Imperial College
London

The Extension of the DICOM Standard to Incorporate 'Omics' Data

Richard I Kitney, Vincent Rouilly and Chueh-Loo Poh
Department of Bioengineering

We stand at the dawn of a new understanding of disease…

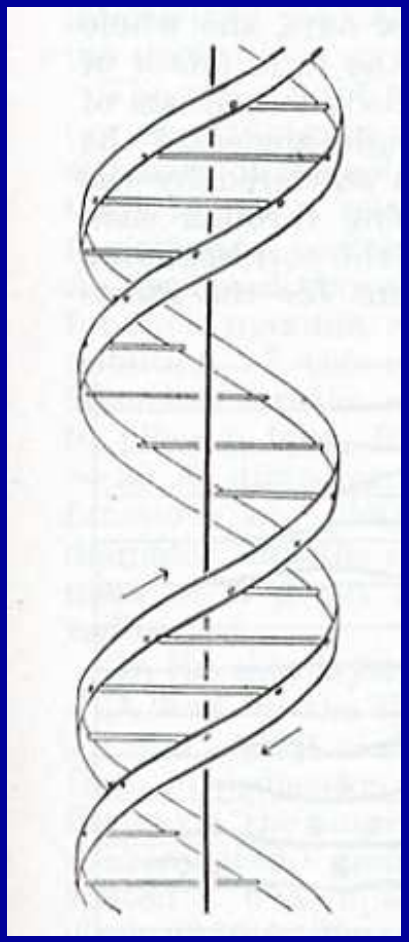
***Nature* 409, 860 - 921 (2001)**

Initial sequencing and analysis of the human genome

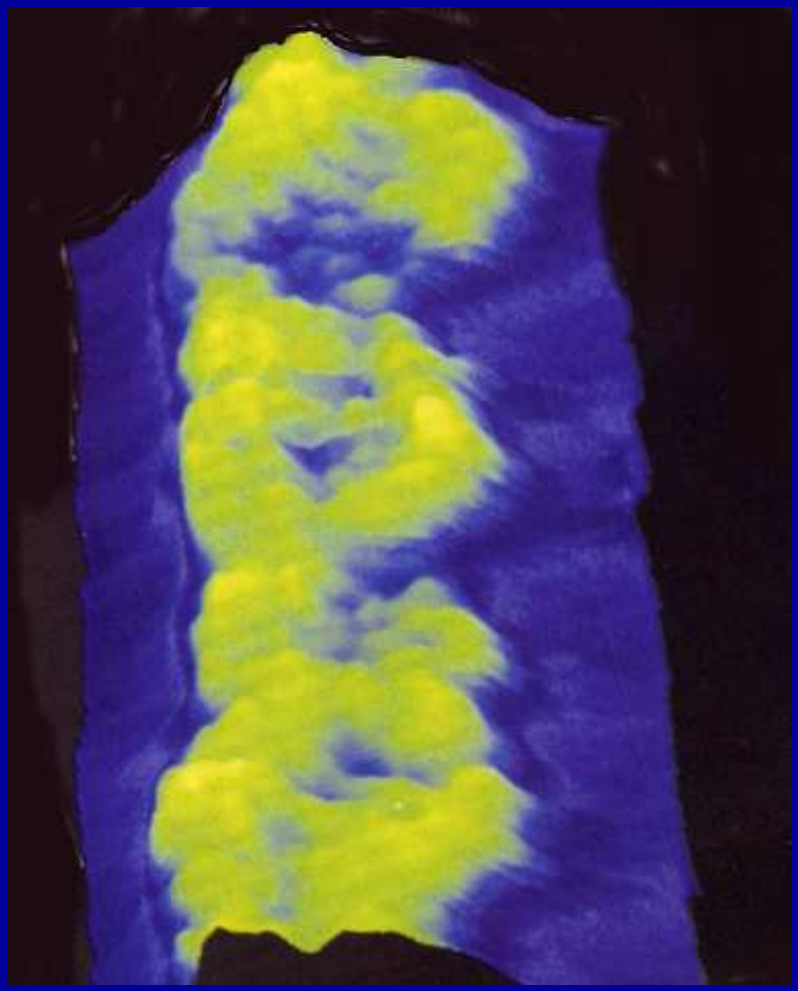
International Human Genome Sequencing Consortium

The human genome holds an extraordinary trove of information about human development, physiology, medicine and evolution. Here we report the results of an international collaboration to produce and make freely available a draft sequence of the human genome. We also present an initial analysis of the data, describing some of the insights that can be gleaned from the sequence.

The Double Helix Model



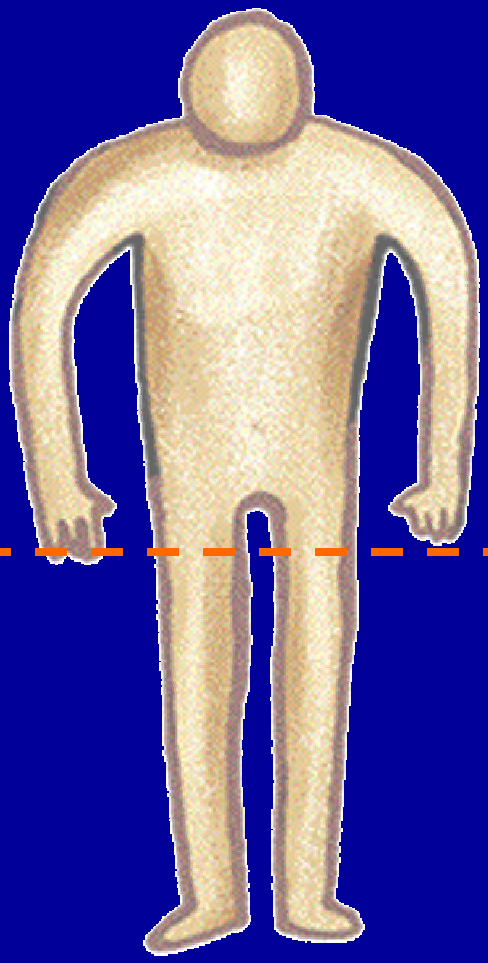
Watson and Crick – Nature 25th April 1953



Scanning Tunnelling Micrograph

The Biological Continuum:

supporting the revolution of molecular medicine



BODY

SYSTEMS

ORGANS

TISSUES

CELLS

MOLECULES

GENES

Patient X

MRI

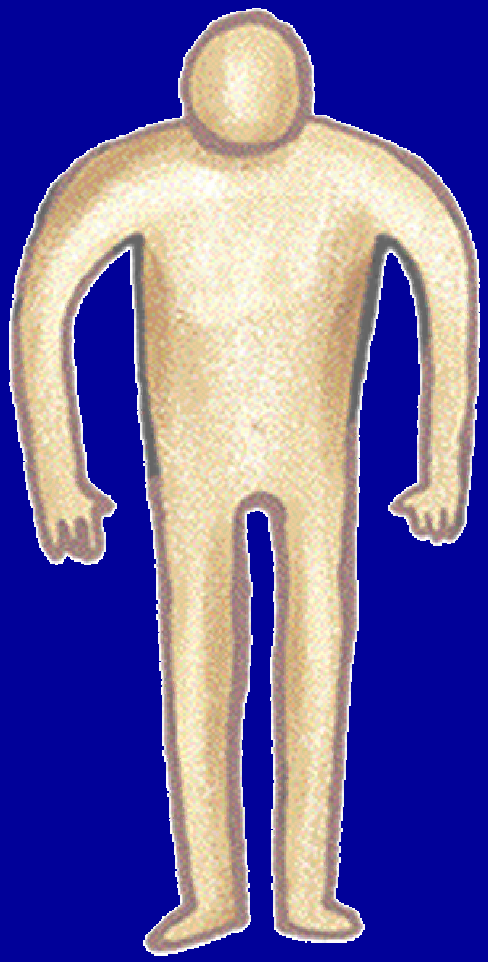
CT

ECG

Today's ePatient record

The Biological Continuum:

supporting the revolution of molecular medicine



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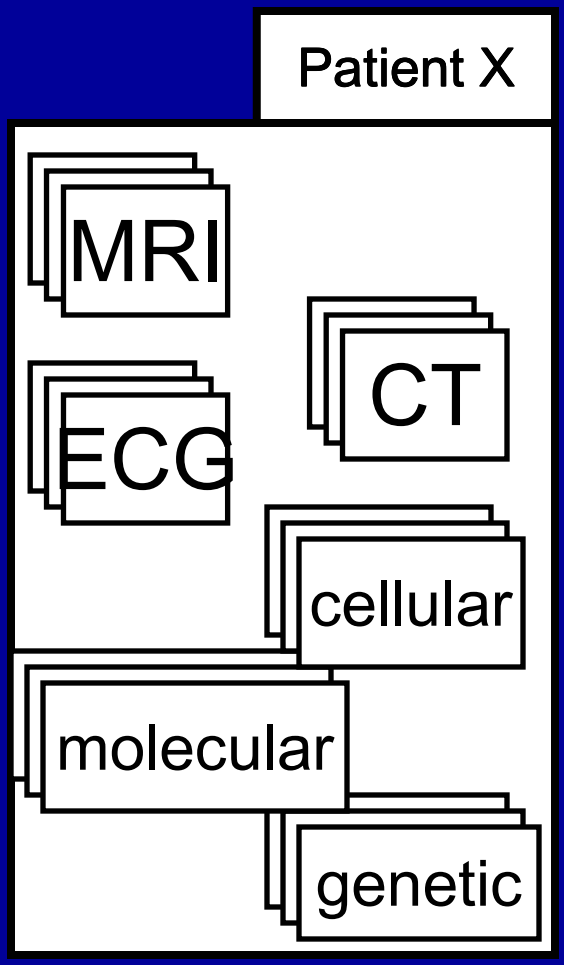
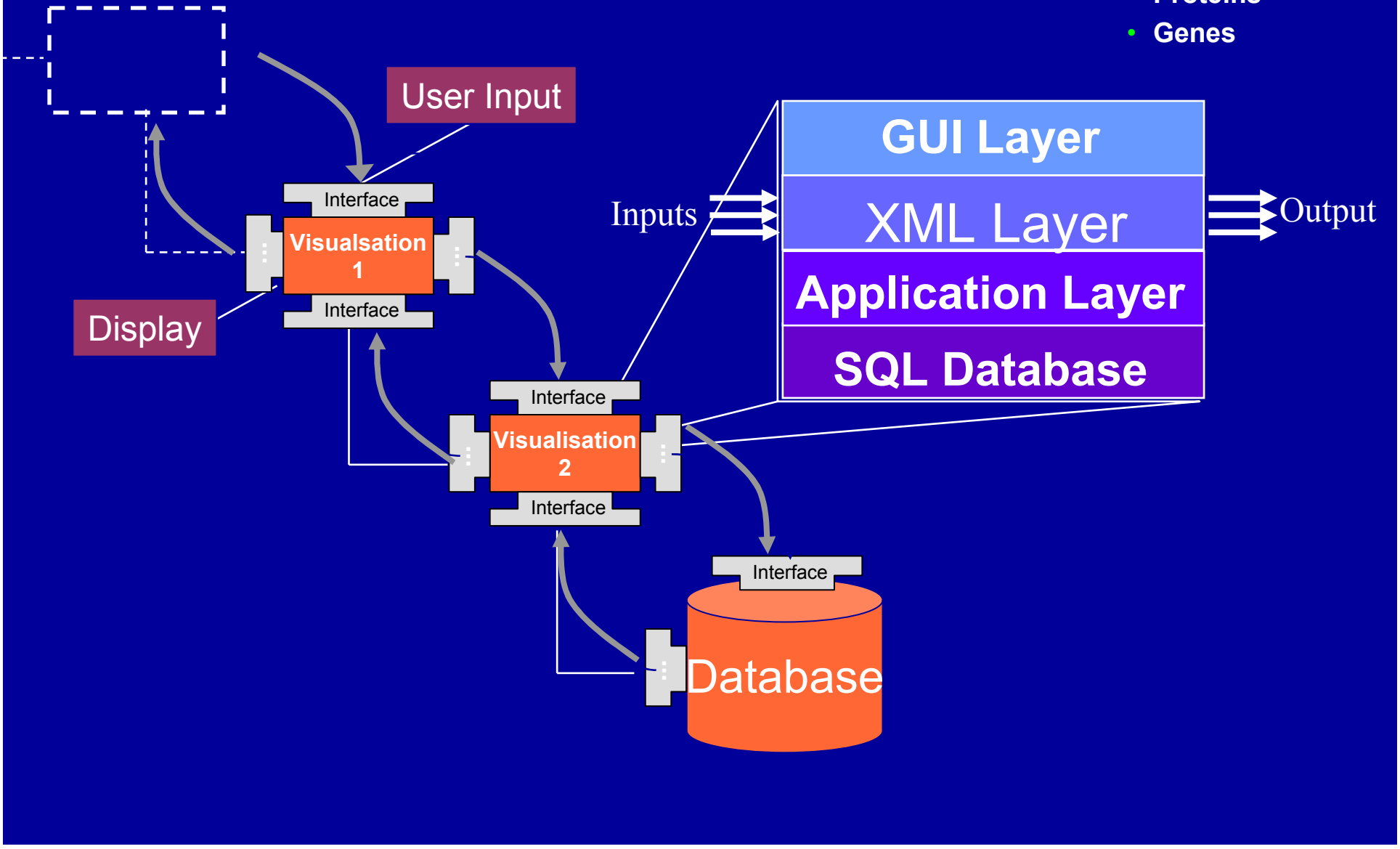


Tomorrow's ePatient record

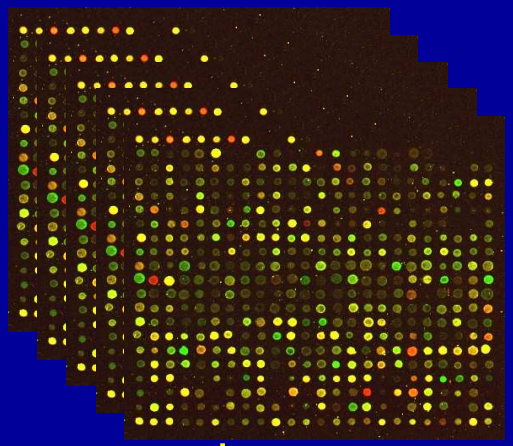
Advanced Web-based Information Systems

- Systems
- Viscera
- Tissue
- Cells
- Proteins
- Genes



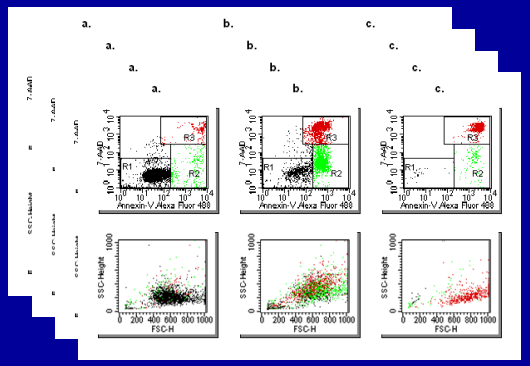
Explosion of Omics Data:

Biology as a high throughput science

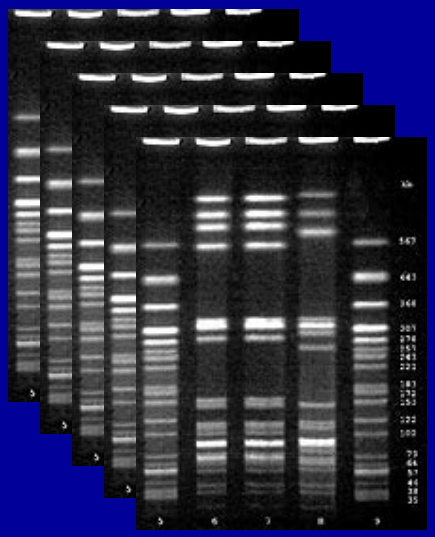


microarrays

Daily lab outputs



Flow cytometry



Gel electrophoresis

<u>And more</u>:

-PCR

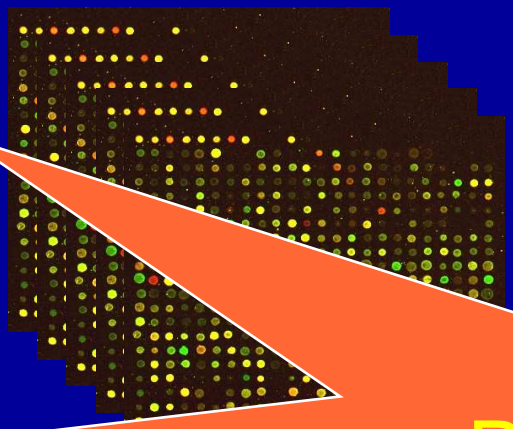
-Spectrometry

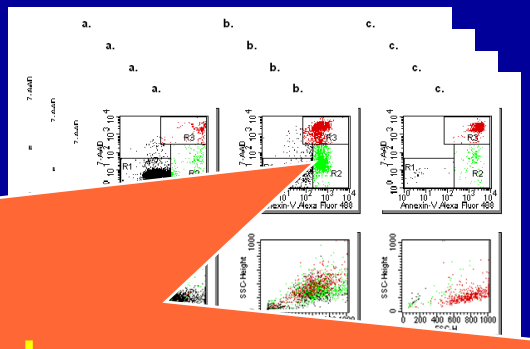
-Microscopy

-…

Explosion of Omics Data:

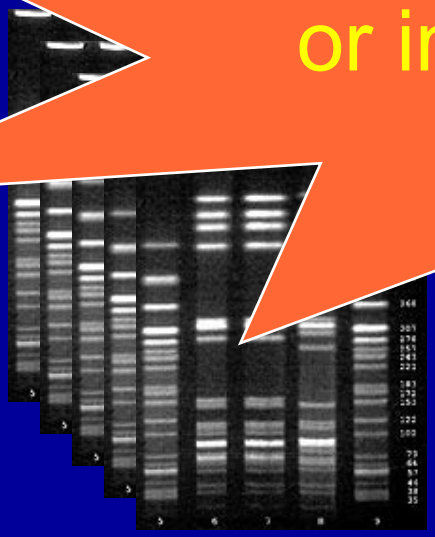
Biology as a high throughput science





Data often not stored

or impossible to retrieve



Gel electrophoresis

Daily outputs

<u>ore</u>:

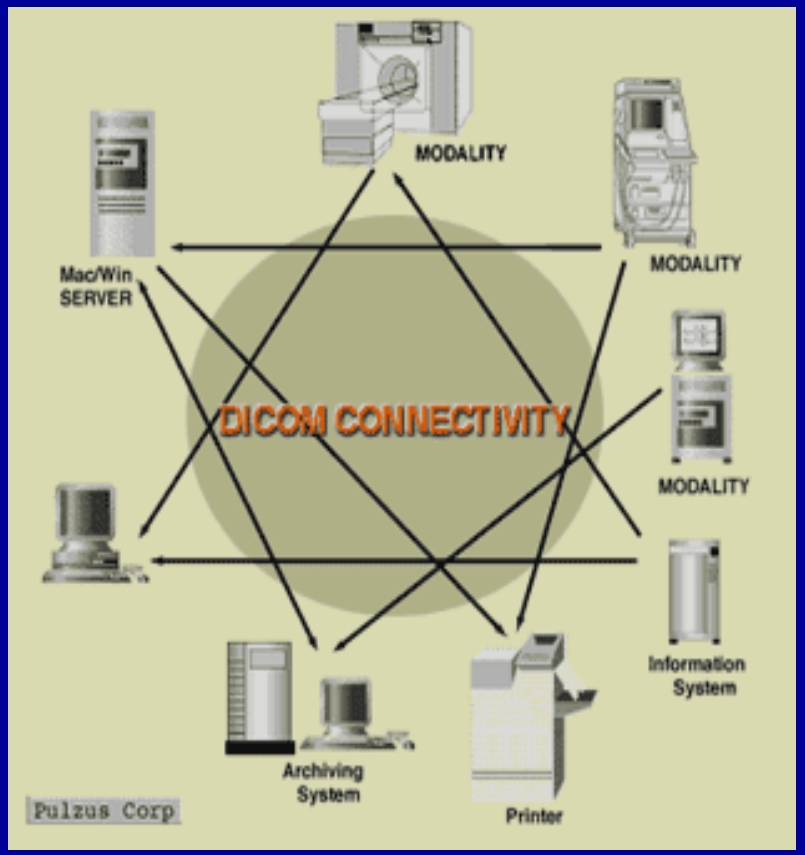
-PCR

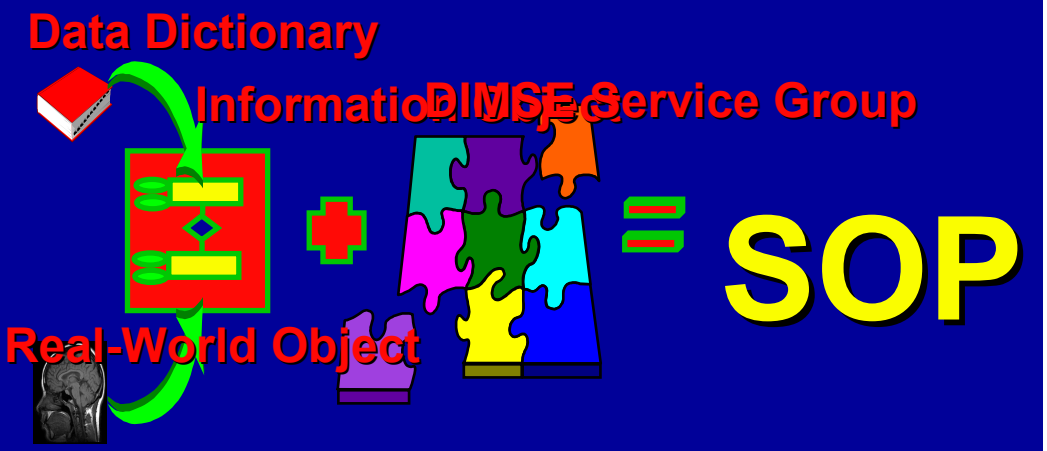
-Spectrometry

-Microscopy

-…

Achievements from DICOM





- Inter Connectivity
- Inter Operability
- Archiving

All what ‘Omics’ data needs

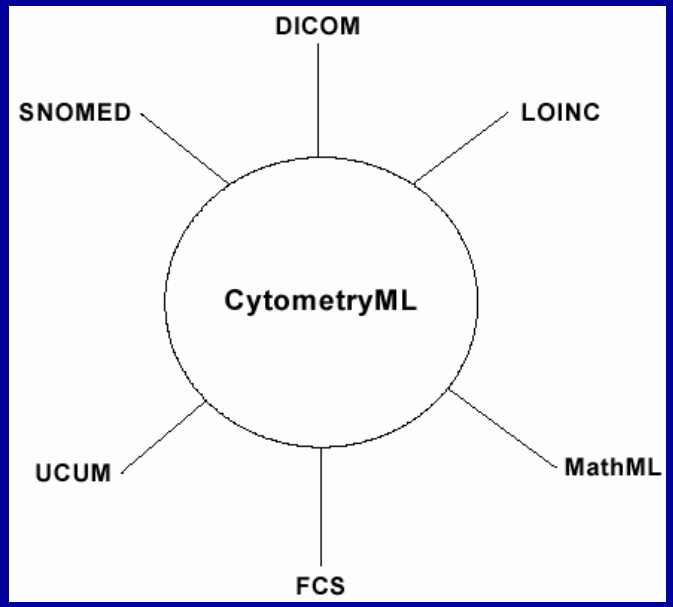
Standardization efforts on biological data

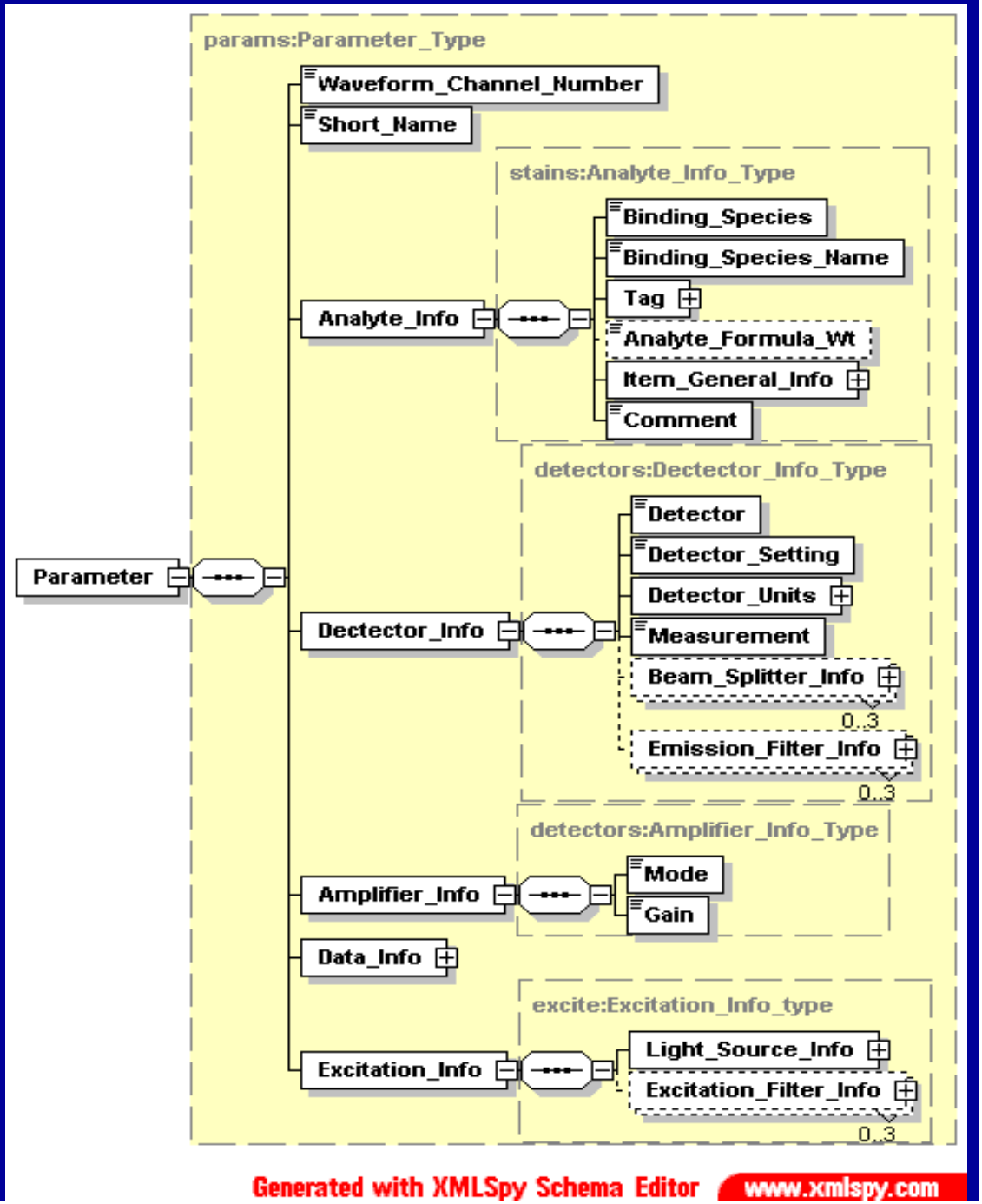
- Gel Electrophoresis
  - Western Blot
  - 1D Gel
  - 2D Gel ……HUPo
- Flow Cytometry / FACS …..CytometryML
- Microarray Experiments BASE, MAGE-OM
- Mass Spectrometry ……HUPo
- Microscope Images ……OME

Complete progress Preliminary

CytometryML

--Robert C. Leif, Suzanne B. Leif, et al., XML_Med, a Division of Newport Instruments

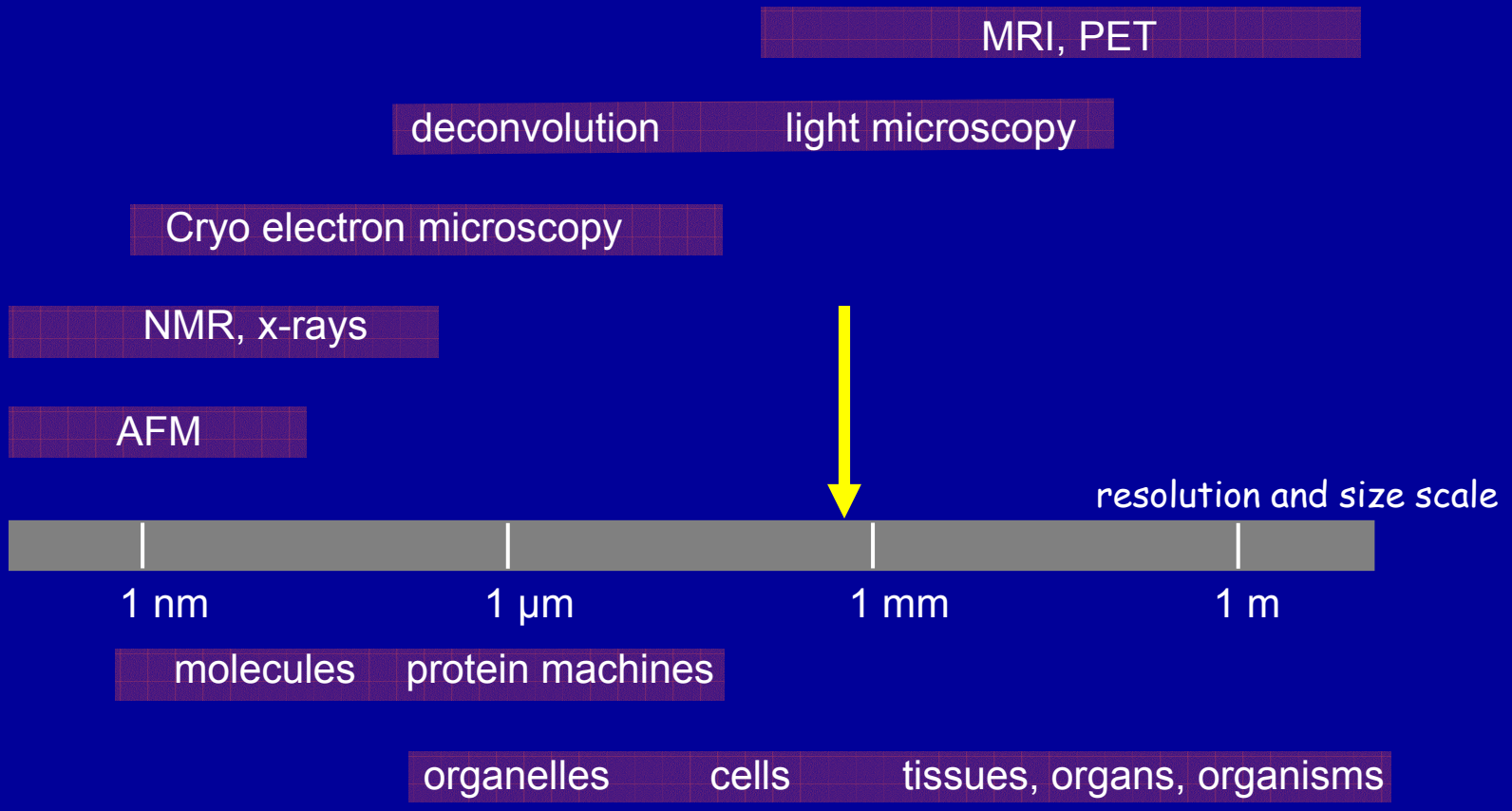




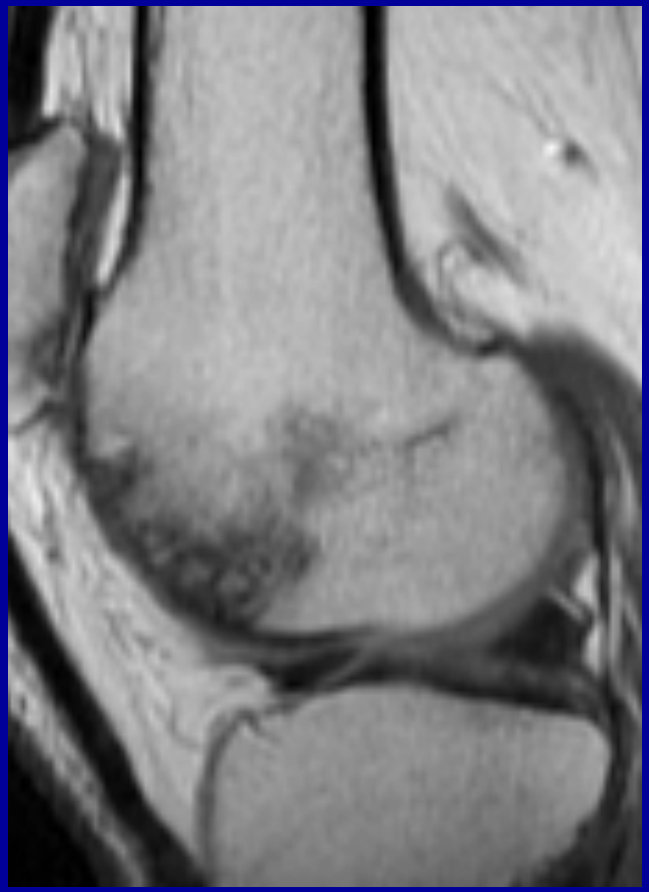
Some Examples

Magnetic Resonance Imaging

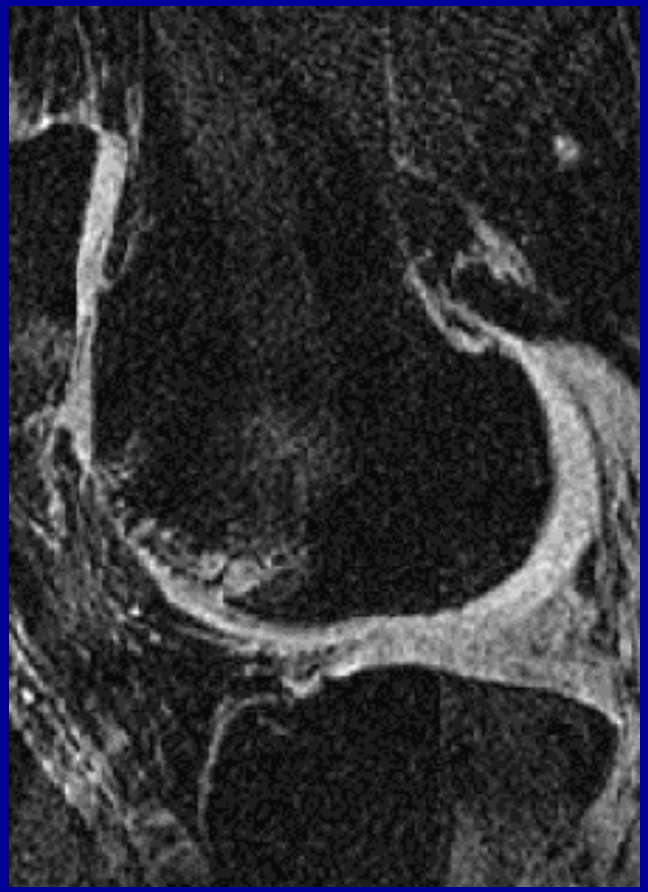
(The Biological Continuum – Tissue)



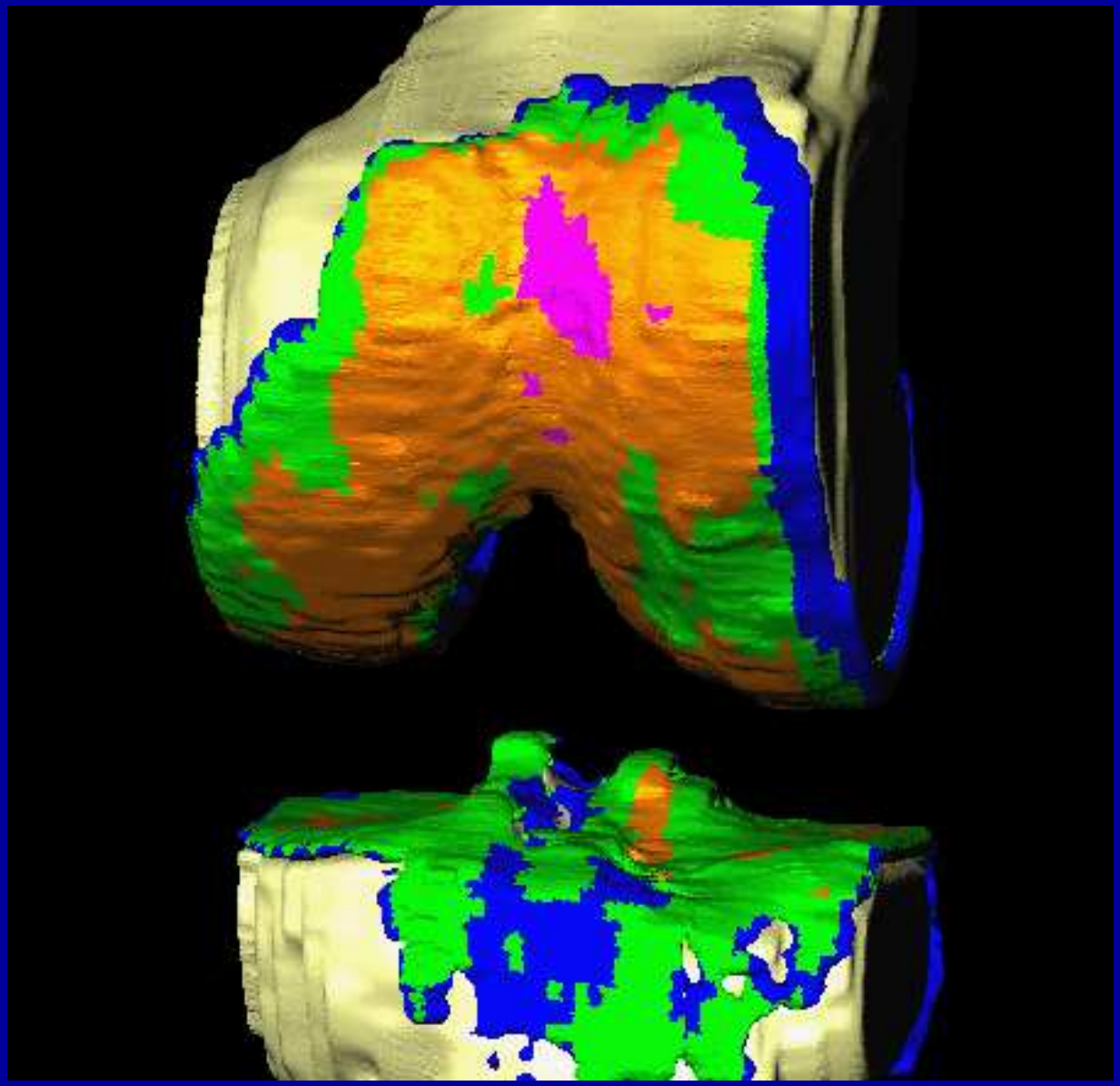
Imaging Bone and Articular Cartilage Damage



PD Sequence for Bone

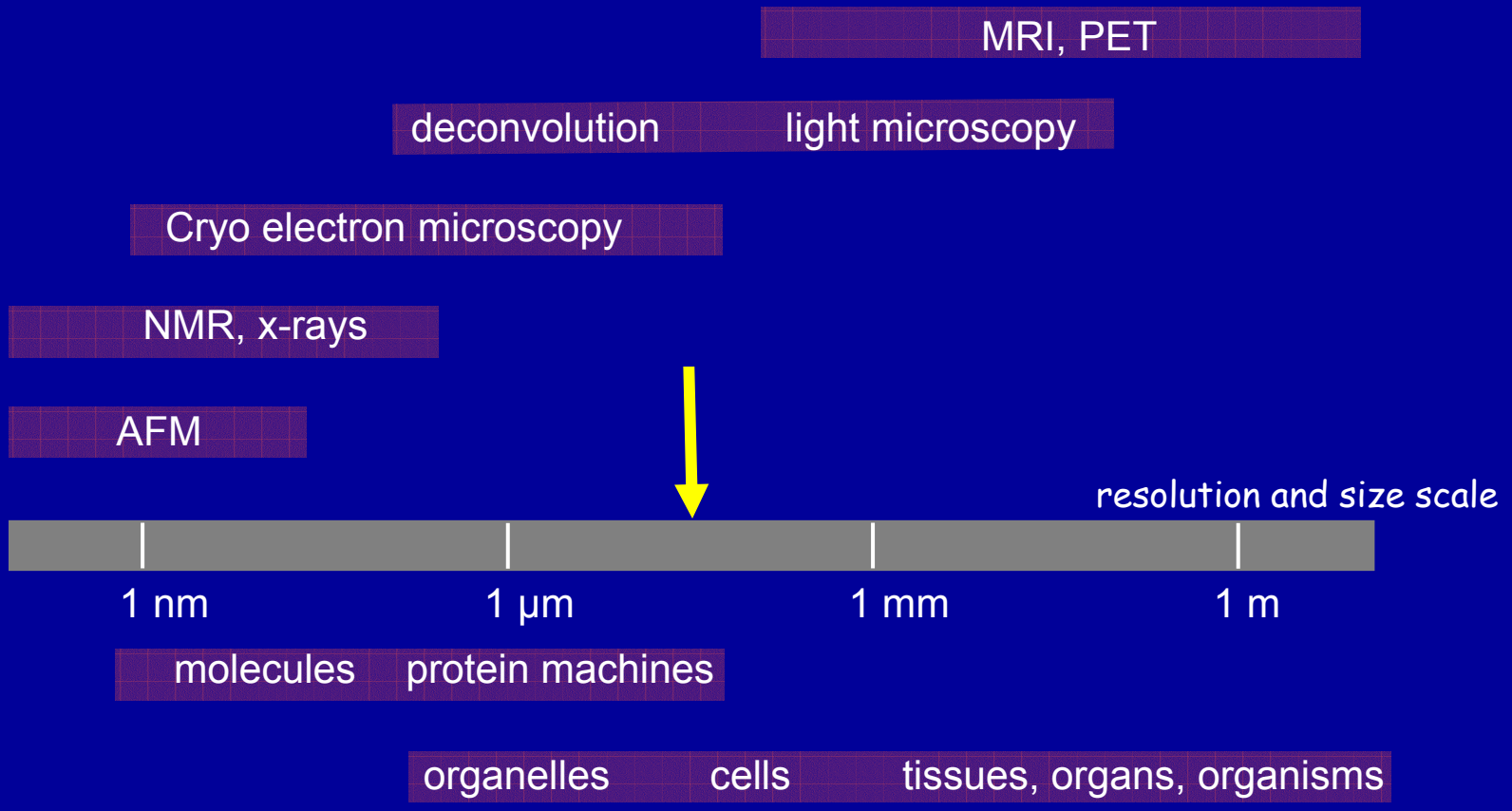


SPGR Sequence for
Articular Cartilage

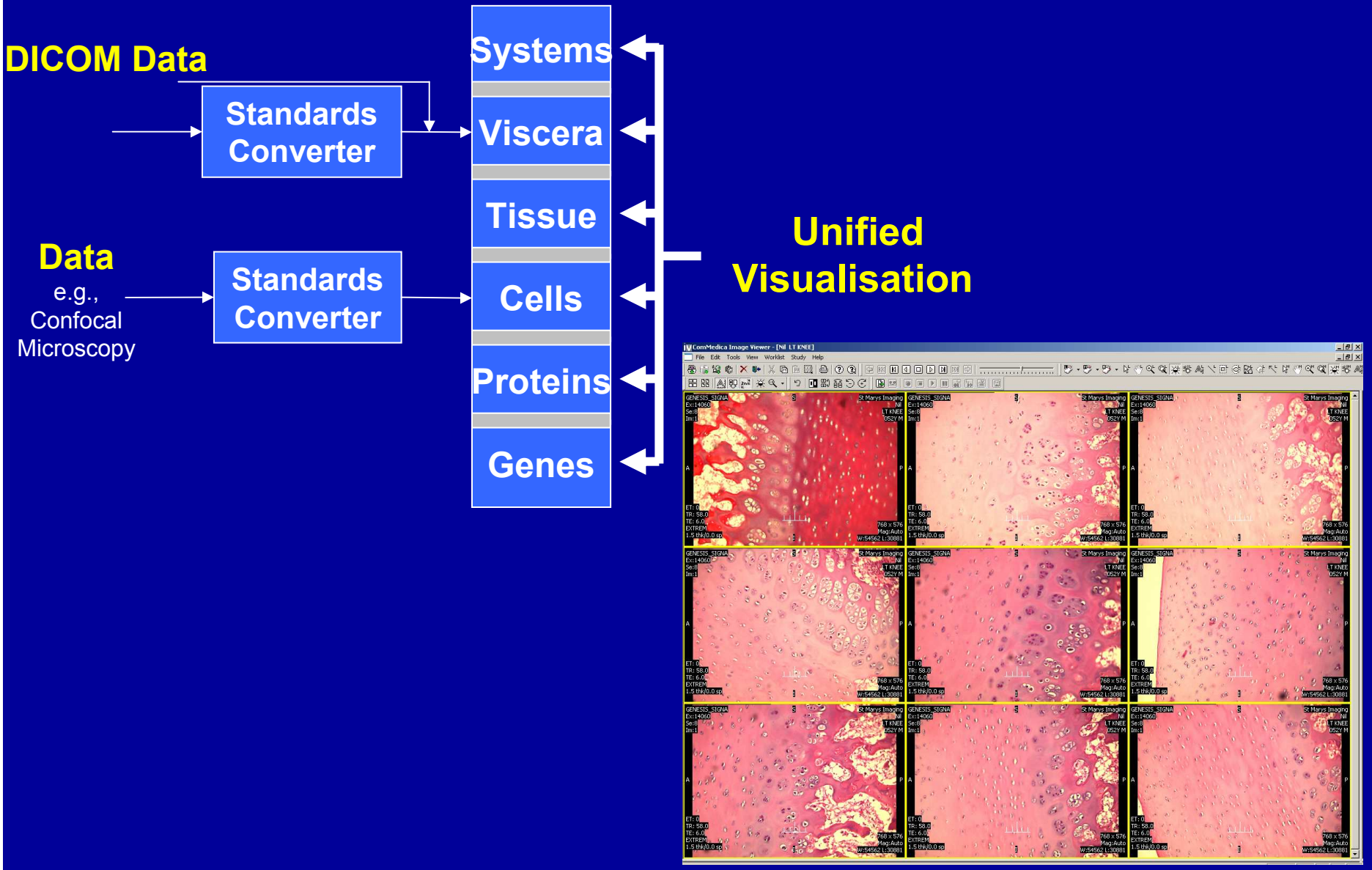


Cashman and Kitney. IEEE Trans on Nanobioscience. March 2002 pp 42-51

Microscopy Imaging (The Biological Continuum – Cells)

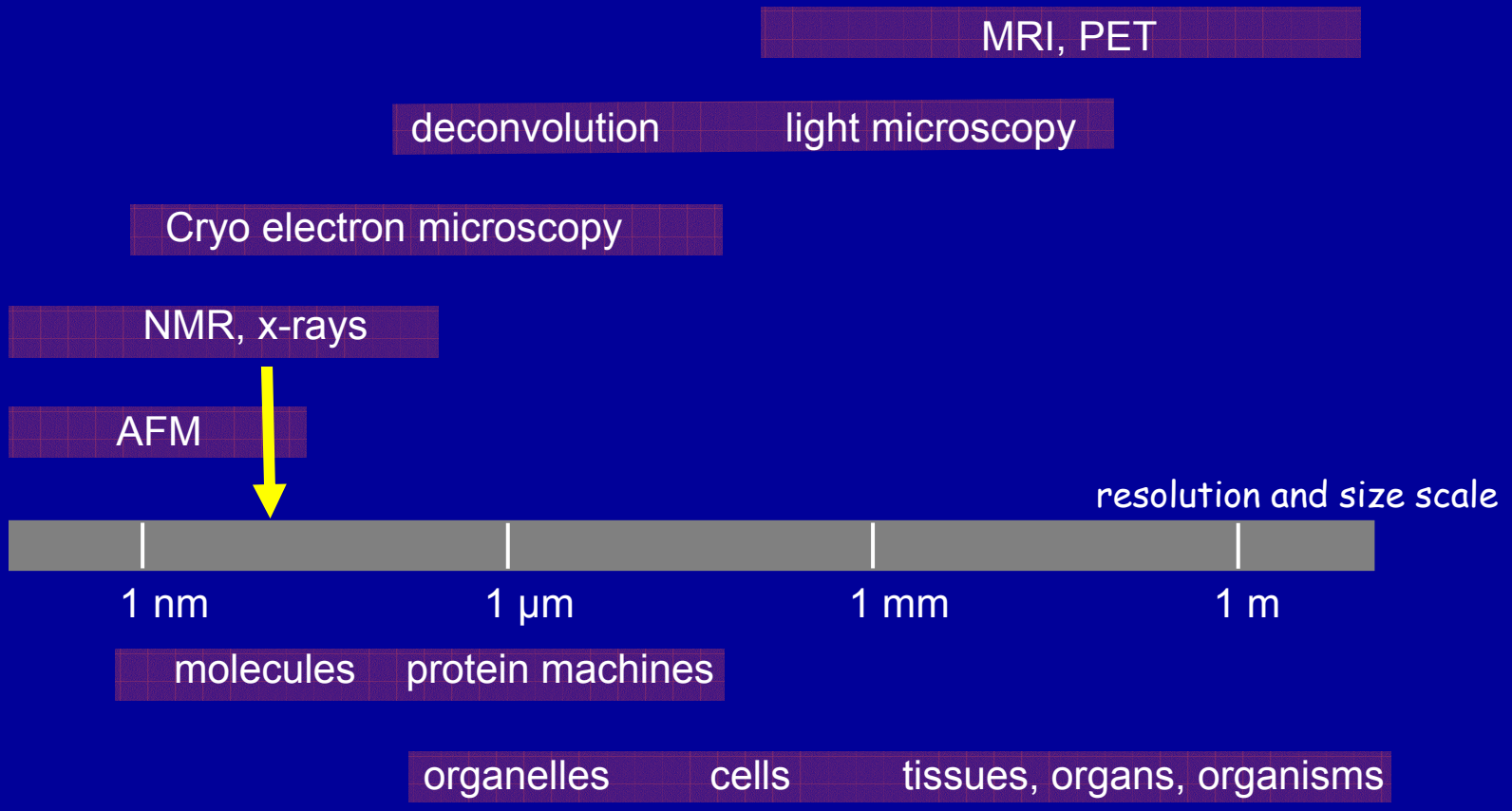


Histological study using microscopy

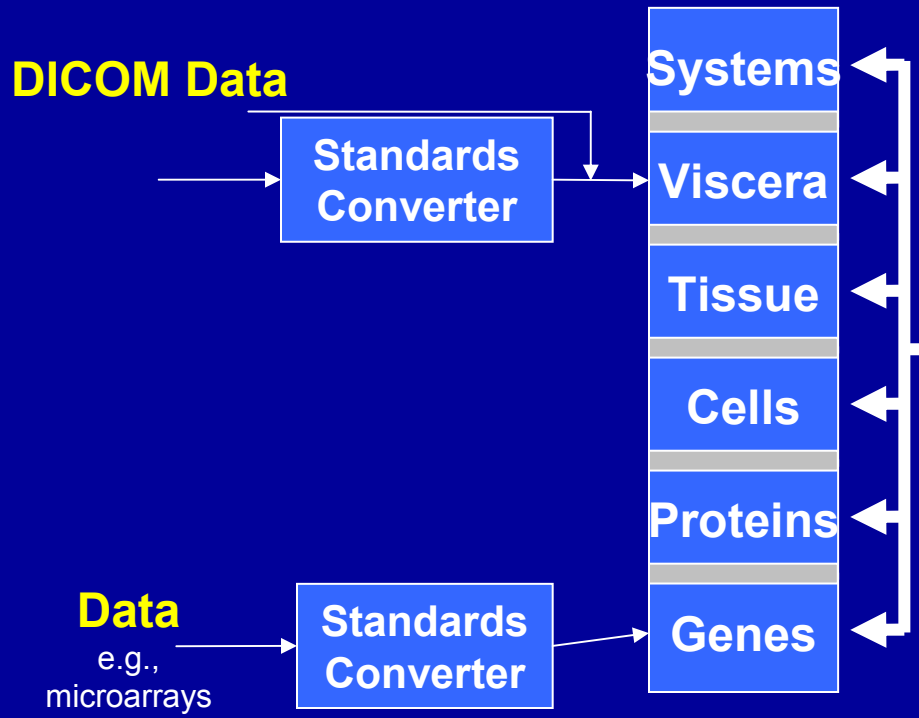


Microarrays Imaging

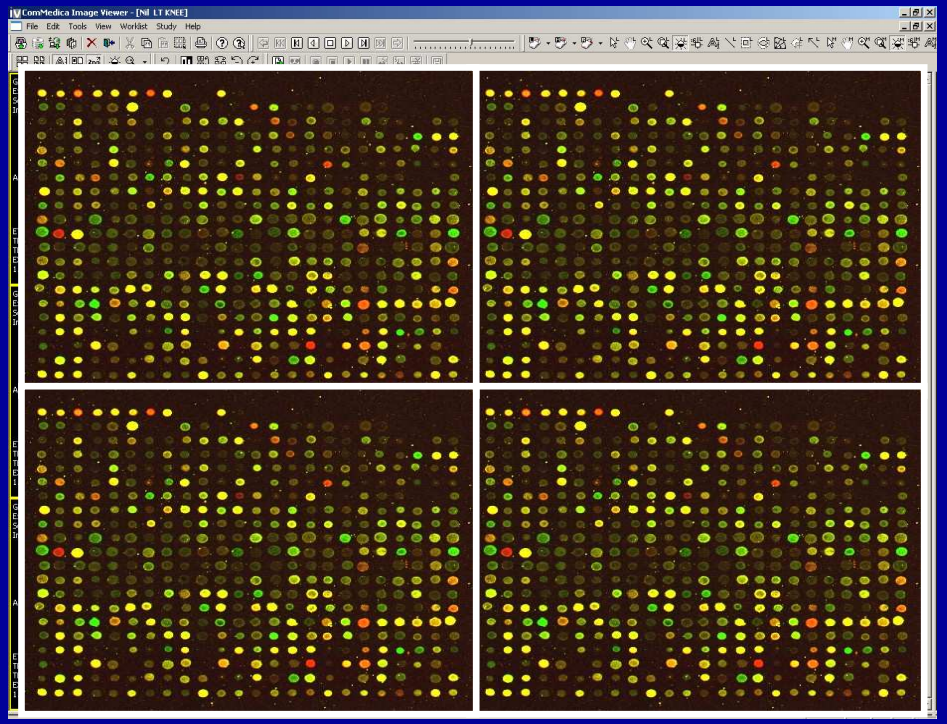
(The Biological Continuum – Cells)



Genetic marker screening using microarrays



Unified Visualisation



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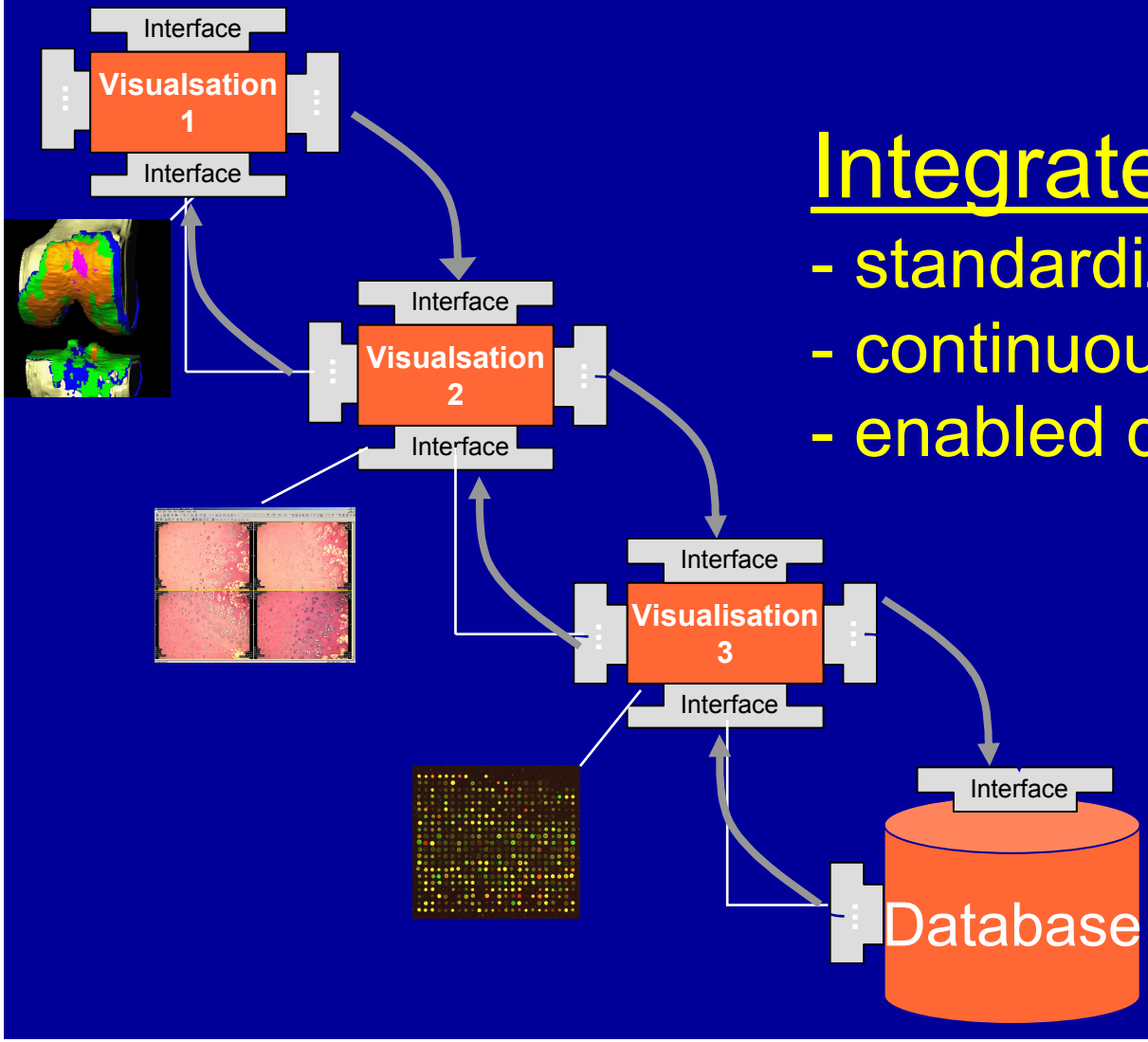

Integrated framework

- standardized infrastructure
- continuous browsing
- enabled data fusion

What we are considering for the next step

Advanced Web-based Information Systems

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- Viscera
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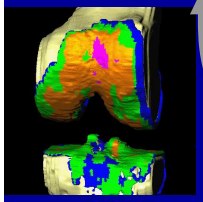
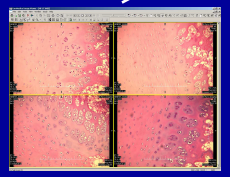
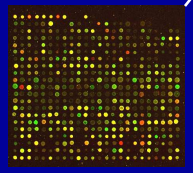






Interface
Visualsation 1
Interface

Interface
Model 1
Interface

User Input

Display

Interface
Visualsation 2
Interface

Interface
Model 2
Interface

Interface
Visualisation 3
Interface

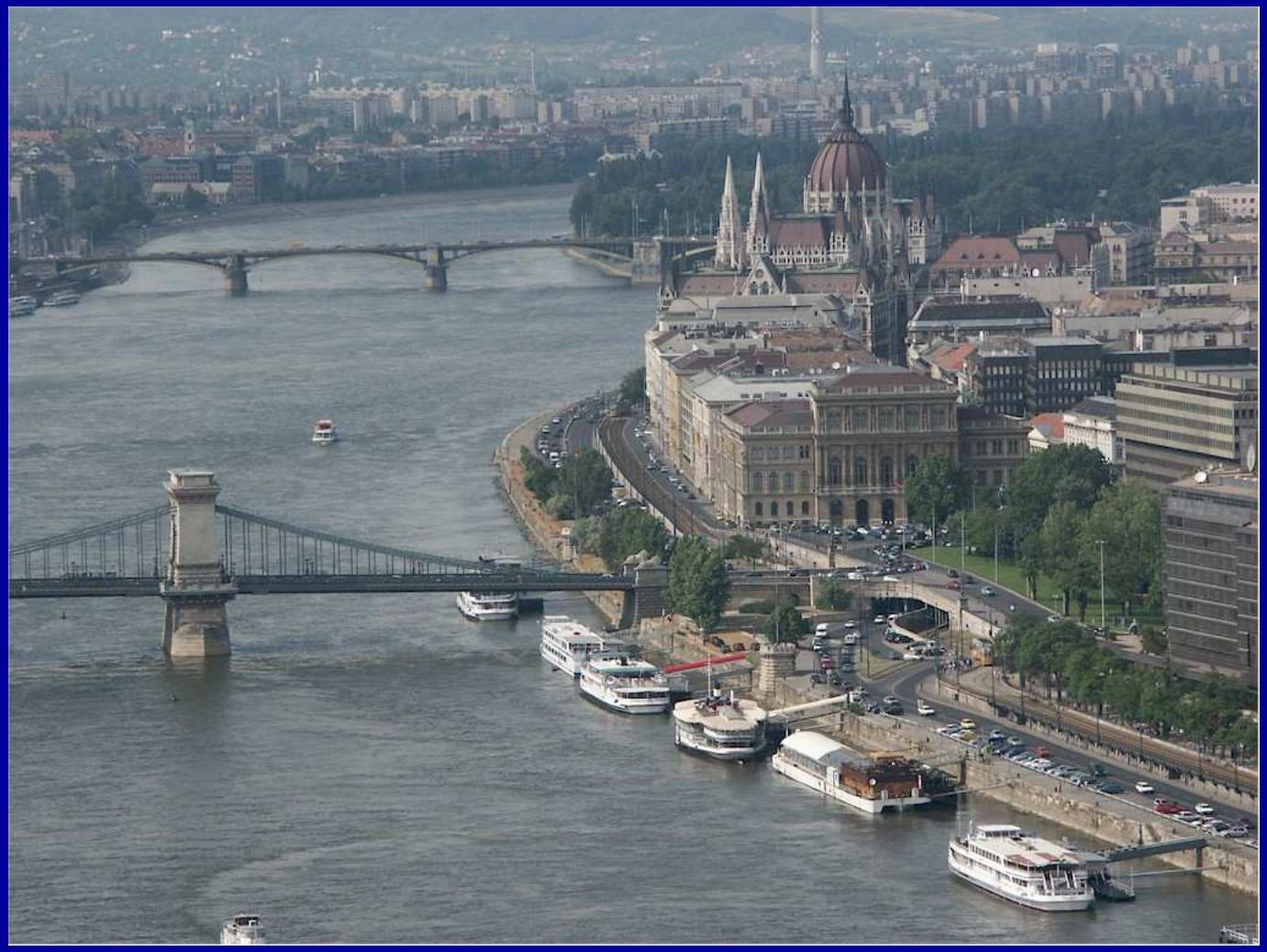
Interface
Model 3
Interface

Interface
Database

Interface
Database

Conclusions

- Because of the rapid development in molecular biology we now have to consider data across the Biological Continuum (BC).
- This is best done by the use of Web-based Advanced Medical Information System
- It is important that data and models at all levels of the BC conform to a common information standard
- DICOM meets these requirements, although it will require some modifications at the ‘Omics’ levels



Thanks