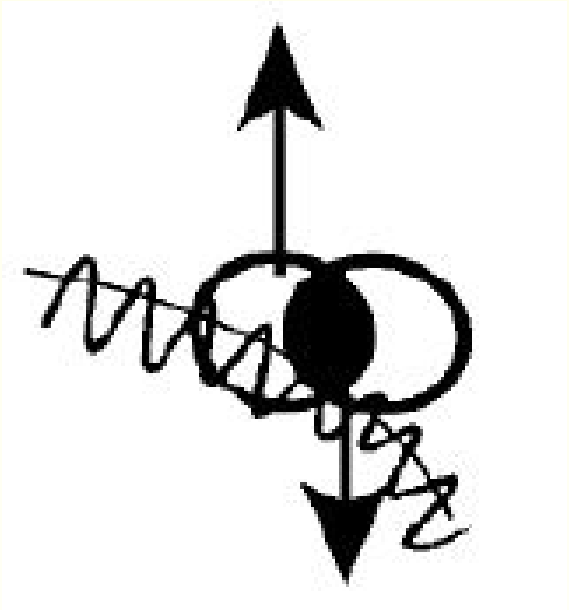


Figure: A schematic view of the the deep overlapping of the wavepackets of valence electrons in singlet coupling resulting in conditions which are known to be *nonlinear, nonlocal,* and *nonpotential* (due to the zero-range, contact character of the interactions), thus not being representable via a Hamiltonian (*non-Hamiltonian structure*), and, consequently, not being unitary. As a result, the ultimate nature of valence bonds is outside any in depth representation via quantum chemistry. Hadronic chemistry has been built for the specific scope of representing the conditions herein considered of the bonding of valence electrons. Source: Hadronic Mathematics, Mechanics and Chemistry Volume V

With the mathematical maturity of hadronic mechanics, Santilli applied it to chemical systems and the results were amenable to the precise experimental verification and industrial applications. **Santilli and Shillady** for the first time in their historical papers in 1999 and in 2000 have proposed new models for the structure of **Hydrogen and Water molecules** which apparently for the first time [3,4] -

[3] R. M. Santilli and D. D. Shillady, *Int. J. Hydrogen Ener.* **24**, 943-956(1999).
[4] R. M. Santilli and D. D. Shillady, *Int. J. Hydrogen Ener.* **25**, 173-183(2000).

1. have introduced a basically new, strongly attractive, non-coulomb force among pairs of valence electrons
2. explained, why these molecules have only two Hydrogen atoms,
3. achieved an exact representation of binding energy from unadulterated first axiomatic principle, and
4. proved the reduction of computer time by at least a factor of 1000 folds.....

These studies of hadronic chemistry categorized it into following branches -

- **QUANTUM CHEMISTRY:** assumed to be exactly valid for all mutual distances of particles bigger than 1 fm $= 10^{-13}$ cm;
- **ISOCHEMISTRY:** characterized by a lie-isotopic, time invariant, axiom-preserving, nonunitary covering of quantum chemistry formulated over Hilbert-Santilli isospaces over Santilli isofields for the representation of *isolated and reversible chemical structures and processes*;
- **GENOCHEMISTRY:** characterized by a Lie-admissible, time irreversible covering of isochemistry formulated on Hilbert-Santilli genospaces over Santilli genofields for the representation of *irreversible chemical structures and processes*;

- **HYPERCHEMISTRY:** characterized by a multi-valued covering of genochemistry for the representation of *organic structures and biological processes*;
- **ISODUEL ISO-, GENO-, and HYPER-CHEMISTRY:** characterized by the isodual map of **Integrability Conditions for the Existence of a Lagrangian or Hamiltonian** for the description of the *chemistry of antimatter*.

Now let us first look at the conceptual foundation of isochemical model molecular bond for simplest possible case of the H_2 molecule.

The Isoelectronium- First Success of Hadronic Chemistry

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 Era

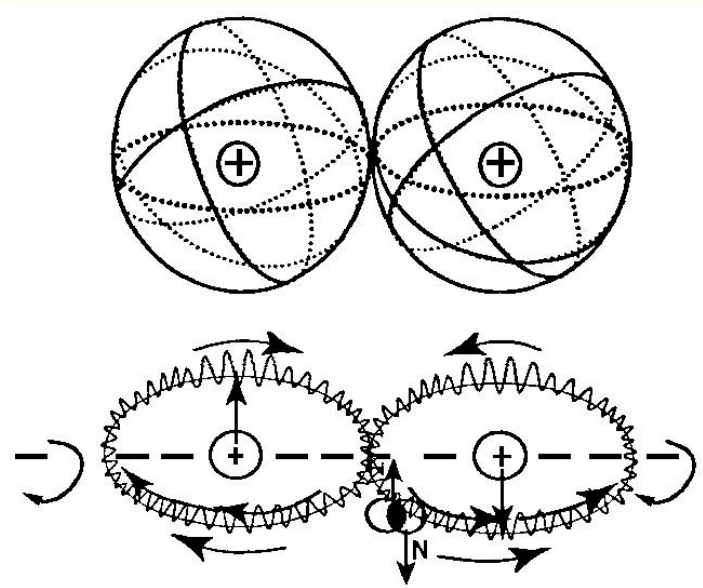


Figure: The isoelectronium

The main assumption made herein was that pairs of valence electrons from two different atoms bond themselves at short distances into a singlet quasi-particle state called as **isoelectronium** which describes an oo-shaped orbit around the respective two nuclei. This then became the necessary condition to justify that **the character of the H - H molecule is not paramagnetic**, in total agreement with the experimental verification. Therefore, it is needless to say, once two valence electrons are bonded into the *isoelectronium*, there is no possibility for bonding additional atoms **justifying, why H- (or Water) molecules admit only two Hydrogen atoms**.

The limit case of stable isoelectronium

The fundamental problem of verification of the three *CONDITIONS* mentioned earlier was achieved by **R M Santilli** and the American Scientist **D D Shillady** in their historical paper[5].
Let us recall its conceptual outline to show the achievement of valence coupling between two identical electrons in a singlet coupling with a strongly attractive force[6].

[5] **R. M. Santilli and D. D. Shillady, International Journal of Hydrogen Energy 24, 943-956(1999)**

[6] **Ivan Gandzha and Jerdsey Kadeisvily, New Science for a New Era - Mathematical, Physical and Chemical Discoveries of Ruggero Maria Santilli, San-Marino draft dated June 28, 2011**

Consider the conventional quantum mechanical equation in relative coordinates and reduced mass for two electrons in singlet coupling,

$$\left(\frac{p \times p}{m} + \frac{e^2}{r}\right)\psi(r) = E\psi(r), \tag{3}$$

where m is the electron mass. The above eqution shows the *repulsive* coulomb force between the *point-like* charges of the electrons. But the electrons have *exended wavepackets* of the order of 1 fm whose mutual penetration, as necessary for the valence bond, cause *nonlinear*, *nonlocal* and *nonpotential* interactions.

The only possibility for an invariant representation of the bonding of the H-electron with a valence electron of another atom of generic charge ze is to exit from the class of unitary equivalence via an isounitary transformation by projecting its conventional nonunitary form

$$U \times U^{\dagger} \neq I, \qquad U \times U^{\dagger} = \hat{I} = 1/\hat{T}, \tag{4}$$

The new unit $\hat{I} = 1/\hat{T} > 0$ is called as Santilli's isounit, its inverse $\hat{T} = (U \times U^{\dagger})^{-1}$ is called as the isotopic element and the multiplication between any two generic quantities is called isomultiplication e.g.

$$\hat{A} = U \times A \times U^{\dagger}, A = p, H, \cdots, \tag{5}$$

$$U \times (A \times B) \times U^{\dagger} = \hat{A}\hat{\times}\hat{B} = \hat{A} \times \hat{T} \times \hat{B}, \hat{\psi} = U \times \psi, \tag{6}$$

$$\left(\frac{1}{m'}\hat{p}\times\hat{T}\times\hat{p}\times\hat{T} \quad + \quad \frac{e^2}{r}\times\hat{T}-\frac{z\times e^2}{R}\right)\times\hat{\psi}(r)$$
$$= \quad E_0\times\hat{\psi}(r), \tag{7}$$

The factor $\hat{T}$ in the first coulomb term originates from the nonunitary transform of equation 3, while the same factor is absent in the second coulomb term because the latter is long range, thus being conventional and m' is the isomass. Note that eigenvalue E_0 is different from E of equation 3.
(due to the general noncommutativity of the Hamiltonian and the isounit.)

At this point let us recall the following realization of the *fundamental isounit of hadronic chemistry* from Foundations of Hadronic Chemistry (FHC),

$$\begin{aligned} U \times U^{\dagger} = \hat{I} = 1/\hat{T} &= exp\left(\left[\psi/\hat{\psi} \right] \int \hat{\psi}_{1\downarrow}(r) \times \hat{\psi}_{2\uparrow}(r) d^3 r \right) \qquad (8) \\ &= 1 + \left[\psi/\hat{\psi} \right] \int \hat{\psi}_{1\downarrow}(r) \times \hat{\psi}_{2\uparrow}(r) d^3 r + \cdots, \end{aligned}$$

$$\hat{T} \approx 1 - \left[\psi/\hat{\psi} \right] \int \hat{\psi}_{1\downarrow}(r) \times \hat{\psi}_{2\uparrow}(r) d^3 r, \qquad (9)$$

$$| \hat{I} | \gg 1, \qquad | \hat{T} | \ll 1, \qquad (10)$$

$$\lim_{r \gg 1 fm} \hat{I} = 1, \qquad (11)$$

That is for all mutual distances between the valence electrons greater than 1 fm, the volume integral of equation 8 is null wherein hadronic chemistry recovers quantum chemistry as seen in equation 11. Additionally, one should note here that the condition of equation 10 is automatically verified by expressions 8 and 9 wherein, the explicit form of the isotopic element $\widehat{T}$, emerges in a rather natural way as being smaller than one in absolute value, equation 9. This property alone is sufficient to guarantee that all slow convergent series of quantum chemistry converges faster for isochemistry[7]

[7] R. M. Santilli, "Hadronic Mathematics, Mechanics and Chemistry: Iso-, Geno-, Hyper-Formulations for Matter and Their Isoduals for Antimatter, **Volume III**, International Academic Press, U.S.A., 2007.

For example let us consider a divergent canonical series,

$$A(k) = A(0) + k \times [A, H]/1! + k^2 \times [[A, H], H]/2! + \cdots \longrightarrow \infty, k > 1,$$

where $[A, H] = A \times H - H \times A$ is the familiar Lie product, and the operators A and H are Hermitian and sufficiently bounded. Then under the isotopic lifting the preceding series becomes

$$\hat{A}(k) = \hat{A}(0) + k \times [A\hat{,}H]/1! + k^2 \times [[A\hat{,}H]\hat{,}H]/2! + \cdots \leq |N| < \infty,$$

$$[A\hat{,}H] = A \times \widehat{T} \times H - H \times \widehat{T} \times A,$$

which holds e.g. for the case $\widehat{T} = \epsilon \times k^{-1}$ where ϵ is sufficiently small positive definite constant. This shows that the original divergent coefficient are now turned into the convergent coefficients. Therefore, by permitting fast convergence of perturbative series, all known applications of hadronic mechanics allows much faster computations. For example, when computer uses iteration method of computation obviously due to the fast convergence of the series having isotopic element as variable it would take drastically less steps of iterations.

Note also that the explicit form of ψ is of coulomb type, thus behaving like

$$\psi \approx N \times exp(-b \times r), \tag{12}$$

where,

$$N = \int \hat{\psi}_{1\downarrow}(r) \times \hat{\psi}_{2\uparrow}(r) d^3 r \tag{13}$$

approximately constant at distances near the hadronic horizon of radius

$$r_c = \frac{1}{b}, \tag{14}$$

while $\hat{\psi}$ behaves like

$$\hat{\psi} \approx M \times \left(\frac{1 - exp(-b \times r)}{r} \right), \tag{15}$$

with M being also approximately constant under the same range[8].
We then have

$$\hat{T} \approx 1 - \frac{V_{Hulthén}}{r} = 1 - V_0 \frac{e^{-b \times r}}{(1 - e^{-b \times r})}, \tag{16}$$

Here one recognizes the emergence of the *attractive Hulthén potential*

$$V_{Hulthén} = V_0 \frac{e^{-b \times r}}{1 - e^{-b \times r}} r. \tag{17}$$

But the Hulthén potential is known to behave like the coulomb potential at short distances and be much stronger than the later, that is

[8] **A. O. E. Animalu, Hadronic J.17, 379(1994).**

$$\frac{V_{Hulthén}}{r} \approx \frac{1}{b} \approx \frac{V_0}{b} \times \frac{1}{r}. \tag{18}$$

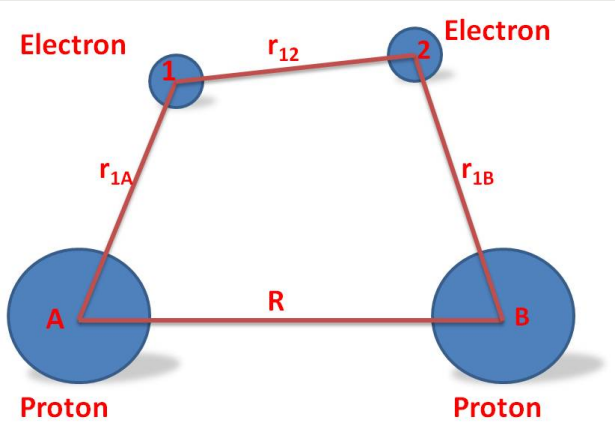
Therefore, inside the hadronic horizon we can ignore the repulsive (or attractive) coulomb forces altogether, and write the columbic terms of equation 7 as,

$$\begin{aligned} +\frac{e^2}{r} \times \hat{T} - \frac{z \times e^2}{r} &\approx +\frac{e^2}{r} \times \left(1 - \frac{V_{Hulthén}}{r}\right) - \frac{z \times e^2}{R} \\ &= -V' \times \frac{e^{-b \times r}}{1 - e^{-b \times r}}, \end{aligned} \tag{19}$$

where the new constant V' reflects the "absorption" of the repulsive Coulomb potential by the much stronger attractive Hulthén potential.
In this way, *Santilli and Shillady strong valence bond achieved for the first time in the history of chemistry a valence coupling between two identical electrons in singlet coupling with a strongly attractive force.*

The isochemical model of the hydrogen molecule with stable Isoelectronium

The isochemical model of the hydrogen molecule with stable Isoelectronium



first submitted by **Santilli and Shillady**[a]. According to quantum chemistry, the hydrogen molecule is a four body system comprising two protons and two electrons with conventional equation for the molecule at rest, that is, the two protons are considered at rest as conventionally done

[a] R. M. Santilli and D. D. Shillady, *International Journal of Hydrogen Energy* **24**, 943-956(1999).

$$\left(\frac{1}{2\mu_1}p_1\times p_1+\frac{1}{2\mu_2}p_2\times p_2+\frac{e^2}{r_{12}}-\frac{e^2}{r_{1A}}\right.$$
$$\left.-\frac{e^2}{r_{2A}}-\frac{e^2}{r_{1B}}-\frac{e^2}{r_{2B}}+\frac{e^2}{R}\right)\times|\psi\rangle = E\times|\psi\rangle \qquad (20)$$

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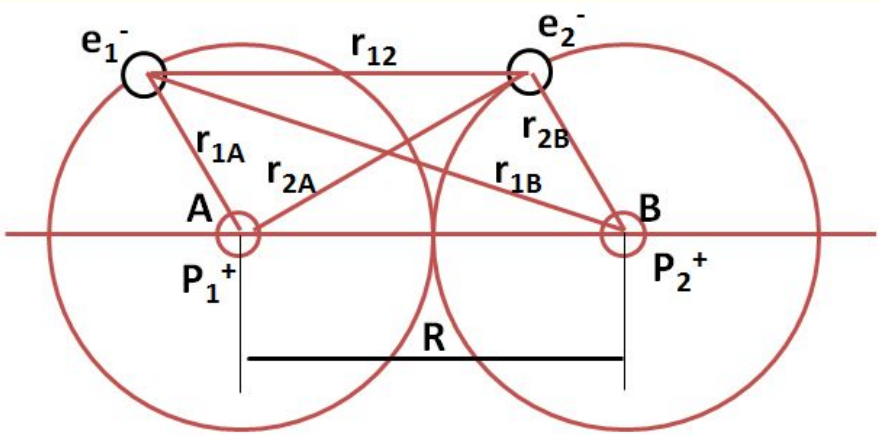
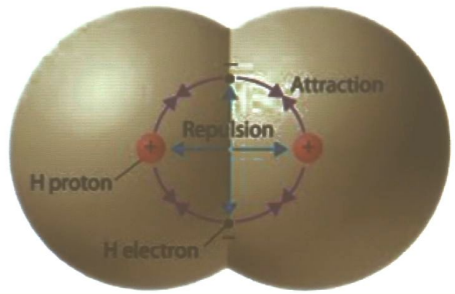




where 1, 2 represents the two electrons; A, B represents the two protons; and R is the distance between the protons.

Due to its four body character, the above equation,
-does not admit any analytic solution;
-misses at least 2% of the binding energy; and
-predicts that the hydrogen molecule is paramagnetic due to the evidence independence of the electrons.
Therefore, again the task is of subjecting the above model to a nonunitary transform, using,

$$U \times U^{\dagger} \mid_{r \approx r_c} = \hat{I} = 1/\hat{T} \neq I, \tag{21}$$

is nonunitary only at short mutual distances

$$r_c = b^{-1} = r_{12} \approx 6.8 \times 10^{-11} \mathrm{cm}, \tag{22}$$

and becomes unitary at bigger distances

$$U \times U^{\dagger} \mid_{r \leq 10^{-10}\mathrm{cm}} \neq I, \qquad \hat{I}_{r \gg 10^{-10}\mathrm{cm}} = I \tag{23}$$

therefore the isochemical model coincides with the conventional model everywhere except for small contributions at small distances.
The Hilbert space of systems given in equation 20 can be factorized in the familiar form in which each term is duly symmetrized antisymmetrized, as

$$\mid \psi \rangle = \mid \psi_{12} \rangle \times \mid \psi_{1A} \rangle \times \mid \psi_{1B} \rangle \times \mid \psi_{2A} \rangle \times \mid \psi_{2B} \rangle \times \mid \psi_{R} \rangle, \tag{24}$$

$$\mathcal{H}_{Tot} = \mathcal{H}_{12} \times \mathcal{H}_{1A} \times \mathcal{H}_{1B} \times \mathcal{H}_{2A} \times \mathcal{H}_{2B} \times \mathcal{H}_{R}. \tag{25}$$

The nonunitary transform under consideration would act only on the r_{12} variable while leaving all others unchanged. The simplest possible solution is given by

$$U(r_{12}) \times U^{\dagger}(r_{12}) = \hat{I} = exp\left[\frac{\psi(r_{12})}{\hat{\psi}(r_{12})}\int d^3 r_{12}\hat{\psi}^{\dagger}_{1\downarrow}(r_{12}) \times \hat{\psi}_{2\uparrow}(r_{12})\right], \quad (26)$$

where ψ's represents conventional wavefunctions and $\hat{\psi}$'s represents isowavefunctions.

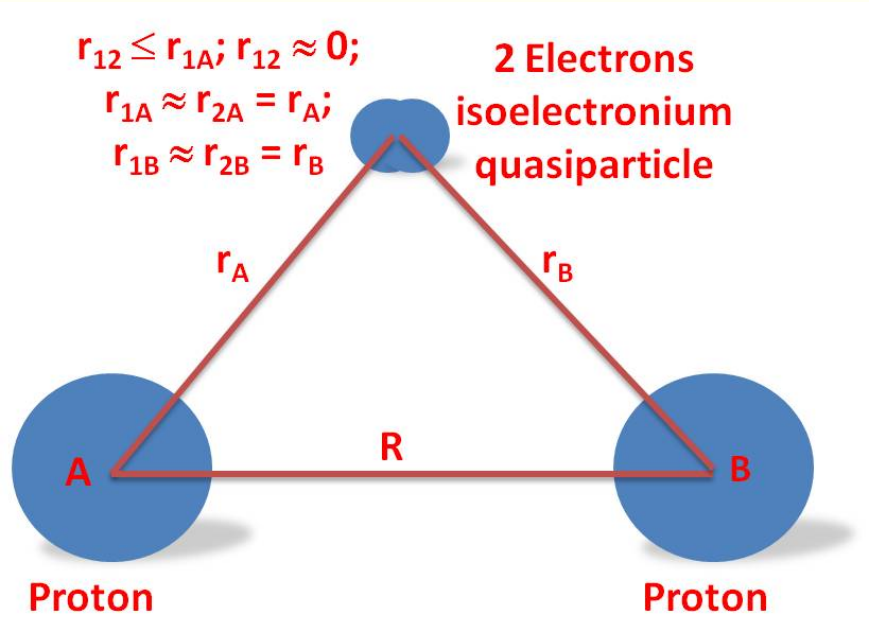
Again recall here that the Hulthén potential behaves at small distances like the Coulomb one, the isounitary transform of equation 20 results the isochemical model of the hydrogen molecule as a four-body system:

$$\left(-\frac{\hbar^2}{2\times\mu_1}\times\nabla_1^2-\frac{\hbar^2}{2\times\mu_2}\times\nabla_2^2 \quad - \quad V'\times\frac{e^{-r_{12}\times b}}{1-e^{-r_{12}\times b}}\right. \tag{27}$$
$$\left.-\frac{e^2}{r_{1A}}-\frac{e^2}{r_{2A}}-\frac{e^2}{r_{1B}}-\frac{e^2}{r_{2B}}+\frac{e^2}{R}\right) \quad \times \quad |\hat{\psi}\rangle = E\times|\hat{\psi}\rangle.$$

showing the effect of the Santilli-Shillady strong valence bond of Hulthén type that absorbs all coulomb potentials. The equation also explains the reason why the H_2 molecule admit only two H-atoms and provides the exact representation of the binding energy and other molecular characteristics.

Three-Body isochemical model of the hydrogen molecule

A fundamental implication of hadronic chemistry is that of restricting the above four-body model to a three-body structure evidently composed by the two protons at mutual distance R and the two valence electrons strongly bonded into the isoelectronium quasiparticle.



In particular, the charge radius of the isoelectronium is sufficiently small to permit the values,

$$r_{12} \leq r_{1A} \quad \text{and} \quad r_{1B}, \qquad r_{12} \approx 0, \tag{28}$$

$$r_{1A} \approx r_{2A} = r_A, \qquad r_{1B} \approx r_{2B} = r_B. \tag{29}$$

Moreover, the H-nuclei are about 2,000 times heavier than the isoelectronium. Therefore the model of equation 27 can be reduced to a restricted three body problem similar to that possible for the conventional H_2^+ ion, but not for the conventional H_2 molecule.

By recalling that Hulthén potential behaves at small distances like the coulomb one and therefore, the isochemical model of hydrogen molecule as a three-body system can be written

$$\left(-\frac{\hbar^2}{2\mu_1}\times\nabla_1^2-\frac{\hbar^2}{2\mu_2}\times\nabla_2^2 \quad - \quad V'\times\frac{e^{-r_{12}b}}{1-e^{-r_{12}b}} \right. \tag{30}$$
$$\left. -\frac{2e^2}{r_A}-\frac{2e^2}{r_B}+\frac{e^2}{R}\right) \quad \times \quad |\hat{\psi}\rangle = E\times|\hat{\psi}\rangle.$$

where the system does admit an analytic solution in its restricted form under the assumption that the isoelectronium is stable. Note also that equation 30 is purely quantum chemical because all distances between the constituents are much bigger than 1 fm.

It is also interesting to note that the above model can be used for the study of the bonding of an H-atom to another generic atom, such as HO, thus permitting, again for the first time, novel exact calculations on the water as HOH , namely, as two intersecting isotopic bonds HO and OH, each admitting an exact solution, with possible extension to molecular chains, and extensions to other molecules.

The Isochemical Model of Water Molecule

Subsequent to the successful study of isochemical molecular model of *isoelectronium* for Hydrogen molecule Santilli and Shillady proposed their second historical study[9] of hadronic chemistry for debatable water molecule resulting from the first axiomatic unadulterated principles of binding energy, sign and values of electric and magnetic moments and other data. Herein, we recall the isochemical model of water molecule H_2O = H-O-H first introduced by Santilli and Shillady under the assumption that the molecule is considered at 0^0C and in absence of any rotational, oscillations or other motion.

[9] **R. M. Santilli and D. D. Shillady, International Journal of Hydrogen Energy 25, 173-183(2000)**

The isochemical model water molecule - Second Success of Hadronic Chemistry

A view of isochemical model of Water Molecule H_2O without any rotational degrees of freedom, showing the H-O-H plane, the 105^0 between the H-O and O-H bonds and, above all, the natural occurrence according to which the orbital of the H atoms are not spherical, but of toroidal character for their coupling with oxygen, thus providing direct verification of the isochemical model of the hydrogen molecule of Figure 1
source: New Science for a New Era

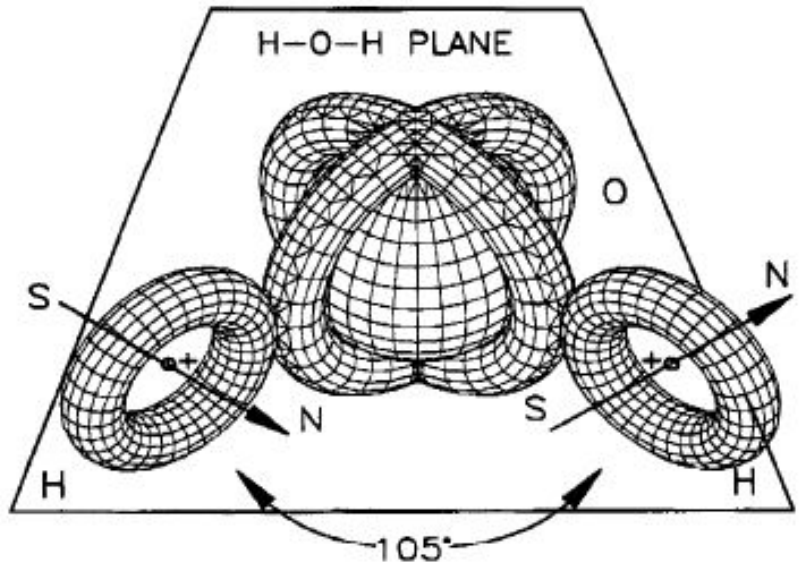


Figure: The water molecule

The hypothesis was that the two valence electrons, one per each pair of hydrogen and oxygen atoms, correlate themselves into a bonded singlet state at a short distance resulting in two *isoelectronia*, one per each H-O dimer. The bonding force between the two H- and O- atoms was justified by Hulthén force between the two valence electrons in the *isoelectronia*. Therefore, the binding energy is characterized by two oo-shaped orbits of isoelectronia around the H-O-H nuclei; and molecule itself is characterized by two isoelectronia, one per each H-O bonding.
This then renders the system of H-O− dimer as restricted to three body system (two protons of hydrogen and oxygen atoms respectively and an isoelectronium H-O dimer) with an exact solution. The addition of another hydrogen was then proposed as a perturbation via other mean.

The approximation that the H-O-H molecule as being composed of two intersecting identical dimers H-O with evidently only one O-atom requires -
a first correction due to the lack of independence of said dimer and
In each H-O dimer we shall assume that the oxygen appears to the isoelectronium as having only net positive charge +e located in the nucleus. This evidently requires -
a second correction which essentially represents the screening of the various electrons of the oxygen.

Now, herein the additional H-atom bonded with the first H-O^- can be represented via a nonunitary image of the coulomb law resulting in screening of Gaussian type

$$2e^2/r \longrightarrow 2e^2(1 \pm e^{-\alpha r})/r, \tag{31}$$

where, the double value 2e originates from the duality of the bonds in H-O-H; α is positive parameter to be determined from the data; the sign "-" applies for screened O-nucleus as seen from an H-electron (because of the repulsion caused by the electron clouds of the oxygen); and the sign "+" applies for the screened O-nucleus as seen from the H-nucleus (due to the attraction caused by said electron cloud).

By denoting with the sub-indices 1 and A to hydrogen; 2 and B, to oxygen, and assuming the absence of all hadronic effects, the conventional quantum chemical representation for above H-O bond with the oxygen assumed to have only one elementary charge $+e$ in the nucleus is given by,

$$\left(\frac{1}{2\mu_1}p_1\times p_1+\frac{1}{2\mu_2}p_2\times p_2+\frac{e^2}{r_{12}}-\frac{e^2}{r_{1A}}-\frac{e^2}{r_{2A}}-\frac{e^2}{r_{1B}}-\frac{e^2}{r_{2B}}+\frac{e^2}{R}\right)\times\mid\psi\rangle=E\times\mid\psi\rangle \tag{32}$$

.

Now again, as we have seen in the case of H_2 molecule, here the task is to transform the above model which ofcourse is nonunitary but only at short mutual distances $r_c = b^{-1} = r_{12}$ of the two valence electrons (hadronic horizon), and becomes unitary at bigger distances
$\hat{I}_{r \leq 10^{-10}\mathrm{cm}} \neq I, I_{r \gg 10^{-10}\mathrm{cm}} = I$.
Moreover, the assumption that the state and related Hilbert space of systems of equation 32 can be factorized in the familiar form where each term is duly symmetrized or antisymmetrized,

$$| \psi \rangle = | \psi_{12} \rangle \times | \psi_{1A} \rangle \times | \psi_{1B} \rangle \times | \psi_{2A} \rangle \times | \psi_{2B} \rangle \times | \psi_R \rangle, \tag{33}$$

$$\mathcal{H}_{Tot} = \mathcal{H}_{12} \times \mathcal{H}_{1A} \times \mathcal{H}_{1B} \times \mathcal{H}_{2A} \times \mathcal{H}_{2B} \times \mathcal{H}_R. \tag{34}$$

The nonunitary transform now shall act only on the r_{12} variable characterizing the isoelectronium while leaving all other variables unchanged. The simplest possible solution for this is to propose for a isounit of the form,

$$U(r_{12}) \times U^{\dagger}(r_{12}) = \hat{I} = exp\left[\frac{\psi(r_{12})}{\hat{\psi}(r_{12})}\int d^3 r_{12}\hat{\psi}^{\dagger}_{1\downarrow}(r_{12}) \times \hat{\psi}_{2\uparrow}(r_{12})\right], \quad (35)$$

where ψ's represents conventional wavefunctions and $\hat{\psi}$'s represents isowavefunctions for which, again the fundamental condition of fast convergence exist as,

$$\mid \hat{T} \mid = \mid (U \times U^{\dagger})^{-1} \mid \ll 1. \quad (36)$$

Therefore, the isochemical model by transforming short-range terms (isochemistry) and adding un-transformed long range ones (chemistry), thus resulting in the radial equation

$$\left(-\frac{\hbar^2}{2\times\mu_1}\hat{T}\times\nabla_1\times\hat{T}\times\nabla_1 \quad - \quad \frac{\hbar^2}{2\times\mu_2}\hat{T}\times\nabla_2\times\hat{T}\times\nabla_2 \right. \tag{37}$$
$$\left. +\frac{e^2}{r_{12}}\times\hat{T}-\frac{e^2}{r_{1A}}-\frac{e^2}{r_{2A}}-\frac{e^2}{r_{1B}} \quad - \quad \frac{e^2}{r_{2B}}+\frac{e^2}{R}\right)\times\mid\hat{\psi}\rangle = E\times\mid\hat{\psi}\rangle$$

By recalling that the Hulthén potential behaves at small distances like Coulomb one, equation 37 becomes

$$\left(-\frac{\hbar^2}{2\times\mu_1}\times\nabla_1^2-\frac{\hbar^2}{2\times\mu_2}\times\nabla_2^2 \quad - \quad V'\times\frac{e^{-r_{12}\times b}}{1-e^{-r_{12}\times b}}\right. \tag{38}$$
$$\left.-\frac{e^2}{r_{1A}}-\frac{e^2}{r_{2A}}-\frac{e^2}{r_{1B}}-\frac{e^2}{r_{2B}}+\frac{e^2}{R}\right) \quad \times \quad |\hat{\psi}\rangle = E\times|\hat{\psi}\rangle.$$

This model can be subjected to an important simplification. Now, under the assumption considered herein, the H-O dimer in equation 38 can be reduced to a restricted three body problem similar to that of H_2^+ but not for H_2 molecule, according to the equation

$$\left(-\frac{\hbar^2}{2\mu_1}\times\nabla_1^2-\frac{\hbar^2}{2\mu_2}\times\nabla_2^2 \quad - \quad V'\times\frac{e^{-r_{12}b}}{1-e^{-r_{12}b}}\right. \tag{39}$$
$$\left.-\frac{2e^2}{r_A}-\frac{2e^2}{r_B}+\frac{e^2}{R}\right) \quad \times \quad |\hat{\psi}\rangle = E\times|\hat{\psi}\rangle.$$

The above indicated corrections / lifting due to the screening of the various electrons in the oxygen and other corrections needed in the "sensing" of the O-nucleus by the isoelectronium as well as by H-nucleus, then yields the *isochemical model of the water molecule* in its projection in the conventional Hilbert space over conventional fields

$$\left[-\frac{\hbar^2}{2\mu_1}\times\nabla_1^2-\frac{\hbar^2}{2\mu_2}\times\nabla_2^2-V'\times\frac{e^{-r_{12}b}}{1-e^{-r_{12}b}}-\frac{2e^2}{r_{2A}}\right.$$
$$\left.-\frac{2e^2(1-e^{-\alpha r_{1B}})}{r_{1B}}+\frac{e^2(1+e^{-\alpha R})}{R}\right]\hat{\psi}(r) = E'\hat{\psi}(r), \quad (40)$$

where E' is half of the binding energy of the water molecule; R is the interatomic distance. α is a positive parameter.

Under the above approximation, plus the assumption that the isoelectronium is stable, model 40 constitutes the first model of the water molecule admitting the exact analytic solution from first principle in scientific history; Being exactly solvable equation 40 exhibits a new explicitly attractive "strong" force among neutral atoms of the H-O molecule, which is absent in conventional quantum chemistry; The equation also explains the reason why the water molecule admits only two H-atoms; The model yields much faster convergence of series with much reduced computer times and resolves many other insufficiencies of quantum theory. Finally, the model is evidently extendable with simple adjustment to an exact solution of other dimer involving the hydrogen, such as H-C.

Independent Studies of Variational Calculations of Isochemical Models of Santilli and Shillady (1999 & 2000)

1. Aringazin A. K. Kucherenko M. G.: Exact solution of the restricted three-body Santilli-Shillady model of H_2 molecule. Hadronic J. 23, 1 (2000).
2. Aringazin A. K.: On variational solution of the four-body Santilli-Shillady model of H_2 molecule. Hadronic J. 23, 57(2000).
3. Pérez-Enríquez R., Marín J. L., Riera R.: Exact Solution of the Three-Body Santilli-Shillady Model of the Hydrogen Molecule. Prog. Phys. 2, 34-41 (2007).

Applications of Hadronic Chemistry in the discovery of novel magnecular fuel

Origin

1. Increasing Cataclysmic Climatic Events.
2. The New Chemical Species of Magnecules.
3. Industrial Method needed for their production.
4. Experimental detection and equipment needed.
5. Magnecular structure.

Gravity of Environmental problems caused via the reformation of fossil fuels:

- Large numbers of hurricanes around the globe since last several years.
- Recently in India heavy rains causing huge damages and clean washout of the area in Kedarnath (in Himalayas) and floods in various parts of the country.
- Slow down of of the gulf stream due to the decreased density and salinity of the North Atlantic caused by the melting of ice in the North Pole region.
- Kohistan Avalanche in Pakistan in 2010.
- Tropical Storm Matthew in 2004 brought heavy rain to the Gulf Coast of Louisiana, causing light damages and deaths on its path.
- in 2010's Tropical Storm Matthew - Made landfall in Central America and later moved into Mexico, causing 2.6 billion in damages and 126 deaths.

Origin of the increasingly Cataclysmic Climactic events -

–The combustion of fossil fuels releases in our atmosphere about sixty millions metric of tons carbon dioxide CO_2 per day that are responsible for the first large environmental problem known as "global warning or green

–The combustion of fossil fuels causes the permanent removal from our atmosphere of about 21 millions metric tons of breathable oxygen per day, a second, extremely serious environmental problem known as "oxygen depletion.

–The combustion of fossil fuels releases in our atmosphere about fifteen millions metric tons of carcinogenic and toxic substances per day.

Basic need of the survival of mankind:

- Ways for removal and recycling of CO_2 from atmosphere.
- Finding out means to convert CO_2 into automotive fuels.
- Developing new processes for the nonpolluting, large scale production of electricity.
- Building large number of reactors for large scale removal and recycling of the excess CO_2 in our atmosphere.
- Development of new clean cost effective fuels that are not derivable from crude oil and are capable of achieving full combustion.

A step towards removal of excess CO_2 from atmosphere

- We have a large excess of CO_2 in our atmosphere estimated to be from 100 to 300 times the CO_2 percentage existing at the beginning of the 20^{th} century, which excess is responsible for the global warming and consequential devastating climactic events.
- The only possible, rational solution of the problem is the removal of CO_2 from our atmosphere via *molecular filtration* or other methods and its processing into non-contaminant gases.
- *The most efficient method for recycling CO_2 is that based on flowing the gas at high pressure through an electric arc.* In fact, the arc decomposes the CO_2 molecule into carbon precipitates and breathable oxygen that can be released into the atmosphere to correct the oxygen depletion caused by fossil fuels.

But these again need a large amount of energy. Unless we find some novel source of energy it would hardly matters however we clean atmosphere.

The Third Success of Hadronic Chemistry

Development of New Fuel whose bond is not Valence

In view of the inability of *valence bond* to describe clearly the origin of attractive forces Santilli's Hadronic chemistry gave for the first time in 1998 the complete new hypothesis of internal attractive forces between molecules/atoms today known as *Magnecules*. The name Magnecule is given because of the dominance of magnetic effects in their formation, as well as for pragmatic needs of differentiations with the ordinary molecules.

The Hypothesis of Santilli Magnecules

Santilli Magnecules[10] 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.

[10] R. M. Santilli, Hadronic J., 21, 789(1998).

These Magnecules are characterized by the following features:

- Magnecules primarily exist at large atomic weights that is, at atomic weights which are ten times or more the maximal atomic weight of conventional molecular constituents;
- Magnecules are characterized by large unidentified peaks, when searched among all existing molecules, present in macroscopic percentages in mass spectrum;
- Said peaks admit no currently detectable infrared signature for gases and no ultraviolet signature for liquids other than those of the conventional molecules constituting the magnecule;

- Said infrared and ultraviolet signatures are generally altered (a feature called mutation) with respect to the conventional versions, thus indicating an alteration (called infrared or ultraviolet mutation) of the conventional structure of dimers generally occurring with additional peaks in the infrared or ultraviolet signatures not existing in conventional configurations;
- Magnecules have an anomalous adhesion to other substances, which results in backgrounds (blank) following spectrographic tests which are often similar to the original scans, as well as implying the clogging of small feeding lines with consequential lack of admission into analytic instruments of the most important magnecules to be detected;

- Magnecules can break down into fragments under sufficiently energetic collisions, with subsequent recombination with other fragments and/or conventional molecules, resulting in variations in time of spectrographic peaks (called time mutations of magnecular weights);
- Magnecules can accrue or lose during collision individual atoms, dimers or molecules;
- Magnecules have an anomalous penetration through other substances indicating a reduction of the average size of conventional molecules as expected under magnetic polarizations;
- Gas magnecules have an anomalous solution in liquids due to new magnetic bonds between gas and liquid molecules caused by magnetic induction;

- Magnecules can be formed by molecules of liquids which are not necessarily solvable in each other;
- Magnecules have anomalous average atomic weights in the sense that they are bigger than that of any molecular constituent and any of their combinations;
- A gas with magnecular structure does not follow the perfect gas law because the number of its constituents (Avogadro number), or, equivalently, its average atomic weight, varies with a sufficient variation of the pressure;
- Substances with magnecular structure have anomalous physical characteristics, such as anomalous specific density, viscosity, surface tension, etc., as compared to the characteristics of the conventional molecular constituents;

- Magnecules release in thermochemical reactions more energy than that released by the same reactions among unpolarized molecular constituents;
- When the magnecules are brought to a sufficiently high temperature, That is at Curie Magnecular Temperature it looses all the properties of Magnecules; in particular, combustion eliminates all magnetic anomalies resulting in an exhaust without magnecular features.

Magnecules are classified based on their characteristics as :

1. **Isomagnecules** when having all single-valued characteristics and being reversible in time, namely, when they are characterized by isochemistry.
2. **Genomagnecules** when having all single-valued characteristics and being irreversible in time, namely, when they are characterized by genochemistry; and
3. **Hypermagnecules** when having at least one multi-valued characteristic and being irreversible in time, namely, when they are characterized by hyperchemistry.

Magnecules are also called:
A) *elementary* when only composed of two molecules;
B) *magneplexes* when composed of several identical molecules;
C) *magneclusters* when composed of several different molecules.

Examples of elementary magnecules in gases and liquids are :

$$\{H-H\}\times\{H-H\},\quad \{O-C-O\}\times\{O-C-O\}, etc. \tag{41}$$

$$\{C_{15}-H_{20}-O\}\times\{C_{15}-H_{20}-O\}$$

Examples of magneplexes in gases and liquids are :

$$\{H-H\}\times\{H-H\}\times\{H-H\}\times\{H-H\}\times\cdots, etc. \tag{42}$$

$$\{H-O-H\}\times\{H-O-H\}\times\{H-O-H\}\times\cdots, etc.; \tag{43}$$

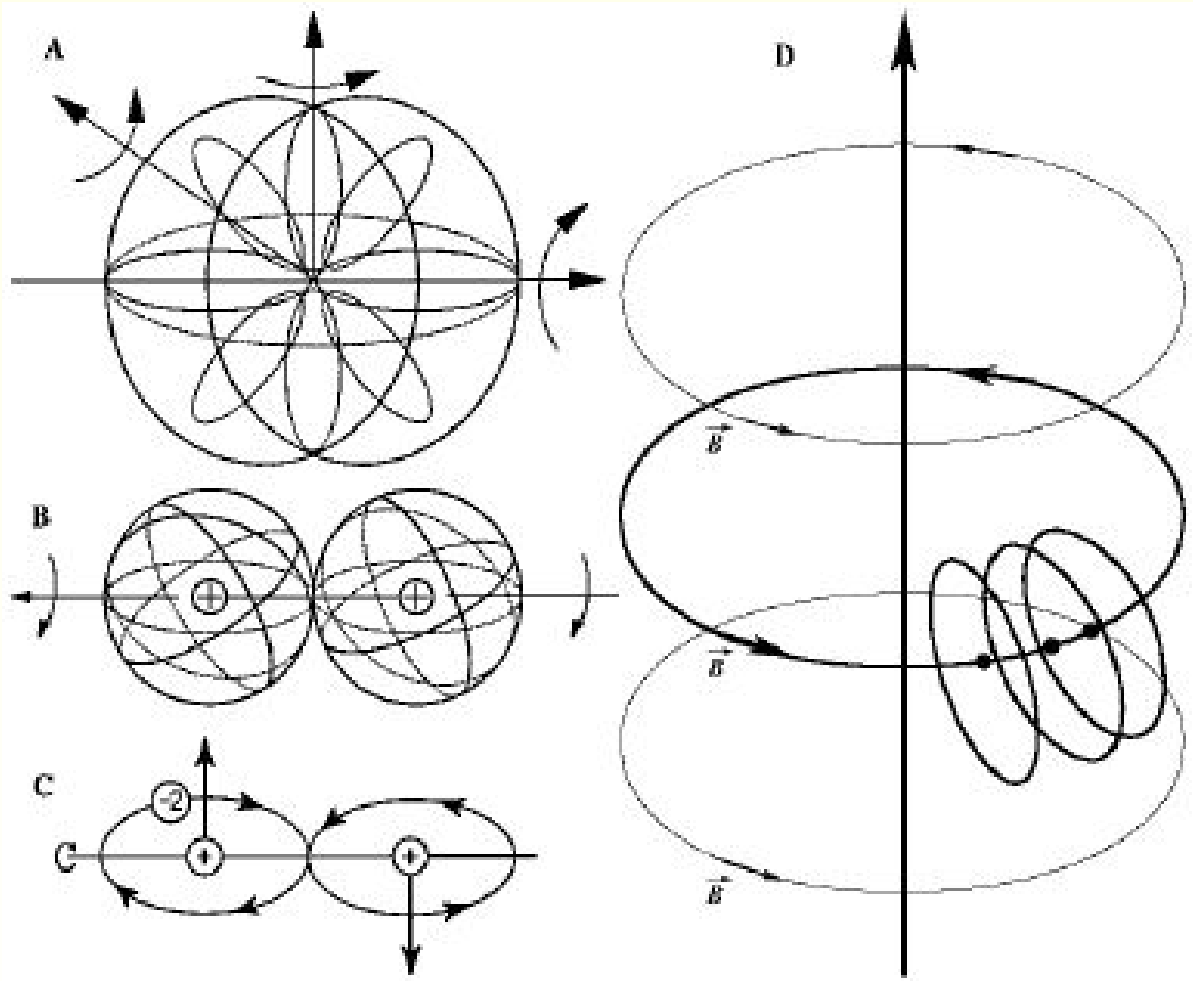
Examples of magneclusters are :

$$\{H-H\}\times\{C-O\}\times\{O-C-O\}\times\{C=O\}\times\cdots, etc. \tag{44}$$

$$\{C_{13}-H_{18}-O\}\times\{C_{14}-H_{12}-O_3\}\{C_{15}-H_{20}-O\}\times\cdots, etc.; \tag{45}$$

Production of Magnecules

Usually a paramagnetic substance is magnetized using *magnetic induction* this results in a stable chain of magnetically polarized orbits from the beginning of the metal to its end with polarities North-South / North-South / North-South / . . . . This chain of polarizations is so stable that it can only be destroyed by high temperatures.
On the other hand the creation of *magnecular bond* can be essentially understood with a similar polarization of the peripheral electron orbits, with the main differences that: *no total magnetic polarization is necessary*; the polarization generally apply to all electrons, and not necessarily to unpaired electrons only; and the substance need not to be paramagnetic.



Mechanism of creation of Magnecules for the case of the Hydrogen Molecule

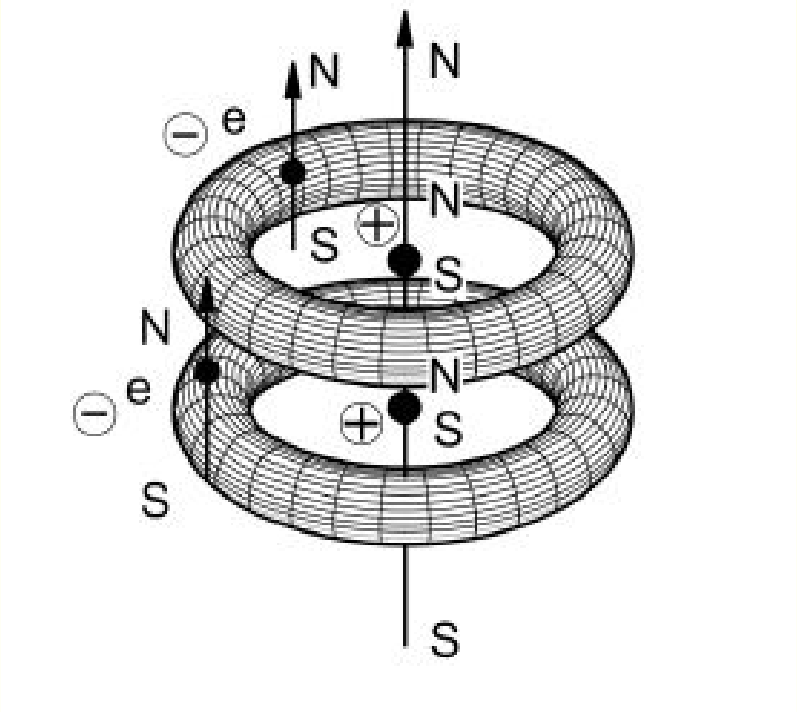
It consists in the use of sufficiently strong external magnetic fields which can progressively eliminate all rotations, thus reducing the hydrogen molecule to a configuration which, at absolute zero degrees temperature, can be assumed to lie in a plane. The planar configuration of the electron orbits then implies the manifestation of their magnetic moment which would be otherwise absent. The r.h.s. of the above picture outlines the geometry of the magnetic field in the immediate vicinity of an electric arc as in hadronic molecular reactors. The circular configuration of the magnetic field lines around the electric discharge, the tangential nature of the symmetry axis of the magnetic polarization of the hydrogen atoms with respect to said circular magnetic lines, and the consideration of hydrogen atoms at orbital distances from the electric arc 10^{-8} cm, resulting in extremely strong magnetic fields proportional to $(10^{-8})^{-2} = 10^{16}$ Gauss, thus being ample sufficient to create the needed polarization. The reason for these results is the intrinsic geometry of the Plasma Arc Flow.

Dismissal of the other recent claim of atomic bonding

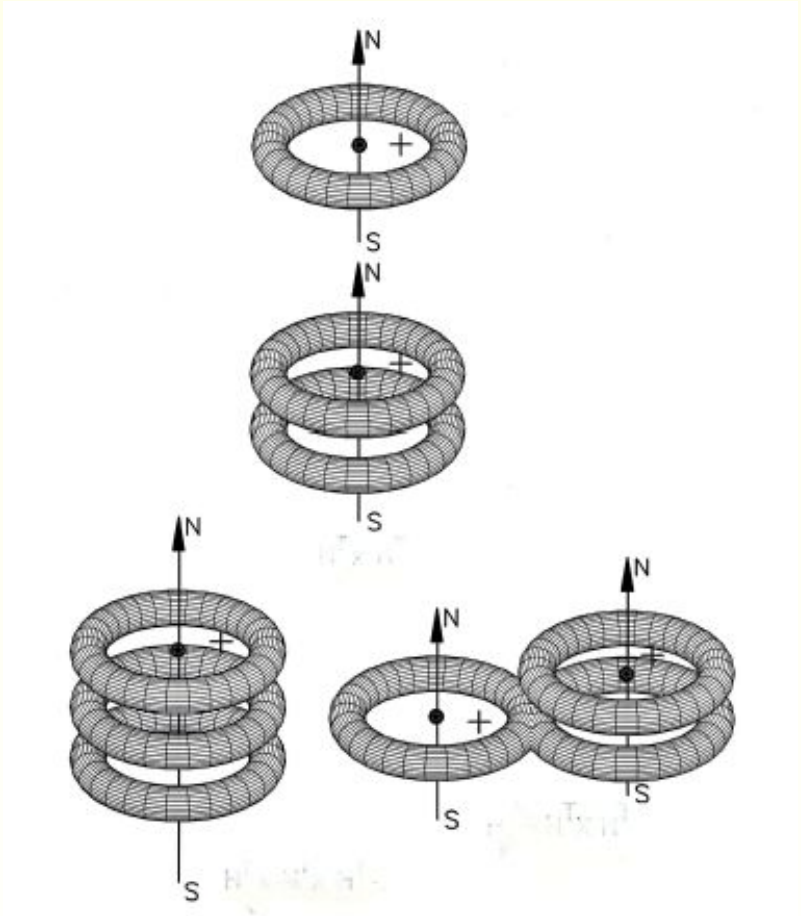
Recently Kai K. Lange, E. I. Tellgren, M. R. Hoffmann and T. Helgaker [11] have suggested the existence of new atomic bonding called perpendicular bonding under certain astrophysical conditions.
However, their claims have been contested in the recent writing by J. Kadeisvilli[12] stating the discovery of such bonding by Prof. Santilli well in advance in 1998 and therefor the claims in the present paper below is merely a verification of such indicated bonding.

[11] Kai K. Lange, E. I. Tellgren, M. R. Hoffmann, T. Helgaker, A Paramagnetic Bonding Mechanism for Diatomics in Strong Magnetic Fields, Science 337, 327(2012).

[12] J. Kadeisvili, Equivalence of the Recently Proposed Paramagnetic Bonding with Santilli's 1998 Magnecular Bonding, Hadronic J., 2012

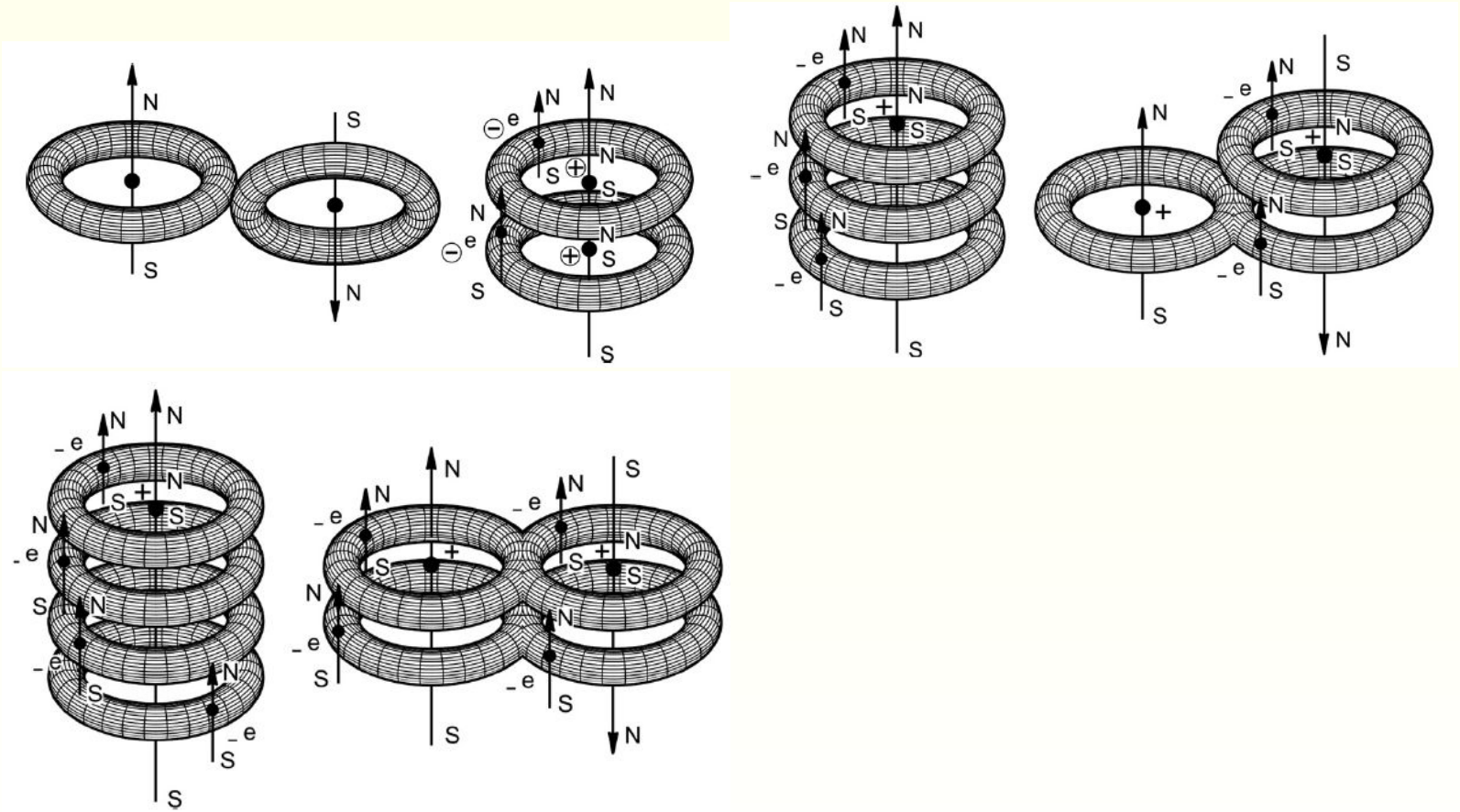


A schematic view of the simplest possible bi-atomic magnecule whose bond originates from opposing magnetic polarities of toroidal polarizations of the orbits of peripheral atomic electrons caused by very strong external magnetic fields whose bond is NOT that of valence



A schematic view of the simplest possible multiatomic magnecular bonds.

MagneHydrogen[13]



[13]Y. Yang, J. V. Kadeisvili, S. Marton, Experimental confirmations of the new chemical species of Santilli MagneHydrogen, *Int. J. Hydrogen Ener.*,**38**, 5003-08(2013).

Detection of Magnecules[a]

[a] R. M. Santilli, J. Hydrogen Ener., 28, 177-96(2003).

- Appearance of unexpected heavy MS peaks.
- Unknown character of the unexpected MS heavy peaks.
- Lack of IR signature of the unknown MS peaks.
- Mutation of IR signatures.
- Mutation of magnecular weights.
- Accretion or emission of individual atoms or molecules.
- Anomalous adhesion.

The Fourth Success of Hadronic Chemistry

Almost all types of combustion are reducible to dissociation of valence bonds among atomic constituents of the conventional original fuel and the creation of new valence bonds among the atomic constituents of the combustion exhaust.

Molecular Combustion

The conventional combustion of molecular fuels such as H_2 and O_2, that as such requires the homolytic cleavage *before* the combustion.

$$H_2 + \frac{1}{2} O_2 \rightarrow H_2O + Energy \ (-57.5 kcal/mol)$$

In fact, the energy required to separate the molecules into isolated atoms is quite large than this amount.

The Fourth Success of Hadronic Chemistry

Magnecular Combustion

Combustion of Magnecular Fuels in which the individually atoms are weakly bonded and therefore do not need separation energy,

$$MH_4 + MO_2 \rightarrow Energy \ (more \ than \ 2 \ times \ of \ \ -57.5 \ \mathrm{kcal/mol})$$

as the atoms are weakly bonded in a magneclusture and we do not need additional energy to separate the atoms.

MAGNECULAR COMBUSTION is that for fuels whose atoms are at least in part, under a magnecular bond, and the rest under a molecular bond, such as MagneGas, HHO, MagneHydrogen and other fuels.

The Fifth Success of Hadronic Chemistry

Intermediate Controlled Nuclear Fusion (ICNF)[a] without the emission of harmful radiations

[a] R. M. Santilli, The novel Intermediate Controlled Nuclear fusions, a report for its industrial realization, Hadronic Journal 31, 15 (2008).

A nuclei has to be systematically exposed from its electron cloud so as to carry out fusion systematically. In *Cold Fusion* the available energy is insufficient for this task.
Whereas, in case of usual *Hot Fusion* energy is in so excess that the atoms are completely stripped out of their electron cloud.
Therefore in both the cases it prevents the control over fusion reactions.

The Fifth Success of Hadronic Chemistry

Intermediate Controlled Nuclear Fusion (ICNF)[a] without the emission of harmful radiations

[a] R. M. Santilli, The novel Intermediate Controlled Nuclear fusions, a report for its industrial realization, Hadronic Journal 31, 15 (2008).

Therefore Santilli for the first time proposed the use of term *Intermediate* to denote the available energy is in between Cold and Hot fusions. More particularly, the available energy for the proposed intermediate fusion is set to a threshold value, sufficient for the controlled exposure of nuclei, verify all conservation laws and control their synthesis without ionizing radiations and radioactive waste predicted using **Hadronic Mechanics**.
These conditions are verified by plasma created by an electric arc at about 10000^0F thus having an energy that cannot be qualified as belonging to either the cold or the hot fusion.

Intermediate Controlled Nuclear Fusion (ICNF)

Basic Assumptions of ICNF

- **Nuclear Force**: The assumption is that part of the nuclear force is potential type representable via Hamiltonian and part of it is nonpotential and not representable via Hamiltonian.
- **Stable Nuclei**: The stability of the nucleus is represented by the identity of the basic isounit to the right and to the left, namely, for motions forward and backward in time and appropriately defined isotopic element.
- **Unstable Nuclei and Nuclear Fusions**: Represented by the Lie-admissible branch of hadronic mechanics wherein the nonpotential interactions are represented by genotopic elements defined in accordance with the irreversibility taken care by different forward and backward genounit for forward and backward motions.

Intermediate Controlled Nuclear Fusion (ICNF)

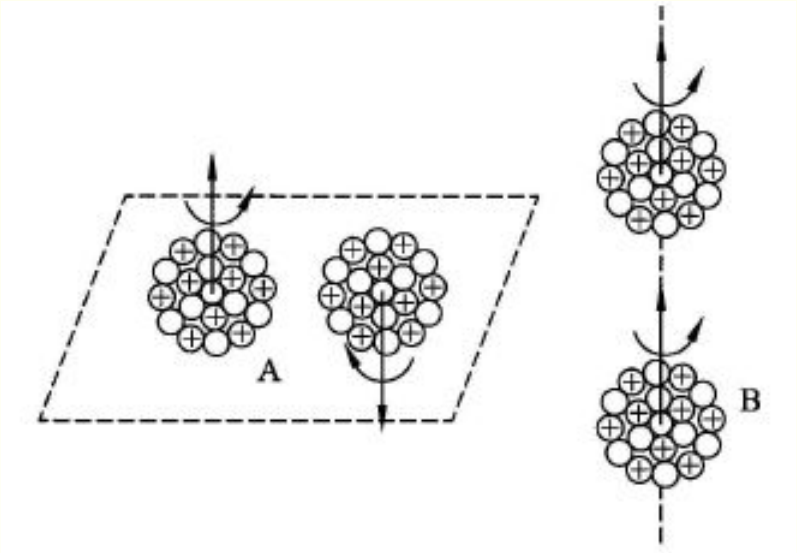
Basic Assumptions of ICNF

- **Neutron Synthesis**: Since the synthesis of neutron is the first most fundamental nuclear synthesis; Santilli spent decades of research on understanding synthesis of neutron from proton and an electron, resulting in the reaction $p^+ + a + e^- \rightarrow n$, where "a" represents *Santilli's etherino*.
- **Nuclear Structure**: Assumption is that nuclei are indeed a collection of protons and neutrons, but only in first approximation, while being at a deeper level a collection of mutated protons and mutated electrons.

Physical Laws of CNF

- LAW I: A necessary condition for CNF to occur is to control the orbital of peripheral atomic electrons in such a way as to allow nuclei to be systematically exposed.
- LAW II: CNF only occur among nuclei whose spins are either in singlet planar coupling or triplet axial coupling.
- LAW III: The most probable CNF are those occurring at threshold energies (namely, at the minimum value of the energy of the original nuclei needed to verify all laws).
- LAW IV: The most probable CNF are those without the release of massive particles (such as protons, neutrons and alpha particles).
- LAW V: CNF cannot occur without a trigger, referred to an external mechanism forcing exposed nuclei to pass through the hadronic horizon.

Satisfying all the above assumptions and physical laws *Santilli Magnecules* indeed achieved the desired controlled exposure of nuclei verifying the spin coupling either in singlet planer or triplet axial coupling.



A schematic view of the only two stable couplings permitted by hadronic mechanics for nuclear fusions, the singlet planar coupling of the l.h.s. and the triplet axial coupling of the r.h.s. All other spin configurations have been proved to produce strongly repulsive forces under which no CNF is systematically possible.

Concluding Remarks

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

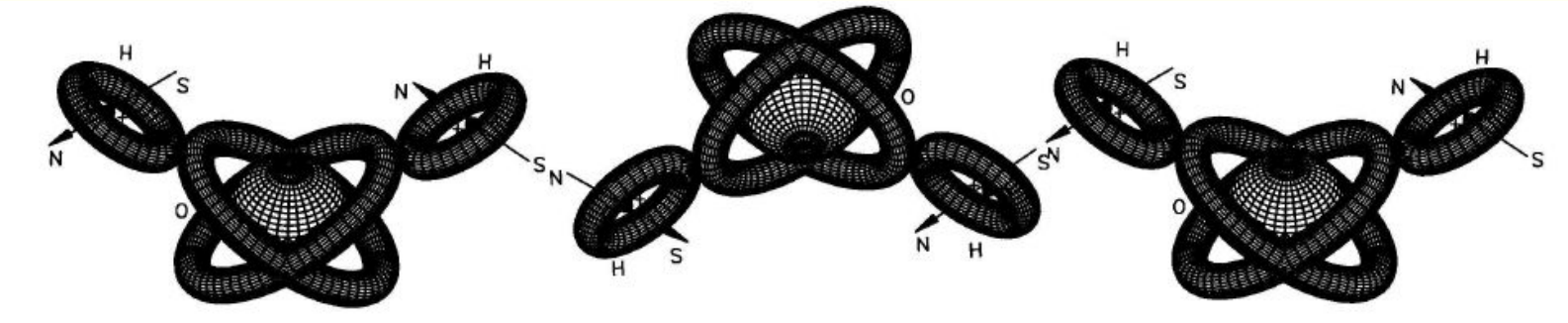
- Exact representation of molecular binding energies from first axiomatic principles without ad hoc adulteration
- An explanation, why hydrogen molecule has only two hydrogen atoms
- Explained the irreversibility in nature such as impossibility of spontaneous decay of water into its constituents, which as such quantum chemistry can never explain owing to its reversible nature.

- The major achievement of this isochemistry is that, absolute value of the isounit as equation 8 is much bigger than one and the isotopic element is much smaller than one turning all slow convergent series into strongly (fast) convergent form. That is Hadronic chemistry has been built to resolve all divergences in the study of the isoelectronium thanks to the isomathematics with product $A\hat{\times}B = A \times \hat{T} \times B$, and the isotopic element $\hat{T}$ restricted to have absolute values much smaller than 1. In this way, the hadronic component of the isoelectronium binding force will absorb all divergent or otherwise repulsive effects, resulting in convergent numerical values.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.

Therefore to conclude here, indeed by the virtue of this isochemical branch of Hadronic mechanics we have overcome almost all insufficiencies of quantum chemical notions. This tool is indeed a promising framework that would help explore many more micro and macro level inconsistencies of the existing literature that one way or other help mankind.

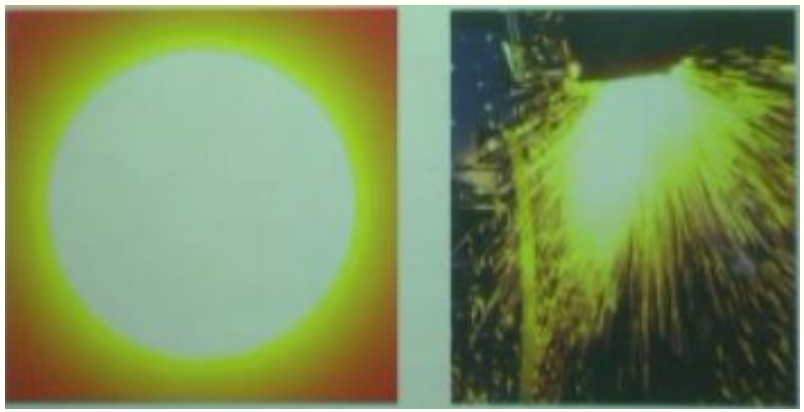
Proposals

- From the species of H_3O can we deduce that liquid state of water is a magnecular structure, 100^0C being Curie temperature?



Mathematical origin of magnecular bond between hydrogen bonds with opposing polarities.

- The bond of species H_3, H_4, H_5, H_6 etc. whether the bond is valence or not.
  but H_3 cannot have molecular structure because According to quantum chemistry itself, for such valence bond one need valence electron.
- Accurate spectroscopic analysis of the flame of magnegas and magnehydrogen in comparison with the sun spectral lines.



THANK YOU