

## **CURRICULUM VITAE**

### **MARIA RITA CASALI**

Born in Sassuolo (MO) on July 30, 1963.

First degree in Mathematics cum laude from the University of Modena on June 27, 1986 (dissertation: "*Rivestimenti di varietà e loro rappresentazioni*", supervised by Mario Pezzana).

#### **POSITIONS**

Faculty of Sciences – University of Modena:

- Research assistant (A01C - GEOMETRY) from July 16, 1990 to October 31, 1999.

Faculty of Engineering in Modena – University of Modena and Reggio Emilia:

- Associate professor (A01C – GEOMETRY) from November 01, 1999 to October 31, 2001; - Full professor of GEOMETRY from November 01, 2001 till today.

She belongs to the Department FIM (Dipartimento di Scienze Fisiche, Informatiche e Matematiche) University of Modena and Reggio Emilia since its establishment.

#### **SCIENTIFIC ACTIVITY**

Studies and research by MARIA RITA CASALI fit into geometric topology (or PL-topology), by making use of the representation method for general  $n$ -dimensional manifolds by means of particular  $(n+1)$ -coloured graphs, called "*crystallizations*".

The obtained results are contained in more than sixty papers, and may be subdivided into the following main subjects:

- Relationships among different methods for combinatorial representation of PL manifolds, in dimension 3 and 4: by means of edge-coloured graphs, as ramified branched coverings, by means of framed links.
- Classification of PL manifolds by "regular genus"; comparison among different invariants, with particular attention to dimensions 4 and 5.
- Search for combinatorial moves which realize the homeomorphism among bounded manifolds.
- Essential enumeration of manifolds by computer; topological classification and automatic recognition of catalogues of 3-dimensional and 4-dimensional manifolds.
- Comparison between different "complexity" notions, with particular attention to the estimation of (Matveev's) complexity via crystallization theory.
- Combinatorial representation of special classes of 3-manifolds and their recognition among existing crystallization catalogues.
- Generation and analysis of catalogues of contracted triangulations of PL 4-manifolds with fixed gem-complexity; use of the program *Gamma\_class\_4dim* for automatic classification of the represented manifolds.

- Characterization of PL 4-manifolds admitting “simple” contracted triangulations; proof of the additivity of gem-complexity and regular genus for these manifolds;
- Search for lower bounds for gem-complexity and regular genus of not simply-connected PL 4-manifolds; characterization of "semi-simple" 4-manifolds, which minimize both gem complexity and regular genus
- Search for relationships among PL-invariants of manifolds defined via colored graphs (in particular: gem-complexity and regular genus) and the "degree" defined on colored graphs within the theory concerning "*random tensors*" and "*quantum gravity*".
- Characterization of compact 4-manifold crystallizations that minimize regular genus, gem-complexity and G-degree invariants.
- Identification of classes of colored triangulations that induce “special” handle decompositions (i.e. without 1-handles and 3-handles) for compact 4-PL manifolds.
- Algorithmic procedure to obtain, starting from any Kirby diagram (with or without dotted components), a 5-colored graph representing the associated compact 4-manifold. Estimation of the complexity of the gems and the regular genus of such 4-manifolds.
- Study of trisections of compact 4-manifolds associated to colored triangulations; estimation of the trisection genus of a closed 4-manifold via G-trisection genus computation; estimation of the G-trisection genus for all compact 4-manifolds that admit a handle decomposition lacking in 3-handles.
- Trisections of closed 4-manifolds arising from colored triangulations; estimation of the trisection genus of all orientable closed 4-manifolds in terms of surgery description.
- Construction of trisection diagrams of closed PL 4-manifolds induced by colored triangulations, also starting from edge-colored graphs which do not admit gem-induced trisections.
- Estimation of the trisection genus of closed 4-manifolds by means of graph-defined invariants (specifically, the regular genus of the closed 4-manifold itself, or the regular genus of any 4-manifold, whose boundary is isomorphic to a connected sum of spherical bundles on  $S^1$ , with the given manifold as the associated closed manifold).

M.R. Casali has been the Principal Investigator of IS CRA-Cineca project of type C "*Generation and classification of PL-manifolds catalogues via contracted coloured triangulations*"; she was also the Principal Investigator of IS CRA-Cineca project of type B "*Cataloguing PL-manifolds in dimension 3 and 4 via crystallization theory*".

#### SOFTWARE PRODUCED:

- **DUKE III:** A program to handle edge-colored graphs representing PL n-dimensional manifolds.
- **Gamma-class:** A program to subdivide a set of rigid crystallizations of closed 3-manifolds into equivalence classes, whose elements represent homeomorphic manifolds

#### **CRYSTALLIZATION CATALOGUES AND ARCHIVES OF CLOSED 3-MANIFOLDS WITH LOW**

**GEM-COMPLEXITY:** a collection of algorithmic procedures, which can be used to construct essential catalogues of bipartite and/or non bipartite edge-colored graphs representing all orientable and/or non orientable 3-manifolds triangulated by a given number of colored tetrahedra.

- **TORUS BUNDLE:** A program to construct edge-colored graphs representing torus bundles over the circle.
- **c\_GM:** A program to compute GM-complexity of edge-colored graphs representing closed 3-manifolds.
- **Gamma-class\_4dim:** A program to subdivide a set of rigid crystallizations of closed 4-manifolds into equivalence classes, whose elements represent homeomorphic manifolds.

### CONFERENCES ATTENDED

M. R. Casali took part in over 40 national and international scientific meetings, presenting in many cases her contribution through communications, invited communications and invited conferences. She also held scientific seminars on Geometric Topology in different Italian Universities and in International Research Centers.

She was member of the Organizing Committee for the international meeting "*COMPUTATIONAL AND GEOMETRIC TOPOLOGY - A conference in honour of Massimo Ferri and Carlo Gagliardi on their 60th birthday*", Bertinoro (FC), 17-19 June 2010.

She was the organizer (together with Vincent Rivasseau of the University of Paris Sud) of the joint Italy-France Workshop "*COLORED GRAPHS AND RANDOM TENSORS*", Laboratoire de Physique Theorique d'Orsay, CNRS e Univ. Paris Sud, from 14th to 15th January 2016. Within the Workshop she presented - upon invitation - two 50 minutes talks: "*COLOURED GRAPHS REPRESENTING PL N-MANIFOLDS: MOVES AND CODE*" and "*CRYSTALLIZATIONS OF PL 4-MANIFOLDS*".

She was the organizer (together with Luigi Grasselli from UniMORE, A. F. Costa Gonzales from UNED - Madrid and B. Benedetti from the University of Miami-USA) of the mini-symposium "*APPLIED COMBINATORIAL AND GEOMETRIC TOPOLOGY*" within the 8th European Congress of Mathematics (8ECM - Portoroz, Slovenia - June 2021).

She held, by invitation, an online seminar entitled "*KIRBY DIAGRAMS AND 5-COLORED GRAPHS REPRESENTING COMPACT 4-MANIFOLDS*" on 6<sup>th</sup> September 2021, within the cycle "Seminars on knot theory and related topics", organized by Prof. Manturov, Ilyutko, Nikonov, Fedoseev and Kim (Moscow State University).

She organized, together with Paola Cristofori, the cycle of "*GEOMETRIC TOPOLOGY SEMINARS*" held at the Department of Physical, Computer and Mathematical Sciences of the University of Modena and Reggio Emilia in September 2021 (8 online seminars).

She was the Head of the Organizing Committee and of the Scientific Committee for the International Conference "*GEOMETRIC TOPOLOGY, ART, AND SCIENCE*", held in Modena (08<sup>th</sup> June 2023) and Reggio Emilia (9-10 June 2023); in this role she held the official opening talk of the Conference on 09<sup>th</sup> June 2023.

On 17<sup>th</sup> July 2024 she gave a talk entitled "*TRISECTIONS OF PL 4-MANIFOLDS ARISING FROM COLORED TRIANGULATIONS*" during the IX European Congress of Mathematics (9ECM - Seville, Spain, from 15 to 19 July 2024).

On 3<sup>rd</sup> February 2025 she held, by invitation, an online seminar entitled "*KIRBY DIAGRAMS, TRISECTIONS AND GEMS OF PL 4-MANIFOLDS*", within "*The First International On-line Knot Theory Congress - In honor of the 80th birthday of Louis H. Kauffman*" (01-05 February 2025).

On 18<sup>th</sup> July 2025 she gave a talk entitled "*GEM THEORY AND COLORED TENSOR MODELS IN QUANTUM GRAVITY*" during the Congress "Applied Topology in Poznan 2025" (Poznan, Poland, 14-18 July 2025).

On 5<sup>th</sup> September 2025 she gave a talk entitled "*TRISECTIONS OF PL 4-MANIFOLDS VIA GEM THEORY*" during the Congress "GLANCES@MANIFOLDS-2025" (Cracow, Poland, 1-5 September 2025).

From July 13<sup>th</sup> to July 15<sup>th</sup> 2026 she will attend as an invited speaker to the workshop "*YOUNG WOMEN IN GEOMETRIC TOPOLOGY*", to be held in Bonn (Germany); she will deliver both a special talk and a career talk.