The FLUID OPTICS™ letter

La lettre des Syzygies

December, 2000

EDITORIAL

We have the pleasure to present you the letter of the sizygies of the winter solstice in which you will find two articles: a first on the various types of flux and their various states of order in answer to a question put by one of our readers, the second on a really innovative glass not as the others.

The inventors of the Fluid Optics

PRODUCTS

SGGPRIVA-LITE : Intelligent glass

We take advantage of this article to present to you SGGPRIVA-LITE® from Saint-Gobain, a double glass with interesting optical properties which should interest many subscribers.

We were working on materials with interesting optical properties

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SUMMARY

THEORY

Classification of flux by their various types and their various states of order

To create an optical system able to succeed in an optical mission, we need to know how to transform any flux, with any level of disorder, into a perfectly organized flux. To solve this problem in its generality, it is necessary to know the types of adequate geometrical tools to create the optics able to organize this initial flux.

Some following examples well illustrate the necessity of knowing how to handle a flux coming from several sources, extended or not, and transform it into an organized flux intended to :
- the imaging projection, of microscopy, of macroscopy,
- or to create homogeneous beams with net edges used in the show business,
- or to create beams of light with outlines well defined for the architecture or for the low beams projectors of the automotive industry,
- or to create a flux fo light, enough fine and dense to enter into a head of optical fibre.

The present article should make the reader sensitive to the characterization of the various types of order of the

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flux which one can meet. The characterization of these flux is fundamental for the research of the curves or necessary geometrical surfaces to create optics. All these optics are intended to organize the even very muddled, initial flux, until the orderly final state.

A correlation between the state of order of the flux and the geometry of optics seems to appear through the study of some hundreds studied optics with very different functions. Some of these optics were realized. It is evident that the results of these works are not exhaustive. Although we do not think it, it is maybe possible to find exceptions contradicting this statement.

All your presented criticisms will be constructive.

NATURE OF FLUX

This first brief synthesis is situated within the framework of 2D studies. The generalization in the case of 3D configurations is immediate and will deduct it easily.

We notice that all the flux can be classified according to their type and their state of order.

We shall make quickly difference, for example, among the modelling of the flux created with a theoretical punctual simple source and the modelling of the flux created by one or several real vast sources. The real sources are modelled by taking into account their emissive zones, their double globe of special glass-surrounding strands or electrodes and different acting secondary reflections each as small not unimportant independent sources.

This variety of flux requires the creation of indicators. First of all, we are going to define a first indicator of type of flux. Then we shall create an indicator of state of order of flux. States and variations of these two indicators define the nature of a flux.

First indicator: The indicator of type of flux

Let any flux, represented in a 2D space. Let us place on this flux, an optical axis which will be directed in the direction of progress of the light. Let us place in a point $x_{observation}$ of the optical axis a plane sensor, perpendicular to this axis, able to record for every ray the distance $y_{observation}$ to the optical axis and the angle $u_{observation}$ made with the optical axis.

We notice, according to the values of the angle $u_{observation}$,, which the ray is going to cross the optical axis in a point x_i more upstream or more downstream to $x_{observation}$,, or even, if $u_{observation}$, is null, the point of crossing x_i will be thrown back to the infinity.

Let us define for every ray the signature $\sigma(x_i - x_{observation})$ of the difference $(x_i - x_{observation})$. This signature will be able to be respectively negative, positive, null or indefinite as the value of $(x_i - x_{observation})$ will be negative, positive, null or indefinite.

We will say by agreement respectively that the ray is negative, positive or null by misuse of language.

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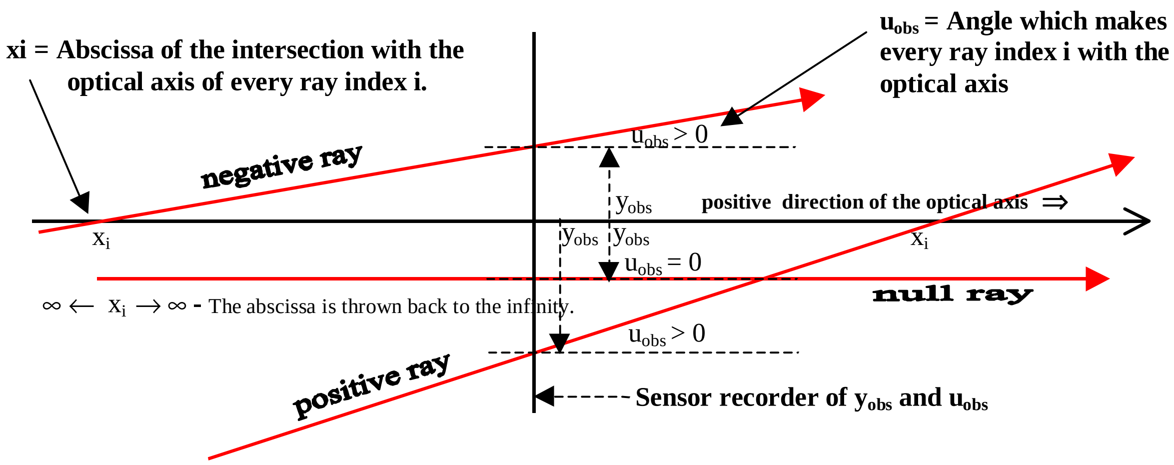
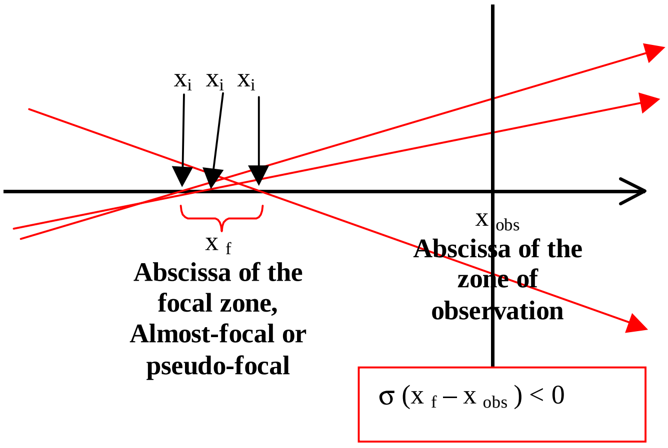
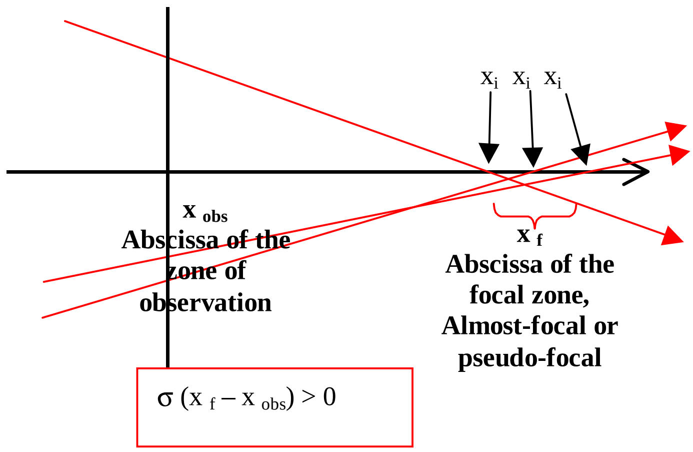


The flux is negative, by agreement, if the signature $\sigma\ (x_f - x_{obs})$ is always negative.



The flux is positive, by agreement, if the signature $\sigma\ (x_f - x_{obs})$ is always positive.



In the case where the signature $\sigma\ (x_f - x_{obs})$ is sometimes negative, sometimes positive, sometimes null or indefinite, the flux is called null by agreement and by misuse of language. This case is a little more complex and can present ambiguities of interpretations (see conclusion).

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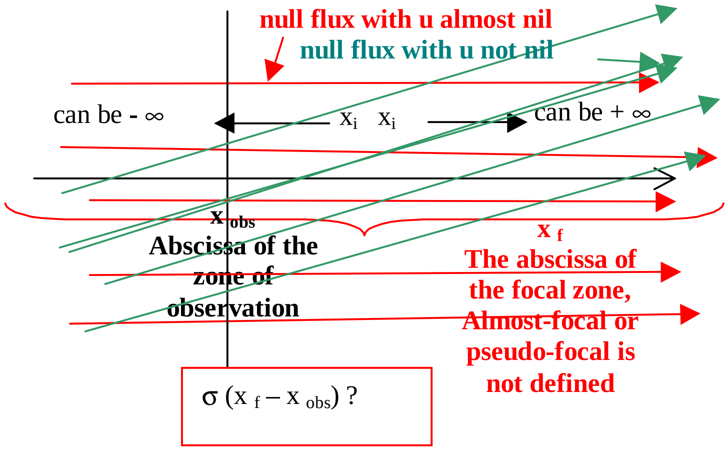


We will deduct from it the following-three definitions, the three types of possible flux.

-A flux is called negative if all the rays are such as all the $\sigma(x_i - x_{observation})$ are negative. We classify in the negative types of flux, the set of the divergent flux (*), almost-divergent (*), pseudo-divergent (*) and jumble-divergent (*).

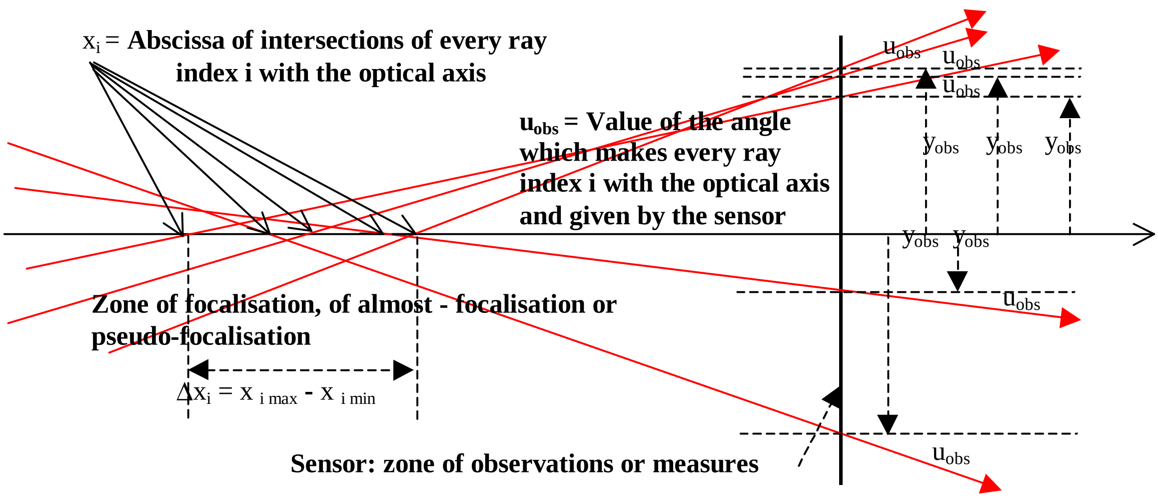
-A flux is called positive if all the rays are such as all the $\sigma(x_i - x_{observation})$ are positive. We classify in the positive types of flux, the set of the convergent flux (*), almost-convergent (*), pseudo-convergent (*) and jumble-convergent (*).

-A flux is said null by misuse of language if all the rays are such as some of the $\sigma(x_i - x_{observation})$ are negative, the others positive, the others still invalid or indefinite. We classify in the invalid types of flux, the set of the parallel flux (*), almost-parallel (*), pseudo-parallel (*) and jumble-parallel (*).

(*) The notion of state of order of flux is defined below.

Second indicator: The indicator of state of order of flux

To simplify study, let us resume the cases of the negative or positive flux.



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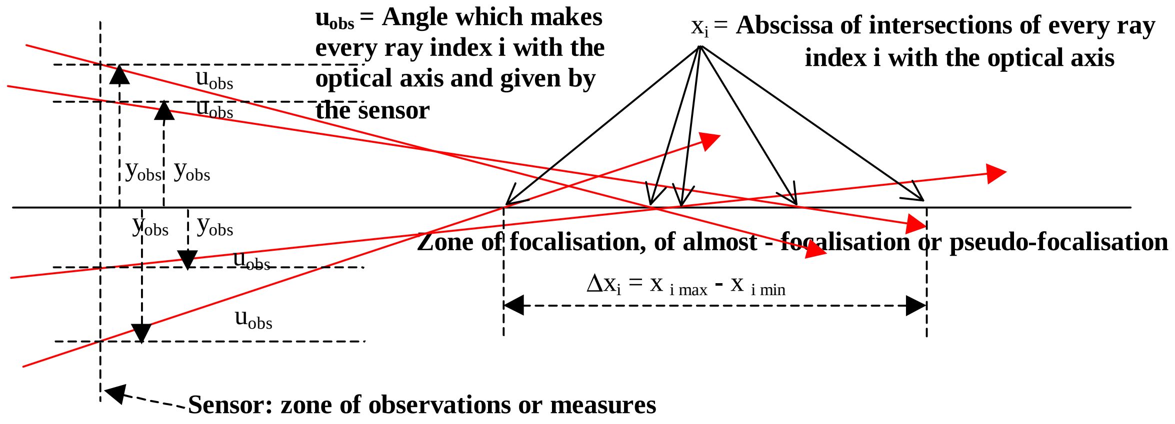

The set of values x_i (intersection of rays with the optical axis), and values y_{obs} (Y coordinate of the rays on the sensor) allow to calculate the following parameters:

$\Delta y_{obs} = y_{obs\,max} - y_{obs\,min}$ is the difference between the maximal and minimal values of y_{obs}.

$\Delta x_i = x_{i\,max} - x_{i\,min}$ is the difference between the maximal and minimal values of x_i .

The values of x_i allow also to calculate the average moy(x_i) and statistical discrepancy $\varepsilon(x_i)$.The values of the ratios $\varepsilon(x_i)/\ \Delta y_{obs}$.

We obtain also from the values of u_{obs}, equivalent values

$\Delta u_{obs} = u_{obs\,max} - u_{obs\,min}$, the average moy(u_{obs}), statistical discrepancy $\varepsilon(u_{obs})$ and $\varepsilon(u_{obs})/\ \Delta y_{obs}$.

We can refine the nature of flux presented above, by extracting the values of the statistical discrepancy of the above parameters $\varepsilon(x_i)$, Δy_{obs}, $\varepsilon(x_i)/\Delta y_{obs}$ and statistical discrepancy $\varepsilon(u_{obs})$, Δy_{obs} , $\varepsilon(u_{obs})/\Delta y_{obs}$.

Strict flux:

As $\varepsilon(x_i)$ = d or c = 0 ou » 0 and that $\varepsilon(x_i)/\Delta y_{obs}$= d' or c' = 0 or » 0, The flux will be divergent if the flux is négatif and convergent if the flux is positif.

As $\varepsilon(u_{obs})$ = p = 0 or » 0 and that $\varepsilon(u_{obs})/\Delta y_{obs}$= p' = 0 or » 0, the flux will be parallel if the flux is null.

<u>flux almost</u> :

As 0 < $\varepsilon(x_i)$ < qd or qc = 1*E-3 and that 0 < $\varepsilon(x_i)/\Delta y_{obs}$= qd' or qc' = 1*E-5, The flux will be almost-divergent if the flux is negative and quasi-convergent if the flux is positive.

As 0 < $\varepsilon(u_{obs})$ < qp = 1*E-3 to 1*E-7 and that 0 < $\varepsilon(u_{obs})/\Delta y_{obs}$= qp' = 1*E-5 à 1*E-9, the flux will be almost-parallel if the flux is null.

<u>flux pseudo</u> :

As qd or qc = 1*E-3 < $\varepsilon(x_i)$ < pd or pc = 1*E2 and that qd' ou qc' = 1*E-5 < $\varepsilon(x_i)/\Delta y_{obs}$= pd' or pc' = 1*E1, the flux will be pseudo-divergent if the flux is negative and pseudo-convergent if the flux is positive.

As qp = 1*E-3 to 1*E-7 < $\varepsilon(u_{obs})$ < pp = 1*E2 and that qp' = 1*E-5 to 1*E-9 < $\varepsilon(u_{obs})/\Delta y_{obs}$= pp' = 1*E0, the flux will be pseudo-parallel if the flux is null.

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flux jumble :

As pd or pc = 1*E2 < $\varepsilon(x_i)$ = any fd and that pd' or pc' = 1*E1 < $\varepsilon(x_i)/\Delta y_{obs}$ = any fd' or fc', the flux will be jumble-divergent if the flux is negative and jumble-convergent if the flux is positive.

As pp = 1*E2 < $\varepsilon(u_{obs})$ = any fp and that pp' = 1*E0 < $\varepsilon(u_{obs})/\Delta y_{obs}$ = any fp', the flux will be jumble-parallel if the flux is null.

CONCLUSION

The conclusions presented here to you are very incomplete. We established other indicators as graphs obtained from the values of y_{obs} and u_{obs} which possess specific appearance as the nature of the flux.

We notice for every ray of order i, when $\pi[y_{obs} \times u_{obs}]$ products are always positive or when $\pi[y_i \times u_i \times \sigma]$ products are always negative the flux is negative.

We shall deduct from it easily the same rules for the other positive or invalid flux.

Very specific cases remain still to clarify. For example, rules governing the almost-parallel flux remain still indefinite. Indeed, these flux have a constant not null average angle u_{obs}, a very weak statistical discrepancy $\varepsilon(u_{obs})$ and every their σ ($x_f - x_{obs}$) can be negative or positive.

It means that it is necessary to be careful well to analyze a state of flux. It is necessary indeed to observe all these indicators and their mutual incidences.

Considering all these precautions, it seems that one can express the following proposition:

The complexity of a flux is in the order of the complexity of curves (2D) or surfaces (3D) which it is advisable to use to process or to improve their order.

It means that more the state of order of a flux will be complex and more it will be necessary to use elaborated geometrical curves to create optics. These optics would be as simple as possible and able to process this flux. It means, as well as, in the case of the flux "strict" or " almost " under the conditions of Gauss, it will be natural and common to use conical or "polynomial" curves. In the other cases, polynomial curves seem not to allow the creation of simple optics.

TABLE OF THE VARIOUS TYPES OF FLUX AND THEIR VARIOUS STATES OF ORDER

DIRECTION OF IMPROVEMENT OF THE STATE OF ORDER OF THE FLUX ← → DIRECTION OF DEGRADATION OF THE STATE OF ORDER OF THE FLUX

	flux STRICT	Flux ALMOST	flux PSEUDO	Flux JUMBLE
	The flux is perfectly ordered (the flux is unreal - the emissive zone is punctual - the focal zone is punctual)	The flux is very slightly degraded (the flux is real - the emissive zone is not punctual - the "focal" zone is not punctual (it is an almost-focal zone))	The flux is very degraded (the flux is real - the emissive zone is vast - the "focal" zone is vast (it is a pseudo-focal zone))	The flux is completely degraded (it can also correspond to a real flux - the emissive zone is multiple and very vast - the "focal" zone is multiple and very vast (it is a multitude of pseudo-focal zones))
Type of application	Theory and traditional simulations	Traditional optical theory and traditional applied optics under the Gauss conditions	Not traditional applied optics and not traditional optical theory (the conditions of Gauss are inapplicable)	Not traditional applied optics and not traditional optical theory (the conditions of Gauss are inapplicable)
Type de traitement mathématique et géométrique du problème optique possible	Treatment by conics with or without condition of Gauss	Treatment by polynomial equations of degree 2 or more, with condition of Gauss for the traditional optics, or, with or without condition of Gauss for the Fluid Optics.	Treatment by equations not polynomial.	Treatment by equations not polynomial.
Tools of traditional treatment of the optical problem	Possible treatment by the traditional optics.	Possible treatment by the traditional optics.	Delicate treatment by the traditional optics	This treatment seems unthinkable by the traditional optics. (We did not manage to resolve these optical problems by the traditional optics)
Tools of fluid treatment of the optical problem	Possible treatment by the Fluid Optics	Possible treatment by the Fluid Optics	Possible treatment by the Fluid Optics	Possible treatment by the Fluid Optics
logiciels de l'état de l'art utilisables	The software packages of the state of the art are usable to resolve this kind of traditional problem	The software packages of the state of the art are usable to resolve this kind of traditional problem	We did not find usable software packages of the state of the art to resolve this kind of problem	We did not find usable software packages of the state of the art to resolve this kind of problem
Software HORUS usable	HORUS software is usable for the research and the resolution of any problem	HORUS software is usable for the research and the resolution of any problem	HORUS software is usable for the research and the resolution of any problem	HORUS software is usable for the research and the resolution of any problem
Type of negative flux	DIVERGENT	ALMOST-DIVERGENT	PSEUDO-DIVERGENT	JUMBLE-DIVERGENT
the σ(xi-xobs) are	ε (xi) = d ≈ 0 or = 0	0 < ε (xi) < qd = 1*E-3	qd = 1*E–3 < ε (xi) < pd = 1*E2	pd = 1*E2 < ε (xi) = any fd
all < 0	ε(xi) / Δ(yobs) = d' = 0	0 < ε(xi) / Δ(yobs) < qd' = 1*E-5	qd' =1*E–5 < ε(xi) / Δ(yobs) < pd' = 1*E1	pd' = 1*E1 < ε(xi) / Δ(yobs) = any fd'
	ε (uobs) (*)	ε (uobs) (*)	ε (uobs) (*)	ε (uobs) (*)
	ε(uobs)/ Δ(yobs) (*)	ε(uobs)/ Δ(yobs) (*)	ε(uobs)/ Δ(yobs) (*)	ε(uobs)/ Δ(yobs) (*)
Type of positive flux	CONVERGENT	ALMOST-CONVERGENT	PSEUDO-CONVERGENT	JUMBLE-CONVERGENT
the σ(xi-xobs) are	ε (xi) = c ≈ 0 ou = 0	0 < ε (xi) < qc = 1*E-3	qc = 1*E–3 < ε (xi) < pc = 1*E2	pc = 1*E2 < ε (xi) = any fc
all > 0	ε(xi) / Δ(yobs) = c' = 0	0 < ε(xi) / Δ(yobs) < qc' = 1*E-5	qc' =1*E–5 < ε(xi) / Δ(yobs) < pc' = 1*E1	pc' = 1*E1 < ε(xi) / Δ(yobs) = any fc'
	ε (uobs) (*)	ε (uobs) (*)	ε (uobs) (*)	ε (uobs) (*)
	ε(uobs)/ Δ(yobs) (*)	ε(uobs)/ Δ(yobs) (*)	ε(uobs)/ Δ(yobs) (*)	ε(uobs)/ Δ(yobs) (*)
Type of null flux	PARALLEL	QUASI-PARALLEL	PSEUDO-PARALLEL	JUMBLE-PARALLEL
the σ(xi-xobs) are	ε (xi) (*)	ε (xi) (*)	ε (xi) (*)	ε (xi) (*)
not all < , > ou = 0	ε(xi) / Δ(yobs) (*)	ε(xi) / Δ(yobs) (*)	ε(xi) / Δ(yobs) (*)	ε(xi) / Δ(yobs) (*)
	ε (uobs) = p ≈ 0 ou = 0	0 < ε (uobs) < qp = 1*E-3 (1*E-7)	qp = 1*E–3 (1*E–7) < ε (uobs) < pp = 1*E2	pp = 1*E2 < ε (uobs) = any fp
	ε(uobs)/ Δ(yobs) = p' = 0	0 < ε(uobs)/ Δ(yobs) < qp' = 1*E-5(1*E-9)	qp' = 1*E–5(1*E–9) < ε(uobs)/ Δ(yobs) < pp' = 1*E0	pp' = 1*E0 < ε(uobs)/ Δ(yobs) = any fp'

(*) and (*) mean that in these cases, these indicators can not be used.

Nota 1: bounds c, d or p are the synthesis of already examined results and can not be considered as definitive. When c, d, or p, positive are < or ≈ 1*E-7 the flux can be considered as convergent, divergent or parallel

Nota 2: bounds qc and qc ', pc and pc ', fc and fc ', qd and qd ', pd and pd ', fd and fd ', qp and qp ', pp and pp ', fp and fp ' are the synthesis of already examined results and can not be considered as definitive.

(Continuation of the page 1)

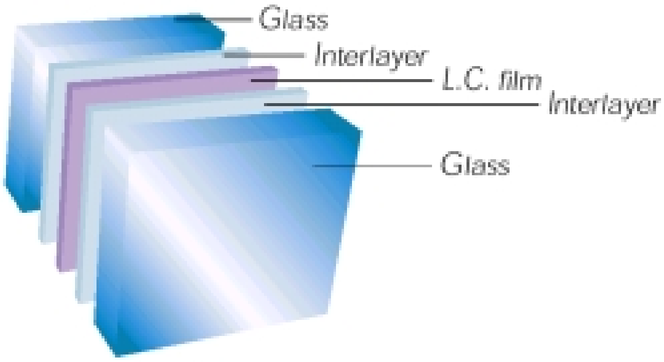
when we discovered the product of the company SAINT-GOBAIN, an intelligent glass which allows to be sometimes transparent, sometimes translucent, at the flick of a switch.

The technology of this glass, commercialized since 1989, come from the United States and the company SAINT-GOBAIN possesses a license of manufacture for Europe and Middles East.

Physical principle

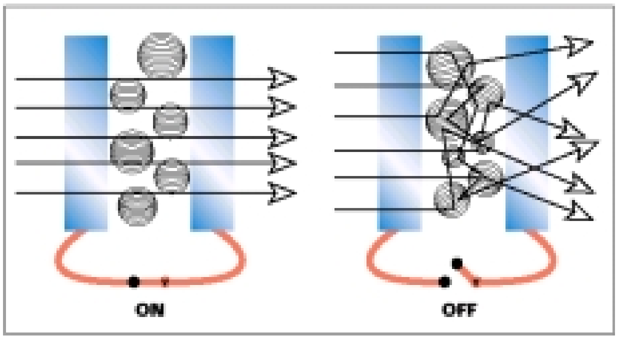
The secret of SGGPRIVA-LITE® lies in the cunning use of liquid crystals.

Indeed, a liquid crystal film is placed between two glass sheets which can be transparent or tinged. The liquid crystal film is sandwiched between two interlayer films.



© SAINT GOBAIN GLASS

Out of gear, the orientation of liquid crystals remains muddled and create optical chaos. Light crossing glass is so diffused everywhere. Glass is translucent (switch OFF).



© SAINT GOBAIN GLASS

By applying an electric tension, an electric field is created within the liquid crystal film. Liquid crystals turn under the influence of this electric field. The light normally cross the glass, without change of direction. Glass becomes transparent (switch ON).

Applications

Many applications exist today: partitionning, safety & security, glass doors and windows, screens, external applications, etc. …

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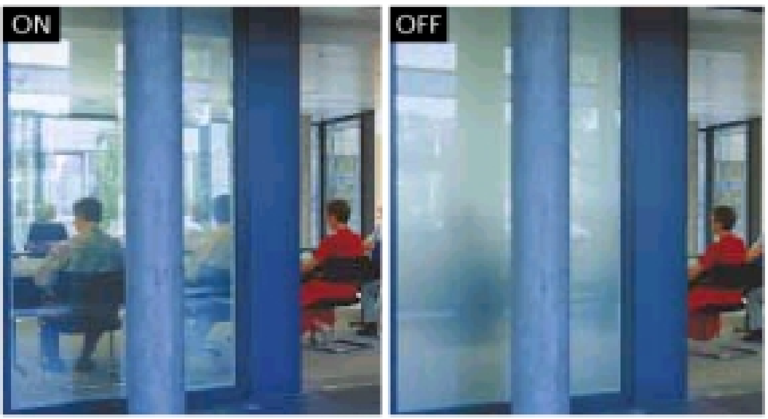
To illustrate SGGPRIVA-LITE®'s fantastic possibilities, you will find below some examples.

PARTITIONING



© SAINT GOBAIN GLASS

Swisscom A.G. - Bern, Switzerland
meeting room partitioning

Main benefits:
ensures privacy and confidentiality.

SECURITY&SAFETY

© SAINT GOBAIN GLASS

55 Av. Georges V - Paris, France - lift

Main benefits:
High level of safety due to the laminated glass.
Original design.
Provides modesty screen.

SCREENS

© SAINT GOBAIN GLASS

"Le verre dans tout son éclat.
L'aventure du cristal et du verre en Wallonie (1800-2000)"
Centre Wallonie-Bruxelles, Paris, France
multimedia animation

Main benefits:
allows amazing multimedia animations.
Possibility to show goods selectively.
Protection against theft.

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New ideas

This innovating product of great promise already arouses many new ideas as for example:

- Dashboards of planes or motorcars : SGGPRIVA-LITE® can be used as a screen on which control can be screened using holographic optics or other. The dashboard can present fundamental information on a foreground and exceptional information on a background. SGGPRIVA-LITE®, tinged with a brilliant colour, can be used as a component of design hiding controls out of gear.

- Computer desks: SGGPRIVA-LITE® allow to see the computer screen situated down or to mask this screen to offer a top of translucent glass desk.

- Glass case : SGGPRIVA-LITE® would allow to show and to protect precious objects of art.

In combination with the possibilities of the Fluid Optics, it becomes possible to create innovative lightings with interesting design where SGGPRIVA-LITE® is used for its diffusion or transparent properties. These new lightings offer dynamism to the light.

For more information about SGGPRIVA-LITE®, visit the Internet site (http://www.sggpriva-lite.com) or contact directly :

SAINT GOBAIN GLASS
Mr. Jean-François OUTIN
Tel : 00 32 475 37 88 89

NEWS

We present to all our subscribers a merry Christmas and a happy new year 2001.

If there is a subject which you wish to see treating in this letter, you can directly contact us by email at the address:

syzygies@optique-fluide.org

You can also join **MEGALUX**, the company charged to exploit the Fluid Optics, at the address:

info@megalux.com

NEXT LETTER

The next Letter "La lettre des Syzygies" will appear for the spring equinox, or for the middle of Mars.

