Test of Oscillation Symmetry applied to some physical properties of various Hydrocarbons

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Abstract

The oscillation symmetry is applied with success to some physical properties (densities, Boiling points, and Melting points) of different Hydrocarbons: Alkanes, Cycloalkanes, Alkenes, Alkynes, Alkadienes, and Polycyclic Aromatic Hydrocarbons. It is also applied to Hydro Silicons. It allows to tentatively predict possible values for several unknown properties.

The same shape of oscillation describes, sometimes after renormalization, the "mass data" of several particle families, nuclei families and Alkane Melting Point "data".

The periods of oscillation exhibit discret values as if they are quantified.

1. Introduction

In the same way as opposite kinetic and potential forces produce oscillations in classical physics, they produce also oscillations in masses (and widths and also several other properties) in quantum physics. So oscillations have been extracted [1] in hadrons [2], [3], fundamental and excited state nuclei [4] and astrophysical bodies [5]. They also have been observed in electromagnetic transitions [6], mainly E1 and M1, between different nuclei excited levels. In the astrophysical field the forces are gravitational and centrifugal related to their kinetic energies. The common property of almost all bodies is that they are composed of smaller bodies.

The data of a given system are first classified in increasing order. The possible oscillations are studied using the following relation:

$$m_{(n+1)} - m_n = f[(m_{(n+1)} + m_n)/2] \tag{1}$$

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where n indicates the increasing data order. The differences between two successive data are plotted versus their corresponding mean values. The data of such studies, corresponding to relation (1), are named "property data" where here property may be either mass, density, Melting point, Boiling point, or else.

A simple normalized cosine function is used for the fits of the data. M is the variable $(\mathrm{m}_{(n+1)} + m_n)/2$ and Δ M is the function for "mass data" studies.

When all studied data are positive, their oscillations are fitted using the following formula:

$$\Delta M = \alpha(1 + cos(M/M_1))exp(\beta.M) \tag{2}$$

where $\mathrm{M/M_1}$ is defined within 2π. The oscillation period $\mathrm{P} = 2\ \pi M_1$.

α, β, and M_1 are the three fitted parameters. There values are given in Table A1.

In several groups, when the Melting points and Boiling points for the concerned elements are either negative, either positive, the oscillations are fitted using the following formula:

$$\Delta M = (\alpha_0 + \alpha_1 cos(M/M_1))exp(\beta.M) \tag{3}$$

The concerned four parameters (α_0, α_1, M_1, and β) are reported in Table A2.

Density stp means (Standard Temperature and Pressure) density. The values read in different tables differ sometimes. They are all read using the references [7], where 'Element' is the name of the Atomic Element which physical properties are concerned.

2. Hydrocarbons

This paper concerns the study of Oscillation symmetry applied to Boiling points, Melting points, and densities for different types of hydrocarbons classified by the number of carbon atoms [8] (up to 12 when the physical properties are known). They are named Alkanes [9] when carbon atoms are bound by a single bond, Alkenes (double bond), Alkynes (triple bond), Cycloalkanes when the carbons of the

molecule are arranged in the form of a ring, and Alkadienes containing two double bonds between carbon atoms [10].

2.1. Alkanes

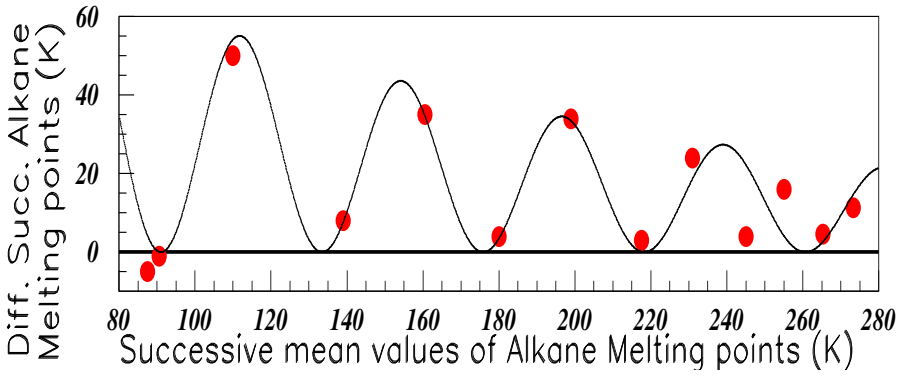

Figure 1: Color on line. (See text). "Alkanes Melting point data"

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The formula of studied acyclic saturated hydrocarbons called Alkanes, with single bond, is C_nH_{2n+2}. They are, up to n=10, Methane (CH_4), Ethane (C_2H_6), Propane, Butane, Pentane, Hexane, Heptane, Octane, Nonane, Decane, Undecane, and Dodecane, depending on the number of carbon atoms. Many other Alkane Boiling and Melting points are known, for example for the Heptacontane ($C_{70}H_{142}$). The first ones are used in fig.1. The number of isomers of Alkane increases with the number of carbons.

Fig.1(a) shows the Alkane "Melting point data" fitted with the period P=42.4 (K). The "Boiling point data" do no suit for the same representation, neither the liquid density, since they do not exhibit oscillations.

2.2. Cycloalkanes

The formula of Cycloalkane (also called naphtalene) molecules is C_nH_{2n} (like alkenes). They are monocyclic saturated cyclic hydrocarbons with only single bonds. Fig.2 uses the data from the following cycloalkanes: Cyclopropane, Cyclobutane, Cyclopentane, Cyclohexane, Cycloheptane, Cyclooctane, Cyclononane and Cyclodecane, all isomers of Alkenes.

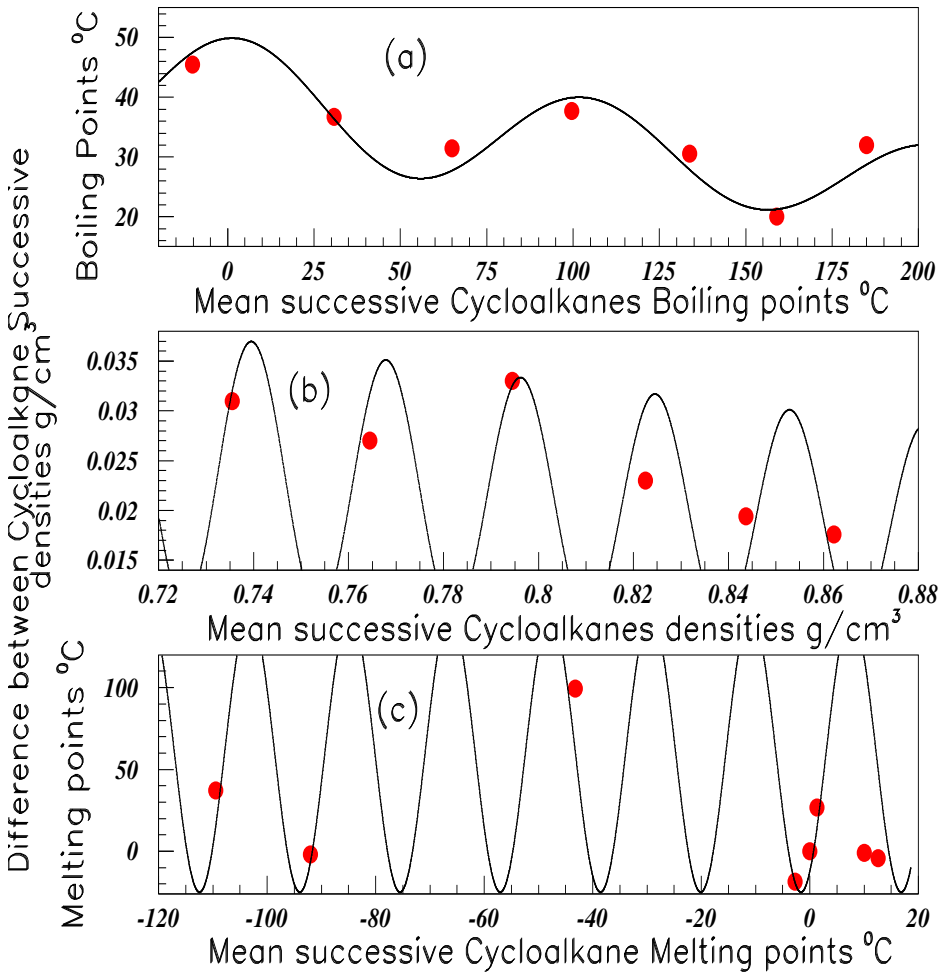


Figure 2: Color on line. (See text). "Cycloalkanes Melting and Boiling points data", and "density data".

Fig.2(a) shows the Cycloalkane "Boiling point data" fitted with period P=100.5 ^{0}C. The uncertainty between 40 ^{0}C and 43 ^{0}C for the Pentacene Boiling Point, due to different values in tables, cannot be improved by our study.

Fig.2(b) shows their "density data" fitted with period P=0.0283 g/cm^3.

Fig.2(c) shows their "Melting point data" fitted with period P=18.5 ^{0}C.

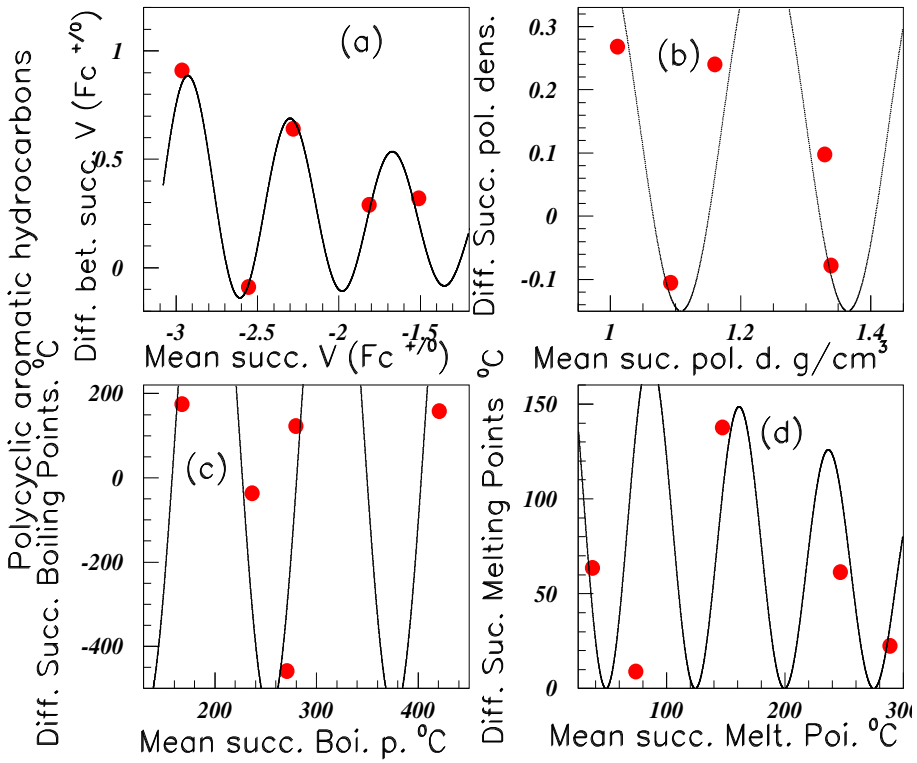


Figure 3: Color on line. (See text). "Polycyclic aromatic hydrocarbons properties: "Potential data", "densities", "Boiling" and "Melting points data".

2.3. Polycyclic Aromatic Hydrocarbons

The Polycyclic Aromatic Hydrocarbons [11], used in fig.3, are benzene, naphtalene, biphenyl, anthracene, perylene, and pentacene, classified in increasing molar mass order.

Fig.3(a) shows the "half-cell potential data" of aromatic compounds against the Saturated calomel electrode SCE (Fc+/0), fitted by the period P=0.628 units.

Fig.3(b) shows the "density data" fitted with period P=0.256 g/cm^3.

Fig.3(c) shows the "Boiling point data" fitted with the period P=122.5 ^{0}C. The uncertainty between 40 ^{0}C and 43 ^{0}C for the Pentacene Boiling Point cannot be improved by our study.

Fig.3(d) shows the "Melting point data" fitted with the period P=75.4 ^{0}C. The uncertainty between 276 ^{0}C and 279 ^{0}C for the Pery-

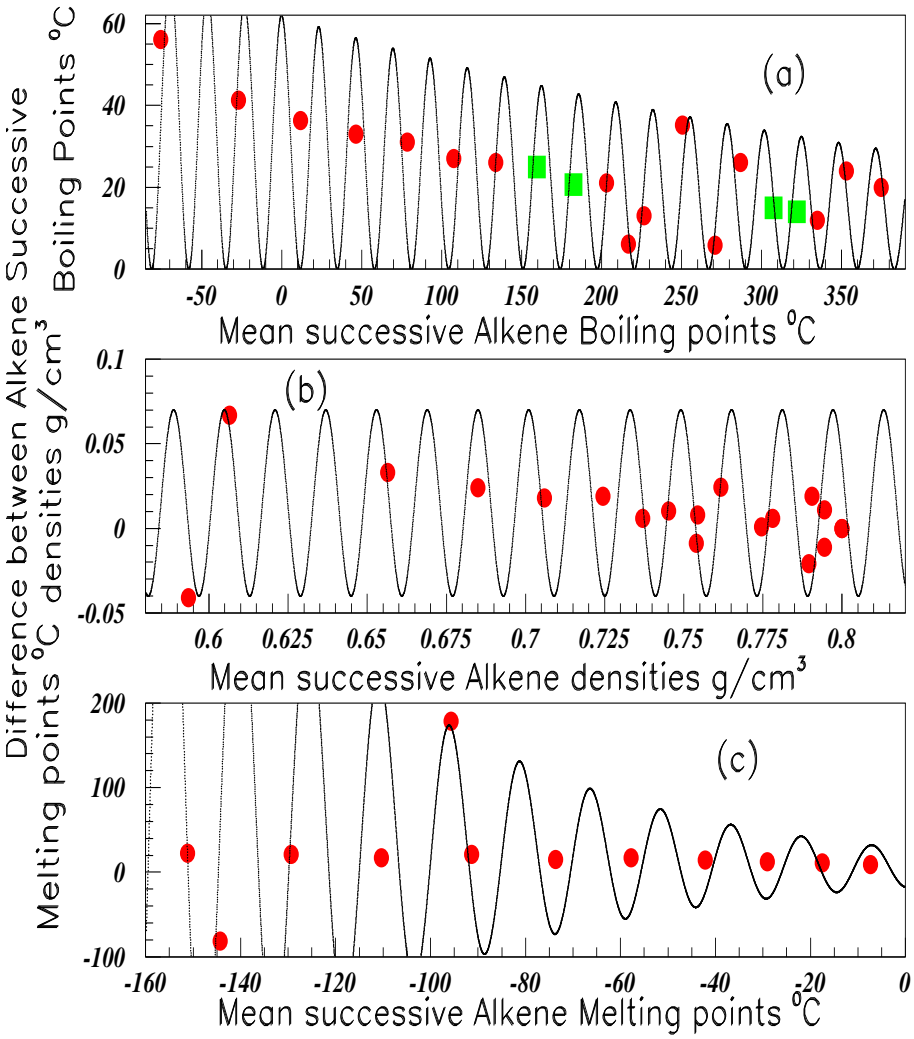


Figure 4: Color on line. (See text). "Alkenes Melting point data".

lene Melting Point cannot be improved by our study.

2.4. Alkenes

The formula of Alkene molecules, double bond hydrocarbons, is C_nH_{2n}. They are Ethene (C_2H_4) also called ethylene, Propene (C_3H_6) also called propylene, Butene (C_4H_8) (butylene), Pentene, Hexene, Heptene, Octene, Nonene, Decene, Undecene and Dodecene. After Propene, all Alkenes exist in different isomeric shapes, therefore I keep the first isomer 1-Alkene.

Fig.4(a) shows the Alkene "Boiling point data" fitted with the pe-

riod P=23.2 ^{0}C. The Boiling points are unknown for Cyclotridecane ($C_{13}H_{26}$) and Henicosene ($C_{21}H_{42}$). A tentatively Cyclotridecane Boiling point value of 220 ^{0}C involves the two left green marks which agree with the oscillation curve. In the same way, a tentatively Boiling point of 365 ^{0}C for Henicosene involves the two right green marks.

Fig.4(b) shows the Alkene "density data" fitted with period P=0.016 g/cm^3.

Fig.4(c) shows the Alkene "Melting point data" fitted with period P=14.8 ^{0}C. The oscillation is poorly observed for these "data".

2.5. Alkynes

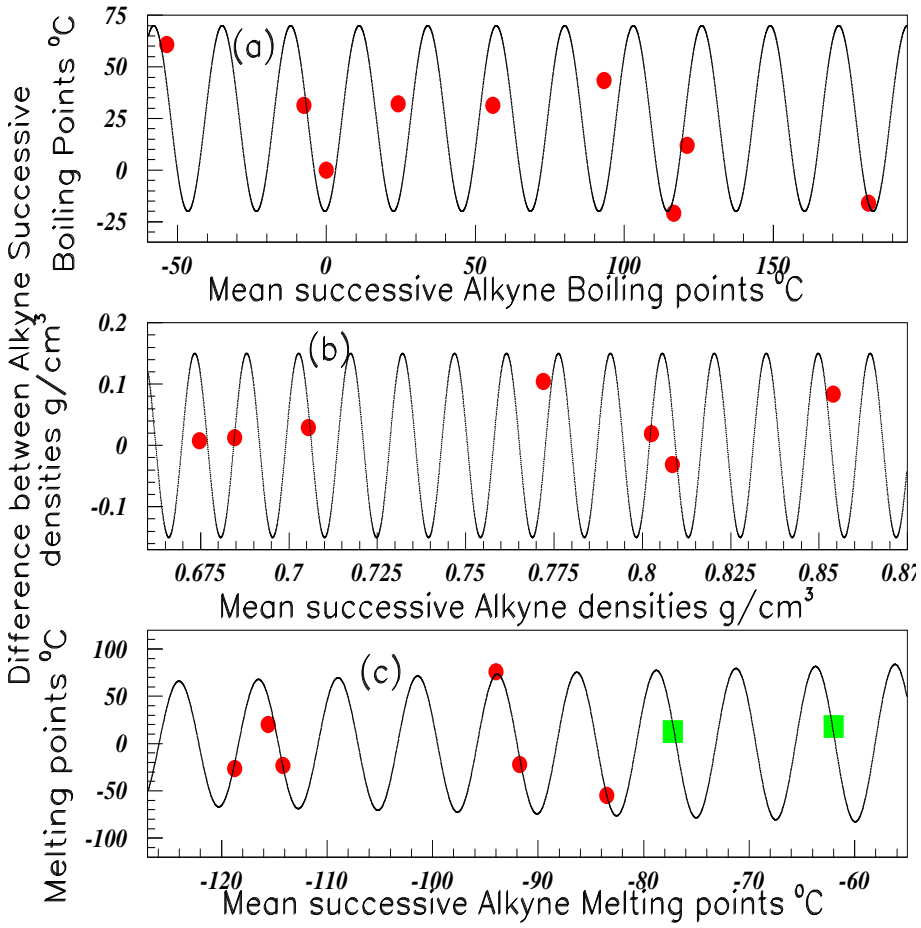


Figure 5: Color on line. (See text). "Alkynes Boiling and Melting points data", and densities.

The formula of studied triple bond hydrocarbons Alkyne molecules

is C_nH_{2n-2}. The firsts such (unsaturated) hydrocarbons are: Ethyne (CH≡CH) (acetylene), Propyne (CH≡C-CH3) (methylacetylene), Butyne (CH≡C-CH2-CH3), Pentyne (CH≡C-CH2-CH2-CH3), Hexyne (CH≡C-CH2-CH2-CH2-CH2-CH3), and so on. Fig.5 studies some Alkyne properties up to Cyclopentyl cyclohexane $C_{10}H_{18}$.

Fig.5(a) shows the Alkyne "Boiling point data" fitted with the period P=23.0 ^{0}C.

Fig.5(b) shows the Alkyne "density data" fitted with the period P=0.0147 g/cm^3.

Fig.5(c) shows the Alkyne "Melting point data" fitted using the known data with the period P=7.54 ^{0}C. Two successive Melting points are unknown, close to the end of the known values list. Their tentative predicted values should therefore only be considered as an exercise since several solutions are possible. The suggested values: Melt.(nonyne C_9H_{16}) ≈ -71 ^{0}C and Melt.(Bornane $C_{10}H_{18}$) ≈ -53 ^{0}C are well fitted by the oscillation curve.

2.6. Alkadienes

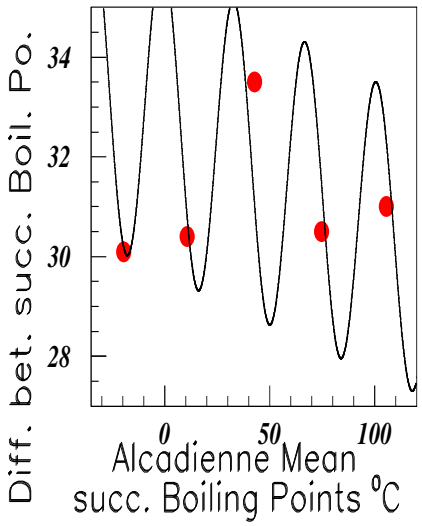


Figure 6: Color on line. (See text). "Alkadiene Boiling points data".

The Alkadiene hydrocarbons contain two double bonds between carbon atoms [10]. The first Alkadienes are Propadiene (allene), Butadienne, Pentadiene, Hexadiene, Heptadiene, Octadiene, Nonadiene,

Decadiene, and Dodecadiene. Only a few Boiling point values are given in tables for Alkadiene molecules and nearly nothing for density or Melting point. The Boiling point for Heptadiene is not precisely known and for Octadiene is given in the range 114-121 ^{0}C. The fig.6 is obtained with the following values for Boiling points: 90 ^{0}C for Heptadiene and 121 ^{0}C for Octadiene. Fig.6 shows the oscillation symmetry applied to Alkadiene "Boiling point data" fitted with period P=33.9 ^{0}C.

3. Hydro Silicons

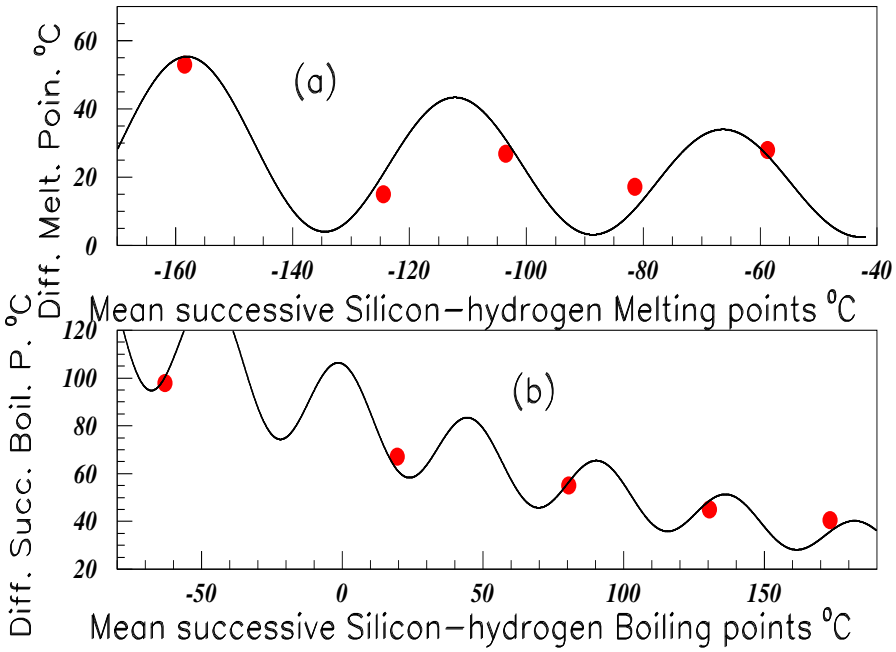
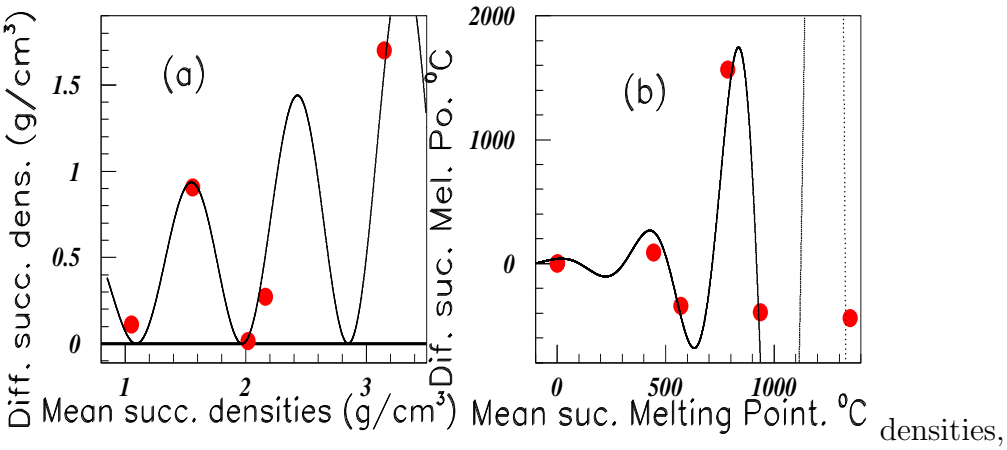


Figure 7: Color on line. (See text). Hydrosilicons properties: "Melting and Boiling points data".

The empirical formula of hydrosilanes is Si_xH_y. Some data of the following compounds are given in [12]. They are: Silanes (SiH_4), Disilane (Si_2H_6), Trisilane (Si_3H_8), cyclotrisilane (Si_3H_6), Tetrasilanes (Si_4H_{10}), n-Pentasilane (Si_5H_{12}), cyclopentasilane (Si_5H_{10}), and n-Hexasilane (Si_6H_{14}). Their formula, except for cyclotrisilane and cyclopentasilane is Si_nH_{2+2n}. Fig.7 shows the results of the symmetry oscillation method applied to the six previously reported elements verifying the

formula Si_nH_{2+2n}. Inserts (a) and (b) show the "Melting point data" and "Boiling point data" fitted both with period P=45.9 ^{0}C. The known number of Hydro Silicons liquid densities is too small for the present study.

4. Oxides of the first column of the Periodic Table of the Elements



densities,

Figure 8: Color on line. (See text). "Density data " and "Melting points data" of oxid molecules.

The "densities data"and the "Melting points data" of the monoxide elements [13] of the first column of the Periodic Table of the Elements: H_2O, D_2O, Li_2O, Na_2O, K_2O, Rb_2O, and Cs_2O, are studied using the oscillation symmetry method, and shown in fig.8. The reference for each Element is obtained by substituting the Element to K_2O in [13]. Insert (a) shows the densities fitted with period P=0.88 g/cm^3, insert (b) shows the Melting point fitted with P=408.4 ^{0}C. The Li_2O Boiling point is not known, preventing the possibility to consider these data.

5. Discussion and Conclusion

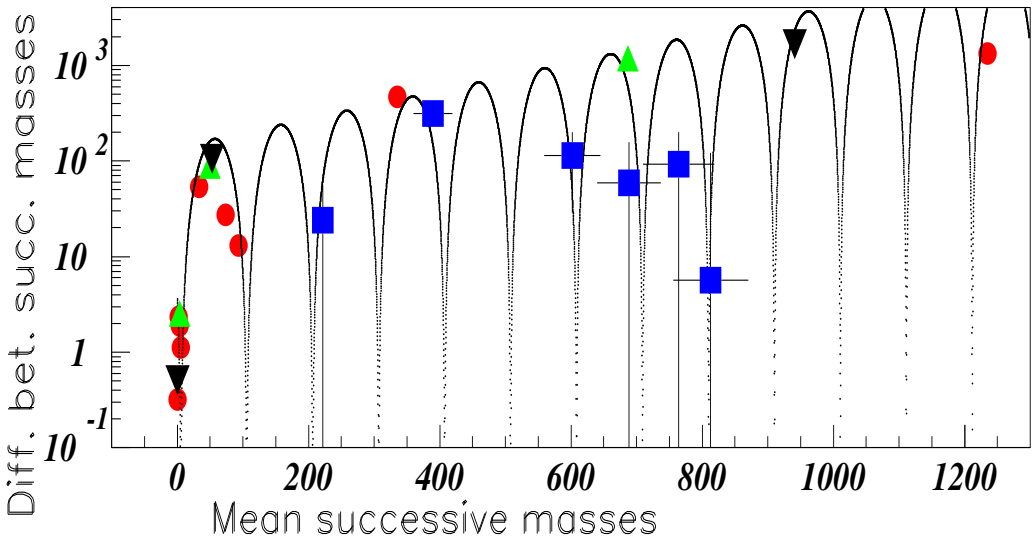
The paper shows the "Density data", "Melting points data", and "Boiling points data" of several chemical elements, mainly Hydrocarbons, analysed inside the Oscillation Symmetry. Some unknown data have been tentatively predicted.

Table A1: Parameters of the fits done using equation (2). See text.

Fig.	α	β	P
1	1.51	-0.0055	42.41
4(a)	31	-0.002	23.2
3(d)	106	-0.0022	75.4
8(a)	0.22	0.49	0.880
9	70	0.0034	100.5

Table A2: Parameters of the fits done using equation (3). See text.

Fig.	α_1	α_0	β	P
2(a)	10.2	40	-0.0022	100.5
2(b)	0.051	0.090	-1.81	0.0283
2(c)	85	60	0	18.47
4(b)	0.055	0.015	0	0.016
4(c)	23	5	-0.019	14.83
5(a)	45	25	0	23.0
5(b)	0.15	0	0	0.0147
5(c)	to102	0	0.0035	7.54
6	3.15	32.8	-0.0007	33.9
3(a)	0.162	0.113!	-0.4	0.628
3(b)	0.3	0.15	0	0.256
3(c)	700	140	0	122.5
8(b)	39	0	0.0046	408.4
7(a)	11	13	-0.0053	45.9
7(b)	20	86	-0.0053	45.9
10	210	265	-0.0005	414.7



densities,

Figure 9: Color on line. (See text). Comparison of "mass data" between different families.

These results confirm the previous observations that oscillations are widely observed inside many properties in nature. It was shown previously in fig. 18 of [14] that the same distribution describes, the "mass data" periods of the following "data" :
- solar (full red circles) and Trappist (blue full squares) exoplanet masses (in units of 10^{24} kg), after an homothetic factor for the exoplanet masses,
- quark masses (green full upside triangles) (in MeV),
- lepton masses (black full dowside triangles) (in MeV).

This fig. is reproduced here in fig. 9.

In a previous paper [15] it was shown that an unique distribution can describe the "mass data" periods of the following "data":
- f2 mesons (full blue squares),
- f0 mesons (full green stars),
- Ξ baryons (full red circles) with an homothetic factor, that is to say that all masses of this family are multiply by the same factor hf=0.94,
- Ξ_C baryons, (full upside purple triangles) with an homothetic factor hf=0.91,

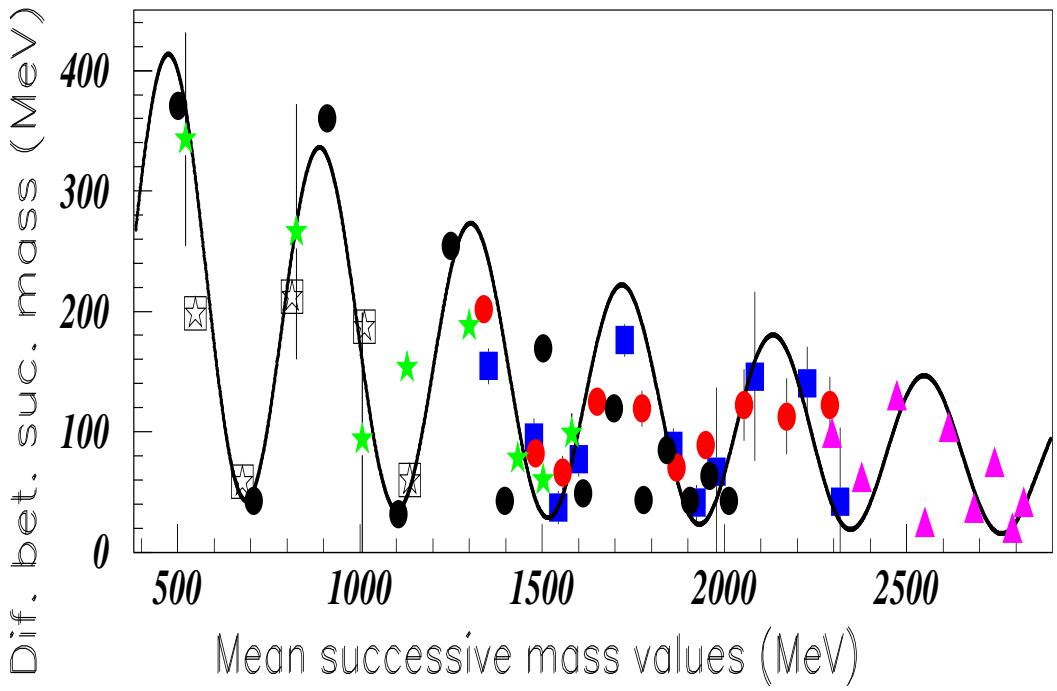


Figure 10: Color on line. (See text). Comparison of "mass data" between different families.

- ^{14}N excited state levels (black empty stars inside empty squares) with an homothetic factor hf=114.

This previous fig. is reproduced here in fig.10, with addition of some data from the present study. The Alkane Melting Point "data" are introduced in the fig.10 of this paper, after normalization, in order to correspond to the previous units (MeV). The new data m_n=m∗10.6-1200 are shown by black full circles, well fitted with a slightly modified curve from the one shown in fig.11 of [15].

In a previous paper [16] it was highlighted that the periods of oscillation extracted from different body "data" follow a "like quantification" property. This "like quantification" property was illustrated showing the periods of:

- in fig10 of [16] the Melting points, Boiling points and density of Atomic Elements periods,
- in fig. 11 the meson "mass data" and width periods,
- in fig. 12 the baryon "mass data" and width periods,
- in fig. 13 the Nuclei Atomic Numbers "mass data" and width peri-

ods,
- in fig. 14 the electromagnetic electric and magnetic interaction mass periods, and
- fig. 15 the mass data and radii of astrophysical periods.

In the present paper, fig.11 shows some enhanced data of nuclei periods from fig. 13 of [16]. The different colors correspond to different mass ranges studied in different tables and figs. in [4]. The horizontal dashed lines are obtained using the relation P=-0.014+0.1$*\delta$ MeV, therefore separated by an integer number of separators= 0.1 MeV which number δ is indicated in the fig.

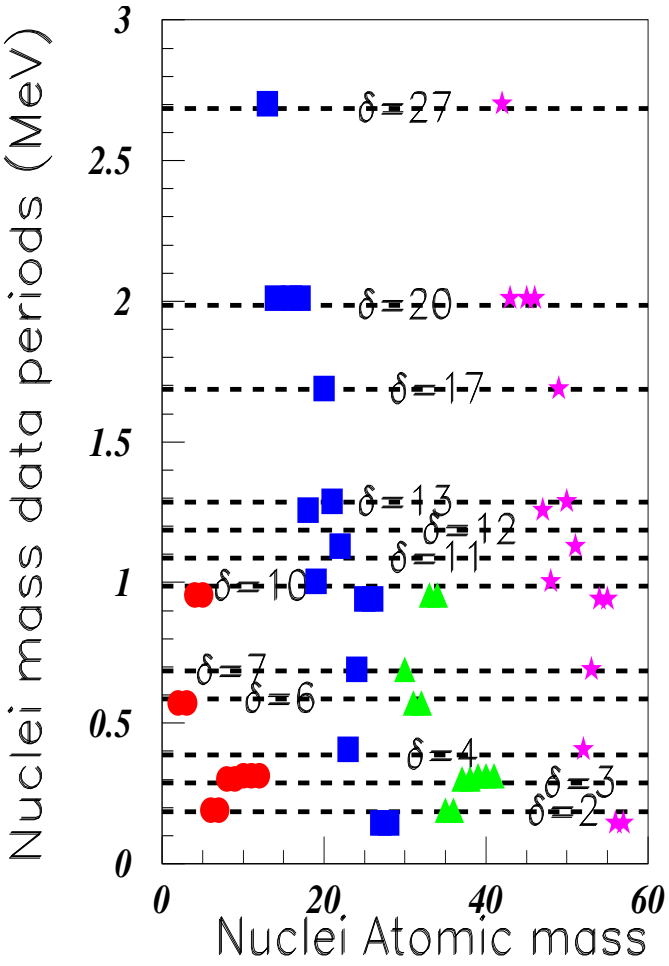


Figure 11: Color on line. (See text). Periods of "Density data ", "Melting points data", and "Boiling points data".

The periods extracted from the present paper are drawn in fig.12.

The horizontal dashed lines are obtained using in insert (a) the relation P=0.016+0.012$*\delta$ g/cm^3, therefore separated by an integer number of separators= 0.012 g/cm^3. The log scale involves that the signification of the agreement between periods and δ decreases for increasing δ values. This agreement is only significant for δ up to 23, mainly for δ = 0 and 1. In insert (b), the dashed lines are defined by the relation P=11$*\delta$ ^{0}C. Here the agreement is significant for all shown δs.

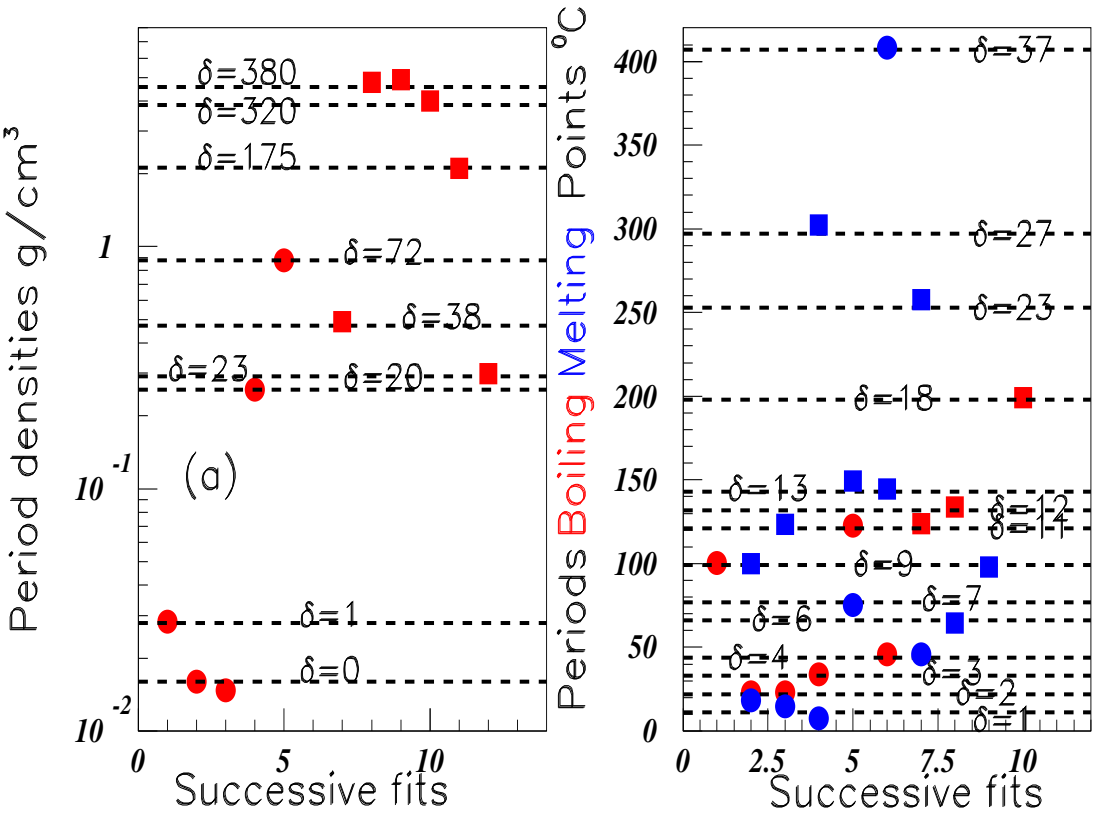


Figure 12: Color on line. (See text). Periods of "Density data ", "Melting points data", and "Boiling points data".

In conclusion, the paper brings new data in favor of the oscillation symmetry confirming its generalization property, and new data in favor of the corresponding periods "quantification".

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