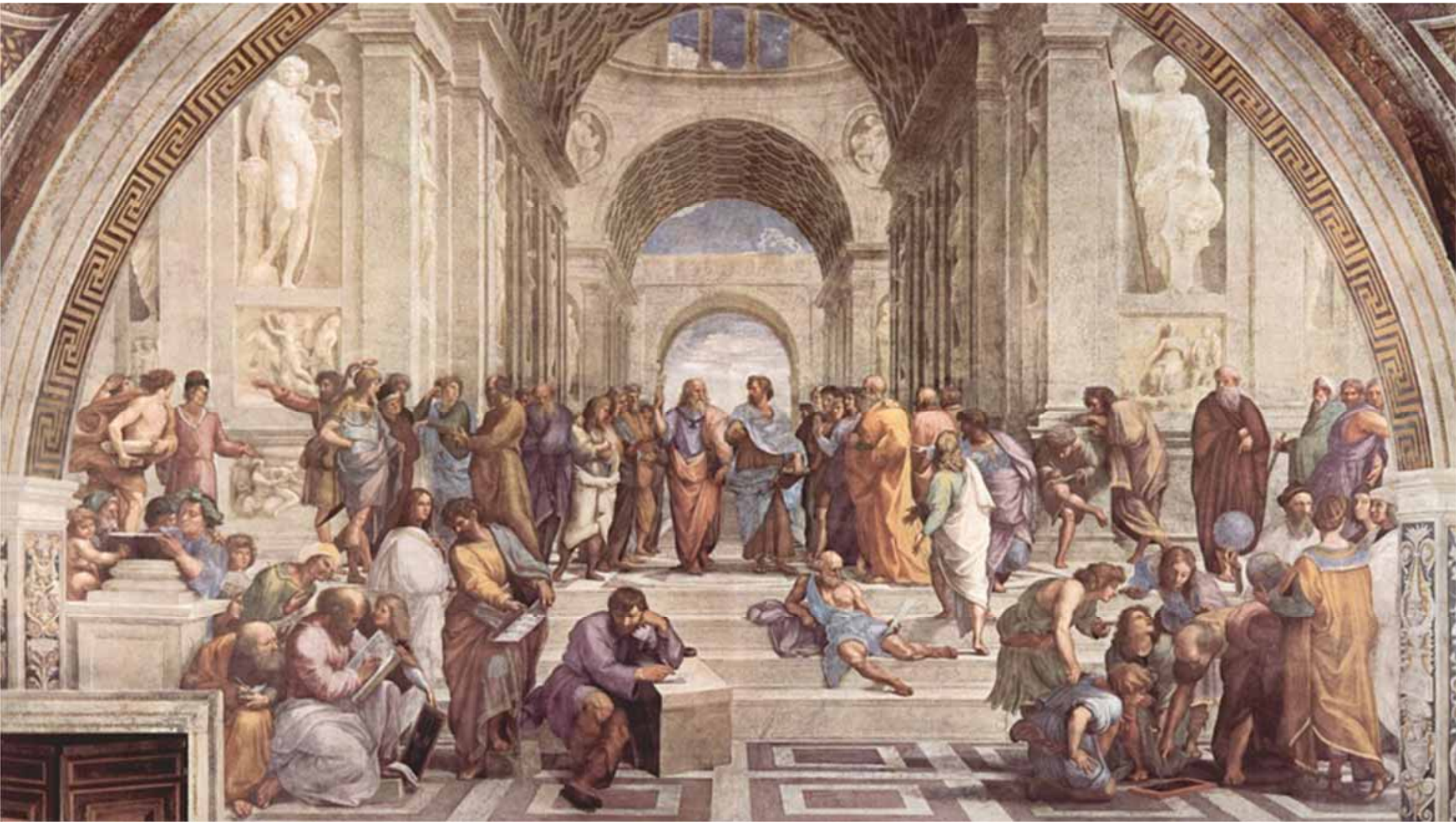

The Moonshot Research and Development Program

- the Japanese government's new emblematic R&D enterprise that the CSTI designates to organize Japan's state-of-the-art scientific and engineering technologies into more disruptive techno-social innovations.
- ambitious and disruptive goals to address the social challenges we face, bringing together the wisdom of researchers from all over the world, and producing cutting-edge research results while making full use of basic research capabilities even as we allow for unexpected failures.

MOONSHOT
RESEARCH & DEVELOPMENT PROGRAM

to realize Society 5.0

3 Mission areas & 6 Working Groups

1. Leveraging the Aging Society: Turning the aging society into the innovative and sustainable society by harnessing diversity through techno-social transformation
2. Save the Planet and our Civilization: Recovery for global environment and growth of civilization
3. Exploring new frontiers of science and technology
   - WG1.Expanding human potential toward a society in which everyone can pursue their dreams
   - WG2. Realizing a human life that “continues to improve both physically and psychologically” through complete understanding of biological functions such as the nervous system and related Tissues
   - WG3:Expanding frontiers through co-evolution of AI and robots
   - WG4:Sustainable Resources Circulation for Global Environment
   - WG5:Innovation for future agriculture –satisfying both food production and environmental conservation
   - WG6 : Creating non-traditional science and technologies based on quantum and related phenomena

WG7: Cross sectional issue

Mathematical Science as Cross-sectional Technology to Pursue All MS Goals

- What are useful mathematical ideas and methods in the era of digital revolution
- What are cross-sectional technologies on mathematics for MS goals
- How we establish a platform to develop mathematical methods for solution of societal problems to make efficient interaction

Speakers &Panelists

- **Emmanuel Candès** “Mathematics in the real world: some recent successes and open challenges “
- **Yasumasa Nishiura** “Living Theorems in the Society”
- **Christian Ratsch** “Good Practice at IPAM: The Impact of Mathematics on other Sciences and Society”
- **Wim van Saarloos** “The unreasonable effectiveness of mathematics for the moonshot program”

- **Hiroshi Suito**(Deputy Director, WPI-AIMR, Tohoku University)

Interdisciplinary collaborations and young student programs

based on mathematical sciences

- **Masato Wakayama**(Executive Vice President, Kyushu University)

Role of Mathematical Science (as broadest sense)

- Has provided Common Language of Science and Technology
- In 17C. Galileo Galilei “this grand book, the universe … is written in the language of mathematics”
- In 20 C, a new paradigm emerged: *computational science.* Mathematical models of complex phenomena of the real world can be simulated using high-performance computing.
- Now in the *Digital Revolution*: management of big data has arisen as a key challenge. The effective interaction between the real world and the digital world is a core concept to realize *Society 5.0* for sustainable development of human centric society. New roles of mathematical sciences are to formulate societal issues into mathematical challenges.

unreasonable effectiveness of mathematics, U.Wigner

- What are useful mathematical Ideas and methods in the era of digital revolution
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Platform to develop mathematical methods for solution of societal problems –Good practices in the US

National Science Foundation
Mathematical Sciences Institutes

https://mathinstitutes.org

American Institute of Mathematics (AIM),
San Jose, California

Institute for Advanced Study (IAS),
Princeton, New Jersey

Institute for Computational and Experimental Research in Mathematics (ICERM), Providence, Rhode Island

Institute for Mathematics and its Applications (IMA),
Minneapolis, Minnesota

Institute for Pure and Applied Mathematics (IPAM),
Los Angeles, California

Mathematical Biosciences Institute (MBI),
Columbus, Ohio

Mathematical Sciences Research Institute (MSRI),
Berkeley, California

Statistical and Applied Mathematical Sciences Institute

There are Mathematical institutes which host long-term(from a few months to one year) thematic programs or series of workshops to incubate ideas to transform societal problems into mathematical concepts, to identify future research directions, and to develop the frontiers of mathematics inspired by inviting researchers related by themes set across disciplines from all around the world. They also function as hubs of international collaboration and by fostering young researchers.

- **The Secret Life of Red Blood Cells Revealed Through Topological Data Analysis** Institute: IMA July 2014
- **Establishing a Theoretical Understanding of Machine Learning** Institute: IAS September 2019
- **Mathematical Optimization of Systems Impacted by Rare, High-Impact Random Events** Institute: ICERM August 2019
- **A Few Self-driving Cars Can Dramatically Improve Traffic Flow** Institute: IPAM April 2018
- **Big Data meets Number Theory** Institute: ICERM May 2016

Mathematics x Humanities and Social Sciences

- **Bystander Roles in Peace and Conflict**, NIAS-Lorentz Program April-May 2019
- **Integrating Qualitative and Quantitative Evidence Using Social Simulation**, NIAS-Lorentz Program April 2019
- **Deep Fakery: Mathematical, Cryptographic, Social, and Legal Perspectives,** IPAM Workshop November 2019

※NIAS (The Netherlands Institute for Advanced Study in the Humanities and Social Sciences

Recommendations

We identify mathematical technologies expected to be useful to accomplish MS goal. Many common ones exist across throughout WGs. We recommend the following:

i. Set a cross-session team on mathematical science to collaborate with MS program teams. Its mission is to discuss useful mathematical methods and researchers who can provide methods to apply and possible solutions to specific problems related to mathematics.

ii. Arrange a platform to gather researchers from around the world to discuss and identify directions to move forward and to identify proper methods of mathematization of the societal problems and challenges in the MS goals that emerge during the course of proceeding with programs on the MS goals.

iii. International collaboration and participation while fostering young people (including students) should be included