



**Welcome  
Daniel Dobos**





[indico.cern.ch/e/VisualAnalytics](https://indico.cern.ch/e/VisualAnalytics)

Data Science

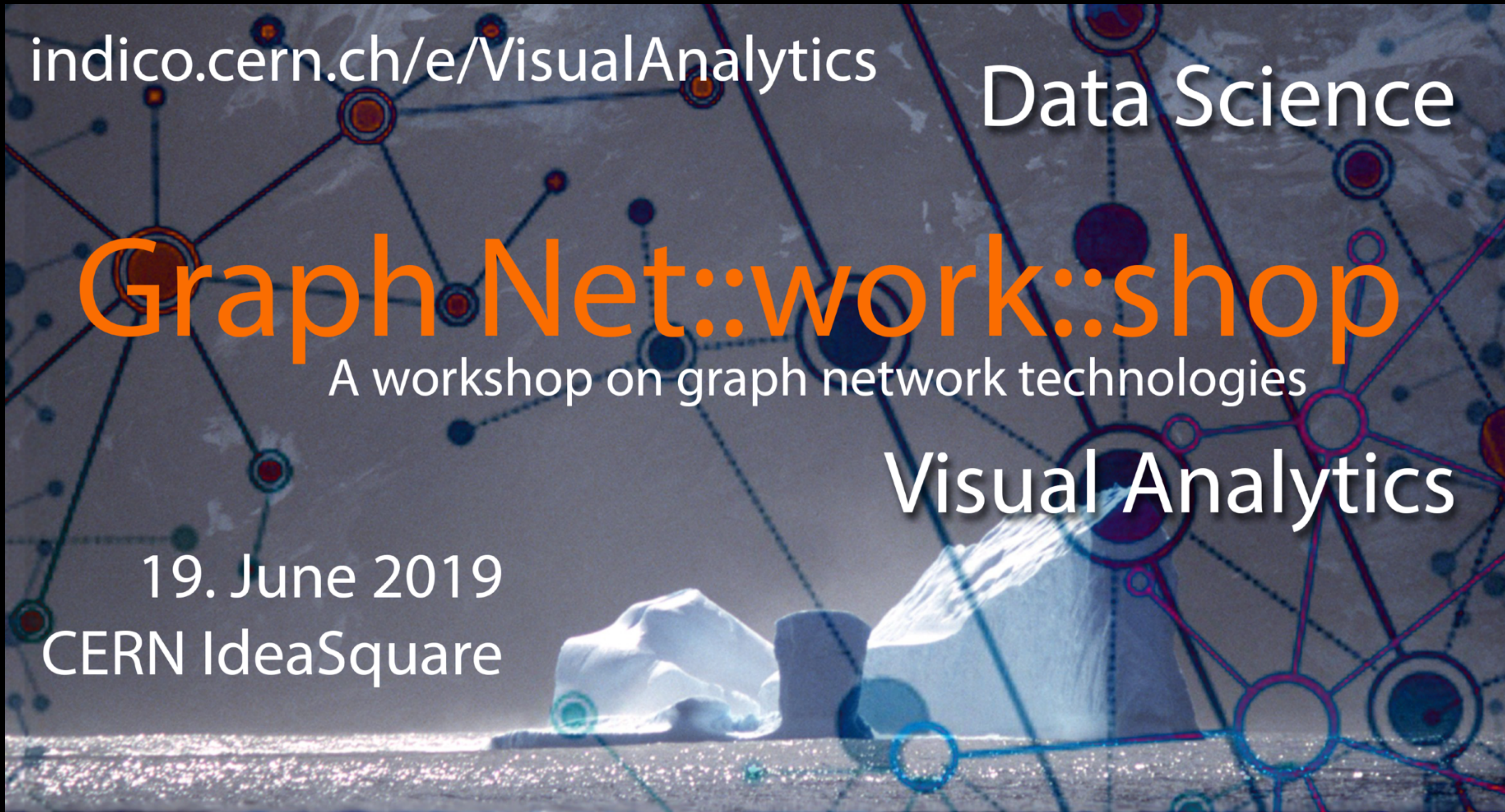
# Graph Net::work::shop

A workshop on graph network technologies

Visual Analytics

19. June 2019

CERN IdeaSquare





indico.cern.ch/e/VisualAnalytics

Data Science

# Graph Net::work::shop

A workshop on graph network technologies

Visual Analytics

19. June 2019  
CERN IdeaSquare

Network Analysis

Graph Networks in HEP

Graph Quantum Computing and QML\*

If you want to learn more about the job of a machine learning expert, data scientist, engineer or analyst in the field of Big Data, this event is for you!

We will present several Graph Analytics use-cases and pilots explored in collaboration with international organisation, non-governmental organisation, academic and industrial partners.

**gluoNet**  
knowledge exchange for smart decisions

**THE Port**  
unite innovators • impact future • act today

climate.space

# Aim & Goals

A workshop on graph network technologies

Data Science - Visual Analytics - Network Analysis -  
Graph networks in HEP - Graph Quantum  
Computing and QML\*

If you want to learn more about the job of a machine learning expert, data scientist, engineer or analyst in the field of Big Data, this event is for you!

We will present several Graph Analytics use-cases and pilots explored in collaboration with international organisation, non-governmental organisation, academic and industrial partners.



indico.cern.ch/e/VisualAnalytics

Data Science

Graph Net::work::shop

A workshop on graph network technologies

Visual Analytics

19. June 2019

CERN IdeaSquare

Network Analysis

If you want to learn more about the job of a machine learning expert, data scientist, engineer or analyst in the field of Big Data, this event is for you!

We will present several Graph Analytics use-cases and pilots explored in collaboration with international organisation, non-governmental organisation, academic and industrial partners.

Graph Networks in HEP

Graph Quantum Computing and QML\*

gluoNNet

Port

climate.space

|       |         |   |       |
|-------|---------|---|-------|
| 09:00 | → 09:15 | Welcome & Goals   | 🕒 15m |
| 09:15 | → 09:30 | Financial Streams to End Violence Against Children<br>Speaker: Daniel Dobos (gluoNNet & THE Port)   | 🕒 15m |
| 09:30 | → 09:45 | High performant smart computations for graph analysis<br>Speaker: Richard Forster (CERN)  | 🕒 15m |
| 09:45 | → 10:00 | Community Graphs of a Child Protection Hub<br>Speaker: Andrea Martini (gluoNNet)  | 🕒 15m |
| 10:00 | → 10:05 | FLASH: 6W's (Insecurity Insight)<br>Speakers: Christina Wille (Insecurity Insight), Daniel Dobos (gluoNNet & THE Port)                                    | 🕒 5m  |
| 10:05 | → 10:20 | The Interactive Visual Explorer Application for ATLAS Computing Metadata<br>Speaker: Maria Grigoryeva (National Research Centre Kurchatov Institute (RU)) | 🕒 15m |
| 10:20 | → 10:35 | Graph Neural Network in High Energy Physics<br>Speaker: Dr Jean-Roch Vlimant (California Institute of Technology (US))                                    | 🕒 15m |
| 10:35 | → 10:50 | Climate.Space<br>Speakers: Daniel Dobos (gluoNNet & THE Port), Stefan Haselwimmer (Climate.Space)   | 🕒 15m |
| 10:50 | → 10:55 | FLASH: 3D, VR & AR<br>Speaker: Daniel Dobos (gluoNNet & THE Port)   | 🕒 5m  |
| 10:55 | → 11:10 | Coffee & Tea & Networking   | 🕒 15m |



indico.cern.ch/e/VisualAnalytics

Data Science

Visual Analytics

Graph Net::work::shop

A workshop on graph network technologies

19. June 2019

CERN IdeaSquare

Network Analysis

Graph Networks in HEP

Graph Quantum Computing and QML\*


If you want to learn more about the job of a machine learning expert, data scientist, engineer or analyst in the field of Big Data, this event is for you!

We will present several Graph Analytics use-cases and pilots explored in collaboration with international organisation, non-governmental organisation, academic and industrial partners.

gluoNNet

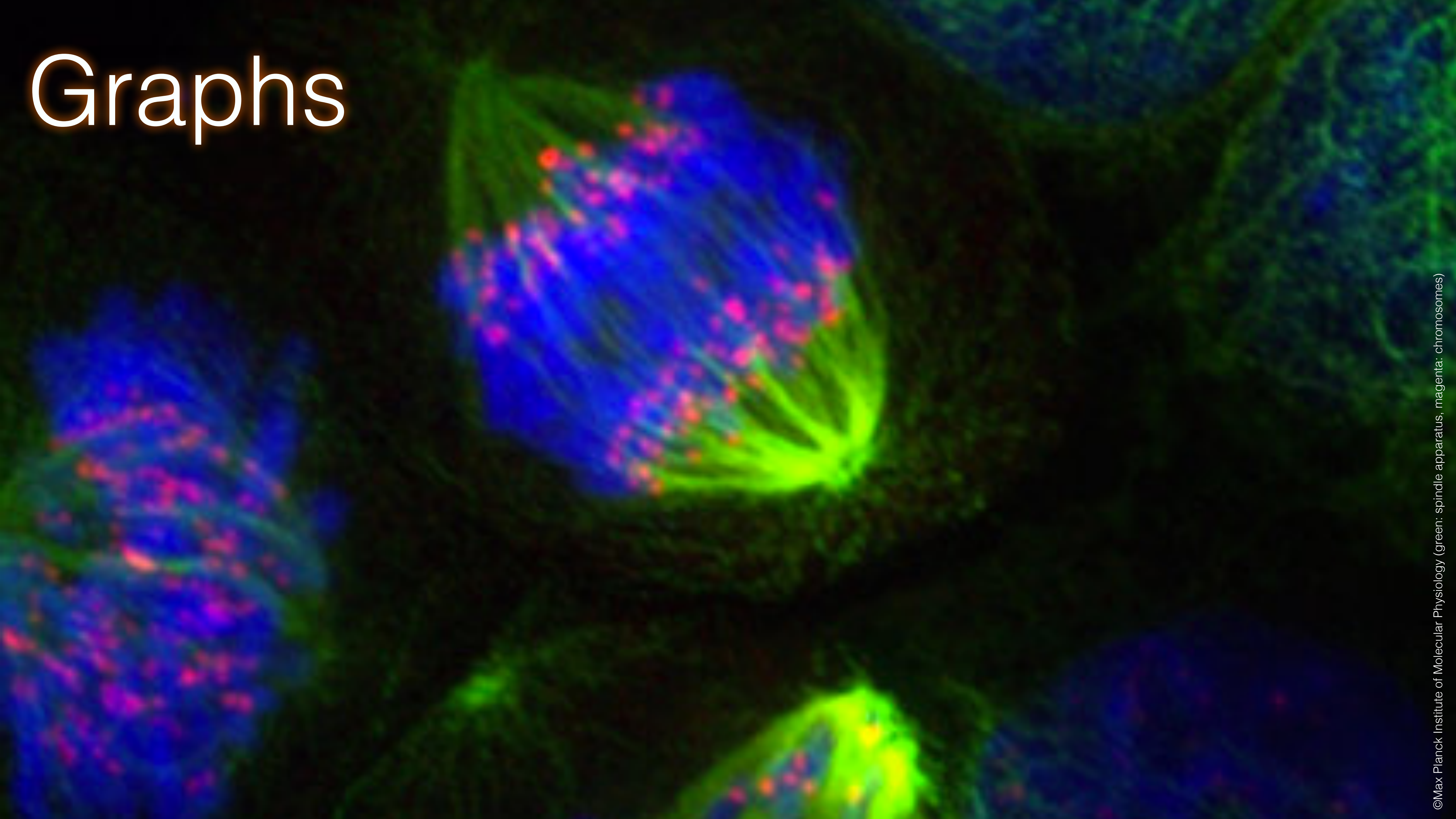
Port

climate.space

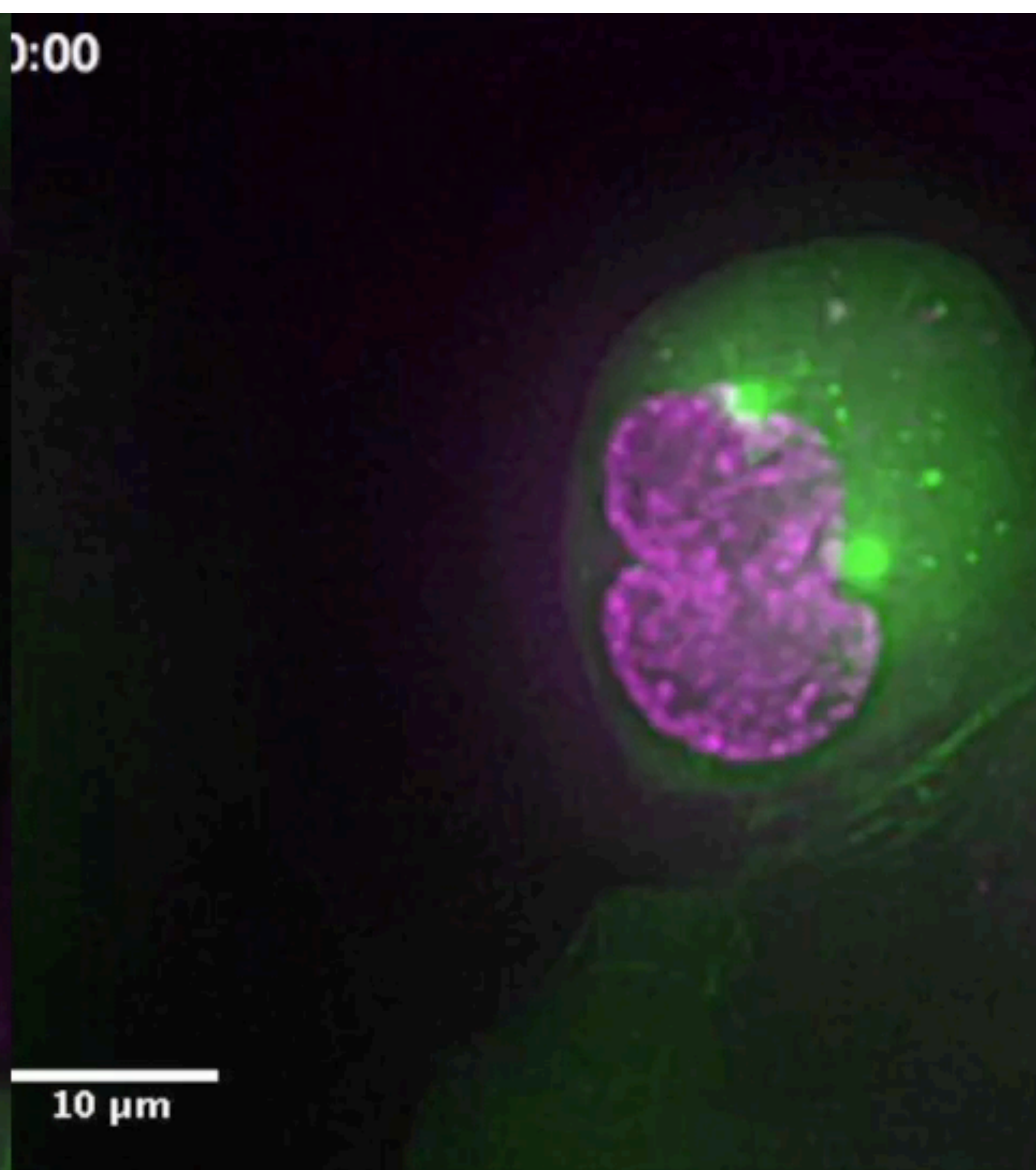
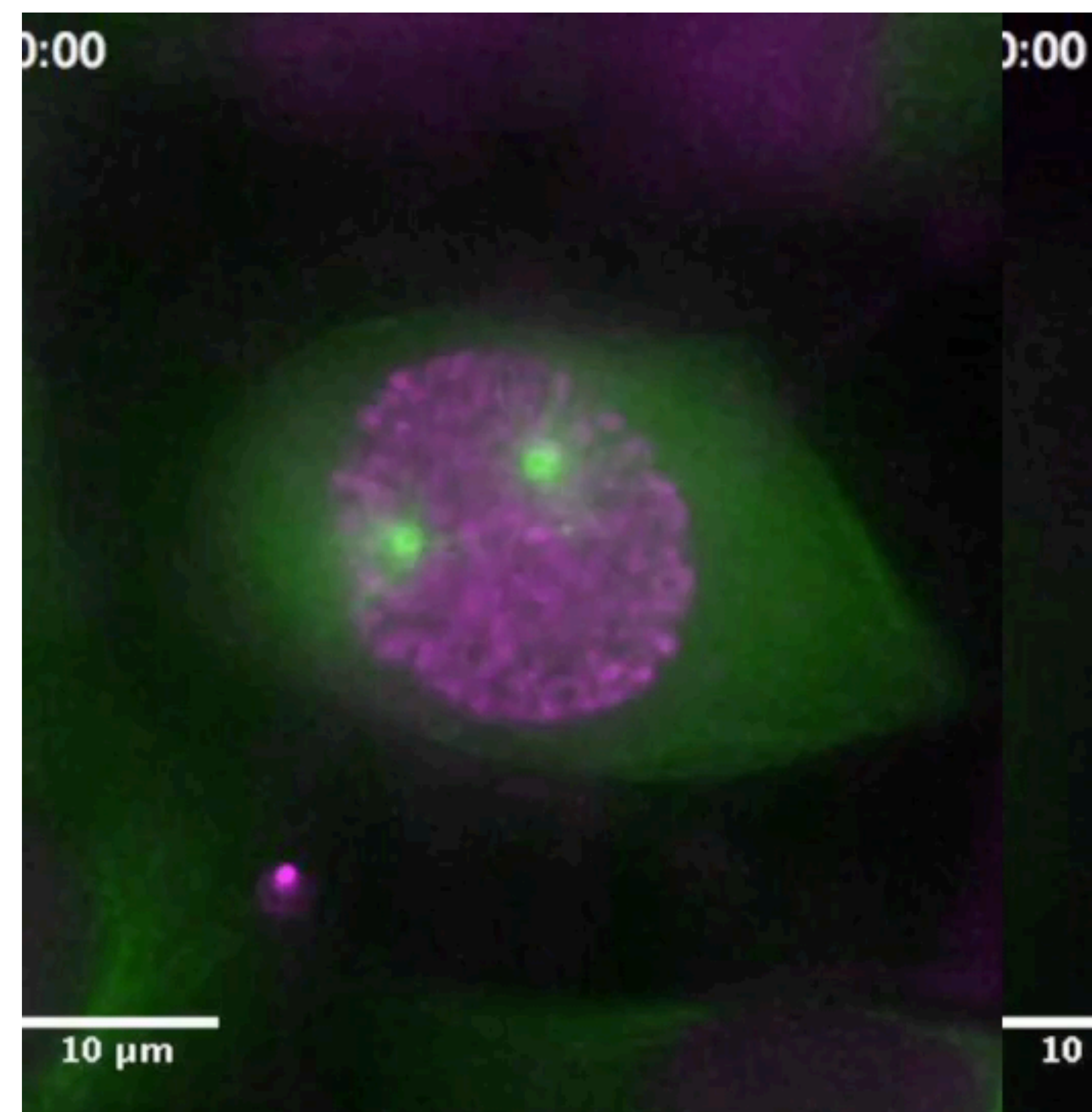
|               |   |       |
|---------------|---|-------|
| 10:55 → 11:10 | Coffee & Tea & Networking   | 🕒 15m |
| 11:10 → 11:25 | <b>Collaboration Mapping in Physics</b><br><b>Speakers:</b> Johanna Eschment (Hansenberg), Kai Kaefer (Hansenberg)  | 🕒 15m |
| 11:25 → 11:40 | <b>Headron Framework</b><br><b>Speaker:</b> Daniel Dobos (gluoNNet & THE Port)  | 🕒 15m |
| 11:40 → 11:55 | <b>Mail Graph</b> 📧<br><b>Speaker:</b> Mathis Gerdes  | 🕒 15m |
| 11:55 → 12:00 | <b>FLASH: Quantum Graphs</b><br><b>Speaker:</b> Daniel Dobos (gluoNNet & THE Port)  | 🕒 5m  |
| 12:00 → 12:15 | <b>Applying IBM quantum computing to LHC physics analysis Higgs coupling to two top quarks</b><br><b>Speakers:</b> Sau Lan Wu (University of Wisconsin Madison (US)), Wen Guan (University of Wisconsin (US))   | 🕒 15m |
| 12:15 → 12:30 | <b>DISCUSSION &amp; Wrap-Up</b>   | 🕒 15m |
| 12:30 → 13:30 | Lunch Break   | 🕒 1h  |
| 13:30 → 15:30 | <b>Connecting Skies</b><br><br>A real-life data brain-storming of graph data<br><br><b>Speakers:</b> Daniel Dobos (gluoNNet & THE Port), Dave Usher, Peter Griffiths<br><br> Connecting Skies P... | 🕒 2h  |



# Graphs







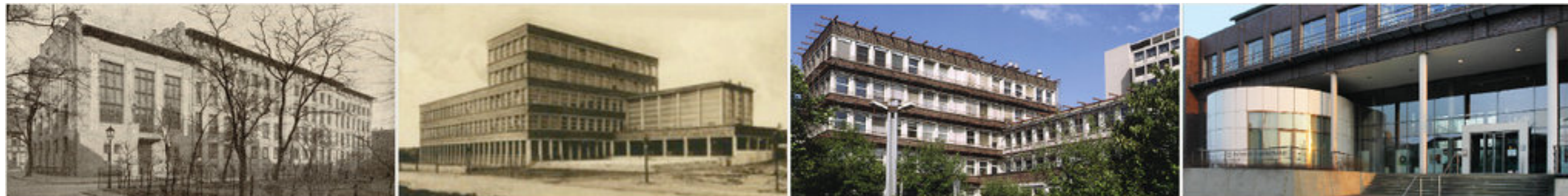


# Graphs

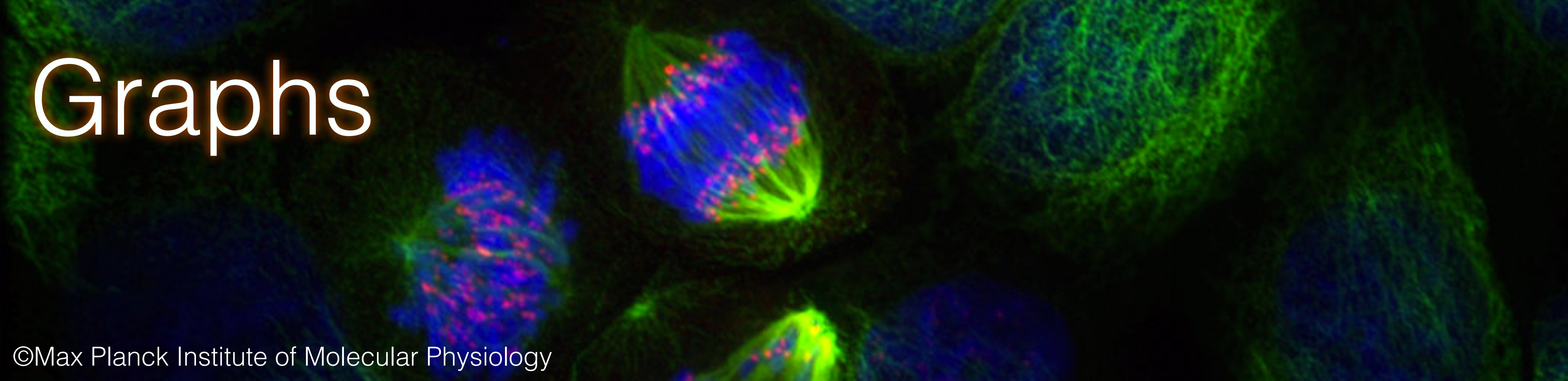
©Max Planck Institute of Molecular Physiology



High-resolution Confocal Laser fluorescence microscopy of intracellular compartments and 3D reconstruction & simulation calculations for optimization of fluorescence color cross sections





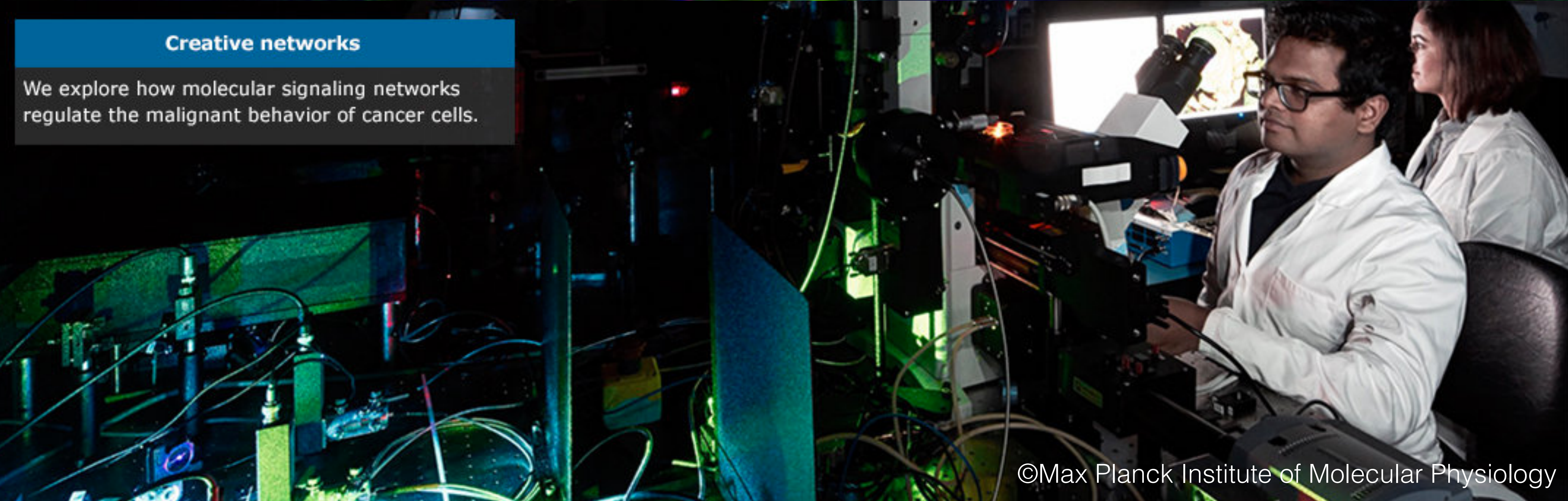


# Graphs

©Max Planck Institute of Molecular Physiology

## Creative networks

We explore how molecular signaling networks regulate the malignant behavior of cancer cells.



©Max Planck Institute of Molecular Physiology



1994







Real 1994



# 1. Internet

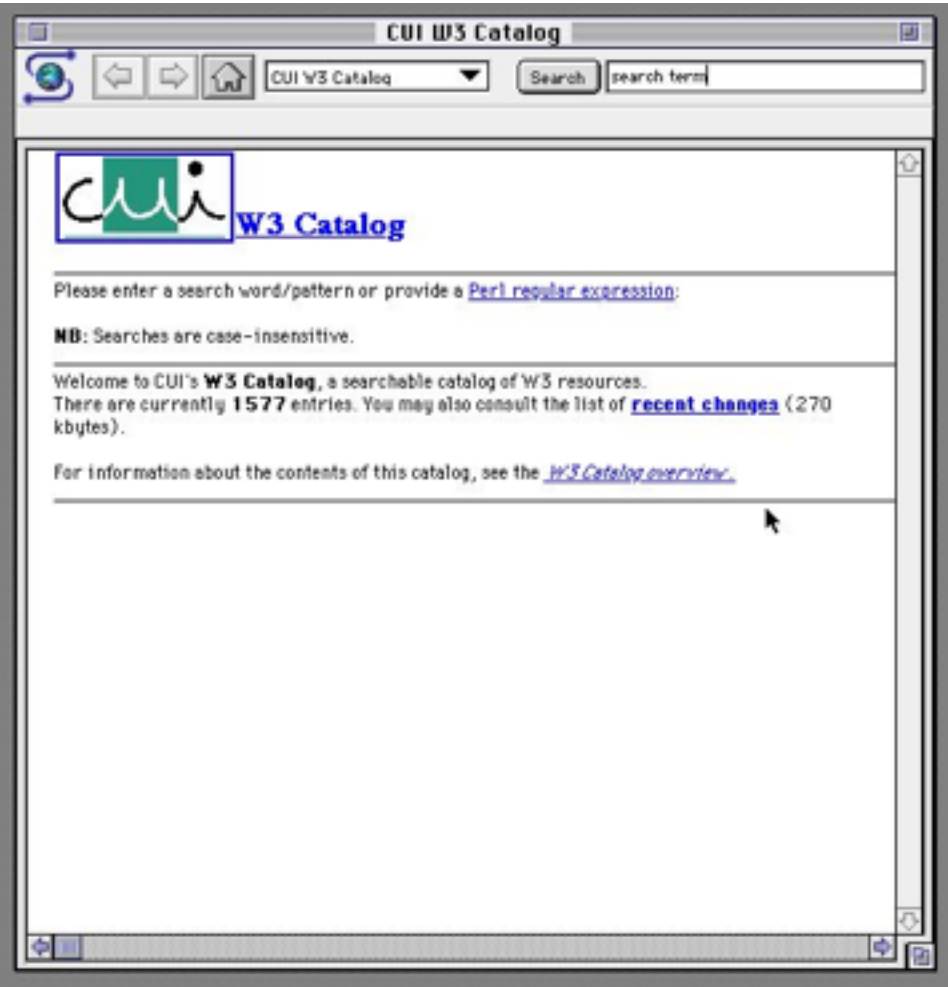




A man with dark hair, wearing a white t-shirt, is looking down at a small, dark-colored dinosaur he is holding in his hands. The background is dark and rocky, with some faint light reflecting off the surfaces. The text "1. Internet" and "2. Jurassic Parc" is overlaid on the right side of the image.

1. Internet  
2. Jurassic Parc





# JumpStation II Results Page

## Search for "sunsite" in document titles

The following list is a verbose list of documents in the JumpStation database the have the word "sunsite" in their titles. Please note that this data is transitory, and not stored on this server.

- <http://www.sun.com:80/sunsite/>  
**Title:** *SunSITE*  
**Last Modification:** *Friday 12-Aug-94 19:17:22 GMT*  
**Type:** *text/html*  
**Links:** *19*

A search for the criteria you requested yielded 1 document whose details are stored in the JumpStation II document database.

---

JumpStation Copyright 1993, 1994 by Jonathon Fletcher

---

[j.fletcher@stirling.ac.uk](mailto:j.fletcher@stirling.ac.uk)

# Internet Access Form

## Applicant and lead user contact information

|                |        |                                 |  |            |  |
|----------------|--------|---------------------------------|--|------------|--|
| Full name      | Daniel | Organization                    |  | Department |  |
| Postal address |        |                                 |  |            |  |
| Telephone      |        | Email<br>daniel@mpi-dortmund.de |  |            |  |

Contact information for **other users**. Please use additional sheets if necessary. **All users must send a signed agreement on conditions of use.**

|                                 |  |              |  |            |  |
|---------------------------------|--|--------------|--|------------|--|
| Full name                       |  | Organization |  | Department |  |
| Postal address<br>16h00 - 16h15 |  |              |  |            |  |
| Telephone                       |  | Email        |  |            |  |

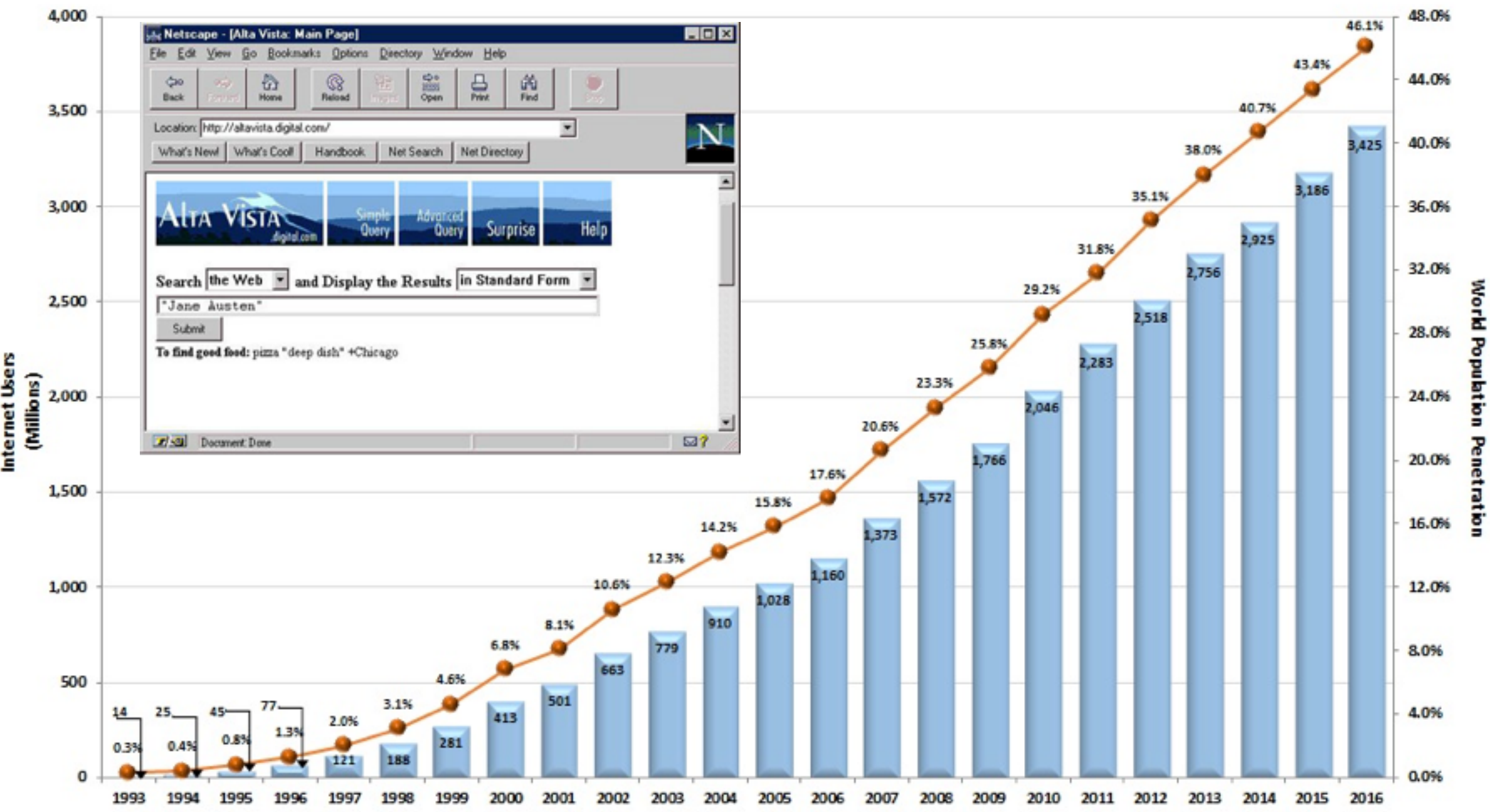
## Dataset(s) to which access is requested

|   |   |
|---|---|
| Dataset Title(s)  |   |
| Research on: <ul style="list-style-type: none"><li>• Cat Photos</li><li>• Baby Photos</li><li>• Wedding Photos</li><li>• ALL DARK WEB</li></ul> | Webpages to visit: <ul style="list-style-type: none"><li>• JumpStation: <a href="http://js.stir.ac.uk/jsbin/jsii">http://js.stir.ac.uk/jsbin/jsii</a></li><li>• w3catalog</li><li>• CERN's WWW Virtual Library: <a href="http://info.cern.ch/hypertext/DataSources/bySubject/Overview.html">http://info.cern.ch/hypertext/DataSources/bySubject/Overview.html</a></li></ul> |

## Intended use of data

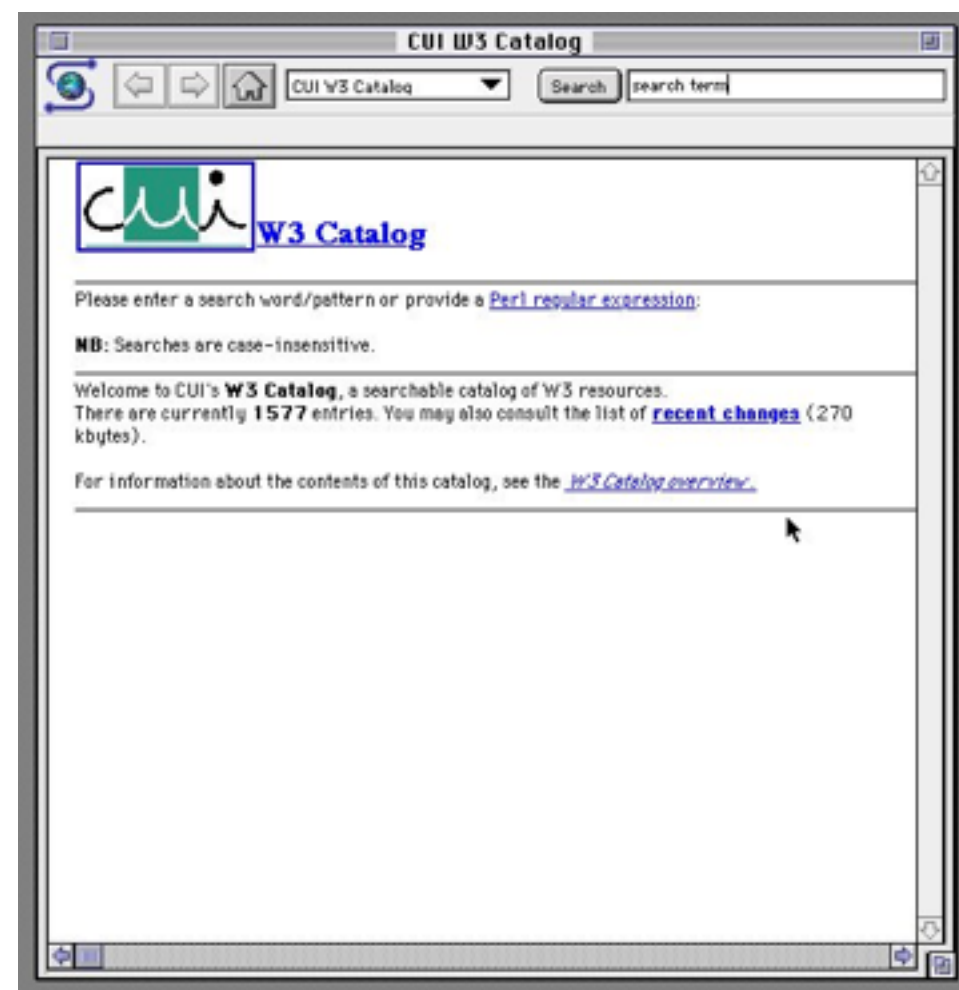
|                          |   |
|--------------------------|---|
| <input type="checkbox"/> | <b>Unfunded Research.</b> This includes: <ul style="list-style-type: none"><li>• Teaching use</li><li>• Research towards publication(s) for which no sources of funding are available</li><li>• Personal, private research</li><li>• Research in the course of academic study</li></ul> |
|--------------------------|---|

Global Internet users and penetration rate



©internetlivestats.com, Data: ITU, World Bank, UN Population Division





## JumpStation II Results Page

### Search for "sunsite" in document titles

The following list is a verbose list of documents in the JumpStation database the have the word "sunsite" in their titles. Please note that this data is transitory, and not stored on this server.

- <http://www.sun.com:80/sunsite/>  
**Title:** *SunSITE*  
**Last Modification:** *Friday 12-Aug-94 19:17:22 GMT*  
**Type:** *text/html*  
**Links:** *19*

A search for the criteria you requested yielded 1 document whose details are stored in the JumpStation II document database.

---

JumpStation Copyright 1993, 1994 by Jonathon Fletcher

[j.fletcher@stirling.ac.uk](mailto:j.fletcher@stirling.ac.uk)

# Internet Access Form

## Applicant and lead user contact information

|                |                                 |              |            |
|----------------|---------------------------------|--------------|------------|
| Full name      | Daniel                          | Organization | Department |
| Postal address |                                 |              |            |
| Telephone      | Email<br>daniel@mpi-dortmund.de |              |            |

Contact information for **other users**. Please use additional sheets if necessary. **All users must send a signed agreement on conditions of use.**

|                |              |            |
|----------------|--------------|------------|
| Full name      | Organization | Department |
| Postal address |              |            |
| Telephone      | Email        |            |

## Dataset(s) to which access is requested

|   |   |
|---|---|
| Dataset Title(s)  |   |
| Research on:<br><ul style="list-style-type: none"> <li>• Cat Photos</li> <li>• Baby Photos</li> <li>• Wedding Photos</li> <li>• ALL DARK WEB</li> </ul> | Webpages to visit:<br><ul style="list-style-type: none"> <li>• JumpStation: <a href="http://js.stir.ac.uk/jsbin/jsii">http://js.stir.ac.uk/jsbin/jsii</a></li> <li>• w3catalog</li> <li>• CERN's WWW Virtual Library:<br/> <a href="http://info.cern.ch/hypertext/DataSources/bySubject/Overview.html">http://info.cern.ch/hypertext/DataSources/bySubject/Overview.html</a></li> </ul> |

## Intended use of data

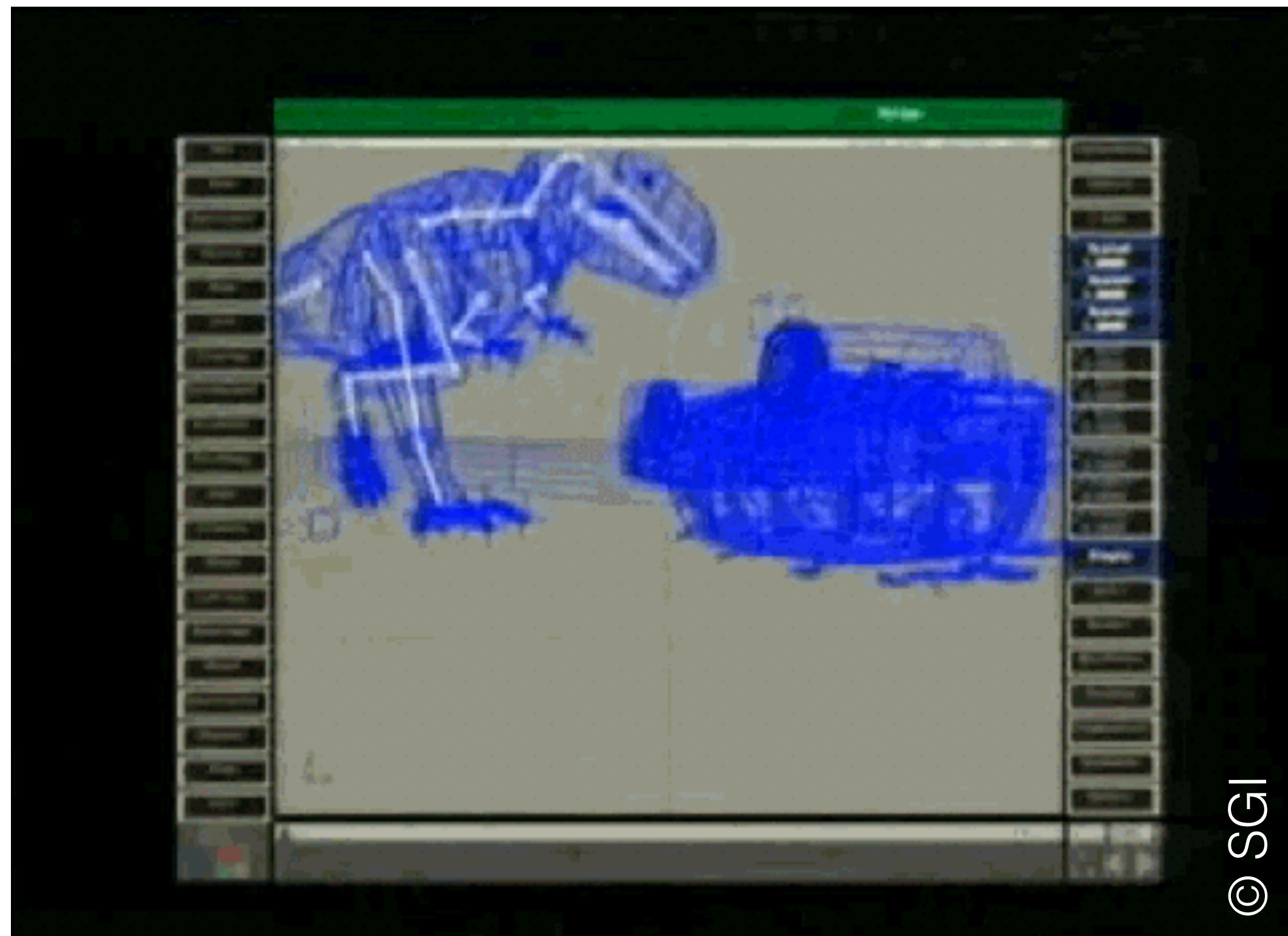
|                          |   |
|--------------------------|---|
| <input type="checkbox"/> | <b>Unfunded Research.</b> This includes:<br><ul style="list-style-type: none"> <li>• Teaching use</li> <li>• Research towards publication(s) for which no sources of funding are available</li> <li>• Personal, private research</li> <li>• Research in the course of academic study</li> </ul> |
|--------------------------|---|

## Global Internet users and penetration rate



©internetlivestats.com, Data: ITU, World Bank, UN Population Division





SGI Indy  
192 MB RAM

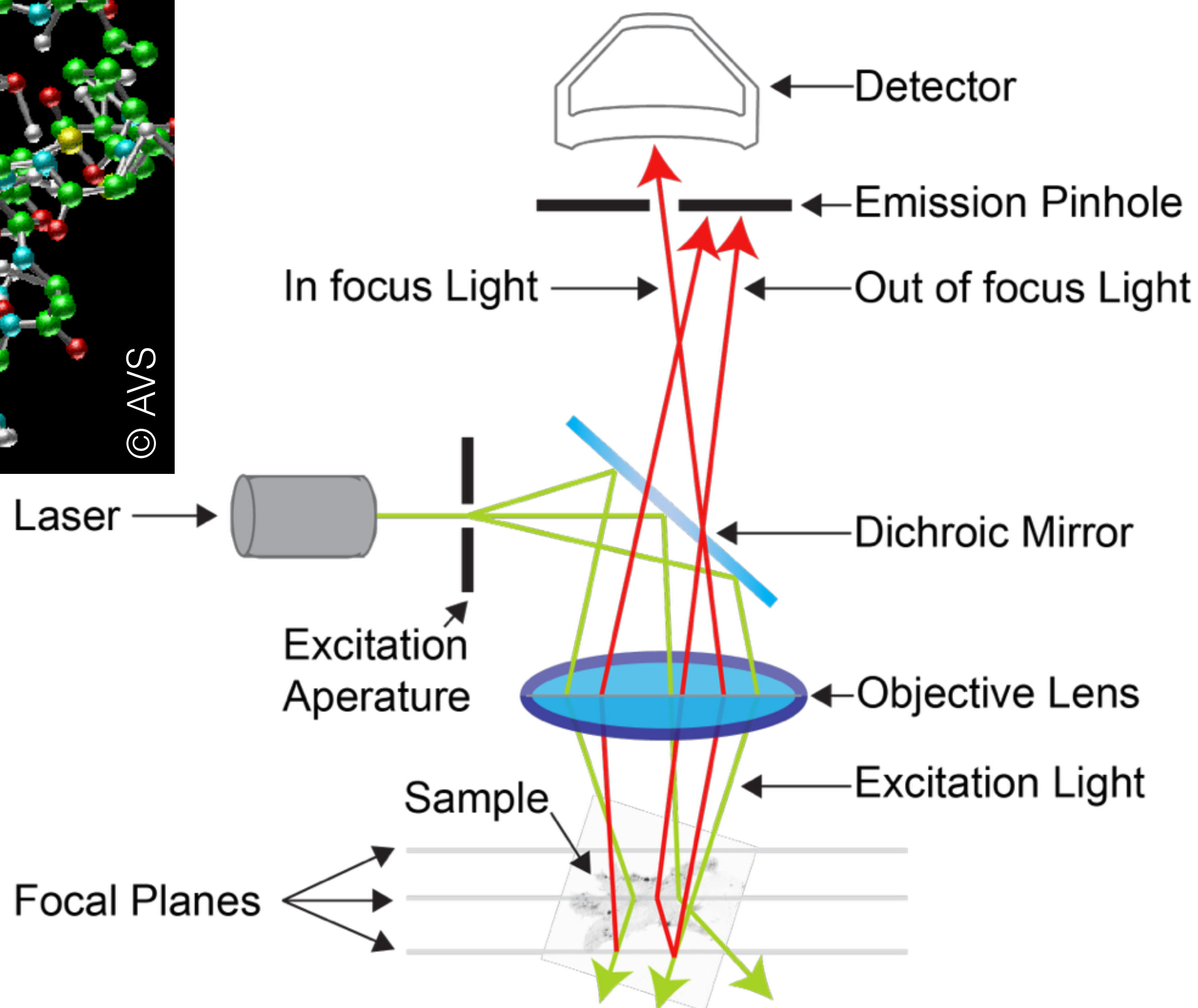
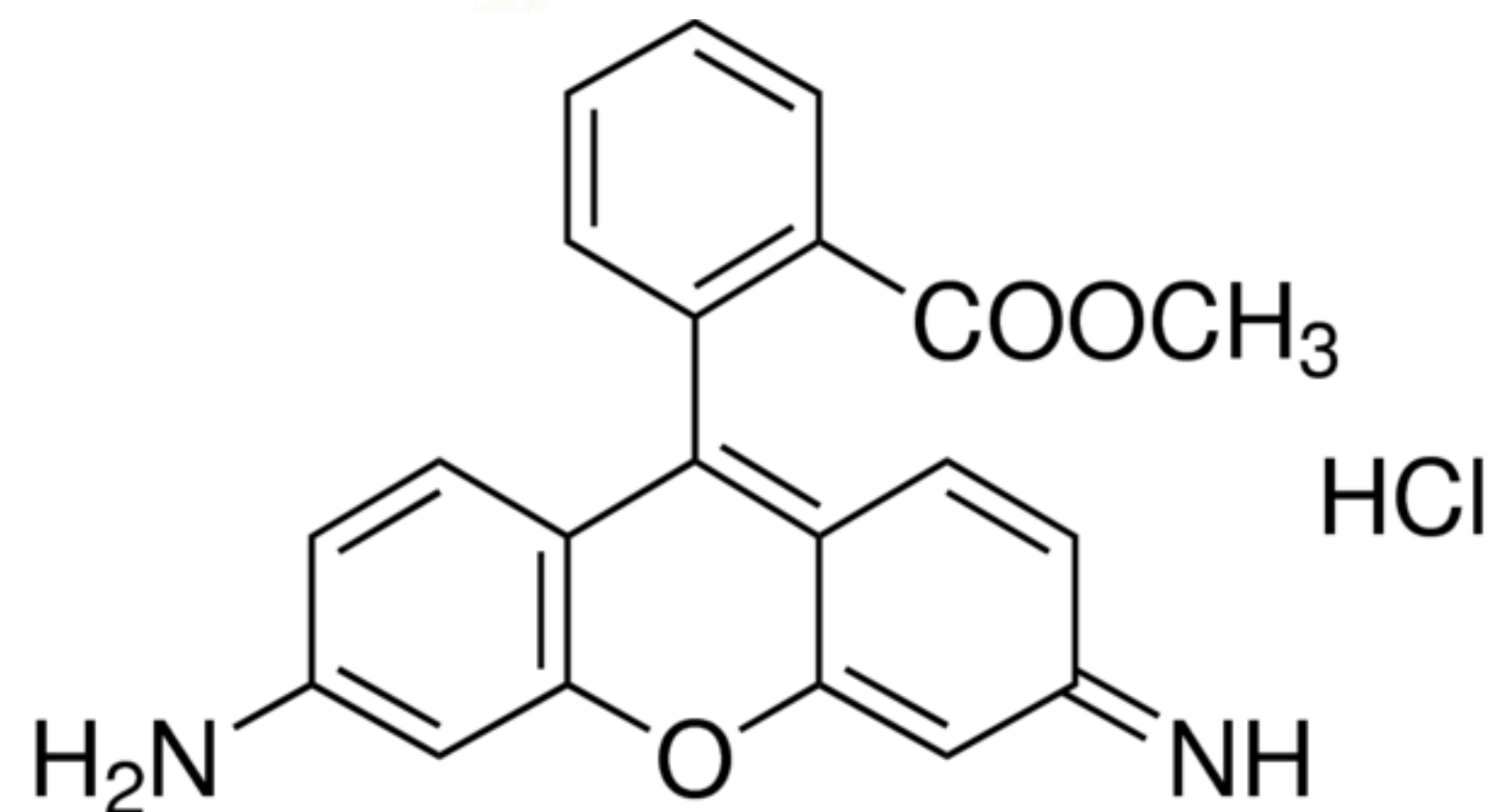
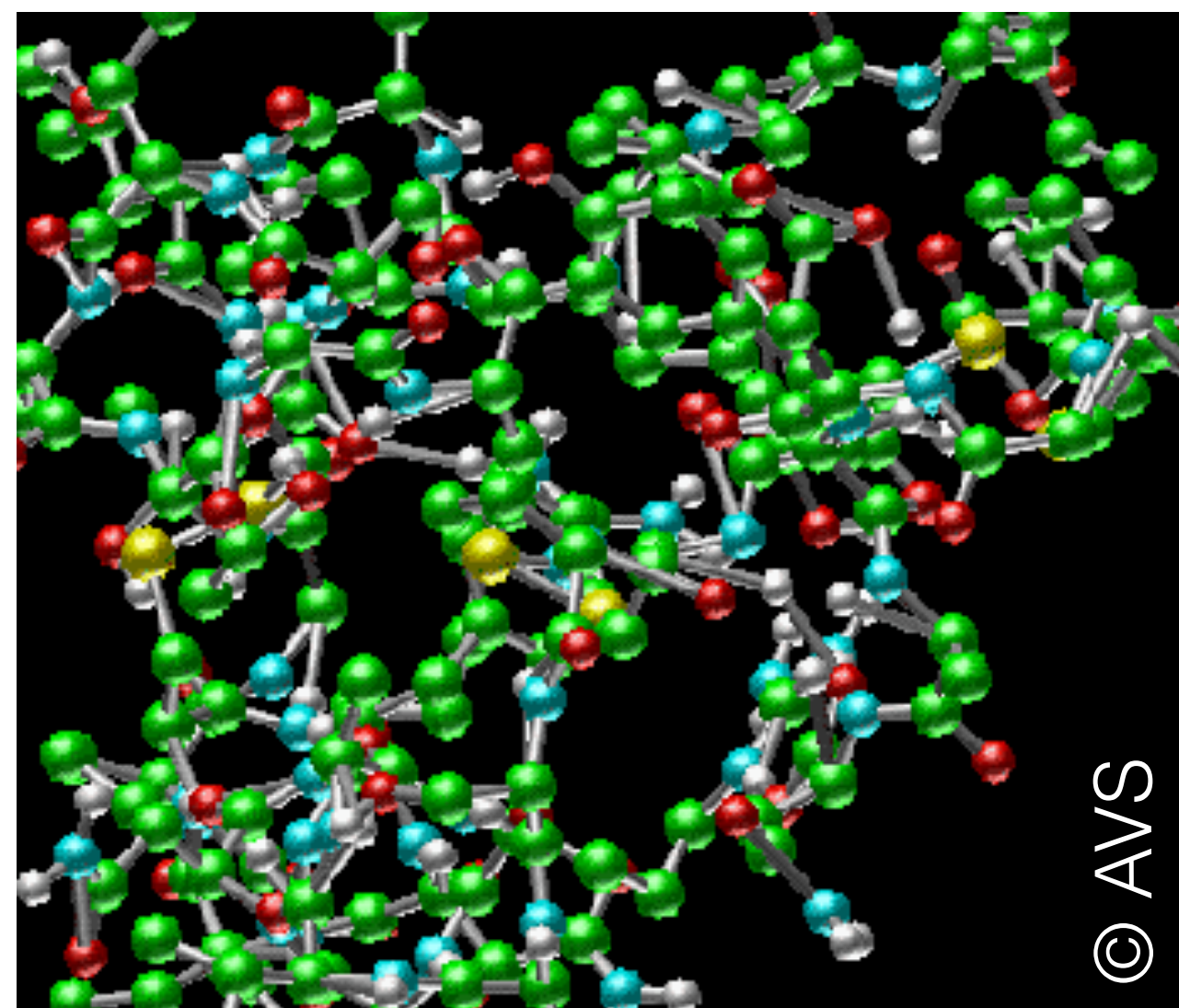
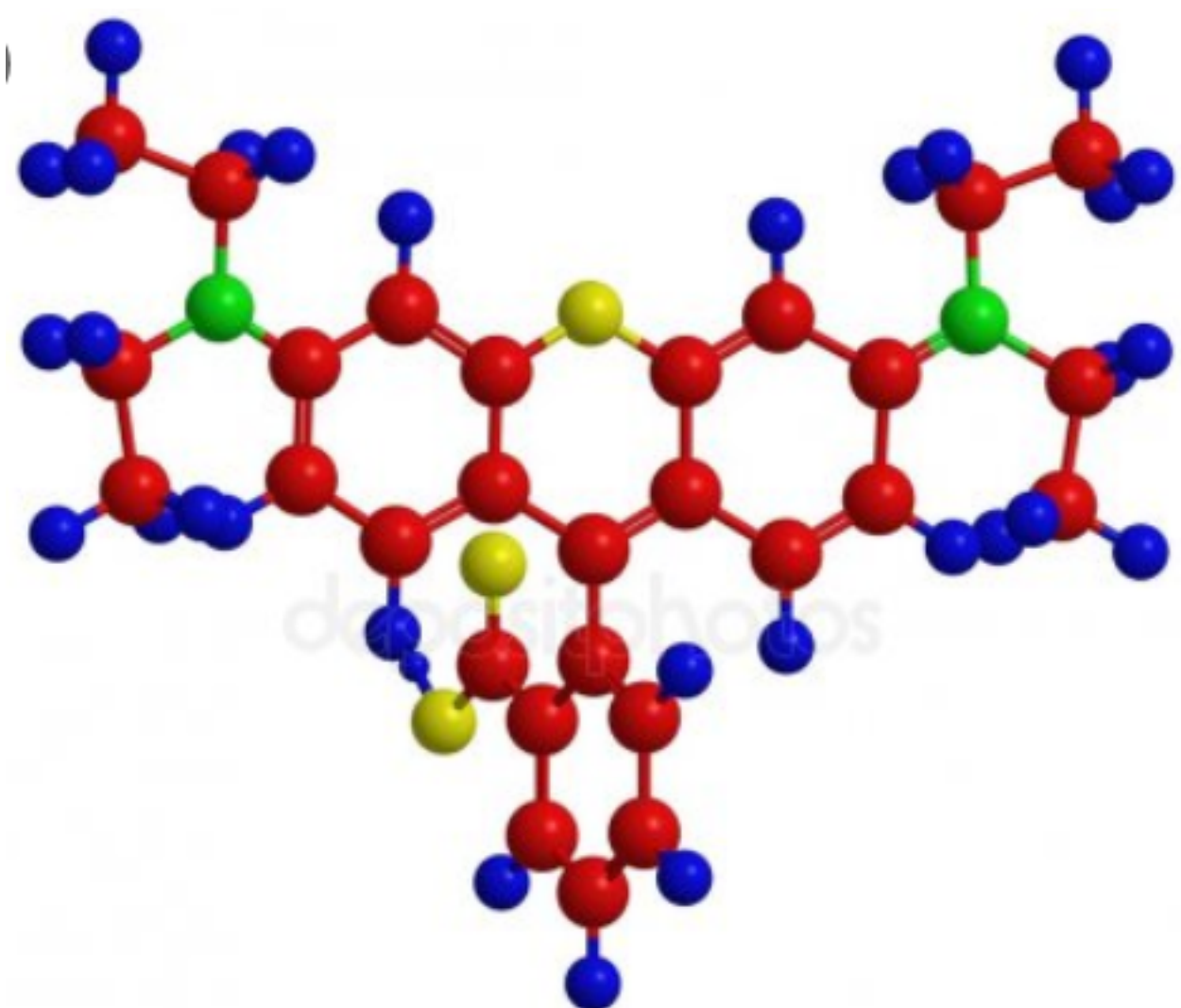


SUN SPARC 10  
96 MB RAM

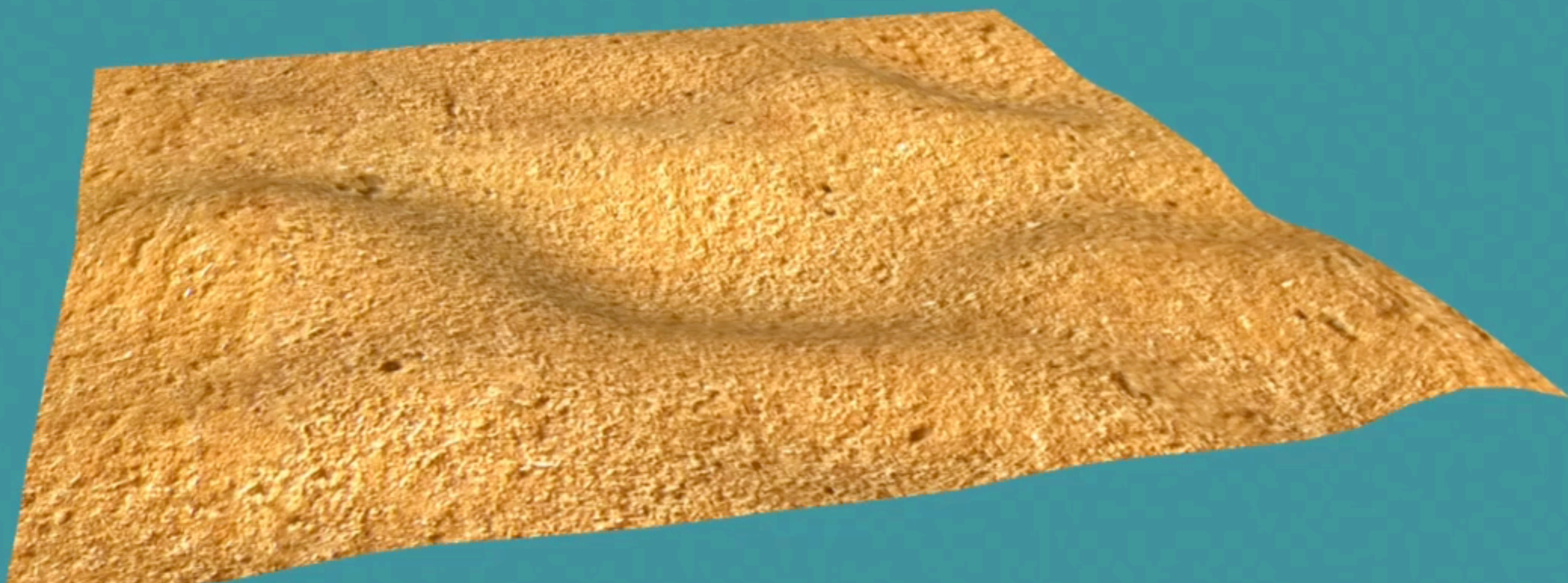




# My 1st Graph 1994

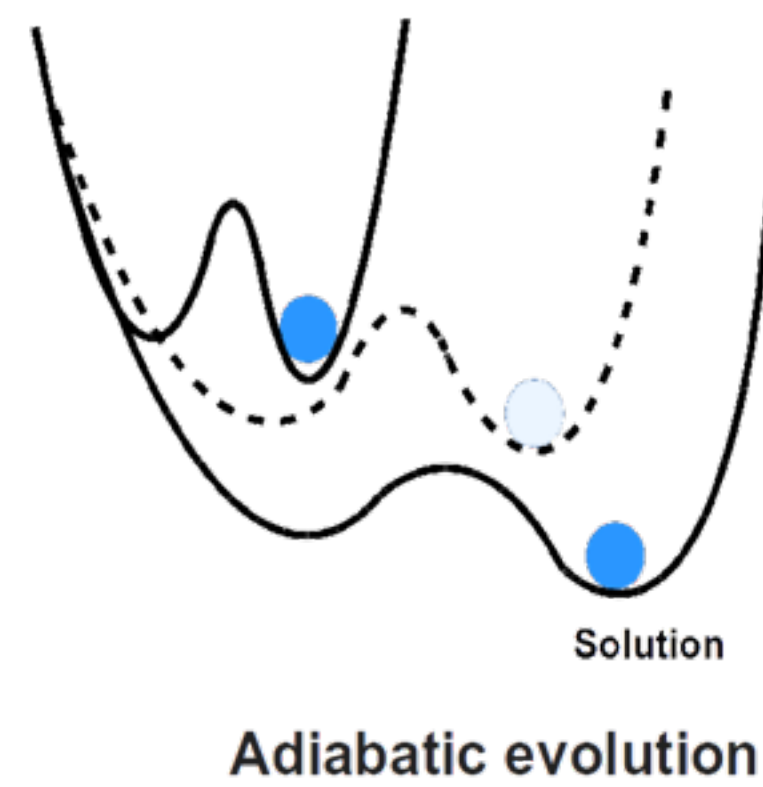
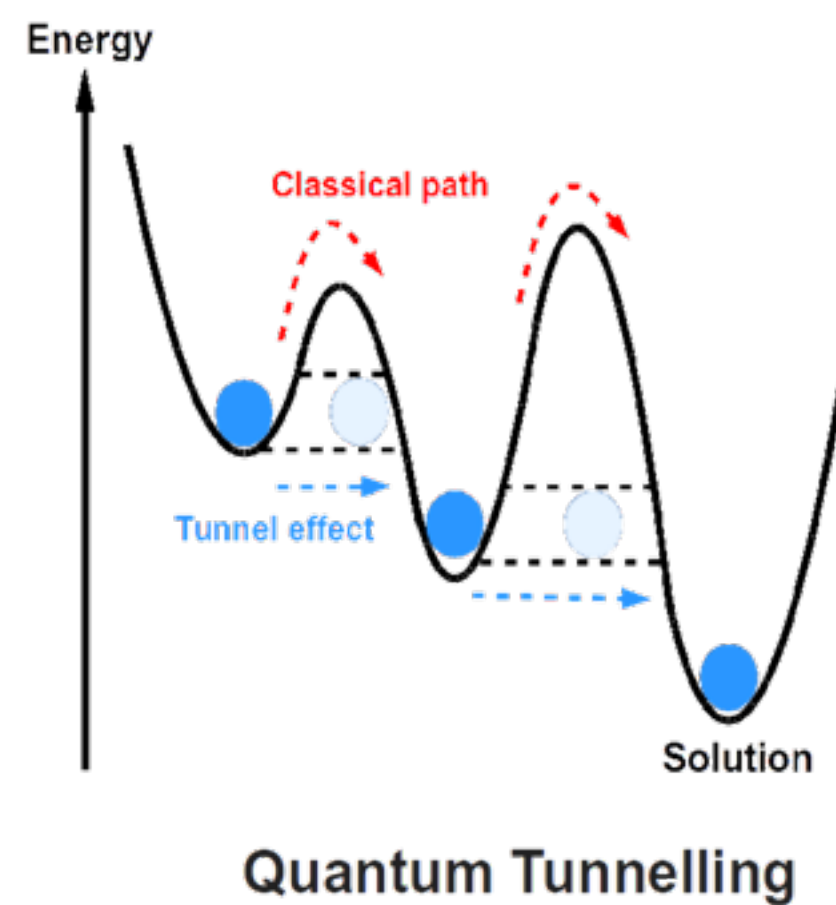
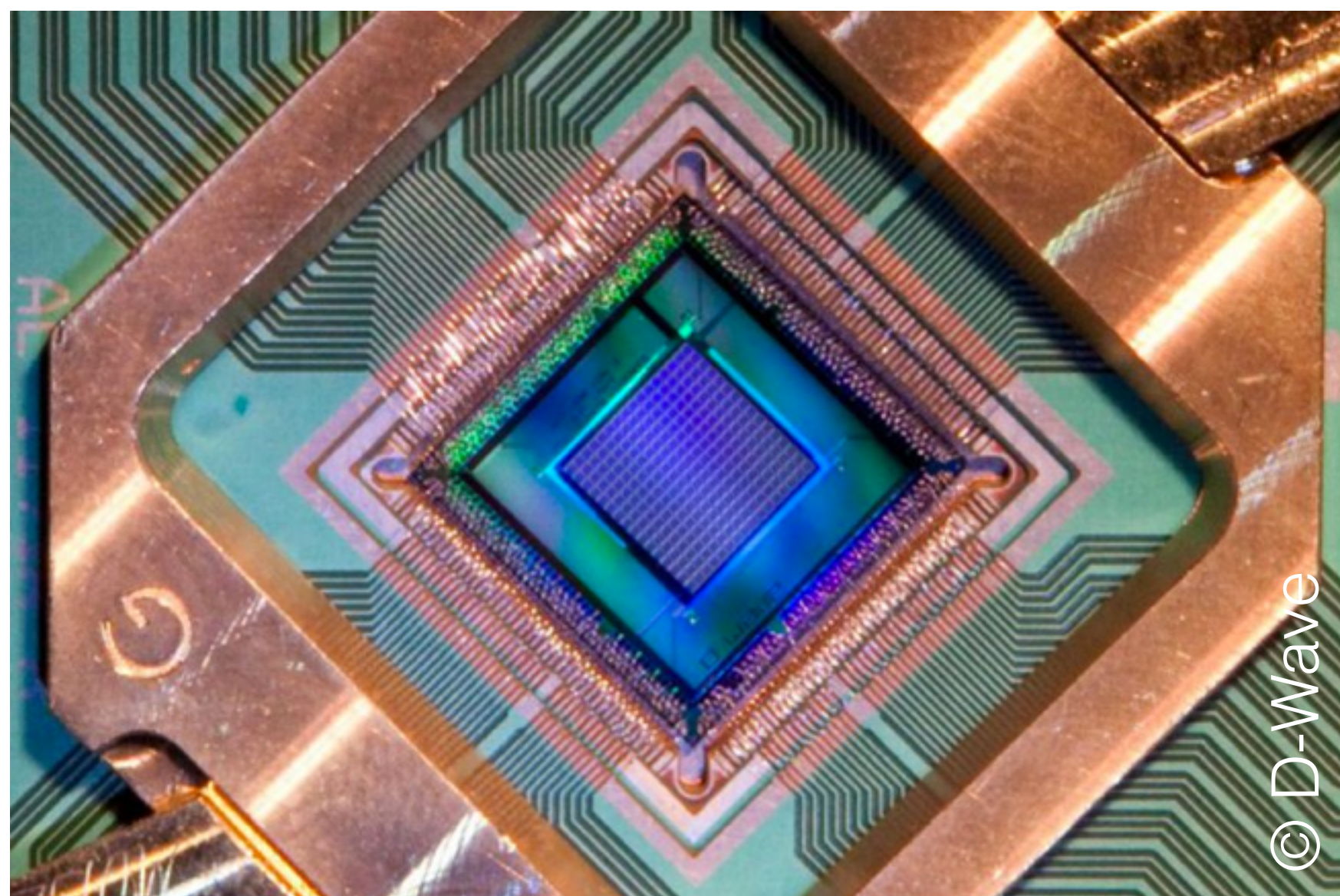
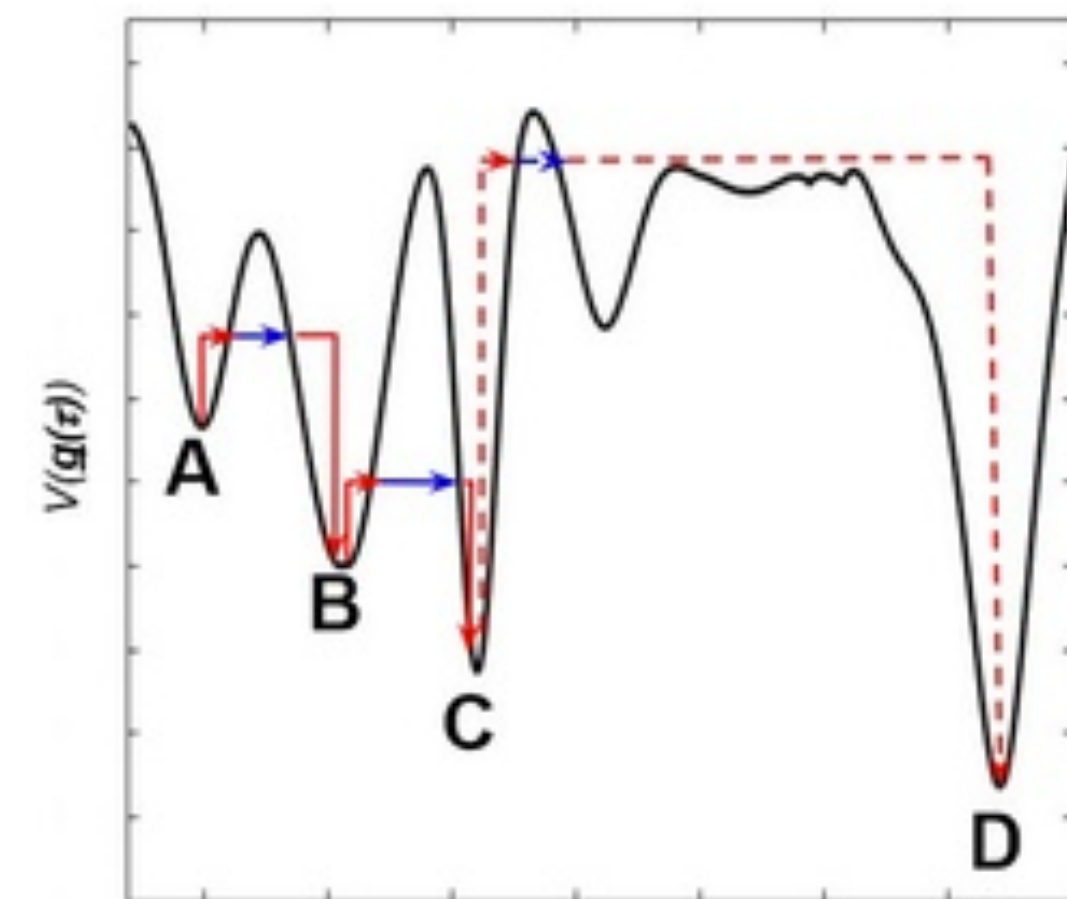
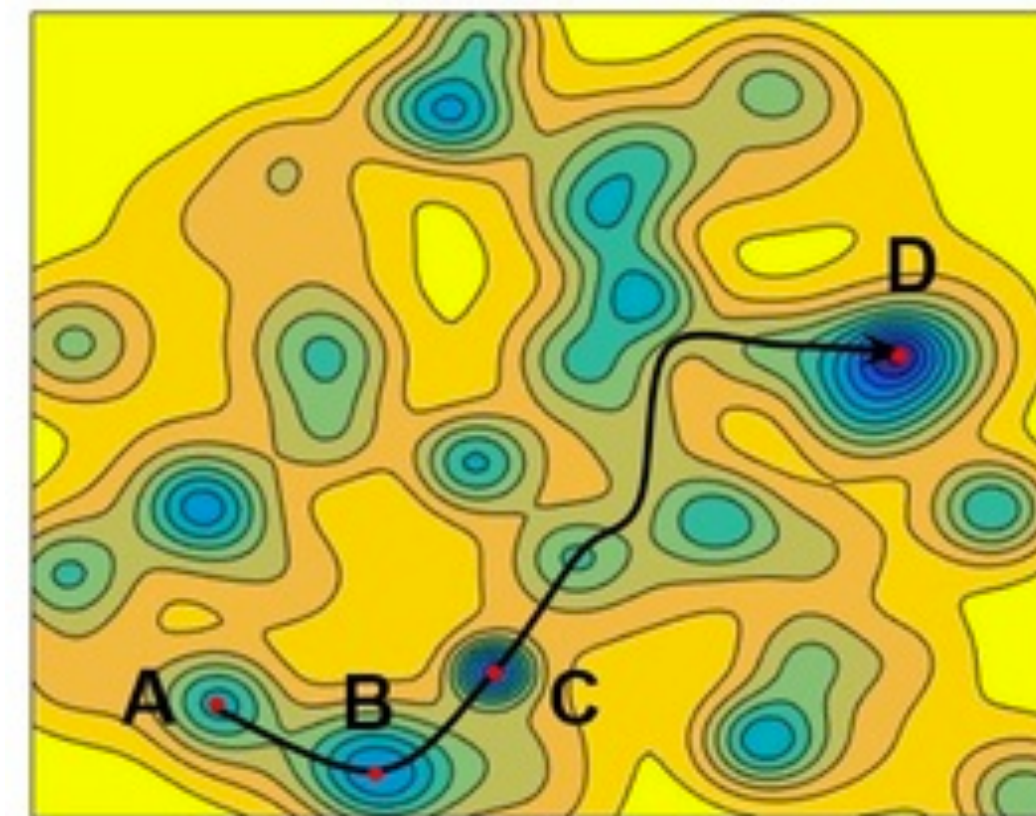
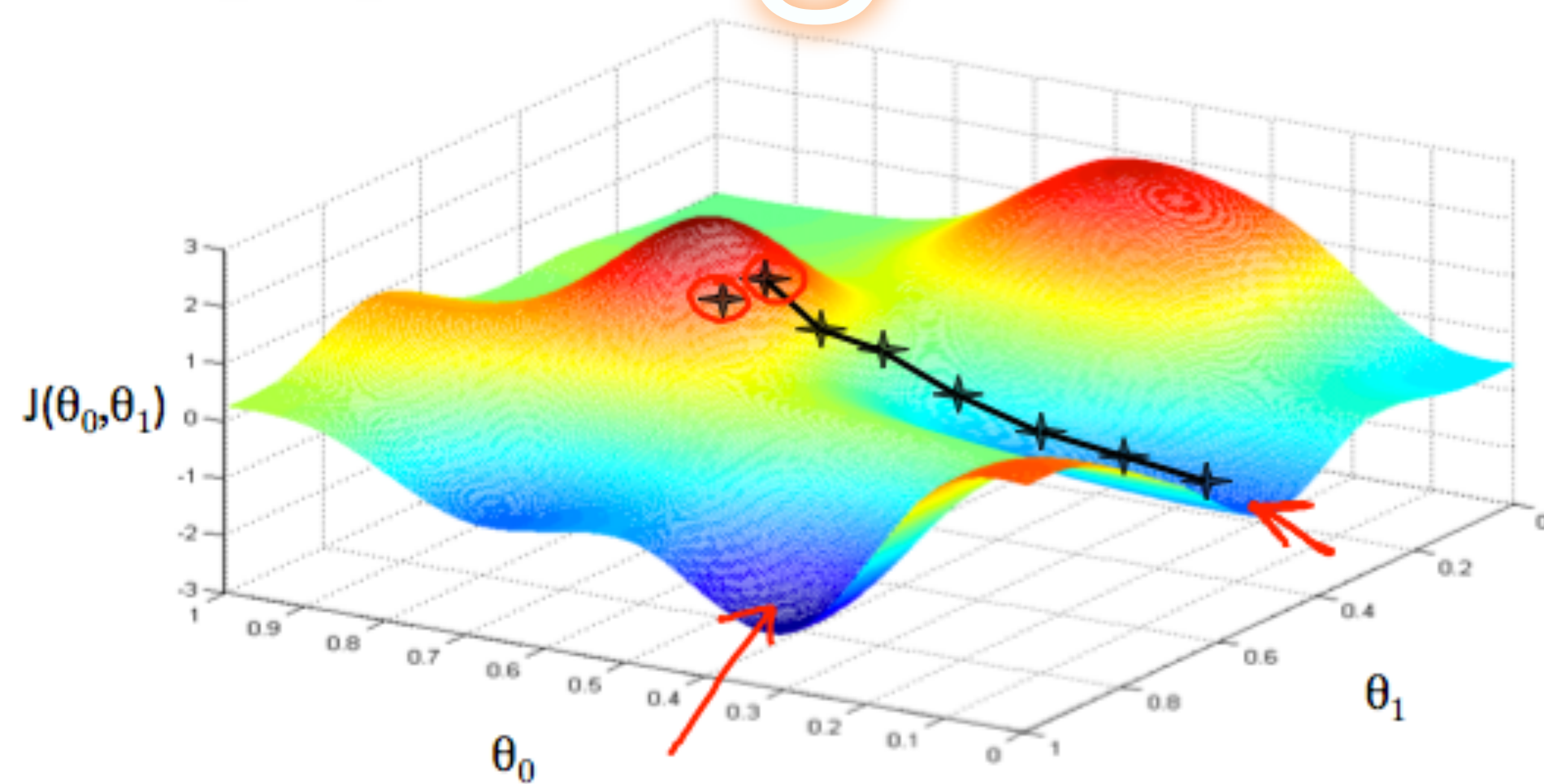
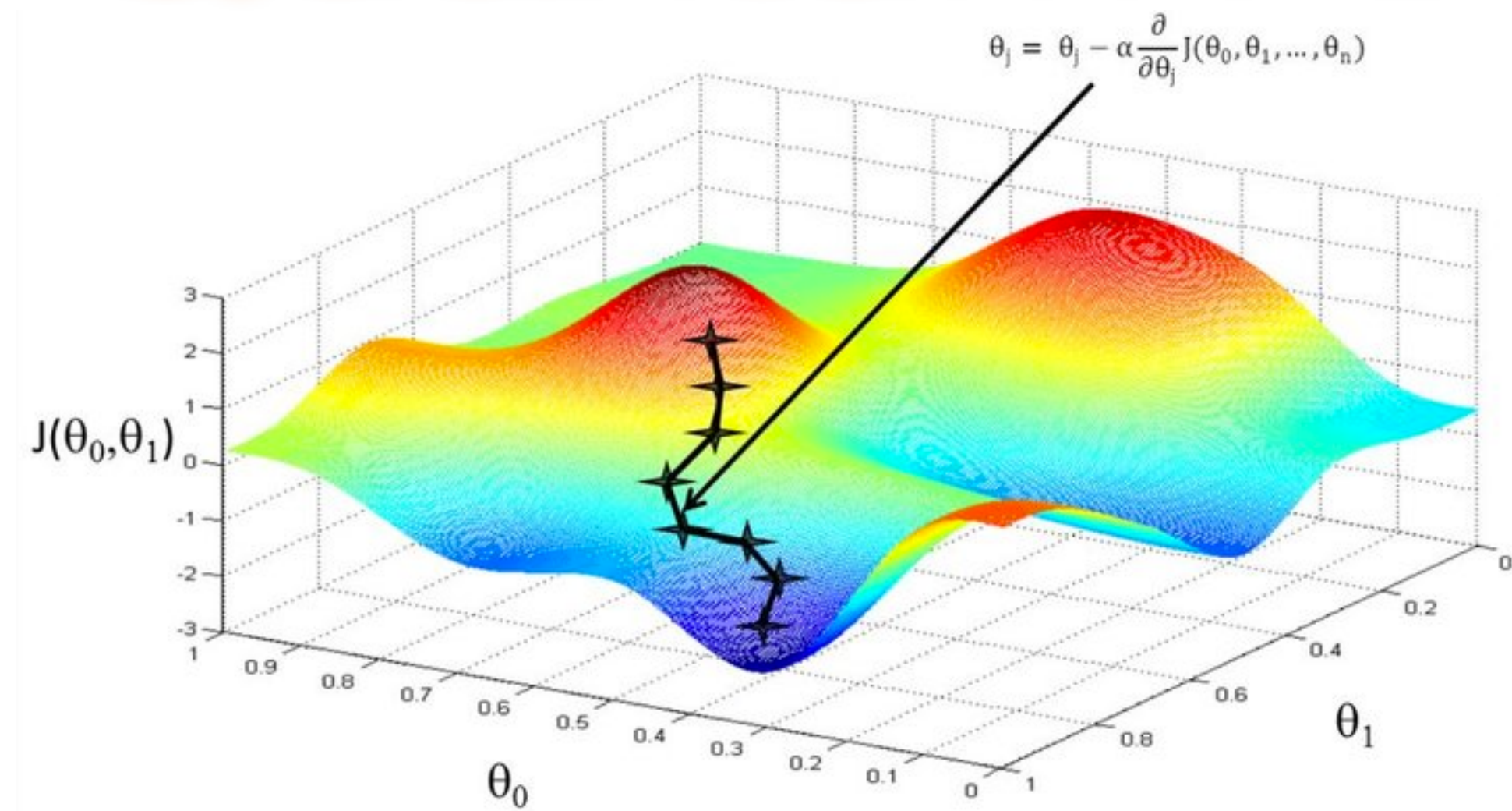






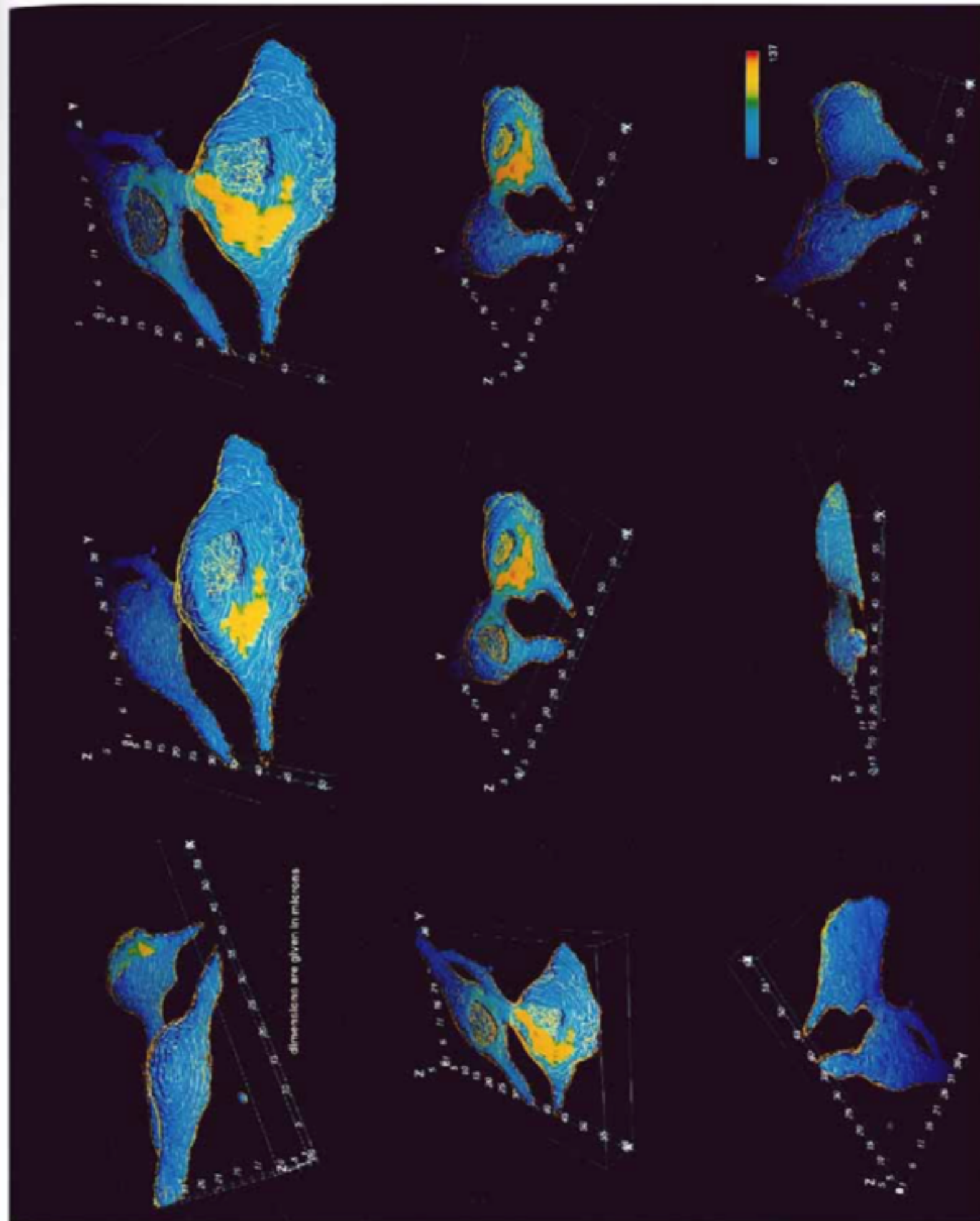


# Quantum Annealing





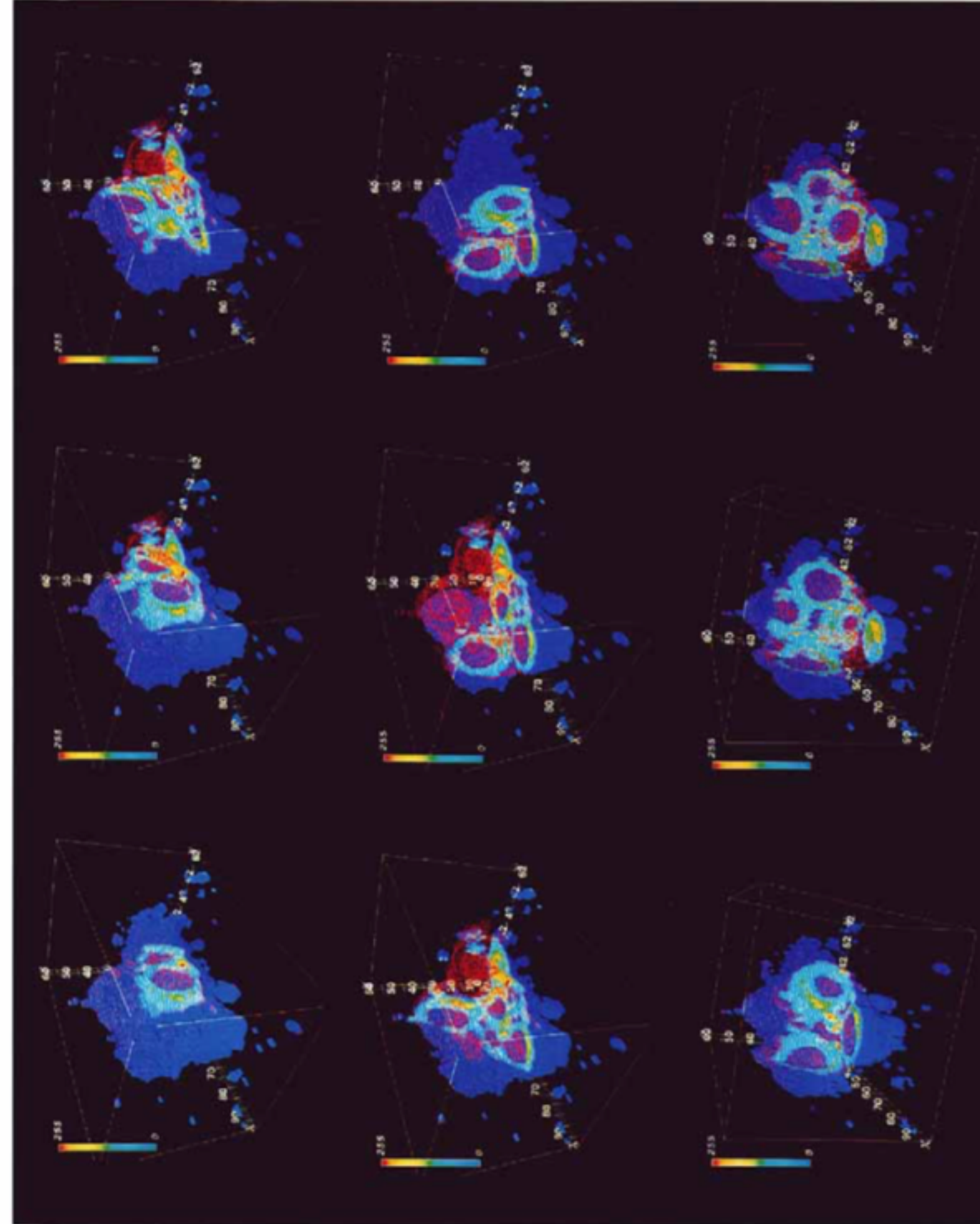
# What I learned ...



3D Reconstruction of Human Melanoma Cells

Acta Anat 1996;157:116-125

121 122



Acta Anat 1996;157:116-125

Porwol/Merten/Opitz/Acker

Acta  
Anatomica

Original Paper

Acta Anat 1996;157:116-125

Received: May 9, 1996  
Accepted: November 13, 1996

T. Porwol  
E. Merten  
N. Opitz  
H. Acker

Max-Planck-Institut  
für molekulare Physiologie, Dortmund,  
Germany

## Three-Dimensional Imaging of Rhodamine 123 Fluorescence Distribution in Human Melanoma Cells by Means of Confocal Laser Scanning Microscopy

© Free Author Copy – for personal use only

ANY DISTRIBUTION OF THIS ARTICLE WITHOUT WRITTEN CONSENT FROM S. KARGER AG, BASEL IS A VIOLATION OF THE COPYRIGHT.

Written permission to distribute the PDF will be granted against payment of a permission fee, which is based on the number of accesses required. Please contact [permission@karger.ch](mailto:permission@karger.ch)

### Key Words

Confocal laser scanning microscopy  
Optical sectioning  
Image processing  
Three-dimensional imaging  
Electromagnetic field strength  
Human melanoma cells  
Multicellular spheroids  
Rhodamine 123  
Mitochondrial membrane potential  
Cell volume

### Abstract

Three-dimensional (3D) imaging of intracellular rhodamine 123 fluorescence distribution was performed by means of confocal laser scanning microscopy (CLSM). Human IGR melanoma cells grown in monolayer or multicellular spheroid culture were studied for elucidating mitochondrial membrane potential characteristics, and cell and nucleus volume dimensions. Microspheres 6  $\mu$ m in diameter loaded with rhodamine B were used to calibrate our instruments for performing 3D imaging of optical sections as obtained by CLSM. Accurate optical slicing is only possible taking into consideration the physical characteristics of the objectives used like chromatic and spherical aberrations, depth discrimination or cover slip correction and the temperature dependence of the immersion medium. While 3D imaging of optical slices can be carried out showing the original shape of the object being tested without physical distortion, 3D images of microspheres show well-reproducible structures of rhodamine B fluorescence. These can be explained by a superposition of two effects, namely scattering of the fluorescence light and a gradient of the electromagnetic field strength of the laser beam due to the shape of the object. 3D imaging of optical slices of IGR cells in monolayer or multicellular spheroid culture, which have been loaded with rhodamine 123, show the location of the dye predominantly within the cytoplasm of the cells with a remarkable heterogeneity of fluorescence intensity within and between single cells, indicating differences in the mitochondrial membrane potential and thus in the metabolic activity. Due to the heterogeneity of the cell shape the cell nucleus occupies between 4 and 14% of the total cell volume. These data reveal calibrated 3D imaging as a valuable noninvasive tool to visualize the heterogeneity of cell parameters under different cell culture conditions.

Abbreviations used in this paper:  
C = Programming language; CLSM = confocal laser scanning microscopy; DAPI = 4',6-diamino-2-phenylindole;  
DMSO = dimethyl sulfoxide; dpi = dots per inch;  
IGRM = IGR cells grown in monolayer; IGRS = IGR cells grown in multicellular spheroid culture; K = Kelvin (SI unit temperature) °C = K - 273.15; mW = 10<sup>-3</sup> J/s;  
MB = megabyte; NA = numerical aperture; PO<sub>2</sub> = oxygen partial pressure; RAM = random access memory;  
UNIX = operating system.

KARGER

E-Mail [karger@karger.ch](mailto:karger@karger.ch)  
Fax +41 61 306 12 34  
<http://www.karger.ch>

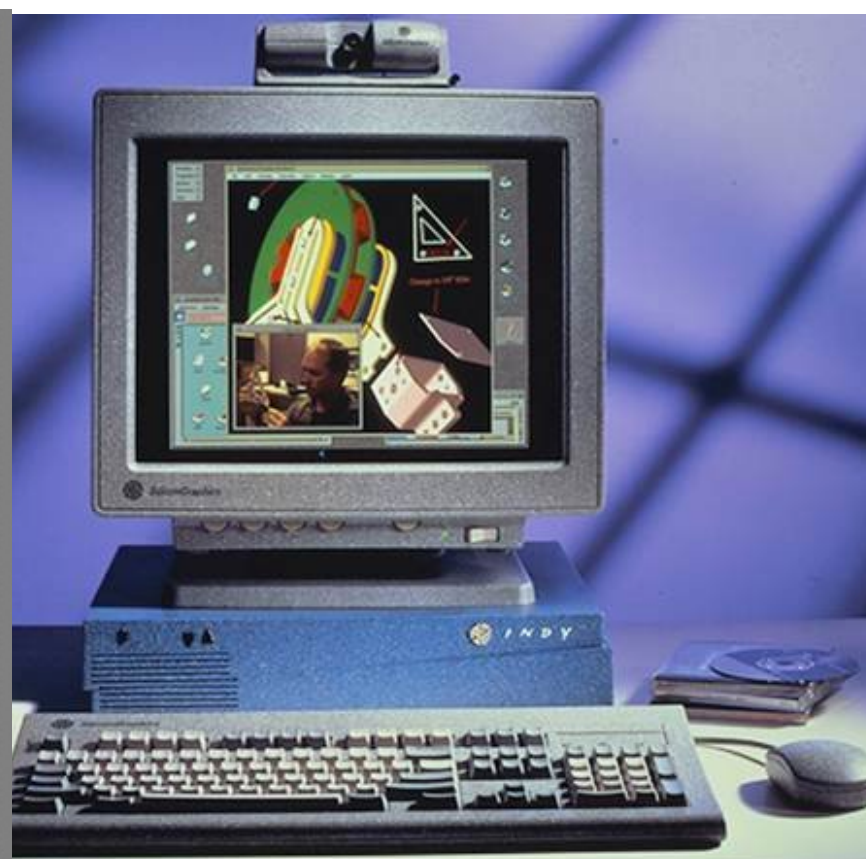
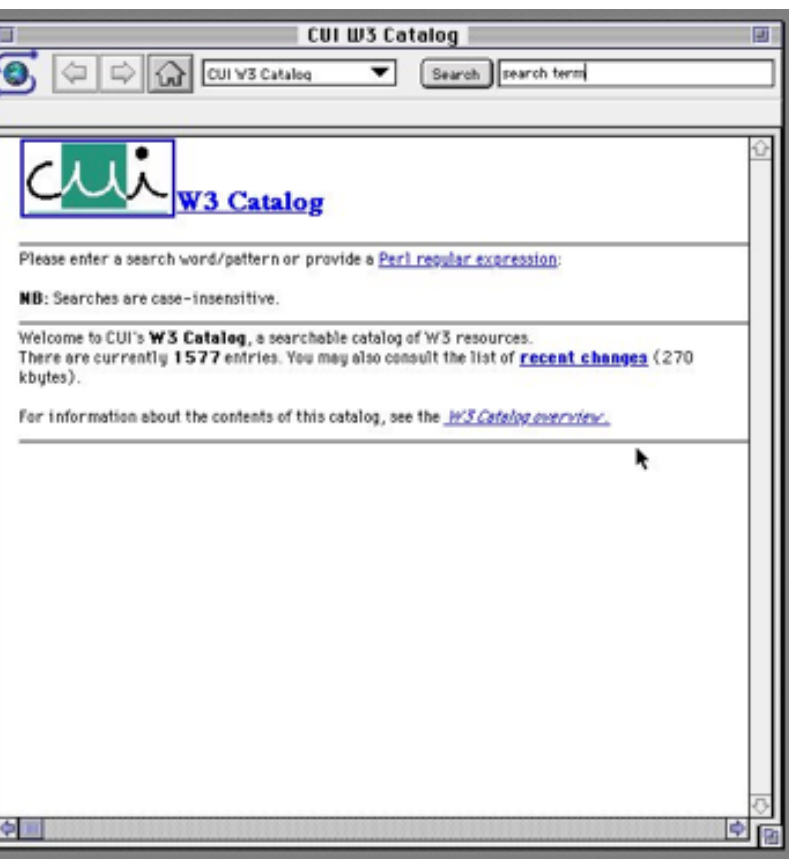
© 1997 S. Karger AG, Basel  
0001-5180/96/1572-0116\$12.00/0

This article is also accessible online at:  
<http://BioMedNet.com/karger>

Prof. Dr. med. H. Acker  
Max-Planck-Institut für molekulare Physiologie  
Rheinlanddamm 201, D-44139 Dortmund (Germany)  
Tel. +49/231/120 65 30, Fax +49/231/120 65 30 (64 64)  
E-Mail [helmut.acker@mpi-dortmund.mpg.de](mailto:helmut.acker@mpi-dortmund.mpg.de)



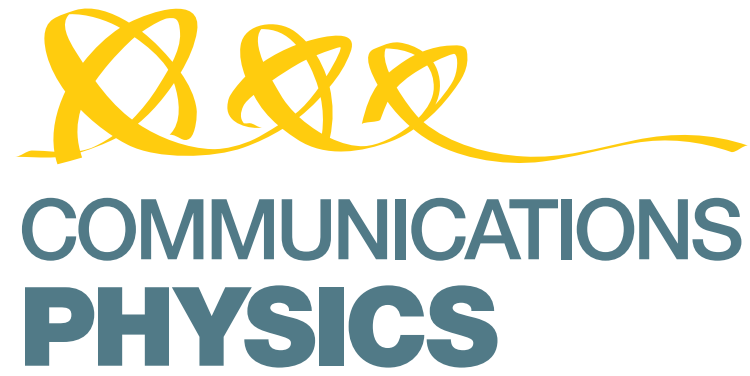
# Graph & Network & Visualisation & Global Minima give you access to the cool tools



But don't listen to me ...



# ...listen to the Experts



## REVIEW ARTICLE

<https://doi.org/10.1038/s42005-019-0152-6>

OPEN

## Complex networks from classical to quantum

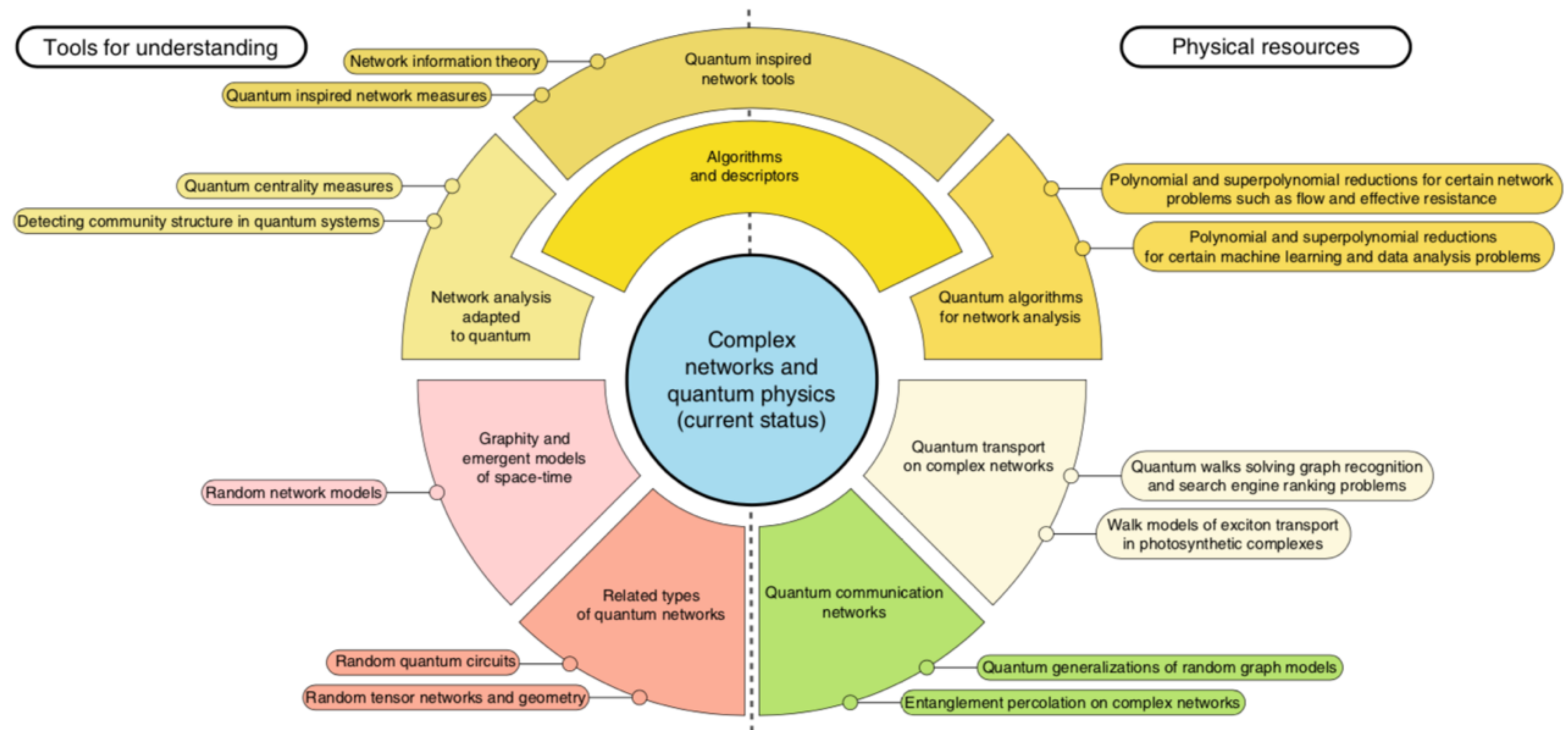
Jacob Biamonte<sup>1</sup>, Mauro Faccin<sup>2</sup> & Manlio De Domenico<sup>3</sup>

Recent progress in applying complex network theory to problems in quantum information has resulted in a beneficial cross-over. Complex network methods have successfully been applied to transport and entanglement models while information physics is setting the stage for a theory of complex systems with quantum information-inspired methods. Novel quantum induced effects have been predicted in random graphs—where edges represent entangled links—and quantum computer algorithms have been proposed to offer enhancement for several network problems. Here we review the results at the cutting edge, pinpointing the similarities and the differences found at the intersection of these two fields.

Quantum mechanics has long been predicted to help solve computational problems in physics<sup>1</sup>, chemistry<sup>2</sup>, and machine learning<sup>3</sup> and to offer quantum security enhancement in communications<sup>4</sup>, including a quantum secure Internet<sup>5</sup>. Rapid experimental progress has pushed quantum computing and communication devices into truly data-intensive domains, where even the classical network describing a quantum system can exhibit complex features, giving rise to what appears as a paradigm shift needed to face a fundamental type of complexity<sup>6–15</sup>. Methods originating in complex networks—traditionally based on statistical mechanics—are now being generalized to the quantum domain in order to address these new quantum complexity challenges.

Building on several fundamental discoveries<sup>14,15</sup>, complex network theory has demonstrated that many (non-quantum) systems exhibit similarities in their complex features<sup>14–18</sup>, in the organization of their structure and dynamics<sup>19–24</sup>, the controllability of their constituents<sup>25</sup>, and their resilience to structural and dynamical perturbations<sup>26–31</sup>. Certain quantum systems have been shown to indeed exhibit complex features related to classical systems, as well as novel mechanisms and principles that interrelate complex features in quantum systems<sup>6–12,32</sup>.

Two types of quantum networks have been of primary focus in the series of pioneering results we review. The first consists of quantum systems whose connections are represented by entangled states<sup>6,33,34</sup>. These quantum networks are used in secure quantum communication systems. The second area of focus consists of networks of quantum systems, such as atoms or superconducting quantum electronics, whose connections are physical<sup>35–40</sup>. Such systems are used to develop quantum-enhanced algorithms or quantum information transport systems, both modeled by quantum walks on complex networks. At a fundamental level, the two types of



<sup>1</sup>Deep Quantum Labs, Skolkovo Institute of Science and Technology, 3 Nobel Street, Moscow 143026, Russia. <sup>2</sup>ICTEAM, Université Catholique de Louvain, Euler Building 4, Avenue Lemaitre, B-1348 Louvain-la-Neuve, Belgium. <sup>3</sup>CoMuNe Lab, Fondazione Bruno Kessler, Via Sommarive 18, 38123 Povo, TN, Italy. Correspondence and requests for materials should be addressed to J.B. (email: [jacob.biamonte@qubit.org](mailto:jacob.biamonte@qubit.org)) or to M.F. (email: [mauro.faccin@uclouvain.be](mailto:mauro.faccin@uclouvain.be)) or to M.D.D. (email: [mdedomenico@fbk.eu](mailto:mdedomenico@fbk.eu))



[indico.cern.ch/e/VisualAnalytics](http://indico.cern.ch/e/VisualAnalytics)

If you want to explore with a real-life state-of-the-art data example, the power of HEP Graph Networks Analysis, this brainstorming is for you!

We will investigate and discuss together with you and air traffic regulator experts, how different HEP Graph Network and data analysis techniques can be used for the benefits of a future networked aviation.

# Connecting Skies

A real-life data brain-storming with graph data

19. June 2019  
CERN IdeaSquare