4-DIMENSIONAL FIELD OF LIGHT AND SHADOW

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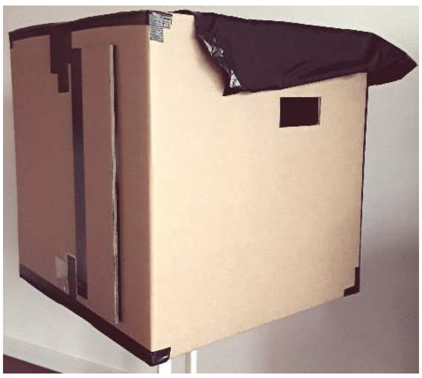
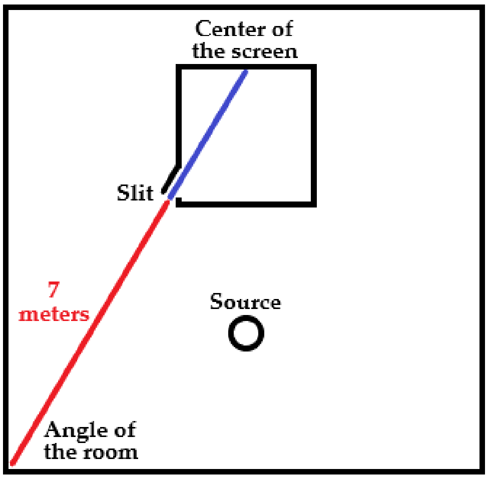
Abstract

The model of a light source able to give the space characteristics of a photon directly in the observation reality, without instrumentation, has already been thought of and then refuted due to its complexity to realize. By this discovery, we see that a specific source allows its validation. This source of almost spherical shape and made of vertical bands diffusing its brightness in a room, we observe in a box equipped with a vertical slit bright and dark vertical fringes; and seeing that these fringes remain vertical when we incline the source, we deduce the presence of a field that involves space. By placing a 3d coordinate system on the fringe screen, we see that this one is directly false, when the inclination of the source varies, by the trajectories of nearby fringes which overlap in incompatible spaces. The geometric configuration on screen requiring adding exactly one dimension to this coordinate system to eliminate these incompatible spaces, we transform it into a coordinate system of the horizontal field in the box by adding the dimension, then we return to a coordinate system in shape 3d of box space which confirms the addition of this dimension orthogonally to the other three in Euclidean, thanks to specific 4d geometry links that bring new properties to the dimensions. In the 4d reality of the box, we obtain the dimensional characteristics of a photon in the horizontal field and a property of discontinuity in direct propagation in space for light and shadow.

The source is a spherical structure of diameter 29.5cm sectioned at the bottom made of 42 bands of average width 1.26cm opening on 42 slits of average width 0.95cm at mid-height. It can be equipped with a bulb with one or two vertical filaments positioned in its center.



The box used measures approximately 60cmx60cmx60cm. One can also use a box with a little more depth between the slit and the screen and/or a higher height, but it is better to limit the width so that the horizontal movement of the fringes on the screen is observed weak everywhere. On the side, the vertical slit is of high length and in front of it there is a white screen.



Positioning, not to scale, of the box in top view. The center of the screen, the slit and the angle of the room are aligned. A minimum distance of 6.50m between the slit and the angle must be taken if one wishes a regular image.

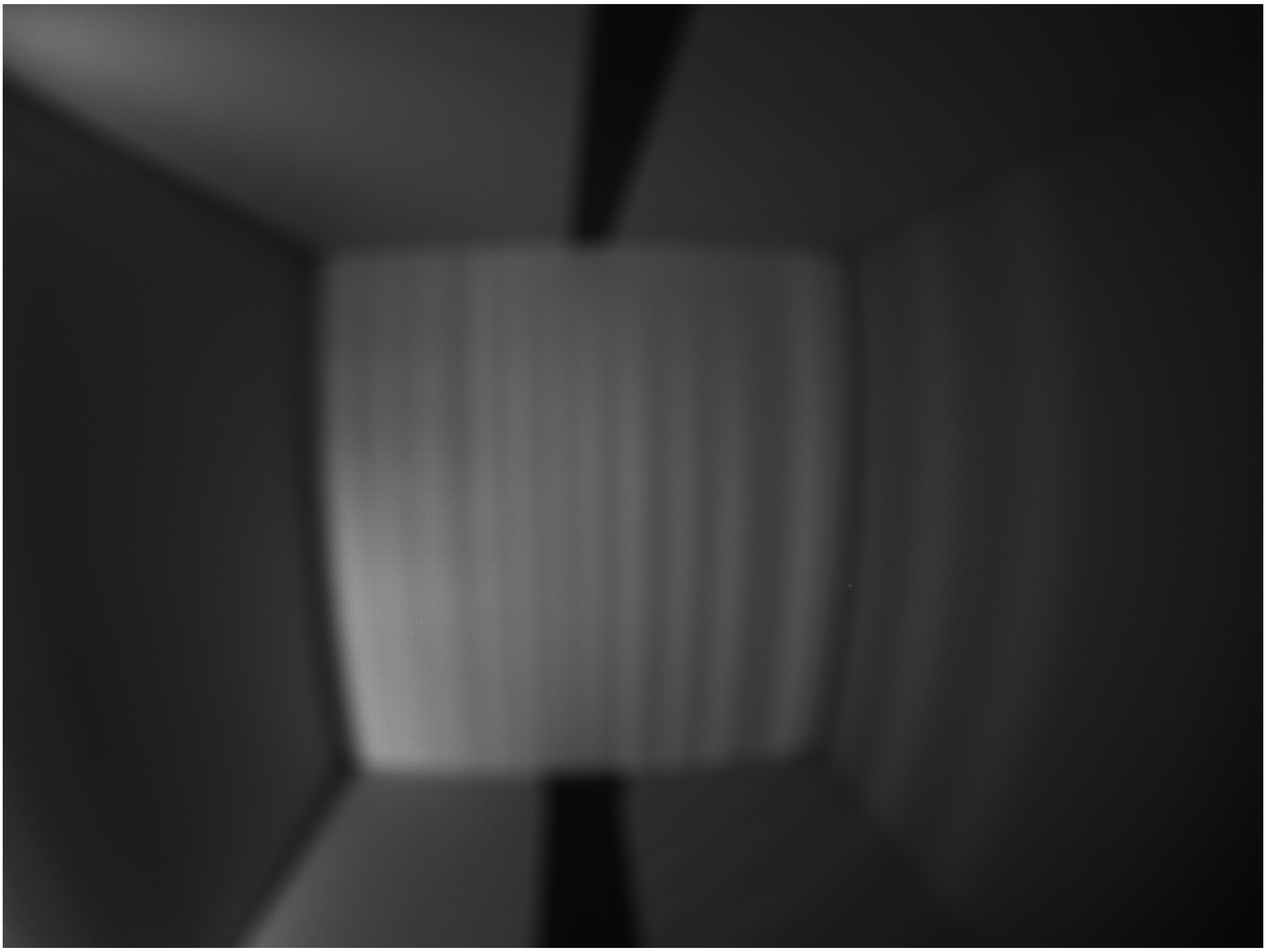
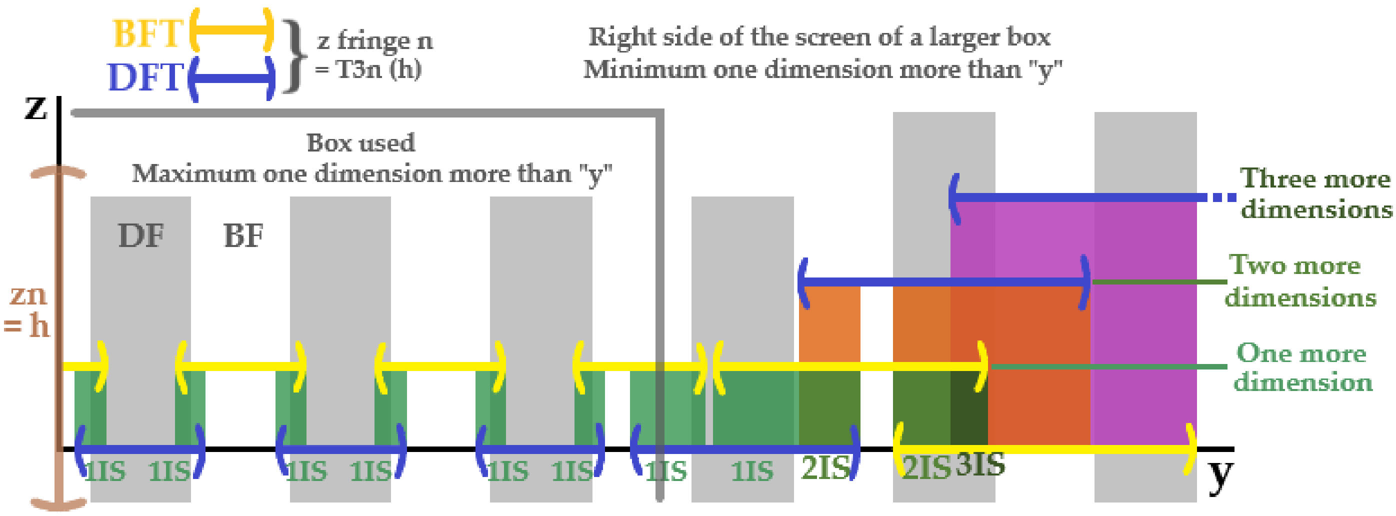
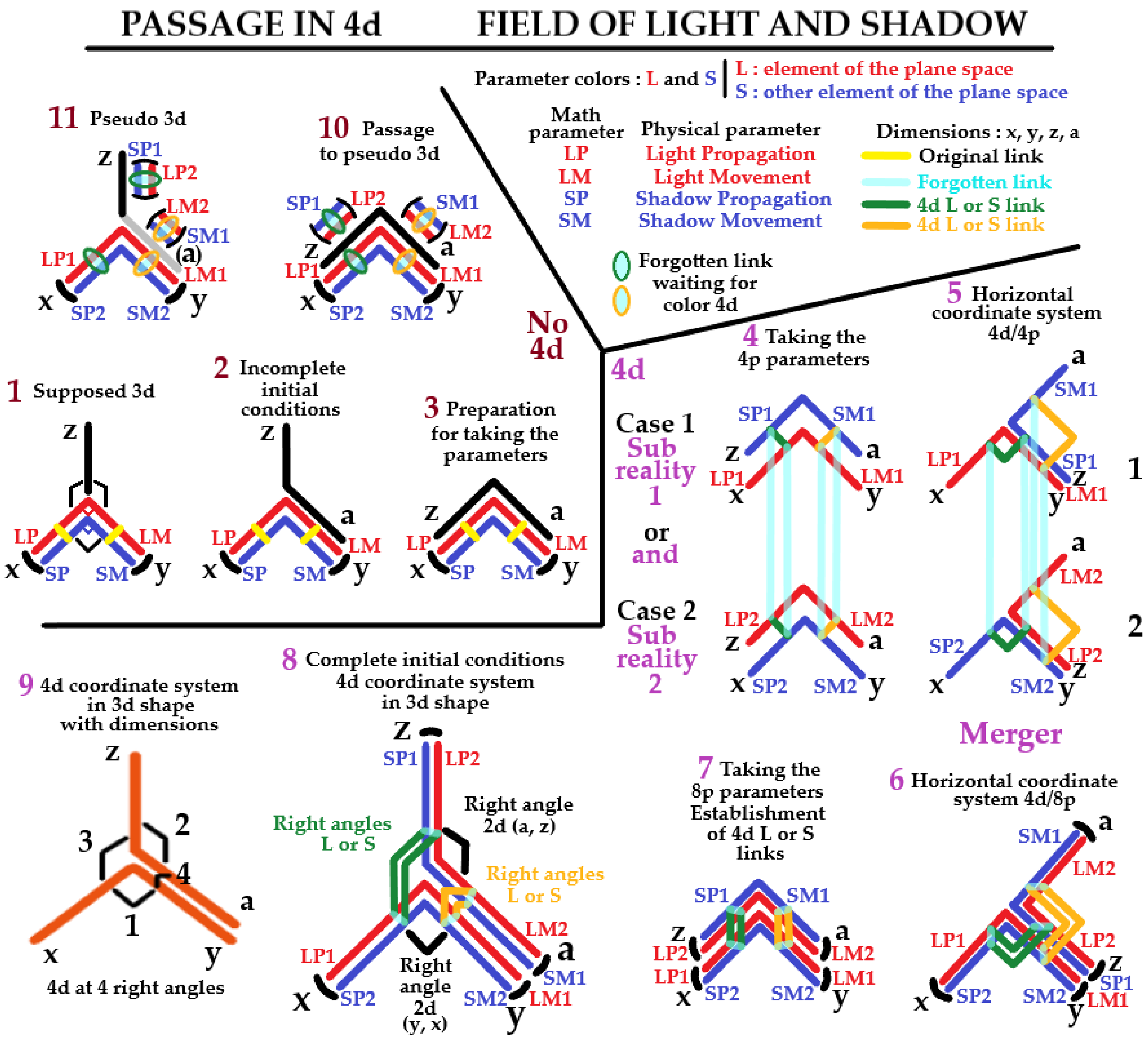


Photo of the fringes made with an astronomy camera. In order to gain brightness, the slit is positioned only 5.50m from the angle of the room. The bulb used is one filament. With two filaments, the fringes have a little more relief and are a little less delimited.

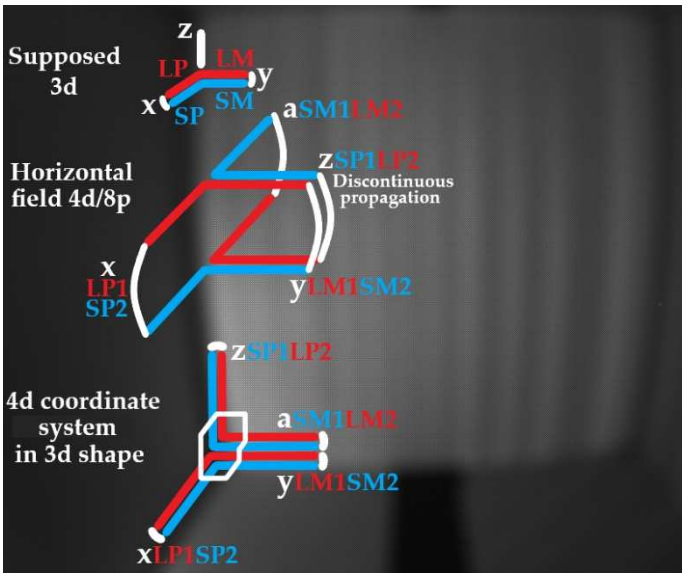
If the source is kept inclined, as if one does a freeze frame of the movement of oscillations, the astronomy camera photographs the vertical and straight fringes in the box and one observes them on the computer screen, in blue. The distance that separates the slit from the angle of the room is 5.50m.



IS: Incompatible Space; DF: Dark Fringe; BF: Bright Fringe; DFT: Dark Fringe Trajectory; BFT: Bright Fringe Trajectory. In the diagram, the DFTs are positioned with priority on “y”. To eliminate ISs, the number of dimensions to add in addition to “y” on the screen depends on the number of ISs on “y”. Large box: minimum number of ISs on “y” overlapping or not = 1; box used: maximum number of ISs on “y” = 1; i.e. we need exactly one dimension in addition to “y” on the screen.



Passage in 4d. Only the new 4d phases are represented. In order to interpret transfer phases 4, 5, 6, 7, 8 and 9, it is necessary to change the color of the numbers of the new phases 4d to NO 4d color and the 4d L or S links to output links, the titles in black being geometrically valid for both, 4d and transfer. Finally, it is requested to delete the forgotten links.



The supposed 3d, the horizontal field 4d/8p and the 4d coordinate system in 3d shape are in position on the fringe image. The slit is located in the extension of "x". In the horizontal field, we see the discontinuous propagation zSP1LP2 positioned on the screen.

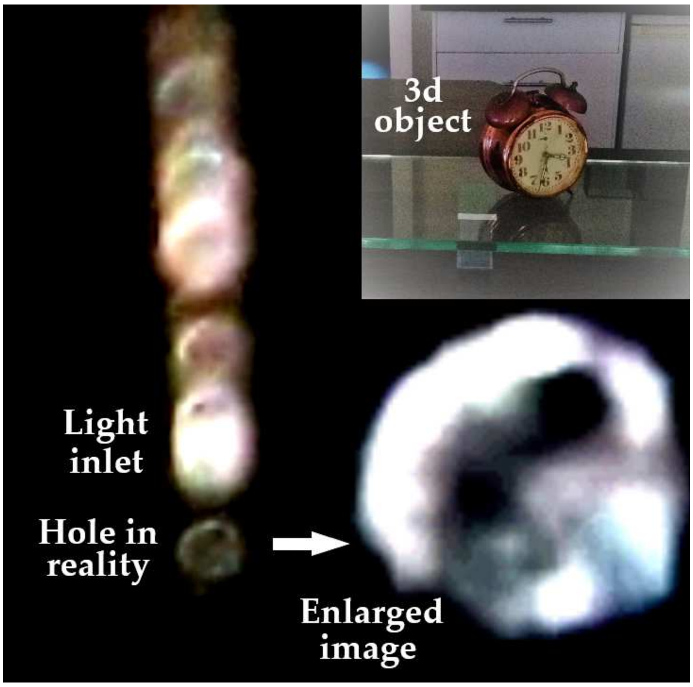


Image of a "hole in reality" obtained using a camera equipped with a small, drilled box placed on the lens, the source being equipped with a bulb with one vertical filament. The brightness of the field that comes inside the box reconstitutes the image of a 3d object located in the field.

The bright and dark fringes

The source consists of a vertical band cover in the shape of a sectioned sphere of precise size equipped with a halogen bulb with one or two vertical filaments in its center and produces vertical light beams and shadow volumes. It is hung by its power cable in a room in which a box of about 60cm of edges with a vertical slit a few mm wide and a screen is placed at 7m in the direction of an angle so that the center of the screen, the slit and the angle are aligned. First, we observe in the box bright and dark fringes vertical and straight from the very top to the very bottom of the screen, the light beams and shadow volumes being sectioned vertically from the slit. Then it becomes very interesting if the source is pushed in any direction so as to impose it large oscillatory movements avoiding a rotation movement on itself, because the fringes remain vertical and distinct and adopt a very weak horizontal movement on either side of a vertical axis positioned in the center of the screen, which makes the phenomenon quite impressive from an observational point of view. With a larger box, these fringes are just as impressive because even higher and still well vertical, distinct and straight, but the phenomenon makes that they have a lot of lateral travel at the left and right ends of the image when the source is oscillating, this is why the use of a box of about 60cm of edges allows to select a 3d space volume in which the horizontal movement is weak everywhere, which delimits a precise space and simplifies the analysis.

The field

The diffraction phenomenon being not considered at the slit level, the latter being wide compared to the wavelength, and the diffraction by the slit edges being not observed, we should be able to use the principle of the reverse return of the geometric optics between the image of the fringes and the walls of the room facing the slit to reconstitute on these walls the images of the reflections. However, the particular drawing of the vertical fringes imposes, in reverse return, to observe on these walls vertical bands, and when the source is inclined, we see very inclined bands or absent depending if it is downright the beam of conical shape projected down the source that lights them, which means that the reverse return does not work. Moreover, as we observe in the room the real images of the inclined bands on these walls and that these real images reach the slit, and considering the beams sectioned vertically that allow the tracing of light rays in straight lines in the box, it is not possible to trace the light rays in straight lines at the passage by the slit, which determines an assured break of the geometric optics at the position of the slit, the shadow projections being not traced in straight lines either. Considering this rupture and the regularity of the 2d horizontal movement of light beams and shadow volumes in the box, we see that we have to deal with a field that involves space. We call it the “field of light and shadow”.

4 dimensions of real space to explain the phenomenon

A dimension designates a line whose geometric content describes the continuous real space; a dimension “emptied of its geometric content” being valid in Euclidean space with its parameters adapted to continuous real space.

In order to learn more about the space exploited by the field, we place in the supposed Galilean reference frame of the experiment room and in the Euclidean space, a right-handed 3d orthogonal coordinate system (x, y, z) of oriented Euclidean vector space of center O with “x” in slit-screen dimension, “y” the horizontal dimension positioned on the screen of the fringes and “z” the vertical dimension ; and although we can’t use the geometric optics at the slit level, we use the fact that the fringes observed are indeed the images of the cover with the bands of the source and therefore that each fringe on the screen has a volume of light or shadow source in the room which is for itself. Let Pn be a fixed point of a source volume numbered n, and Fn the transformed point of Pn, positioned on the fringe numbered n attributed to this volume, for a complete displacement of the source in a given direction when it is in oscillations, if dzPn is the vertical component of the small displacement $\overrightarrow{dPn}$ of the point Pn, and if $\overrightarrow{dFn}$ is the small rectilinear horizontal displacement observed of the point Fn, T3n being the transformation which transforms dzPn into dzFn, dzPn is solution of the displacement equation dzFn of $\overrightarrow{dFn}$:

$$\overrightarrow{dPn}\begin{cases} dxPn \\ dyPn \\ dzPn \end{cases} \qquad \overrightarrow{dFn}\begin{cases} dxFn = T1n\ (dxPn) \\ dyFn = T2n\ (dyPn) \\ dzFn = T3n\ (dzPn) \end{cases}$$

The dzPn taking place continuously on the vertical space zn of "z" which is the height of the room h, i.e. zn = h, the dzFn observed over the entire horizontal trajectory of the fringe n take place on this vertical space zn = h transformed:

$$z\ fringe\ n = T3n\ (zn) = T3n\ (h)$$

That is to say, the fringe n travels the transformed vertical space of the room height T3n (h) on its horizontal trajectory. In transformation from a point to a point, a single point transformed on "y" cannot have several untransformed points of different heights. When different offset fringe trajectories overlap on "y", "y" sees "z" with various spatial positions of "z" at the same point of "z", i.e. with a geometric content supposed to describe the continuous real space which is deformed; and "z" seeing itself in good condition because it locates the position of the source volumes at a single height of room h, "z" is falsified and the 3d coordinate system is also. We call the length on "y" of overlap of two different fringe trajectories "incompatible space". On the screen of a larger box, as all the fringes have horizontal movement and that one fringe trajectory makes minimum one incompatible space with the fringe trajectory to its left and one incompatible space with the fringe trajectory to its right, we need minimum one more dimension to put these fringe trajectories of left and right if they don't overlap between them and don't cause the overlap of two incompatible spaces, and if one fringe with strong horizontal movement causes the overlap of two incompatible spaces, we need two more dimensions, three incompatible spaces three more dimensions, and so on, to eliminate incompatible spaces. But with the box used, according to the weak horizontal movement of all the fringes, all the trajectories of the bright fringes can be arranged on a line without overlapping and it is the same for the trajectories of the dark fringes, which means that we need maximum one more dimension to arrange the trajectories of the dark fringes if the trajectories of the bright fringes remain arranged on "y" or to arrange the trajectories of the bright fringes if the trajectories of the dark fringes remain arranged on "y", and therefore that we need exactly one more dimension on the screen to eliminate incompatible spaces, with two possible cases of arrangement. This dimension being necessary for a given direction of the oscillatory movement of the source, but also for all the directions of pushes at 360°, because the movement of the fringes remains weak, we are informed on the quality of the field which is excellent at any point in the room. In the passage to 4d, we will geometrically add the dimension in the coordinate system by transforming it and we will see that both cases are done at the same time. We go into the box.

Passage in 4d

Knowing that we have placed in 2d (y, x) the slit-screen dimension in "x" and the screen dimension in "y", the only way to make these cases is to separate shadow and light in this 2d at phase 1 using parameters specially set for box space, i.e. two shadow parameters, SP the propagation of shadow in "x" and SM the movement of shadow to which we attribute the trajectories of the dark fringes in "y", and two light parameters, LP the propagation of light in "x" and LM the movement of light to which we attribute the trajectories of the bright fringes in "y", position at phase 2 the additional dimension we call "a" coincident with "y" and with the same orientation, transform horizontally the 2d (a, z) at phase 3, and transfer to this 2d (a, z) either SP and SM in case 1 or LP and LM in case 2 at phase 4. According to the usual technique of adding a dimension in the horizontal plane, after adding “a” orthogonally to “y”, we obtain at phase 5 the 4d/4p 1 coordinate system of case 1 or the 4d/4p 2 coordinate system of case 2, each one being without incompatible spaces because SM and LM are in different dimensions, but observationally incomplete because the first has only light propagation in “x” which allows it to display only bright fringes on the screen, and the second has only shadow propagation in “x” which allows it to display only dark fringes. We would like to have a single observationally complete coordinate system of the horizontal field with LP and SP in “x”, but if we merge these two 4d/4p coordinate systems, as each one follows independently from the 3d reality of start, the merged coordinate system obtained is not in continuity of the reality of start but it is there twice. Moreover, when we merge at phase 6 and transform this merged coordinate system from phase 6 to phase 7 by rotation at a right angle, in the horizontal plane, of the 2d (a, z) in the opposite direction, as phase 7 is the same as phase 4 but merged, we should be able to go there from phase 3, but with the transfer this is not possible because the number of parameters is doubled after merging. Despite this, we will validate the merger after transfer by validating phase 7 of transfer by making a “copy-cross” to go from phase 3 to a new phase 7 of the 4d reference frame geometrically compatible with phase 7 of transfer, for phase 3, thanks to the rule of limitation of “geometry links between parameters in and outside dimensions”, which will also validate the new phase 7 in the technique: we replace phase 7 with its transfer parameters and its output links by the new phase 7 which has parameters identical to these transfer parameters for the phase 3, the copy-cross parameters, but with, instead of the output links, internal links constructed in this new phase 7 and limited by phase 3 to the transfer output links.

To be able to alternate since phase 3 between transfer parameters and copy-cross parameters, we assign a number to all the parameters starting at phase 4. Phases 1, 2 and 3: LP and SP are geometrically linked in “x” by an internal link and LM and SM in “y” by an internal link. Transfer phase 3 to phase 4: as soon as the parameters are output from (y, x) and positioned in (a, z) at phase 4, we assign a case number to all the parameters, and we have two output links per case i.e. a total of twice two output links; then we arrive at phase 7 in this same configuration, i.e. with transfer parameters and twice two output links. Copy-cross phase 3 to new phase 7: we copy the parameters of (y, x) into (a, z), or we use parameters from an external contribution which function like these copies. As soon as these parameters are positioned in (a, z) in the new phase 7, we establish the change to the reference frame 4d here, and in accordance with phase 7 of transfer, we assign the number to all the parameters and we cross the links: we take advantage that “x” is coincident with “z” and “y” coincident with “a” to organize the four internal links of the four dimensions “x”, “y”, “z” and “a” of the 4d reference frame so that one dimension keeps a parameter of one color and assigns to itself the parameter of the other color of the coincident dimension. The dimensions being colored by the parameters at one parameter per dimension in phase 4, they give a link of the color of the parameter kept, and we obtain color links per side, i.e. two L links or two S links between “x” and “z” on the left and two L links or two S links between “y” and “a” on the right. Having the choice since phase 3 between a phase 7 with output links and a new phase 7 with internal links, the limitation rule limits in terms of properties the links obtained to output links, which means that immediately constructed, the 4 internal color links of the 4d reference frame of the new phase 7 are limited by the 3d to the transfer’s output links. This limitation rule is very good because firstly, it validates the links obtained. Secondly, limiting internal links to output links allows the parameters and trajectories of fringes of different colors to be geometrically isolated between different dimensions, which eliminates incompatible spaces, the merged dimensions being "emptied of their geometric content". Thirdly, the links obtained have the properties of output links, that is to say full-fledged geometry links which “remember” what happens geometrically from the starting 3d between parameters, dimensions, and also between planes, because we work by transformations of planes. We call them 4d L or S links. Fourthly, the new phase 7 being geometrically united with the transfer phase 7 by this limitation rule, the technique is validated and the copy-cross parameters and the 4d L or S links are distributed to the new phases 6, 5 and 4 of the 4d reference frame, the internal links of the 3d forgotten by the dimensions of the 4d reference frame during the copy-cross being called “forgotten links”.

Fifthly, as the new phase 7 of the 4d reference frame follows directly from phase 3 and the starting 3d, the 4d reality merged at the new phases 7 and 6 is located in continuity of the starting reality of phases 1, 2 and 3. By unmerging the new phase 7 into the new phase 4, we unmerge this 4d reality into two 4d sub-realities united by an "and" each with a number 1 or 2 which is the one assigned during the copy-cross. Sixthly, having validated the frame of reference of the observable horizontal field of the new phase 6, this frame of reference is already present in the starting reality to observe the field, which makes it possible to give the exact provenance of the 4d parameters of (a, z): when we go from phase 3 to the new phase 7 and indirectly to the new phase 4, we do not directly copy the parameters of (y, x) into (a, z) because this amounts to adding parameters already present, but we use parameters from an external contribution which function like these copies. This means that, in addition to the parameters that we set in 3d, the technique involves new ones which come directly from 4d space. Now, we go from new phase 7 to new phase 8, and we obtain a new property of the dimensions. If we look at the two 4d L or S links between "y" and "a", when we lift the plane (a, z) at a right angle with the plane (y, x) to return to a box space in 3d shape, each of them makes this same right angle between the planes directly between the dimensions, which defines two pivots at right angles between "y" and "a". And as one link is given by "y" and the other by "a", we obtain the direction of these pivots. For the "y" link, it is "y" that feels the pivot, and for the "a" link, it is "a" that feels the pivot.

Pivot "y" with respect to "a" = $\pi/2$
Pivot "a" with respect to "y" = $\pi/2$

In this 4d coordinate system in 3d shape, the right angle being the same for one or both pivots, "a" is orthogonal to "y" by two pivots of $\pi/2$. Regarding "x" and "z", as we make a right angle between them to lift the 2d (a, z), it is a simple right angle between dimensions that unites them, which can be, as with the pivots, subdivided into two right angles of the planes (y, x) and (a, z) directly between "x" and "z". In the 4d coordinate system in 3d shape of new phase 9 which summarizes the right angles, we count the right angle number 1 of the 2d (y, x), the right angle number 2 of the 2d (a, z), the right angle number 3 between the dimensions "x" and "z", and the right angle number 4 of the two pivots between "y" and "a" i.e. :

"x" orthogonal to "y" orthogonal to "a" orthogonal to "z" orthogonal to "x"

The particularity of these coordinate systems 8 and 9 being, because of the orthogonality between "y" and "a", that we can't give the orthogonalities between "x" and "a" and between "y" and "z" unless we switch to 3d. Which returns in 3d to phase 2 and allows us to confirm the addition of the dimension orthogonally to the other three when going to 4d. We use 3d to obtain the position of the axes, with in particular "y" and "a" coincident, and 4d in which "y" and "a" are fundamentally orthogonal, to give all the necessary orthogonalities:

"x" orthogonal to "a" and "y" orthogonal to "z" in 3d; "x" orthogonal to "y", "a" orthogonal to "z" and "z" orthogonal to "x" in 3d and 4d; and finally we place ourselves in 4d with "a" orthogonal to "y".

In Euclidean, this means that the dimension is well added orthogonally to the other three in the 3d coordinate system since the coordinate system of 3d Euclidean vector space is transformed into a 4d coordinate system formed of two orthogonal planes that is compatible with the scalar product and also valid in Euclidean. Although the merged dimensions of the 4d reality are compatible outside the box because initially set in 3d for the whole experiment space, they are the result of merging dimensions each colored by a parameter of box space at the 4d sub-realities, which implies that the 4d coordinate system in 3d shape is fundamentally a coordinate system of box space. Regarding the incompatible spaces we have in

3d on “y”, just switch to 4d to eliminate them: the T3n (h) described by the horizontal trajectories of the fringes are directly taken into account by the light and shadow parameters of “y”, which are geometrically linked to the shadow and light parameters of “a”, which does not create incompatible spaces, the overlap spaces being neither in “y” nor in “a”. Finally, we end with phase 11 with pseudo 3d which is a 4d coordinate system in 3d shape without the parameters of (a, z) in which the “forgotten links waiting for color 4d” are ready to accommodate these parameters. Pseudo 3d is useful for easily seeing this underlying dimension “a” of the observed space.

Field and photon

We obtain the characteristics in space dimensions of the horizontal field and of a photon in the 4d reality of the box. The two 4d/4p coordinate systems of the 4d sub-realities of the new phase 5 are merged into an observationally complete 4d/8p coordinate system of the horizontal field in the new phase 6, which gives the characteristics of an observable photon $E=hC/\lambda$ at a point of the horizontal field i.e. 4 dimensions and 8 parameters 4d/8p, this photon itself being made by two 4d/4p sub-parts each formed by a 2d light and a 2d shadow.

Discontinuous propagation

After noticing, from the image of the fringes, that zSP1 positioned on the screen in the 4d/8p coordinate system of the new phase 6 is a discontinuous propagation of shadow because of its orthogonality with LP1 in “x”, the shadow propagating along the screen only where we see it i.e. at the dark fringes, and that zLP2 positioned on the screen still in the 4d/8p coordinate system of the new phase 6 is a discontinuous propagation of light because of its orthogonality with SP2 in “x”, the light propagating along the screen only where we see it i.e. at the bright fringes, we obtain a property of discontinuity in direct propagation in space for the light and the shadow, zSP1LP2 being a “double discontinuous propagation of light and shadow observed on the screen”. And this interesting property will be useful to create pieces of light and shadow stopped or suspended in space like holograms using the field of light and shadow and its geometry.

The experience is just beginning

By using a smaller box in which we let in a little brightness of the field, positioned on an eye or equipped with a camera, we see the light propagate in the darkness of the box in the shape of small luminous discs, and among the few special observations already made, we can note the “hole in reality” which is the transformation of one of these discs into the image of an area of the 3d space located in the field viewed from a position different from the observation position, i.e a shortcut of space directly observable, which can be useful for example to observe an area hidden by 3d relief. But the light and shadow field will also demonstrate a great compatibility with the observer’s thinking, its discovery marking the beginning of new physics, more natural.

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