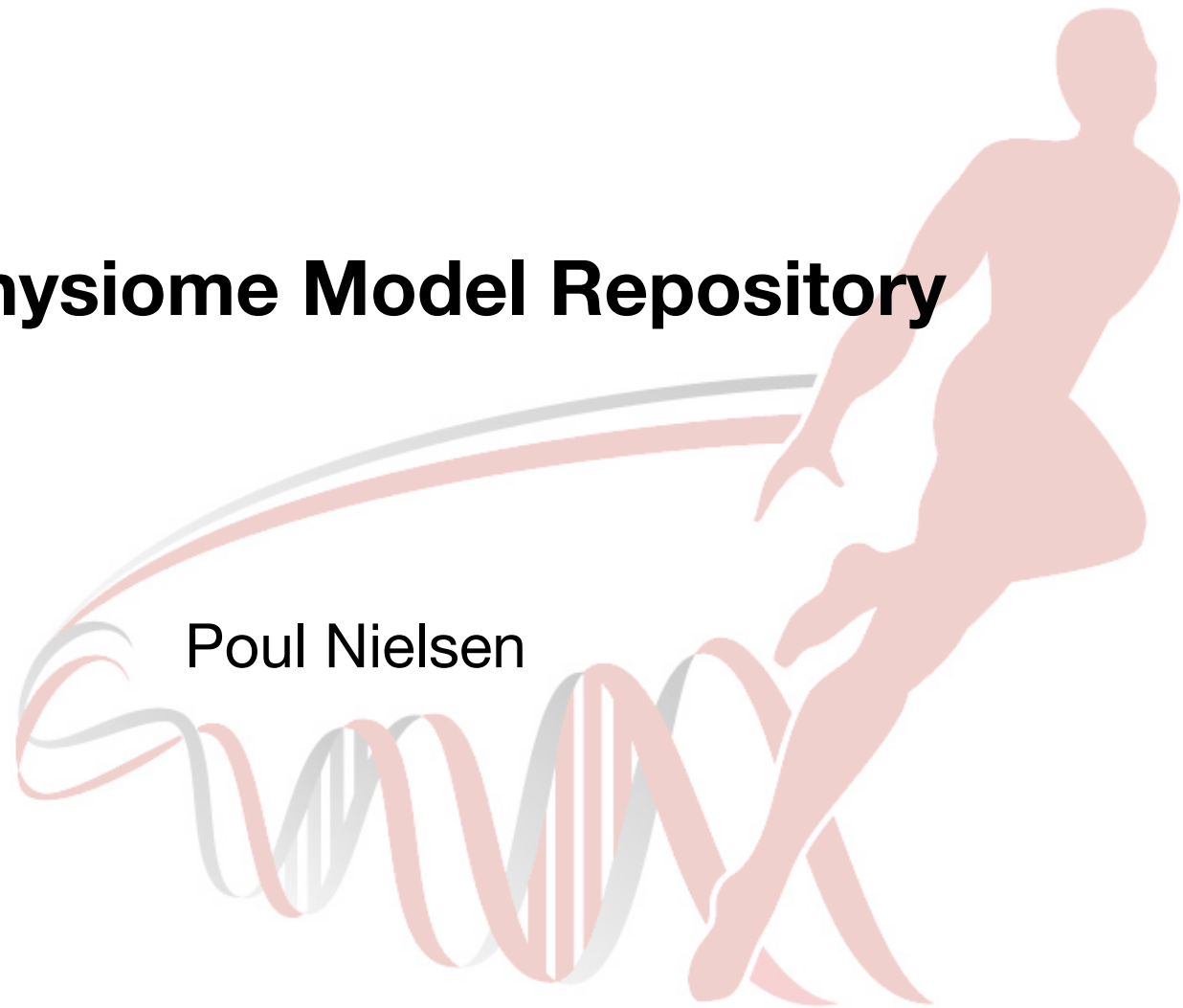
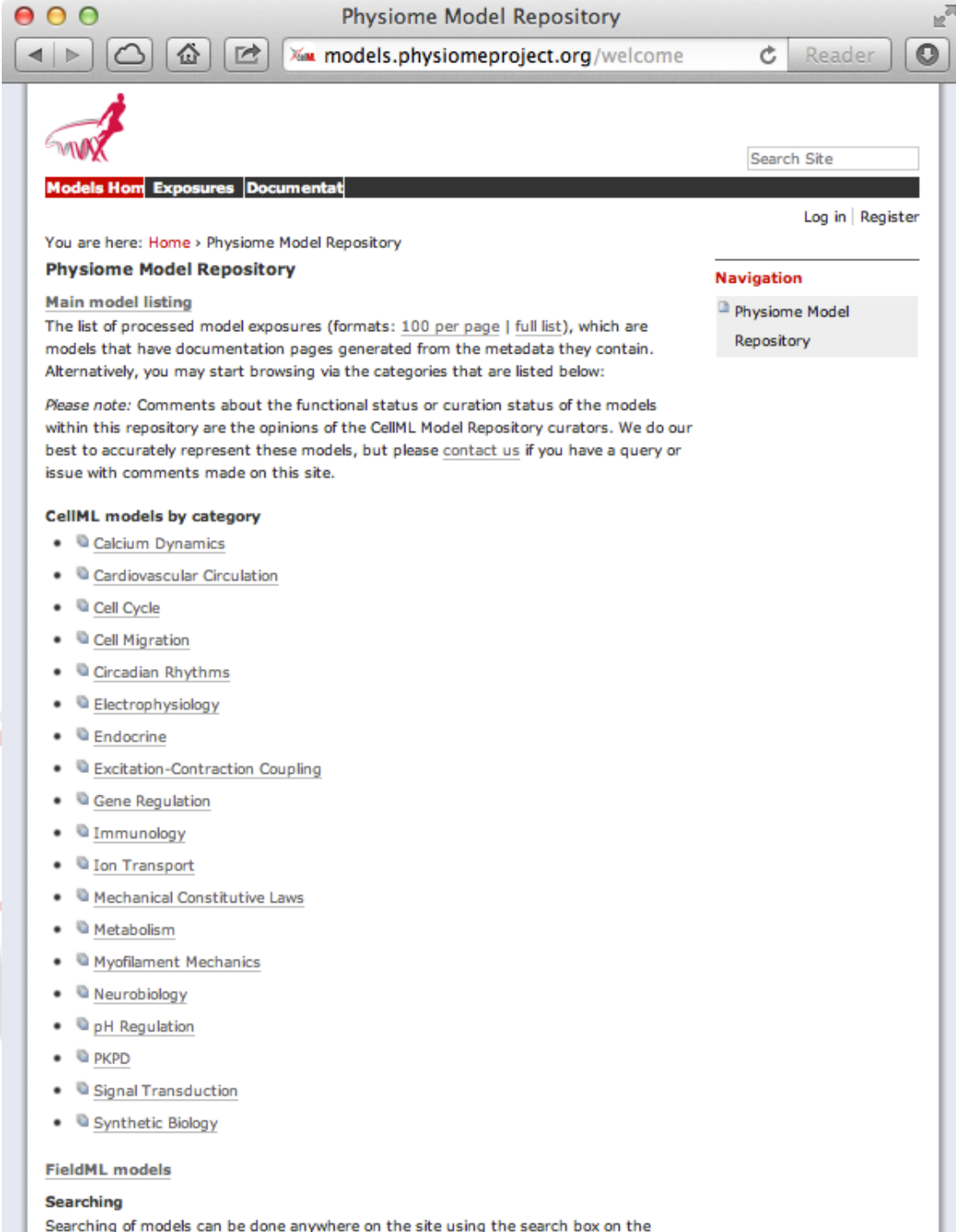


The Physiome Model Repository



Poul Nielsen

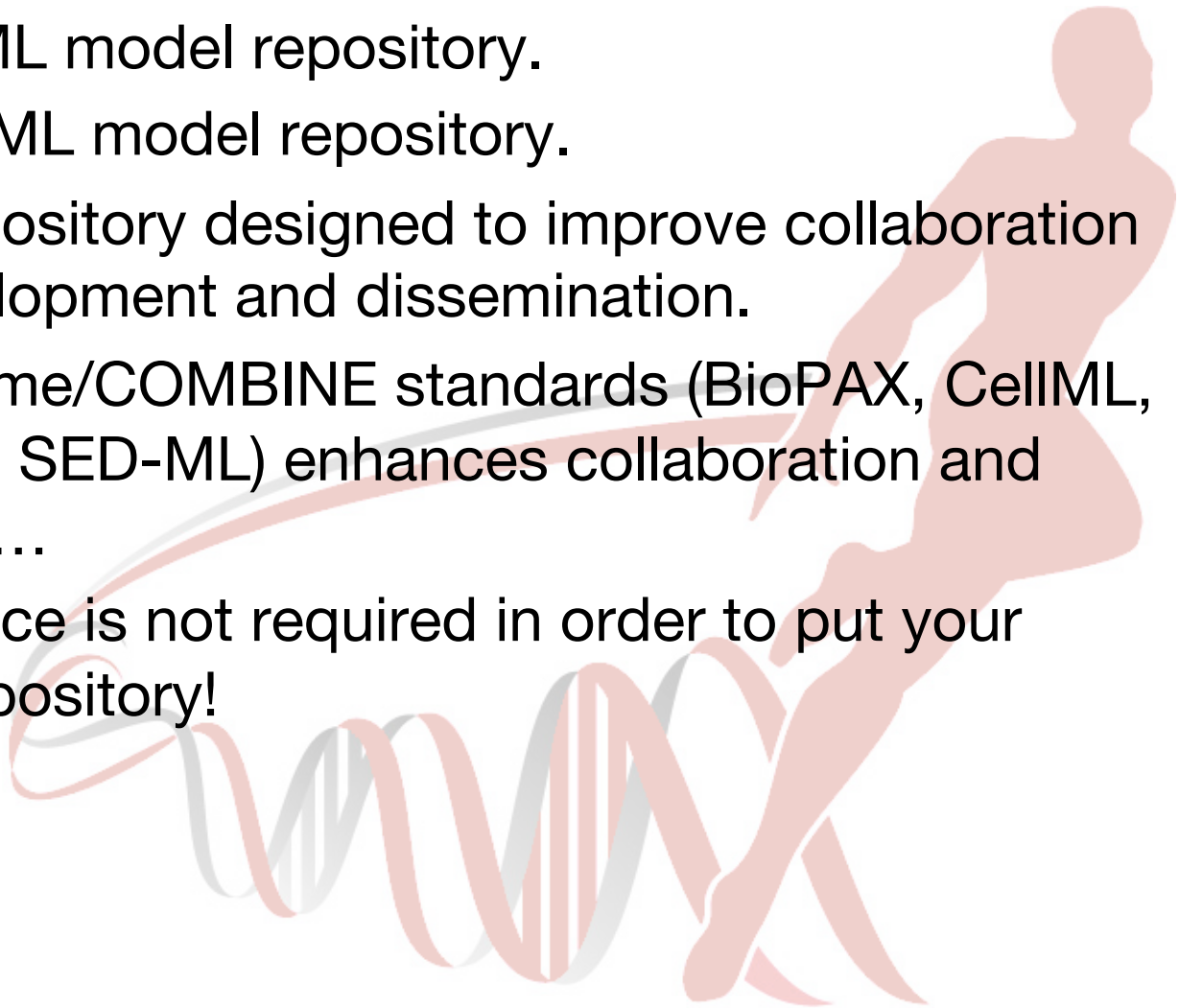
- The Physiome model repository (PMR) is a freely accessible site for researchers to find, store, and share models.
- Contains over 500 published models encoded in CellML, and some examples of FieldML models.



The screenshot shows the Physiome Model Repository website. The browser address bar displays "models.physiomeproject.org/welcome". The page features a navigation menu with "Models Home", "Exposures", and "Documentation". A search box is located in the top right corner. The main content area includes a breadcrumb trail "You are here: Home > Physiome Model Repository", a "Physiome Model Repository" heading, and a "Main model listing" section. A note states: "Please note: Comments about the functional status or curation status of the models within this repository are the opinions of the CellML Model Repository curators. We do our best to accurately represent these models, but please contact us if you have a query or issue with comments made on this site." Below this is a "CellML models by category" section with a list of categories: Calcium Dynamics, Cardiovascular Circulation, Cell Cycle, Cell Migration, Circadian Rhythms, Electrophysiology, Endocrine, Excitation-Contraction Coupling, Gene Regulation, Immunology, Ion Transport, Mechanical Constitutive Laws, Metabolism, Myofilament Mechanics, Neurobiology, pH Regulation, PKPD, Signal Transduction, and Synthetic Biology. A "FieldML models" section is also visible at the bottom.

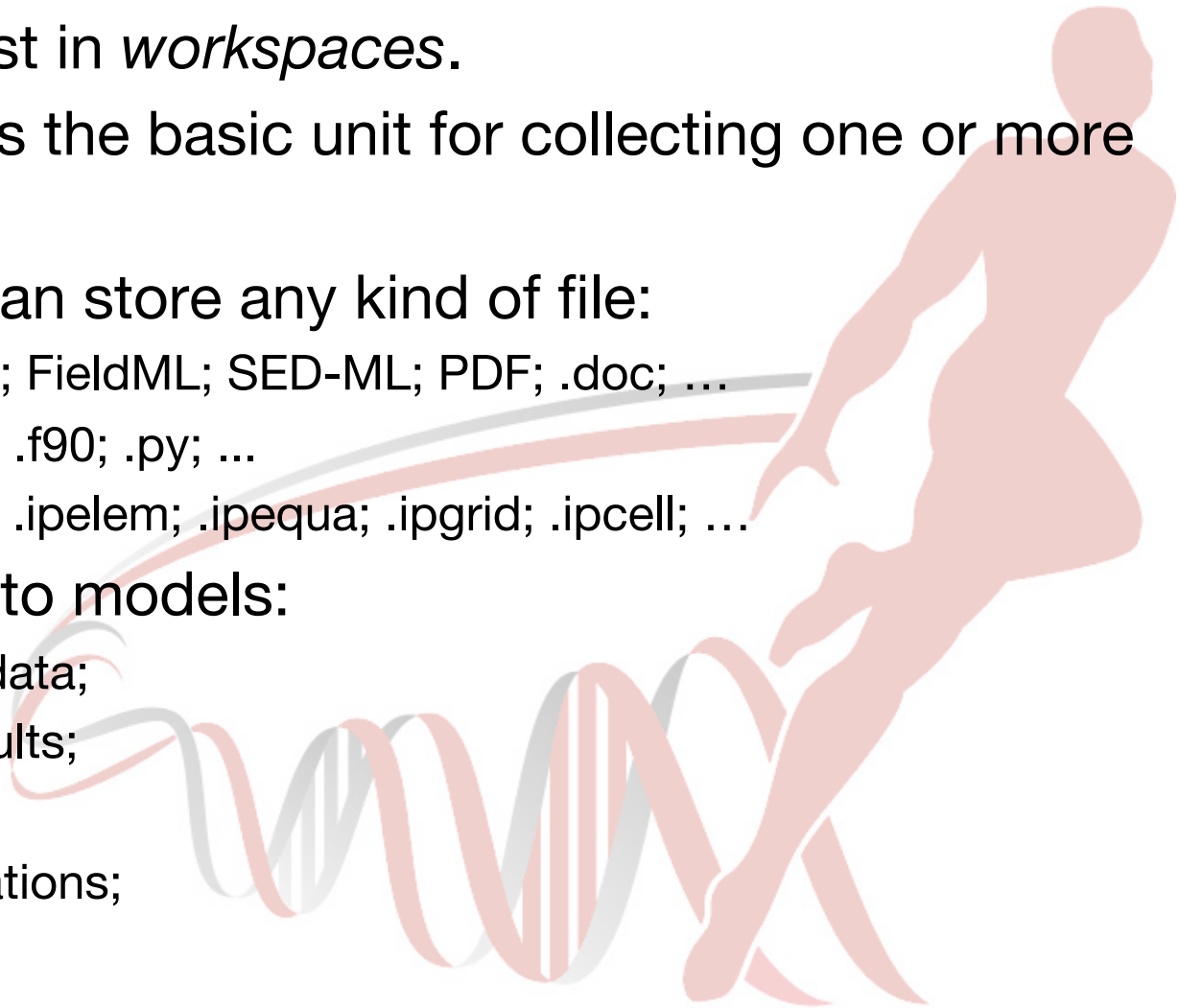
The **PHYSIOME** model repository

- NOT the CellML model repository.
- NOT the FieldML model repository.
- IS a useful repository designed to improve collaboration in model development and dissemination.
- Use of Physiome/COMBINE standards (BioPAX, CellML, SBGN, SBML, SED-ML) enhances collaboration and dissemination...
- ...but adherence is not required in order to put your work in the repository!

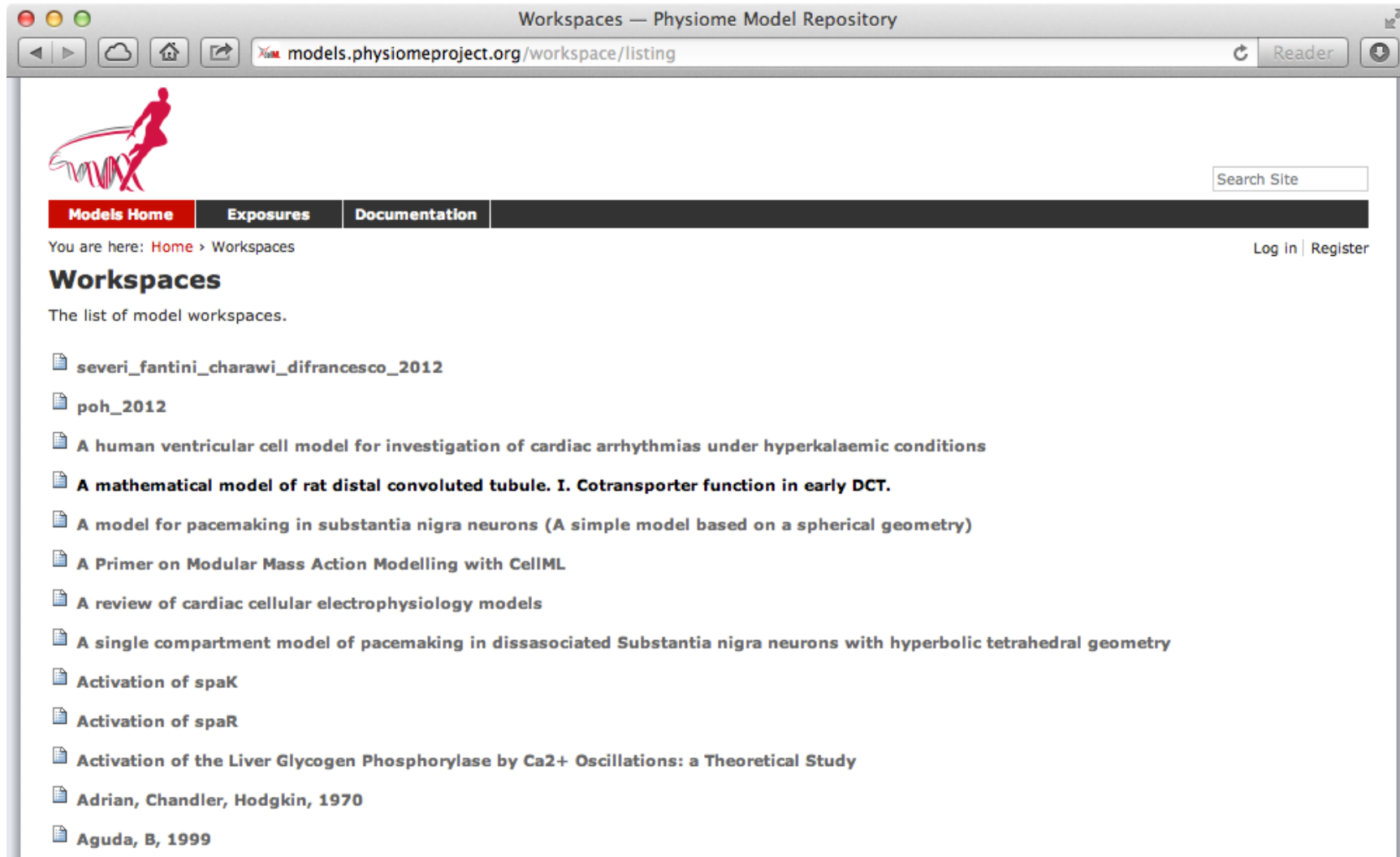


Workspace

- All models exist in *workspaces*.
- A workspace is the basic unit for collecting one or more related files.
- Workspaces can store any kind of file:
 - CellML; SBML; FieldML; SED-ML; PDF; .doc; ...
 - .m; .c; .cpp; .f; .f90; .py; ...
 - .com; .ipnode; .ipelem; .ipequa; .ipgrid; .ipcell; ...
- Not restricted to models:
 - experimental data;
 - simulation results;
 - images;
 - journal publications;
 - ...



Viewing list of workspaces



The screenshot shows a web browser window with the title "Workspaces — Physiome Model Repository". The address bar contains the URL "models.physiomeproject.org/workspace/listing". The browser interface includes navigation buttons (back, forward, home, refresh) and a search bar labeled "Search Site".

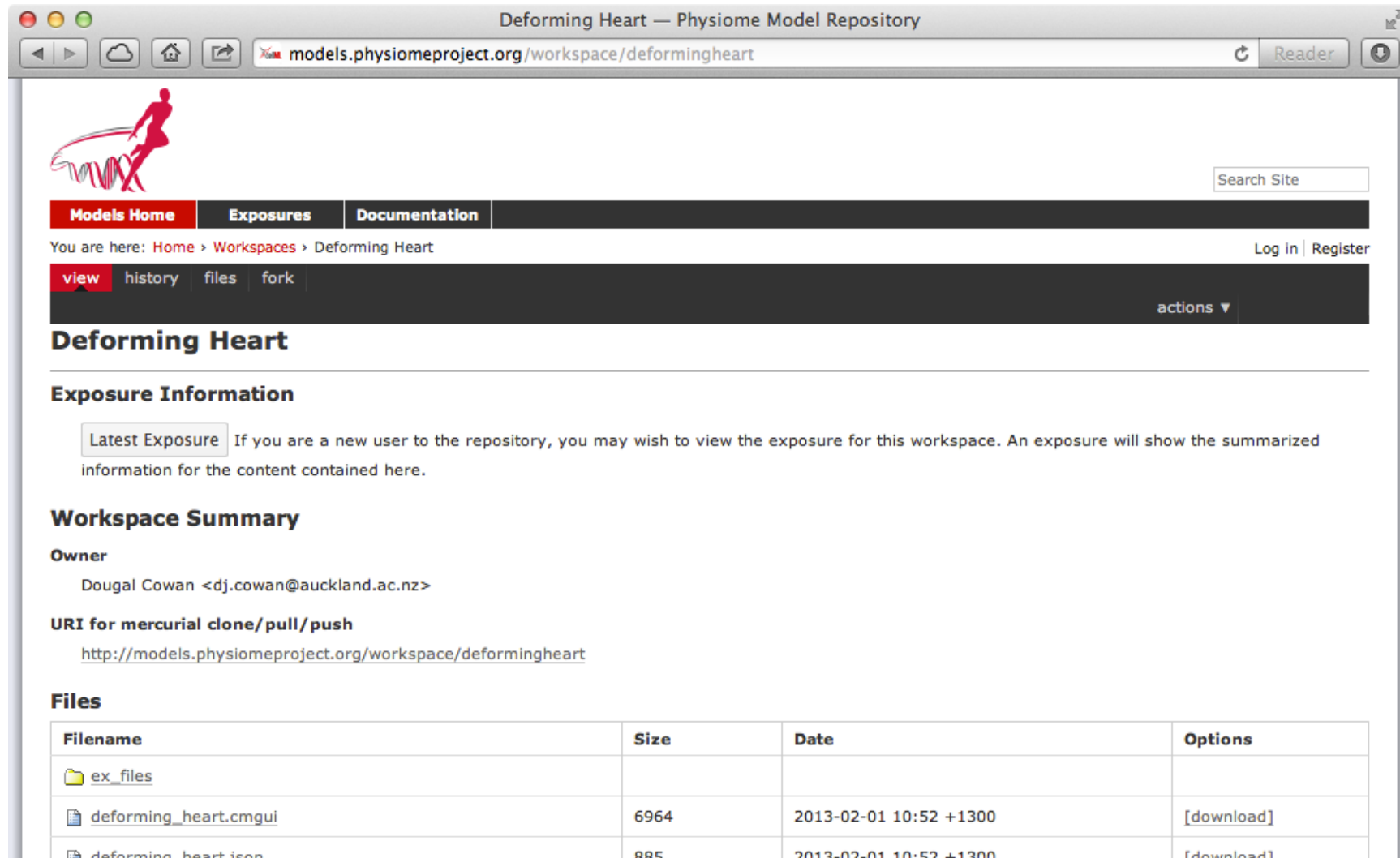
The website content features a logo on the left depicting a red silhouette of a person running on a DNA double helix. Below the logo is a navigation menu with three items: "Models Home" (highlighted in red), "Exposures", and "Documentation".

Below the navigation menu, the text "You are here: [Home](#) > Workspaces" is displayed on the left, and "Log In | Register" is on the right. The main heading is "Workspaces", followed by the subtext "The list of model workspaces."

A list of workspace entries follows, each preceded by a small document icon:

- [severi_fantini_charawi_difrancesco_2012](#)
- [poh_2012](#)
- [A human ventricular cell model for investigation of cardiac arrhythmias under hyperkalaemic conditions](#)
- [A mathematical model of rat distal convoluted tubule. I. Cotransporter function in early DCT.](#)
- [A model for pacemaking in substantia nigra neurons \(A simple model based on a spherical geometry\)](#)
- [A Primer on Modular Mass Action Modelling with CellML](#)
- [A review of cardiac cellular electrophysiology models](#)
- [A single compartment model of pacemaking in dissociated Substantia nigra neurons with hyperbolic tetrahedral geometry](#)
- [Activation of spaK](#)
- [Activation of spaR](#)
- [Activation of the Liver Glycogen Phosphorylase by Ca²⁺ Oscillations: a Theoretical Study](#)
- [Adrian, Chandler, Hodgkin, 1970](#)
- [Aguda, B, 1999](#)

Viewing a particular workspace



Deforming Heart — Physiome Model Repository

models.physiomeproject.org/workspace/deformingheart

Search Site

Models Home Exposures Documentation

You are here: [Home](#) > [Workspaces](#) > Deforming Heart [Log in](#) | [Register](#)

[view](#) [history](#) [files](#) [fork](#) [actions](#) ▼

Deforming Heart

Exposure Information

[Latest Exposure](#) If you are a new user to the repository, you may wish to view the exposure for this workspace. An exposure will show the summarized information for the content contained here.

Workspace Summary

Owner
Dougal Cowan <dj.cowan@auckland.ac.nz>

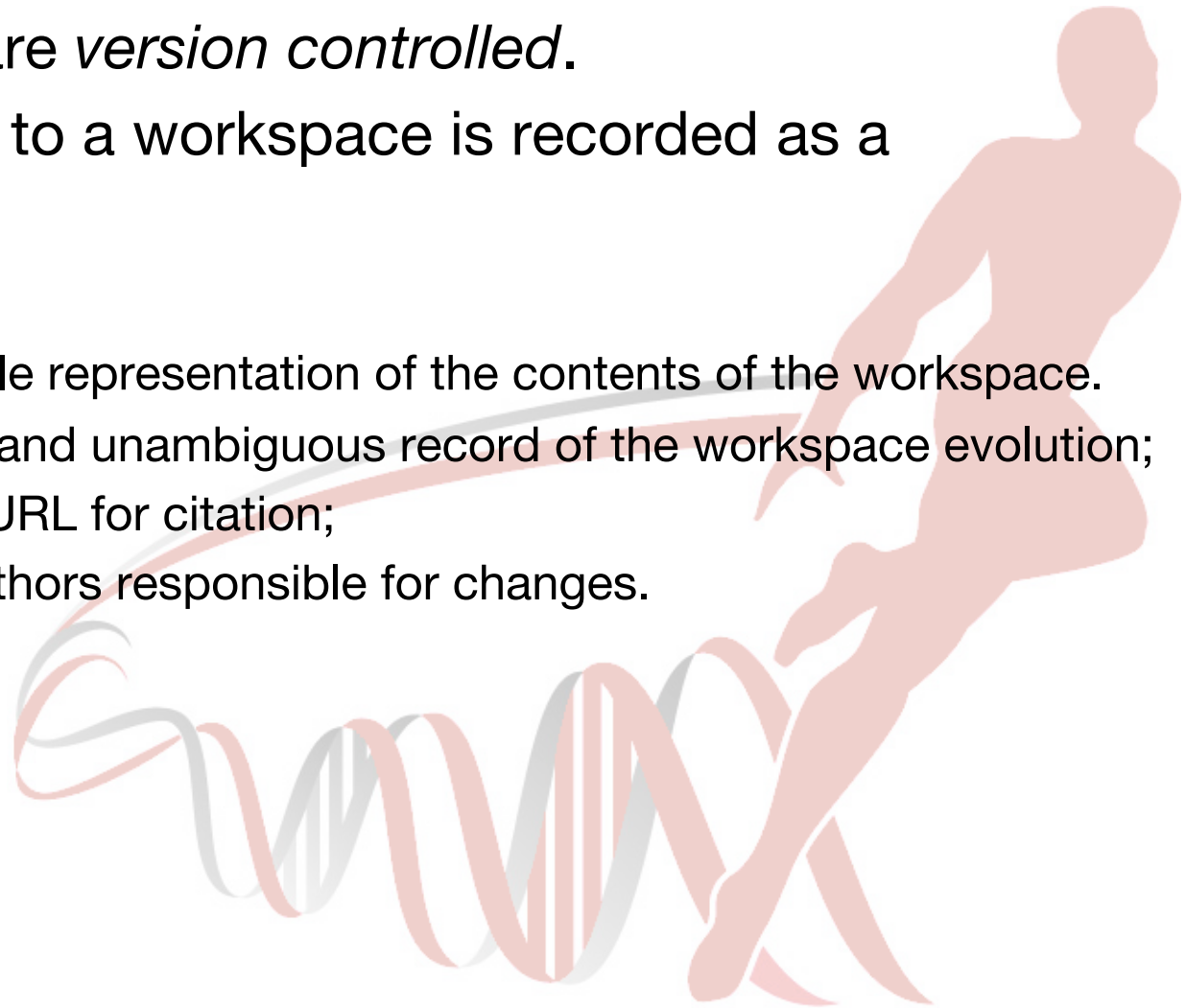
URI for mercurial clone/pull/push
<http://models.physiomeproject.org/workspace/deformingheart>

Files

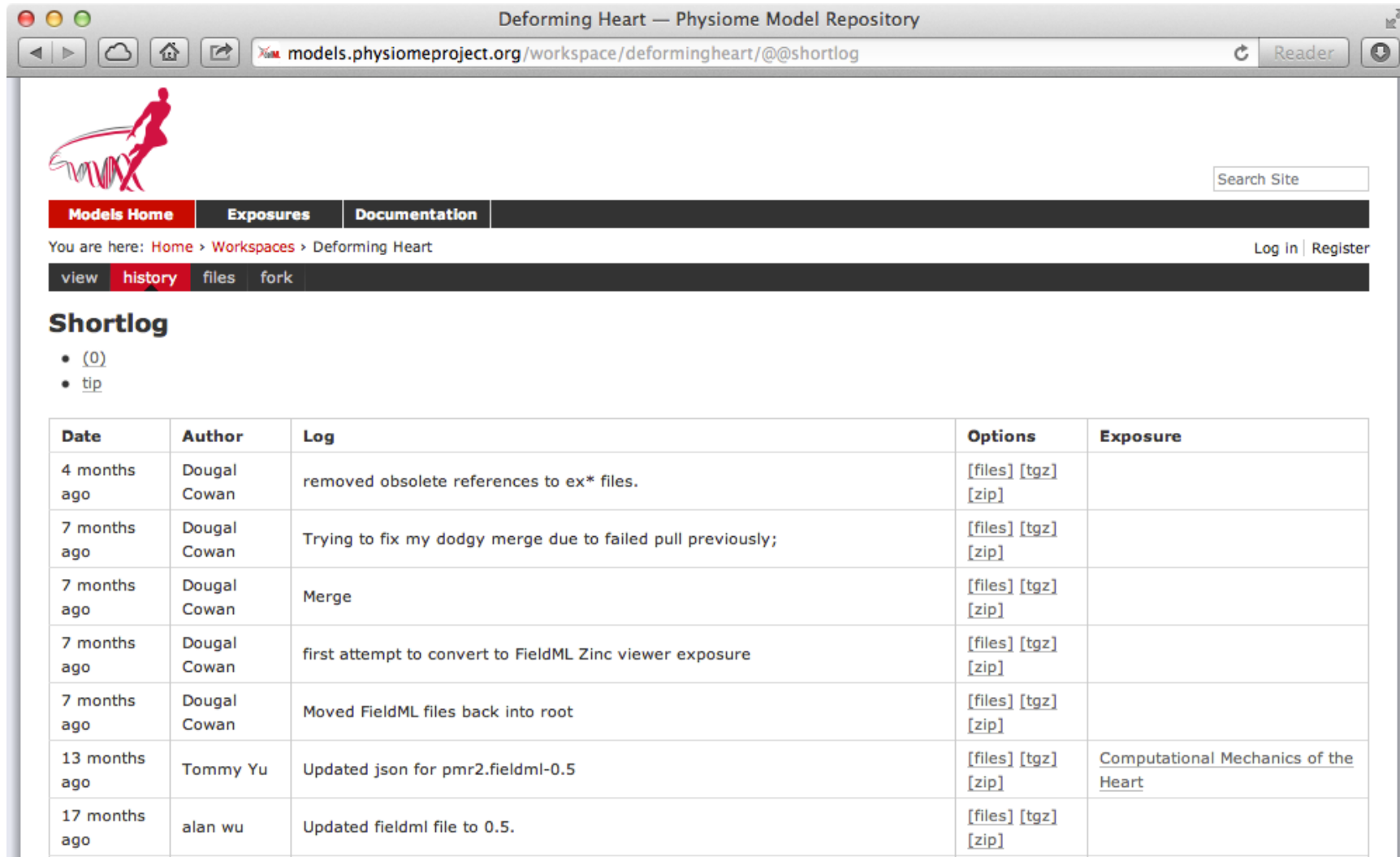
Filename	Size	Date	Options
ex_files			
deforming_heart.cmgui	6964	2013-02-01 10:52 +1300	[download]
deforming_heart.ison	885	2013-02-01 10:52 +1300	[download]

Workspace provenance

- Workspaces are *version controlled*.
- Every revision to a workspace is recorded as a *changeset*.
- A changeset:
 - is an immutable representation of the contents of the workspace.
 - is a complete and unambiguous record of the workspace evolution;
 - has a unique URL for citation;
 - is linked to authors responsible for changes.



Viewing changesets in a workspace



Deforming Heart — Physiome Model Repository

models.physiomeproject.org/workspace/deformingheart/@@shortlog

Search Site

Models Home Exposures Documentation

You are here: [Home](#) > [Workspaces](#) > Deforming Heart [Log in](#) | [Register](#)

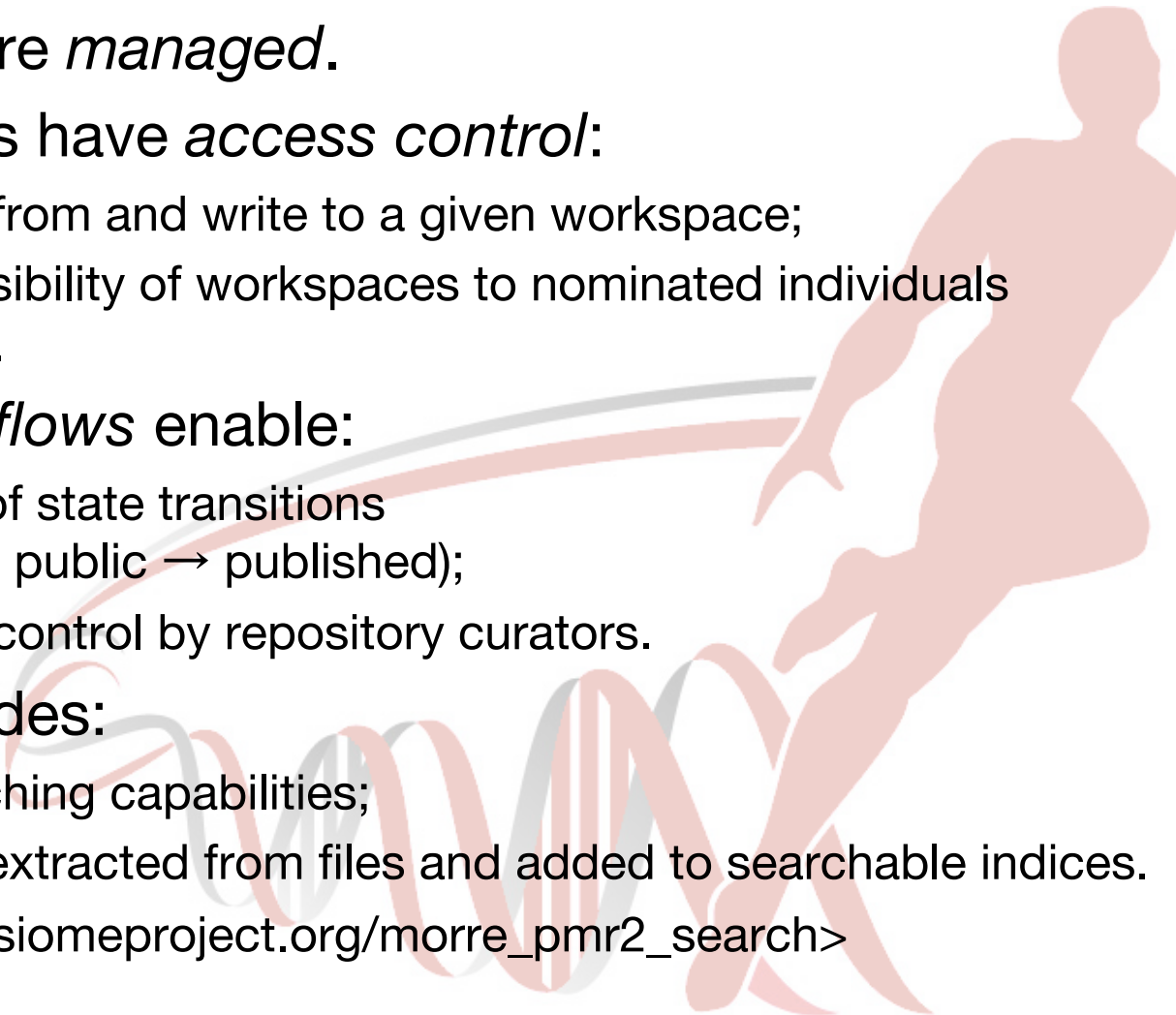
view **history** files fork

Shortlog

- (0)
- [tip](#)

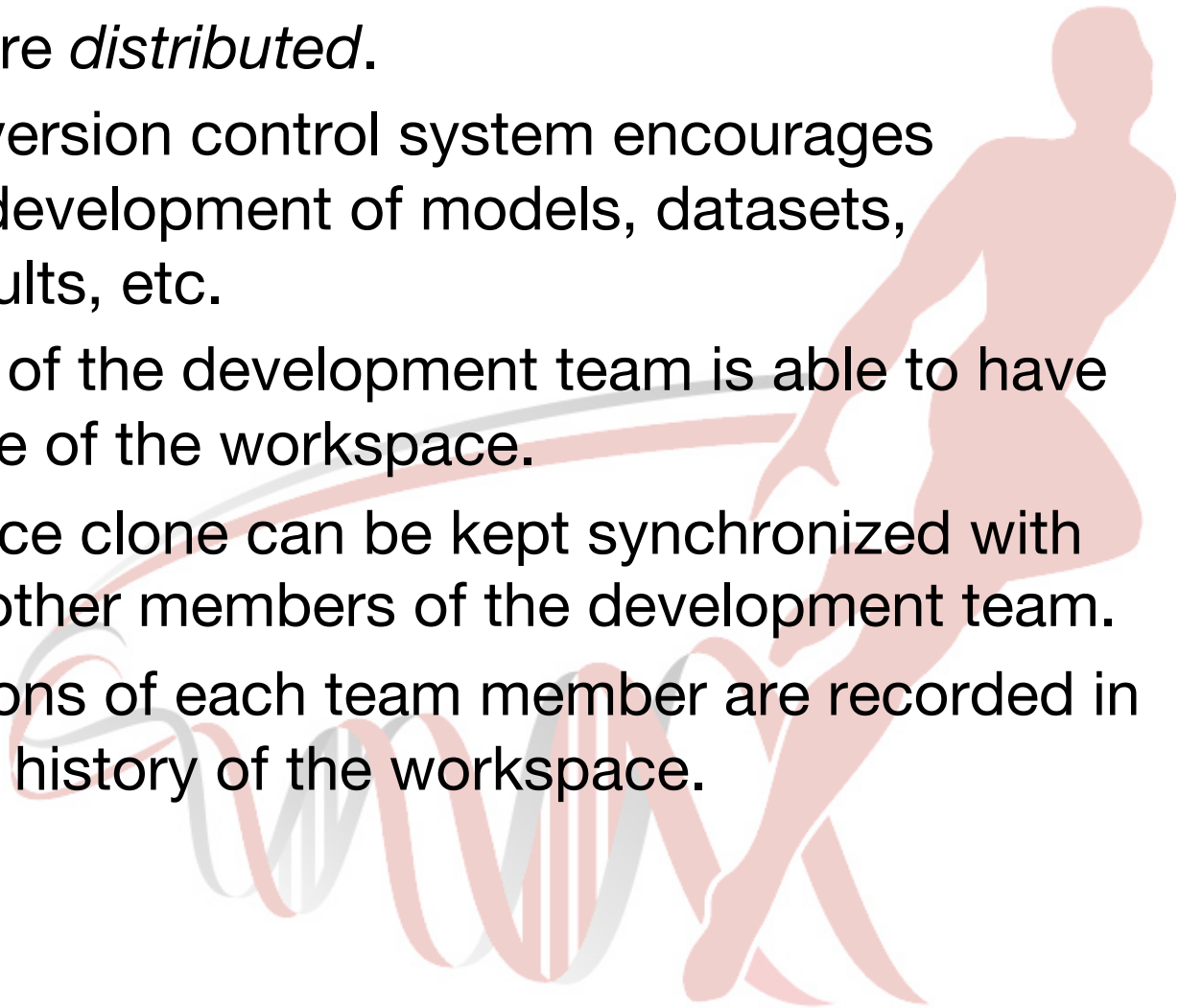
Date	Author	Log	Options	Exposure
4 months ago	Dougal Cowan	removed obsolete references to ex* files.	[files] [tgz] [zip]	
7 months ago	Dougal Cowan	Trying to fix my dodgy merge due to failed pull previously;	[files] [tgz] [zip]	
7 months ago	Dougal Cowan	Merge	[files] [tgz] [zip]	
7 months ago	Dougal Cowan	first attempt to convert to FieldML Zinc viewer exposure	[files] [tgz] [zip]	
7 months ago	Dougal Cowan	Moved FieldML files back into root	[files] [tgz] [zip]	
13 months ago	Tommy Yu	Updated json for pmr2.fieldml-0.5	[files] [tgz] [zip]	Computational Mechanics of the Heart
17 months ago	alan wu	Updated fieldml file to 0.5.	[files] [tgz] [zip]	

Workspace management

- Workspaces are *managed*.
 - All workspaces have *access control*:
 - who can read from and write to a given workspace;
 - controls the visibility of workspaces to nominated individuals and/or groups.
 - *Interface workflows* enable:
 - management of state transitions (e.g. private → public → published);
 - oversight and control by repository curators.
 - *Indexing* provides:
 - powerful searching capabilities;
 - metadata are extracted from files and added to searchable indices.
 - teaching.physiomeproject.org/morre_pmr2_search
- 

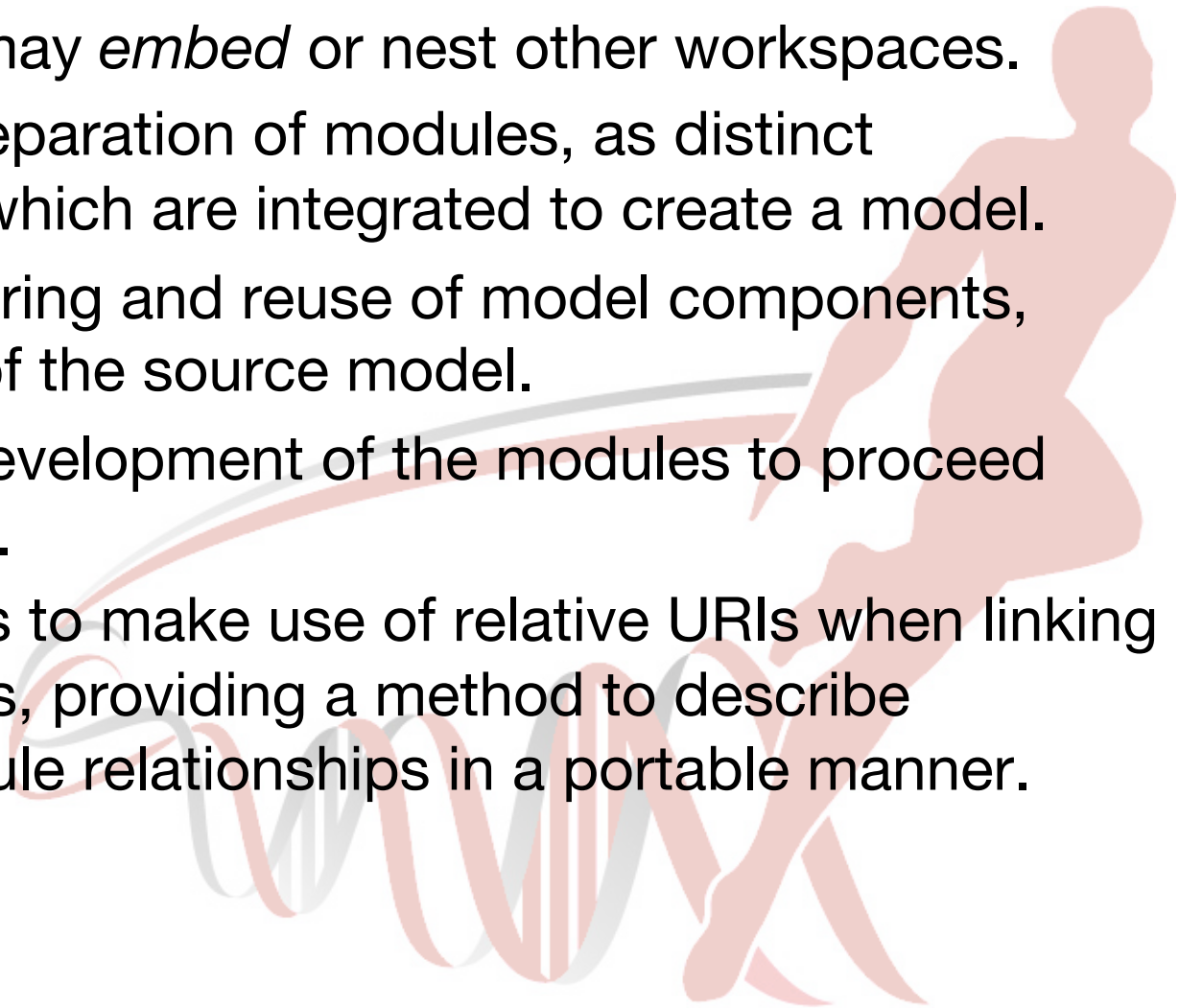
Workspace collaboration

- Workspaces are *distributed*.
- A distributed version control system encourages collaborative development of models, datasets, simulation results, etc.
- Each member of the development team is able to have their own clone of the workspace.
- Each workspace clone can be kept synchronized with the clones of other members of the development team.
- The contributions of each team member are recorded in the changeset history of the workspace.

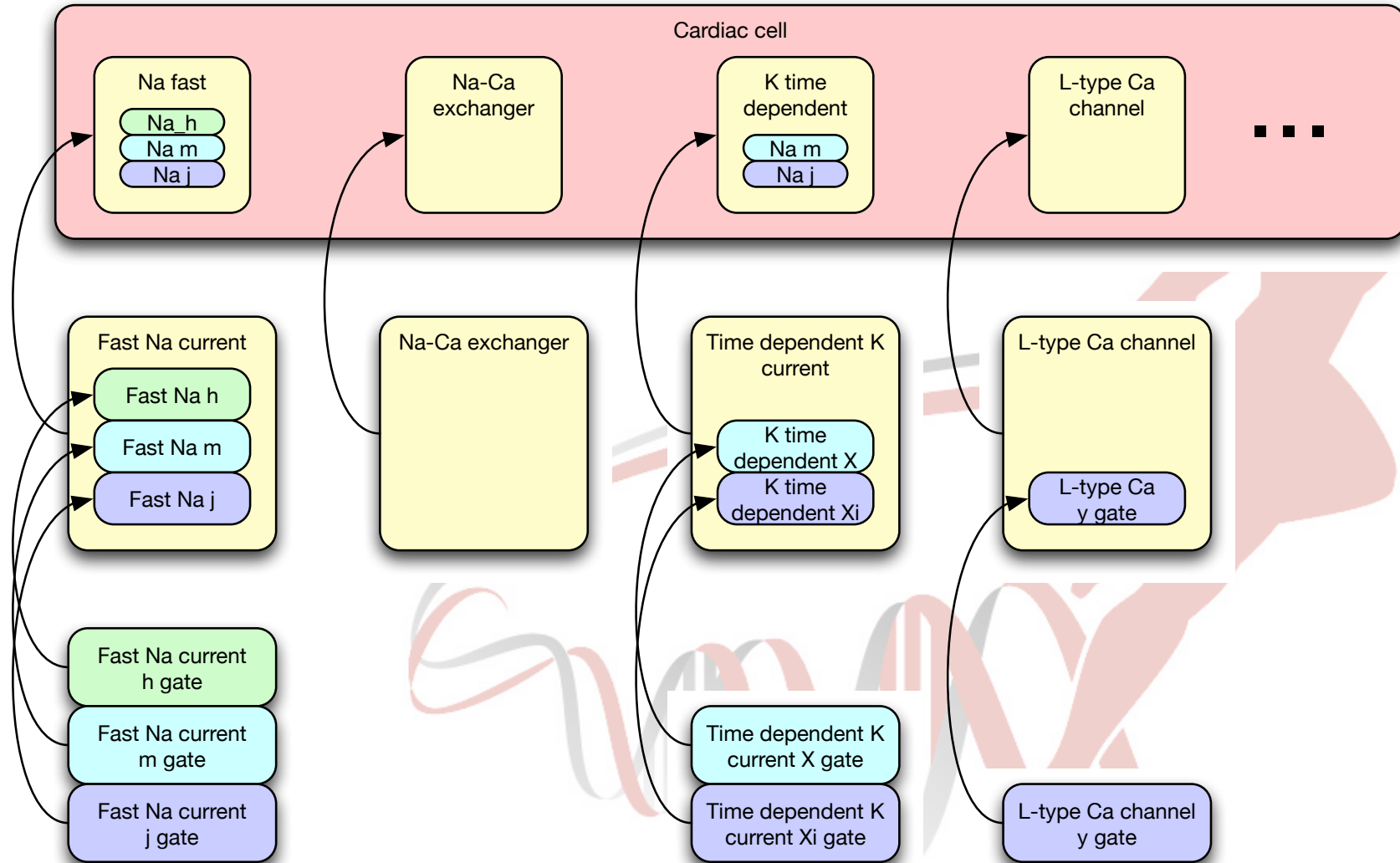


Workspace embedding

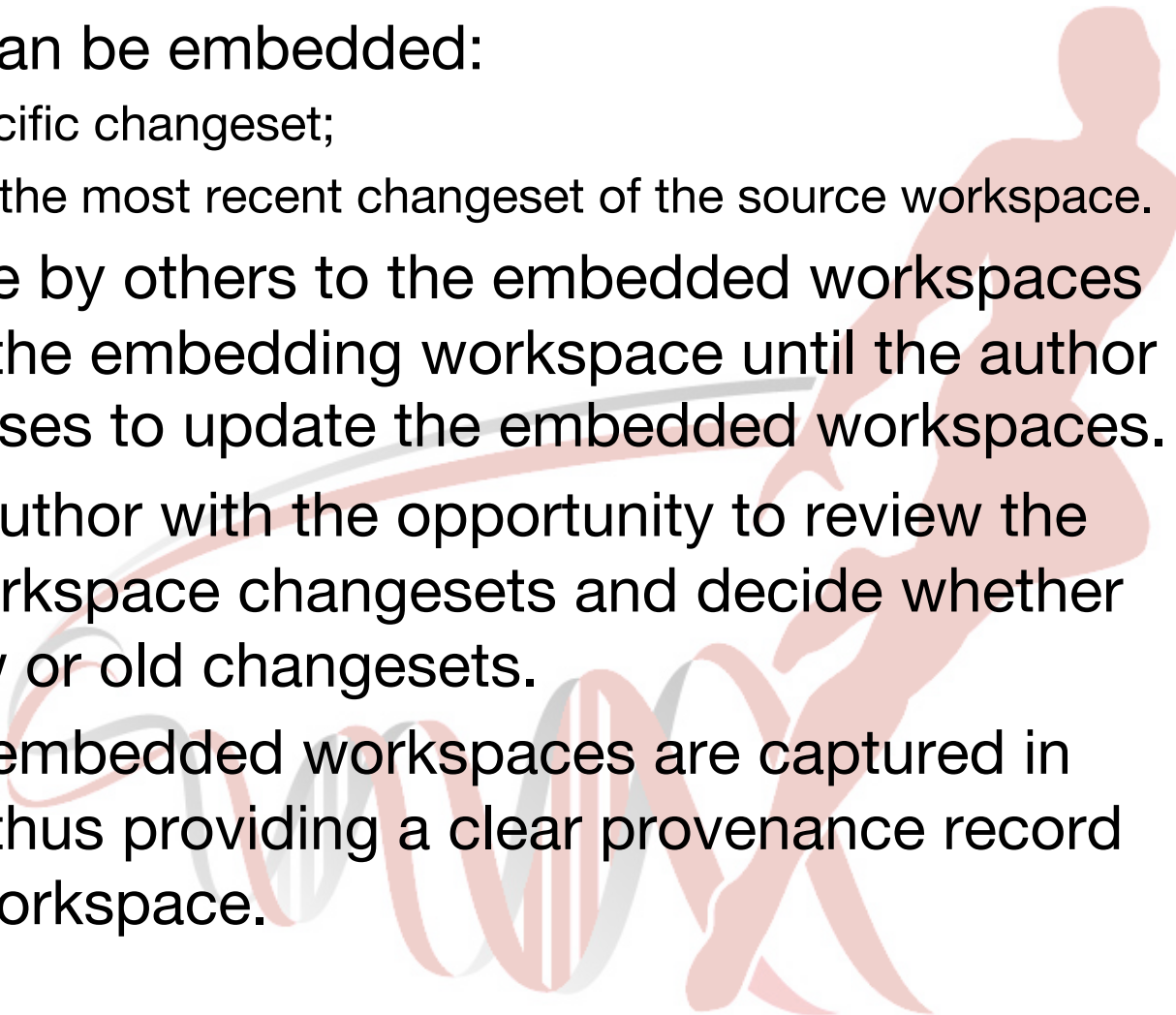
- Workspaces may *embed* or nest other workspaces.
- Enables the separation of modules, as distinct workspaces, which are integrated to create a model.
- Facilitates sharing and reuse of model components, independent of the source model.
- Enables the development of the modules to proceed independently.
- Allows authors to make use of relative URIs when linking data resources, providing a method to describe complex module relationships in a portable manner.



Example of embedding workspaces

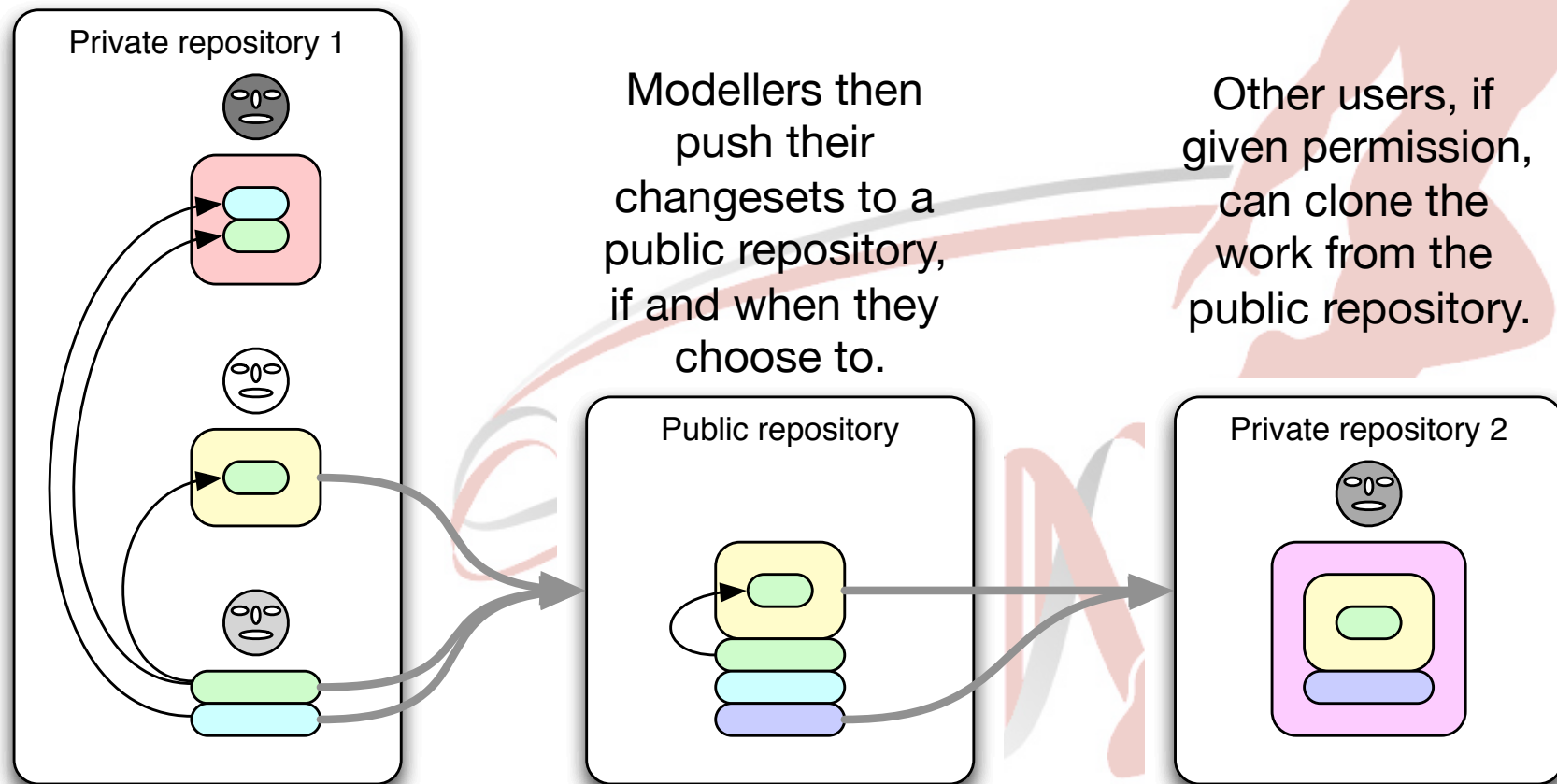


Versioning embedded workspaces

- Workspaces can be embedded:
 - either at a specific changeset;
 - or set to track the most recent changeset of the source workspace.
 - Changes made by others to the embedded workspaces will not affect the embedding workspace until the author explicitly chooses to update the embedded workspaces.
 - Provides the author with the opportunity to review the embedded workspace changesets and decide whether to use the new or old changesets.
 - Alterations to embedded workspaces are captured in changesets – thus providing a clear provenance record of the entire workspace.
- 

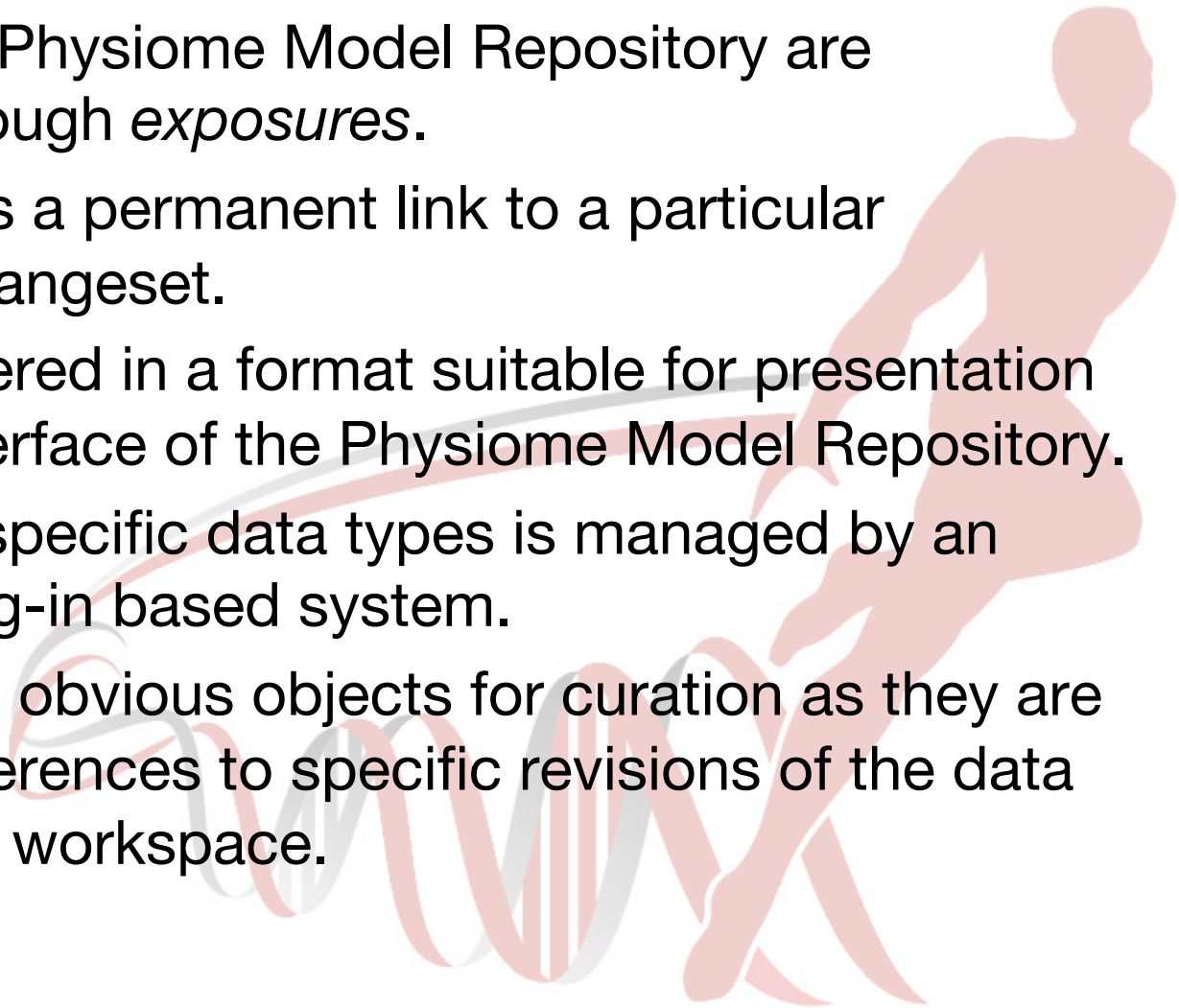
Collaborative model development

A group develops models privately, until they are ready to publicise their work.

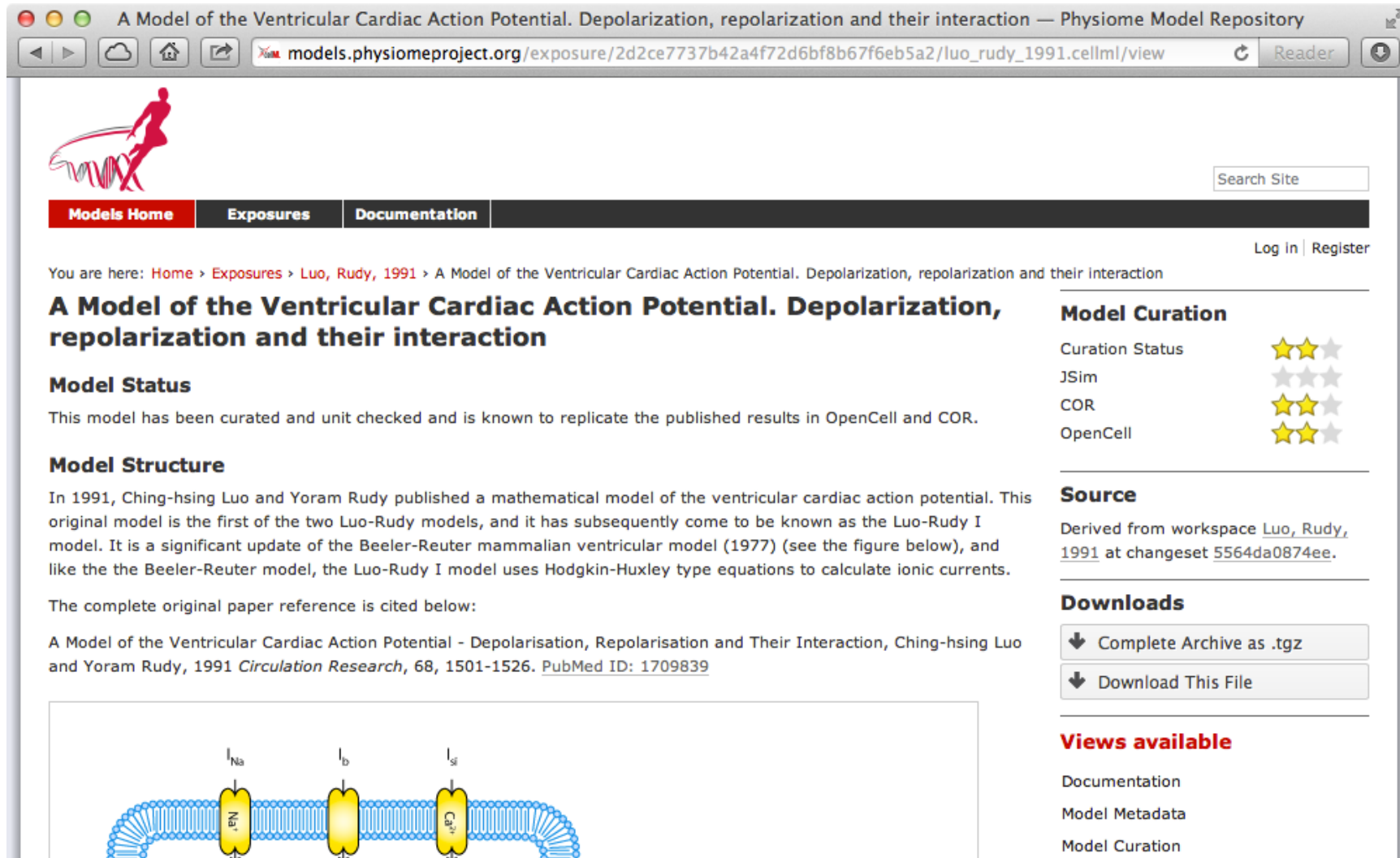


Exposures

- Models in the Physiome Model Repository are presented through *exposures*.
- An exposure is a permanent link to a particular workspace changeset.
- Data are rendered in a format suitable for presentation in the web interface of the Physiome Model Repository.
- Rendering of specific data types is managed by an extensible plug-in based system.
- Exposures are obvious objects for curation as they are immutable references to specific revisions of the data contained in a workspace.



Viewing an exposure of a CellML model



The screenshot shows a web browser window with the address bar displaying the URL: `models.physiomeproject.org/exposure/2d2ce7737b42a4f72d6bf8b67f6eb5a2/luo_rudy_1991.cellml/view`. The page title is "A Model of the Ventricular Cardiac Action Potential. Depolarization, repolarization and their interaction — Physiome Model Repository".

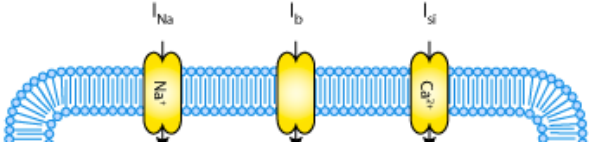
The page features a navigation menu with "Models Home", "Exposures", and "Documentation". A search bar is located in the top right corner. The main content area displays the model title: "A Model of the Ventricular Cardiac Action Potential. Depolarization, repolarization and their interaction".

Model Status
This model has been curated and unit checked and is known to replicate the published results in OpenCell and COR.

Model Structure
In 1991, Ching-hsing Luo and Yoram Rudy published a mathematical model of the ventricular cardiac action potential. This original model is the first of the two Luo-Rudy models, and it has subsequently come to be known as the Luo-Rudy I model. It is a significant update of the Beeler-Reuter mammalian ventricular model (1977) (see the figure below), and like the the Beeler-Reuter model, the Luo-Rudy I model uses Hodgkin-Huxley type equations to calculate ionic currents.

The complete original paper reference is cited below:
A Model of the Ventricular Cardiac Action Potential - Depolarisation, Repolarisation and Their Interaction, Ching-hsing Luo and Yoram Rudy, 1991 *Circulation Research*, 68, 1501-1526. [PubMed ID: 1709839](#)

The diagram below illustrates the membrane structure with three ion channels: I_{Na} , I_b , and I_{Si} .



The diagram shows a cross-section of a cell membrane with three ion channels. The first channel is labeled I_{Na} and has a yellow arrow pointing inward. The second channel is labeled I_b and has a yellow arrow pointing outward. The third channel is labeled I_{Si} and has a yellow arrow pointing outward.

Model Curation

Curation Status	★ ★ ★
JSim	★ ★ ★
COR	★ ★ ★
OpenCell	★ ★ ★

Source
Derived from workspace [Luo, Rudy, 1991](#) at changeset [5564da0874ee](#).

Downloads

- Complete Archive as .tgz
- Download This File

Views available

- Documentation
- Model Metadata
- Model Curation

Viewing an exposure of a FieldML model

Laminar structure of the Heart: A mathematical model. — Physiome Model Repository

models.physiomeproject.org/e/11b/heart.rdf/view

Search Site

Models Home Exposures Documentation

Log In | Register

You are here: [Home](#) > [Exposures](#) > [Laminar structure of the Heart: A mathematical model.](#) > Laminar structure of the Heart: A mathematical model.

Laminar structure of the Heart: A mathematical model.

A mathematical description of cardiac anatomy is presented for use with finite element models of the electrical activation and mechanical function of the heart. The geometry of the heart is given in terms of prolate spheroidal coordinates defined at the nodes of a finite element mesh and interpolated within elements by a combination of linear Lagrange and cubic Hermite basis functions. Cardiac microstructure is assumed to have three axes of symmetry: one aligned with the muscle fiber orientation (the fiber axis); a second set orthogonal to the fiber direction and lying in the newly identified myocardial sheet plane (the sheet axis); and a third set orthogonal to the first two, in the sheet-normal direction. The geometry, fiber-axis direction, and sheet-axis direction of a dog heart are fitted with parameters defined at the nodes of the finite element mesh. The fiber and sheet orientation parameters are defined with respect to the ventricular geometry such that 1) they can be applied to any heart of known dimensions, and 2) they can be used for the same heart at various states of deformation, as is needed, for example, in continuum models of ventricular contraction.

Model Curation

Source

Derived from workspace [Heart Model](#) at changeset [d820d0d1e0da](#).

Downloads

↓ Complete Archive as .tgz

↓ Download This File

Views available

- Documentation
- FieldML Metadata
- Model Curation
- Source View
- Zinc Viewer
- Cite this model

Acknowledgements

- Funding:

- Maurice Wilkins Centre for Molecular Biodiscovery
<<http://mauricewilkinscentre.org/>>
- Auckland Bioengineering Institute
<<http://www.abi.auckland.ac.nz>>
- VPH NoE
<<http://www.vph-noe.eu>>

- Hard work:

- Tommy Yu
<tommy.yu@auckland.ac.nz>



Tutorial and documentation

- Some documentation available under PMR section at: [<https://abibook.readthedocs.org/>](https://abibook.readthedocs.org/)
- Please report issues at: <https://github.com/nickerso/ABIBook>
- See the CellML model repository tutorial for a guided run through some of the features of PMR.
- Testing instance of PMR available at: <http://teaching.physiomeproject.org/>
- Don't worry: no changes make it back into the actual repository unless you migrate them.
- Have a play!

