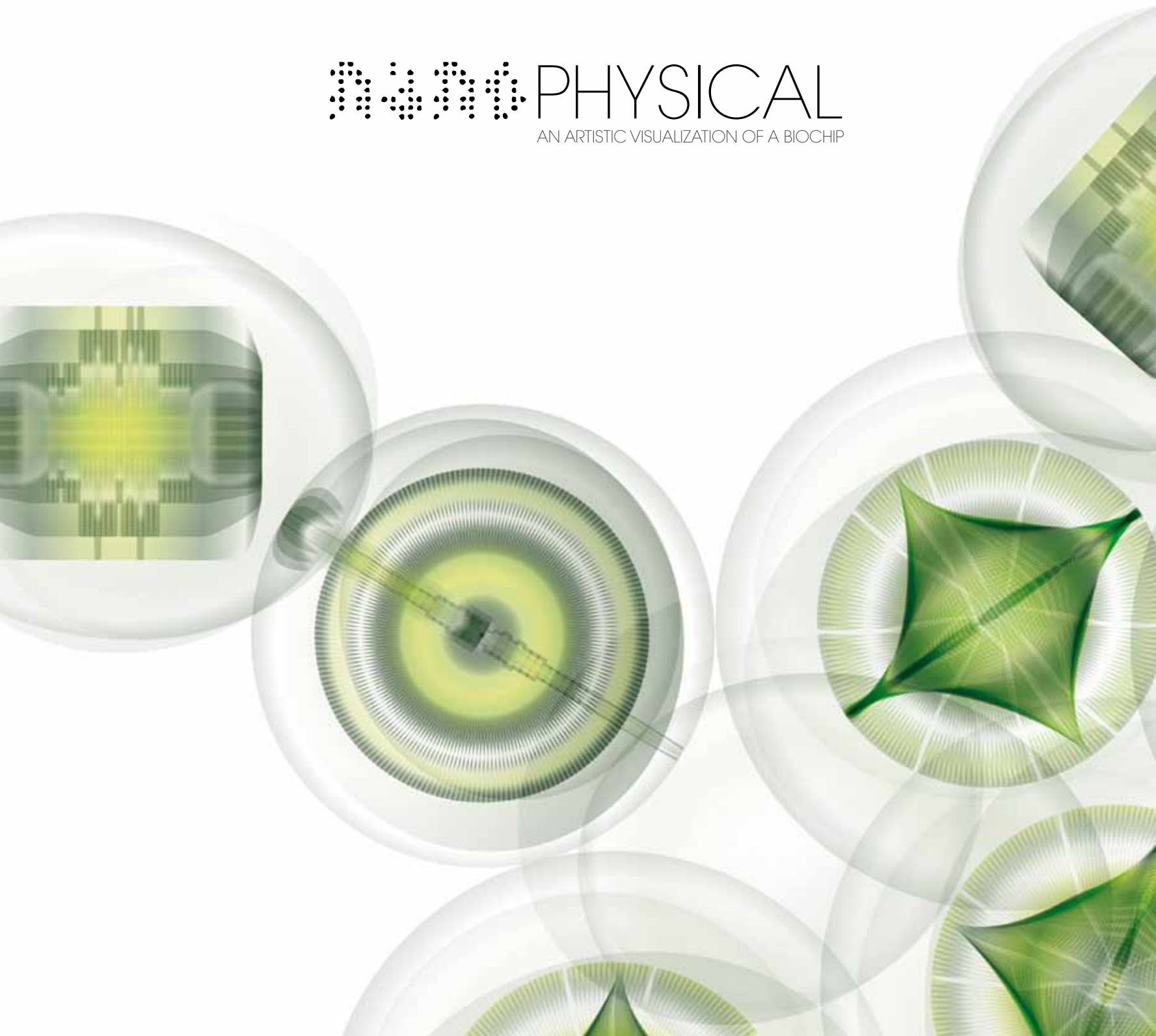
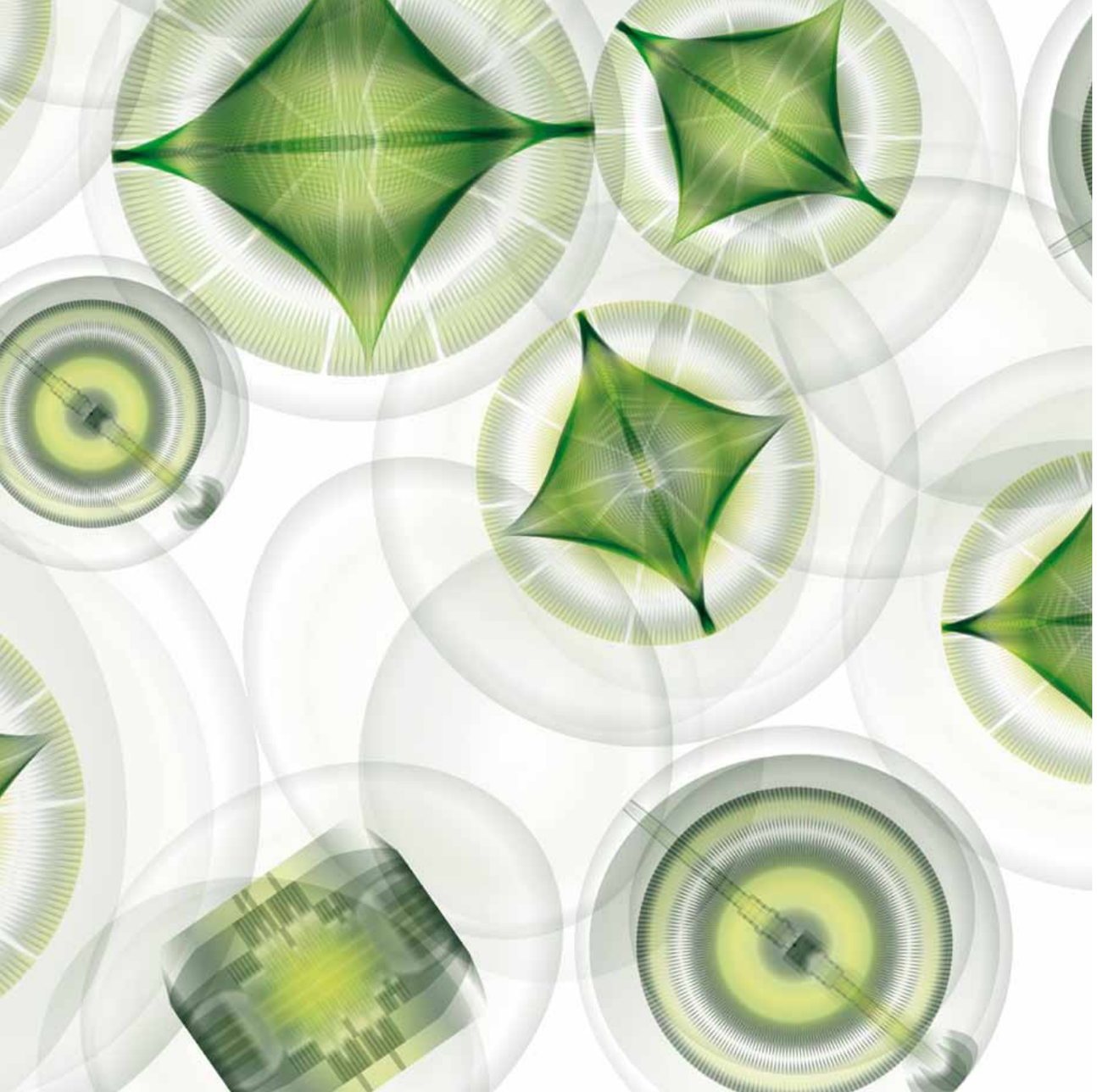
PHYSICAL

AN ARTISTIC VISUALIZATION OF A BIOCHIP





PHYSICAL

AN ARTISTIC VISUALIZATION OF A BIOCHIP

Ludivine Lechat, Tom De Smedt, Imke Debecker - imec,
Leuven, Belgium, 2010

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imec

° BELGIUM

www.imec.be

Imec is Europe's largest independent research center in nano-electronics and nanotechnology. In 2007 imec organized the first Nanotech Outreach Workshop in order to identify potential collaborators for new outreach communication initiatives. For this occasion imec teamed up with Addict Creative Lab and together they published 'the Nano Issue', an international magazine showcasing new visions, cultural perspectives and ideas on nanotechnology applications and communication. Ludivine's and Tom's contribution stood out and inspired us to approach visual communication of nanotechnology concepts differently.

In its outreach projects imec aims to show its scientific research through an educational, artistic or design perspective. By inviting artists, designers and interested people from various backgrounds and disciplines, imec aims to open up its research to a broader range of interested communities

LUDIVINE LECHAT

°1979, SACRAMENTO, UNITED STATES

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I am an artist and graphic designer specializing in digital illustrations inspired by nature : cells, plants, insects, creatures, behavior, evolution,.... My work is applied in various domains such as the graphic design industry (corporate identity and illustration), interior design, computer games, music artwork, etc. I'm intrigued by detail and I like to see myself as a *graphic lab rat*. My approach to design is inspired by scientific method. The artwork I create is the result of observation and subdivision of an assignment into smaller building blocks. Instead of a single panoramic composition, I create a graphic set of components (e.g. flowers, leaves, stems, spores, legs, wings, eyes or imaginary items) that can be recombined and thus evolve into new compositions.

Because of its reusability, this component-based approach fits excellently with procedural design techniques. I regularly collaborate with Tom De Smedt from NodeBox (www.nodebox.net, a software application that creates 2D graphics using programming code). The components re-imagine what I see and hear. Tom then lifts the compositions to a higher level by algorithmically reinventing the (physical) processes we read about.

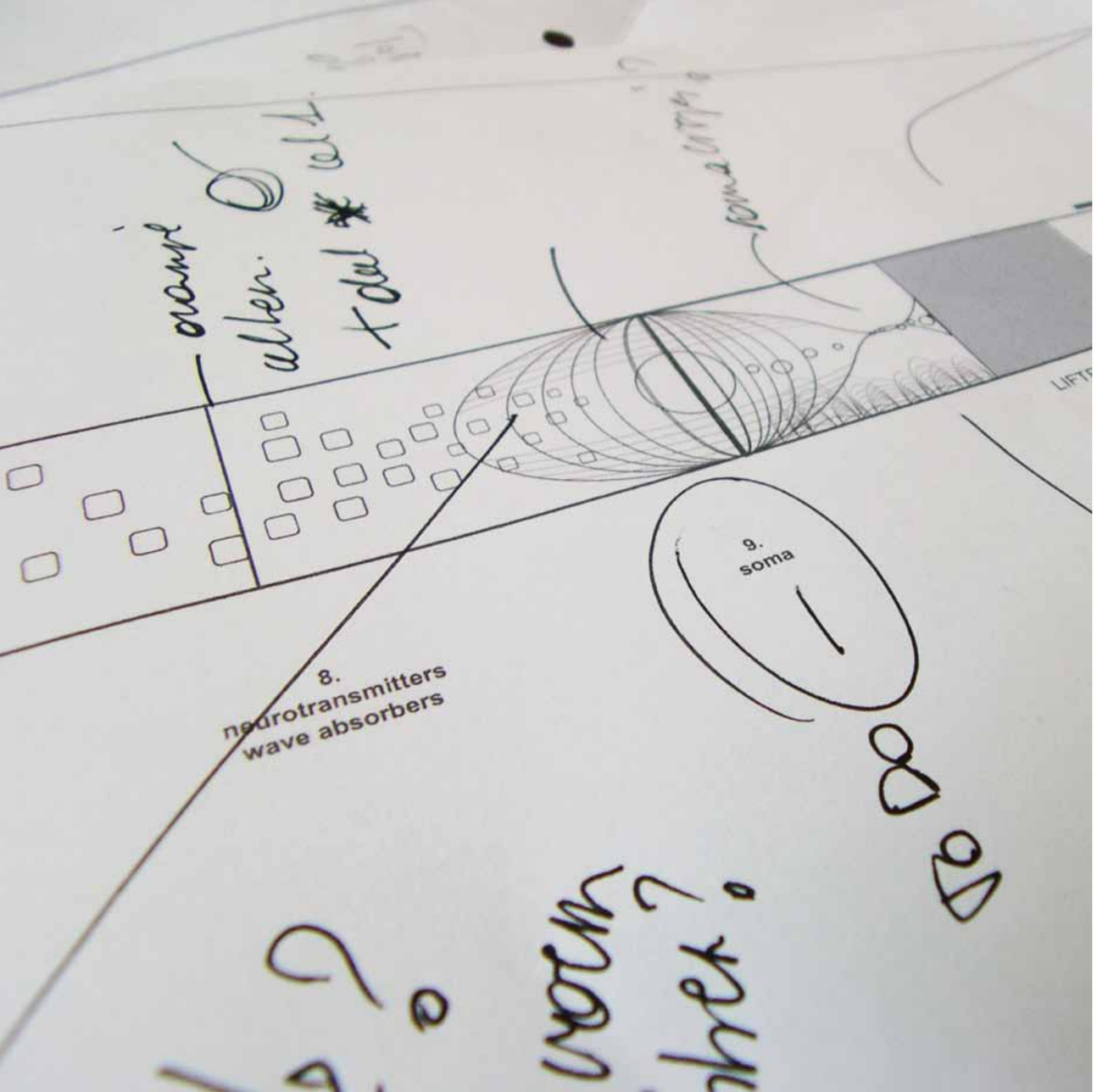
My favorite quote:
"*The relation of work and play is the source of style and beauty*". Malcolm Mcluhan.

TOM DE SMEDT

°1978, ANTWERP, BELGIUM

www.organisms.be

I am an artist, software engineer and a cognitive science hobbyist, affiliated with the Computational Psycholinguistics Group (University of Antwerp) since 2008 and co-founder of the Experimental Media Group (EMG, Sint Lucas School of Arts, Antwerp) in 2004. The EMG has been involved in various research projects bordering between art and technology. We draw inspiration from domains such as artificial intelligence, cognitive science, linguistics, biology and toys, in an attempt to define the nature of creativity. Our expertise includes state-of-the-art graphics software, tangible user interfaces, tools for computational linguistics and machine creativity. We have been involved in projects funded by the Institute for Innovation by Science and Technology (IWT), the Institute for Broadband Technology (IBBT), and Vlaams Audiovisueel Fonds (VAF).



MAKING OF

I would describe my first visit to imec as a trip down the rabbit hole. Beneath our own tangible level of interest (animals, objects, societies) is an entirely different microscopic world. The scientists that work here can grasp this system, interact with it, through the use of nanotechnology to generate effects on a macroscopic level. It is amazing to see how fast technology is progressing (exponentially, according to Moore). To me it was all magic. Questions arise as to where exactly is the boundary between what we call 'life', and what we say is 'dead matter'.

But I did not need to understand everything to be able to visualize this unseen world graphically. I could create visual components that represent principal concepts in nanotechnology, I could also use color and composition as functions expressing the dynamics in the system. By making the components reminiscent of real-life organisms, I could define the system artistically and physically. I hope the results help scientists come up with new creative inspiration during their coffee break.

COMPONENTS

The first step was to create a library of individual elements. Each element is a detailed vector drawing that can stand on its own. These are then combined in bottom-up experimentation with different (algorithmic) compositions. The components in the library are inspired by the following concepts:

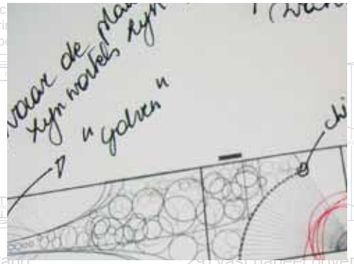
Chemistry & physics: atoms and molecules. Fullerenes are introduced in the composition as invisible grids (or signals) in the background.
Biology: cells, single-celled organisms, viruses (viruses are actually introduced in a follow-up gaming project, see below).
Bio-electronics: chips, biochips, MEMS-technology (micro-electromechanical systems), nano-robotics, tissue self-assembly.

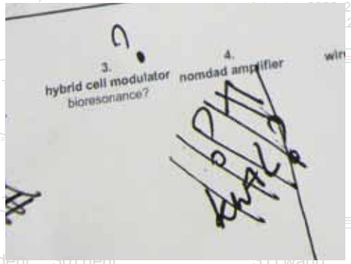
COMPOSITION

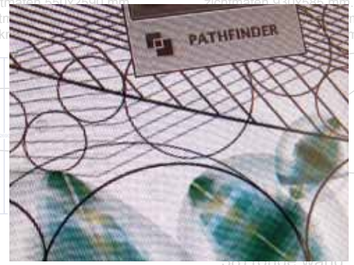
A role (or behavior) is then assigned to the individual elements according to their location in the composition. The composition is based on an invisible grid circuit. The entire artwork acts as an imaginary biochip, powered by solar energy emitted from the window in the room. The window is the origin point of a fluid wave of components that ripples throughout the hallway along the walls. Components can be seen to interact with each other in interesting ways. They change state and ordering as the wave progresses.

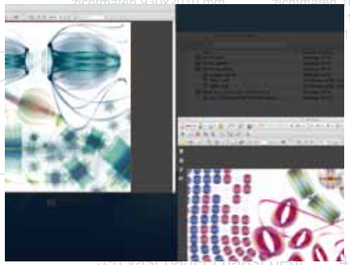
The hypothetical goal of the wave is to support one big cell, the receptor or brain of the biochip. From the left it is fed with energy to keep it alive. From the right it is fed with the genetic instructions that generate it.

TECHNICAL DETAILS







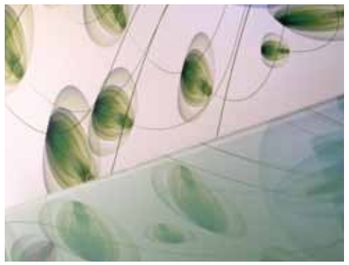


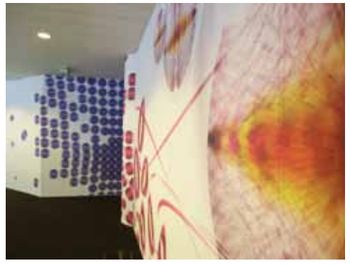
Format: 66.6 x 2.6 meters, produced on canvas mounted to the walls.
Software: NodeBox & Adobe Illustrator.

The production of the final artwork introduced several problems against the technical limitations of software, memory and printing machinery.

NodeBox would habitually crash when rendering the intricately detailed source components. One component can consist of more than 500 color surfaces and we worked with a physics algorithm (i.e. explosions, water ripples etc.) that used hundreds of such elements. We introduced a skeleton model that worked with simple ellipses, which were then replaced with the original components as the rendered composition was piped to Adobe Illustrator.

Panel 5 for example features approximately 300,000 points (where two points connect a straight line or curve), 35,000 gradient surfaces and over 45,000 surfaces with transparency. Because of the historical difficulty of press machines to deal with transparency and color gradients, a high-resolution version would take about 24 hours to render on a MacBook Pro issued in 2010. This would however quickly crash the system. The final result is actually a low resolution print which took only four hours to render per panel.

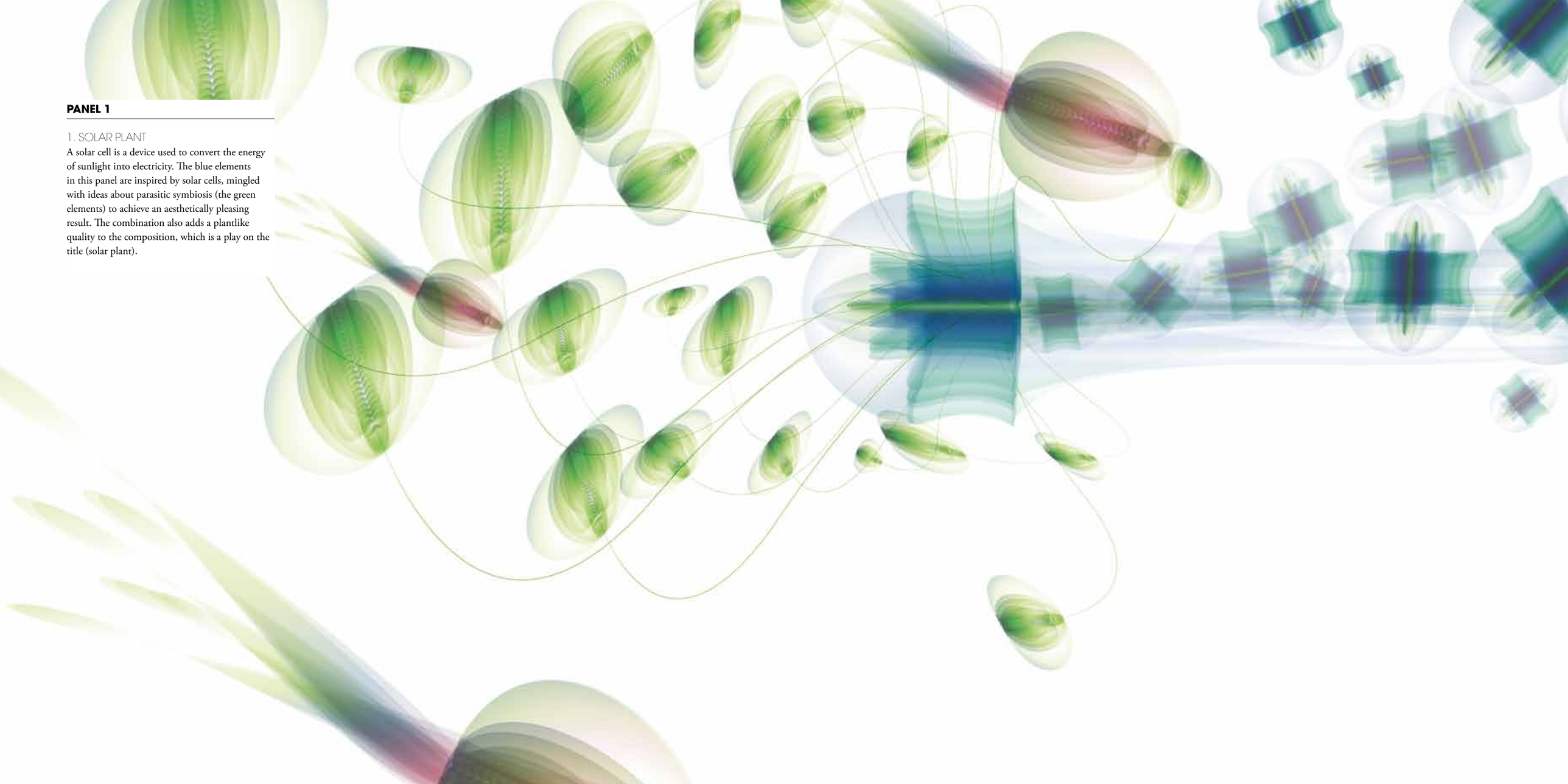




panels

WINDOW

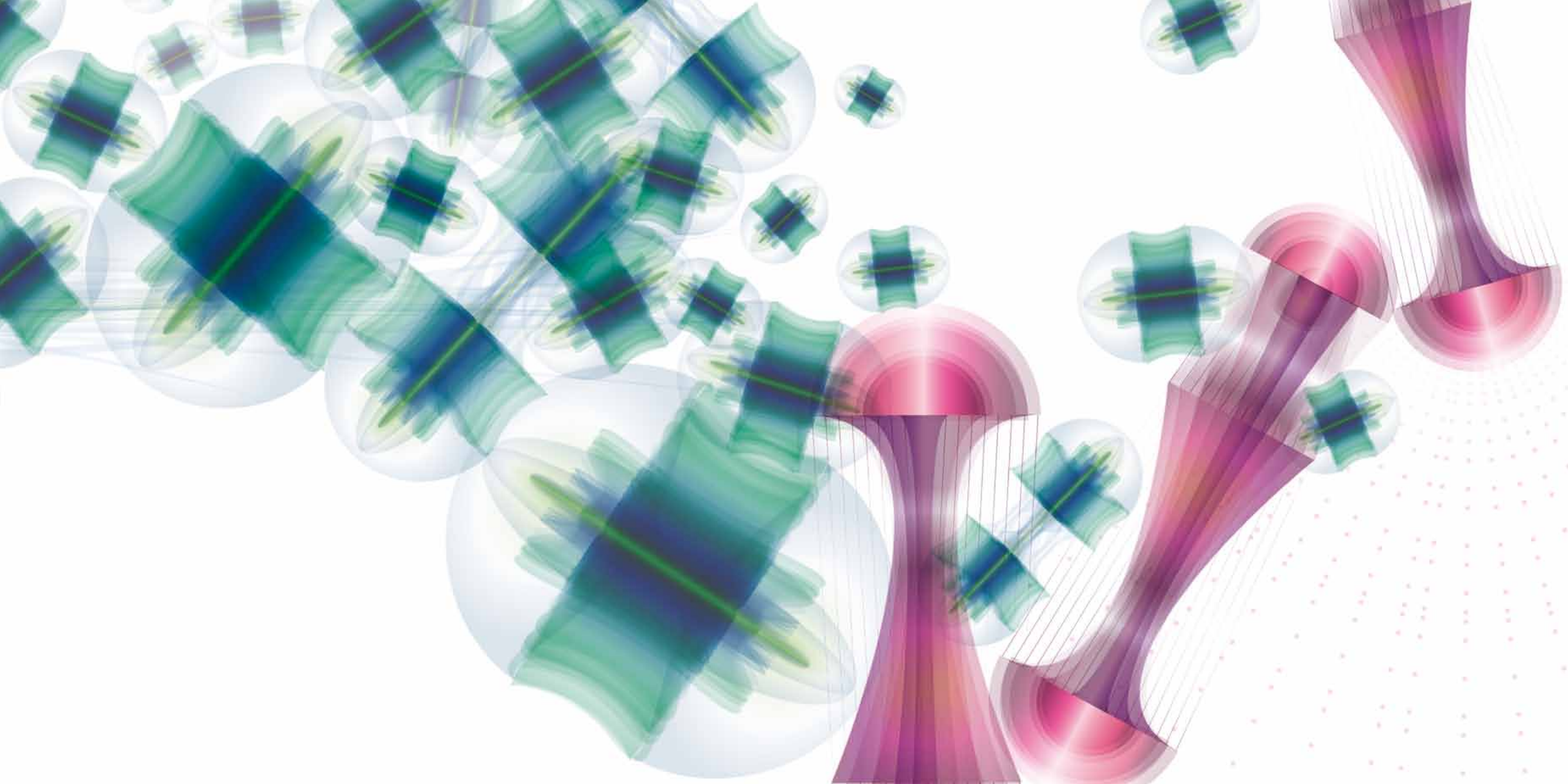
The artwork's energy source



PANEL 1

1. SOLAR PLANT

A solar cell is a device used to convert the energy of sunlight into electricity. The blue elements in this panel are inspired by solar cells, mingled with ideas about parasitic symbiosis (the green elements) to achieve an aesthetically pleasing result. The combination also adds a plantlike quality to the composition, which is a play on the title (solar plant).



PANEL 2

2. RESONANCE

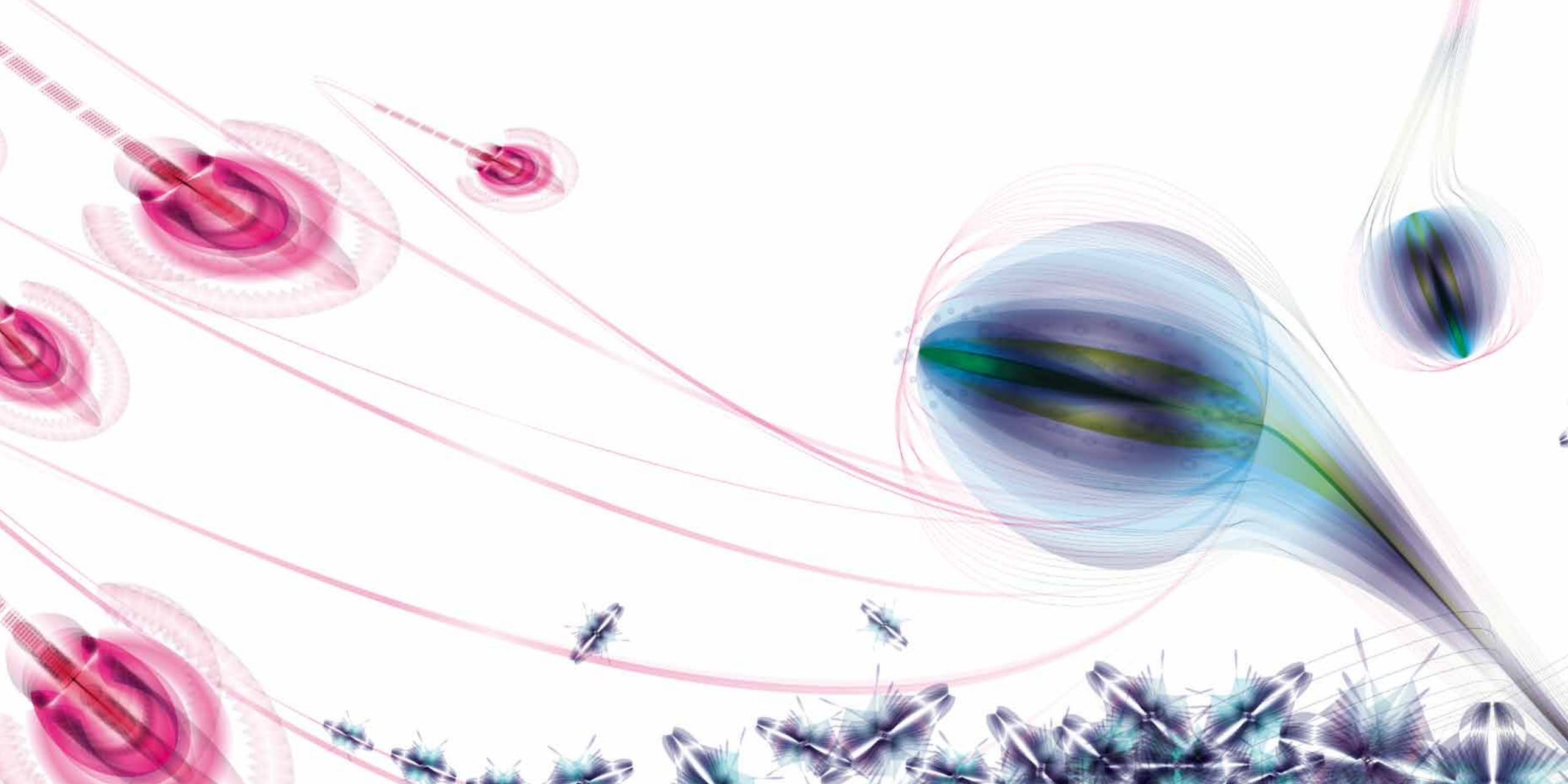
We needed to keep one wall blank for multimedia projections. How to preserve the flow of the artwork while also arranging a gap in it? Here we toyed with ideas about wireless communication. Signals from [1] are depicted to be packed as wireless information, transmitted invisibly across the gap to the receiving neuron in [3].

PANEL 3

3. NEURON (SOMA)

In nerve cells, the soma is the bulbous end of a neuron that receives chemical stimulation from the neuron's branched projections, called dendrites. This panel shows an artistic interpretation of a neuron passing on information to the stream in [4].

This was the hardest panel to produce. Many variations in different shapes and colors have been banished to the garbage bin. Perhaps because the panel acts as the perceived focal point of the artwork; perhaps in turn an effect of the fact that this wall was central in all of our photographs and sketches.



PANEL 4

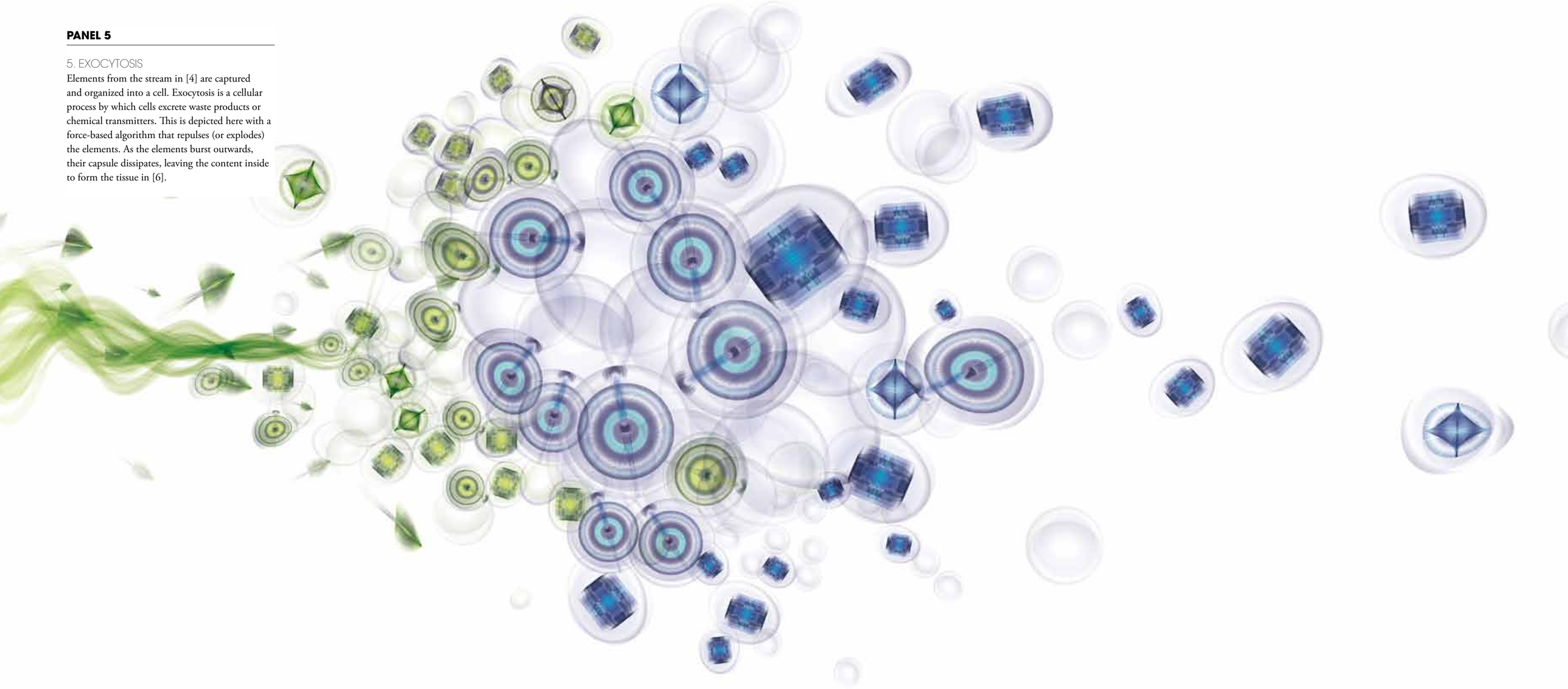
4. KINETIC STRING

A stream carries particles (or, if we may, units of information) off to form a cell in [5]. It is inspired by principles of fluidity and kinetic energy. The increase in pressure in the stream is visualized by a change in color.

PANEL 5

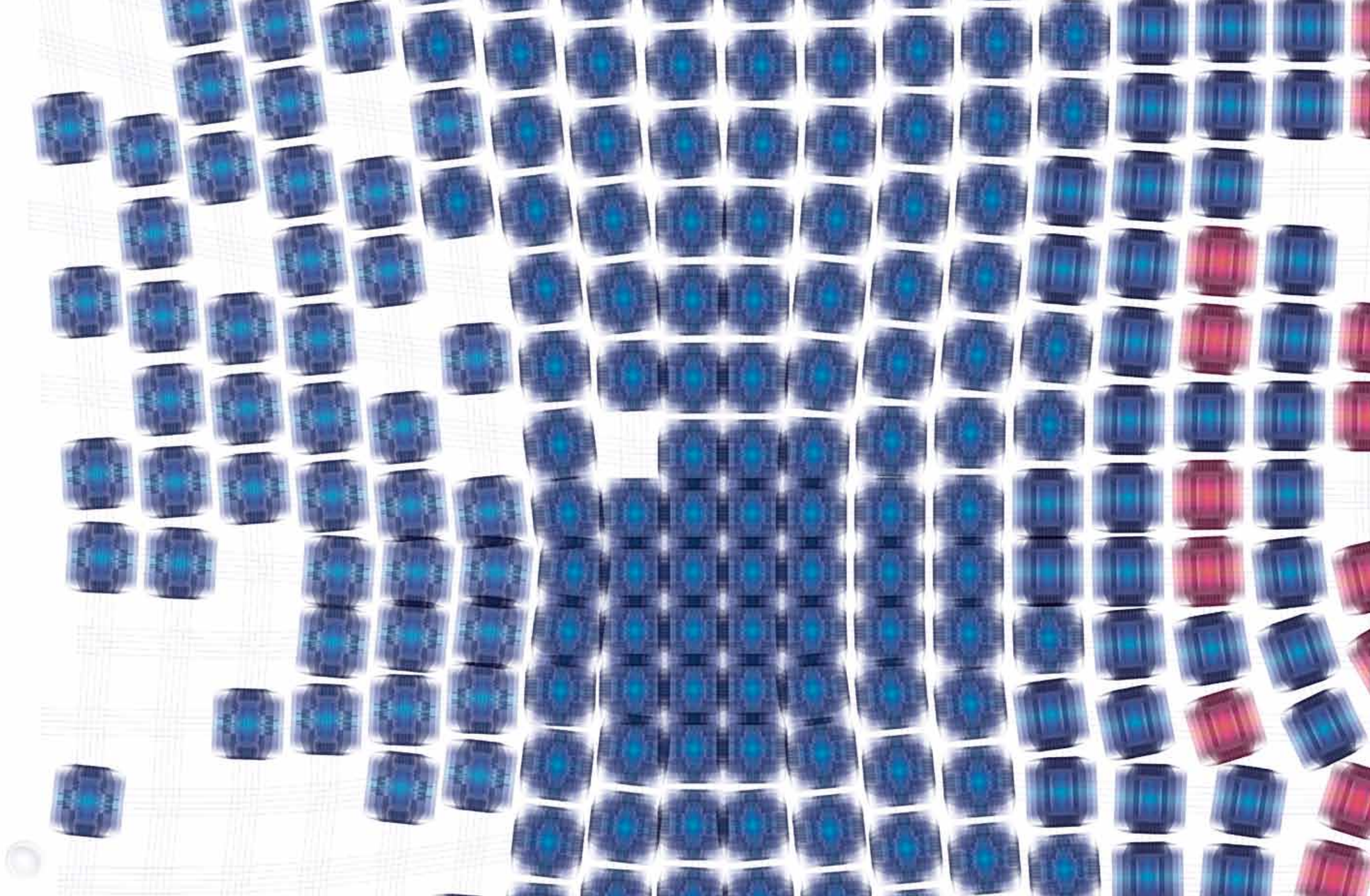
5. EXOCYTOSIS

Elements from the stream in [4] are captured and organized into a cell. Exocytosis is a cellular process by which cells excrete waste products or chemical transmitters. This is depicted here with a force-based algorithm that repulses (or explodes) the elements. As the elements burst outwards, their capsule dissipates, leaving the content inside to form the tissue in [6].



6. SELF-ASSEMBLY

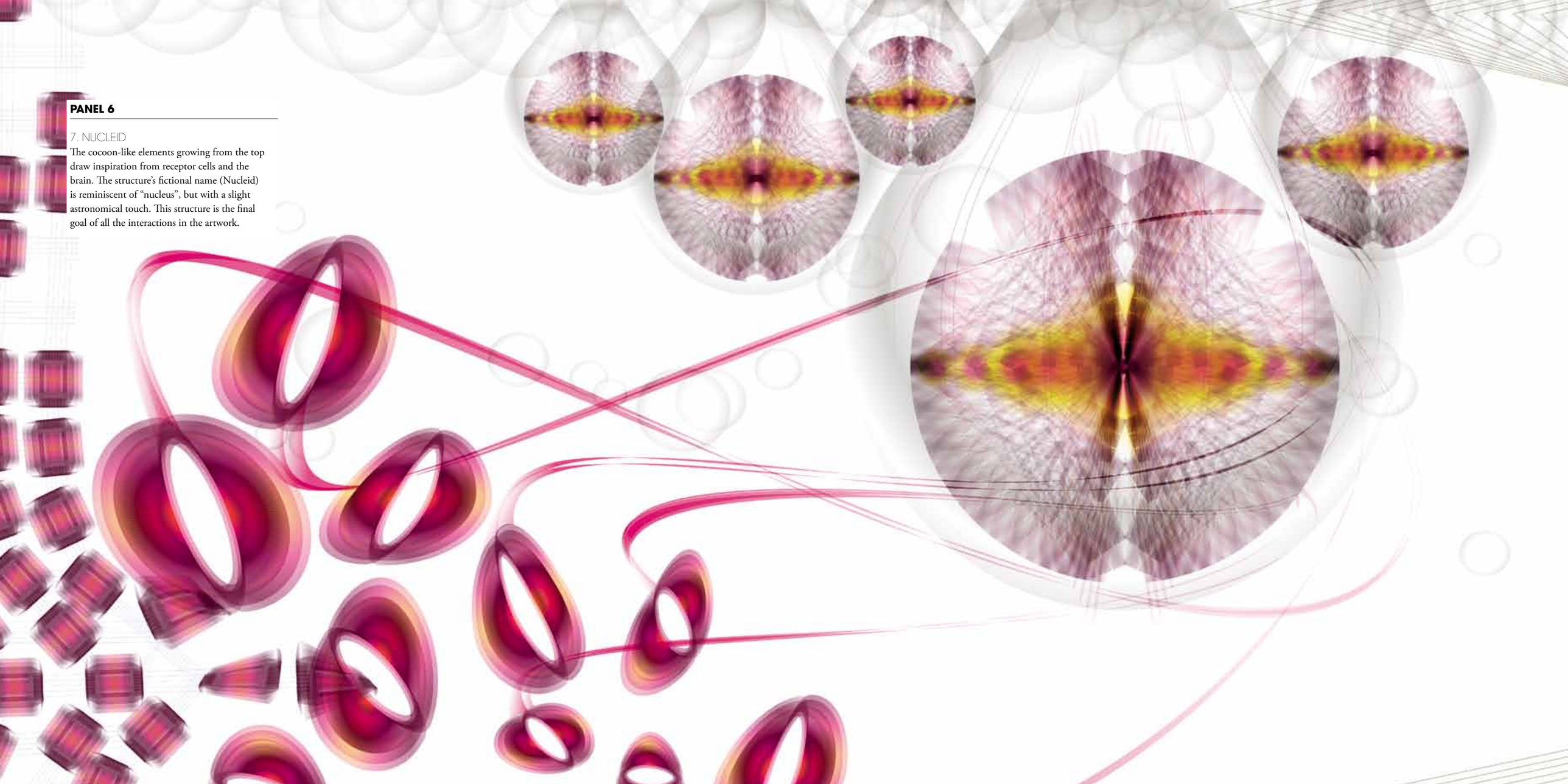
The tissue is modeled by using a force-based algorithm in which the connections between the elements are springs that pull at neighboring elements (Hooke's Law). This tissue basically functions as food for our master cell in [7].

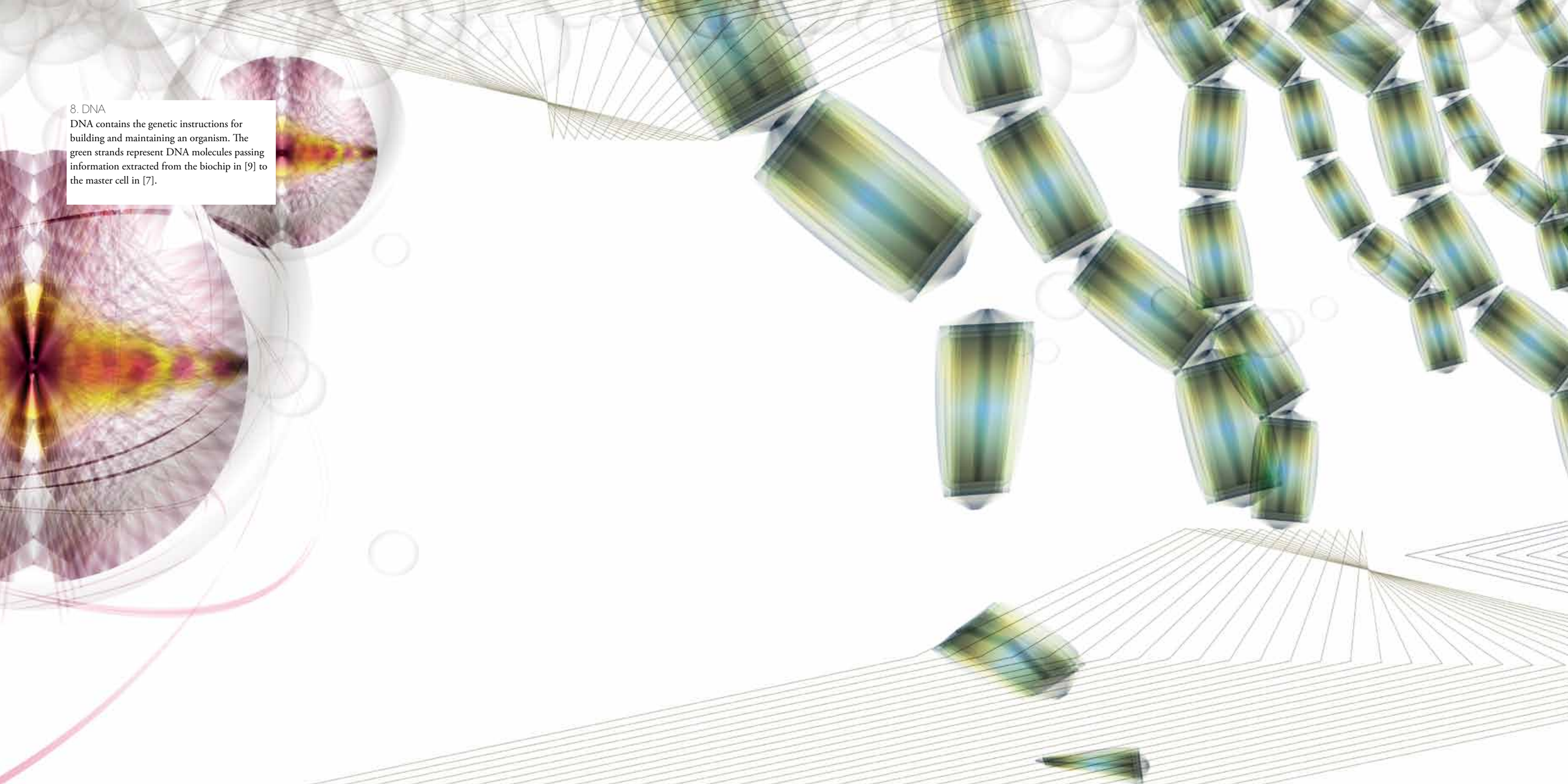


PANEL 6

7. NUCLEID

The cocoon-like elements growing from the top draw inspiration from receptor cells and the brain. The structure's fictional name (Nucleid) is reminiscent of "nucleus", but with a slight astronomical touch. This structure is the final goal of all the interactions in the artwork.





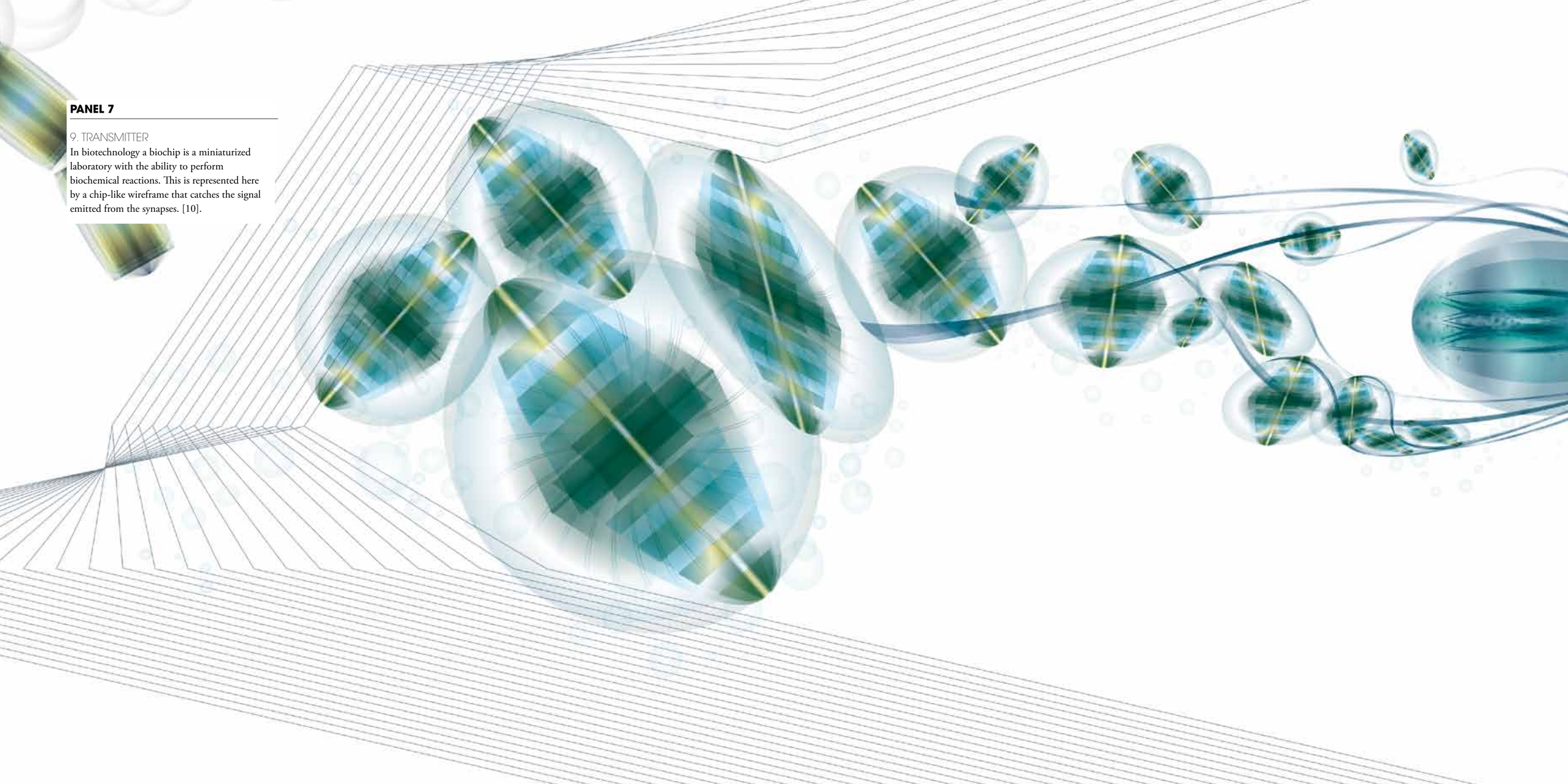
8. DNA

DNA contains the genetic instructions for building and maintaining an organism. The green strands represent DNA molecules passing information extracted from the biochip in [9] to the master cell in [7].

PANEL 7

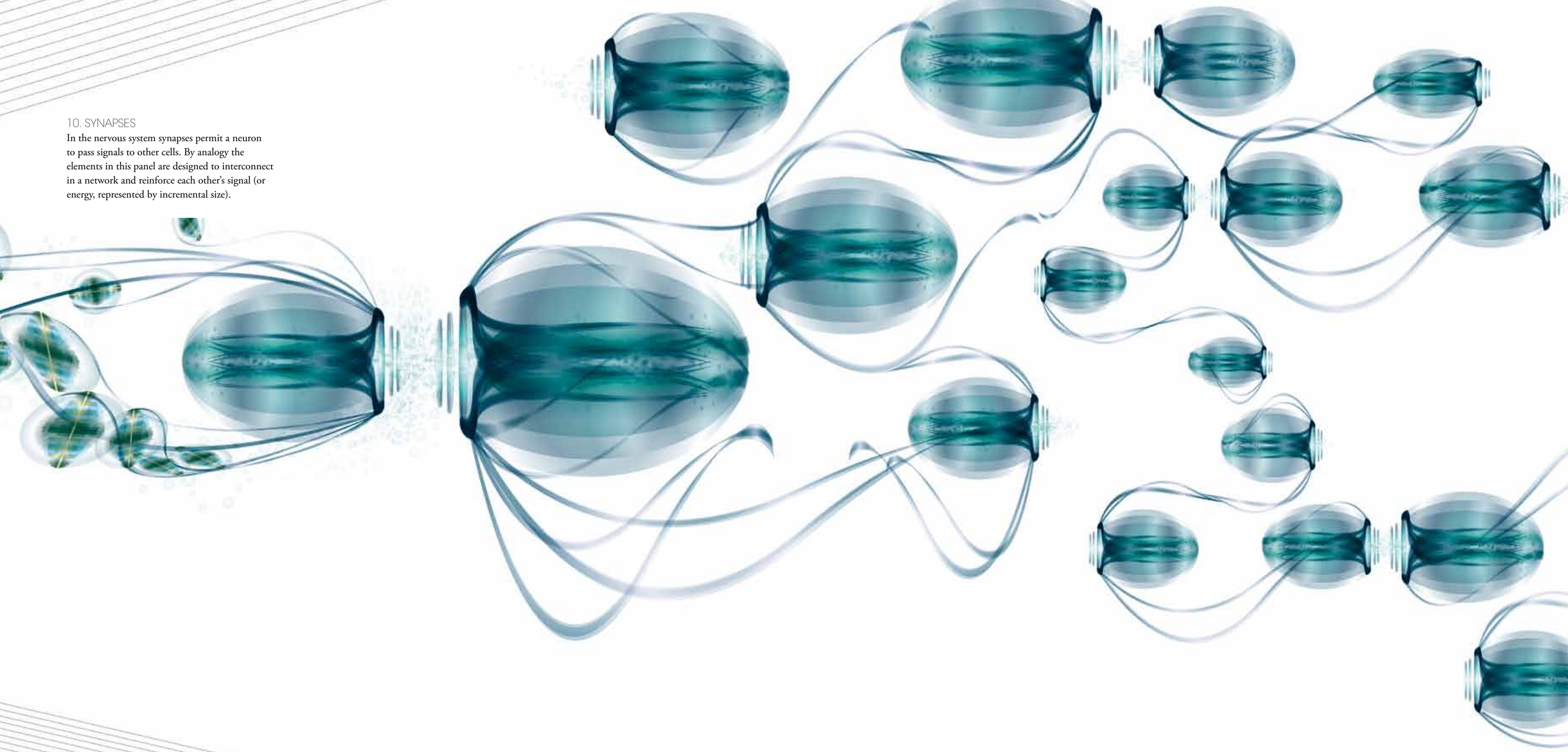
9. TRANSMITTER

In biotechnology a biochip is a miniaturized laboratory with the ability to perform biochemical reactions. This is represented here by a chip-like wireframe that catches the signal emitted from the synapses. [10].



10. SYNAPSES

In the nervous system synapses permit a neuron to pass signals to other cells. By analogy the elements in this panel are designed to interconnect in a network and reinforce each other's signal (or energy, represented by incremental size).



PANEL 1
SOLAR CELL - 1 / 2 / 3 / 4

PANEL 1&2
RESONANCE CELL - 5 / 6

PANEL 3
NEURON CELL - 7 / 8 / 9

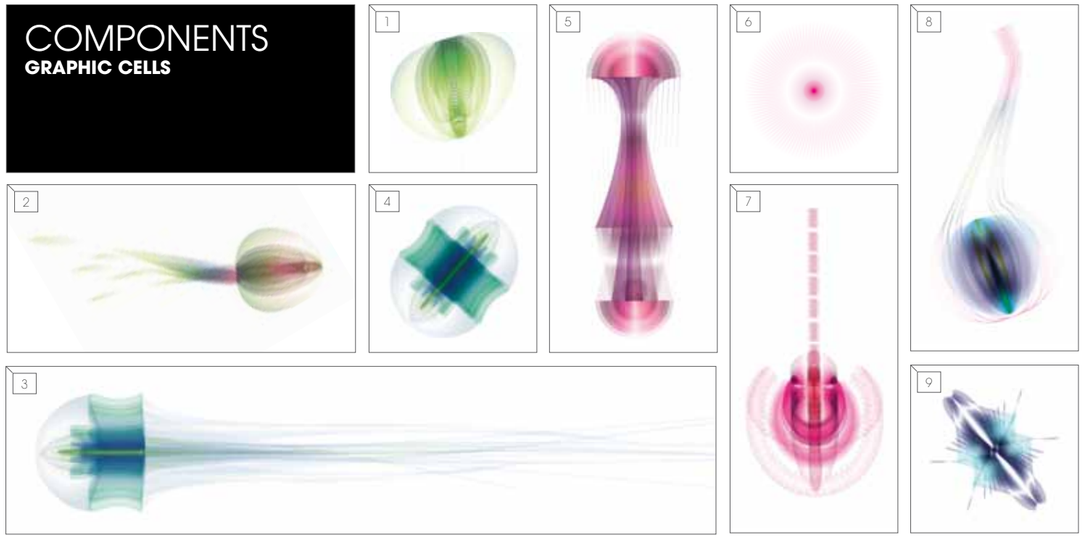
PANEL 4
KINETIC STRING CELL - 10

PANEL 5
EXOCYTOSIS CELL - 11 / 12 / 13 / 14
SELF-ASSEMBLY CELL - 15 / 16 / 17

PANEL 6
NUCLEID CELL - 18 /19
DNA CELL - 20

PANEL 7
TRANSMITTER CELL - 21
SYNAPS CELL - 22

COMPONENTS
GRAPHIC CELLS



NANOPHYSICAL

EEG-DRIVEN GAME

In 2009, imec and its research affiliate Holst Centre released a miniaturized and wireless 8-channel EEG system. The system records high quality EEG signals when connected to gel electrodes. Early tests with dry electrodes are promising, although more research is required to achieve reliable measurement in non-controlled environments. The data is wirelessly transmitted in real-time to a receiver located up to 10m from the system. Imec has also developed algorithms to interpret the brain signals, linking the brain activity to the degree of relaxation.

In a follow-up project we want to create a setup in which the EEG system is linked to NodeBox for OpenGL, an engine for creating simple computer games using Python programming code. The Nintendo Wii controller is used as a secondary input device. We will create an interactive braingame prototype that is controlled by a unique combination of physical actions (Wii) and mental processes (EEG). Gameplay will focus on events at a nanoscopic scale, in a similar visual style as the NANOPHYSICAL artwork.

References:
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http://www.cityinabottle.org/blog/game-engine-source-code/

ACKNOWLEDGEMENTS

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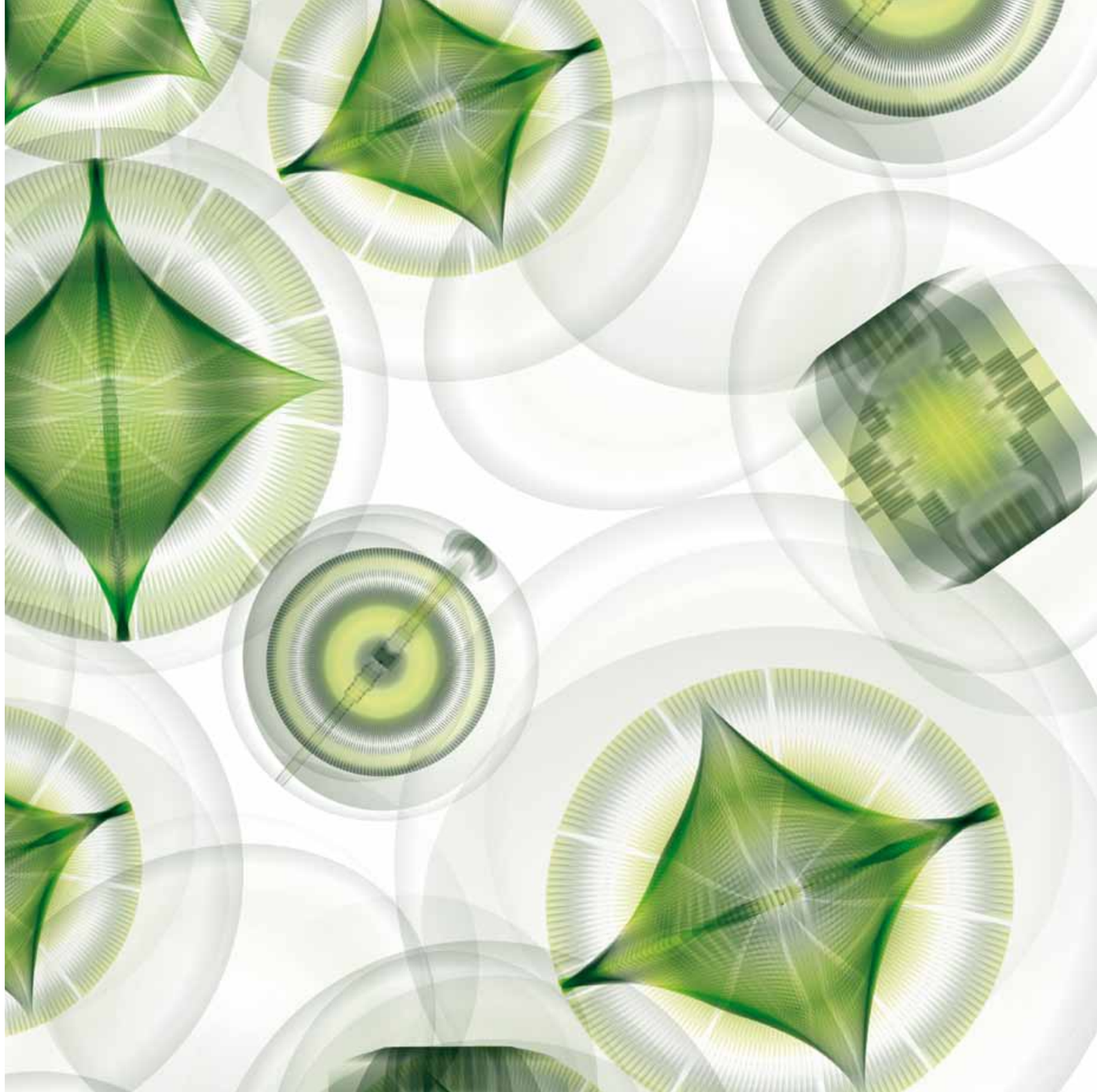

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