NumHyp 2021

7th international conference on Numerical methods for Hyperbolic Problems

Conference program

26 – 30 July 2021

Hotel Villa Madruzzo, Trento, Italy

Organized by the University of Trento
The instrument that mediates between theory and practice, between thought and observation, is mathematics; it builds the connecting bridge and makes it stronger and stronger. Thus it happens that our entire present-day culture, insofar as it rests on intellectual insight into and harnessing of nature, is founded on mathematics. Already, Galileo said: Only he can understand nature who has learned the language and signs by which it speaks to us; but this language is mathematics and its signs are mathematical figures. Kant declared, “I maintain that in each particular natural science there is only as much true science as there is mathematics.” In fact, we do not master a theory in natural science until we have extracted its mathematical kernel and laid it completely bare. Without mathematics today’s astronomy and physics would be impossible; in their theoretical parts, these sciences unfold directly into mathematics. These, like numerous other applications, give mathematics whatever authority it enjoys with the general public.

David Hilbert

Radio address given in Königsberg on 8 September 1930, on the occasion of the yearly meeting of the Society of German Natural Scientists and Physicians (English translation by James T. Smith)
This conference is dedicated to the 75th birthday of Prof. Dr. Dr. h.c. Eleuterio F. Toro, OBE
Scientific committee:

Emmanuel Audusse (University of Paris 13, France)
Christophe Berthon (University of Nantes, France)
Mária Lukáčová-Medvid’ová (University of Mainz, Germany)
Pep Mulet (University of Valencia, Spain)
Sebastian Noelle (RWTH Aachen, Germany)
Carlos Parés (University of Málaga, Spain)
Gabriella Puppo (University La Sapienza, Italy)
Giovanni Russo (University of Catania, Italy)

Organizing committee:

Michael Dumbser (University of Trento, Italy)
Saray Busto (Universidad Politécnica de Madrid, Spain)
Ilya Peshkov (University of Trento, Italy)
Simone Chiocchetti (University of Trento, Italy)
Laura del Río (University of Trento, Italy)

Conference secretary:

Lorena Galante (University of Trento, Italy)
This conference has been supported by:

European Commission, via the FET-HPC project ExaHyPE
European Research Council (ERC)
University of Trento
Ministero dell’Istruzione e dell’Università
Agenzia per il Turismo di Trento
Welcome to NumHyp 2021!

We are very pleased to welcome you to NumHyp 2021, the 7th International Conference on Numerical Methods for Hyperbolic Problems, held in Trento, Italy.

NumHyp 2021 is the seventh in a series of biannual conferences that began with a meeting in Castro Urdiales, Spain in 2009. Further editions of this conference were held in Roscoff, France in 2011, Aachen, Germany in 2013, Cortona, Italy in 2015, Monte Verità, Switzerland in 2017 and in Málaga, Spain in 2019. These conferences focus on recent developments and new directions in the area of numerical methods for hyperbolic and convection dominated time-dependent partial differential equations (PDEs). These PDEs arise in a large number of models in science and engineering. Prominent examples include the compressible and incompressible Euler and Navier-Stokes equations, the shallow water equations, the magneto-hydrodynamics equations, multiphase fluid models, hyperbolic formulations of continuum mechanics and even general relativity. Examples of application areas are aerodynamics, oceanography, plasma physics, solid mechanics, computational astrophysics etc.

These PDEs have been subject to extensive analytical and numerical studies over the last decades. It is widely known that their solutions can exhibit very complex behavior including the simultaneous presence of smooth waves, like acoustic or electromagnetic waves, as well as discontinuities such as shock waves and material interfaces. They also exhibit a sensitive dependence on initial conditions, presence of multiple scales in space and time, appearance of turbulent regimes, etc. The design and the analysis of numerical methods with good properties to solve them are still major challenges even nowadays.

NumHyp 2021 is a key activity of the PRIN 2017 project Innovative numerical methods for evolutionary partial differential equations and applications, funded by the Italian Ministry of University and Research (MIUR).

We would like to thank the scientific committee, our sponsors and all the participants for their enriching contributions and we wish you a very pleasant stay in Trento and productive scientific and personal interactions during the conference!

Michael Dumbser
Chairman of the NumHyp 2021 organization committee

Saray Busto, Ilya Peshkov, Simone Chiocchetti, Laura del Río
NumHyp 2021 local organizing committee
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<th>Friday, 30.7.2021</th>
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<td>Klingemberg</td>
<td>Bassi</td>
<td>Loubère</td>
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<td>09:00 – 09:30</td>
<td>Abgrall</td>
<td>Gómez-Bueno</td>
<td>Russo</td>
<td>Puppo</td>
<td>Iollo</td>
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<tr>
<td>09:30 – 10:00</td>
<td>Munz</td>
<td>Kurganov</td>
<td>Groppi</td>
<td>Cristiani</td>
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<td>10:30 – 11:30</td>
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<td>Room Belvedere</td>
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<tr>
<td>11:30 – 12:00</td>
<td>Drikakis</td>
<td>Chen</td>
<td>M. Castro</td>
<td>Pareschi</td>
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<td>12:00 – 12:30</td>
<td>Lukáčová-Medvíďová</td>
<td>Parés</td>
<td>Peshkov</td>
<td>Cordero-Carrión</td>
<td>Vergara</td>
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<td>12:30 – 13:00</td>
<td>Vázquez-Cendón</td>
<td>Tscherpel</td>
<td>Busto</td>
<td>Gaburro</td>
<td>Müller</td>
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<td>13:00 – 15:00</td>
<td>Lunch</td>
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<td>15:00 – 15:30</td>
<td>Del Río, Torlo</td>
<td>Macca, Yuan</td>
<td>Falcone, Carlino</td>
<td>Gavrilyuk</td>
<td>Dimarco</td>
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<td>15:30 – 16:00</td>
<td>Putti, Scholz</td>
<td>Siviglia, Öffner</td>
<td>Semplice, Solán</td>
<td>Parisot, Iske</td>
<td>Bertaglia</td>
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<td>16:00 – 16:30</td>
<td>C. Castro, Pimentel</td>
<td>Caballero, Nikodemou</td>
<td>Albi, Groom</td>
<td>Iske</td>
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<td>Fambri, Chrysanthou</td>
<td>Sherwin, Echeveribar</td>
<td>Chiocchetti, Wallis</td>
<td>Chertok, Nikiforakis</td>
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<td>18:00 – 18:30</td>
<td>She, Orlando</td>
<td>Gasner, Del Grosso</td>
<td>Dhaouadi, Dematté</td>
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<td>18:30 – 19:00</td>
<td>Güçlüli, Millmore</td>
<td>Schneider, Conde</td>
<td>Dumbser, Mi</td>
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<td>19:00 – 19:30</td>
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<td>20:30 – …</td>
<td>Welcome Reception</td>
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<td>Conference Dinner</td>
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**Daily program: Monday, 26 July 2021**

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<tr>
<td>08:40 – 09:00</td>
<td>Opening and Welcome – Room Madruzzo</td>
<td>Room Madruzzo</td>
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<tr>
<td>09:00 – 09:30</td>
<td>Rémi Abgrall (University of Zürich)</td>
<td>On the notion of conservation for hyperbolic problem</td>
</tr>
<tr>
<td>09:30 – 10:00</td>
<td>Claus-Dieter Munz (University of Stuttgart)</td>
<td>The Riemann problem in the sharp interface approximation of two-phase flow with evaporation</td>
</tr>
<tr>
<td>10:00 – 10:30</td>
<td>Andrea Thomann (University of Mainz)</td>
<td>An all-speed scheme for isentropic two phase flow</td>
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<td>10:30 – 11:30</td>
<td>Coffee Break</td>
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<tr>
<td>11:30 – 12:00</td>
<td>Dimitris Drikakis (University of Nicosia)</td>
<td>Uncertainty reduction in turbulent simulations using high-order methods</td>
</tr>
<tr>
<td>12:00 – 12:30</td>
<td>Mária Lukáčová-Medviďová (University of Mainz)</td>
<td>Approximating viscosity solutions of the Euler equations</td>
</tr>
<tr>
<td>12:30 – 13:00</td>
<td>Maria Elena Vázquez-Cendón (University of Santiago de Compostela)</td>
<td>Evolution of a hybrid finite volume/finite element scheme for low-Mach number flows to all Mach number flows</td>
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<tr>
<td>13:00 – 15:00</td>
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<tr>
<td>15:00 – 15:30</td>
<td>Laura Del Río (University of Trento)</td>
<td>A family of semi-implicit hybrid FV/FE methods for computational fluid dynamics using an efficient MPI parallel implementation</td>
</tr>
<tr>
<td>15:30 – 16:00</td>
<td>Mario Putti (University of Padua)</td>
<td>Geometrically intrinsic shallow water equations on moving surfaces</td>
</tr>
<tr>
<td>16:00 – 16:30</td>
<td>Cristóbal Castro (University of Taparacá)</td>
<td>High-Order Splitting schemes for the shallow water equations with applications to tsunami wave propagation</td>
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<tr>
<td>16:30 – 17:30</td>
<td>Coffee Break</td>
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<tr>
<td>17:30 – 18:00</td>
<td>Francesco Fambri (Max Planck Institute for Plasma Physics)</td>
<td>A novel structure preserving semi-implicit finite volume method for viscous and resistive magnetohydrodynamics</td>
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<tr>
<td>18:00 – 18:30</td>
<td>Bangwei She (Institute of Mathematics of the CAS, Prague)</td>
<td>On convergence of numerical solutions for the compressible MHD system</td>
</tr>
<tr>
<td>18:30 – 19:00</td>
<td>Yaman Güçlü (Max Planck Institute for Plasma Physics)</td>
<td>Efficient compatible finite element solution of the time-dependent Maxwell equations on mapped grids</td>
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<tr>
<td>20:30 –</td>
<td>Welcome Reception</td>
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Daily program: Tuesday, 27 July 2021

09:00 **Opening – Room Madruzzo**

09:00 – 09:30 Christian Klingenberg (University of Würzburg)
Structure preserving numerical methods for the Euler equations with gravity

09:30 – 10:00 Irene Gómez-Bueno (University of Málaga)
Collocation methods for high-order well-balanced methods for 1D systems of balance laws

10:00 – 10:30 Alexander Kurganov (Southern University of Science and Technology, Shenzhen)
High-order path-conservative central-upwind schemes

10:30 – 11:30 **Coffe Break**

11:30 – 12:00 Guoxian Chen (Wuhan University)
A unified surface-gradient and hydrostatic reconstruction scheme for the shallow water equations

12:00 – 12:30 Carlos Parés (University of Málaga)
Well-balanced high-order finite difference WENO methods for systems of balance laws

12:30 – 13:00 Tabea Tscherpel (Bielefeld University)
Boundary conditions for time-discrete Green-Naghdi equations

13:00 – 15:00 **Lunch**

15:00 – 15:30 Emmanuele Macca (University of Catania)
Adaptive high order well balanced compact approximate method for systems of balance law

15:30 – 16:00 Annunziato Siviglia (University of Trento)
A second-order well-balanced splitting scheme for the non-conservative Saint-Venant-Exner model

16:00 – 16:30 Celia Caballero (University of Málaga)
An exactly well-balanced semi-implicit Lagrange-projection type scheme for the shallow-water system

16:30 – 17:30 **Coffe Break**

17:30 – 18:00 Spencer Sherwin (Imperial College London)
Development and application of a spectral/hp element, implicit compressible solver

18:00 – 18:30 Gregor Gassner (University of Cologne)
On compatible Legendre-Gauss-Lobatto subcell low order finite volume methods (and what we can do with it)

18:30 – 19:00 Kleiton A. Schneider (University of Mato Grosso do Sul)
Multidimensional approximate Riemann solvers for hyperbolic nonconservative systems

19:00 – 20:00 **Dinner**

20:00 – 21:00 **After-party**
**Daily program: Wednesday, 28 July 2021**

09:00  **Opening – Room Madruzzo**

09:00 – 09:30 **Francesco Bassi** (University of Bergamo)
Oscillation control in discontinuous Galerkin solutions of the 1D Euler equations

09:30 – 10:00 **Giovanni Russo** (University of Catania)
Conservative semi-Lagrangian methods for kinetic equations

10:00 – 10:30 **Maria Groppi** (University of Parma)
BGK models for gas mixtures: asymptotics and numerics

10:30 – 11:30 **Coffe Break**

11:30 – 12:00 **Manuel Castro** (University of Málaga)
Artificial viscosity to get both robustness and discrete entropy inequalities

12:00 – 12:30 **Ilya Peshkov** (University of Trento)
Computational aspects of the unified hyperbolic formulation for continuum mechanics

12:30 – 13:00 **Saray Busto** (Universidad Politécnica de Madrid)
Thermodynamically compatible schemes for continuum mechanics

13:00 – 15:00 **Lunch**

15:00 – 15:30 **Maurizio Falcone** (Università di Roma “La Sapienza”)
A tree structured method for high-dimensional evolutive Hamilton-Jacobi equations and applications

15:30 – 16:00 **Matteo Semplice** (Università dell’Insubria, Como)
One- and multi-dimensional CWENOZ reconstructions for implementing boundary conditions without ghost cells

16:00 – 16:30 **Giacomo Albi** (University of Verona)
IMEX multistep method for hyperbolic systems with relaxation

16:30 – 17:30 **Coffe Break**

17:30 – 18:00 **Simone Chiocchetti** (University of Trento)
Tips and tricks for simple hyperbolic viscous flow

18:00 – 18:30 **Firas Dhaouadi** (University of Trento)
A hyperbolic augmented model for the Nonlinear Schrödinger equation

18:30 – 19:00 **Michael Dumbser** (University of Trento)
High order ADER discontinuous Galerkin schemes for nonlinear hyperelasticity with material failure

**Room Madruzzo**

16:30 – 17:30

**Room Belvedere**

16:30 – 17:30

**Coffe Break**

18:00 – 18:30 **Tim Wallis** (University of Cambridge)
A Flux-enriched Godunov method for multi-material problems with interface slide and void opening

18:00 – 18:30 **Riccardo Dematté** (University of Cambridge)
Reacting condensed phase explosives in direct contact

18:30 – 19:00 **XiaoCheng Mi** (McGill University, Montréal)
GPU-accelerated meso-resolved simulation of detonation waves in multiphase energetic materials
Daily program: Thursday, 29 July 2021

09:00  Opening – Room Madruzzo

09:00 – 09:30  Raphaël Loubère (University of Bordeaux)
Towards bridging Lagrangian and Eulerian Riemann solvers

09:30 – 10:00  Gabriella Puppo (Università di Roma “La Sapienza”)
Traffic models, or what we can learn coupling transport and source terms

10:00 – 10:30  Emiliano Cristiani (CNR, Roma)
Macroscopic and multi-scale models for multi-class vehicular dynamics with uneven space occupancy: a case study

10:30 – 11:30  Coffe Break

11:30 – 12:00  Lorenzo Pareschi (University of Ferrara)
Hyperbolic models and numerical methods for the spatial spread of infectious diseases

12:00 – 12:30  Isabel Cordero-Carrión (University of Valencia)
Numerical evolution of the resistive relativistic magnetohydrodynamic equations: a minimally implicit Runge-Kutta scheme

12:30 – 13:00  Elena Gaburro (Inria Bordeaux Sud-Ouest)
A well balanced finite volume scheme for general relativity

13:00 – 15:00  Lunch

15:00 – 15:30  Sergey Gavrilyuk (Aix-Marseille University)
Singular solutions of the BBM equation: analytical and numerical study

15:30 – 16:00  Martin Parisot (Inria Bordeaux Sud-Ouest)
On the 1D steady states of the 1D Green-Naghdi equations

16:00 – 16:30  Armin Iske (University of Hamburg)
Flexible kernels for particle-based fluid flow simulations

16:30 – 17:30  Coffe Break

17:30 – 18:00  Alina Chertok (North Carolina State University, Raleigh)
Well-balancing via flux globalization: applications to shallow water equations with wet/dry fronts

18:00 – 18:30  Nikos Nikiforakis (University of Cambridge)
Computational multiphysics for interacting states of matter under extreme conditions

18:30 – 19:30  Eleuterio Francisco Toro (University of Trento)
Some models and methods for physiological flows in collapsible conduits

19:30 – 20:30  Conference Dinner
### Daily program: Friday, 30 July 2021

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#### Room Madruzzo

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<tr>
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<tr>
<td>09:00–09:30</td>
<td>Bruno Després (LJLL Sorbonne University, Paris)</td>
<td>The implicit Lagrangian Riemann problem: how and why?</td>
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<tr>
<td>09:30–10:00</td>
<td>Angelo Iollo (Inria Bordeaux Sud-Ouest)</td>
<td>Discretization of a simple hyperbolic system rising in incompressible fluid-structure interaction</td>
</tr>
<tr>
<td>10:00–10:30</td>
<td>Walter Boscheri (University of Ferrara)</td>
<td>3D cell-centered Finite Volume schemes for solving updated Lagrangian hyperelasticity on unstructured grids</td>
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#### Coffe Break

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<th>Time</th>
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<tr>
<td>10:30–11:30</td>
<td>Arturo Hidalgo (Universidad Politécnica de Madrid)</td>
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<td>12:00–12:30</td>
<td>Christian Vergara (Politecnico di Milano)</td>
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<tr>
<td>12:30–13:00</td>
<td>Lucas Müller (University of Trento)</td>
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#### Lunch

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<tr>
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<tr>
<td>15:00–15:30</td>
<td>Giacomo Dimarco (University of Ferrara)</td>
<td>High order finite volume schemes with IMEX time stepping for the Boltzmann model on unstructured meshes</td>
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<tr>
<td>15:30–16:00</td>
<td>Vladimir Titarev (FRC Computer Science and Control, Moscow)</td>
<td>ALE-type discrete velocity scheme for kinetic equations as applied to rapid gas expansion problems</td>
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<td>16:00–16:30</td>
<td>Stephan Gerster (RWTH Aachen)</td>
<td>Hypocoercivity of Stochastic Galerkin formulations for stabilization of Kinetic Equations</td>
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<tr>
<td>16:30–17:00</td>
<td>Alessandro Coclite (Politecnico di Bari)</td>
<td>Strategies for time integration in fluid/structures interaction problems within dynamic-IB methods</td>
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#### Coffe Break

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<tr>
<td>17:00–18:00</td>
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Registered participants:

Rémi Abgrall  Francesco Fambri  Giuseppe Orlando
Nina Aguillon  Faezeh Farivar  Carlos Parés
Giacomo Albi  Alexander Farmakalides  Lorenzo Pareschi
Elena Bachini  Davide Ferrari  Martin Parisot
Francesco Bassi  Peter Frolković  Ilya Peshkov
Paul Bennett  Elena Gaburro  Ernesto Pimentel
Giulia Bertaglia  José M Gallardo  Ivan Prusak
Walter Boscheri  Gregor Gassner  Gabriella Puppo
Lukas Brencher  Sergey Gavrylyuk  Mario Putti
Cristian Brutto  Stephan Gerster  Giovanni Russo
Saray Busto  Beatrice Ghitti  Samuel Santos-Pérez
Celia Caballero  Irene Gómez-Bueno  Kleiton A. Schneider
Mauricio Caceres  Michael Groom  Ullika Scholz
Michele Giuliano Carlino  Maria Groppi  Matteo Semplice
Manuel Castro  Yaman Gųčľų  Bangwei She
Cristóbal Castro  Arturo Hidalgo  Spencer Sherwin
Morena Celant  Yannick Holle  Annunziato Siviglia
Agnes Chan  Elefterios Ioannou  Pablo Solán
Guoxian Chen  Angelo Iollo  Alessandra Spilimbergo
Alina Chertock  Armin Iske  Maurizio Tavelli
Simone Chiocchetti  Christian Klingenberg  Andrea Thomann
Maria Chrysantou  Alexander Kurganov  Vladimir Titarev
Alessandro Coclite  Shannon Leakey  Wei Tong
Daniel Conde  Raphaël Loubère  Davide Torlo
Isabel Cordero-Carrió  Alessia Luca  Eleuterio Francisco Toro
Emiliano Cristiani  Mária Lukáčová-Medviďová  Elena Travaglia
Alessia Del Grosso  Emmanuelle Macca  Tabea Tschepel
Laura Del Río  James Mckenna  Davide Vanzo
Riccardo Dematté  XiaoCheng Mi  María Elena Vázquez-Cendón
Bruno Després  Louisa Michael  Christian Vergara
Firas Dhaouadi  Stephen Millmore  Tim Wallis
Giacomo Dimarco  Lucas Müller  Xue Wang
Minh-Hieu Do  Claus-Dieter Munz  Sandra Warnecke
Dimitris Drikakis  Nguyen Tri Nguyen  Ruifang Yan
Michael Dumbar  Nikolaos Nikiforakis  Yuhuan Yuan
Isabel Echeverribar  Maria Nikodemou  Yichi Zhang
Maurizio Falcone  Philipp Öffner