

Management of Light in the Photonic Computer

L'Architech (Gabriel Breton-Breault)

Introduction

Light is the functional core of the photonic computer. It is not merely a signal: it is the structure of computation, the internal geometry, the direction, the density, and the fractal that define every operation. In this architecture, light circulates, divides, recombines, and transforms to produce a directional result that the processor can read directly.

This document, *Management of Light in the Photonic Computer*, describes in detail:

- the bidirectional circulation of rays,
- directional division in optical networks,
- recombination in return mode,
- the use of lasers as emitters and receivers,
- optical switches through micro-rotation,
- and the dynamic selection of computation networks.

It constitutes the third conceptual pillar of the photonic architecture.

Documents to read before this one

To fully understand the mechanisms described here, it is strongly recommended to first read the following two documents, which establish the theoretical and material foundations of the photonic computer:

♦ **1. The Photonic Computer** <https://zenodo.org/records/22149130> This document presents directional logic, computation modes, internal fractals, and the conceptual structure of the photonic processor. It explains why light replaces electronics and how optical networks become computation units.

♦ **2. 3D Printing of the Motherboard and Photonic Processor** <https://zenodo.org/records/22311343> This document describes the material fabrication: the photonic motherboard, optical networks, division cavities, internal prisms, optical ports, and the three-dimensional structure that allows light to circulate in multiple directions.

Objective of this document

Once the theoretical and material bases are understood, this document explains how light is actually managed inside the photonic processor:

- how it is injected,

- how it is directed,
- how it is divided,
- how it is fractalized,
- how it is recombined,
- how it is read.

This is where the photonic computer becomes a directional organism capable of computing by transforming light itself.

Chapter 1 — Directional Lasers

Directional lasers are the fundamental organs of the photonic computer. They perform two essential functions: emitting the light that serves as the basis for directional computation, and receiving the light after its path through optical networks in order to read its internal geometry. This bidirectional capability transforms each laser into a true photonic computation node, capable of interacting with division, fractalization, and recombination networks.

1.1 — The Two Groups of Lasers in the Scorpions

Each Scorpion contains **50 lasers**, divided into two distinct groups, each with a specific role in the photonic architecture.

Group A — The 25 Quartz Cube Lasers

These lasers are directly anchored onto a full face of the quartz cube. They are arranged in an **X-Y grid**, fully covering:

- the **Y-axis**,
- the **Z-axis**,
- on two sides of the cube (one side per Scorpion).

These lasers ensure:

- directional reading of the quartz,
- writing of luminous patterns,
- stabilization of internal fractals,
- conversion of binary data into photonic geometry.

Around each laser, selection tubes (switches) are arranged in a circle, allowing micro-rotation to select different internal micro-channels of the quartz.

The two Scorpions operate as a pair, each covering one full face of the cube, enabling perfectly synchronized bilateral reading/writing.

Extended Selection Capacity (Quartz Cube)

Unlike the lasers of the photonic processor, limited to 30 fibers, ➔ **the quartz cube lasers can select a much larger number of internal paths.**

This is made possible by:

- internal micro-channels of the quartz,
- holographic directional layers,
- three-dimensional fractal structure,
- zones of luminous density,
- the full X-Y grid coverage,
- circular switches enabling fine angular rotation.

The exact number of paths remains to be determined, but it is significantly greater than 30—potentially in the hundreds or thousands depending on the internal resolution of the quartz.

Group B — The 25 Photonic Processor Lasers

These lasers are oriented toward the photonic processor rather than the quartz. They are mounted in alignment mini-tubes, each capable of selecting **30 optical fibers** arranged in a fan.

A micro-rotation of the laser selects a specific fiber, giving access to:

- a division network (2, 3, 10, etc.),
- a fractal network,
- a saturation network,
- a recombination network,
- a directional reading network.

These lasers ensure:

- emission of rays into optical networks,
- reception of the returned ray after computation,
- management of division modes,
- directional recombination in return mode.

1.2 — Connection of Processor Lasers to the Photonic Motherboard

The optical fibers of the processor lasers do not go directly to the quartz. They are connected to dedicated fiber wires that:

- anchor physically into the photonic motherboard,
- join the internal optical networks printed in 3D,

- ensure directional coherence of the computation.

The photonic motherboard is a three-dimensional network of optical fibers that:

- links the Scorpions to the photonic processor,
- distributes light into division networks,
- stabilizes phase and directional density,
- enables bidirectional circulation of light.

The complete topology is:

Processor Laser (Scorpion) → Dedicated Fiber → Photonic Motherboard → Internal Optical Network → Photonic Processor

And in return:

Photonic Processor → Internal Optical Network → Photonic Motherboard → Dedicated Fiber → Scorpion Laser (reception mode)

1.3 — Bidirectional Operation of Light

Light circulates in both directions.

Forward: Division Mode

The laser emits a ray that traverses an optical network. This network divides the light into multiple directions, creating internal fractals and geometric densities that constitute the computation.

Return: Addition Mode

The ray returns to the laser after traveling through the network. The directions created in forward mode recombine into a single beam. This recombination represents **directional addition**, allowing the laser to read the computation result.

Thus, a division network automatically becomes an addition network when light travels in reverse. This reversibility is one of the fundamental principles of the photonic computer.

1.4 — Directional Capacity Toward the Photonic Processor

Each Scorpion contains:

- **25 lasers** oriented toward the photonic processor
- **30 optical paths** per laser

Which gives:

$25 \times 30 = 750$ paths per Scorpion

With two Scorpions:

$750 \times 2 = 1500$ directional paths

➔ **Directional capacity toward the photonic processor: 1500 paths.**

The quartz cube paths add to this value, but their exact number remains to be defined.

1.5 — Importance in Directional Logic

Directional lasers are not simple components. They are the **entry and exit points** of photonic logic. They ensure:

- injection of light into networks,
- selection of computation mode,
- reading of directional results,
- coherence between division and addition networks.

They are the photonic equivalents of control units in an electronic processor, but with geometric computation capabilities impossible to reproduce with traditional circuits.

Chapter 2 — Optical Switches by Rotation

Optical switches by rotation constitute the main routing system of the photonic computer. They allow each laser, whether oriented toward the quartz cube or toward the photonic processor, to select a precise light path among a set of optical fibers or internal micro-channels. This mechanism relies on a micro-angular rotation of the laser inside a mini-tube, ensuring purely photonic directional selection.

2.1 — General principle of the directional switch

Each laser is mounted in a rotation mini-tube, a high-precision mechanical structure that allows:

- orientation of the light beam,
- selection of an optical path,
- maintenance of directional coherence.

In front of this tube are:

- optical fibers arranged in a circle (laser side),
- or internal micro-channels of the quartz (cube side).

A micro-rotation of the laser aligns the beam with a specific path.

2.2 — Hybrid geometry: circle → X-Y grid

The optical fibers associated with the quartz cube lasers exhibit a hybrid geometry.

Circular arrangement on the laser side

Fibers are arranged in a ring around the laser. Rotation of the mini-tube allows selection of a specific fiber by angular orientation.

X-Y grid arrangement on the quartz side

The other end of the fibers is arranged in a grid on the X and Y axes of the quartz cube. This arrangement allows:

- complete coverage of the active Y-Z surface of the cube,
- precise spatial distribution,
- access to internal micro-zones of the quartz.

This circle → X-Y grid geometry enables angular selection on the laser side and spatial distribution on the quartz side.

2.3 — Circular switches of the quartz cube lasers

Lasers oriented toward the quartz cube use circular switches to select:

- internal micro-channels,
- holographic layers,
- directional fractals,
- zones of luminous density.

Thanks to the hybrid geometry, a cube laser can:

- select a fiber by circular rotation,
- send light to a precise zone of the X-Y grid,
- access a number of paths greater than 30.

The holographic and fractal structure of the quartz potentially allows:

- hundreds,
- thousands,
- or even tens of thousands of internal micro-paths.

2.4 — Fan-shaped switches of the photonic processor lasers

Lasers oriented toward the photonic processor use fan-shaped switches with **30 optical fibers**. Each fiber leads to a distinct optical network:

- division networks (2, 3, 4, 5, 10, etc.),
- fractal networks,
- saturation networks,
- recombination networks,
- directional reading networks.

With **25 lasers per Scorpion**, the directional capacity toward the photonic processor is:

$25 \times 30 = 750$ paths per Scorpion

With two Scorpions:

$750 \times 2 = 1500$ directional paths

2.5 — Directional precision and stability

Rotation mini-tubes must guarantee:

- micrometric angular precision,
- perfect mechanical stability,
- total luminous coherence,
- absence of vibration,
- directional continuity between forward and return paths.

To achieve this, each tube is equipped with:

- optical micro-bearings,
- phase stabilizers,
- directional tension rings,
- photonic dampers.

2.6 — Role of switches in directional logic

Optical switches determine:

- which optical network is used,
- which fractal is activated,
- which quartz zone is read or written,
- which computation mode is executed,
- which path is taken in return mode.

They make the photonic processor:

- reconfigurable,
- modular,
- directional,
- bidirectional,
- geometric.

2.7 — Summary

- **Laser side: circular arrangement** Selection by angular rotation.
- **Quartz side: X-Y grid arrangement** Complete spatial distribution over the Y-Z surface.

- **Quartz cube lasers** Internal paths greater than 30.
- **Photonic processor lasers** 30 fibers → 1500 directional paths.

Optical switches by rotation constitute the photonic routing elements that allow light to circulate in the computer as in a coherent directional structure.

Chapter 3 — Division Networks

Division networks are the fundamental optical structures of the photonic processor. They transform a single light beam into several distinct directions, creating internal fractals, geometric densities, and directional patterns that form the basis of photonic computation. Each division network has its own geometry, specific directional capacity, and behavior determined by the internal structure of fibers and optical cavities.

3.1 — Role of division networks in photonic computation

Division networks provide the first step of directional computation. When a photonic processor laser emits a ray into a network, it is divided into several directions according to a predefined geometry. This division creates:

- directional fractals,
- multiple luminous densities,
- internal geometric patterns,
- reversible optical structures.

These elements form the basis of photonic computation, which relies on geometric transformation of light rather than electronic operations.

3.2 — Types of division networks

Each division network is designed to produce a specific directional geometry. The most common networks are:

- **Division by 2:** splitting the beam into two opposite directions.
- **Division by 3:** creation of a triangular directional pattern.
- **Division by 4:** four-branch directional grid.
- **Division by 5:** pentagonal fractal structure.
- **Division by 6:** hexagonal directional pattern.
- **Division by 7:** heptagonal fractal.
- **Division by 8:** octagonal directional pattern.
- **Division by 9:** nonagonal structure.
- **Division by 10:** high-density decagonal network.

Each network has a unique internal geometry determined by:

- the shape of optical cavities,
- the arrangement of internal fibers,
- the density of micro-channels,
- the three-dimensional structure printed in the photonic motherboard.

3.3 — Internal geometry of networks

The internal geometry of division networks is designed to produce precise fractalization of light. Each network contains:

- directional optical cavities,
- internal prisms,
- density micro-channels,
- recombination fibers,
- luminous saturation zones.

Light divides according to the internal structure of the network, creating a stable and reproducible directional pattern.

3.4 — Interaction with photonic processor lasers

Photonic processor lasers select a division network via fan-shaped switches. Each laser can access **30 optical networks**, allowing dynamic reconfiguration of the computation mode.

The total directional capacity toward the photonic processor is:

25 lasers per Scorpion×30 networks=750 paths

With two Scorpions:

750×2=1500 directional paths

Each path corresponds to a specific division network, enabling a wide variety of directional computations.

3.5 — Reversibility of division networks

Division networks are fully reversible. When a ray traverses a network in forward mode, it is divided into several directions. When it returns in reverse mode, these directions recombine into a single beam.

This recombination constitutes **directional addition**, allowing the laser to read the computation result.

Reversibility is ensured by:

- internal symmetry of optical cavities,

- directional coherence of fibers,
- stability of micro-channels,
- fractal geometry of the network.

3.6 — Role of networks in directional logic

Division networks determine:

- the generated directional fractal,
- the produced luminous density,
- the internal geometry of the computation,
- the structure of the beam in return mode,
- the directional value read by the laser.

They are the fundamental computation units of the photonic processor, transforming light into exploitable geometric structure.

3.7 — Summary

- Division networks fractalize light into multiple directions.
- Each network has a specific internal geometry.
- Photonic processor lasers select these networks via fan-shaped switches.
- Total directional capacity toward the processor is **1500 paths**.
- Networks are reversible: division in forward mode, addition in return mode.
- They constitute the geometric computation units of the photonic computer.

Chapter 4 — Bidirectional Circulation of Light

Bidirectional circulation of light is the central mechanism of the photonic computer's operation. It allows a single light ray to perform two complementary operations:

- **directional division during the forward path,**
- **directional recombination during the return path.**

This principle transforms each optical network into a reversible computation unit, where light encodes, transports, and returns an exploitable directional geometry.

4.1 — General structure of the light path

Light circulates in the photonic computer along a path structured in four stages:

1. Emission by a directional laser

2. Selection of a path via an optical switch
3. Division in an optical network
4. Return to the laser for recombination and reading

This path is identical for all lasers oriented toward the photonic processor and adapts to internal micro-channels in the case of lasers oriented toward the quartz cube.

4.2 — Forward path: directional division

During the forward path, the laser emits a coherent ray into a selected optical network. This network divides the light into several directions according to its internal geometry:

- optical cavities,
- directional prisms,
- micro-channels,
- fractal structures,
- luminous density zones.

Directional division produces:

- internal fractals,
- geometric patterns,
- multiple densities,
- independent directions.

These elements form the basis of photonic computation, where light is transformed into directional structure.

4.3 — Return path: directional recombination

After traversing the optical network, light returns to the laser. This return path is essential: it allows recombination of the directions created in forward mode.

Directional recombination:

- merges fractal directions,
- reconstructs a single beam,
- encodes the internal geometry of the computation,
- returns a readable directional value.

The laser, in reception mode, reads this directional geometry and extracts the result of the photonic computation.

4.4 — Reversibility of optical networks

Optical networks are designed to be fully reversible. Their internal geometry is symmetrical, allowing:

- division in forward mode,
- addition in return mode.

This reversibility is ensured by:

- coherence of fibers,
- stability of optical cavities,
- symmetry of internal prisms,
- directional continuity of micro-channels.

A division network automatically becomes an addition network when light travels in reverse.

4.5 — Bidirectional circulation in the quartz cube

In the quartz cube, bidirectional circulation follows a holographic logic. Lasers oriented toward the cube use:

- circular switches on the laser side,
- fibers arranged in an X-Y grid on the quartz side,
- internal micro-channels,
- holographic directional layers.

The forward path allows:

- writing of luminous patterns,
- creation of internal fractals,
- modification of directional density.

The return path allows:

- reading of holographic structures,
- recovery of directional patterns,
- stabilization of internal fractals.

Bidirectional circulation in the quartz forms the basis of photonic memory.

4.6 — Synchronization between the two Scorpions

The two Scorpions operate as a pair. Bidirectional circulation is synchronized between:

- quartz cube lasers,
- photonic processor lasers,

- circular switches,
- fan-shaped switches,
- internal optical networks,
- the photonic motherboard.

This synchronization ensures:

- total directional coherence,
- bilateral reading of the quartz,
- stability of internal fractals,
- continuity of photonic computation.

4.7 — Summary

- Bidirectional circulation allows light to perform a complete computation.
- The forward path divides light into multiple directions.
- The return path recombines these directions into a single beam.
- Optical networks are reversible: division → addition.
- The quartz cube uses a bidirectional holographic logic.
- The two Scorpions synchronize the entire process.

Bidirectional circulation of light is the core of the photonic computer's operation, transforming each ray into a directional structure capable of computing, storing, and returning information.

Conclusion

The photonic computer presented in this document is based on a fully directional architecture, where every component—laser, fiber, optical network, circular switch, or X-Y grid—contributes to a computation logic founded on the geometry of light. The Scorpions, with their two groups of lasers, simultaneously manage the quartz cube and access the processor's networks, enabling coherent interaction between holographic memory and fractal computation.

Bidirectional circulation of light is the central mechanism of this architecture. The forward path divides light into fractal structures, while the return path recombines these directions to produce a readable directional value. This reversibility transforms each optical network into a complete computation unit capable of executing an operation and returning its result without loss of coherence.

Rotational optical switches ensure precise routing of light, whether toward the processor's fibers or the quartz's internal micro-channels. The hybrid geometry—circular arrangement on the laser side and X-Y grid on the quartz side—allows full coverage of active surfaces and very high directional density.

The entire system forms a coherent, modular, and fully geometric photonic architecture, where light becomes an information vector capable of computing, storing, and returning complex directional structures. This architecture opens the way to a new generation of processors based not on electronics, but on the direct manipulation of light within fractal and holographic structures.