

GCOE 国際会議 報告書

2008 年 12 月 15 日

文責：荒木武昭

開催会議名：

Unifying Concepts in Glass Physics IV

開催日時：

2008 年 11 月 25 日（火）～28 日（金） 4 日間

開催場所：

社団法人 芝蘭会館 稲盛ホール、山内ホール

主催：

京都大学基礎物理学研究所

後援：

九州大学大学院理学研究院、京都大学グローバル COE「普遍性と創発性から紡ぐ次世代物理学」、京都大学グローバル COE「物質科学の新基盤構築と次世代育成国際拠点」、京都大学教育研究振興財団、小笠原科学技術振興財団、鹿島学術振興財団、村田学術振興財団、旭硝子財団、吉田科学技術財団、コーニング・ホールディング・ジャパン合同会社、日本板硝子材料工学助成会、日本物理学会

実行委員会メンバー：

小田垣 孝（九州大学，組織委員長），山本 量一（京都大学，実行委員長），福島 孝治（東京大学），深尾 浩次（立命館大学），荒木 武昭（京都大学），Silvio Franz (Universite Paris-Sud)，Srikanth Sastry (Jawaharlal Nehru Centre for Advanced Scientific Research)，Francesco Sciortino (University of Rome)，金 鋼（分子研），小西 隆史（京都大学）

国別出席者数（計 151 名）：

日本(93 名)、フランス(15 名)、アメリカ(10 名)、インド(7 名)、イギリス(5 名)、デンマーク(4 名)、オーストラリア(3 名)、カナダ(3 名)、イタリア(2 名)、韓国(2 名)、中国、ドイツ、ポーランド、スペイン、台湾、オランダ、ウクライナ(1 名)

会議の意義、内容、成果等の概要

会議の意義、内容

ガラスは人類にとって最も馴染みの深い材料の1つであり、旧石器時代にすでに使われていた形跡が残っている。現代においては窓ガラスや食器類などの消費材としては言うまでもなく、液晶表示板やガラスファイバーなどの高機能性材料としても不可欠となっている。ガラスは氷や金属などと同様に固体であるが、後者のように周期的結晶構造をもたない非晶質(アモルファス)であり、その性質は特異である。液体の水を冷却するとある温度で急に(非連続的に)固化して結晶の氷となるが、ガラスの場合には液体から固体への変化が狭い温度範囲で緩慢に(連続的に)起こるに過ぎない。これがガラス転移と呼ばれる古くから知られた現象であるが、その本質的なメカニズムは未だにわかっておらず、現代科学に残された重要な未解決問題の1つになっている。

ガラス物理学では、上記に代表される「ガラス化に付随した原因のよくわからない現象」を物理学的な問題としてとらえて解決を目指している。最新の実験や計算機実験により新しい解析方法が登場し、それに触発されてこれまでに様々な理論的枠組みが提案されてきた。「個々の枠組みを総合的・統合的にとらえることで、各種ガラスの特徴や異常性を統一的に理解する新たな枠組みを構築することが出来ないか?」、この様な意欲的な目標で1999年に始められたのが、国際会議「ガラス物理の統一概念」である。

成果の概要

本会議に対する会議参加者の印象は極めて高く、今後開催されるガラス形成物質関連の研究集会への先鞭をつけたと考えられる。以下に項目に分けて成果をまとめる。

(1) 理論

第一原理に基づくモード結合理論(MCT)を改良し、コロイド系、粉体系、ずり流動下へ応用する研究、ホッピング過程を取り込んだ低温までの拡張、場の理論の立場からの基礎づけなどが多数報告された。一方で、自由エネルギーランドスケープ猫像により、広い温度範囲でガラス転移現象と統一的に理解する試みが提案された。また、粉体系で見られるジャミング転移と構造ガラス転移の相関をスピングラス、情報理論で開発された数理物理的な手法を用いて理論的に追求する研究など、若手フランス人研究者の洗練された講演があった。

(2) シミュレーション

2成分混合系で欠陥をコントロールし、また、ずりを印加することによりポリクリスタルからガラスへの転移が起こり、不均一なダイナミクスが誘起されることが示され、ガラス転移研究の新たな道筋が提案された。また、イオン液体での不均一ダイナミクス、ガラスでのボゾンピークの起源解明、ストークス・アインシュタイン則の破れなどに関するシミュレーション研究が多数発表され、ガラス転移研究におけるシミュレーション研究の重要性が示された。

(3) 実験

ガラス転移を特徴付けるキーコンセプトとして、動的不均一性、特性長の増大があるが、このような問題に対する理論的なアプローチとして、密度相関の相関関数から特性長を評価するモデルを実験的に検証する研究がポスターにより発表された。また、粉体系でのジャミング転移での力学的剛直さの出現とガラス転移での動的な拘束を実験的に比較するため、2成分ディスク系でのジャミング転移に至るダイナミクスを測定し、J 転移点で極大になる空間特性長をもった長時間相関の存在が報告された。高分子ガラスに関しては、空間的な拘束がもたらすガラス転移ダイナミクスへの効果が、蛍光法、中性子散乱、反射率測定などにより調べられ、詳細な報告がなされた。

(4) 今後に向けて

構造ガラス、コロイド、粉体、スピングラスなどこれまで独立に研究されてきた系でのガラス転移、不均一ダイナミクスに関する研究が互いに密接な相関を持っていることが明らかになってきている。本会議においては、スピングラス、構造ガラス、情報数理のバックグラウンドを持って、果敢にガラス転移関連の諸問題に挑むフランス人若手研究者たちの講演は大きなインパクトを内外に与えた。また、粉体関係のわが国の研究者もその存在を十分に示した。今後はジャミング転移と構造ガラス転移の関連性の解明など、これまでの分野の垣根を越えた共通の認識を思っガラス転移研究の諸問題へ望むことが不可欠であることが明らかとなった。このような明確な分野の方向性を打ち出すことが可能になったことに、本会議の大きな成果があると考えられる。

会議プログラム

Unifying Concepts in Glass Physics IV (UCGP2008) Program

November 25 (Tuesday)

09:00-10:00 **Registration**

10:00-10:10 **Opening Address [Takashi Odagaki, Chair]**

Session 1: Kinetic Approach I [Chair: Kenneth Schweizer]

10:10-10:40 (30 min.)

Kunimasa Miyazaki (University of Tsukuba, Japan)

"Recent Progresses and Open Problems in Mode-Coupling Theory of Glass Transition"

10:40-11:00 (20 min.)

Grzegorz Szamel (Colorado State University, USA)

"Divergent four-point dynamic density correlation function of a glassy suspension"

11:00-11:20 (20 min.)

Sarika Maitra Bhattacharyya (Indian Institute of Science, India)

"Interaction between activated and continuous diffusion in supercooled liquid"

11:20-11:40 (20 min.)

Kang Kim (Institute for Molecular Science, Japan)

"Slow dynamics in random media: Type A-B and reentrant transitions"

11:40-12:10 (30 min.)

Peter H. Poole (St. Francis Xavier University, Canada)

"Was Kauzmann right?: Onset of instability of a deeply supercooled liquid to crystal nucleation due to Stokes-Einstein decoupling"

12:10-12:30 (20 min.)

Kostya Trachenko (University of Cambridge, UK)

"Understanding glass transition on the basis of elastic interactions in a liquid"

12:30-14:00 **Lunch**

Session 2: Colloid and Granular matter I [Chair: Wilson Poon]

14:00-14:30 (30 min.)

David Weitz (Harvard University, USA)

"Dynamic Arrest in Colloidal Glasses and Gels"

14:30-14:50 (20 min.)

Akio Nakahara (Nihon University, Japan)

"Visualization of memories in paste: jammed state with directional order"

14:50-15:10 (20 min.)

Lenka Zdeborova (Universite Paris-Sud, France)

"A Lattice Model for Colloidal Gels and Glasses"

15:10-15:30 (20 min.)

Angel J. Moreno (Centro de Fisica de Materials, Spain)

"Slow dynamics in a novel state of soft matter: Cluster crystals of ultrasoft particles"

15:30-15:50 (20 min.)

Andriy Kyrylyuk (Utrecht University, The Netherlands)

"Jamming of Non-Spherical Particles: from Dense Colloidal Mixtures to Polydisperse Granular Materials"

15:50-16:20 **Coffee Break**

Session 3: Thermodynamic Approach [Chair: Francesco Sciortino]

16:20-16:50 (30 min.)

Akira Yoshimori (Kyushu University, Japan)

"Free energy landscape and configurational entropy"

16:50-17:10 (20 min.)

Srikanth Sastry (Jawaharlal Nehru Centre for Advanced Scientific Research, India) ... 15
"Growing length scales, configurational entropy and dynamics in glass"

17:10-17:30 (20 min.)

Peter Harrowell (University of Sydney, Australia)
"The Mechanism of Stress Relaxation in a Continuous Random Network"

17:30-17:50 (20 min.)

Jeppe C. Dyre (Roskilde University, Denmark)
"Strong pressure-energy correlations in liquids"

17:50-18:20 (30 min.)

Francesco Zamponi (Ecole Normale Supérieure, France)
"Dynamically correlated regions and configurational entropy in supercooled liquids"

November 26 (Wednesday)

Session 1: Mechanical Properties I [Chair: Michael L. Falk]

09:00-09:30 (30 min.)

Akira Onuki (Kyoto University, Japan)
"Heterogeneous dynamics in glass and polycrystal"

09:30-09:50 (20 min.)

Daniel J. Lacks (Case Western Reserve University, USA)
"Interplay of aging, structure and mechanical deformation in glassy materials"

09:50-10:10 (20 min.)

Masaharu Isoe (Nagoya Institute of Technology, Japan)
"Molasses tail of the shear stress autocorrelation function"

10:10-10:40 **Coffee Break**

Session 2: Colloid and Granular matter II [Chair: Peter Sollich]

10:40-11:10 (30 min.)

Takahiro Hatano (University of Tokyo, Japan)

"Rheology, Relaxation, and Critical Exponents at the Jamming Transition"

11:10-11:30 (20 min.)

Michio Otsuki (Aoyama Gakuin University, Japan)

"Universal scaling in the jamming transition"

11:30-11:50 (20 min.)

Hisao Hayakawa (Kyoto University, Japan)

"Can we use the mode-coupling theory for sheared granular fluids?"

11:50-12:10 (20 min.)

Vincent Arnaud Martinez (Royal Melbourne Institute of Technology, Australia)

"Ageing of a colloidal hard sphere glass"

12:10-12:30 (20 min.)

Francesco Sciortino (Universita' di Roma La Sapienza, Italy)

"Dynamic arrest in colloidal systems at low packing"

12:30-14:00 **Lunch**

14:00-16:00 **Poster Session**

Session 3: Frustration [Chair: Giulio Biroli]

16:00-16:30 (30 min.)

Hikaru Kawamura (Osaka University, Japan)

"Chiral order in spin glass"

16:30-16:50 (20 min.)

Gilles Tarjus (Universite Pierre et Marie Curie, France)

"A Monodisperse Glassforming Atomic Liquid on the Hyperbolic Plane: Frustration, Fragility, Dynamical Heterogeneities and Topological Defects"

16:50-17:10 (20 min.)

Nalluri Veeraiah (Acharya Nagarjuna University, India)

"Spectroscopic and dielectric studies on PbO-Bi₂O₃-As₂O₃ glasses doped with copper ions"

17:10-17:30 (20 min.)

Silvio Franz (Universite Paris-Sud, France)

"Glassy lengths in long but finite range models"

17:30-18:00 (30 min.)

Michel Gingras (University of Waterloo, Canada)

"Geometric Frustration in Magnetic Pyrochlore Oxides"

November 27 (Thursday)

Session 1: Jamming [Chair: Silvio Franz]

09:00-09:30 (30 min.)

Giulio Biroli (CEA Saclay, France)

"Quantum Jamming and the Superglass Phase"

09:30-09:50 (20 min.)

Olivier Dauchot (CEA Saclay, France)

"Jamming versus Glass transition in dense granular systems"

09:50-10:20 (30 min.)

Hajime Yoshino (Osaka University, Japan)

"Vortex Jamming and Granular Rheology"

10:20-11:00 **Coffee Break**

Session 2: Non-equilibrium Phenomena [Chair: Srikanth Sastry]

11:00-11:30 (30 min.)

Wilson Poon (The University of Edinburgh, UK)

"Repulsive and Attractive (Colloidal) Glasses Revisited"

11:30-11:50 (20 min.)

Shankar Prasad Das (Jawaharlal Nehru University, India)

"Nonequilibrium dynamics in an amorphous solid"

11:50-12:20 (30 min.)

Peter Sollich (King's College London, UK)

"Duality in trap and barrier models"

12:20-14:00 **Lunch**

Session 3: Information Theory [Chair: Koji Hukushima]

14:00-14:30 (30 min.)

Florent Krzakala (ESPCI, France)

"Jamming, Glasses and ... Constraint Optimization Problems"

14:30-14:50 (20 min.)

Kei Tokita (Osaka University, Japan)

"Statistical mechanics of a biological community with random interactions"

14:50-15:20 (30 min.)

Yoshiyuki Kabashima (Tokyo Institute of Technology, Japan)

"Replica symmetry breaking and solution search in a power reduction precoding problem of wireless communication"

15:20-15:50 **Coffee Break**

Session 4: New Material [John Torkelson]

15:50-16:20 (30 min.)

Osamu Yamamuro (University of Tokyo, Japan)

"Glass Transitions and Related Slow Dynamics of Ionic Liquids"

16:20-16:40 (20 min.)

Marian Paluch (Silesian University, Poland)

"Effect of compression on the liquid-glass and liquid-liquid transition in TPP"

16:40-17:00 (20 min.)

Junko Habasaki (Tokyo Institute of Technology, Japan)

"Heterogeneous Dynamics and Glass Transition in Ionic Liquids"

Session 5: Polymer Glass [Chair: Koji Fukao]

17:00-17:30 (30 min.)

John Mark Torkelson (Northwestern University, USA)

"Strong Perturbations to the Glass Transition Temperature and Physical Aging Rates in Polymers Confined at the Nanoscale: Effects of Interfaces and Free Surfaces"

17:30-18:00 (30 min.)

Toshiji Kanaya (Kyoto University, Japan)

"Glassy Dynamics of Polymer Thin Films"

18:00-18:20 (20 min.)

Riccardo Casalini (Naval Research Laboratory, USA)

"Peculiarities in the dynamics of polymers densified by different routes: when dynamics and thermodynamics disagree"

18:30-20:30 **Banquet**

November 28 (Friday)

Session 1: Mechanical Properties II [Chair: Gilles Tarjus]

09:00-09:30 (30 min.)

Michael L. Falk (University of Michigan, USA)

"What does shear banding reveal regarding the structure of amorphous solids?"

09:30-09:50 (20 min.)

Hajime Tanaka (University of Tokyo, Japan)

"Origin of the boson peak in glass"

09:50-10:10 (20 min.)

Fathollah Varnik (Max-Planck Institut für Eisenforschung, Germany)

"Response of a driven model glass and the Stokes-Einstein relation"

10:10-10:40 **Coffee Break**

Session 2: Kinetic Approach II [Chair: Peter Poole]

10:40-11:10 (30 min.)

Kenneth S. Schweizer (University of Illinois, USA)

"Activated Hopping, Heterogeneous Dynamics, and Mechanical Response in Glassy Particle Fluids and Suspensions"

11:10-11:30 (20 min.)

Frederic Affouard (Université Lille1, France)

"Molecular dynamics of binary Lennard-Jones mixtures: breakdown of the Stokes-Einstein relation"

11:30-11:50 (20 min.)

Bongsoo Kim (Changwon National University, Korea)

"Field theory for interacting Brownian particles: FDR-preservation, irreducible memory function, MCT and beyond"

11:50-12:10 (20 min.)

Patrick Charbonneau (Duke University, USA)

"Dynamical Heterogeneity in a Glass-Forming Ideal Gas"

12:10-12:40 (30 min.)

Ludovic Berthier (Montpellier University, France)

"Understanding the glass transition using soft particles"

12:40-12:50 **Closing Remarks [Koji Fukao, Co-Chair]**

Poster Program

- P1. **Paddy Royall** (University of Bristol, UK)
"The importance of local structure as a mechanism for dynamical arrest in colloidal systems"
- P2. **Hiroshi Kobayashi** (AIST(Retired), Japan)
"On Intermediate Range Orders in Viscosity-Temperature Relationship including Glass Transition"
- P3. **Rongping Wang** (The Australian National University, Australia)
"Raman Spectra of $GexAsySe_{1-x-y}$ glasses"
- P4. **Rami Reddy Mangalampudi** (Acharya Nagarjuna University, India)
"Spectroscopic features of some rare earth ions in MF_2 (M=Ca, Zn and Pb)-PbO-P₂O₅ glass systems"
- P5. **Gandhi Yerramreddy** (Acharya Nagarjuna University, India)
"Vanadium ion as a structural probe in ZnF_2 -As₂O₃-TeO₂ glass system"
- P6. **Satyanarayana Talam** (Acharya Nagarjuna University, India) 8
"Influence of mixed alkali effect on a.c conduction phenomenon of Li_2O -Na₂O-B₂O₃:Fe₂O₃ glass system"
- P7. **Livia Eleonora Bove** (Université Pierre et Marie Curie Paris VI, France)
"Damping of sound waves in the terahertz range and strength of the boson peak"
- P8. **Li Wang** (Beijing University of Technology, China)
"Acoustical Properties of Vitreous As₂S₃ and As₂Se₃"
- P9. **Hideyuki Nakayama** (Gakushuin University, Japan)
"Low- and High-Density Glass of Ethylbenzene and the Liquid-Liquid Transformation in Its Supercooled Liquid State"
- P10. **Alexander Krivchikov** (B. Verkin Institute for Low Temperature Physics and Engineering of NAS Ukraine, UKRAINE)
"Thermal Conductivity of Simple Solids with Hydrogen Bonds in Non-equilibrium States at Low Temperatures"
- P11. **Takashi Arai** (National Defense Academy, Japan)
"Vibrational entropy of a soft-core glass"
- P12. **Yosio Hiki** (Tokyo Institute of Technology, Japan)
"Calorimetric Study of Kinetic Glass Transition in Various Glasses"
- P13. **Ken-ichi Izutsu** (National Institute of Health Sciences, Japan)

- "Structure and Physical Property of Ionic Glass Prepared by Freeze-drying"
- P14. **Shankar Prasad Das** (Jawaharlal Nehru University, India)
"Vacancy dynamics in a crystal from a density functional approach"
- P15. **Yoshihisa Miyamoto** (Kyoto University, Japan)
"Relaxation with a peak and the memory effects"
- P16. **Denis L'Hote** (CEA Saclay, France)
"Experimental Investigation of Dynamical Heterogeneities Temperature Dependence in Supercooled Liquids"
- P17. **Kenneth S. Schweizer** (University of Illinois, USA)
"Slow Segmental Dynamics in Polymers: From Supercooled Melts to Stressed and Aging Glasses"
- P18. **Valentin Levashov** (University of Tennessee, USA)
"Equipartition theorem, atomic level stresses and connectivity network in simple supercooled liquids"
- P19. **Tomoko Mizuguchi** (Kyushu University, Japan)
"Crystallization of a monatomic glass-forming system"
- P20. **Ten-Ming Wu** (National Chiao-Tung University, Taiwan)
"Hard-sphere perturbation theory for a model of liquid Ga"
- P21. **Hiroki Ohta** (University of Tokyo, Japan)
"Critical phenomena in an excitable system from the viewpoint of Jamming transitions"
- P22. **Mami Iwata** (University of Tokyo, Japan)
"Dynamics of k-core percolation in a random graph"
- P23. **Masakazu Matsumoto** (Nagoya University, Japan)
"Local order and frustration in supercooled liquids"
- P24. **Takeshi Kawasaki** (The University of Tokyo, Japan)
"Structural Origin of Dynamic Heterogeneity and the Violation of the Fluctuation-Dissipation Theorem in a 2D Model Glass Former"
- P25. **Takeaki Araki** (Kyoto University, Japan)
"Glassy behaviors of nematic liquid crystal confined in porous media"
- P26. **Yu Matsuda** (University of Tsukuba, Japan)
"Inelastic Neutron and Raman Scattering Study of the Boson Peak in Lithium Borate Glass System"
- P27. **Hayato Shiba** (Kyoto University, Japan)
"Heterogeneous Intermediate States around Melting in One and Two Component LJ"

Particle Systems"

P28. **Takashi Konishi** (Kyoto University, Japan)

"Discontinuous Enhancement of Crystal Growth below Glass Transition in Molecular Liquids"

P29. **Ryo Moriyama** (Gakushuin University, Japan)

"Formation and relaxation of low- and high-density glass of ethylbenzene and related compounds"

P30. **Rut Besseling** (University of Edinburgh, School of Physics, UK)

"3D Imaging of yielding and shearlocalization in colloidal glasses"

P31. **Yuki Matsuoka** (Kyoto University, Japan)

"Correlation between Dynamic Heterogeneity and Static Particle Configurations: Normal Mode Analysis"

P32. **Mitsuo Machida** (Kyushu University, Japan)

"NMR Study on Nematic Glassy Phase of 4-cyano-4pentylbiphenyl (5CB)"

P33. **Akira Akaishi** (Tokyo Metropolitan University, Japan)

"Frustration and glass dynamics on the hyperbolic plane"

P34. **Yasuo Saruyama** (Kyoto Institute of Technology, Japan)

"A Kinetic Study on the Response of the Relaxation Time to Temperature Change"

P35. **Ken-ichiro Murata** (The University of Tokyo, Japan)

"Roles of medium-range order in the liquid-liquid transition"

P36. **Akira Furukawa** (The University of Tokyo, Japan)

"Deformation-induced instability of general viscoelastic materials"

P37. **Toru Ekimoto** (Kyushu University, Japan)

"Stochastic dynamics in the free energy landscape"

P38. **Takahiro Nishino** (Kyoto University, Japan)

"A FDR-preserving field theory of glass transition in terms of the fluctuating hydrodynamics"

P39. **Claudio Maggi** (Roskilde University, Denmark)

"Shear-Mechanical and Dielectric Dynamic Heterogeneity in Supercooled Liquids"

P40. **Stephanie L. Thomas** (Dalhousie University, Canada)

"Wavelength Dependence of the Stress-Optic Response in Glass"

P41. **Tetsu Ichitsubo** (Kyoto University, Japan)

"Nanoscale elastic inhomogeneity in metallic glasses"

P42. **Tadashi Muranaka** (Aichi Institute of Technology, Japan)

Vector-like dynamical heterogeneities in simple fragile glasses"

P43. **Kiyoshi Sogo** (Kitasato University, Japan)

"Thermodynamic aspects of glass as a non-equilibrium steady state I"

P44. **Keiko M. Aoki** (JST Yokoyama Nano-system Liquid Crystal Project, Japan) 1

"Thermodynamic aspects of glass as a non-equilibrium steady state II"

P45. **Jun Matsui** (Kyushu University, Japan)

"Crystalline structure of binary soft-disk mixture"

P46. **Ikuzo Kanazawa** (Tokyo Gakugei University, Japan)

"The glass transition, one origin of boson peak, and duality symmetry breaking"

P47. **Volodymyr Gnatyuk** (Shizuoka University, Japan)

"Local Laser-Induced Damage in Glass and Formation of Marks"

P48. **Yuji Ike** (University of Tsukuba, Japan)

"Giga to terahertz dynamics of bioprotective solutions"

P49. **M. Jaipal Reddy** (Sreenidhi Institute of Science and Technology, India)

"Spectroscopic and Transport properties of $\text{Li}_2\text{O} - \text{LiF} - \text{B}_2\text{O}_3$: FeO glass system"

P50. **Shajahan Gulam Razul** (Saint Francis Xavier University, Canada)

"Investigating Dynamical Heterogeneity in the binary Lennard-Jones liquid"

P51. **Ulf R Pedersen** (Roskilde University, Denmark)

"Density scaling of strongly correlating liquids"

P52. **Ulf R Pedersen** (Roskilde University, Denmark)

"Long-lived structural fluctuations and crystallization of a binary mixture"

P53. **Albena Nielsen** (Roskilde University, Denmark)

"Prevalence of approximate $\tau \propto \sqrt{t}$ relaxation for the dielectric alpha process in viscous organic liquids"

P54. **Robert Botet** (CNRS and University Paris-Sud Orsay, France)

"Universal Approach to the Jamming State in Sticky Colloidal Systems"

P55. **Shio Inagaki** (Kyoto University, Japan)

"Packing process dependence of elastic material property in granular systems"

P56. **Rei Kurita** (Emory University, USA)

"Study of fragility in binary colloidal suspension"

P57. **Cancelled**

P58. **Patrick Charbonneau** (Duke University, USA)

"Glass Formation Without Geometrical Frustration: A Study of 4d Hard Spheres"

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P60. **Aleksei Bytchkov** (ESRF, France)

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P63. **Joonhyun Yeo** (Konkuk University, Korea)

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