Cavities in the L_A media and cavitary propagation

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1 - Introduction

We begin by reminding the reader (see chap. 6 of [1]) that a L_A medium is a material forced holding distributed system, with attractive and permanent interactions between elements and able to allow quasi-free rotation of either the medium elements or the clusters of elements.

Comment 1.1: In [1] we also point out that there is another category of L media called L_R with repulsive interactions between elements (for example the medium of free electrons in conductors) in which the occurrence of cavities is not possible because the repulsive interaction does not allow surface tension to occur.

There is a widespread preconception among physicists, especially those with philosophical concerns, that whereas the so-called "quantum" phenomena are far below the threshold of direct human perception, the reasoning of common human logic are therefore no longer valid for those phenomena. This way of looking at things is not justified at all because:

1) Even if man cannot directly perceive subatomic phenomena, modern research equipment that has become an extension of our sense organs, can provide experimental data in this dimensional field. What each researcher does with this data and how they interpret it is another matter;

2) There is no rational reason to consider these phenomena *ab initio* as something unprecedented and difficult to explain, as long as there can be at least one simple and logical way to clarify things;

3) Human logic has worked for thousands of years according to the same basic principles, being one of the main "tools" of knowledge of the surrounding reality (obviously provided that the principles of logic are correctly applied), therefore a process that seems not to be subject to these principles, is much more likely to have a rather wrong (mental) pattern. Let's not forget that the models of atomic or subatomic objects and phenomena used today are abstract objects, more often than not purely mathematical, conceived by the minds of researchers; however, abstract models are not always materially feasible (do not correspond to reality).

At the dimensional boundary between the macroscopic and the microscopic world there is a physical phenomenon on the basis of which the above statements can be proved. The information acquired from the analysis of this phenomenon, of the objects and processes involved in it, can be used in the elaboration of such a possible model for the structure of field particles itself. This phenomenon is *cavitation*.

Comment 1.2: The boundary between the macroscopic and the microscopic world is given (as indicated by the etymology) by the very limit of the field of direct visual perception of man (by its resolution and by the extent of the visual field). Any object smaller than this limit (which is in the order of tens of μm) can no longer be perceived except by means of auxiliary instruments (magnifying glasses, microscopes, etc.) hence it is a microscopic object. Things are no different at the opposite end either, that is, with very large objects; and here if the object exceeds certain sizes and we are in its immediate vicinity, it can no longer be perceived directly. This is the case of the Earth, the shape and size of which have been controversial for millennia, shape and size indirectly determined by the ancient Greeks (Eratosthenes, using human logic challenged by some) and which were accessible to direct perception only at man's first exploration of outer space.

2 - Cavitation

Let's see very briefly what this phenomenon consists of. Some parts operating in liquid media with very high turbulence (propellers, hydraulic turbines, valves, etc.) were seen to have a pronounced surface wearing (erosion) on certain portions that, once triggered, became more and more accentuated to the destruction of the part. The analysis of the process showed that the wear was caused by the formation of some unstable microscopic cavities (bubbles) (hence the name of the phenomenon probably) in the turbulent liquid medium which after the formation were maintained for a very short time (of the order of tens of μs) and then they imploded, generating an acoustic shock wave so intense that it dislocated the material of the part with the formation of a micro-crater. This whole process took place at the interface between the liquid medium and the solid medium the part was made of (liquid-solid separation surface), the bubbles that generated the shock wave by implosion having to be very close to this surface so that the energy flux intensity of this wave be above the threshold of the cohesive energy of the atoms of the part.

Comment 2.1: The implosion of a cavitation bubble generates both a pressure wave and a huge temperature jump of the gas inside (in some cases there is a scintillation - sonoluminescence - with temperatures of several thousand degrees).

The same cavitation phenomenon was also found to be caused by intense sound waves fluxes in the ultra-acoustic domain (tens of kHz, according to [2]) generated in a L_A medium also, but in this case with the desired effects, namely that of non-destructively cleaning the surface of parts in areas inaccessible to conventional cleaning processes, of certain impurities deposited during their operation (such as, for example, the holes in the dies). The operating principle is the same for this case also: the cavities generated by the ultrasonic fluxes at the liquid-solid separation surface generate by implosion shock waves that this time dislocate not the material of the part but the impurities (also solid) deposited on its surface. The process is more complicated, but for now we are only interested in the occurrence of cavities in a L_A medium and the "behaviour" of these cavities during their existence.

Analysing the two cases of unstable cavities (which implode after a certain period of time), let's extract the common components of the information:

1) In both cases, at the origin of the cavities there are some open fluxes (of displacement[1] in the case of turbulent flow, and of propagation in the case of sound waves), but also with rotational components (obvious in case of turbulence);

2) During the existence (life) of the cavity, inside it there is a stored flux coming from the initial open flux, a flux that is closed after a closing process by the occurrence of an real separation surface (RSS) between the two phases. In the volume delimited by the liquid-gas separation surface we will therefore have a locatable flux. This flux consists of elements of the L_A medium which received from the initial flux a surplus of energy besides the average energy per element, specific to the L_A medium, a surplus that determined the transition of these elements from phase L to phase G.

3) At the end of the life of the cavity, with a stored flux no longer having the necessary resources to maintain it, all stored fluxes (both in the G medium and in the

[1] We remind you that no clear distinction can be made between the two types of fluxes in the case of actual fluxes; each displacement flux will also contain a propagation component, just as each propagation flux also contains a displacement component. When we talk about a displacement flux it means that this (displacement) component is predominant as it is the propagation one in the case of propagation fluxes.

separation surface) are turned into an acoustic shock wave and a lot of thermal photons (open fluxes) that dissipate in the surrounding space.

We therefore have an interesting series of qualitative transformations of fluxes represented in fig. 2.1:

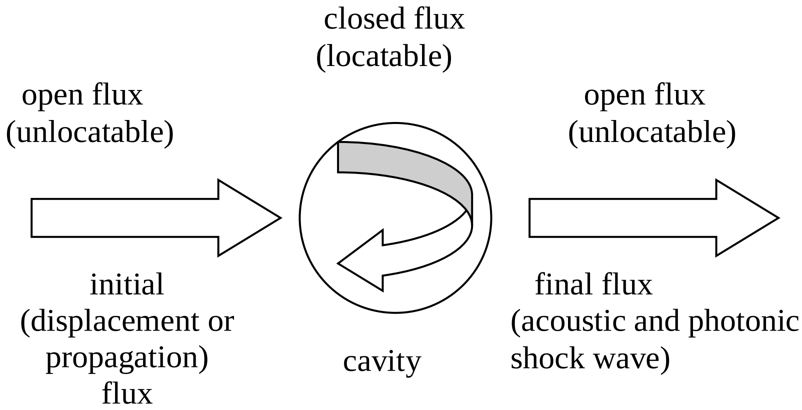

Fig. 2.1

At the top are the names of the flux classes (according to the nomenclature specific to the objectual philosophy), and at the bottom the names of the corresponding real objects or processes. From a <u>strictly qualitatively</u> point of view we can't help but notice the similarity of this string of transformations with another string of transformations encountered in the generation of EP[2] pairs with opposite charges (e.g. e^+, e^-), a string shown in Fig. 2.2.

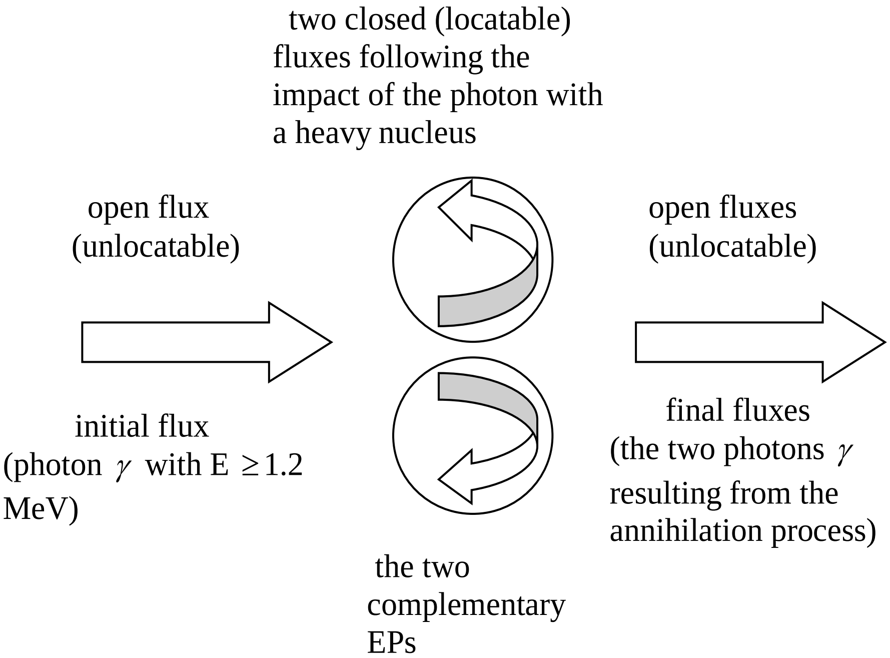

Fig. 2.2

Please be advised! In this phase of our overview the objectual philosophy should not be understood in any way as sustaining the model of spheroidal cavities for the EP, as the cavitation bubbles in fluids are. The purpose of this paragraph is to show the reader that, under certain conditions, cavities filled with a G-type medium may occur in L_A media, cavities that can be maintained either for a limited time as in the case of cavitation bubbles or

[2] EP is the acronym in [1] for particles carrying electric charge (electrons, protons and their antiparticles).

indefinitely, as in the case of gas bubbles in mineral water. These cavities have some very remarkable properties, which is why we will analyse them in more detail.

3 - Objectual analysis of cavities in the L_A media

This type of analysis implies the application of basic objectual philosophy methods, i.e. the identification of *objects* and *processes* involved in that phenomenon. In the case of cavities in L_A media, the object is the cavity itself, and its properties at a given momentum *t* (a time PD[3]) forms the $S_0(t)$ state of it (a state defined relative to an internal or external reference). There are noticeable quantitative differences (hence contrast attributes) between homologous properties specific to the outer L_A medium and the inner G medium (such as mass density or kinetic energy per element), which leads to the discernibility of the object *cavity* from the rest of the L_A medium.

The newly formed cavity, after a transient stabilization time interval in which the surface waves disappear, will have a stable shape with respect to an internal reference system (RS). In the case of a medium without a pressure gradient (a hypothetical situation to be however considered for a start), the cavity will have a perfectly spherical shape regardless of its size, so the internal reference T will be the center of the sphere and will have a invariant position with respect to an external T reference[4]. Assuming a L_A medium which does not contain dissolved gases, the cavity contains only elements of this medium (water vapours in the case of water), but which must have higher kinetic energies than the average kinetic energy per element of the L_A medium, to be able to balance the static pressure of the cumulative liquid with that generated by the surface tension (inversely proportional to the cavity radius of curvature). This difference in energy between the two media is provided precisely by the initial energy flux, the one to be partially or totally stored inside. In terms specific to the objectual philosophy we will say that during the life of the cavity the stochastic flux density in the inner G medium must be equal to the flux density (also stochastic) of the outer L_A medium[5]. But as aforementioned, as the density of elements in the G medium is much lower than in the L_A medium, the energies of the elements in the G medium must be correspondingly higher.

As seen in chapter 7 of [1], the spatial area of transition from one flux density to another, from one distribution of properties to another distribution is an RSS, and in the case of cavities, the separation surface itself between the outer L_A medium and the inner G medium (see Fig. 3.1).

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[3] The acronyms in this material are those in [1]. PD means point domain.

[4] We infer that the internal kinetic flux has a zero coherent component relative to the external reference, in which case the cavity is immobile relative to this reference.

[5] In common terms, an equivalent expression would be: the pressure exerted by the G medium on the liquid separation surface must be equal to the pressure exerted by the liquid on the gas.

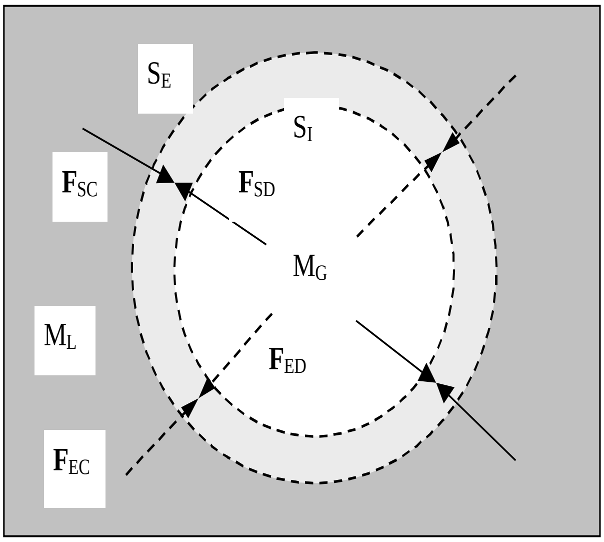

Fig. 3.1

For stabilized cavities in the L_A media (i.e. without surface waves), this RSS has thicknesses of the order of several molecular diameters (between the two virtual surfaces S_E and S_I in Fig. 3.1), a range in which there is a transition from the density of elements of the L medium to that of the G medium. One of the essential and specific properties of the RSS is that it contains *equilibrium surfaces* (which we discussed in Chapter 7 in [1]). In the case of stable cavities in the L_A media, RSS contains the equilibrium surfaces between the following opposite fluxes:

- *Divergent displacement flow* of G medium molecules which recondense in the liquid phase, leaving the G medium and *convergent displacement flux* of the L_A medium elements which escape from the liquid phase and pass into the G medium. In Fig. 3.1 these fluxes are $\mathbf{F}_{SC}$ (structural-convergent input flux) and $\mathbf{F}_{SD}$ (structural-divergent output flux). According to the classification of fundamental fluxes in the structure of material systems (MS), these fluxes are structural and its elements contribute to the spatial structure of the system.
- *The normal component of the variation of the kinetic flux of the G medium elements* at the impact with the elements of the L_A medium (which generates the pressure of the G medium on the L_A medium) and *the normal component of the variation of the kinetic flux of the* L_A *medium elements* at the impact with the elements of the G medium (which generates the pressure of the L_A medium on the G medium). In Fig. 3.1 these fluxes are $\mathbf{F}_{EC}$ (for the energy-convergent flux) and $\mathbf{F}_{ED}$ (for the energy-divergent flux). These fluxes belong to the class of energy fluxes.

Both types of fluxes should be understood as fluxes with uniform surface distributions (in the case of resting cavities), however, for the simplicity of the figure they have been reduced as representation in Fig. 3.1 only to two arrows (continuous for structural fluxes and dotted for energy fluxes).

As seen in Chapter 7 of [1], the equilibrium surface is included in an RSS, and with it, its spatial configuration (shape, position, etc.) changes (self-establishes) depending on the spatio-temporal distribution of the flux density of the interacting fluxes. In the case of cavities in the L_A media this fact causes the spatio-temporal distribution of the flux density of the interactive fluxes to determine the shape of this surface (the external flux can be considered isotropic in the L_A media devoid of an internal pressure gradient). For this reason, in the case of an internal stochastic flux, devoid of a pressure gradient (isotropic by definition) and without a coherent common component (immobile), the shape of the surface of a cavity at equilibrium will be spherical and immobile.

Comment 3.1: An observant reader who has read (and understood) chap. 7 of [1], in which the general model proposed by the objectual philosophy for material systems is described, cannot fail to notice the similarity between this model and the structure of fluxes that we have just found in the L_A media cavities. In these objects there is a union of fluxes Ψ_i (input), a union of fluxes Ψ_e (output) and a union of stored fluxes Φ enclosed in the RSS of the cavity, the RSS consisting of the transition zone from phase L to phase G. Yes, dear reader, the cavities in the L_A media have all the characteristic attributes of a m*aterial system*, i.e. the triad of fluxes and the real separation surface, a surface that has the property of reflecting the incident photonic flux, and this reflected flux we can see and thus we can ascertain the existence (materiality) of the cavity (as discussed in Chapter 8 of [1]). These objects appear (are generated) after the storage of some initial open fluxes and disappear (are annihilated) turning also into open flows that dissipate in the generating medium. And as if that weren't enough, the same objects also have the property of moving (and deforming) under the action of a field, namely, of a pressure gradient in the L_A medium as we shall see below.

4 – Cavities in the L_A media with a pressure gradient

We saw in Chapter 7 of [1] that pressure is a volume density of potential energy stored in a medium, but also a surface density of an energy flux through an RSS (of a force). Hence we can conclude that if a MS is "immersed" in a pressure gradient medium, on the actual separation surface of the MS the surface density of the external energy flux will have an uneven distribution, meaning that the integral on the RSS of this density will be non-zero, which leads to the occurrence of a force in the direction opposite to the pressure gradient, i.e. the well-known Archimedes' principle.

The gradient of a scalar pressure field $p(\bar{r})$ is a vector $\bar{V}(\bar{r})$ given by the general ratio:

$$\bar{V}(\bar{r}) = grad\, p(\bar{r}) = \frac{\partial p}{\partial x}\bar{i} + \frac{\partial p}{\partial y}\bar{j} + \frac{\partial p}{\partial z}\bar{k} \tag{4.1}$$

In a simplified case, that of a small portion[6] from the planetary ocean, if the unit vector $\bar{k}$ is collinear with the vertical of the place (the opposite direction of gravity), the pressure gradient no longer depends on the variables *x* and *y* but only on *z*, the depth relative to the free surface of the water, a situation illustrated in Fig. 4.1. In this case, the ratio 4.1 is simplified:

$$\bar{V}(z) = grad\, p(z) = -\frac{\partial p}{\partial z}\bar{k} \tag{4.2}$$

Under these conditions, between two isobaric planes $p(z) = p$ and $p(z+\Delta z) = p + \Delta p$ at a distance Δz, whose intersection with the plane of Figure 4.1 are the two horizontal dotted lines, there will be a pressure difference:

$$\Delta p = \frac{\partial p}{\partial z}\Delta z \tag{4.3}$$

[6] So that an isobaric surface can be considered flat

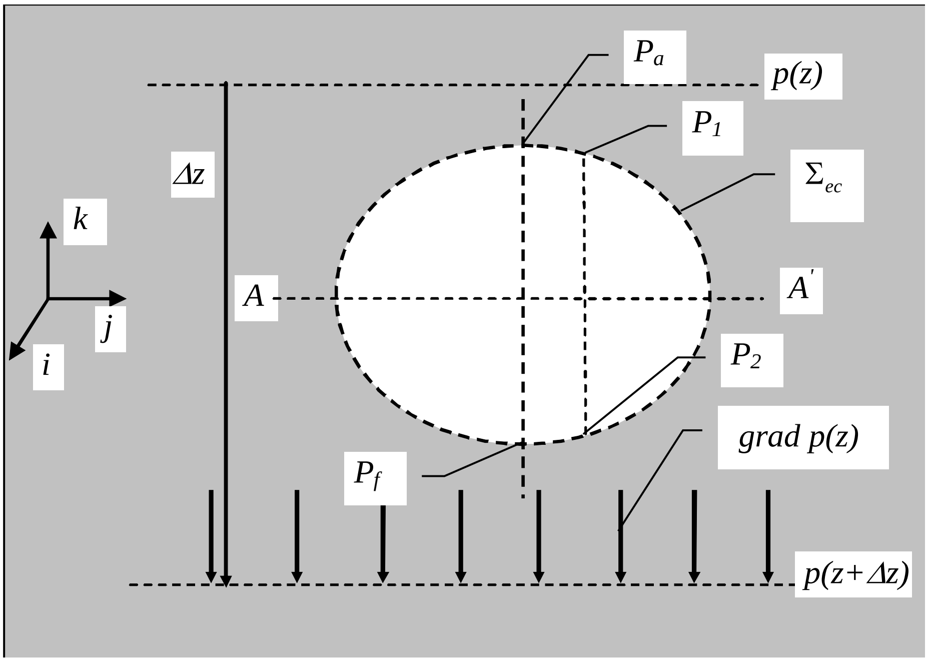

Fig. 4.1

Relative to the external reference system R (external to the cavity), represented by the directions of the unit vectors $\overline{i}$, $\overline{j}$, $\overline{k}$, from which the couple $\overline{i}$, $\overline{j}$ is included in a horizontal (isobar) plane and $\overline{k}$ has the direction of the vertical of the place, the internal reference system R of the cavity has the following elements:

- The equatorial plane of the cavity, a horizontal plane whose intersection with the surface of the cavity defines its equator, and the projection of the equator on the plane of Fig. 4.1 is the straight line AA'. The equatorial plane divides the surface of the cavity into two caps: the upper cap (referred to in this study as the *leading cap*) and the lower cap (referred to as the *trailing cap*)[7].
- The axis of poles P_aP_f, a vertical straight line passing through the center of the cavity (this center being its internal T reference), an axis that intersects the surface of the two caps at two important points: P_a – leading pole and P_f – trailing pole;

For the convenience in the drawing up of the figure, the two theoretical surfaces that delimit the transition volume of the cavity RSS have no longer been represented on Fig. 4.1, but only the equilibrium surface Σ_{ec} of the opposing fluxes that have been described in par. 3.

Comment 4.1: As aforementioned, each type of couple of interactive fluxes has its own equilibrium surface, therefore there are as many equilibrium surfaces as there are types of fluxes in opposition to a particular material system. In the case of cavities in the L_A medium, we have seen hereinbefore that we have two types of interactive fluxes: structural fluxes and energy fluxes. As a result, we will have two distinct equilibrium surfaces, but both included in the RSS of the cavity. As the thickness of this RSS in this case is very small (several molecular diameters), we can consider that both equilibrium surfaces overlap in a single one, Σ_{ec}.

Let us now analyse, in the context of the pressure gradient, which is the situation of the fluxes on the surface of the cavity. If at any point of the trailing cap (lower cap in Fig. 4.1) the pressure is higher than in the image[8] points of the leading cap, in terms of objectual

[7] The names were adopted from the fluid dynamics, being established for the surfaces of bodies moving through fluid media (e.g. aircraft wings) as a *leading edge* and a *trailing edge*.

[8] Two image points are at the intersection of a vertical with the two caps, for example (P_1, P_2) or (P_a, P_f).

philosophy this translates in that the density of the energy flux (EF) on the trailing cap is higher than the density of the EF on the leading cap. So we have a state of imbalance between energy fluxes, an imbalance that determines the movement of the surface Σ_{ec} , and with it, of the RSS that includes it. The direction of movement is the natural one, i.e. the direction of the flux having higher resources, in our case, of the EF on the trailing cap, the reverse direction of the pressure gradient (see Fig. 4.1). But any movement of the equilibrium surface means a mechanical work, an energy transfer from the agent flux to the driven system. In our case, the agent flux is EF with higher resources, i.e. EF distributed on the trailing cap, and the driven system is the entire cavity (especially its inner G medium) considered as a material system (MS). As seen in chapter 7 of [1] also, the action of a flux on a MS has two successive phases: *the internal action* (the external traflux cumulating effect with the pre-existing stored flux) and *the external action* (the change of the external state of the MS, a change given by the common component of the internal flux resulting from the internal action).

If we consider the internal flux to be the stochastic one from the previous stage, without a pressure gradient, i.e. uniform and isotropic, the result of the composition with the agent traflux on the trailing cap will be a coherent/stochastic flux, i.e. a stochastic flux with a coherent component, with the direction of the agent flux. The coherent component of the internal flux in the cavity is a molecular flux with an ascending direction (agent flux direction), having a velocity proportional to the pressure difference between the image points of the two caps (velocity is maximum on the pole axis and zero on the equator of the cap).

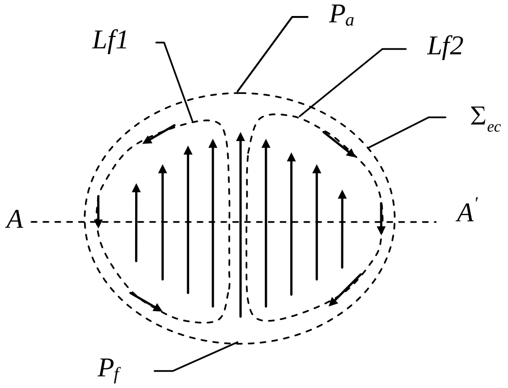

Fig. 4.2

Fig. 4.2 shows a section through the cavity that includes the pole axis, with the velocity distribution of the coherent component of the internal flux (vertical arrows), and two flux lines *Lf1* and *Lf2*, to illustrate the internal flux resulting from the existence of a pressure gradient outside the cavity. The internal action of the external agent energy flux is represented by the appearance of the coherent component of the internal stochastic flux. The consequence of this internal action is the external action - the displacement of the equilibrium surface and with it the whole cavity in the opposite direction to the pressure gradient. Relative to the internal reference R of the cavity (polar axis P_aP_f and the equatorial plane), following the appearance of the internal coherent flux, on the two caps we will have two types of fluxes of the external L_A medium elements and these fluxes are represented in Fig. 4.3.

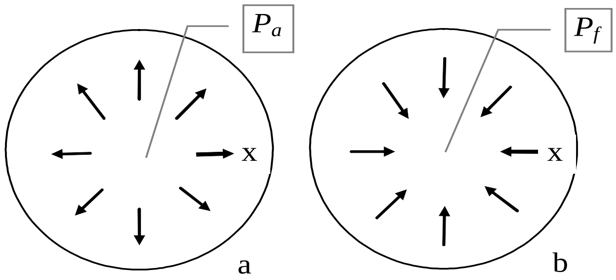

Fig. 4.3

In Fig. 4.3.a the apparent flux of elements of the L_A medium from the leading cap is represented, where P_a is the leading pole, and in Fig. 4.3.b the apparent flux of the elements of the L_A medium from the trailing cap, where P_f is the trailing pole.

Comment 4.2: We remind the reader of some of the notions introduced in Annex X.7 of [1], namely, those of *absolute flux* and *relative flux*. We saw there that the motion of a MS relative to an external RS (considered as an absolute RS) is an absolute flux, while the motions of external systems evaluated relative to the internal RS of the MS (even if these systems are immobile relative to the absolute RS), are relative (apparent) fluxes for that MS. In the case of cavities in L_A media with pressure gradient, relative to the internal RS of the cavity, the fluxes of the elements of the L_A medium in Fig. 4.3 on both caps are relative, apparent fluxes, the L_A medium being considered immovable.

We notice that in its motion through the L_A medium, the cavity displaces (makes its way through) the L_A medium, so that the leading pole P_a can be considered as a source of new elements of the medium that will enter the RSS structure of the cavity (of the leading cap), while the trailing pole P_f is a pit (a negative source), through which the elements of the RSS structure of the cavity (of the trailing cap) will be re-embedded in the L_A medium considered immobile relative to a RS external to the cavity.

Obviously, as mentioned above, the relative fluxes in Fig. 4.3 are evaluated against the internal RS of the cavity. Relative to a RS external to the cavity, the motions of the L_A medium elements are completely different, only those elements that are part of the cavity RSS being involved, the remaining of the medium elements being immobile (in the case of an immobile medium relative to the external RS).

Fig. 4.4 shows the evolution of the position vector[9] of a L_A medium element originally located in the direction of the axis (P_a, P_f) of a cavity in ascending motion, in which the horizontal axis is the position in horizontal plane of the element, and the vertical axis collinear with the axis (P_a, P_f) in Fig. 4.2 and with the vertical of the place is time. The medium element (molecule in the case of water) located in the direction of the axis (P_a, P_f) will have a trajectory along a cavity meridian (the intersection of a plane that includes the axis (P_a, P_f) with the surface of the cavity), in the case of Fig. 4.4, the meridian in the plane of figure 4.2 on the right itself, with the direction marked with X in Fig. 4.2. We notice that once the leading pole P_a of the cavity reaches the point where the element to be observed is located, at the time t_a, that element enters the cavity RSS structure and begins to move horizontally, a motion that reaches a maximum at the time t_m when the element crosses the cavity equator, then it will approach the initial position, until the time t_f, when it will leave the RSS structure being re-embedded in the immobile medium. Note that in the interval (t_a, t_f), an interval in which the L_A medium element is part of the cavity RSS structure, it can escape from the L medium passing into the internal G medium.

[9] A trajectory, or according to objectual philosophy, a Lagrange distribution.

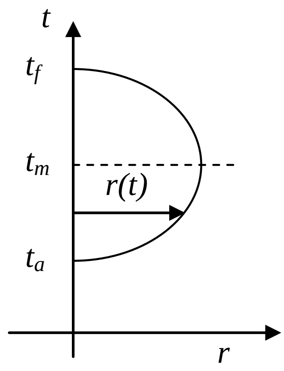

Fig. 4.4

The full description of the processes involved in the motion of a cavity in an L_A medium made so far has a precise purpose, namely, to draw the reader's attention to two important aspects:

1. The only part of the material system *cavity in the L_A medium* that moves (travels) under the influence of the pressure gradient (in the opposite direction to the gradient) is the inner G medium;
2. The L_A medium in which this motion takes place is immobile, except for the elements located in the cavity direction motion, which will temporarily enter the cavity RSS structure and have displacements equal to the radius of the cavity, with <u>normal</u> (perpendicular) directions on<u> its direction of motion</u>.

However, dear reader, a process of local variation in the state of the elements of a medium that is transmitted gradually (from element to element), as seen in chapter 6 of [1], is called *propagation*.

5 - Cavitary propagation

As we have seen during this paper, a cavity in an L_A medium occurs as a result of two types of generating processes:

- A variation of the local state of energy per medium element[10], a variation that leads to a phase change (also local) of the medium, from phase L, to phase G;
- A stream of elements of a G medium, either introduced (blown, injected) at a certain position in the L medium, or collected locally from the gases dissolved in that medium.

Under the influence of a pressure gradient (an uneven distribution of baric stochastic energy flux) in the L_A medium, this cavity moves in the opposite direction to the gradient.

Comment 5.1: It should be noted that both a cavity and a solid body (a plastic bubble) with the same dimensions will be driven (pushed) by Archimedes' force due to the pressure gradient, however, while the RSS of a solid body is always made up of the same elements (polymer molecules), the cavity RSS elements will always be different, as we saw in the previous paragraph.

In chapter 6 of [1], when we spoke of propagation, we referred mainly to waves propagating through various media, with speeds proportional to the intensity and frequency of interactions between the elements of the medium, the gradually developing object that propagated being the *wavefront*. This object is an Euler spatio-temporal distribution of the variation of the intensity of the interaction between the elements of the medium, a variation that is transmitted from element to element.

Comment 5.2: It is worth noting that the variations transmitted through the medium in the case of waves have such values that they remain reversible, being well below the value that would lead to a

[10] In this case we are talking about cavities (bubbles) that contain only elements of the L medium (vapours), produced in the cavitation process, not cavities that contain dissolved or blown gases.

change in the type of medium at the wavefront. We do not encounter the same situation in the case of cavitation bubbles, in which case the source of local disturbance of the medium state is a free vortex.[11], produced by a radial-uneven distribution of the velocity of the fluid elements. In such a vortex, if the velocity of the central elements of the vortex is high enough, the static pressure decreases so much that in the central zone there is a phase change of the medium from phase L to phase G, with the appearance of a separation surface at the interface between the two media (see also fig. 6.2). This real separation surface (RSS), initially ellipsoidal in shape (in the case of cavitation), will change due to the surface tension, after a few oscillations, in a spheroidal surface. Depending on the density of the energy distribution of the stochastic fluxes in the L_A medium (baric and heat flux), the lifetime of the cavity thus formed will be proportional to this density.

Regardless of the type of generating process, the cavity formed in the L_A medium has an RSS, an object that we analysed in detail in par. 3 of this paper. Taking into account the definition of RSS in chapter 7 of [1], as a transit area from the parameters of the internal G medium to the parameters of the external L medium, it results that the cavity RSS is also a state variation of the L medium, but with a change in its phase. Under the influence of an uneven distribution of the energy flux density in the medium, such a state disturbance will propagate at a rate proportional to the magnitude of the non-uniformity (gradient) of the flux density. We call this particular type of propagation, possibly exclusively in the L_A media, *cavitary propagation*. If we look at the two types of propagation that we have identified as being possible in the L_A media, we will note that:

1. The propagation of waves (the only possible waves in the L_A media being those of compression, longitudinal) is done with a speed specific to a certain type of medium, proportional to the frequency and intensity of bilateral interactions between elements. The wavefront (propagating object) cannot be located as it is in constant motion. This is the wave-like aspect of the propagation phenomenon in the L_A media.
2. Cavitary propagation (possible only in the L_A[12] media) takes place under the influence of a pressure gradient, with a velocity proportional to this gradient and inversely proportional to the viscosity of the medium. In a medium without pressure gradient the cavity can be located (invariant position vector) relative to an external reference system (RS). Also with respect to the same RS, in case of a pressure gradient, a Lagrange distribution (a trajectory) can be defined for the moving cavity. This is the corpuscular aspect of the propagation phenomenon in the L_A media.

6 –Types of closed fluxes in the cavities in the L_A media.

We have seen so far that in a cavity in a medium without a pressure gradient, the flux of the inner G medium is a purely stochastic flux, therefore without a common component and in global rest with respect to a reference outside the cavity. We also saw that in an L_A medium with a pressure gradient, a component coherent with the direction opposite to the pressure gradient appears in the G medium inside the cavity, a component that determines the displacement of the cavity in that direction with a speed directly proportional to the gradient modulus and inversely proportional to medium viscosity. A common example of such cavities is insufflation, in which the gaseous medium (air) inside the cavity is produced (for example) by the expiration of a diver (see Fig. 6.1).

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[11] A free vortex is produced by a flux with a circular motion, with initial velocity, but without subsequent maintenance, thus it is maintained only until the dissipation of the energy initially stored due to the viscosity of the fluid.

[12] When we talked in chapter 6 of [1] on the maintenance of media, we have seen that L_A media are forced holding media, for their maintenance an energy barrier is needed that forces the elements of the medium to remain in permanent contact. Usually this barrier is static pressure, and if this pressure drops below a certain threshold, there is a change in the phase of the medium, with the occurrence of a cavity.

Fig. 6.1

In this case, the size of a cavity (bubble) reaches 10-15 cm, the leading cap is spherical, and the trailing cap tends towards an isobar (a flat surface). The internal flux of the air+water vapour mixture is as described in par. 4, a flux coherent with the direction opposite to the pressure gradient and stochastic flux due to external hydrostatic pressure and surface water tension.

When we discussed the phenomenon called cavitation, we saw that the generation of cavities is based on an open flux of the L_A medium, a flux of either displacement or propagation, which at some point turns into a free vortex, namely it closes locally. Depending on the intensity of the generating flux, at the center of such a vortex the velocity of the L_A medium can reach such values that the static pressure falls below the liquid state holding value, a phase transition from state L to state G taking place. As a result, in the center of the vortex a cavity containing gaseous elements of the L_A medium appears.

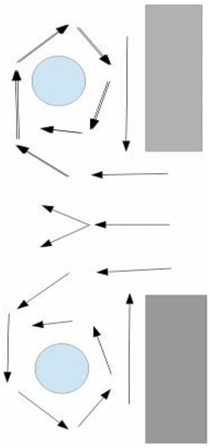

Fig. 6.2

Comment 6.1: Fig. 6.2 outlines the occurrence of a toroidal vortex following an intense but short-lived flux through a hole in a wall. Everything is due to the pressure balance in the fluid medium. In the jet area (represented by the horizontal arrows) the static pressure decreases, which leads to the occurrence of a concentric current towards the orifice, a current that closes with the formation of a vortex. In this vortex the fluid velocity distribution is uneven, increasing towards its center. Increasing the fluid velocity means decreasing the static pressure to the limit of maintaining the state L, below which the $L \rightarrow G$ phase transition takes place in the coloured circular area. In this area the vortex flux is maintained in the inner G medium, a closed circular flux[13] whose normal component on the RSS of the cavity will counterbalance the hydrostatic pressure of the L_A medium and the one due to the surface tension.

An example of such man-made cavities[14] in Fig. 6.3.a, in which two of the three cavities touch and concatenate[15] at a certain time (Fig. 6.3.b).

[13] No axial component. This is the axis of the toroidal cylinder.
[14] However those produced for fun by dolphin also frequently observed.
[15] A process we will be discussing in the photon model proposed by objectual philosophy.

a *Fig. 6.3* *b*

In addition to the spheroidal or toroidal cavities described so far, there are cavities similar in internal structure to the toroidal ones, but this time longitudinal (with axial component), which appear for example at the top of the propeller blades, where vortices develop and we have seen that a vortex can lead to the phase transition of the medium. This time the flux of the inner G medium has both a rotational (due to the vortex) and a longitudinal (axial) component due to the displacement of the propeller relative to the medium.

7 - Conclusions

1. In certain circumstances in an L_A medium (e.g. water) cavities filled with a G medium may occur, a medium consisting of either the same elements as the L medium (water vapour) or of blown or dissolved gases;
2. The process of generating cavities produced in a liquid by phase transition in the center of a free or forced vortex is called cavitation;
3. The G medium contained in the liquid cavity moves under the action of a pressure gradient in the direction opposite to the gradient, by cavitary propagation, even if the L medium is immobile;