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SUMMARY OF A M.E.M.S. ALLOWING THE EXTRACTION OF VACUUM ENERGY CONFORM TO EMMY NOETHER THEOREM 31_12_2022

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Patrick Sangouard. SUMMARY OF A M.E.M.S. ALLOWING THE EXTRACTION OF VACUUM ENERGY CONFORM TO EMMY NOETHER THEOREM 31_12_2022. 2022, 10.5772/intechopen.105197 . hal-03920787

HAL Id: hal-03920787

<https://hal.science/hal-03920787v1>

Submitted on 3 Jan 2023

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BRIEF SUMMARY OF THE ARTICLE:

M.E.M.S. WHICH ALLOW THE EXTRACTION OF VACUUM ENERGY CONFORM TO EMMY NOETHER THEOREM 20_12_2022

Dr SANGOUARD Patrick

A brief summary of the operation of this MEMS which presents the hope of extracting low energy from the quantum vacuum, is as follows.

A perpetual and timeless Casimir F_{CA} force, resulting from quantum vacuum fluctuations, causes the deformation of a microscopic piezoelectric bridge embedded in a silicon wafer. This deformation generates in the piezoelectric bridge internal ionic electrical charges which attract mobile charges from the mass, to its insulated outer metal surfaces. These free mobile charges lead to the appearance of an opposite Coulomb force F_{CO} , which can be much greater than the Casimir force F_{CA} and which automatically triggers at a predetermined value.

This Coulomb force suppresses the collapse of the 2 electrodes of the Casimir reflector, reduces, then cancels the deformation of the bridge, and therefore its electrical charges! So, the Coulomb force disappears automatically when this deformation becomes zero!

The structure returning to its initial state, is again deformed by the timeless and homogeneous Casimir force F_{CA} and this cycle should reproduce itself!

The system must then vibrate with the vacuum energy transmitted by the FCA force, as a source of continuous drive and with a self-constructed, superior and opposite Coulomb force. This return to initial position, therefore without deformation or ionic electric charges in the piezoelectric bridge, also generates a current peak during a small part of the system's vibration period!

At each cycle, the automatic commutation of integrated switches distributes differently the mobile electrical charges located on one of the faces of the bridge. This redistribution of these mobile charges produces a current peak ΔI during the short time of their homogenization!

These systematic current peaks crossing an integrated inductance are therefore transformed into voltage peaks ΔU , without any external input energy!

This power $\Delta U \cdot \Delta I$ at the terminals of an inductance in series, supplies electronics without any external power source, and is automatically transformed into a direct voltage of several volts, usable on a high impedance!

An original technological realization is proposed to maximize the chances of manufacturing this NEMS device and in particular with regard to the self-controlled realization of the very weak Casimir interface around 200 Å!

This presented system, should be able to function as described above, because it includes:

1/ A Casimir reflector

2/ A piezoelectric bridge

3/ Five integrated electronic devices made with four different electronics' switches and an autonomous amplifier transformer (without any electrical alimentation) of alternating signals into direct voltage.

These switches are made with

a/ with MOS P and MOS N transistors enriched and in parallel

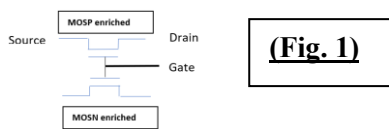
b/ with MOS P and MOS N transistors in depletion and in series.

An important point is that the absolute value of the threshold voltage of these transistors is as close as possible. (Fig 7)

Consequently (see figure n° 5 p 9) Circuit switch n° 1 is open or closed in opposition to Circuit 2 switches n° 2,3,4!

These switches and electronic are quickly described below.

Circuit 1: Switch n° 1



Switch n°1 consists of an enriched P-type MOS in parallel with an enriched N-type MOS (see the preceding circuit 1 and diagram n° 5 page 9)

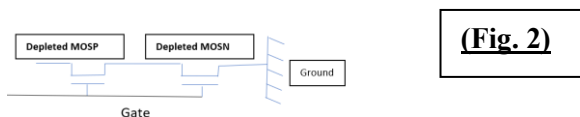
The common gates of this MOS switch n°1, are controlled by the free charges appearing on face n°2 of the piezoelectric bridge!

The N and P sources of these MOS are connected to face n° 1 of the bridge and the drains to the input of a series inductor. The output of this inductance is connected to a return Coulomb electrode and to an electronic n°5 in parallel! This return Coulomb electrode is itself in series with ground via switch n°4 (figure N°5)

These two types of enriched MOS P or MOS N transistors of switch n°1 are in parallel in order to avoid the exact nature (Holes or electrons) of the mobile electric charges appearing on the metal face of the piezoelectric bridge!

Circuit 2: Switches n°2

Consist of a P-type depletion MOS in series with an N-type depletion MOS (see the following circuit 2 and figure n°5 page 9).



(See figure 5)

The common gates of these MOS switches are controlled by the free charges appearing on face 2 of the piezoelectric bridge!

The drain of switch n°2 is connected to return electrode, and the source and the bulk are grounded!

Electronics n°5 ; Is an autonomous device operating without any electrical power source (page 10, figure 10)! It rectifies and accumulates the AC power delivered to the terminals of the inductance and transforms them into a usable DC voltage source (See page 10 figure 11)!

This system (Casimir Reflector, piezo electric's bridge, switches) is found in the following repetitive, because cyclical situations!

DESCRIPTION OF THE DIFFERENTS AND CYCLIC SITUATIONS

Situation 1 : Initial position : Situation 1, Figure 12

The piezoelectric bridge, covered by a metallic film on both, electrically isolated sides, is without deformation, therefore the barycenter of the negative ions is the same as that of the positive ions. There is no electrical field and so any mobile electrical charges appear!

The switch n°1 is on OFF, the switches n° 2,3,4 are ON connecting the electrodes of the bridge and that of return of Coulomb to the ground!

The piezoelectric bridge is subject only to the Casimir force which deforms it!

Situation 2: THE GATE VOLTAGES APPEARING ON THE DIFFERENT MOS OF THE SWITCHES ARE LOWER THAN THEIR THRESHOLD VOLTAGE: Situation 2 , Figure 12

In this situation:

Circuit 1 is OFF! So, it isolates face 1 of the bridge from the Return electrode!

Circuit 2 are ON and connect to ground faces 1 and 2 of the piezoelectric bridge and also the return Coulomb electrode!

So, the only force applied, is the Casimir force F_{CA} applies perpetually between the metallic electrodes of the Casimir reflector, and mechanically transmitted on the piezoelectric bridge. These Casimir's electrodes are separated by a vacuum!

We have the Casimir force $F_{CA} = \frac{dE_{CA}}{dz} = S \left(\frac{\pi^2 \hbar c}{240 z^4} \right)_{(1)}$ with z_s the separation of Casimir electrodes and E_{CA} the vacuum quantum energy!

This force F_{CA} transmitted by the connecting finger on the piezoelectric bridge, deforms it! So, an electric field appears inside the bridge!

The Ionics's charges inside the bridge attracts mobiles electricals charges (Holes and Electrons) from the ground, to the 2 metallic's faces of the bridge via the switch 2 and 3. These mobile charges accumulate on the 2 faces of the piezoelectric bridge.!

As a result, the gate voltages of MOS transistors; connected at the face 2 of the piezoelectric bridge, increase!

However, electric charges on return Coulomb metallic electrode (without any electrical field) are zero because circuit 2 is to ground.

In the situation 1 and 2, when circuit n°1 is open; the circuit n°2 are closed and connect the metallic film of the piezoelectric bridge and of the return Coulomb to the ground.

So, the bridge is subjected only to the Casimir force.

The differential equation (following the conservation of kinetics' moment) which governs the movement of deformation of this bridge is

$$\frac{d^2z}{dt^2} = \frac{I_P^2}{8 I_Y^3} S_s \frac{\pi^2 \hbar c}{240} \frac{1}{z^4} - B \text{ with } B = \frac{I_P^2}{8 I_Y^3} S_s \frac{\pi^2 \hbar c}{240}$$

With \hbar the reduced Plank constant, c the speed of light, S_s the surface of the Casimir reflector and I_Y the inertia matrix of the system (Casimir reflector + connecting finger + piezoelectric bridge) and z the Casimir reflector interval

During the deformation of the piezoelectric bridge between 0 to z_e (the switching position), potential electrostatic energy is accumulated in it, and is suddenly triggers for a very short time, only when the gate voltage of the MOS transistors exceeds their threshold voltage.

As long as the voltage on the gates of the enriched and depleted MOS transistors does not reach their threshold voltages, the state of circuit 1 and 2 do not change!

Situation 3: THE GATE VOLTAGES APPEARING ON THE DIFFERENT MOS OF THE SWITCHES ARE HIGHER THAN THEIR THRESHOLD VOLTAGE: Situation 3, Figure 12

When the gate voltages (due to the accumulation of moving electrical charges on face n°2 of the electrical bridge) on the MOS transistors exceed their threshold voltages, then:

1/ circuit 1 toggle ON and connects face 1 of the bridge with the return electrode, via the self L_{IN} !

2/ At the same time, circuit 2 toggle OFF and isolate from the ground the metal faces 1 and 2 of the piezoelectric bridge as well as that of the return coulomb electrode!

The face 1 of the bridge is now connected to the return electrode! Knowing that the electric field inside a conductor is zero, the electric charges, accumulated on the faces 1 of the bridge, must be distributed between this face 1 and the return electrode. Remember that this return electrode was grounded previously!

During this homogenization there is displacement of mobiles charges in a metallic electrode during a small time, so a current peak appears (fig 9 p 9)!

This current peak ΔI , passing through an integrated inductor, which is in series between switch 1 and the return electrode, induce a voltage peak ΔU on the terminals of the inductor! This power peak $\Delta U \cdot \Delta I$ supply the input of an autonomous electronics, that is without any power supply! This autonomous electronic transform the AC peaks power to a usual DC voltage!

On the other hand, we now have electric's mobiles charges of opposite signs, between the metallic electrode of face 2 of the piezoelectric bridge and the metallic's return Coulomb electrode (both electrically isolated from ground, because the circuit 2 are OFF). (See fig 4 and 5 p 9)

So, a force of Coulomb opposed to the force of Casimir appears between the face 2 of the bridge and the return electrode!

Indeed, this Coulomb force is proportional to the products of the charges accumulated at the terminals of these 2 electrodes and inversely proportional to the square of the interface between the face 2 of the bridge and the return electrode!

Now, it is known that the free charges appearing at the terminals of the piezoelectric bridge are: $Q_F = (d_{31} \cdot F_{CA} \cdot l_p) / a_p$. With d_{31} one value of the piezoelectric tensors of the bridge, F_{CA} the Casimir force, l_p and a_p the length and thickness of the bridge.

We get, all calculations made, a Coulomb force whose expression is

$$F_{CO} = \frac{Q_F^2}{4 \pi \epsilon_0 \epsilon_r} \left(\left(\frac{1}{z_r + z_0 - z_s} \right)^2 \right) =$$

$$\left(S_s \frac{\pi^2 \hbar c}{240} \frac{d_{31} l_p}{2^* a_p} \left(\frac{1}{z_s^4} - \frac{1}{z_0^4} \right) \right)^2 \left(\frac{1}{4 \pi \epsilon_0 \epsilon_r} \right) \left(\frac{1}{z_r + z_0 - z_s} \right)^2$$

With z_r , z_0 , z_s = initial interface between the face 2 and the return electrode, initial and current Casimir's reflector interval. We note that $F_{CO} = 0$ when the bridge has no deflection ($z_s = z_0$)!

This Coulomb Force in $1/z_s^{10}$, is in the opposite direction and can be adjusted (by the values of threshold voltage of the MOS transistors) to become much greater than that of Casimir which is in $1/z_s^4$. (We can have $F_{CO}/F_{CA} > 100000$!)

Submit now with the resulting and opposite forces $F_{CO} - F_{CA}$, the deformation of the piezoelectric bridge decreases very rapidly and is canceled when it finds the situation n° 1 without any deformation! Because, no electrical charges appearing on the face of the piezoelectric bridge, the Coulomb's force disappears!

The device finding its original position the switches 1 commute to OFF and the switches 2,3,4 commute to ON.

The system then returns to the situation 1 and is only subjected to the omnipresent force of Casimir.

These situations 1, 2, 3 being repetitive, the system should therefore enter into continuous vibrations with the use of Casimir and Coulomb forces as the only automatically generated forces! (Figures 8 and 9 p 10)

The frequency of these vibrations depends on the physico-geometrical characteristics of the piezoelectric bridge and the values of the threshold voltages of the switches.

The values of the threshold voltages of the switches are set during manufacture of the system!

The return from situation 3 to situation 1 takes place much faster than from situation 1 to 3 and the differential

$$\frac{d^2 z}{dt^2} = \frac{l_p^2}{8 \cdot I_p^2} (F_{CA} - F_{CO}) = \frac{l_p^2}{8 \cdot I_p^2} \left(l_s b_s \frac{\pi^2 \hbar c}{240} \frac{1}{z_s^4} - l_s b_s \frac{\pi^2 \hbar c}{240} \frac{d_{31} l_p}{2^* a_p} \frac{1}{4 \pi \epsilon_0 \epsilon_r} \left(\frac{1}{z_s^4} - \frac{1}{z_0^4} \right)^2 \left(\frac{1}{z_r + z_0 - z_s} \right)^2 \right)$$

equation that governs the movement of the bridge back to the initial position is :

These 2 equations have no analytical solutions, we programmed them on MATLAB and the curves resulting from these numerical solutions are presented in chapter 4!

The position z_e of appearance of the Coulomb force F_{CO} is such that $F_{CO} = p F_{CA}$, with p a proportionality coefficient which can be very large and greater than 10^5 : This factor depends on the values of the threshold voltages of the MOS transistors, and is defined during the technological realization of the system!

To obtain this value of z_e , we must solve the equation in z_s :

$$F_{CO} = \left(S_s \frac{\pi^2 \hbar c}{240} \frac{d_{31} l_p}{a_p} \right)^2 \left(\frac{1}{z_e^4} - \frac{1}{z_0^4} \right) \left(\frac{1}{z_s^4} - \frac{1}{z_0^4} \right) \left(\frac{1}{8 \pi \epsilon_0 \epsilon_r} \right) \left(\frac{1}{z_r + z_0 - z_s} \right)^2 = p l_s b_s \left(\frac{\pi^2 \hbar c}{240} \right) \frac{1}{z_s^4}$$

The position z_e of the appearance of this force is when:

$$\left(S_s \frac{\pi^2 \hbar c}{240} \frac{d_{31} l_p}{2^* a_p} \left(\frac{1}{z_s^4} - \frac{1}{z_0^4} \right) \right)^2 \left(\frac{1}{4 \pi \epsilon_0 \epsilon_r} \right) \left(\frac{1}{z_r + z_0 - z_s} \right)^2 = p l_s b_s \left(\frac{\pi^2 \hbar c}{240} \right) \frac{1}{z_s^4}$$

This position and evolution z_e in function of the coefficient of proportionality p is numerically calculable!

The creation of a Coulomb force opposite to that of Casimir and which can be greatly superior to it, is a consequence of the creation of the potential energy W_{bridge} by the energy of Casimir!

It avoids the collapse of the Casimir electrodes and cancels the deformation of the bridge which therefore returns to its initial position without deformations. So, the electric charges disappear because the switches of circuits 1 return to the OFF position (thus isolating the return electrode from the bridge electrodes) and those circuits 2 in the ON position (so they ground the bridge and the booster electrodes).

The system regains its initial characteristics! The only force that applies is again the force of Casimir F_{CA} and everything starts again!

The bridge then should begin to vibrate! (Fig 8 p9)

ENERGY BALANCE

1/ We remark that there is no bending of the free Casimir reflector electrodes. This only moving parallelepiped metallic electrode is in parallel to a fixed metal electrode defined on an S.O.I wafer and stay parallel to it. It transmits its motion to a piezoelectric bridge that deforms by bending.!

2/ So the entropy expulsion ΔS from this Casimir vibrating structure and transmitted to the piezoelectric bridge is done by heat expulsion out of this bridge, but causes an extremely low temperature increase of the piezoelectric bridge!

A quick order of magnitude calculation gives:

ΔQ_{vib} = heat transmitted by the vibrations of the piezoelectric bridge and evacuated outside follow, in first approximation, the well-known formula $\Delta Q_{vib} = \Delta S \Delta T$, with ΔS entropy variation ($J \text{ } ^\circ K^{-1}$) and ΔT = temperature variation ($^\circ K$).

However, we know that: (cf: M. BARTHES, M. Colas des Francs SOLID MECHANICAL VIBRATIONAL PHYSICS, ESTP: (Special School of Public Works)

$\Delta Q_{vib} = 1/2 * m (2 \pi f_{vib})^2 x_{max}^2$; with: f_{vib} = Vibration frequencies of the piezoelectric bridge, m = mass of this bridge, x_{max} = maximum deflection of the bridge.

This heat, expended at the level of the piezoelectric bridge, causes a temperature increase.

As a first approximation we can say: $\Delta Q_{vib} = m C_{piezo} \Delta T$, with C_{piezo} = Specific heat capacity of the piezoelectric bridge ($J \text{ Kg}^{-1} \text{ } ^\circ K^{-1}$), ΔT = Temperature variation ($^\circ K$).

Consequently $\Delta T = 2 (\pi f_{vib})^2 x_{max}^2 / C_{piezo}$ = Temperature variation.

We have for example:

$C_{piezo} = C_{PMN-PT} = 310 (J \text{ Kg}^{-1} \text{ } ^\circ K^{-1})$, $f_{vib} \cong 10^6 \text{ Hz}$, $x_{max} \cong 100 * 10^{-10} \text{ m}$, we obtain: $\Delta T \cong 10^{-3} \text{ } ^\circ K$ which is negligible!!

So, the expulsion of entropy from the vibrating Casimir Electrode is negligible!

From z_0 to z_e :

In a cycle from 0 to z_e and return from z_e to 0, the energy $E_{Casimir}$ is:

$$E_{Casimir} = \int_0^{z_e} F_{ca} dz = \int_0^{z_e} \left(\frac{\pi^2 \hbar c}{240 z_s^4} \right) dz$$

No mobile electric charges appear on the face of return electrode connected to the mass and isolated of the piezoelectric bridge, and so the Coulomb force disappears! which is

During this displacement " going " from z_0 to z_e the deformation of the piezoelectric bridge, generates a potential energy W_{Bridge} accumulated in the capacity of this bridge which follows the equation:

$$W_{Bridge} = \int_0^{Q_e} \frac{Q_r}{C_{pi}} dQ_r = \left[\frac{Q_r^2}{2 * C_{pi}} \right]_0^{Q_e} = \frac{a_p}{2 l_p b_p \epsilon_0 \epsilon_{pi}} \cdot \left(\frac{d_{31} l_p}{2 a_p} \right)^2 F_{CA}^2 = \frac{a_p}{2 l_p b_p \epsilon_0 \epsilon_{pi}} * \left(\frac{d_{31} l_p l_s b_s \pi^2 \hbar c}{480 \cdot a_p} \right)^2 \left(\frac{1}{z_e} \right)^8$$

With Q_F the naturally creating fixed charges on this piezoelectric structure. $Q_F = \frac{d_{31} F_{CA} l^P}{a^P}$ Eq. (3), Q_e the accumulated mobile charges on both the two surfaces of the "return" electrode when coulomb's force triggered at $F_{CO} = p F_{CA}$, C_{pi} = electrical capacity of the piezoelectric bridge, z_e the position of appearance of the Coulomb force.

From z_e to z_0 :

For this very quick "returning" from position z_e to position 0, the associated energy $E_{Returning}$ is:

$$E_{Returning} = \int_{z_e}^{z_0} (F_{CO} + F_{Ca}) dz = E_{Coulomb} - E_{Casimir}$$

Thus, we see that in the balance $E_{Casimir} + E_{Returning} = E_{Coulomb}$.
So, over a complete cycle, the energy $E_{Casimir}$ is conservative.!

The Coulomb energy $E_{Coulomb}$ is the net energy appearing during a cycle. It is not due to any electrical energy applied, but to the consequence of vacuum energy!

The expression of $E_{Coulomb}$ is,
$$E_{Coulomb} = (l_s b_s \frac{\pi^2 \hbar c}{240} \frac{d_{31} l^P}{a^P})^2 (\frac{1}{8\pi \epsilon_0 \epsilon r}) (\frac{1}{z_e^4} - \frac{1}{z_0^4}) \int_{z_r+z_0-z_e}^{z_r} (\frac{1}{z_s^4} - \frac{1}{z_0^4}) (\frac{1}{z_r+z_0-z_s})^2 dz_s$$

Some important remarks

The energy expended by the Coulomb force is of course lower than that calculated by the previous simple expression (Eq 25). Indeed, this $E_{Coulomb}$ energy is maximized in the above formula for at least three reasons.

1/ The previous formula 25 presupposes that all the points along the length of the piezoelectric bridge move on a length $z_0 - z_e$, so from a position of $z = z_r + z_0 - z_e$ to $z = z_r$. This consideration is wrong because the bridge is recessed at both ends. The ends of this bridge do not move at all, and those between the end of bridge and the middle move on a distance shorter than $z_0 - z_e$, only the points in $x = l_p/2$ move on a length $z_0 - z_e$!
So, the simpler calculation assuming that the piezoelectric bridge is completely free to move parallel to the Coulomb electrode maximize the energy $E_{COULOMB}$ and the Coulomb's energy must to be lower!

2/ The surfaces between the gate electrode of the piezoelectric bridge and that of the Coulomb electrode are not parallel. So, the Coulomb forces which appears at each point depend on the longitudinal position considered along the bridge! Due to the non-parallelism of the electrodes, the Coulomb force as the Casimir force are a function of the x and z coordinates and we must include an expression of the $F_{CO}(x,z)$ and $F_{CA}(x,z)$ type.

The average value of F_{CO} is a little larger than that calculated in preceding expression. But we have not calculated the balance of these first two reasons because the following point 3 seems to us to be more predominant.

3/ The Coulomb force appears only because circuits 1 and 2 have switched from OFF to ON (for circuit 1) and from ON to OFF for circuit 2.
The mobile charges coming from the mass adapt and compensate continuously the ionic charges in the piezoelectric bridge because the two electrodes of this bridge are constantly connected to the mass! (fig 3)

When the Coulomb force F_{CO} appears, it decreases the deformation of the piezoelectric's bridge, therefore the ionic charges in the bridge!

The effect of this ionic charge reduction is that switch 1 again switches very quickly from ON to OFF. The same for the switch of circuit 2 which again switches very quickly from OFF to ON.
Thus, the Coulomb electrode is grounded again and the electric charges present on the Coulomb electrode are evacuated exponentially! The Coulomb electrode is therefore without electrical charges and the Coulomb force disappears very quickly!

An estimate of this duration is not simple because it depends on the technology used to produce these electronic components but this time should be on the order of nanoseconds.

In conclusion, as the Coulombs F_{CO} force decreases exponentially with time, it exists only for a very short time! Its power can be significant, but its energy remains low and does not exceed that of Casimir.!

For these 3 reasons, the energy expended by the Coulomb force is much lower than the simple equation 25 suggests and lower than the Casimir energy which induced it!

We can't create energy!

We remark the expression of E_{Coulomb} depends on the term z_r and fall down on an increase of z_r with a power of $(z_r)^{-5}$
So, we can adapt the interval z_r to minimize the energy E_{Coulomb} !

If the interval z_r increases, the Coulomb energy expended on the return of the bridge to its starting position is reduced, but the peak of the current is increased since the charges accumulated on this bridge must increase before the ratio p between the Coulomb Force and Casimir's strength be obtained!

When the electrical potential on the gate of the switches is greater than their threshold voltage, then this switch commute and the accumulated energy in the piezo electric's bridge will be used for the homogenization of the mobile charges of the bridge's electrodes connected to sources or drains of the MOS switch n°1 and the Coulomb return electrode.

During the time of this homogenization appears a current peak for a short time. So, an electrical voltage at the terminals of the self in series between switch 1 and the return electrode appears also!

Its expression is:
$$I_{IN} = -\frac{Q_{mn2}}{R_m C_s} \left(\text{Exp}\left(-\frac{t}{R_m C_s}\right) \right)$$

With defining $t_e = R_m * C_s * \ln(2)$ the delay in which the mobile charges equalize between the electrode of face 1 and the return electrode. With R_m = the resistance (Ω) of the devices in series (Self + switch n°1); C_s the capacity (F) of the device constructed on face n° 2 of piezoelectric bridge, vacuum, return electrode).

These cyclic current peaks induce at the terminals of the coil voltage peaks whose expression is:

$$U_{IN} = L_{IN} \frac{d(I_{IN})}{dt} = L_{IN} \frac{Q_{mn2}}{R_m C_s} \text{Exp}\left(-\frac{t}{R_m C_s}\right) = L_{IN} \frac{Q_{mn2}}{R_m C_s} \frac{\ln(2)}{t_e} \text{Exp}\left(-\frac{t \ln(2)}{t_e}\right)$$

With L_{IN} the value of the inductance, Q_{mn2} the charges on the return electrode and the face n°1 of the bridge.

The only energy which is effectively used outside, during one cycle, is associated with these current and voltage peaks becomes:

$$W_{\text{electric}} = \text{Abs}\left(\int_0^{t_e} L_{IN} U_{IN} d(t) = L_{IN} \left(\frac{d_{31} F_{CA} l_P}{d_P}\right)^2 \left(\frac{\ln(2)}{t_e}\right)^2 |1 - \text{Exp}(-2 \ln(2))|\right)$$

For example, we obtain, for an interface between Casimir's electrodes $z_0 = 200 \text{ \AA}$, dimensions of the Casimir electrodes (length = $500 \mu\text{m}$, width = $15 \mu\text{m}$, thickness = $10 \mu\text{m}$), dimensions of the piezoelectric bridge in PMN -PT (length = $50 \mu\text{m}$, width = $15 \mu\text{m}$, thickness = $10 \mu\text{m}$), a proportionality factor $p = F_{CO} / F_{CA} = 1000$, an inductance $L_{IN} = 1.10^{-6} \text{ H}$:

- $Z_e = 9.46 \cdot 10^{-9} \text{ (m)}$ i.e., a displacement of the mobile Casimir electrode of about 105 \AA
- $W_{CA} = 3.4 \cdot 10^{-11} \text{ (Joule)}$ = Energy of vacuum = Energy dispensed by the force of Casimir
- Peak current = $350 \cdot 10^{-6} \text{ A}$
- Voltage peak across the coil = 1.2 V
- Structure vibration frequency = 750 kHz
- Threshold Voltage of enriched MOSE = Threshold Voltage of in depletion MOSD= 3.25 V
- $W_{\text{bridge}} = 2.7 \cdot 10^{-11}$ the potential energy accumulated in the piezoelectric bridge
- $W_{\text{electric}} = 2.7 \cdot 10^{-11} \text{ (Joule)}$ = Usable energy associated with current and voltage peaks.

We remark that this energy $W_{electric}$ is equal to the energy W_{bridge} accumulated in the bridge and is not brought by an external electrical source but is caused by the omnipresent and perpetual force of Casimir, itself controlled by a Coulomb force of opposite direction. This Energy is less than that developed by Casimir's strength.

- We notice that $\Delta Q_{vib} + W_{electric} < W_{CA}$ which is consistent with Noether's theorem!
- The intensity of the Coulomb force is defined and technologically adjustable by adjusting the threshold voltage of the MOS transistors of circuits 1,2,3,4!
- ΔQ_{vib} = heat transmitted by the vibrations of the piezoelectric bridge = $7.8 \cdot 10^{-14}$ J and is very small!

This energy $W_{electric}$ is equal to the energy W_{bridge} accumulated in the bridge and not brought by an external electrical source, but is caused by the omnipresent, timeless and perpetual force of Casimir, itself controlled by a Coulomb force of opposite direction

Remember that Energy is defined as the “physical quantity that is conserved during any transformation of an isolated system” However, the system constituted by simply the MEMS device is not an isolated system, but the system constituted by the MEMS device plus the vacuum becomes an isolated system!

A system of 200 structures (Fig 62 page 49) gives a usable energy by second and so 750000 peaks,
 $W_{electric} \cong 60 \cdot 10^{-3}$ (Joule) for a coefficient of proportionality $p = F_{CO}/F_{CA} = 10^6$ and all switch transistors
 (Width = Length = $100 \mu m$, SiO_2 grid thickness = 250 \AA), thresholds voltage = 3 V !

We present below a drawing of this integrated device and a schema of this system with the switches.

Fig. 4 MEMS device

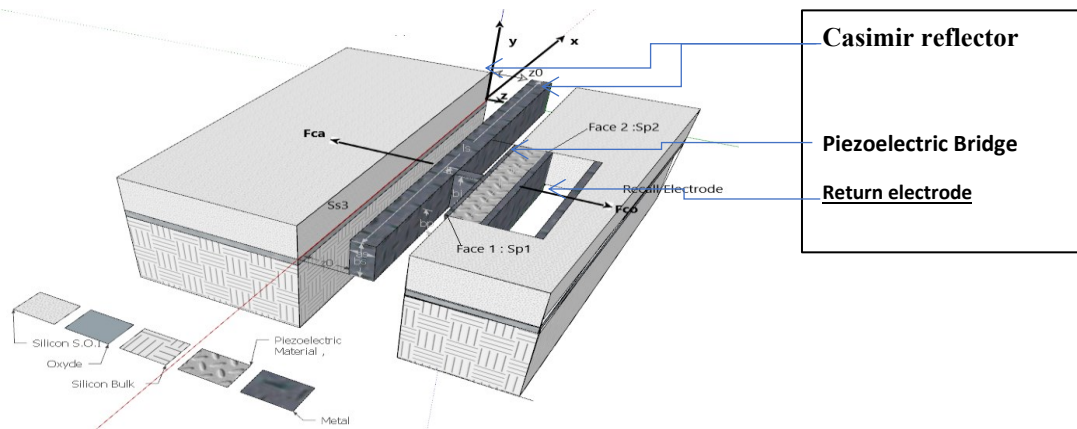


Fig. 5 Vue of the top of device

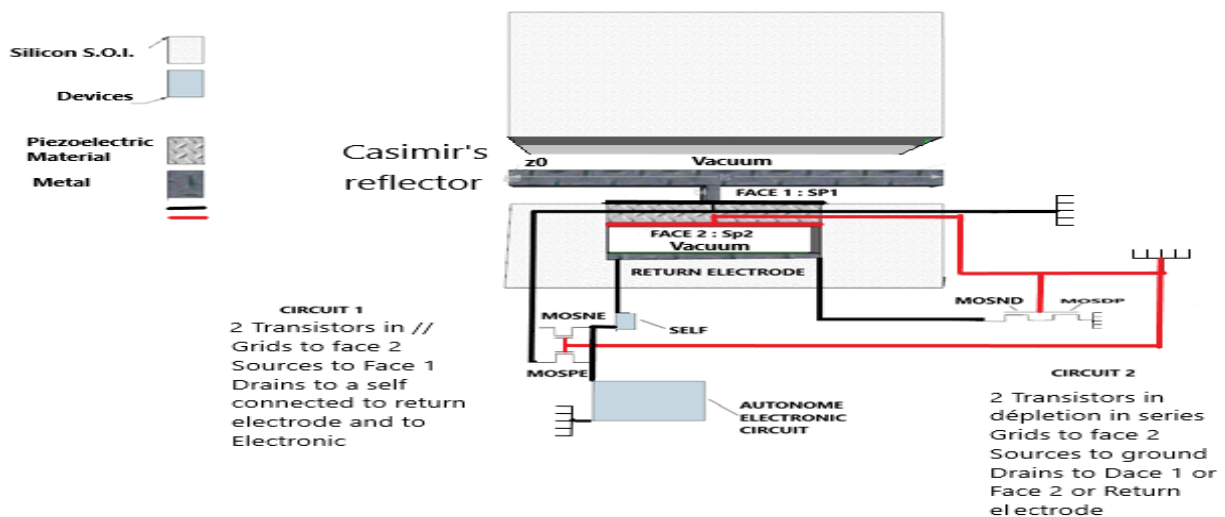


Fig.6 Dimensions of the vibrating structure

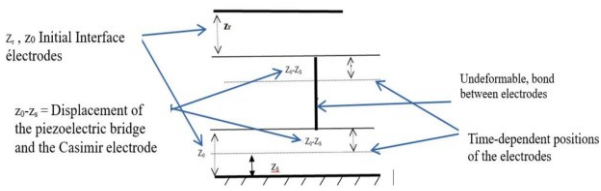


Fig. 7 MOS threshold

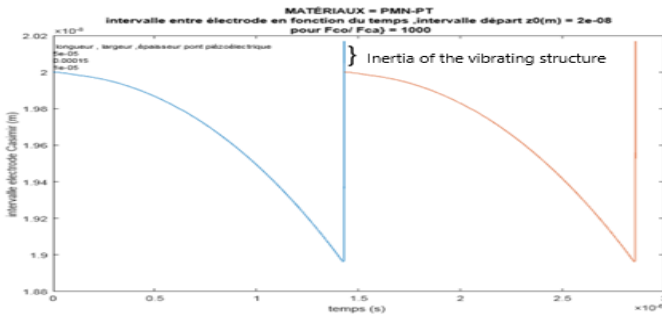
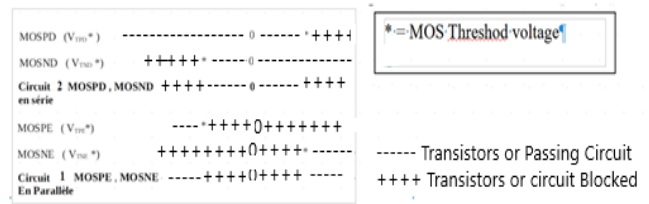


Figure 8: Plot of the evolution of the Casimir inter-electrode interval as a function of time over two periods and an F_{co} / F_{ca} ratio = 1000: Casimir inter-electrode interface = 200 A°

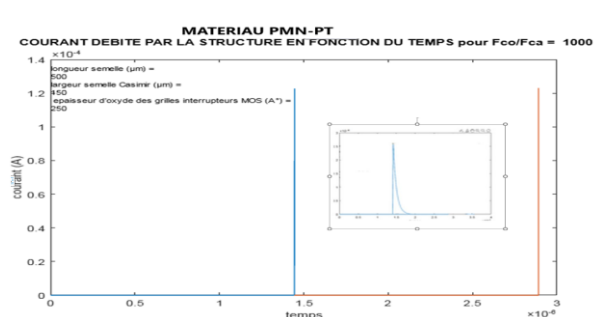


Figure 9: Materials = PMN-PT: Current peak as a function of time obtained over 2 cycles. Starting interface = 200A Ratio $p=F_{co} / F_{ca}=1000$

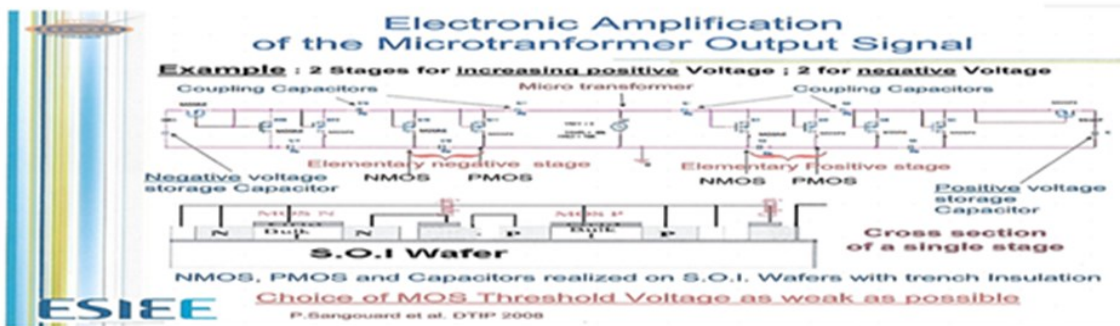


figure 10 Principle of electronics for amplifying and rectifying a weak AC signal

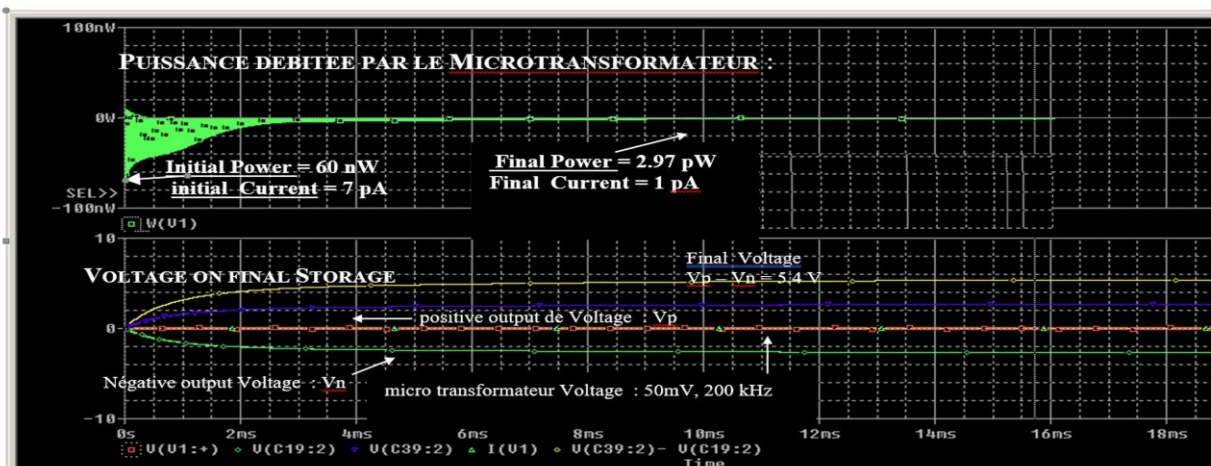
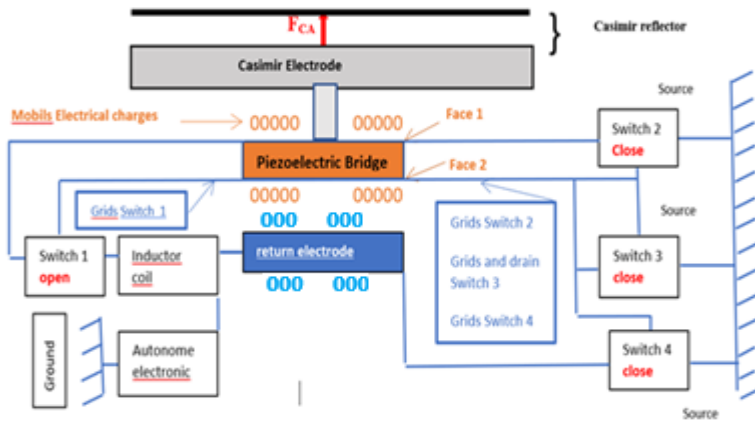


Figure 11: SPICE simulations of the voltages, current, power consumed by the electronics for the transformation into DC voltage (5.4 V) of an AC input signal of 50 mV, frequency= 150 kHz, Number of stages =14, Coupling capacitances = 20 pF, storage capacitance = 10nF

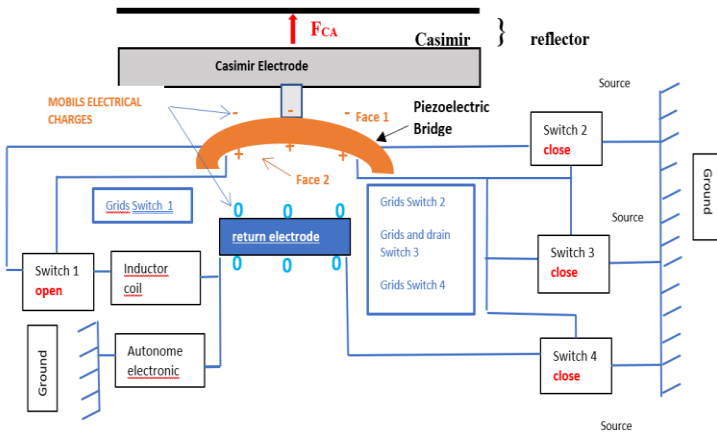
FIGURE 12 : LES 3 SITUATIONS PERIODIQUES DU DISPOSITIF VIBRANT DU MEMS

1/ Figure 1 : initial Position



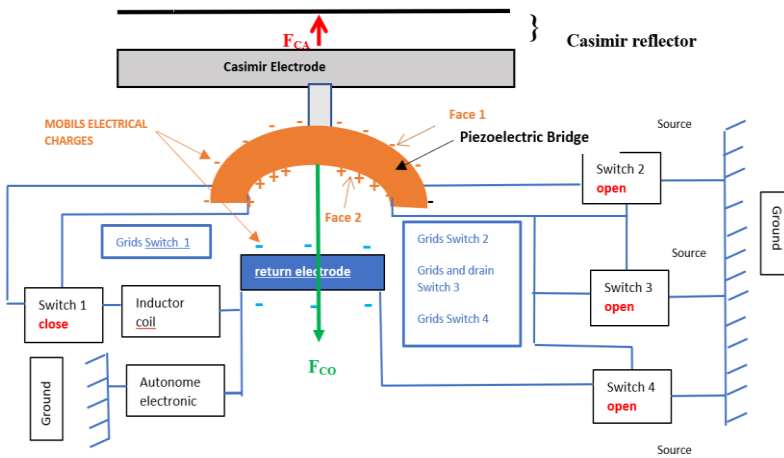
Initial Situation

2/ Figure 2: Intermediate position

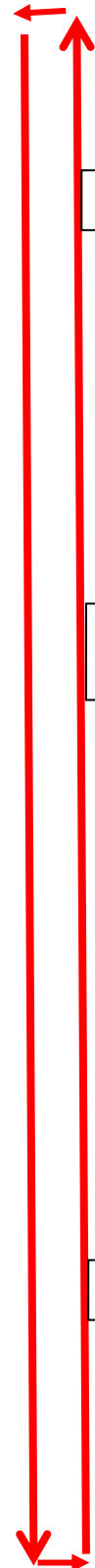


Intermediate Situation

3/ Figure 3 : switching position



Switching Situation



11 EXTRACTION OF A VACUUM ENERGY CONFORMING TO EMMY NOETHER'S THEOREM:
10/7/2022 Dr SANGOUARD Patrick