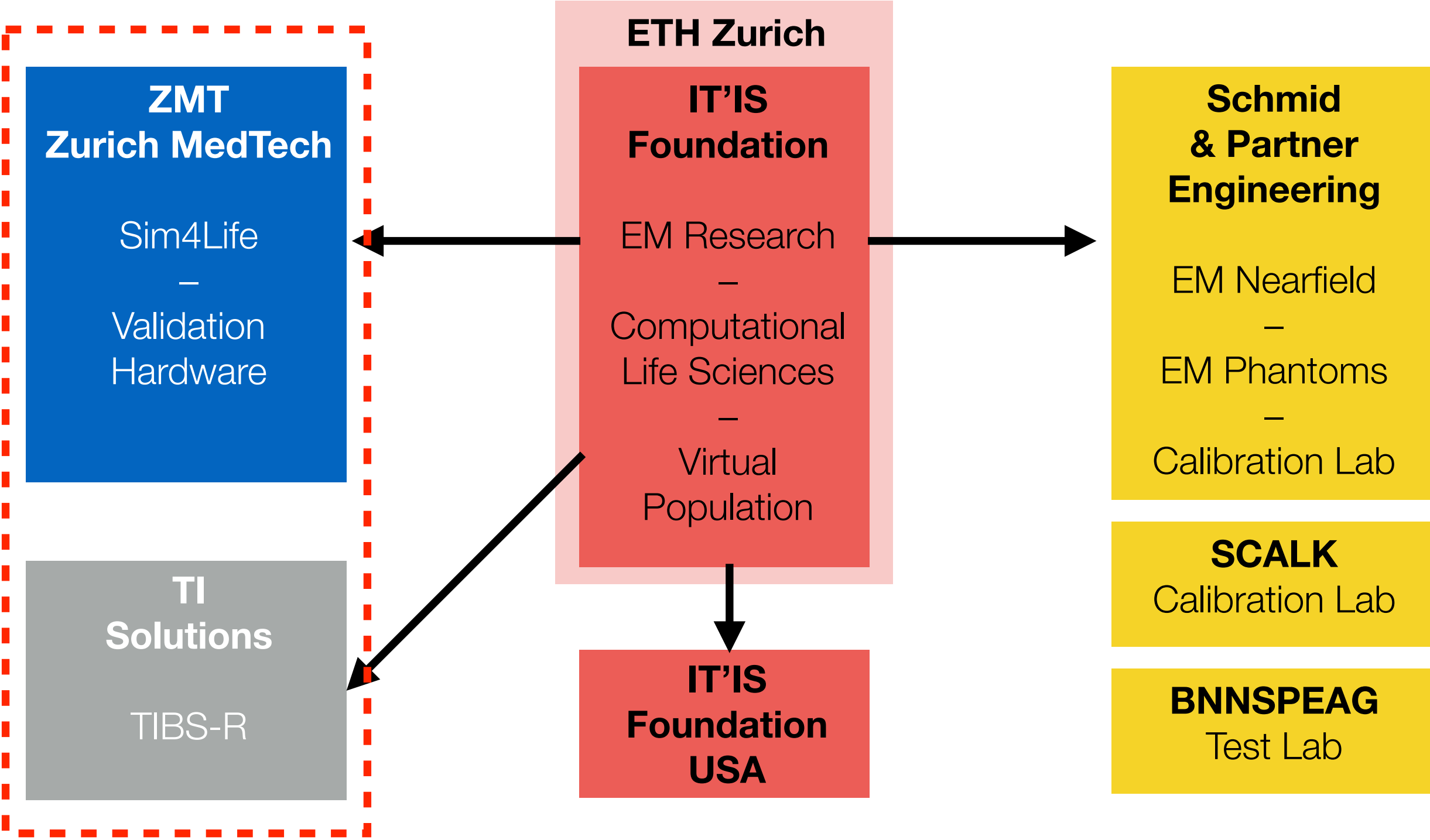


# Welcome & Introduction

*Zurich43, Sim4Life, Workshop Agenda*

Dr. Michael Oberle  
Head of Global Business Development Zurich43

# Zurich43 - Strategy Alliance of ETH Spin-offs

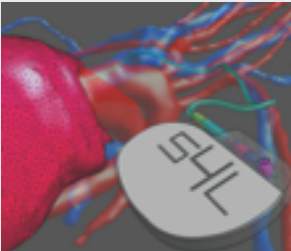


# Sim4Life - Validated Solutions for *in Silico* Life Sciences

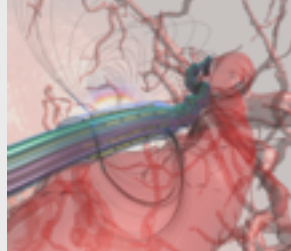
- #1 in detailed, image-based, posable, parameterised anatomical CAD phantoms - **Virtual Population**
- #1 in simulating physiological responses to physical exposure - **Tissue Models**
- #1 MRI RF implant safety solutions - **Sim4Life MDDT**
- leading platform for MRI safety evaluations
- unique cross-validation software-hardware

- ✓ leading tool to innovate technologies  
*Boston Scientific CRM*
- ✓ instrumental for fast development & FDA approval of MRI Safe lead  
*MSEI / Biotronik*
- ✓ Superior solution for neuromodulation computational modeling & simulation  
*Cala Health*
- ▶ **we enable our customers to achieve critical product goals in shorter time**

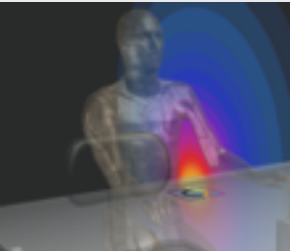
## Markets / Applications



MRI Implant Safety



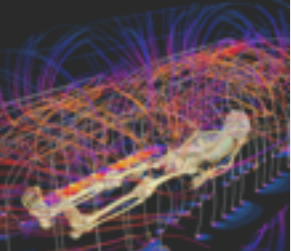
Neuro-modulation



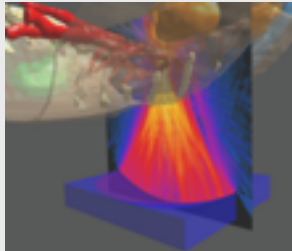
WPT



Wireless BAN



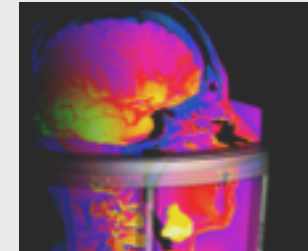
MRI Safety



Focused US



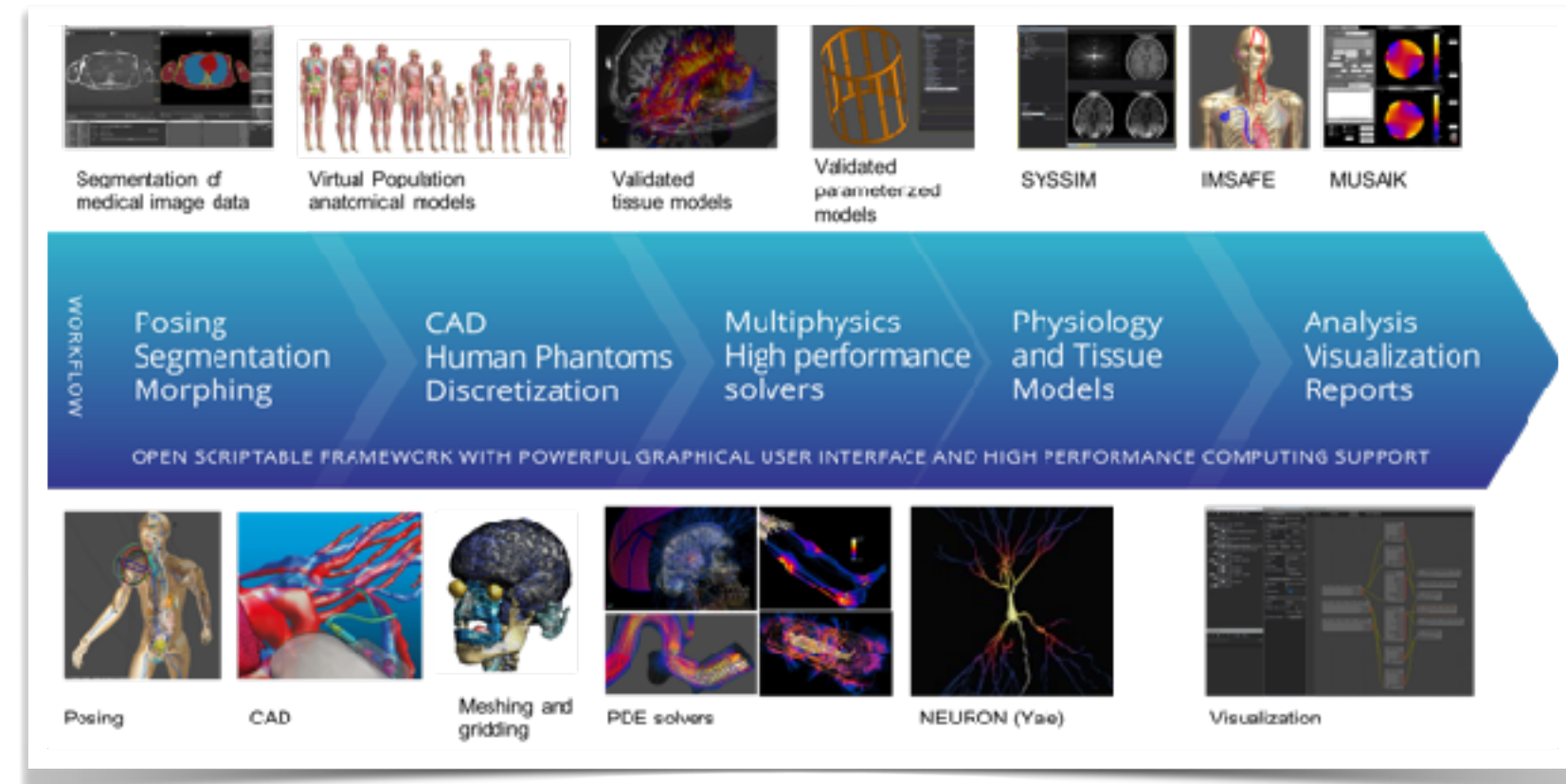
EM Safety



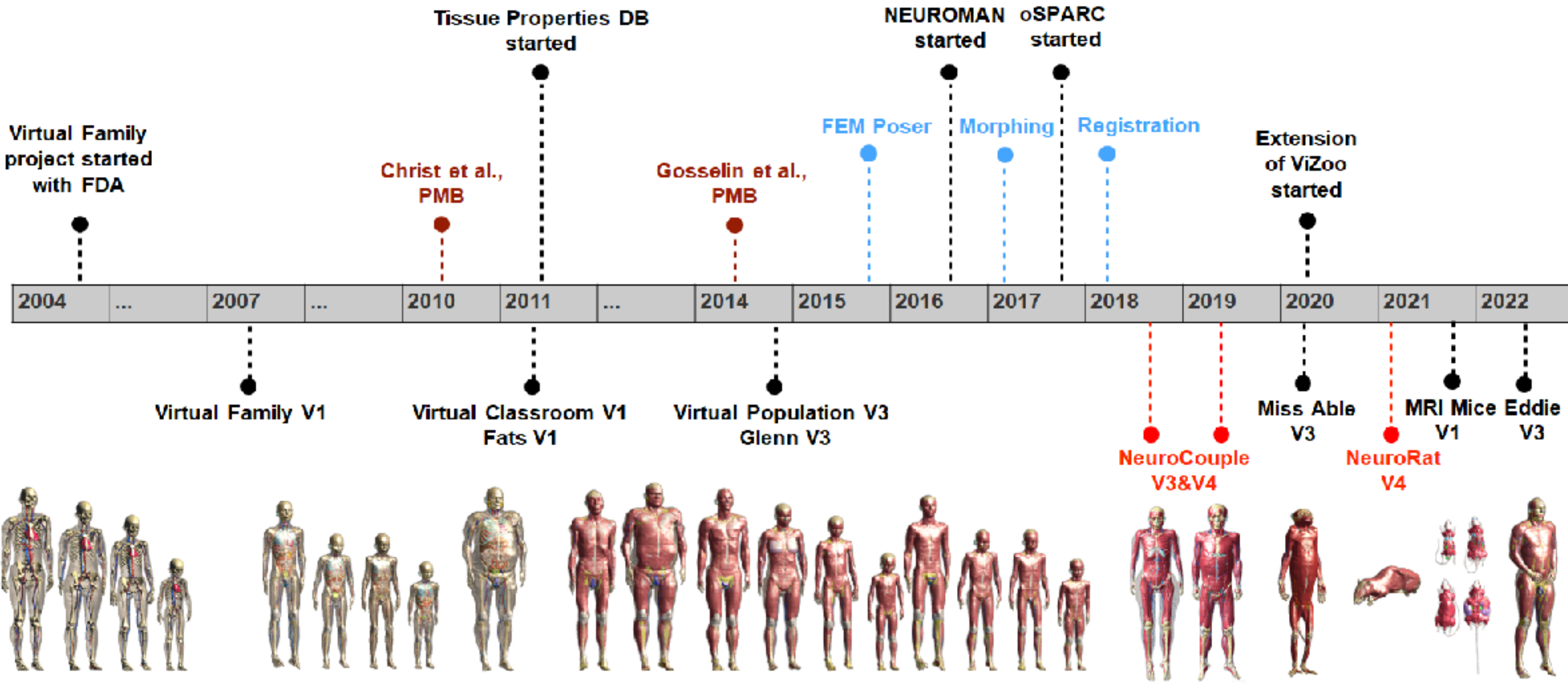
Hyperthermia

# Sim4Life: Unique Patient & Application Driven Workflow

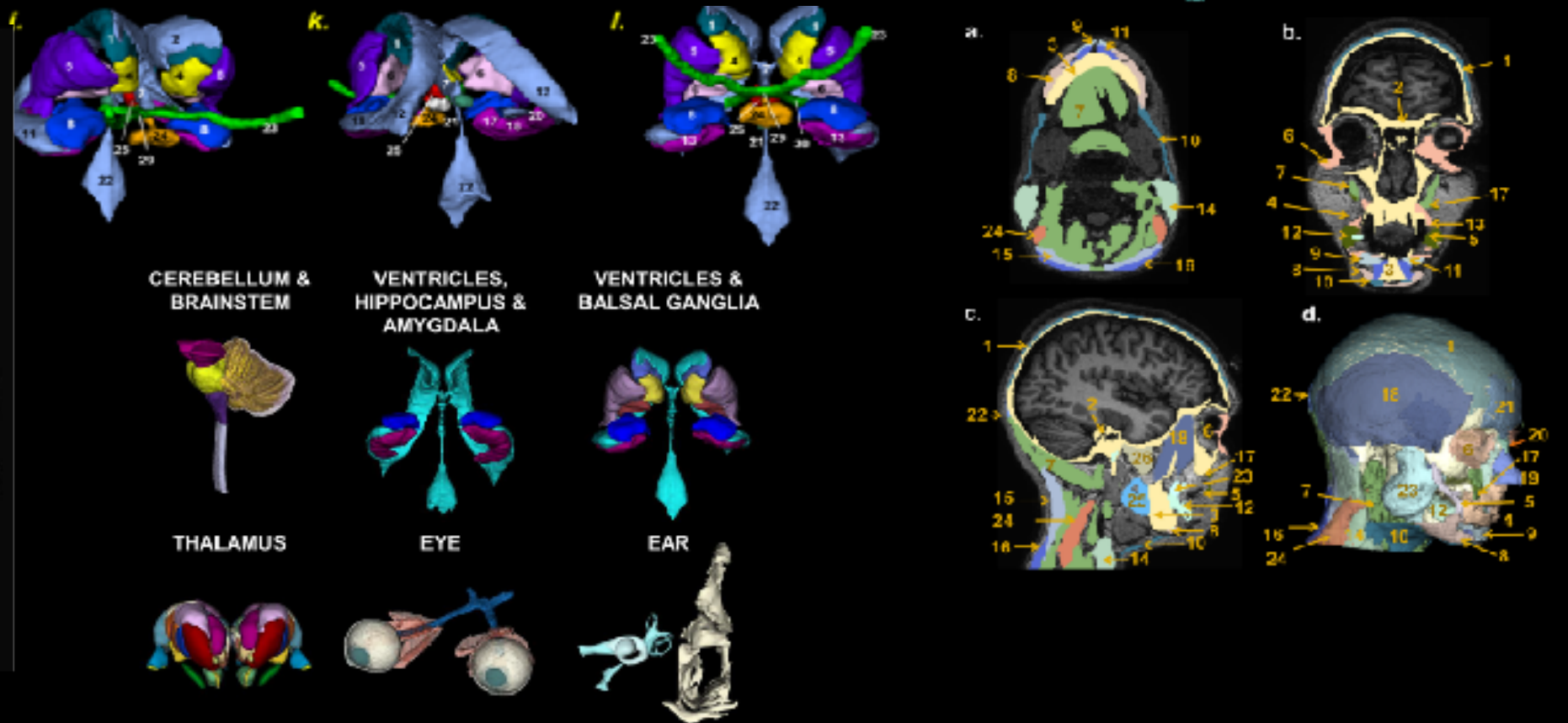
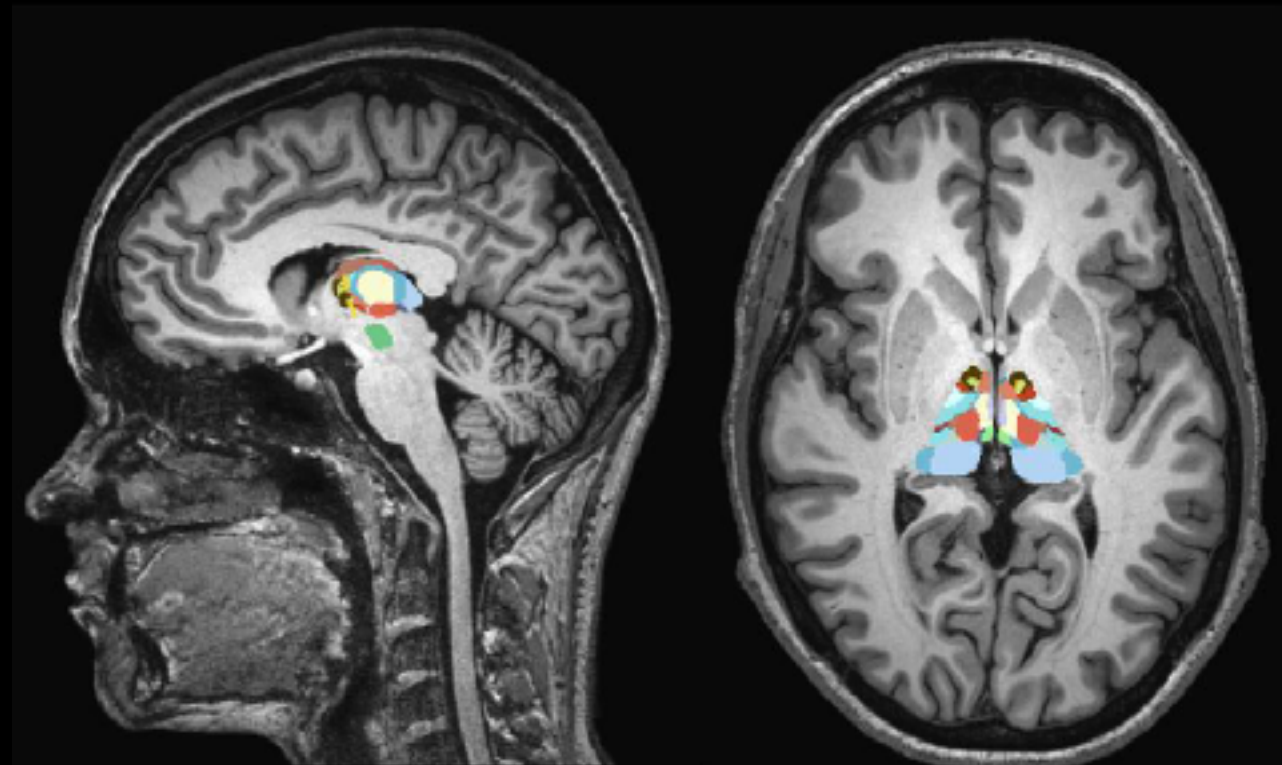
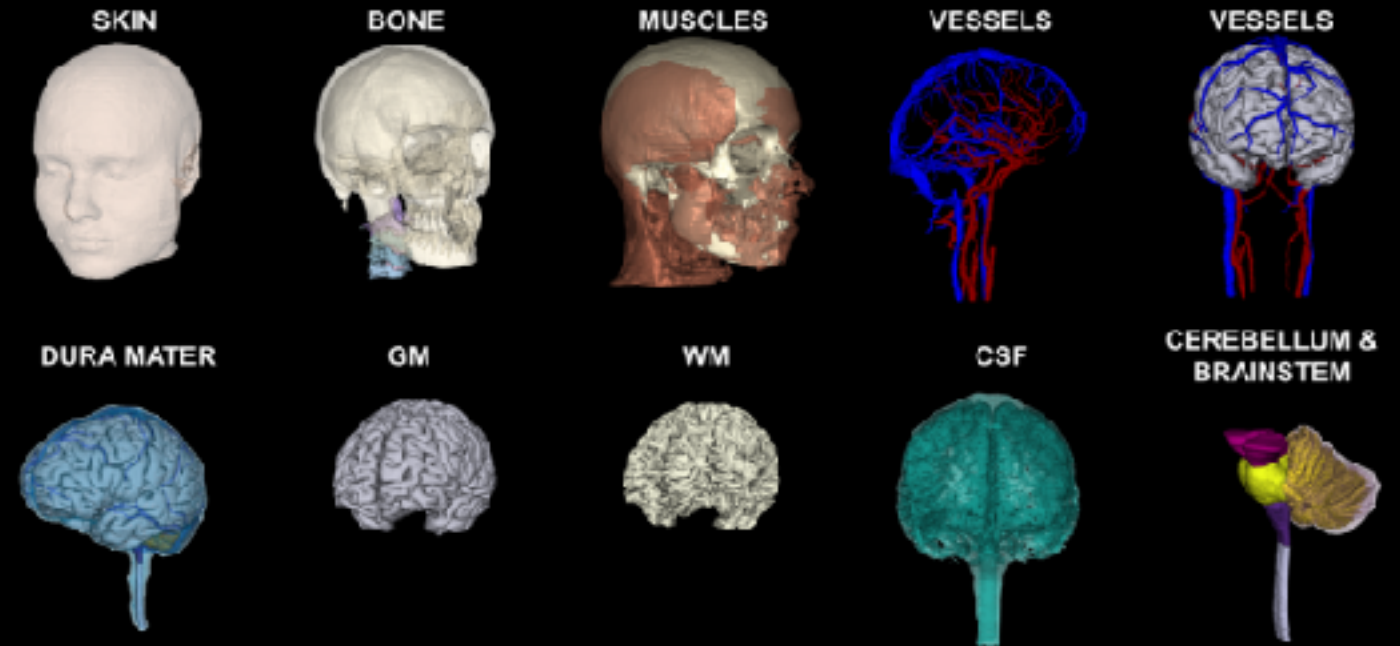
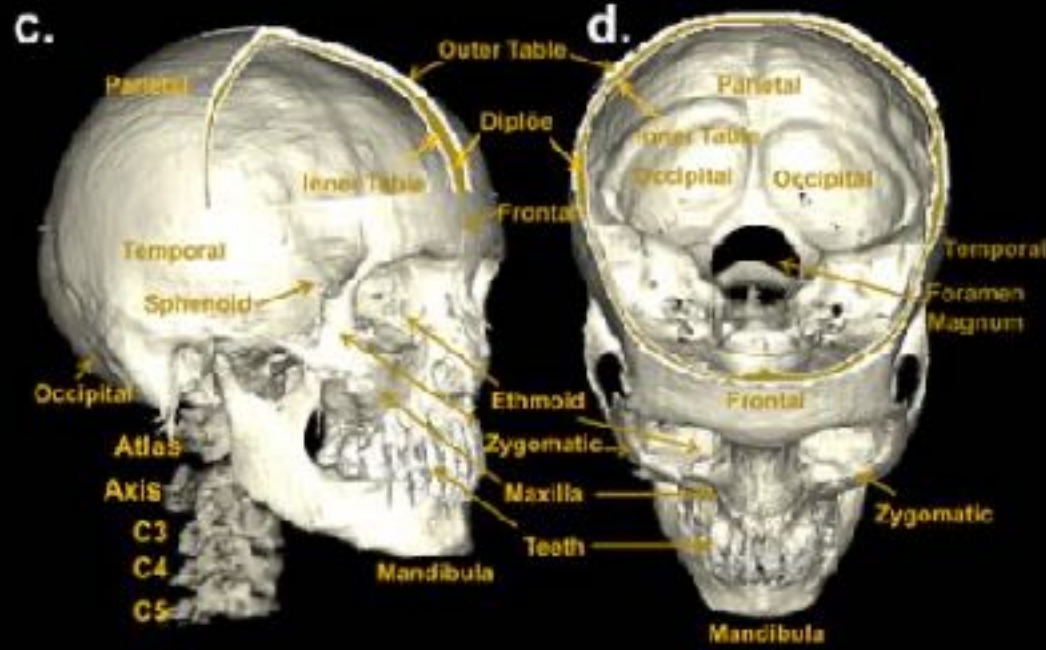
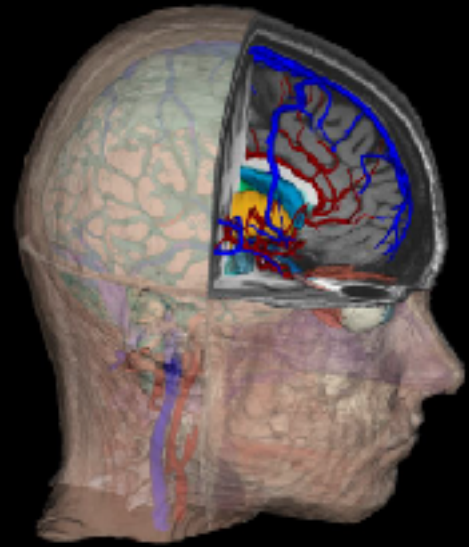
- anatomy-based modeling
  - trusted: validated anatomical models
- image-based modeling workflow
  - realistic: intersubject variability covered
- tissue response models
  - realistic: neuroelectric response predicted
- powerful & validated solvers
  - realistic: medical devices in large anatomies
- 3<sup>rd</sup> party expert tools & workflow
  - minimize risk: no need to change tools
- scripting environment
  - save time: integration into user workflow



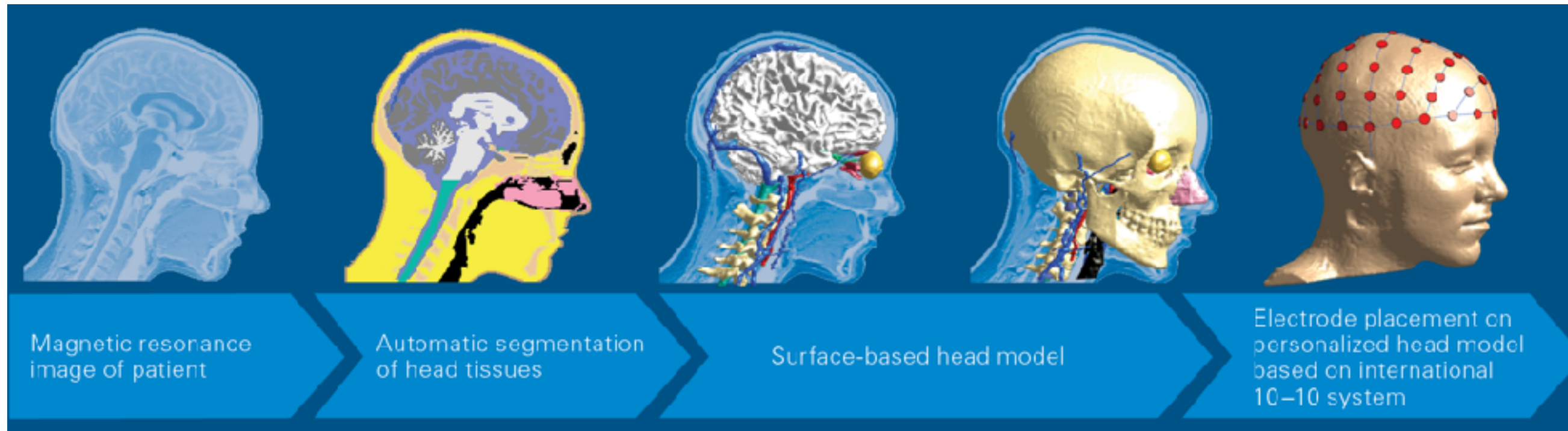
# Gold Standard in High-Resolution Anatomical Models



# MIDA Head Model



# AI Power: Personalized Brain Stimulation Applications



- personalized/precision medicine
  - treatment planning and optimization
  - “personalized” safety assessment
- registration approach
  - find transform that maps “template model” to new patient images
- machine learning approach
  - train network (e.g., UNet) to predict tissue segmentation in new patient images

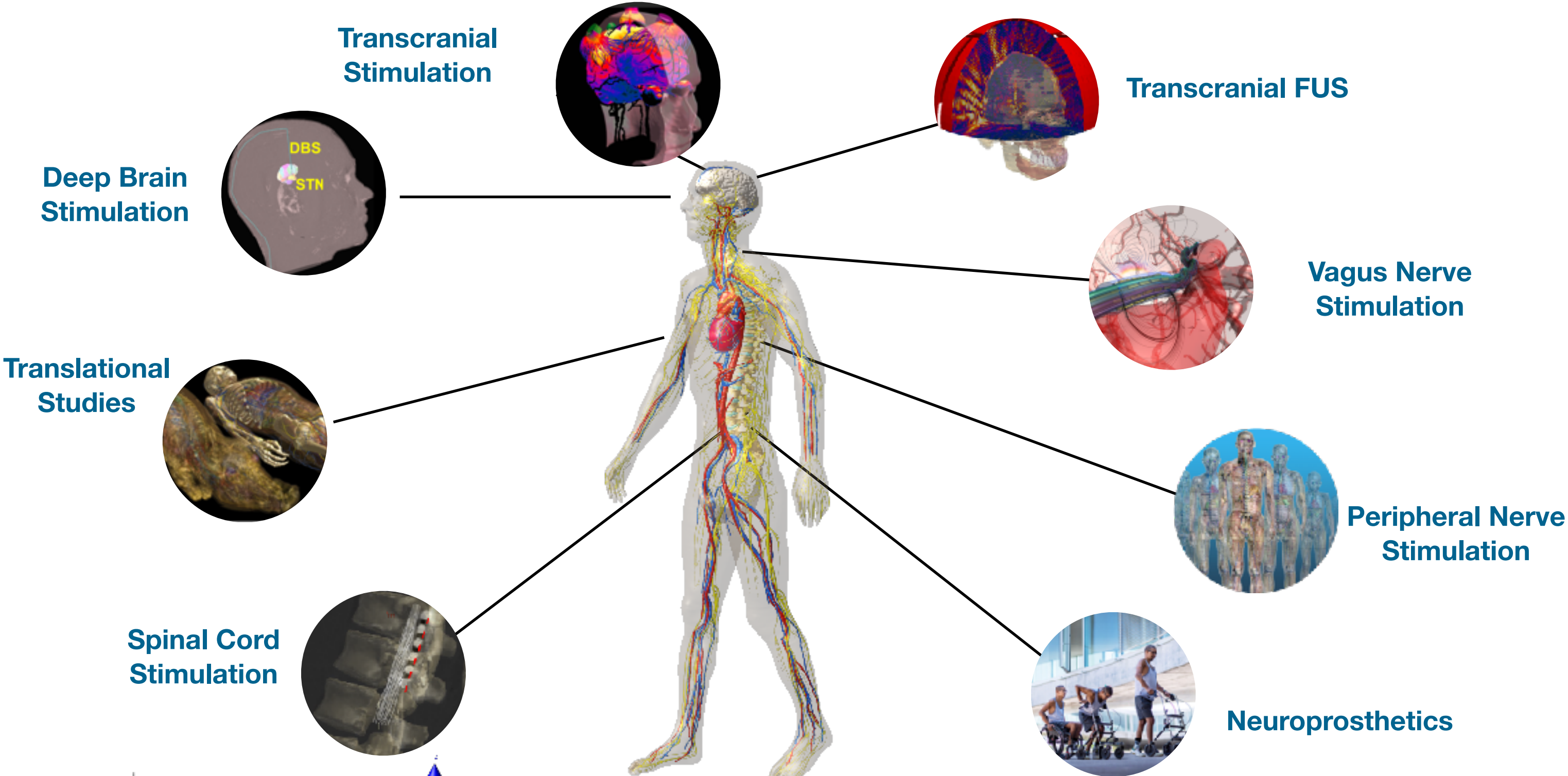
# Tissue Models and Dielectric Properties

- IT'IS provides and curates a database of selected tissue properties for use in life-sciences investigations
  - dielectric properties, radiofrequency (RF) and low-frequency (LF) regions
  - densities
  - thermal properties (conductivity and transfer)
  - viscosity
  - MRI relaxation times
  - elemental compositions
- neurostimulation: LF dielectric parameters are essential
  - Gabriel values of dielectric properties available with caution
  - selected values (conductivity only) from literature reported in a separate table
- all tissue properties are already available and assignable to tissues in Sim4Life

The screenshot shows the IT'IS Tissue Properties database interface. It features a navigation menu at the top with options like 'NEW', 'VIRTUAL POPULATION', 'IT'IS FOR HEALTH', 'EM RESEARCH', 'CUSTOM BMD', and 'ABOUT'. Below the navigation is a search bar and a main heading 'TISSUE PROPERTIES'. The main content area includes a 'Dielectric Properties' section with a table of values for various tissues. The table has columns for 'Tissue', 'Source', 'Permittivity', and 'Elec. Cond. (S/m)'. A 'Frequency' dropdown menu is set to 'LF'. To the right of the table is a 'Database Summary' sidebar with a list of property categories such as 'Density', 'Heat Capacity', 'Thermal Conductivity', etc.

Tissue	Source	Permittivity	Elec. Cond. (S/m)
Atrial Card	Atrial Card	5.4E+1	6.0E-1
Air	Air	1.0E+0	0.0E+0
Bile	Bile	4.5E+1	1.5E+0
Blood	Blood	7.0E+1	1.7E+0
Blood (MDF)	Blood	7.0E+1	0.0E+0
Blood Serum	Blood	7.0E+1	0.0E+0
Blood Vessel Wall	Blood Vessel Wall	5.9E+1	4.0E-1
Bone (Cancellous)	Bone (Cancellous)	2.7E+1	1.2E-1
Bone (Cortical)	Bone (Cortical)	1.5E+1	6.4E-2
Bone Marrow (Red)	Bone Marrow (Red)	1.4E+1	1.0E-1
Bone Marrow (Yellow)	Bone Marrow (Yellow)	5.4E+0	2.0E-2
Brain	CBFDB/IT'IS	8.0E+1	1.0E-1
Brain (Grey Matter)	Brain (Grey Matter)	8.0E+1	5.0E-1
Brain (White Matter)	Brain (White Matter)	5.0E+1	3.2E-1
Breast Fat	Breast Fat	5.0E+1	0.0E+0
Breast Gland	IT'IS/IT'IS	5.0E+1	1.0E-1
Bronchi	Tissue	5.0E+1	5.4E-1
Bronchi Lumen	Bronchi Lumen	1.0E+0	0.0E+0

# Sim4Life – Key Solutions in Neuromodulation R&D



# *In Silico* Modeling for Medical Device Industry

## ■ mechanistic investigations

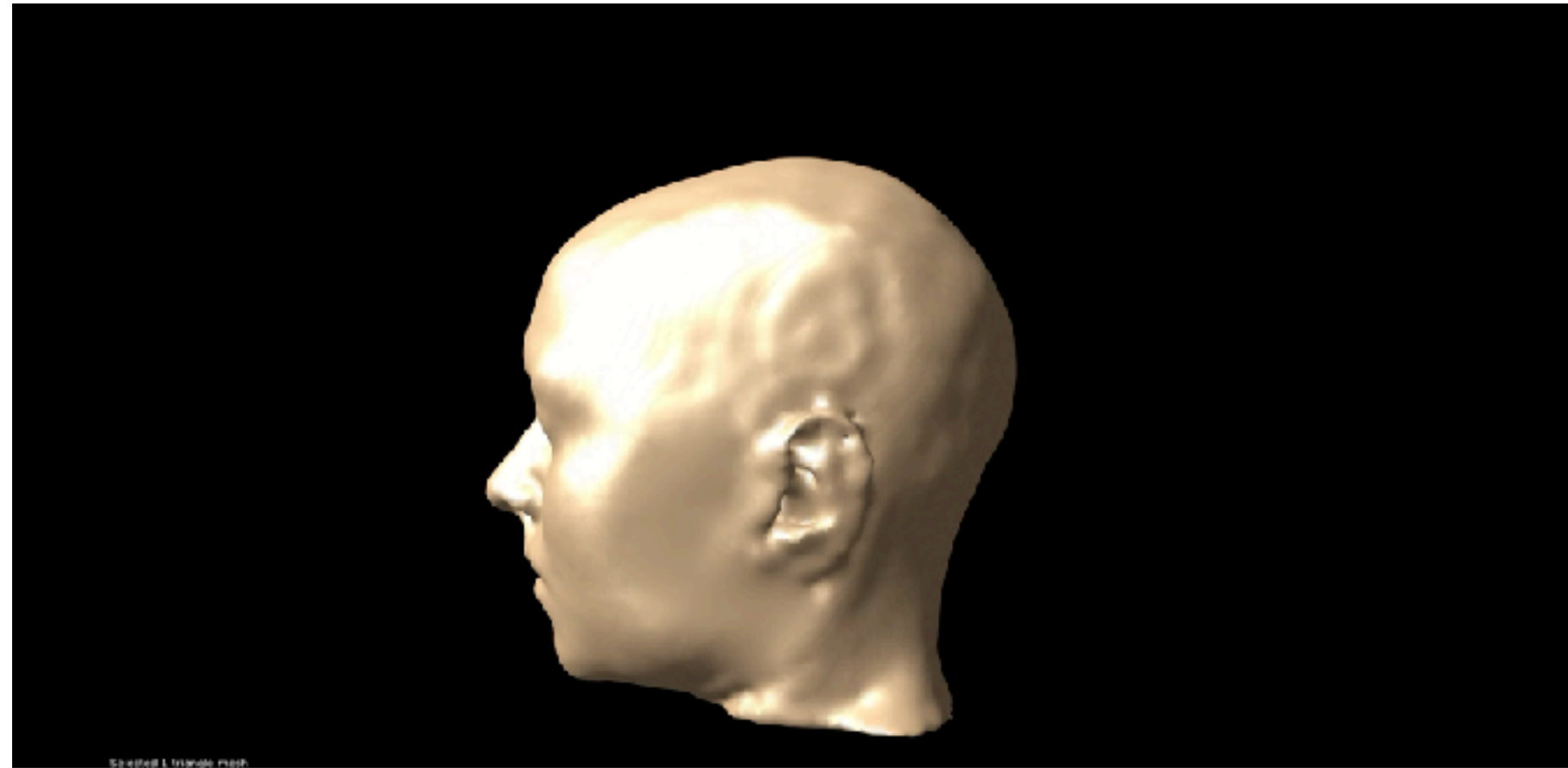
- quantities of interest (QoIs) for stimulation (E-field, E-field gradients, etc.)
- quantities of interest for safety (charge injection, thermal heating, etc.)

## ■ device design and optimisation

## ■ treatment parameters identification

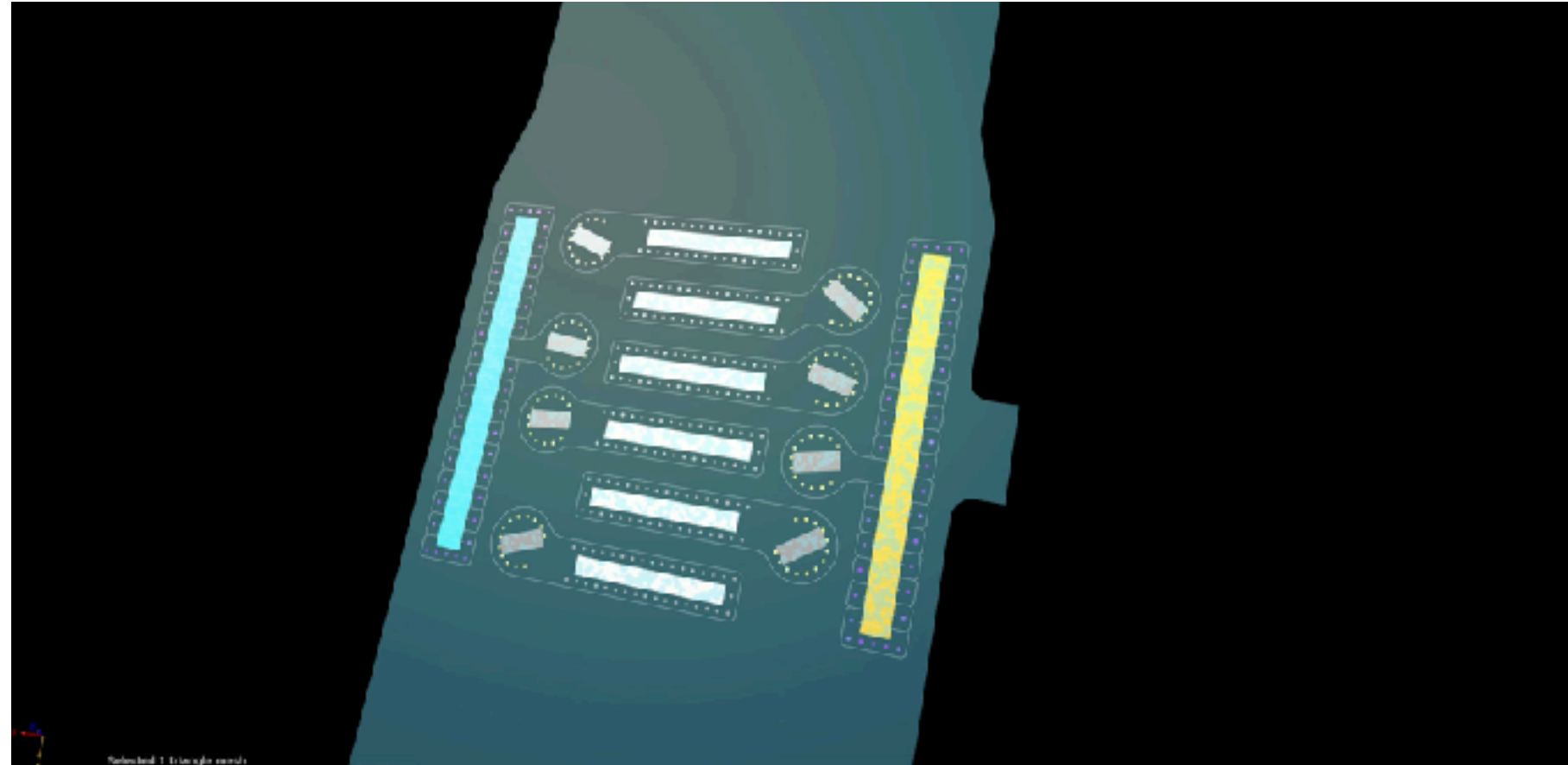
## ■ personalization & optimisation

## ■ safety with respect to other technologies



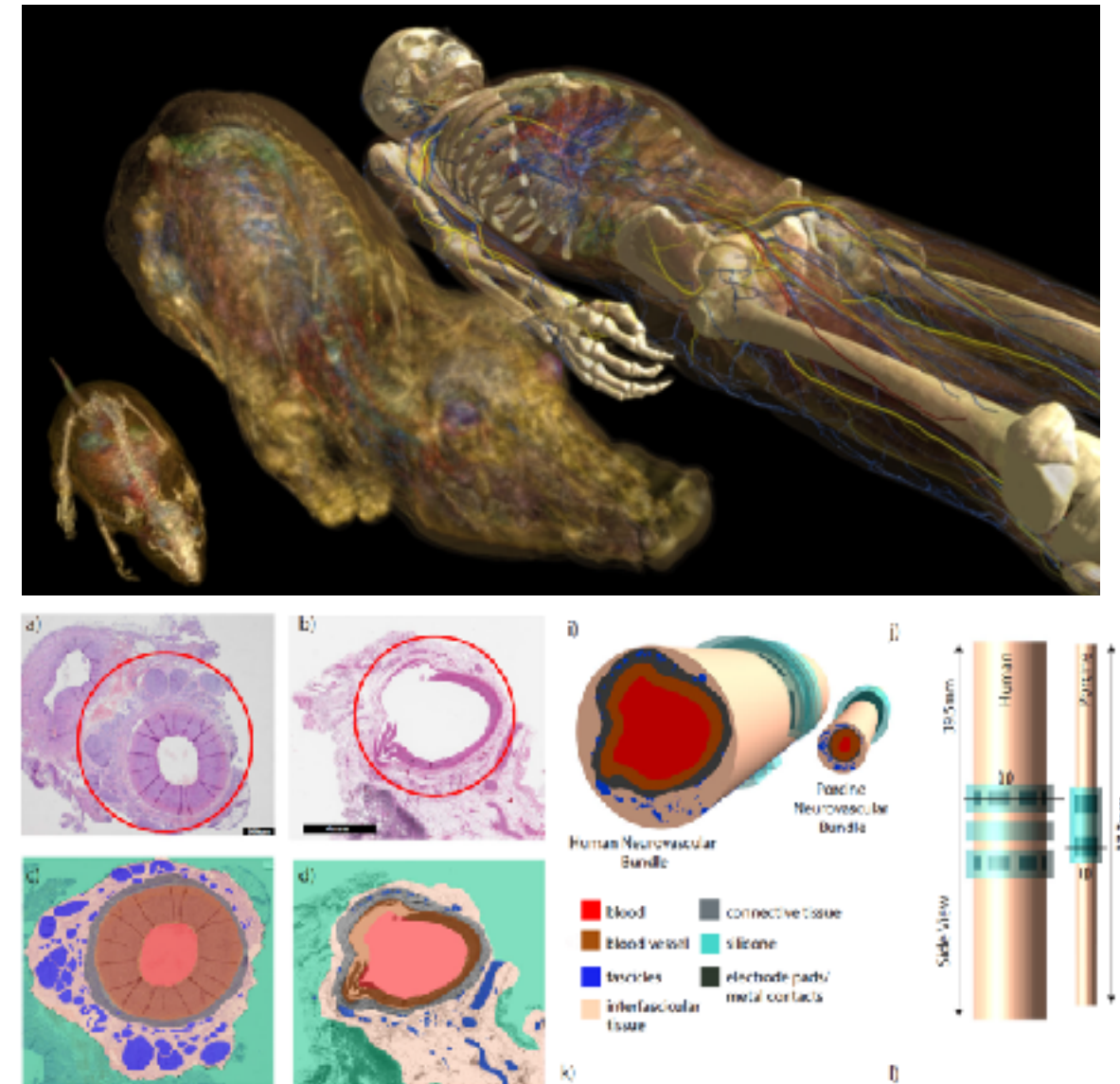
# *In Silico* Modeling for Medical Device R&D

- mechanistic investigations
- **device design and optimisation**
  - safety and performance-related questions
- treatment parameters identification
- personalization & optimisation
- safety with respect to other technologies



# De-Risking of Clinical Trials using In Silico Models

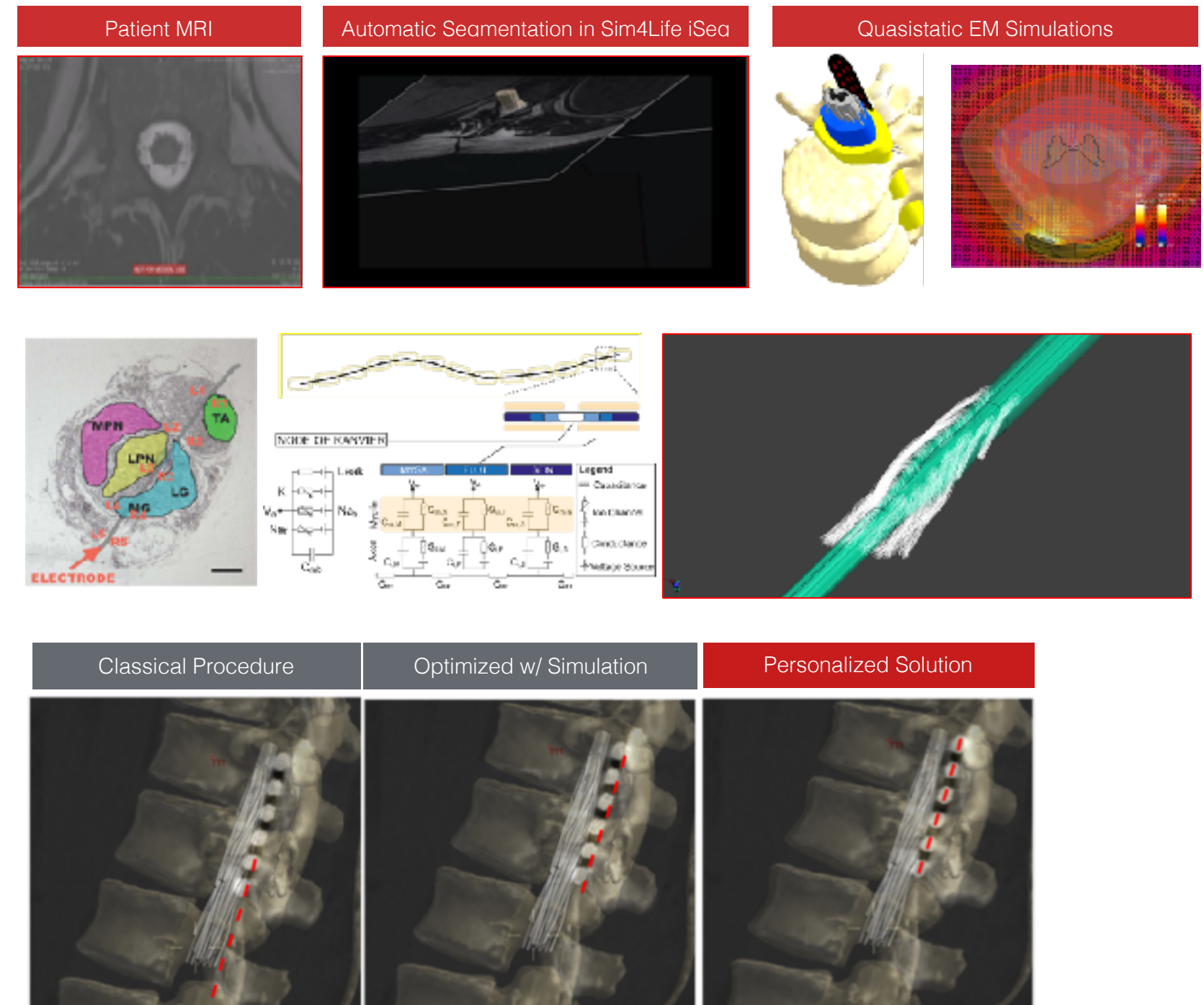
- mechanistic investigations
- device design and optimisation
- **treatment parameters identification**
  - dose quantification between different species
  - dose variation (e.g. acute vs chronic)
  - identification of stimulation access points
  - safety considerations
- personalization & optimisation
- safety with respect to other technologies



Quantification of clinically applicable stimulation parameters for precision near-organ neuromodulation of human splenic nerves. *Commun Biol* **3**, 577 (2020). Gupta, I., Cassará, A.M., Tarotin, I. et al.

# Personalised in Silico Model – Personalised Treatment

- mechanistic investigations
- device design and optimisation
- treatment parameters identification
- **personalization & optimisation**
  - impact of subject-specific anatomy
  - healthy vs disease
  - closed-loop technologies
- safety wrt other technologies



# *Personalised in Silico* Model – Personalised Treatment

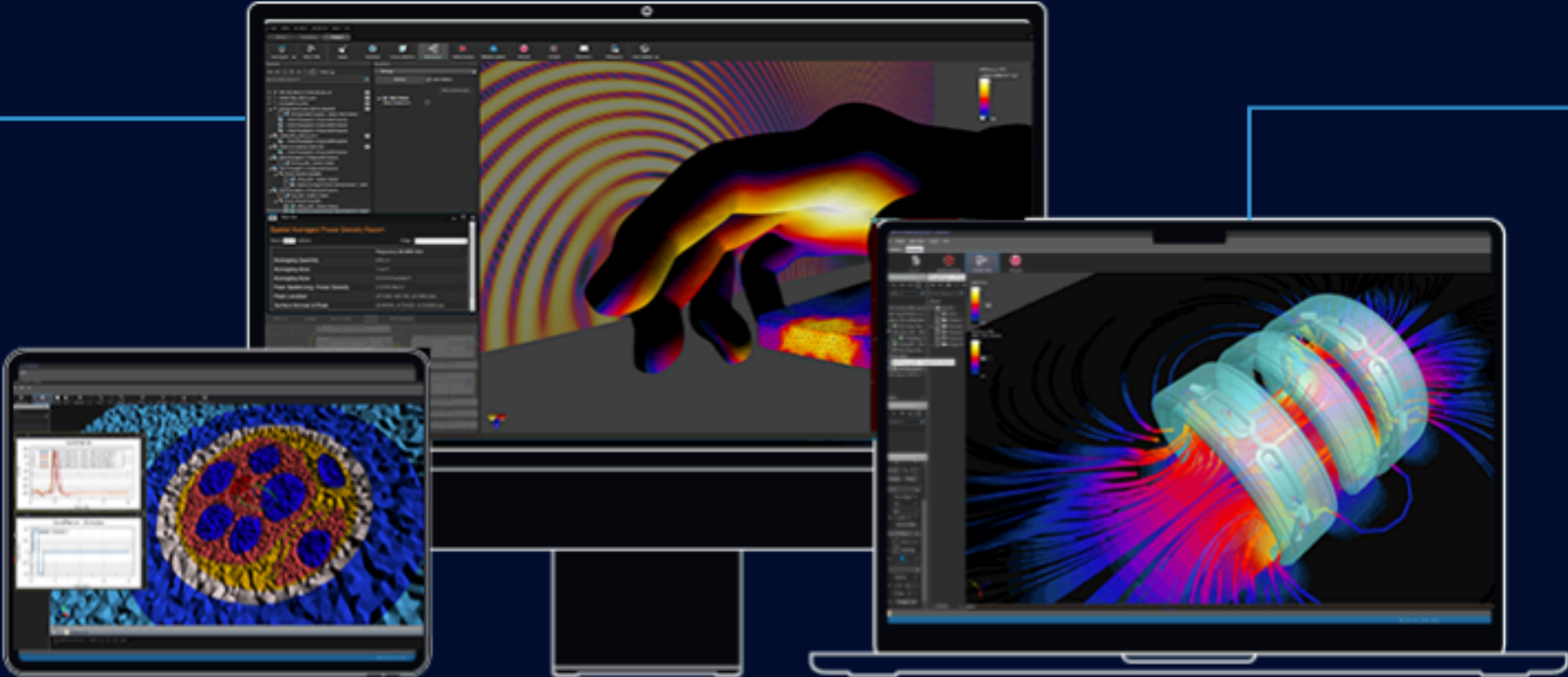
- mechanistic investigations
- device design and optimisation
- treatment parameters identification
- **personalization & optimisation**
  - impact of subject-specific anatomy
  - healthy vs disease
  - closed-loop technologies
- safety wrt other technologies



# Natively in the Cloud or on Your Desktop Machine

Desktop Version: Single Investment for In-House Use

Web Version: Pay-Per-Use, Flexible And Scalable



Work Effortlessly on Any Device

# Sim4Life for Business – Time to Speed-up your R&D!

## Web

Native Sim4Life in the Cloud / AWS  
Best for SMEs



- ✓ pay-per-use (w/ welcome credits)
- ✓ instant access anywhere
- ✓ private and shared projects
- ✓ collaborate in real-time
- ✓ all solvers and the majority of tools
- ✓ two ViP V3 models
- ✓ extendable with 3rd-party tools
- ✓ basic support

## Desktop

Sim4Life Compiled for the Desktop / Servers  
Best for Large R&D Teams

- ✓ licensed for specific needs
- ✓ local network (desktop / servers)
- ✓ all data local, fast access
- ✓ cost-efficient for intensive R&D efforts
- ✓ all solvers, all tools
- ✓ all functionalized ViP V3.0 / V4.0 models
- ✓ all projects compatible with the web version
- ✓ Start-up/SME Program available
- ✓ premier support

# Sim4Life for Science – We Support Research!

Lite 	Web	Desktop 
<p>Free &amp; Limited Best for Students &amp; in the Classroom</p>	<p>Native Sim4Life in the Cloud / AWS Best for Collaborative Research</p>	<p>Sim4Life Compiled for the Desktop / Servers Best for Research</p>
<ul style="list-style-type: none"><li>✓ free but limited #elements</li><li>✓ instant access anywhere</li><li>✓ private and shared projects</li><li>✓ all projects compatible with the desktop versions</li><li>✓ collaborate in real-time</li><li>✓ all solvers, many tools</li><li>✓ one ViP V3 model</li><li>✓ no HPC-enabled solvers</li><li>✓ no 3rd-party tools</li><li>✓ with educational email address only</li></ul>	<ul style="list-style-type: none"><li>✓ pay-per-use (w/ welcome credit)</li><li>✓ instant access anywhere</li><li>✓ private and shared projects</li><li>✓ all projects compatible with the desktop versions</li><li>✓ collaborate in real-time</li><li>✓ all solvers, majority of tools</li><li>✓ Duke V3 and Yoon-sun V4 ViP models</li><li>✓ HPC-enabled solvers (MPI and GPU)</li><li>✓ extendable with 3rd-party tools</li><li>✓ with educational email address only</li></ul>	<ul style="list-style-type: none"><li>✓ no commercial use</li><li>✓ Sim4Life for Science program contract</li><li>✓ local network (desktop / servers)</li><li>✓ all data local, fast access</li><li>✓ all solvers and most tools</li><li>✓ Duke V3 and Yoon-sun V4 ViP models</li><li>✓ GPU acceleration: only CUDA</li><li>✓ all projects compatible with the web version</li></ul>

 <https://sim4life.swiss/science>

# Sim4Life Desktop – Solutions Tailored to Your Needs

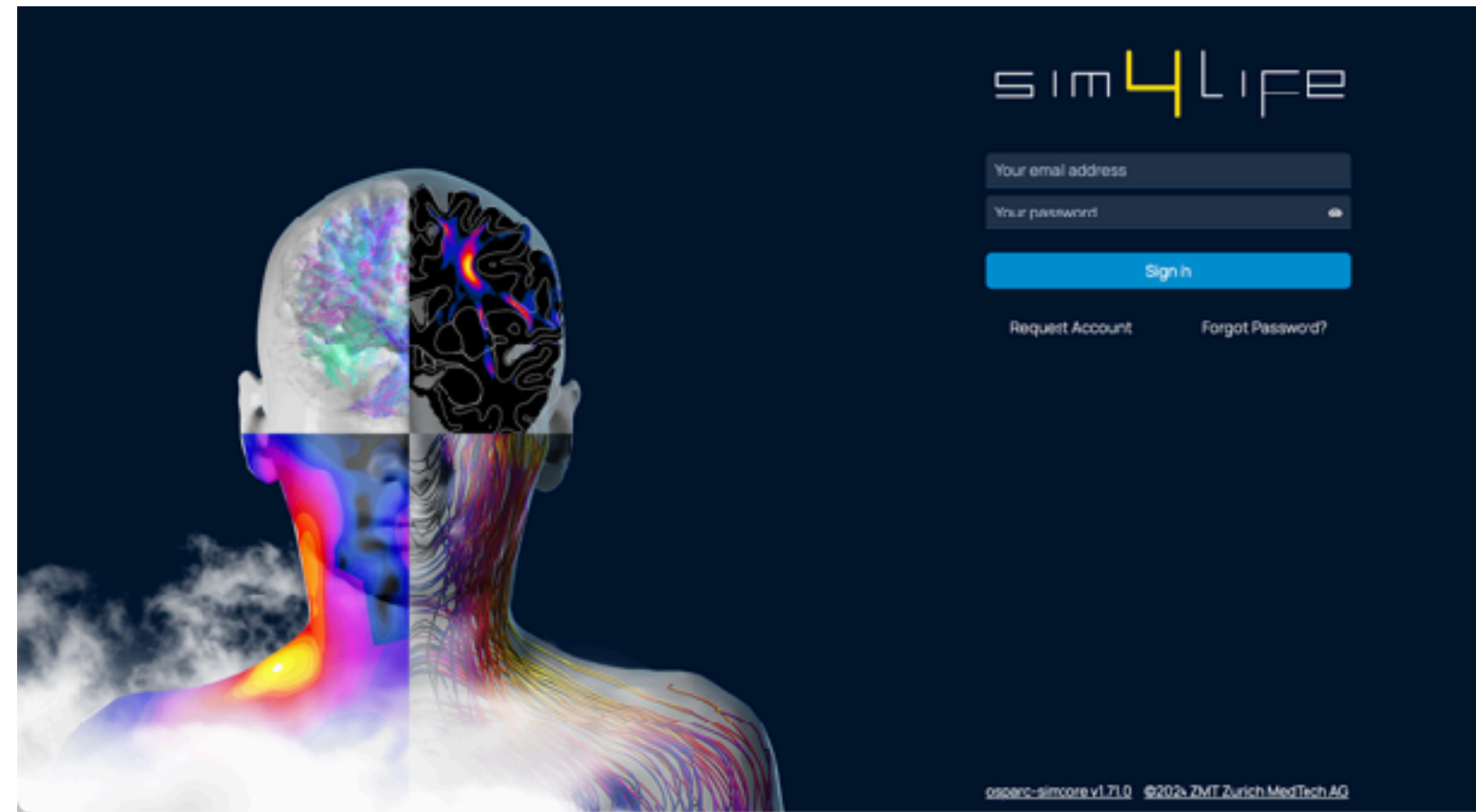
- several models & modules
  - tailor configuration to project need
  - no need to license “all”
- add / replace modules later on
  - meet changing project needs & budgets

typical product configuration for neuromodulation customer

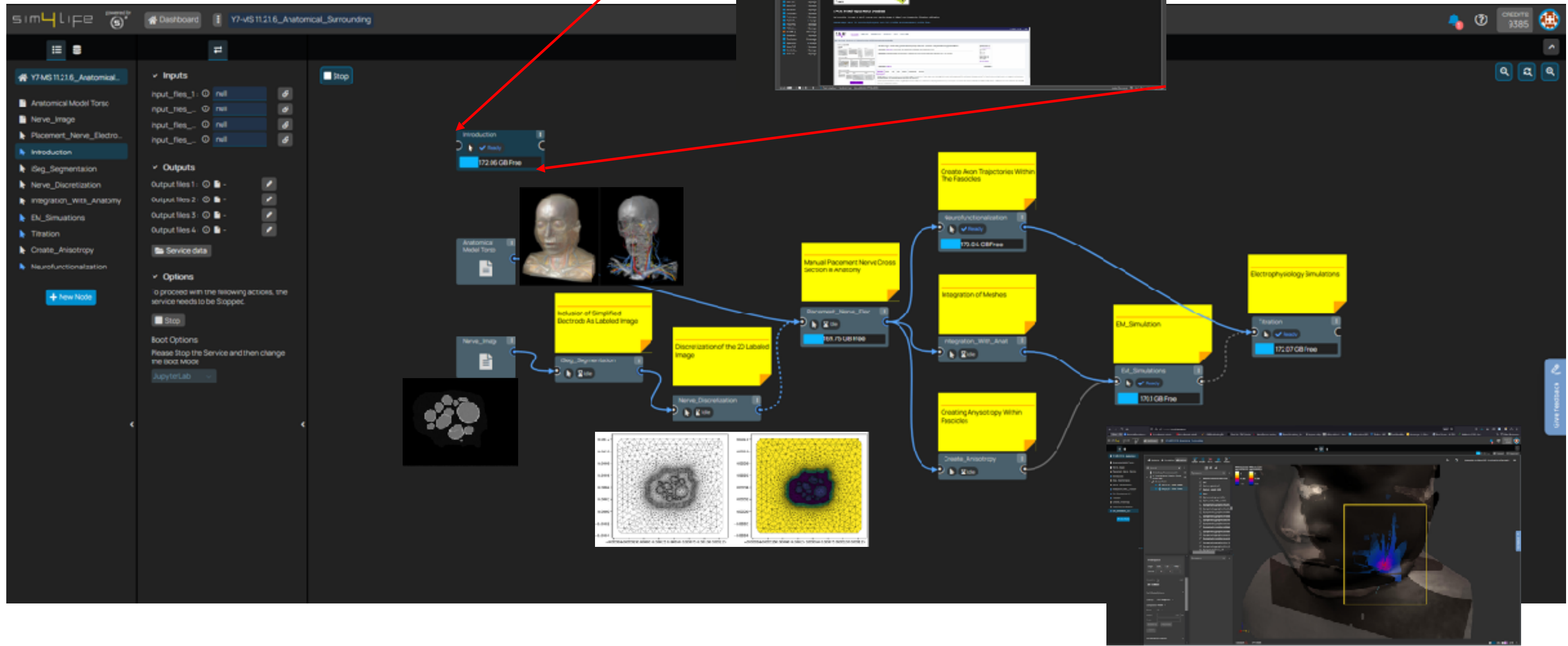
Computable Human Phantoms	Physics Models	Tissue Models	Intuitive GUI and Workflow	Licensed Modules
VIP 4.0 Virtual Population	P-EM-FDTD Electromagnetics Full Wave Solvers	T-NEURO Neuronal Tissue Models	MODELER Advanced Modeling Tool Set	MRI IMANALYTICS M-MUSAIK M-TxCOIL M-BCAGE M-SYSSIM M-GRAD M-IMSAFE
ViZoo 1.0 Animal Models	P-EM-QS Quasi-Static Electromagnetics Solvers	T-CEM43 Tissue Damage Models	MESHER Robust & Effective Meshing	MODELING M-ISEG M-REMESH
3rd-Party Models	P-THERMAL Thermodynamics Solvers		POSER Physics-based Realistic Posing	CALCULATORS M-DISPFIT M-PPCALC
	P-FLOW Fluid Dynamics Solvers		SWEEPER Fully Configurable Parameter Sweeps	TOOLBOX M-MATCH M-MIMO M-MBSAR M-HAC M-5G
	P-ACOUSTICS Acoustics Solvers		ANALYZER Versatile Postprocessor and Analyzing Tool Set	IMPORT M-HUYGENS M-IMG M-VOX
			PYTHON Control via Python Scripting	OPTIMIZER Multi-Parameter Multi-Goal Optimizer
High Performance Computing Auto-Scheduler & Control ARES				

# Why Sim4Life Web?

- pipeline Sim4Life w/ other Services
- large library of existing Services
- create your own Services – and share
- automate complex scalable workflows
- JupyterLab/Python notebooks
- fast and scalable on-boarding
- benefit from wealth of special modules
- build complete workflows



# Computational Pipeline



# Sim4Life Student Competition

- to recognize outstanding work in numerical simulations in a variety of research areas

## who may participate

- Bachelor's, Master's, and PhD students

## how to participate

- define a unique problem that can be solved numerically with sim4life-lite or sim4life.science
- submit your project incl. a brief explanation of the approach along with the Sim4Life simulation file
- alternatively: share your scientific publication with/ the corresponding Sim4Life file
- deadline: 31 October 2025

## winners

- will be notified (email) between 1.-15.12.2025

sim4LIFE

## Student Competition 2025

Take your research to the next level by submitting your published scientific paper or abstract to the "Sim4Life Student Competition 2025" for a chance to win one of three attractive prizes!

The awards recognize exceptional use of numerical simulations across diverse research areas at universities.

### Who can participate?

Undergraduate, masters, and PhD students who use Sim4Life-lite or Sim4Life.science in their research. If you have not yet started using Sim4Life, register for a free Sim4Life-lite account at <https://sim4life-lite.io/> or a Sim4Life.science account at <https://sim4life.science>.

### How to participate?

- Define a unique numerical problem and use Sim4Life to model and solve the problem
- To enter the competition, submit your project, including a brief explanation (based on this template) of your approach, along with the corresponding Sim4Life simulation file
- Alternatively, if you have published a scientific paper or presented at a scientific meeting in 2025, submit the paper or abstract along with the corresponding Sim4Life simulation file to enter the competition

### Deadline

October 31, 2025

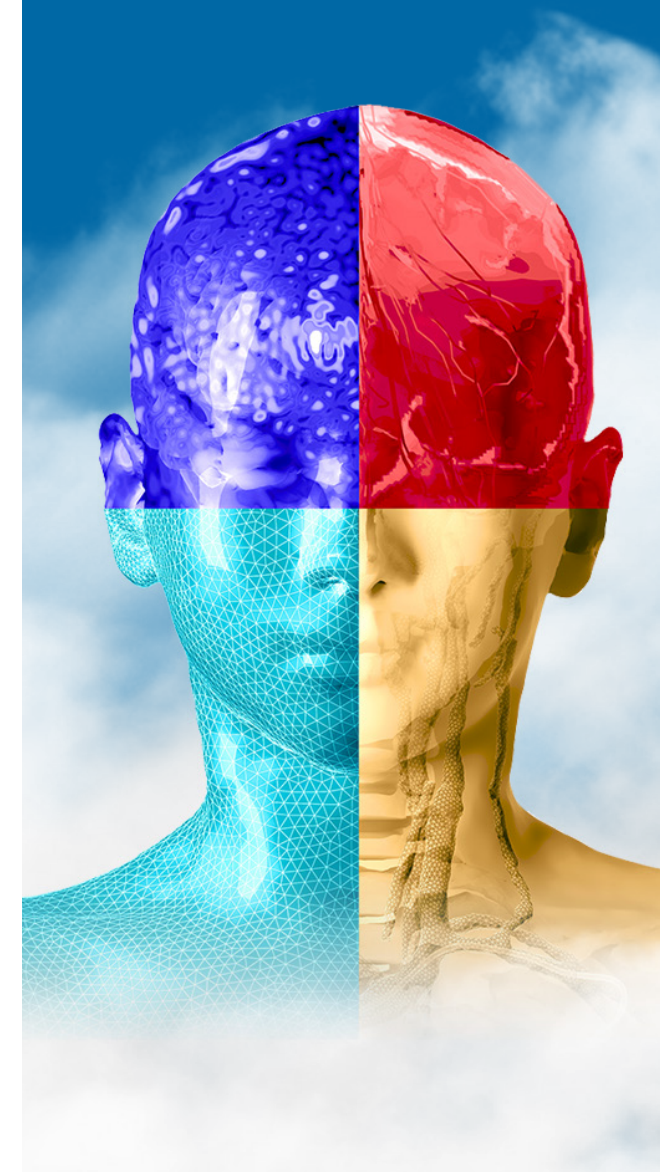
### Prizes

1st Prize	USD 3,000
2nd Prize	USD 2,000
3rd Prize	USD 1,000

Submissions will be judged by a panel who evaluates the complexity, creativity, and correct use of Sim4Life. The winning projects will be announced, published and documented as Sim4Life tutorials on

<https://sim4life-lite.io> and <https://sim4life.science>.

WIN  
USD 3,000



# Agenda

- Welcome & Introduction  
*Michael Oberle, ZMT Zurich MedTech AG*
- Optimization of TI stimulation targeting  
*Esra Neufeld, TI Solutions AG*
- Personalized modeling of brain responses to noninvasive stimulation  
*Taylor Newton, IT'IS Foundation*
- Safety modeling for patients with neural implants  
*Tobias Ruff, IT'IS Foundation*
- Conclusion

<https://sim4life.swiss>

Booth #23+24

