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An Intrinsically Irreversible, Neural-network-like Approach to the Schrödinger Equation and some Results of Application to Drive Nuclear Synthesis Research Work

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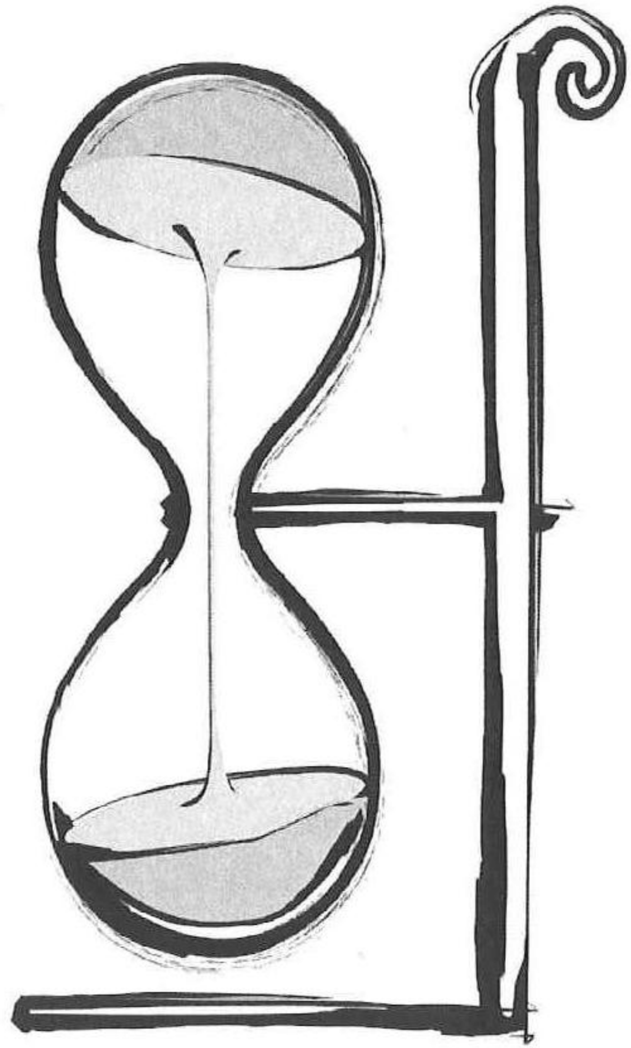
About time arrow



SHORT PREFACE

According to Cohen and Grossberg, let us consider the process capable to store and transform input patterns, by a generalized formal neural network.

As a consequence of initial data and arbitrary input solicitation, a large variety of behaviours is possible.

They may include travelling waves, standing waves, resonance, chaos.

Therefore, a question of fundamental interest is what general constraints lead to a global approach towards equilibrium rather than increasing amplitude waves.

In other words, whether global pattern formation occurs.

A related question is whether the global pattern formation process persists in presence of slow changes of system parameters in an unpredictable way, owing to self-organization (development, learning).

The authors develop a criterion for a set of functional dependences (the Cohen-Grossberg forms):

the **symmetry** of connecting coefficients is ***sufficient*** to assure global pattern formation, and the system defines a global Liapunov function, preventing the disgregation of the structure.

In the case the coefficients are asymmetric, in the present work it is shown that the information U is not a state function and the behaviour path is predictable, but the information content of the configuration is not defined.

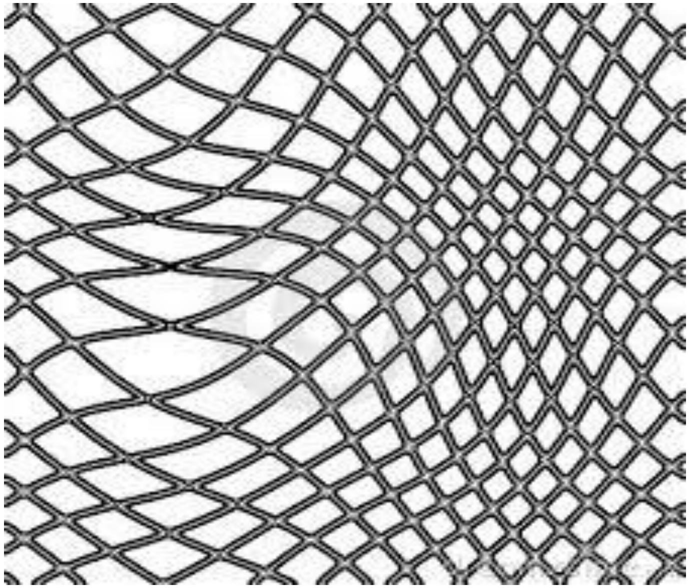
It will be shown that the Schrodinger equation belongs to the ***special case*** of coefficients symmetric and all ***equal*** each other; therefore a generalization of such an equation is needed, with coefficients symmetric but **varying (in function of time, position and so on)** to analyze situations of strong interaction between mutual interacting close particles.

Indeed, the above considerations lead to limit the adoption of Schrodinger equation to high interparticle distance cases, when the potential created by the first particle may be considered constant across the extension of the second one, so assumed point-like.

When the particles are close, the mutual interaction modifies the connecting coefficient field

$$c_{ji} = c_{ij} = c_{ij}\,(r,t,\psi)$$

by deforming the lengths of the mesh branches;



consequently , the standard unitary "I" mesh branches (proportional to connecting coefficients) are no longer unitary (owing to the inhomogeneous deformation of the net by the strong fields involved)

$$I = I(r,t,\psi)$$

and the dependence

$$c_{ji} = c_{ij} = c_{ij}(r,t,\psi)$$

must be introduced in the network evolution equation, so providing the need for a generalized Schrodinger equation.

The last consideration may constitute a premise to Hadronic Mechanics from the point of view of the neural analogy.

Abstract

An analogy is drawn among the irreversible evolution of a neural-network-based A.I., an information field associated to spacetime configurations and the behaviour of entities described by the Schrödinger equation.

Some results are shown dealing with applications to drive nuclear synthesis research work and to offer a key for reading about the Universe evolution.

AIMS

Anthropic Principle (reference):

the Universe structure has the finality to be intelligible by human beings.

Tool problem (ours):

what characteristics must be in possession of *entities* to be able to store, carry and manage information ?

Targets:

- to build the equation of an A.I. as a chaotic ∞–dimensional incubator able to let emerge by *resonance* stable entities obeying the Schrödinger equation;
- to utilize the approach by information as a key to reading of some concepts generally subtended to the theories, such as entity, structure, interaction
- to disclose the meanings of time, potential, energy
- to show some applications ranging from nuclear synthesis researchs to the Universe evolution.

AN OUTLINE

J. Von Neumann Cellular Automaton :

network of neurons with finite states, connected only to nearest ones, *if* extended to infinite number of levels, has descriptive capababilities ranging from physical systems dynamic to biological entities one, to collective behaviour, of neurons or individuals.

Kohonen neural network :

can self-organize, creating emerging structures.

Ramacher and Nachbar:

the general dynamics of neural networks is dealt with by an Hamiltonian approach.

Cohen and Grossberg :

specify the sufficient constraints about the nodal equation to warrant the convergence of the self-organization process.

Fredkin:

deals with the Universe like a selfcomputing program.

Cherbit:

analyses a chronotope having a Mandelbrot’s fractal structure.

Ord:

establishes an analogy between such a chronotope and quantum mechanics equations.

Prigogine:

attributes to the irreducibile chaoticness of microscopic world, the direction of the time arrow towards entropy increase; indeed, in chaotic – dissipative phenomena , information decreases during evolution.

Shannon theorem:

limits the propagation velocity of information by the ratio between the network transmissive capability and the code dimension.

Moreover Ord :

following the Einstein's result achieved by General Relativity, *to geometrize physics*, suggests *to physicize geometry* intending, by his own analogy, to acknowledge the concreteness of existence to geometric relations.

Our work :

a look is taken at *physicizing logic*.

THE NETWORK

- An A.I. supported by a fully interconnected neural network, with complex asymmetric connections, selfvarying depending on its evolution dynamics, with an infinite number of neurons and activity levels, arranged in an ∞-dimensional structure.

- Absence of aprioristic constraints to behaviour: the evolution is merely more probable towards the configurations corresponding to a greater number of microstates.

owing to the dependence of entropy on probability, the evolution runs towards the configurations whose information potential (counter-entropy) decreases according to the steepest descent direction (counter-gradient):

$$\psi_i^{(n_i+\Delta n_i)} = \psi_i^{(n_i)} - \Delta n_i \frac{\Delta U(\psi_i, \psi_j, c_{ij})}{\Delta \psi_i} \qquad (1)$$

where Δn_i is the evolution step of i-th node, ψ_i its activity, ψ_j are the ones of the other nodes, c_{ij} the internodals connections, U is the information potential associated with the configuration.

THE CHRONOID

space-time pure oscillator

$$\frac{\partial \psi}{\partial t} = -\frac{c^2}{j\omega} \nabla^2 \psi \qquad (2)$$

whose solution is $\psi(\boldsymbol{x},t) = \psi(\boldsymbol{x}) e^{-j\omega t}$

let us subject equation (2) to equation (1) obtaining

$$\Delta t = -\frac{1}{2j\omega} \ln \frac{U}{U_0} \qquad (3)$$

expressing the velocity of flowing of *own times* vs. each neuron information potential drop, by ratio with the instantaneous frequency pulsation (degradation rate).

- On the other hand, the farthest is the future, the least is the information about future forecast

- Let us regard time as a fuzzy quantity whose membership function M is assumed as symmetric (the adopted logic deserts the not-contraddiction principle).

- Assign to the present a Normal-distributed duration; owing to the equation (3) high values of ω make narrow the membership function, i.e. less indeterminate the time instant, proposing a key to reading of Heisenberg Indetermination Principle, owing to the dependence of energy on ω. A consequence of incoherent fuzzy approach is the loss of causality.

THE A.I. EVOLUTION EQUATION

By counting all the contributes (n) of axes (k) to coupling factors Ω and θ (accounting for different time axes and elapsed times) with i axis, and adopting a kinetics exclusively probabilistic (therefore a first-order diffusional one), the production rate of i-th species (activity of the neuron i) is determined by the balance between the transformation of i-th species in other ones, and the transformation of the others in i-th one.

Each neuron evolves *in its own time* according to

$$\frac{\Delta\psi_i(t_i)}{\Delta t_i} = \frac{1}{\cap}\left\{\sum_{k=1}^{\infty}\sum_{n=0}^{\infty}\Omega_{k,i|n}\theta_{k,i|n}\left[-\psi_i(t_i)\eta_i + \psi_k(t_{kn})\eta_k\right]\right\} \quad (4)$$

Dimensional analysis applied to the transferability of information by stable travelling waves

$$\dot{\varphi} = \eta \Sigma_j \varphi_j$$

(network)

must be identified with

$$\dot{\varphi} = \frac{c^2}{-j\omega} \nabla^2 \varphi$$

(waves)

it is possible only if

$$\eta = \frac{c^2}{-j\omega \Delta l^2}$$

$$-j\omega\eta$$

can be obtained, as a combination of the fundamental constants, c (relativistic), G (gravitational) and h (quantistic), in *only a way*:

$$\eta = \frac{1}{-j\omega}\frac{c^5}{hG} \tag{5}$$

leading to the *A.I. evolution equation*

$$\frac{\Delta\psi_i(t_i)}{2\pi_j/\omega_i} = \frac{1}{\cap}\frac{c^5}{hG}\left\{\sum_{k=1}^{\infty}\sum_{n=0}^{\infty}\Omega_{k,i|n}\theta_{k,i|n}\left[-\frac{\psi_i(t_i)}{\omega_i}+\frac{\psi_k(t_k)}{\omega_{kn}}\right]\right\} \tag{6}$$

(equation of the cognizable)

When the connections are asymmetric, the information potential *U* is not a state function (to each configuration does not correspond a definite information), but always it is such, the derivative that from [5] is

$$\frac{dU}{dt_i} = -\omega_i \sum_k \frac{1}{\omega_k} \left(\frac{d\psi_k}{dt_k} \right)^2 \qquad (7)$$

that permits to express the evolution of the decrement of *U* only depending on the configuration parameters.

Hidden time evolution equation:

$$\frac{\partial \psi_i}{\partial U} = \frac{F_i}{-\omega_i \sum_k \frac{F_k^2}{\omega_k}} \qquad (8)$$

F_i is the second member of (6), showing the behaviour in *intrinsic* form, transforming the time into a ***derived*** quantity

When ω_i forces by *resonance*

$$\omega_k \to \omega_i = \omega$$

$$\eta_k \to \eta_i \propto 1/\omega \Rightarrow \Omega_{ik} \to 1$$

the time axes rotate and the times synchronize themselves

$$t_k \longrightarrow t_i = t$$

equation (6) becomes

$$\frac{\Delta\psi_i}{\Delta t} = \frac{1}{-j\omega}\frac{\theta}{\cap}\frac{c^5}{hG}\sum_k\left(-\psi_i + \psi_k\right)$$

producing the single time axis

$$\Delta t = -\int_\gamma \frac{dU}{\sum_k F_k^{\ 2}} = -\int_\gamma \frac{dU}{\sum_k\left(-\frac{\partial U}{\partial \psi_k}\right)^2} = -\int_\gamma \frac{dU}{|\,gradU\,|^2} \qquad (9)$$

time represents the **information drop**, in rate to local slope of the path γ on the surface $U-\psi$

THE SCHRÖDINGER EQUATION

- rotating pulse with pulsation ω_0
- velocity *c*
- steady orbit $r_0 = c/\omega_0$
- rotation center advances with velocity υ
- rest mass $m_0 = \dfrac{\hbar\omega_0}{c^2}$
- kynetic energy $\hbar\omega_c$

$$m = \frac{\hbar(\omega_0 + \omega_c)}{c^2} = \frac{\hbar}{c^2}\omega$$

Let us identify $\gamma = \dfrac{\omega_0}{\omega_0 + \omega_c}$ and $\gamma = \sqrt{1 - \dfrac{\upsilon^2}{c^2}}$ obtaining

$$m = \frac{m_0}{\sqrt{1 - \dfrac{\upsilon^2}{c^2}}}$$

if $\omega_0 = 0 \Rightarrow \gamma = 0 \Rightarrow \upsilon \equiv c$

describing also the behaviour of photons in a unified way, with the solution

$$\psi(x,t) = \psi(x)\, e^{-j(\omega_0+\omega_c)(1-\gamma^2)t} \qquad (10)$$

network-like form

$$\begin{cases} \dot{\psi} = \varphi & \text{(activation equation)} \\ \dot{\varphi} = \mathrm{c}^2\left(1-\gamma^2\right)\nabla^2\psi & \text{(learning equation)} \end{cases} \qquad (11)$$

relativistic complete form

$$\frac{\partial\psi(x,t)}{\partial t} = \frac{c^2}{-j(\omega_0+\omega_c)}\nabla^2\psi(x,t) - \frac{jV}{\hbar}(1+\gamma)\psi(x,t) \qquad (12)$$

where $\psi(t) = e^{-\frac{j}{\hbar}(1+\gamma)[K+V]t}$

In case of small υ

$$E_T\,\psi(x,t) = -\frac{\hbar^2}{(1+\gamma)\,m}\nabla^2\psi(x,t) + V\psi(x,t) \qquad (13)$$

(complete original Schrödinger equation)

The fundamental involved quantities can be proved:

momentum $p = \hbar k = h\mu$

spatial frequency $\mu = k/2\pi$

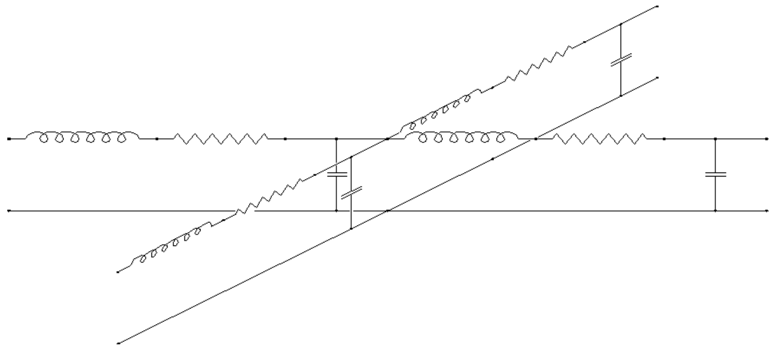
wave number $k = \dfrac{\omega_0 + \omega_c}{c}\sqrt{1-\gamma^2}$

kinetic energy $K = \hbar\left(\omega_0 + \omega_c\right)\left(1-\gamma\right) = \hbar\omega_c$

wavelength $\lambda = \dfrac{2\pi}{k} = \dfrac{h}{p}$ (De Broglie equation)

(14)

Network scheme



model of the network under electric analogy, where the mesh branch is like in picture, with distributed parameters R, L, C:

$$\nabla^2\psi = LC\frac{\partial^2\psi}{\partial t^2} + RC\frac{\partial\psi}{\partial t} \qquad (15)$$

By comparison with (12) and putting $\omega_\nu = \frac{V}{\hbar}$

$$\begin{cases} LC = \dfrac{\omega_0 + \omega_c}{c^2(1+\gamma)(\omega_c + \omega_v)} \\ RC = \dfrac{j\omega_v}{c^2} \cdot \dfrac{\omega_0 + \omega_c}{(\omega_c + \omega_v)} \end{cases} \qquad (16)$$

The parameters R, L, C are *learned* from the behaviour

$(\omega_0, \omega_c, \omega_v)$ that the network actually exibits.

Let us specialize the **Shannon theorem**

- *transmission capability:* the frequency of (10) $C = (\omega_0 + \omega_c)(1-\gamma^2)$
- encoding: *H=k*

thus $$\upsilon = \frac{C}{H} = c\sqrt{1-\gamma^2}$$

$\upsilon < c \text{ when } \omega_0 \neq 0 \ (\textit{particles})$

$\upsilon = c \text{ when } \omega_0 = 0 \ (\textit{photons})$

Such a proof of the "*c-postulate*" of relativity theory is a consequence of assumptions about encoding and transmission modalities and ***it does not*** *preclude* that other encodings might behave in a different way, constraining the velocity limitation to remain as a **postulate**.

The form (2) is obtained from evolution equation (6) when the pulsation colonizes the chaos *transforming it into its own chronotope :*

$$\begin{cases} \text{connection coefficients symmetric and equal (U is a state function)} \\ \text{pure imaginary} \\ \text{dependant on } \omega \\ \text{connections of each node only to first neighbours} \\ \text{time monodimensional synchronized} \end{cases}$$

THE INTERACTION POTENTIAL

By differentiating equation (3) it can be obtained the meaning of energy

$$\hbar\omega = -\frac{\hbar}{2j}\frac{dU}{Udt} \tag{17}$$

as specific rate of information dissipation, and owing to $k = \omega/\upsilon$ the meaning of momentum

$$p = \hbar k = -\frac{\hbar}{2}\frac{dU}{Ud\tau} \tag{18}$$

as dissipation specific rate along the time co-ordinate of its own chronotope $\left(d\tau = j\upsilon dt\right)$

The definition of υ and the equation (18) lead to *p* as the specific dissipation spatial gradient

$$p = \hbar k = -\frac{\hbar}{2j}\frac{dU}{Udx} \qquad (19)$$

Making the derivative of equation (19) and inverting the derivation order:

$$\dot{p} = \frac{\partial}{\partial x}\left[-\frac{\hbar}{2j}\frac{dU}{Udt}\right] \qquad (20)$$

$\dot{p}$ is *constructed* by the energy gradient that the information field is able to confer to the particle immersed into. The energy associated to U field can be called *interaction potential* in each point of an information field, associated with a spatial configuration of dynamically variable levels.

$$\wp = \frac{\hbar}{2}\frac{d(\ln U)}{d(jt)} \qquad (21)$$

Resonance

From (12) we obtain

$$\frac{\partial \varphi^2}{\partial t^2} = \frac{c^2}{-j(\omega_0 + \omega_c)}\left[\frac{-j}{h}(1+j)(k+v)\right] \nabla^2\varphi - \frac{\partial v}{\partial h}(1+\gamma)\frac{\partial \varphi}{\partial t} \quad (22)$$

to be compared with (15) in the form

$$\frac{\partial \varphi^2}{\partial t^2} = \frac{1}{L'C'}\nabla^2\varphi - \frac{R'C'}{L'C'}\frac{\partial \varphi}{\partial t} \quad (23)$$

and from (16)

$$\frac{R'}{L'} = j\omega_v(1+\gamma) \quad (24)$$

In the case of mesh branch “RLC *series*” the own pulsation ω (resonance) is:

$$\omega_r = \sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2} \qquad (25)$$

and for small R

$$\omega_r = \frac{1}{\sqrt{LC}} \qquad (26)$$

Relation between L,R,C and L' , R', C'

If around a node of the network (with mesh branch *l)* runs a circular perturbation whose resonance λ closes itself on 2π*l* :

$$l = \frac{\lambda_r}{2\pi}$$

$$L = lL' = \frac{\lambda_r}{2\pi} L' \quad ; \qquad R = lR' = \frac{\lambda_r}{2\pi} R'; \qquad C = lC' = \frac{\lambda_r}{2\pi} C'$$

that inserted into (25) gives

$$\omega_r = \frac{\lambda_r}{2\pi}\sqrt{\frac{1}{LC} - \left(\frac{R'}{2L'}\right)^2} \qquad (27)$$

First case: $\omega_v = 0$

$$\omega_r = \frac{2\pi c}{\lambda_r}\sqrt{1-\gamma^2}$$

Owing to $\omega_r = 2\pi \nu_r$

it leads to

$$\lambda_r \upsilon_r = c\sqrt{1-\gamma^2}$$

i.e. v

$\lambda_r \nu_r = v$ is a ***fundamental relation*** that shows as the stable *free* particle ($\omega_v = 0$) , in motion, is the representation of a steady wave whose pulsation is the resonance of the space , ***as well as modified*** by the particle during its motion.

Second case: $\omega_v \neq 0$

$$\omega_r = \sqrt{\frac{4\pi^2 c^2 (1-\gamma^2)}{\lambda_R^2} + \frac{\omega_v^2}{4}(1+\gamma)^2}$$

If v is small ($\Upsilon \longrightarrow 1$) it can be simplified

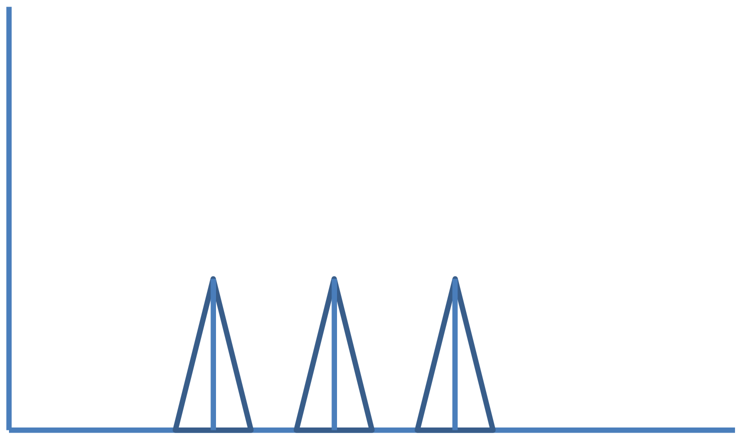
$$\omega_r \equiv \omega_v = \frac{V}{\hbar} \qquad (28)$$

showing that the non-relativistic particle can be pushed to high energy by a suitable application of a potential V.

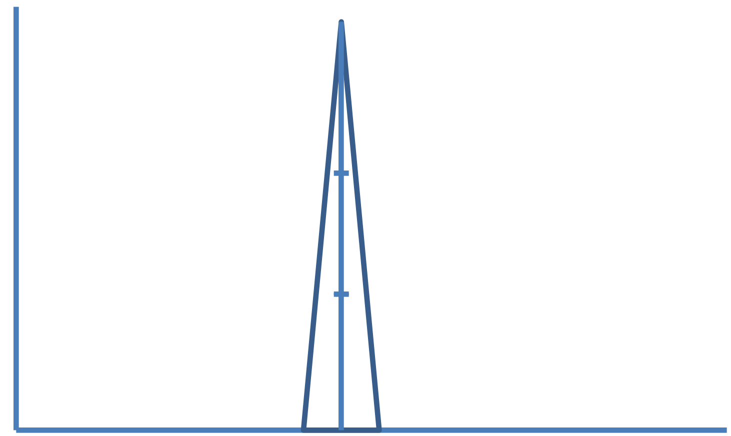
Information in fuzzy sets

(from Claudia Abundo, *"On a method for measuring information and entropy in crisp and fuzzy statistical distributions"*, PhD Thesis in Statistics, "La Sapienza" University, 2009, Rome)

$$U = \frac{1}{2}\sum_{i=1}^{n}\left(c_{ii}\, x_i^2\right) - \sum_{i=1}^{n}\sum_{j\neq i}^{n} c_{ij}\, x_i\, x_j$$



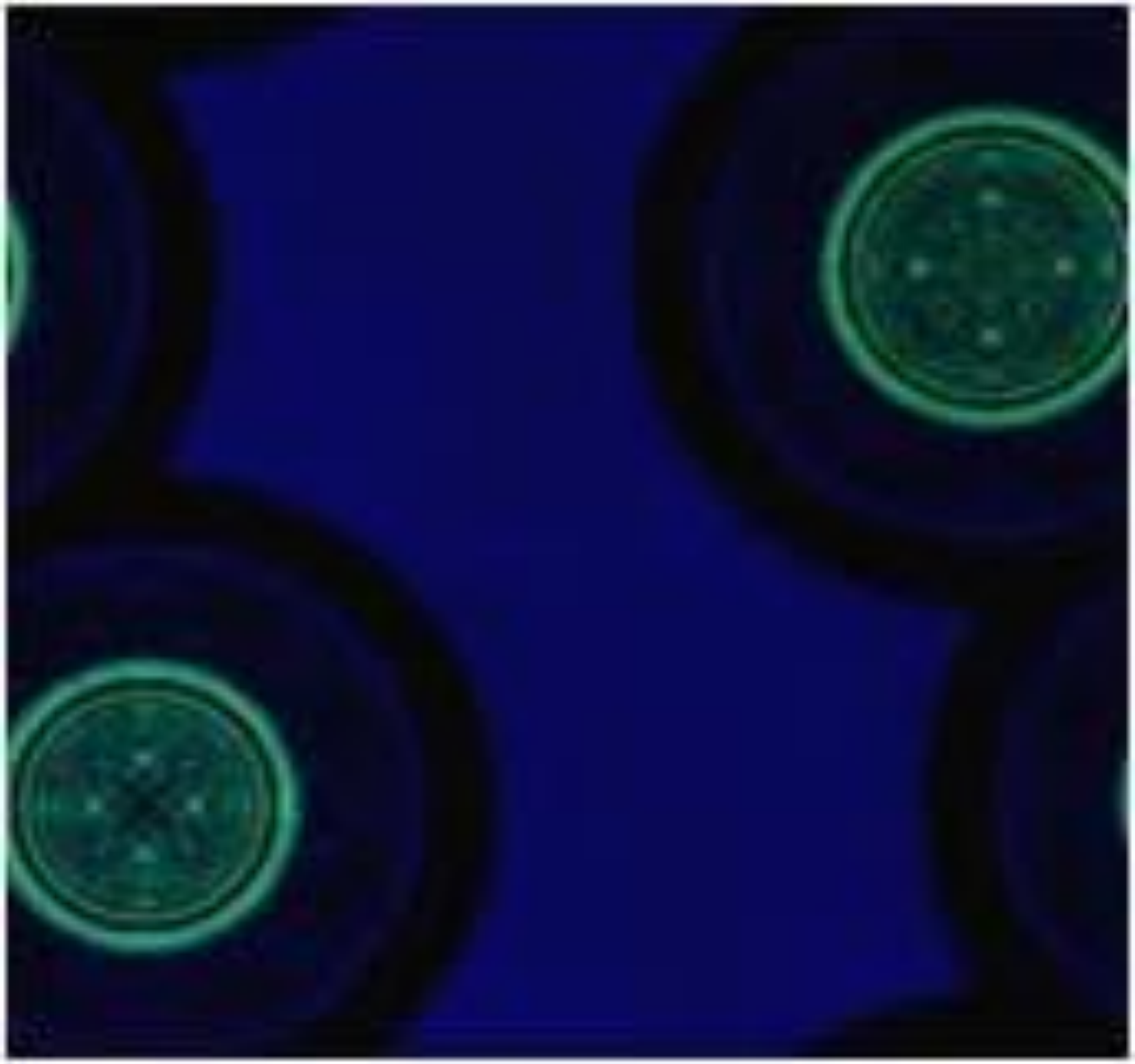
U= 0

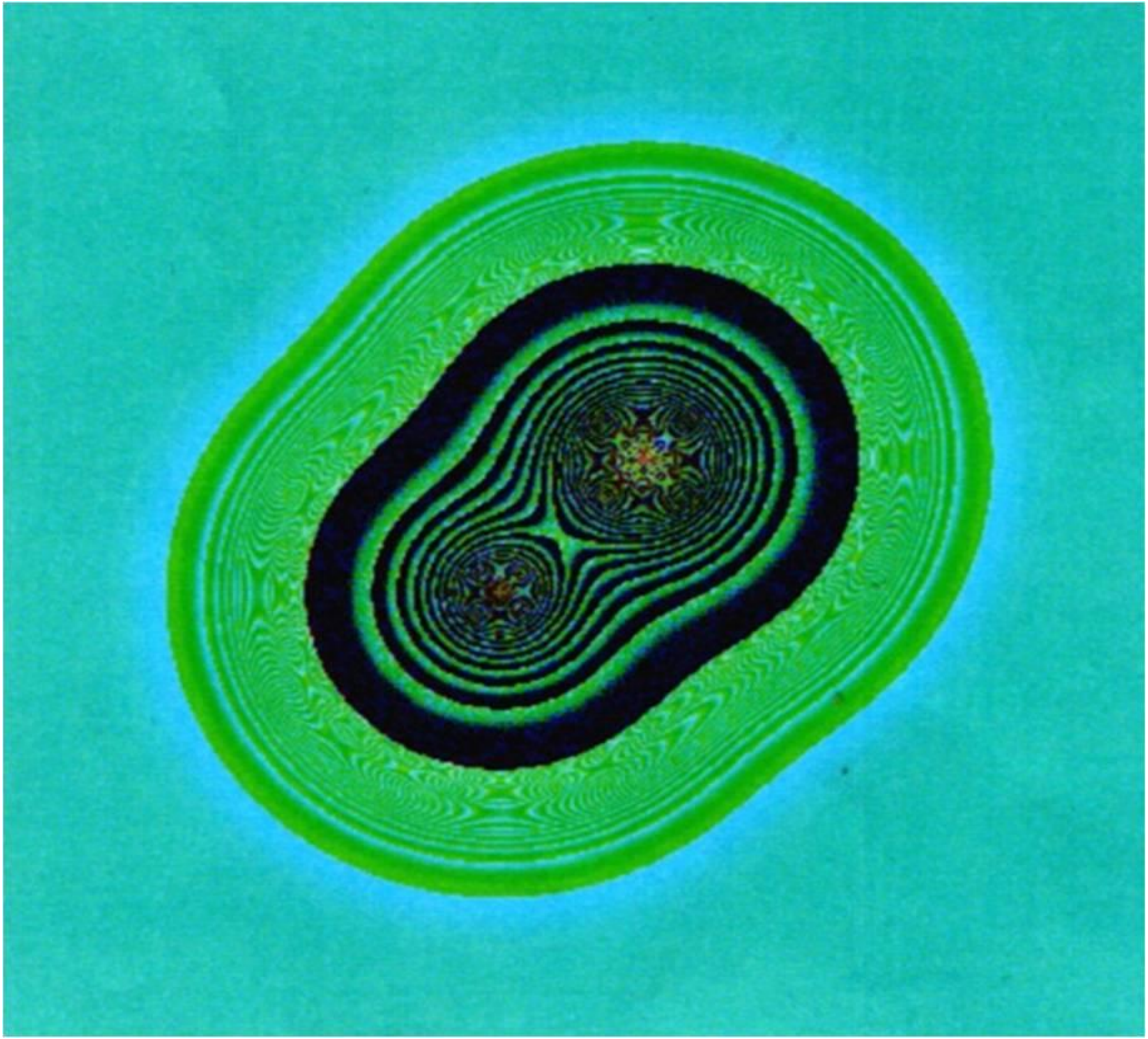


U= 1

Thus justifying the repulsive character of electric forces among same charged particles

Some computer simulations





PERSPECTIVES
in nuclear synthesis research work

The above considerations suggest the possibility to search for high energies trying to establish steady resonance conditions at high frequencies.

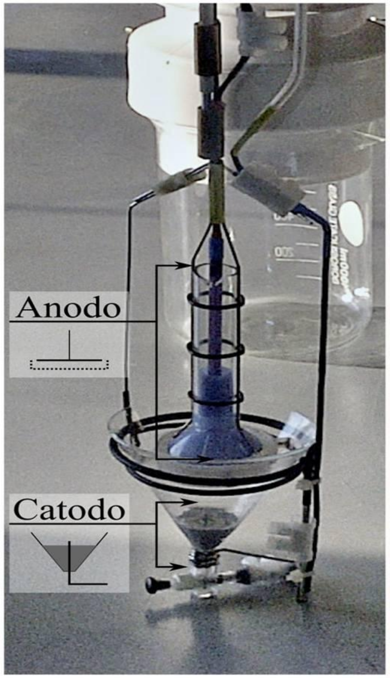
Then the work will follow some directions:

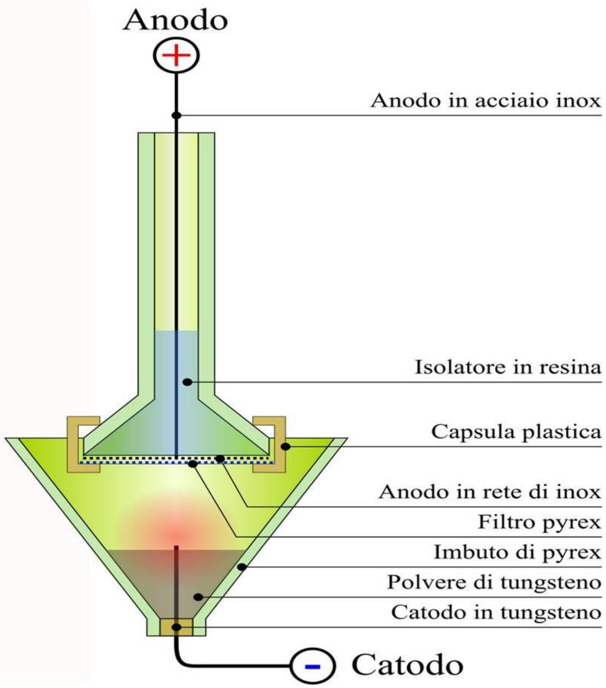
- exploiting the natural oscillations of electrolytic plasma;
- fine-grain structuring of the reactive material to activate stable resonances at very small wavelengths;
- soliciting the reacting system by high frequency forcing pulses;
- employing mixtures of different materials to trigger energy localization.

SOME EXPERIMENTAL RESULTS

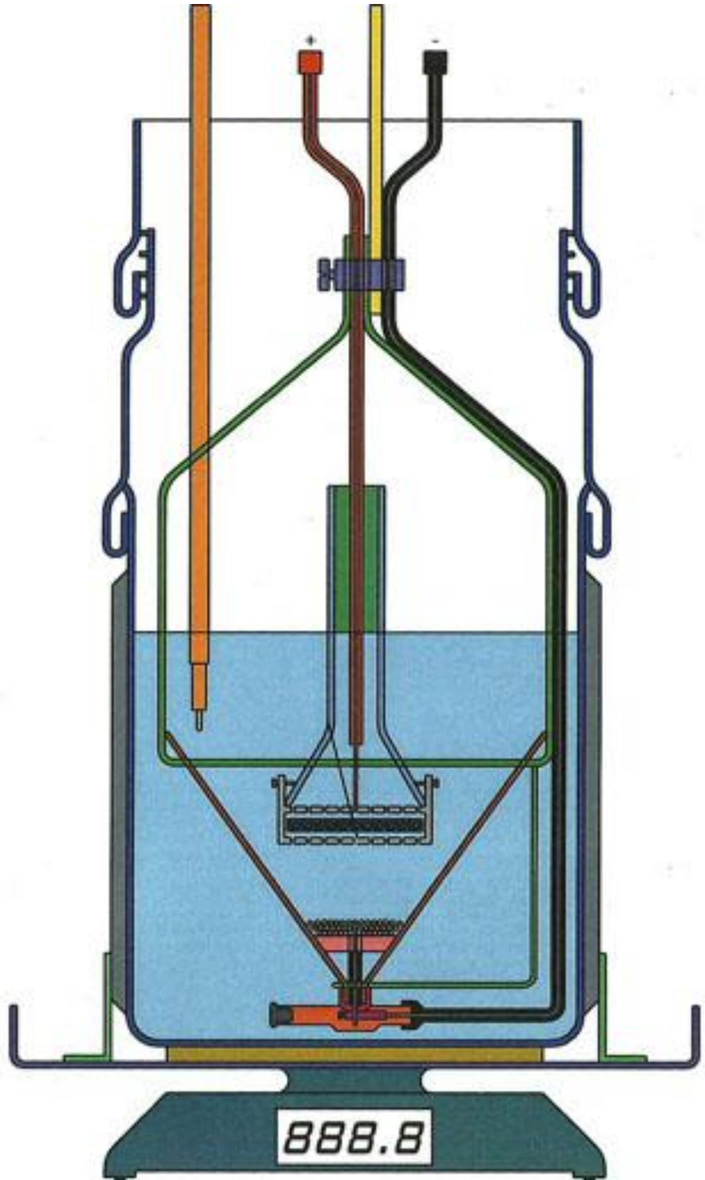
In 2012, in the Physics Lab at “L. Pirelli” High School, in Rome an experimentation begins by a group of teachers and students

Athanor reactor (anomalous heat excesses)
inox mesh (anodic) and a tungsten cylinder (cathodic) in an aqueous solution of K_2CO_3 running in electrolytic plasma

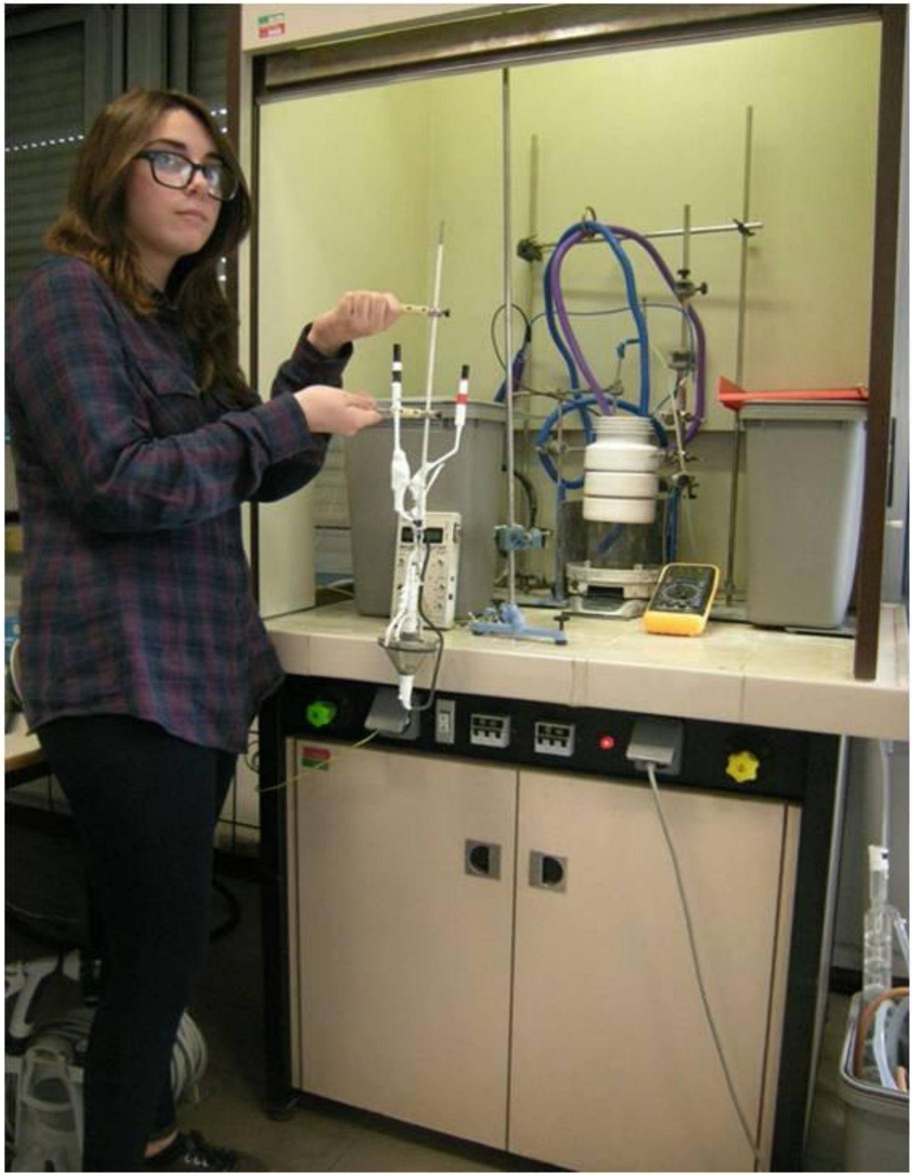




Athanor Reactor



Athanor reactor (IIS L. Pirelli)



Hydrobetatron

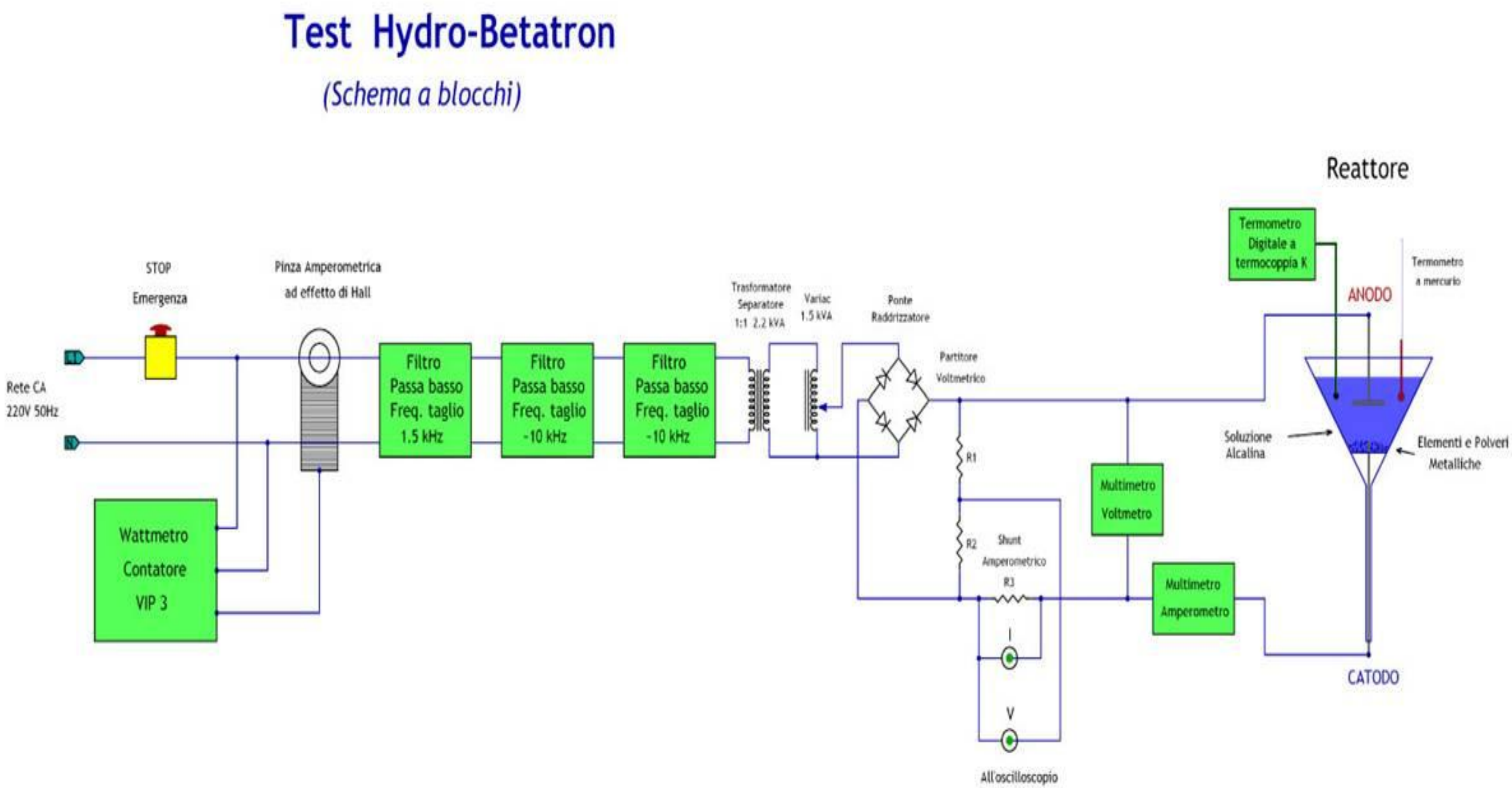
experimental campaigns

at *J. Von Neumann Foundation* Lab in Rome

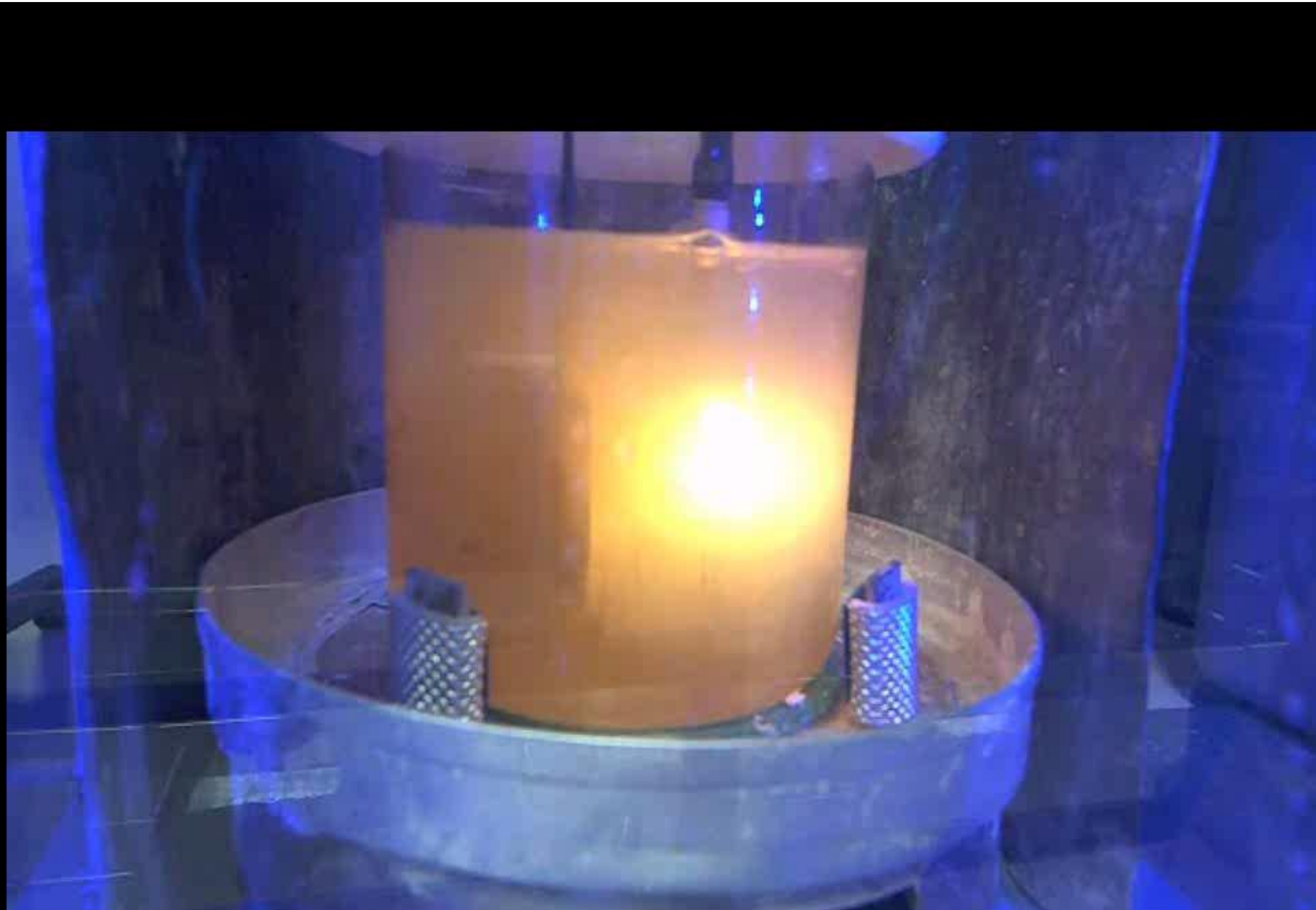
From **Athanor** to its heir **Hydrobetatron 1.0** reactor

(special powder cathode)

Experimental set up



Cylinder – Cell (Sun in the Lab)



Funnel - Cell

The reactor operates in an self-referential way:

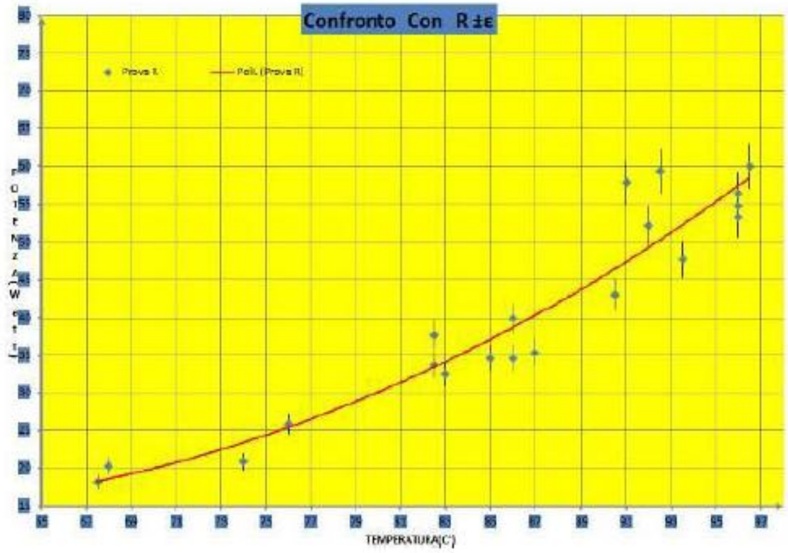
If the powder surface exceeds a minimum threshold, the current density is insufficient to ignite plasma, all the power (exceeding the electrolysis demand) heats the solution by Joule effect (the graph of input power W_{in} vs solution equilibrium temperature is about superimposable at the one related to heating by a resistor)

If the powder surface is less than the threshold, electrolytic plasma occurs.

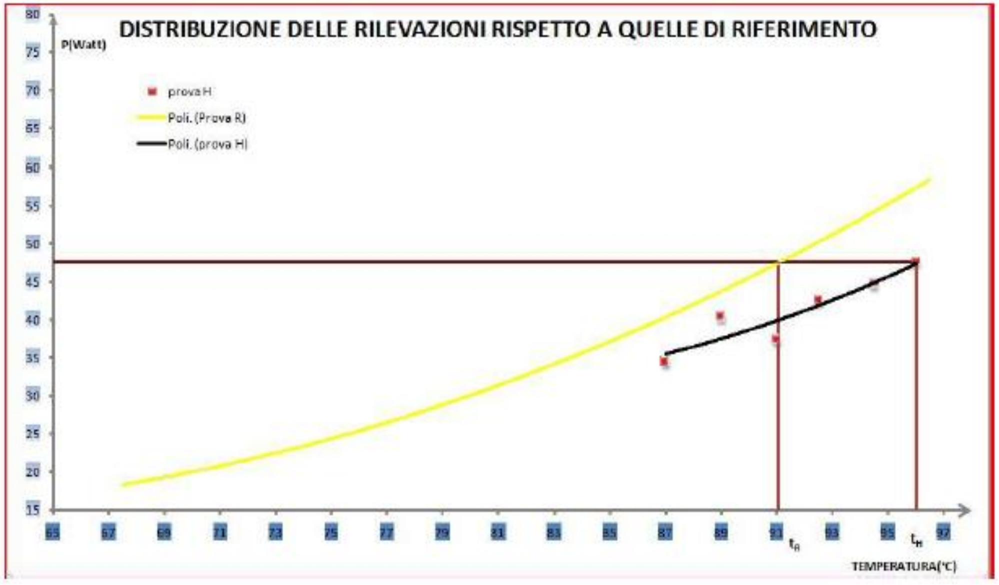
At temperatures exceeding about 70°C

Input power W_{in} vs the reactor equilibrium temperature:

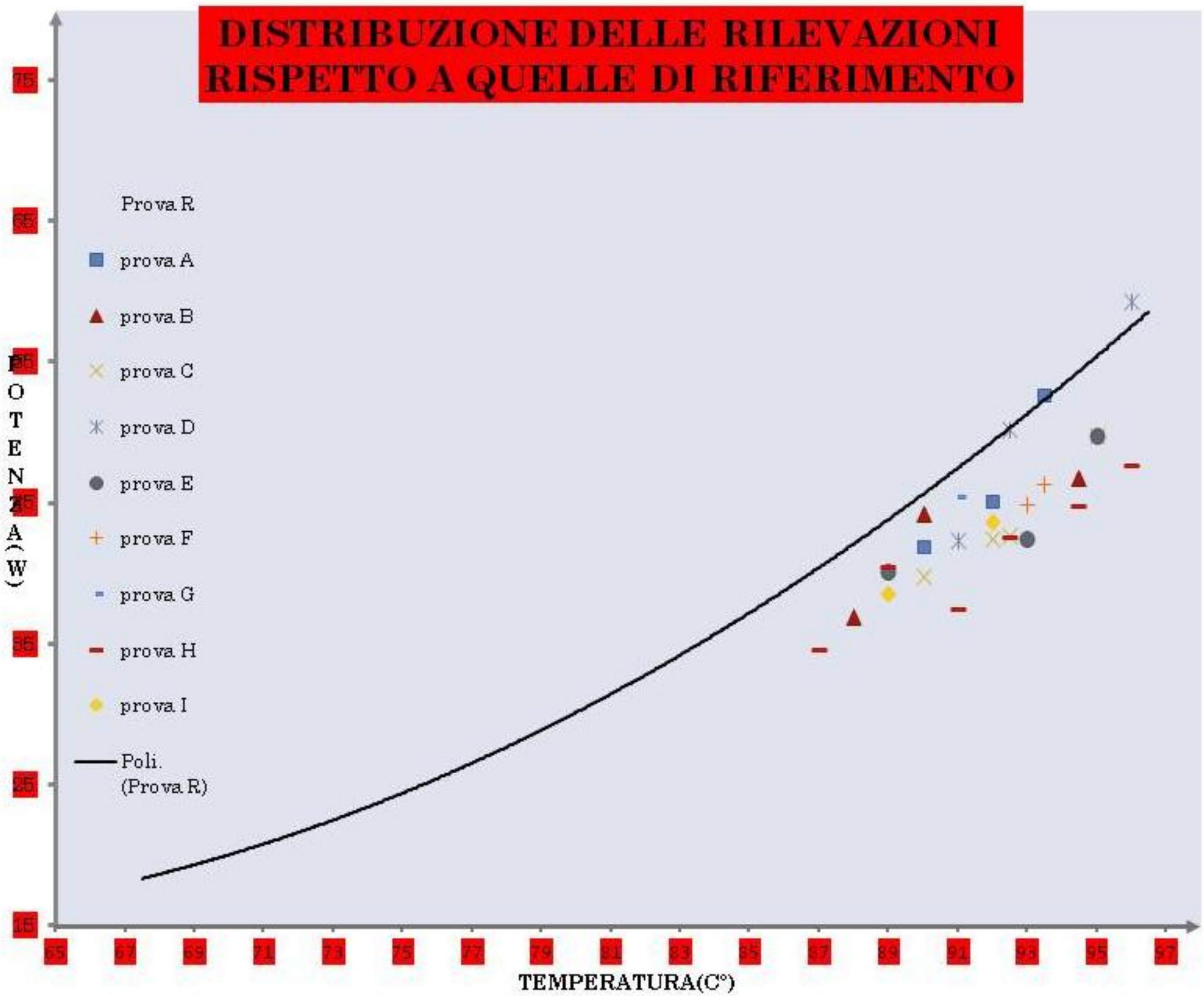
- always in the b) case, less than in the a) case
- increasing distance between graphs as T increases
- In particular, a specific cathodic composition of grains, needles, micropowders behaves optimally showing, at a same T_{eq} , **a ratio W_{in} (a) / W_{in} (b) >1.3**



Curva di riferimento

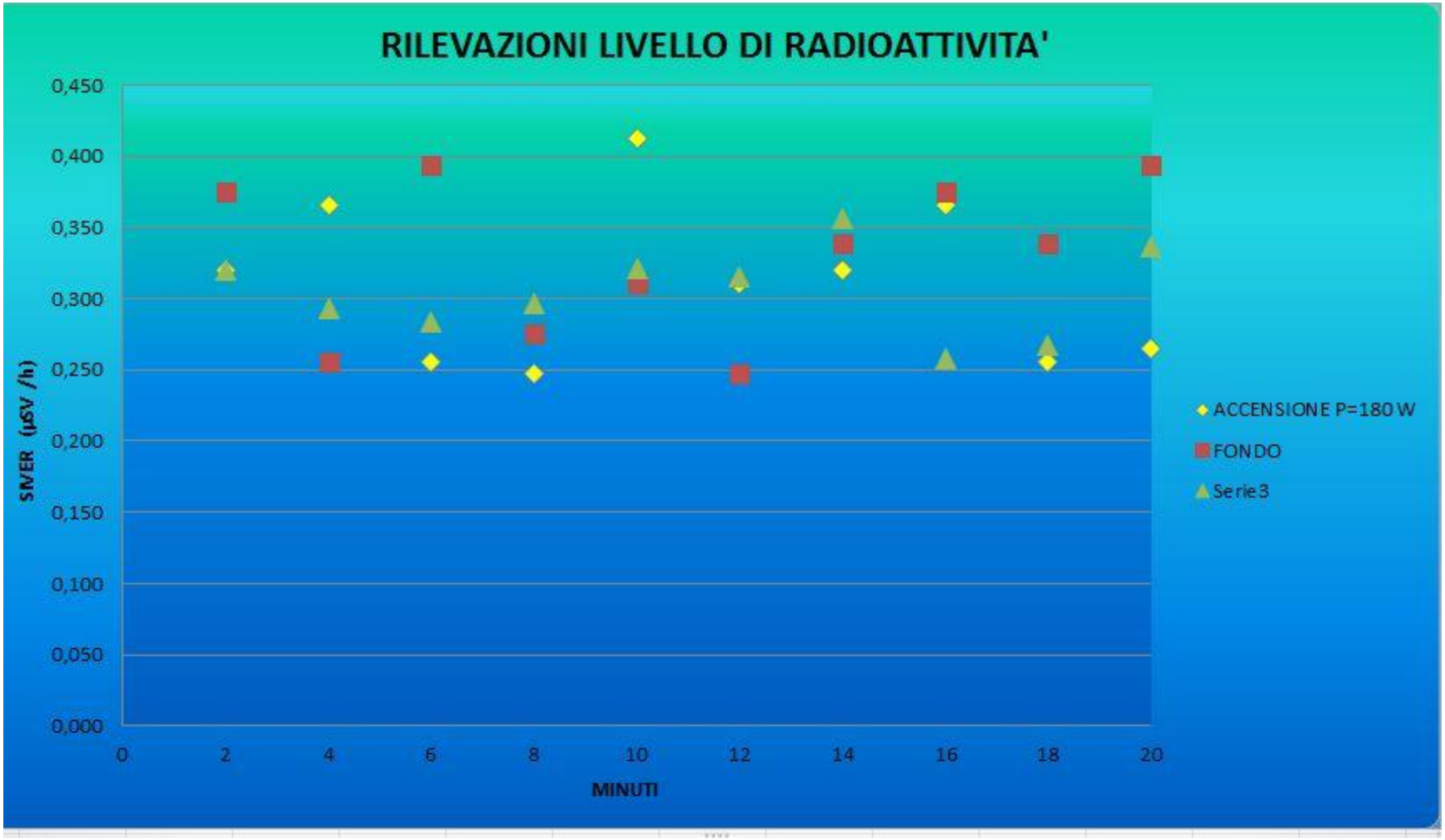


Distribution of results vs reference curve

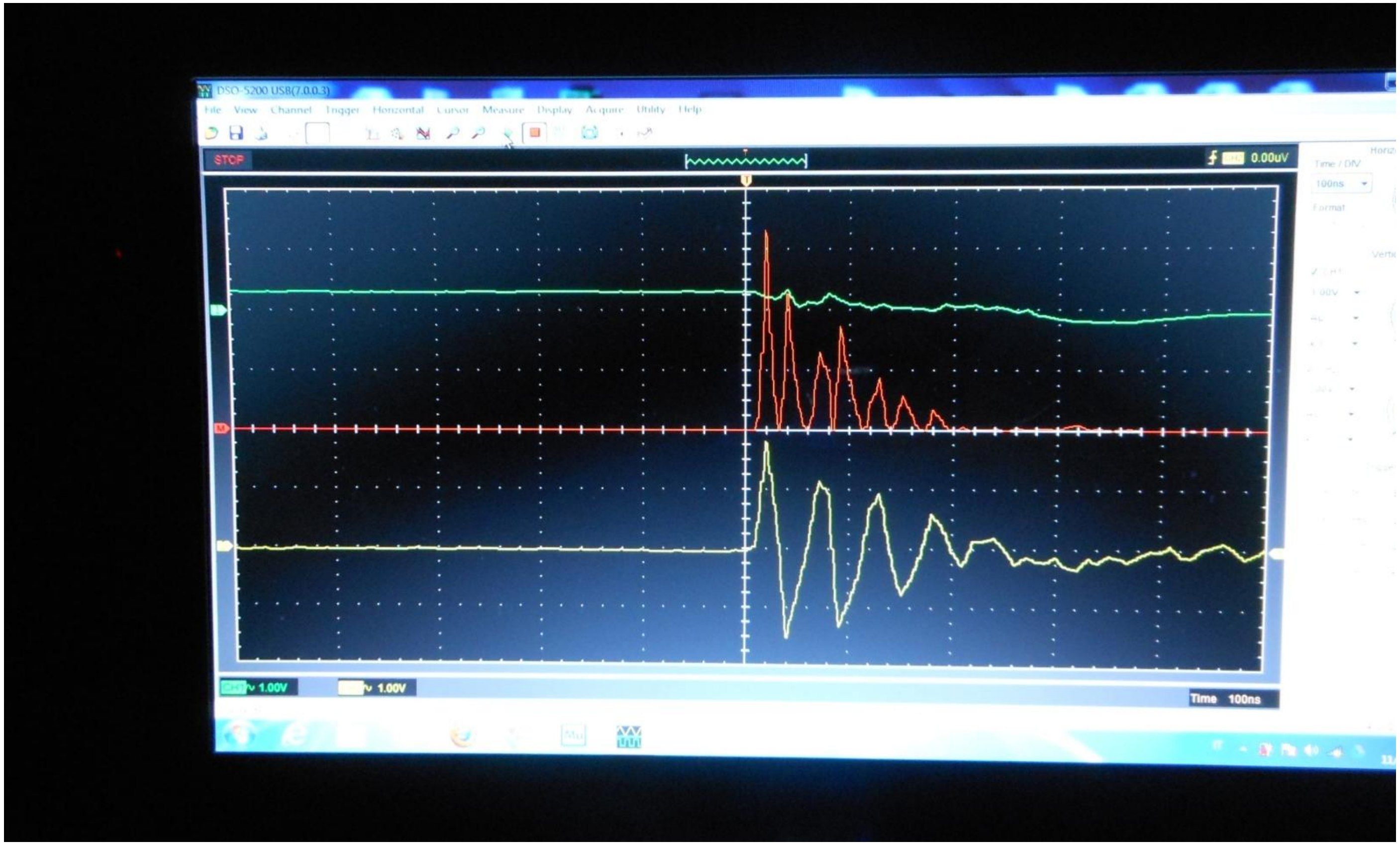


F-pulsator, **laboratorio Fondazione J. Von Neumann**

continue monitoring does not show any **gamma rays** emission

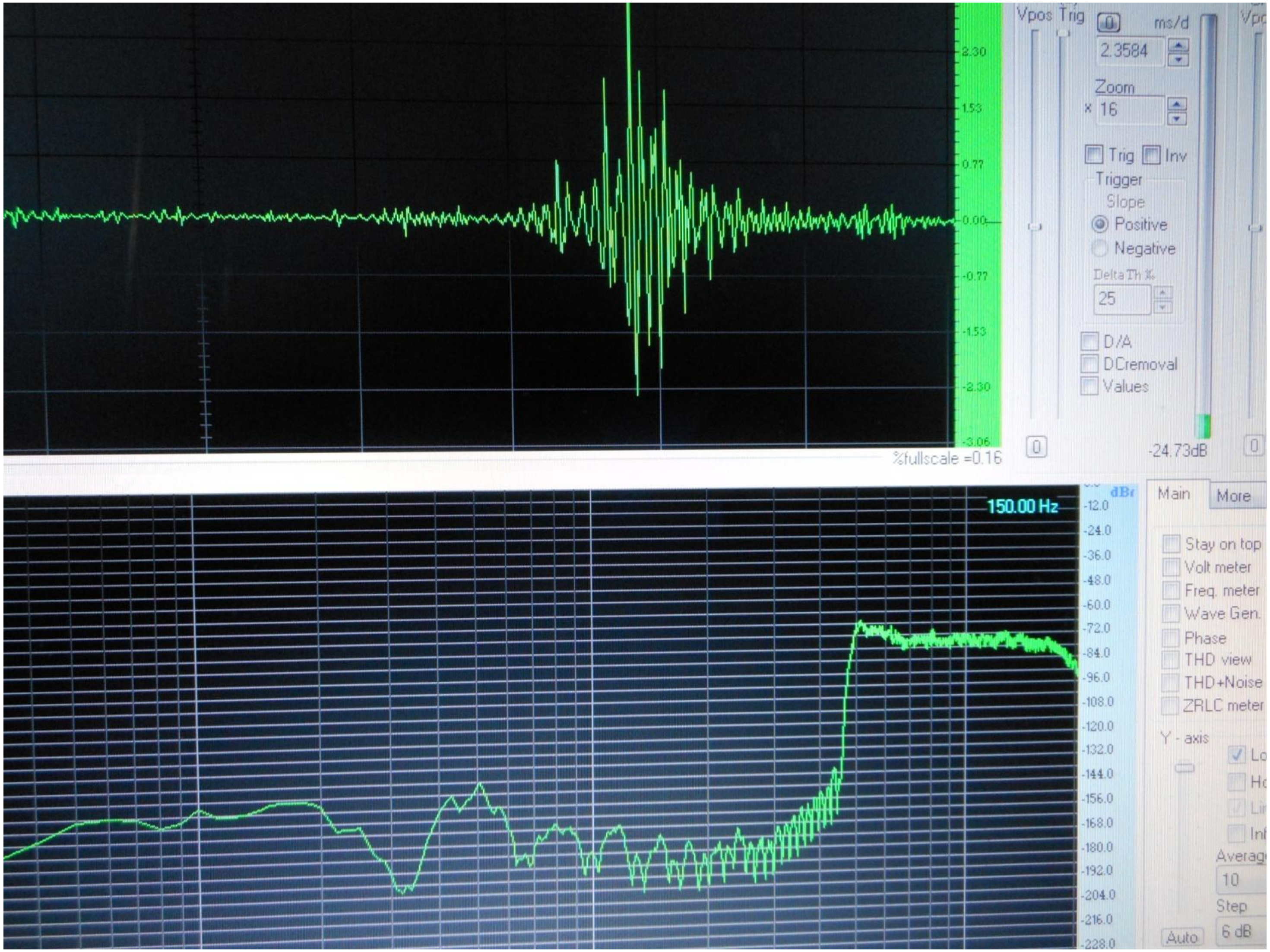


In the plasma phase, by recording and analyzing the electric and acoustic power oscillations induced by plasma, we find electric pulses, 10 – 20 nanoseconds long, carrying **instantaneous** power up to **40 KW**, while the **mean** input power is about 200 W.

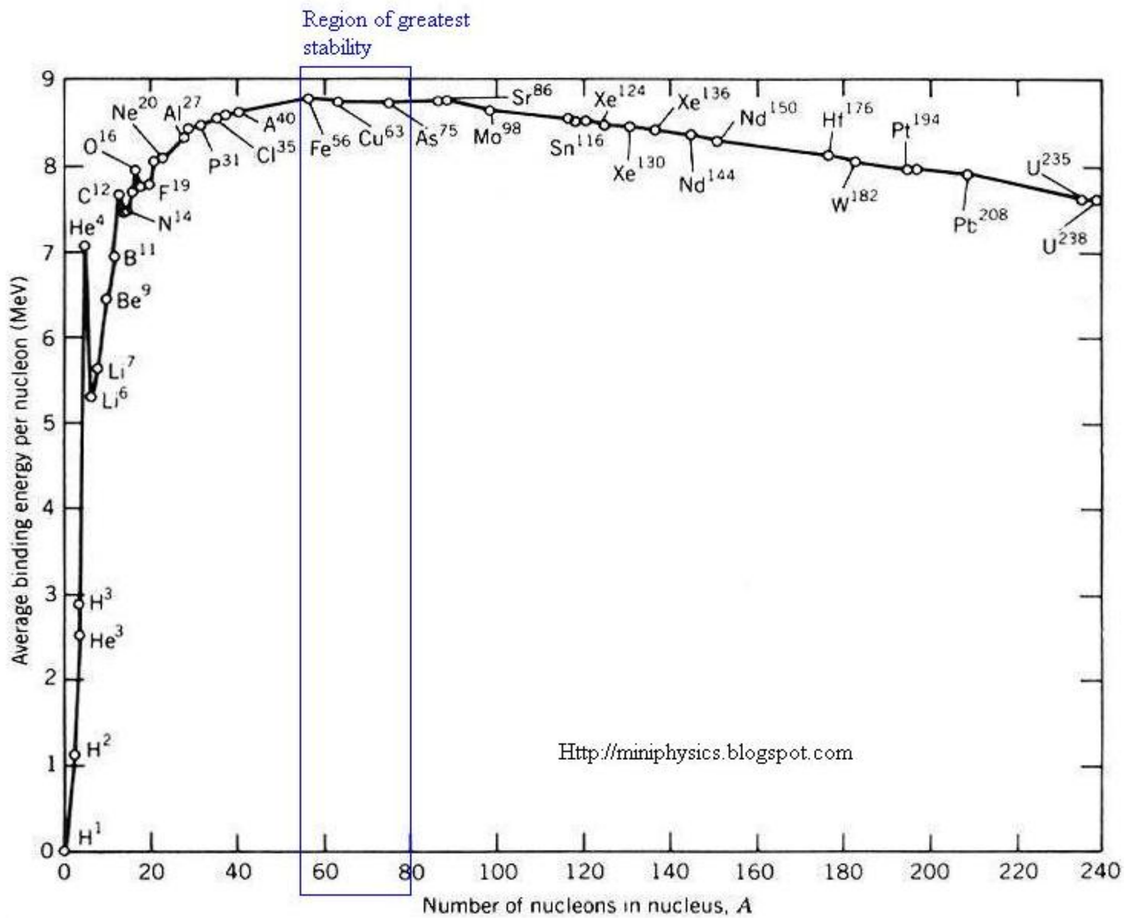


Oscilloscope – time division 100 nsec

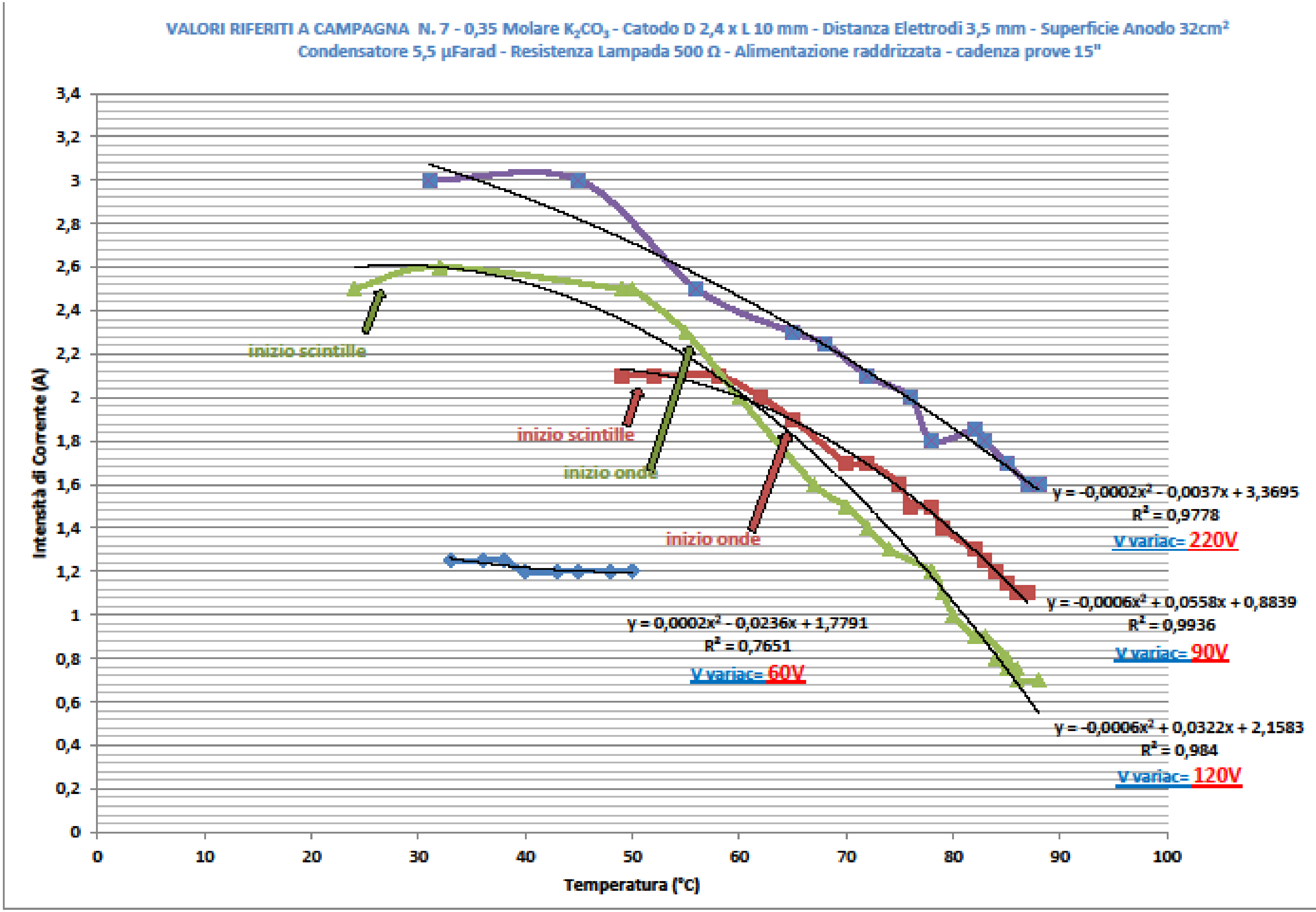
Acoustic oscillations



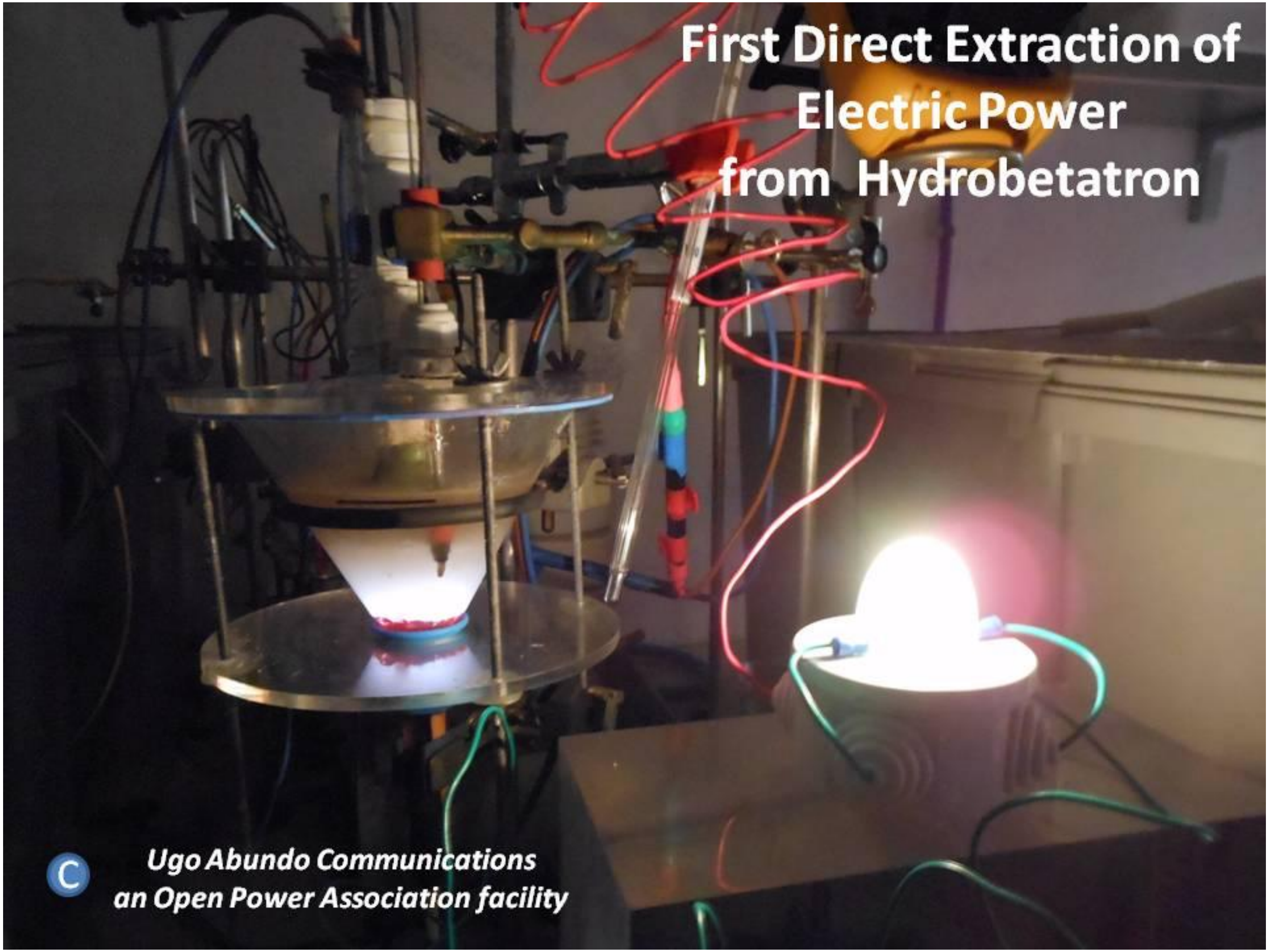
By relating the corresponding energy to the fluid volume inside the sound wave front during the above times, volumetric energy densities are valued **comparable** to the nuclear binding ones, per nucleon.



Dealing with the possibility of direct electric energy extraction from plasma, an extensive experimental campaign, using a suitable RC circuit connected in parallel to the electrodes, by varying shapes and dimensions of the electrodes, electrolyte concentration, interelectrode distance, voltage, reactor temperature and extraction circuit characteristics, shows the presence of regions where occurs the so called (improperly) phenomenon of "negative resistance", i.e. the complexity of involved phenomena is combined to show a current drop vs an increase of interelectrode voltage: in such a condition, several authors put the possibility of extracting power from plasma, by collecting the fluctuations spontaneously autotriggering, as well as actually our data confirm when the circuit is closed on a lamp as load.

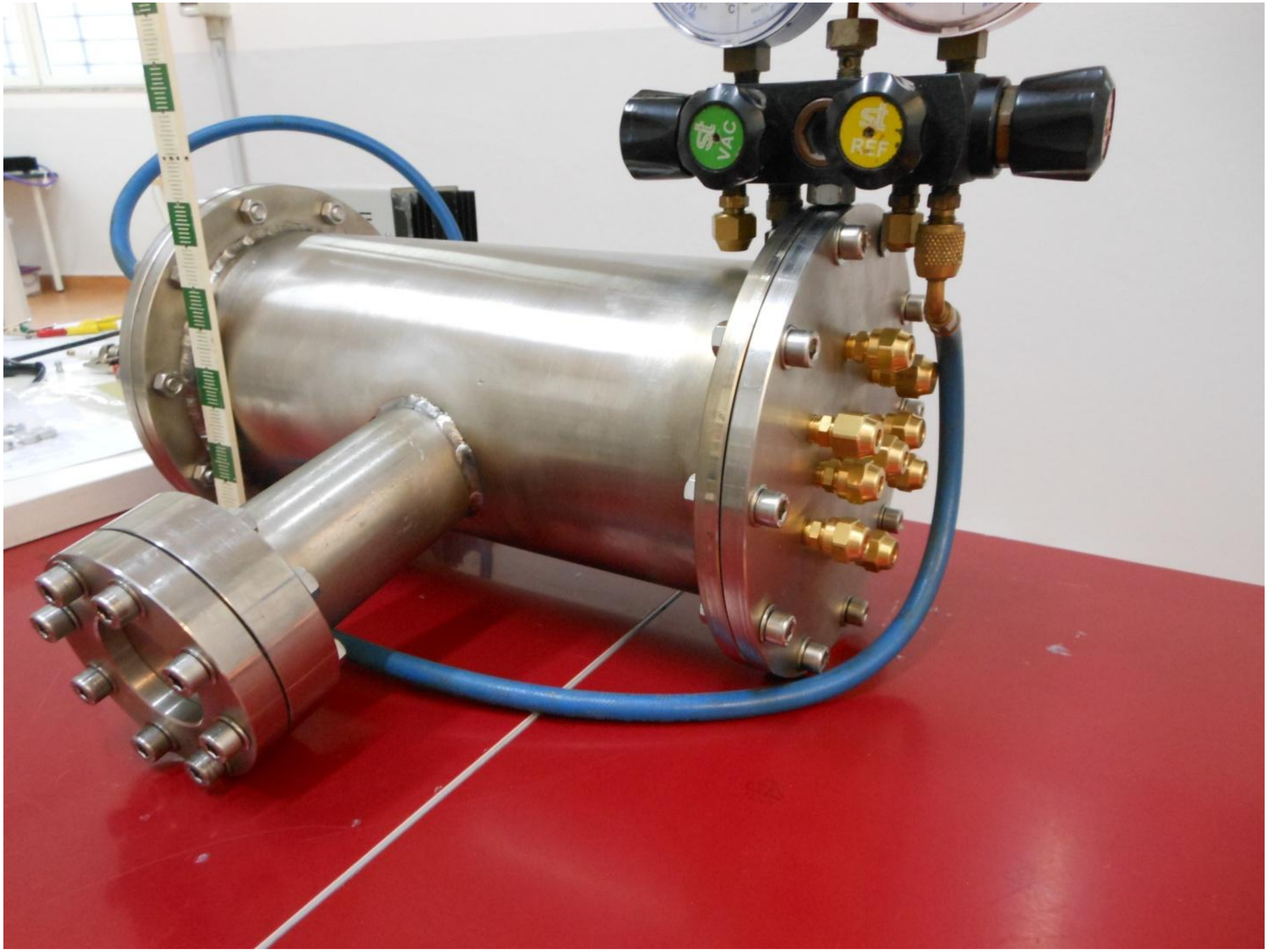


VALORI RIFERITI A CAMPAGNA N. 7 - 0,35 Molare K2CO3 - Catodo D 2,4 x L 10 mm - Distanza Elettrodi 3,5 mm - Superficie Anodo 32cm²
Condensatore 5,5 µFarad - Resistenza Lampada 500 Ω - Alimentazione raddrizzata - cadenza prove 15"
Intensità di Corrente (A)
Temperatura (°C)
inizio scintille
inizio scintille
inizio onde
inizio onde
y = -0,0002x² - 0,0037x + 3,3695
R² = 0,9778
V variac= 220V
y = -0,0006x² + 0,0558x + 0,8839
R² = 0,9936
V variac= 90V
y = 0,0002x² - 0,0236x + 1,7791
R² = 0,7651
V variac= 60V
y = -0,0006x² + 0,0322x + 2,1583
R² = 0,984
V variac= 120V

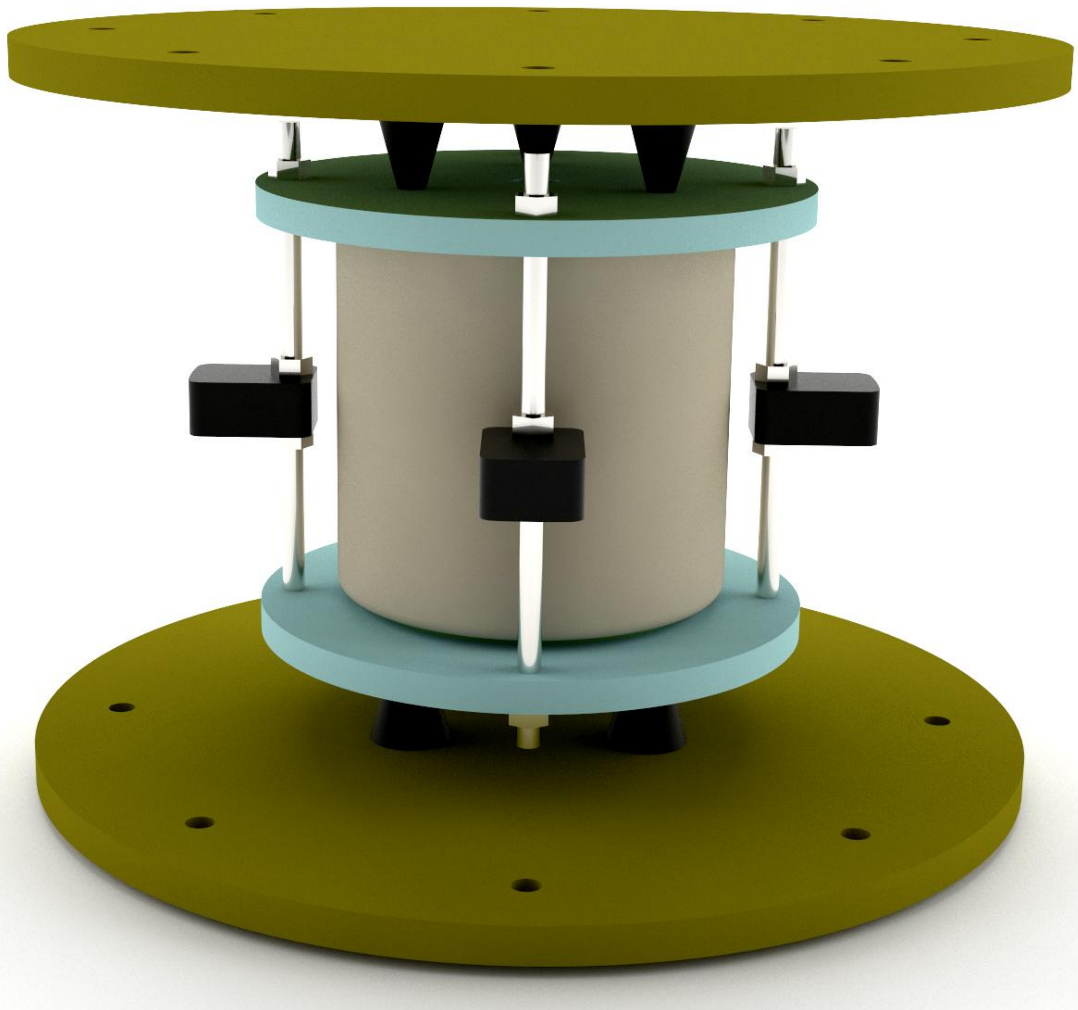

First Direct Extraction of
Electric Power
from Hydrobetatron
Ugo Abundo Communications
an Open Power Association facility

Actually (**Hydrobetatron 2.0**) experimentation is continuing by studying about the effect of a deliberately pulsed solicitation, variable in amplitude, ascent slope, pulse duration, repetition frequency, duty-cycle (proprietary pulse device) on nanometric composite structures (sintered cathodes from multicomponent powders, electroplated multilayers, and so on) both in electrolytic or hydrogen plasmas, under the effect of magnetic field.

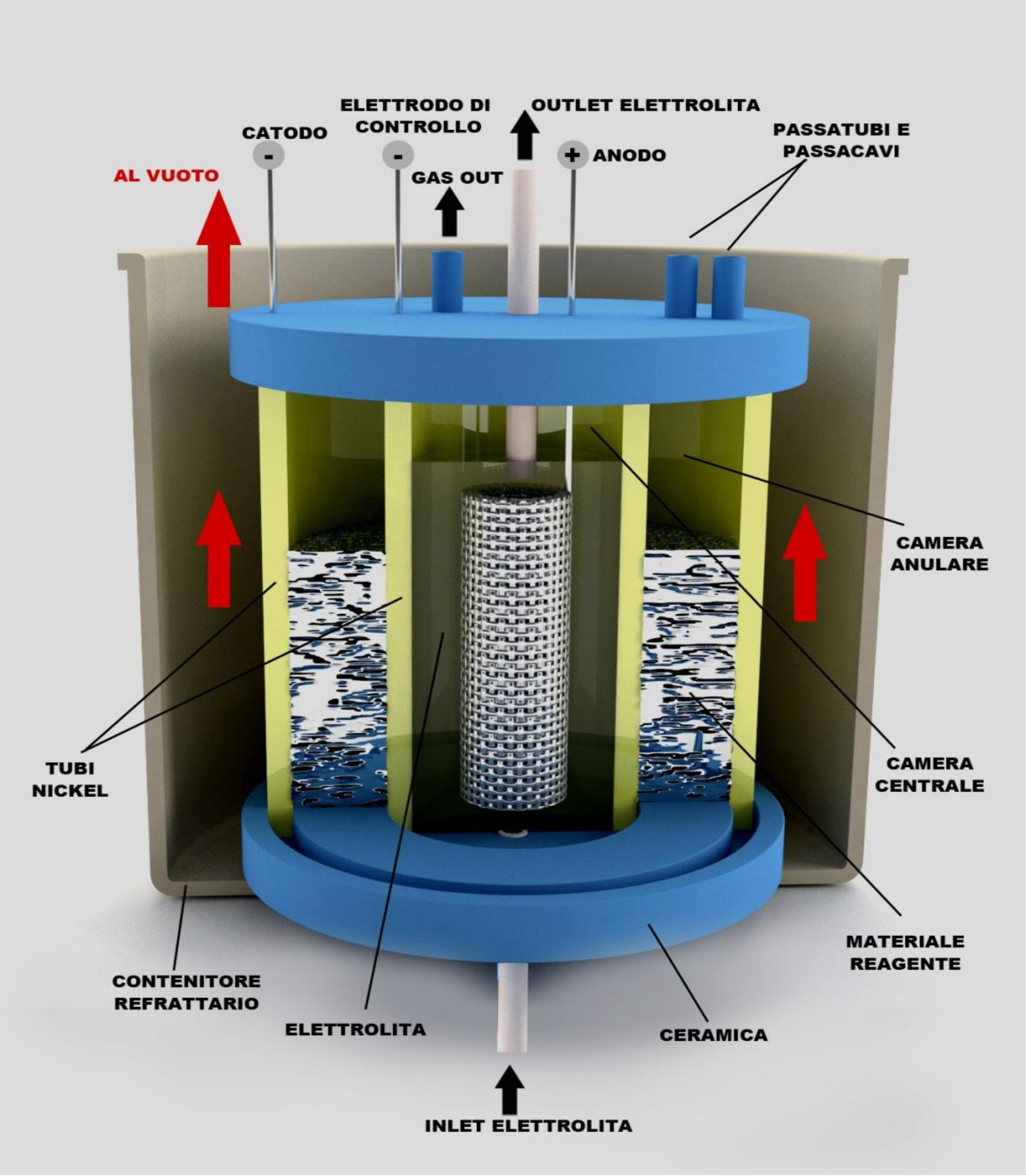
Hydrobetatron 2.0



Reactor core



Inner chambers



Reactor-calorimeter

PERSPECTIVES
in Universe evolution research work

Selfcomputing: Universe may be regarded as a neural machine that computes itself

Universe dynamics: the cosmic information descent may drive evolution, since the time was born, towards its future

Selfcomputing

Computing requires energetic fluxes. A compact–structured computer can not exceed the dimension that permits to drawn energy dissipated on computing.

Drain efficiency (ratio between transmission through external surface $\propto R^2$ and inner production $\propto R^3$) varies as $\frac{1}{R}$ and tends to zero in case of large dimensions. Only a *biphasic porous* structure (chaotic phase and structured one) can locally dissipate computative energy without dimension limits.

Let us pose $\frac{dU}{Udt} = \sigma$

The energy in equilibrium with a ΔL is obtained from balance

$\frac{Gm^2}{\Delta L} = mc^2$ ("no-cost" mass production) $E = mc^2 = \frac{c^4}{G}\Delta l$

About frequencies, $\omega = \frac{c^4}{\hbar G}\Delta L$ (29) and from equation (17)

$$\omega = \frac{1}{-2j}\sigma \Rightarrow \sigma = \frac{-2jc^4}{\hbar G}\Delta L$$

representing the maximum information that can be lost at a certain mesh .

To *read* space at a resolution ΔL we need a particle with

$$\omega = \frac{2\pi c}{\Delta L} \quad (30)$$

Equality between required σ and dissipable one is achieved when ΔL satisfies simultaneously equations (29), (30):

$$\Delta L^2 = \frac{Gh}{c^3} \Rightarrow \Delta L \equiv l_p$$

Planck length is therefore the last stable structure construction limit, under which energy released during structure construction can not be locally drained.

Under l_p, not–causal multidimensional and multitemporal chaos; above l_p, spatial structure, causal and synchronized time.

Universe dynamics

Since Newton, Universe dynamics was described by an equation:

$$R^2\ddot{R} = -G\rho + X(R) \qquad (31)$$

with a term opposing gravity, to permit steady states.

During whole evolution *coexist* two organization states:

- the (amorphous) chaotic phase
- the (crystallized) one provided with structure.

When the times are larger than Planck time, to transition from chaos to structure is associated an energy release; the deeper the order structure, the greater the release

$$\Delta E = -\frac{\alpha}{\Delta l}$$

where Δl is lactice structure mesh under whose dimension chaos persists.
Dimensional analysis assigns to proportionality constant (when combination of *h*, *c*, *G*) the dimensions of *hc*:

$$\Delta E \propto -\frac{hc}{\Delta l}$$

therefore proportional to energy required by a particle when it carries out a reading with resolution Δl

Constructing a structure mesh l_p, the dimension *R* releases

$$\Delta E \propto -\frac{hc}{l_p} \cdot \frac{R}{l_p} \qquad (32)$$

In presence of a cosmological factor Λ , Friedmann developed an acceleration equation

$$\ddot{R} = -\frac{4}{3}\pi GR\left(\rho_m - \frac{\Lambda c^2}{4\pi G}\right) \qquad (34)$$

Identifying $\dfrac{\Lambda c^2}{4\pi G} = \rho_{\mathrm{v}}$

as contribution by vacuum to mass-equivalent density, the dynamic equation is arranged in *elastic* form

$$\ddot{R} = -\frac{4}{3}\pi GR(\rho_m - \rho_{\mathrm{v}}) \qquad (35)$$

The relation indicates the presence of a possible equilibrium situation, when matter mass-equivales density and vacuum one would be equal, with respect to which other situations generate a ***call-back* force**.

If one hypothesizes that vacuum energy must respect, relatively to its own contribution, a balance according to which energy is created at expense of its own effect on gravitation (**extension of Rees conjecture**), the hypothesis yelds, disregarding an inessential form factor, that vacuum mass-equivalent must respect

$$\boxed{-\frac{G{m_{\mathrm{V}}}^{2}}{\mathrm{R}}+c^{2}m_{\mathrm{V}}=0} \qquad (36)$$

$$m_{\mathrm{V}} \propto \frac{c^{2}}{G}\cdot R$$

$$\boxed{\rho_{\mathrm{V}} \propto \frac{c^{2}}{GR^{2}}} \qquad (37)$$

that *stretches* quickly as R increases.

The acceleration equation becomes:

$$\ddot{R} = -\frac{4}{3}\pi G R \rho_m + \alpha \frac{c^2}{R} \qquad (38)$$

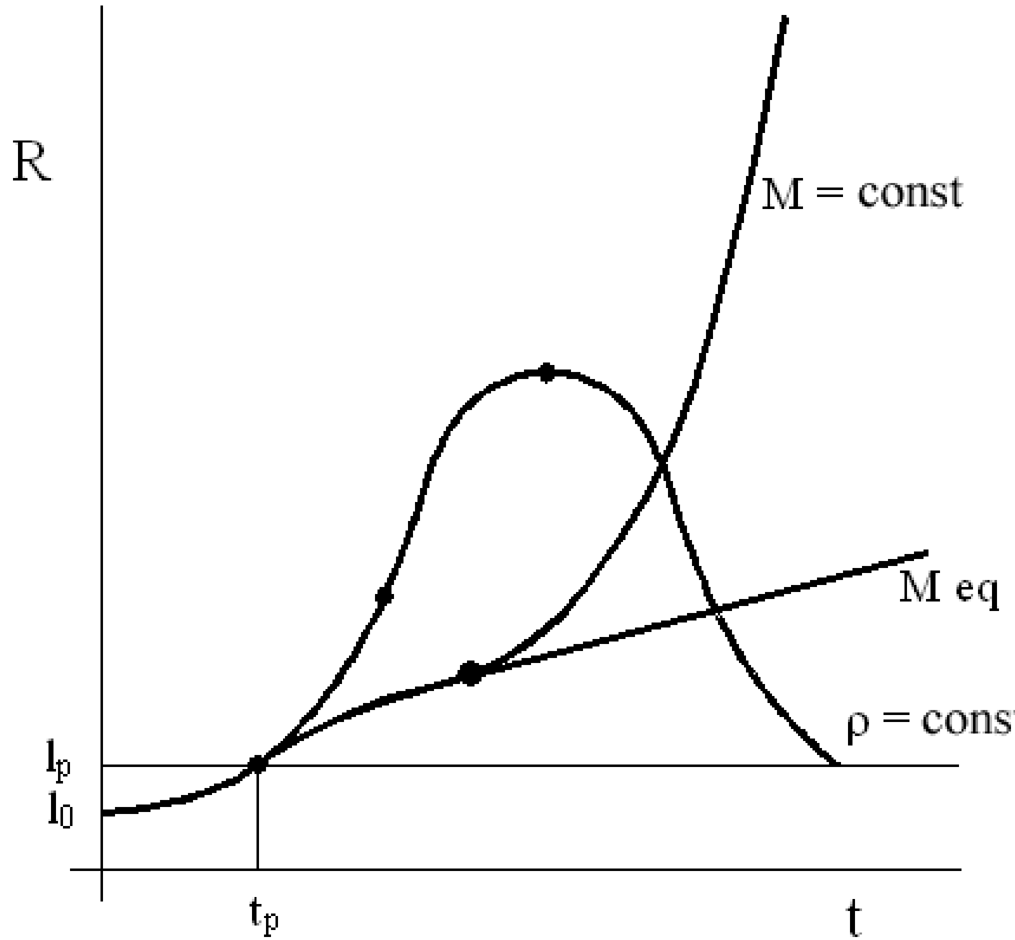
Now we are able to recognize, in the repulsive term, the contribution brought to acceleration by vacuum transition energy, by computing the *countergradient* per mass unit:

$$a \propto -\frac{1}{m_{\mathrm{v}}}\frac{\partial}{\partial \mathrm{R}}\left[-\frac{hc}{l_{\mathrm{p}}^{2}} \cdot R\right] = \frac{hcG}{c^{2} R l_{\mathrm{p}}^{2}} \equiv \frac{c^{2}}{R}$$

The open system gains transition energy at expansion boundary and dissipates through pores the entropy released during evolution. Thus, it can ***self-organize*** avoiding the condemnation of *thermal death*.

The cosmological equation (38) so obtained shows that at large scales it is possible an eventual equilibrium able to stabilize velocity on constant values (owing to vacuum energy contribution), if mass grows proportionally to radius according to a process of *continuous creation* like one proposed by H. Bondi.

simulated trend of radius in relation with three possible sceneries



Cosmic information

By integration of acceleration equation, is obtained the energy one

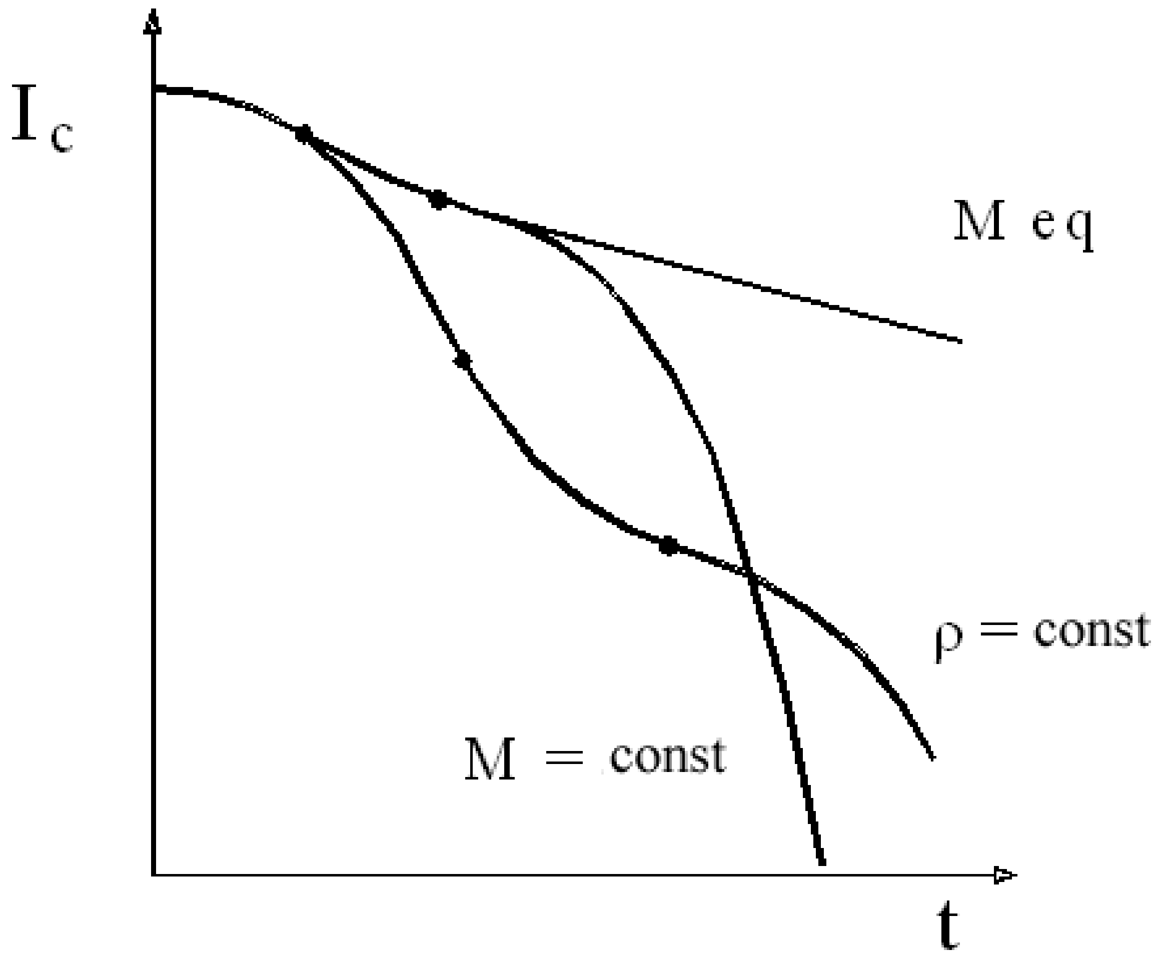
$$T = \frac{1}{2} M \dot{R}^2 = \frac{GM^2}{R} + \frac{h\nu_p}{l_p} R$$

and owing to $\dot{R} = -\frac{\partial I_c}{\partial R}$ we conclude that

$$I_c = \int_{l_p}^{R} \sqrt{\frac{2GM}{R} + 2\frac{h\nu_p R}{M l_p}}\, dR$$

may be the information potential expression whose descent drives Universe dynamics

Cosmic information potential trend



CONCLUSIONS

- The experimental work about **Nuclear Synthesis** should continue trying to accomplish *highly unlikely configurations*, quickly decaying towards conditions at decreasing information content, sustaining isolated high fluctuation frequencies (B. Ahern's *energy localization* [19]). Indeed the present tool is suitable for describing dynamical transients, not only steady states.

- The theoretical work about **Universe evolution** should try to explain the dynamical behaviour by the trend of cosmic information (accounting for vacuum phases one) since its first chaotic information fields, specially according to new required experimental observations about actual mean matter density, matter creation, dark matter presence and G variability.

At last, the presented analogy may provide an enormous wealth of potential behaviours to disclose to understanding.