

RIKEN-Vancouver Joint Workshop on Quantum Computing

- Aug. 24 - Aug. 25 (Tokyo) starting at 8:30 am
- Aug. 23 - Aug. 24 (Vancouver) starting at 4:30 pm

Purpose of the workshop:

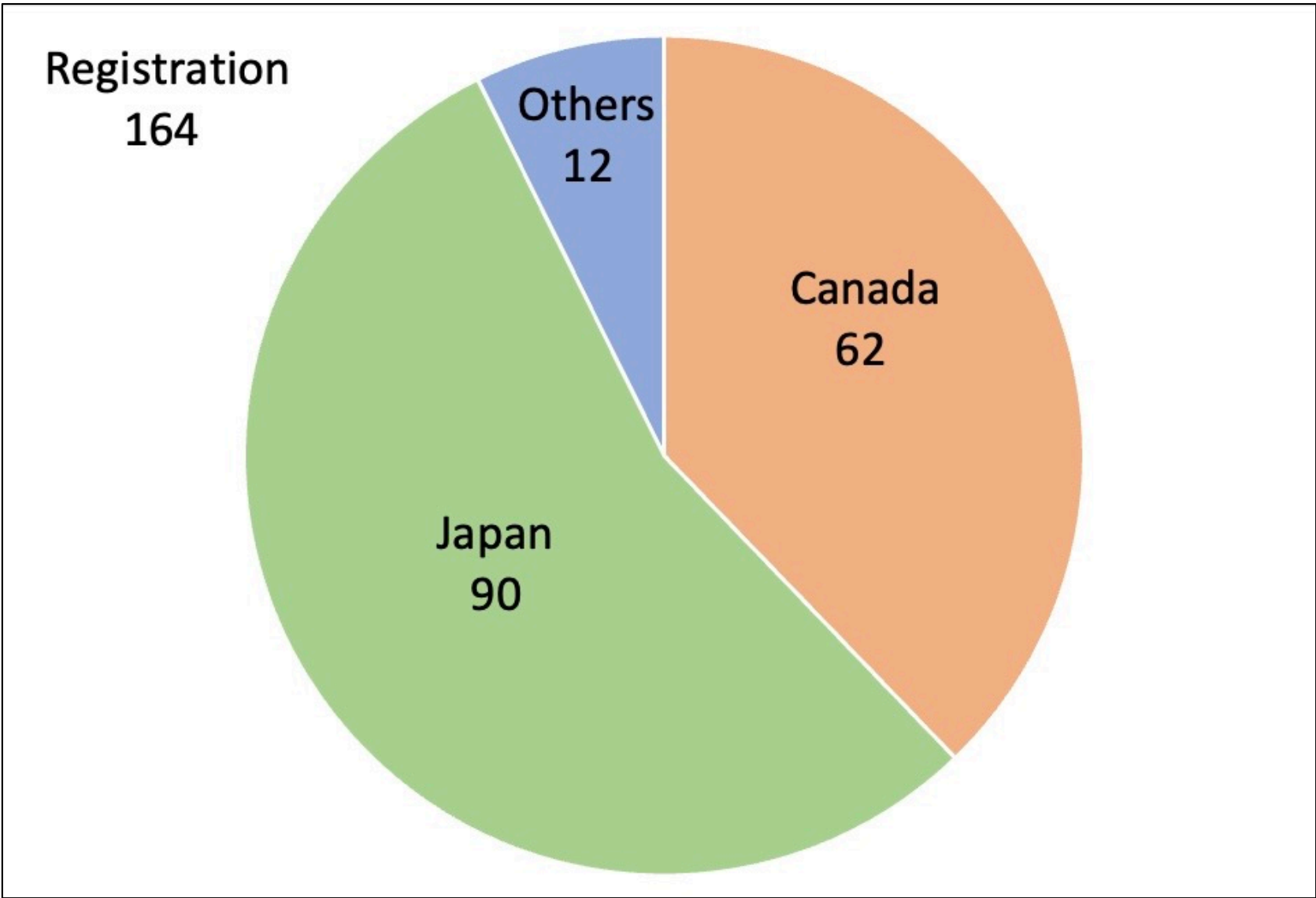
The main aim of this workshop is that the quantum people in RIKEN ([iTHEMS](#) and [RQC](#)) and Vancouver ([Quantum BC](#)) get together online to discuss scientific activities and explore future collaborations.

Organizing Institutes:

iTHEMS: RIKEN Interdisciplinary Theoretical and Mathematical Sciences Program
RQC: RIKEN Center for Quantum Computing
Quantum BC

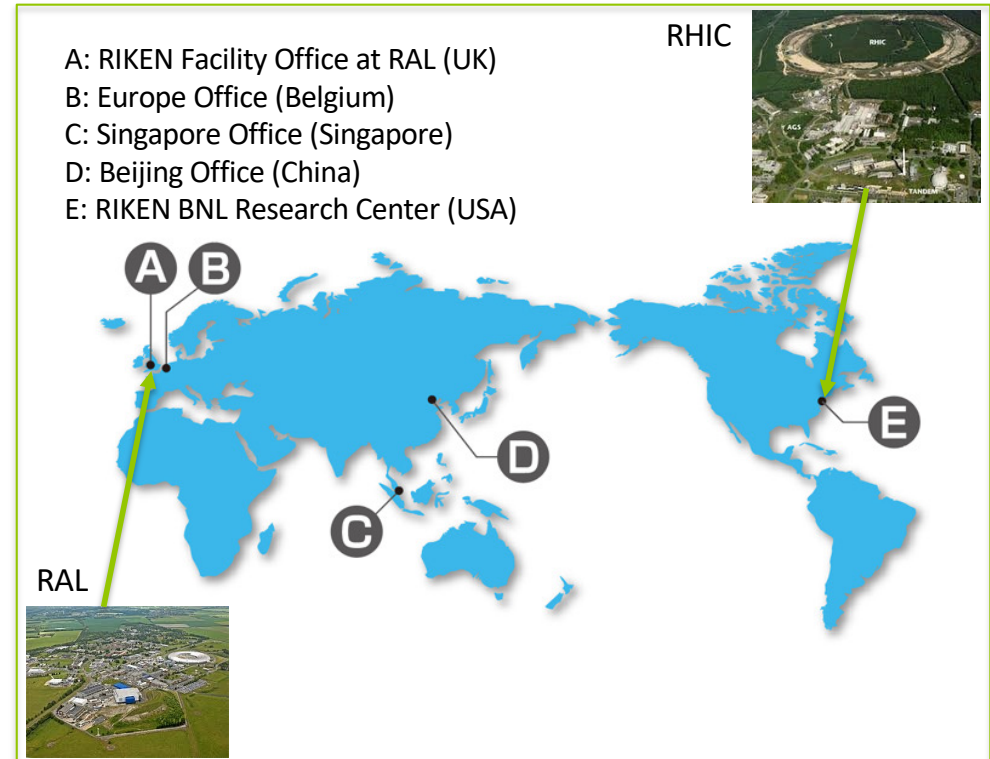
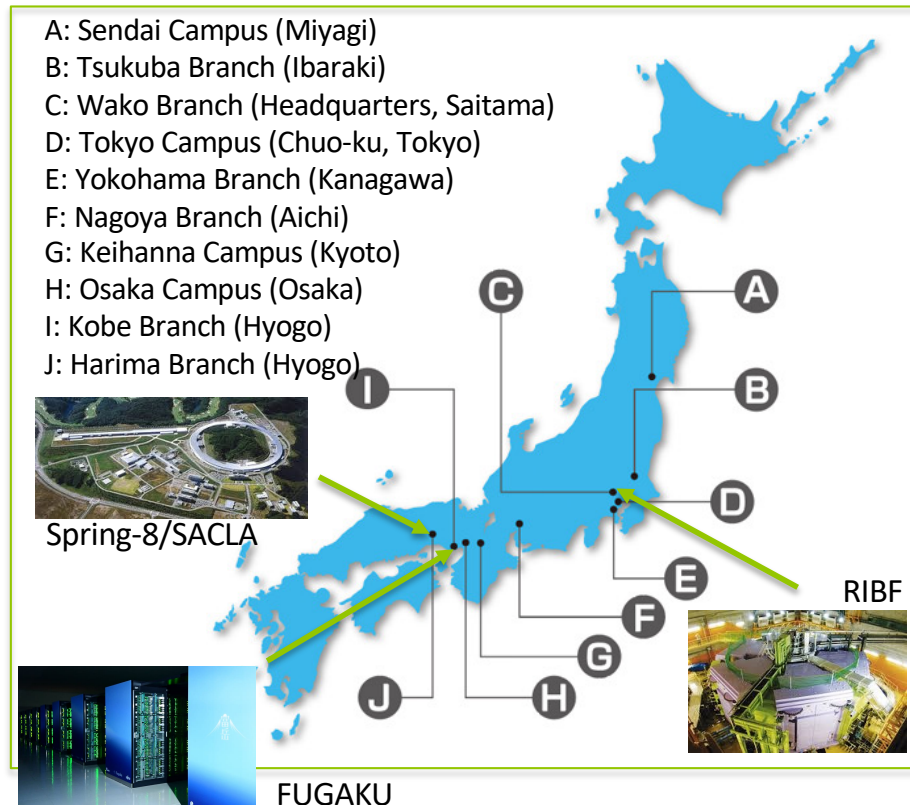
Organizers:

[Tetsuo Hatsuda](#) (iTHEMS), [Yasunobu Nakamura](#) (RQC)
[Shunji Matsuura](#) (1QBit), [Joseph Salfi](#) (UBC)
[Erika Kawakami](#) (RQC / RIKEN CPR), [Neill Lambert](#) (RIKEN CPR)

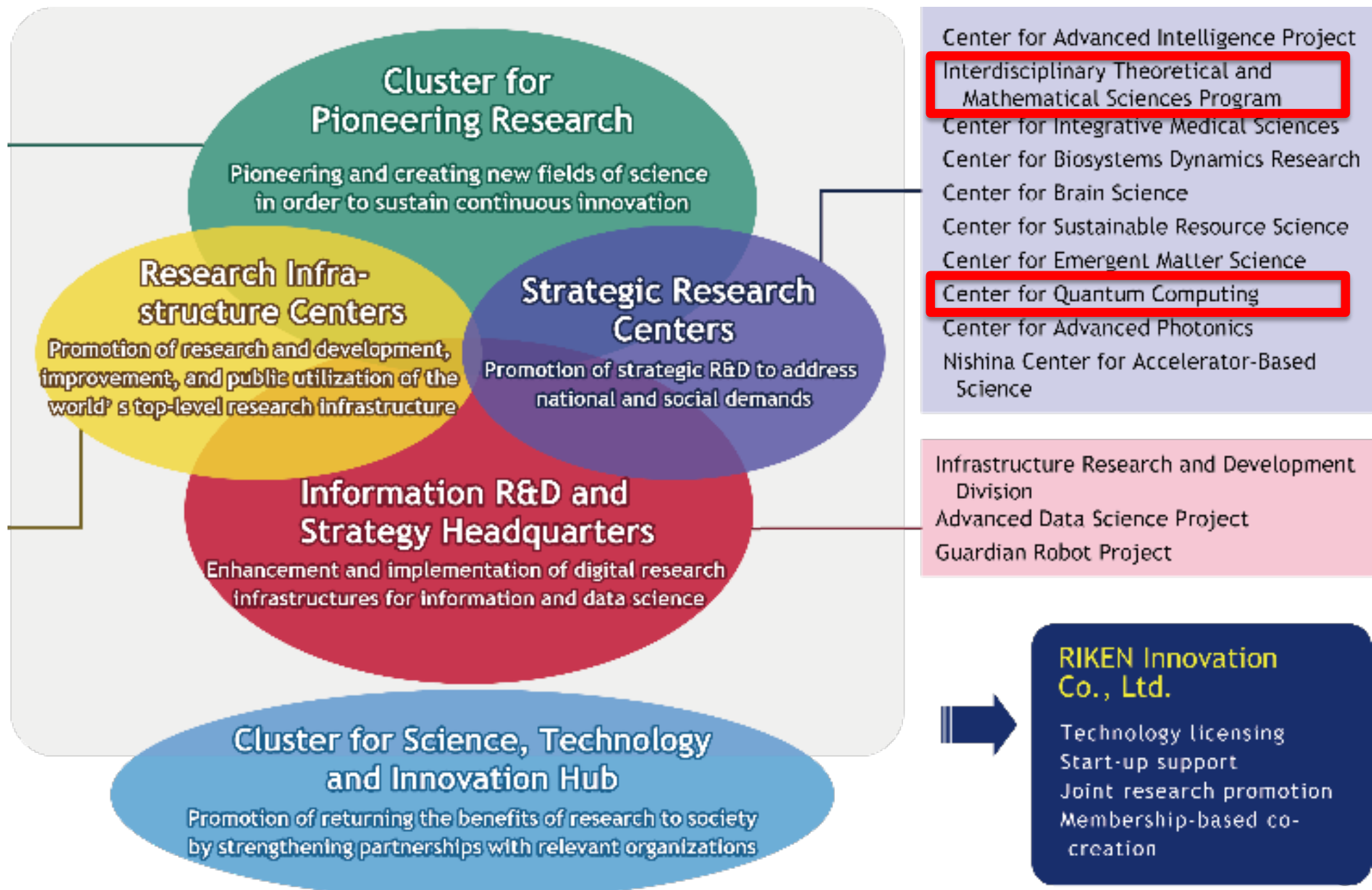


RIKEN (1917-)

- **First and Largest national research Institute in Japan**
~ 3000 researchers (10 domestic campuses and 5 overseas offices)
- **Covering all fields in natural sciences**
Physics, Chemistry, Life, Mathematics, Engineering, Information, Computation etc
- **Having big facilities**
Light source (SPring-8), Supercomputer (FUGAKU), Heavy-Ion Accelerator (RIBF)



Structure of RIKEN





RIKEN Interdisciplinary Theoretical and Mathematical Sciences Program

FEATURED NEWS

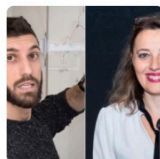
RIKEN NEWS: What is the Significance o...



Program Director Tetsuo Hatsuda is interviewed on the RIKEN website and summer issue of RIKEN NEWS 2021...

2021-06-25

The work of a research group, including ...



The work of a research group, including Dr. Maria Dainotti and Enrico Rinaldi, has been featured in several institutional...

2021-06-01

First Clarification of the Network Structu...



A collaborative research group, including Prof. Hideaki Aoyama (Senior Visiting Scientist, iTHEMS), has successfully use...

2021-05-27

Is



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Group of theorists (~ 50) under one roof

- mathematicians
- theoretical physicists
- astrophysicists
- theoretical chemists
- theoretical biologists
- information scientists
- computational scientists

RIKEN iTHEMS

極限宇宙

Extreme Universe CELL

新しい幾何学

Future Geometry CELL

数理 AI

Mathematics and AI CELL

生命進化

Life and Evolution CELL

$$2b\gamma = \pi(s+s'),$$

$$2b\psi = \pi(s'-s').$$

$$\Lambda \frac{d}{d\Lambda} Z[\Lambda] = i \int d\phi \int \frac{d^4 p}{(2\pi)^4}$$

$$(\phi(p)(p^2 - m^2)\phi(-p) \frac{b^2}{\Lambda^2} e^{-\frac{b^2}{\Lambda^2} \phi^2} + \Lambda \frac{d}{d\Lambda} Y_{int}(\phi)) e^{iS}$$

$$\overline{w\Delta z} = Cov[w, z] + E[w\Delta z]$$

$$P^2 + 2pg + g^2 = 1$$

$$\frac{dV_{\text{total}}}{dt} = P_{\text{total}} \sum_j I_j - C_{\text{total}} V_{\text{total}}$$

$$S = k_B \log \Omega$$

$$\square \tilde{\phi}(x)$$

$$= 0, [\tilde{\phi}(x, t), \tilde{\pi}(x', t')] = i\hbar \delta^4(x - x')$$

$$G_{\mu\nu} = \frac{8\pi G}{c^4} \langle \psi | T_{\mu\nu} | \psi \rangle$$

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$\langle \psi | \psi \rangle = \frac{2}{\sqrt{2}} \frac{1}{\sqrt{2}} \log 2$$

$$\langle e^0 \rangle = 1$$

$$P_r(0) = P_r(-\sigma) e^{\sigma}$$



$$\int_{-\infty}^{\infty} dx e^{-x^2} = \sqrt{\pi}$$

$$F_{n+2} = F_n + F_{n+1}$$

$$S_{\text{HVV}} = \int_{R_0}^{\infty} \int_{R_0}^{\infty} d^4x e^{-\epsilon(|t|+|z|)} d^4z$$

$$\frac{\partial u}{\partial t} = f(u, v) - \tau_u u + D_u \Delta u$$

$$\frac{\partial v}{\partial t} = g(u, v) - \tau_v v + D_v \Delta v$$

$$\begin{cases} \frac{dx}{dt} = \alpha xy - \beta xy \\ \frac{dy}{dt} = \delta xy - \gamma y \end{cases}$$

$$\frac{R'}{R} = \frac{\partial \ln R}{\partial \ln(\tau_u - \tau_v)}$$

$$S = \int_{\mathcal{M}} \int_{\mathcal{M}} \mathcal{L}(x, y) dx dy$$

$$+ 2 \int_{\mathcal{M}} \int_{\mathcal{M}} \mathcal{L}(x, y) dx dy$$

$$ADM = \frac{1}{16\pi G} \int_{\Sigma} \sum_{i,j} (g_{ij} - 3\delta_{ij}) \dot{h}_{ij} \geq 0$$

$$\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s} = \prod_p \frac{1}{1 - p^{-s}}$$

2718281828459045	23538 82874 71352
66291 75274 7893 9895	35149 46964 62172 48766
39355 57292 7171 82176	52516 82716 27666
39189 26868 9921	81741 55968 29845 57298
81592 52686 95616 87381	32328 82799 54987
63293 2689 87251 95251	81581 18268 34187 93878
21518 89149 95188	41675 89244 76146 86588
82264 88016 8474 11853	71253 54251 31 8735987
71445 120613 571	27618 33888 28135 12915
83888 75284 49338 26568	29768 67371 13288 78932 87891
27445 47484 72586 94871	28951 81516 92636

$$V(G, D) = E_{P_1} [\log D(x)] + E_{P_2} [\log (1 - D(G(x)))]$$

$$W(G, D) = \max_D E_{P_1} [D(x)] - E_{P_2} [D(G(x))]$$

$$\mathcal{H} = \sum_{i=1}^n x_i, \dots, i \in I_1, \dots, I_n$$

$$G(z) = \int \frac{GM(z)}{z - t} dz$$

$$\lim_{\Lambda \rightarrow \infty} \frac{1}{\Lambda} \log E [C_{\Lambda}(u)] = \Theta_{\Lambda}(u)$$

$$\frac{\partial P(x, y)}{\partial \theta} = \frac{\partial}{\partial x} \alpha_1(x, y) P(x, y) + \frac{1}{2} \frac{\partial^2}{\partial x^2} \alpha_2(x, y) P(x, y)$$

$$P(B|A) = \frac{P(A|B)P(B)}{P(A)}$$

$$\frac{\partial u}{\partial t} = D \nabla^2 u + f(u)$$

$$\dot{v} = v - \frac{v^2}{2} - w + I_{ext}$$

$$\tau \dot{w} = v - a - bw$$

$$Y(M) := \sup_c \inf_{g \in C} \int_{\mathcal{M}} \frac{du^2 + dv^2}{\sqrt{g(u, v) + \tau}}$$

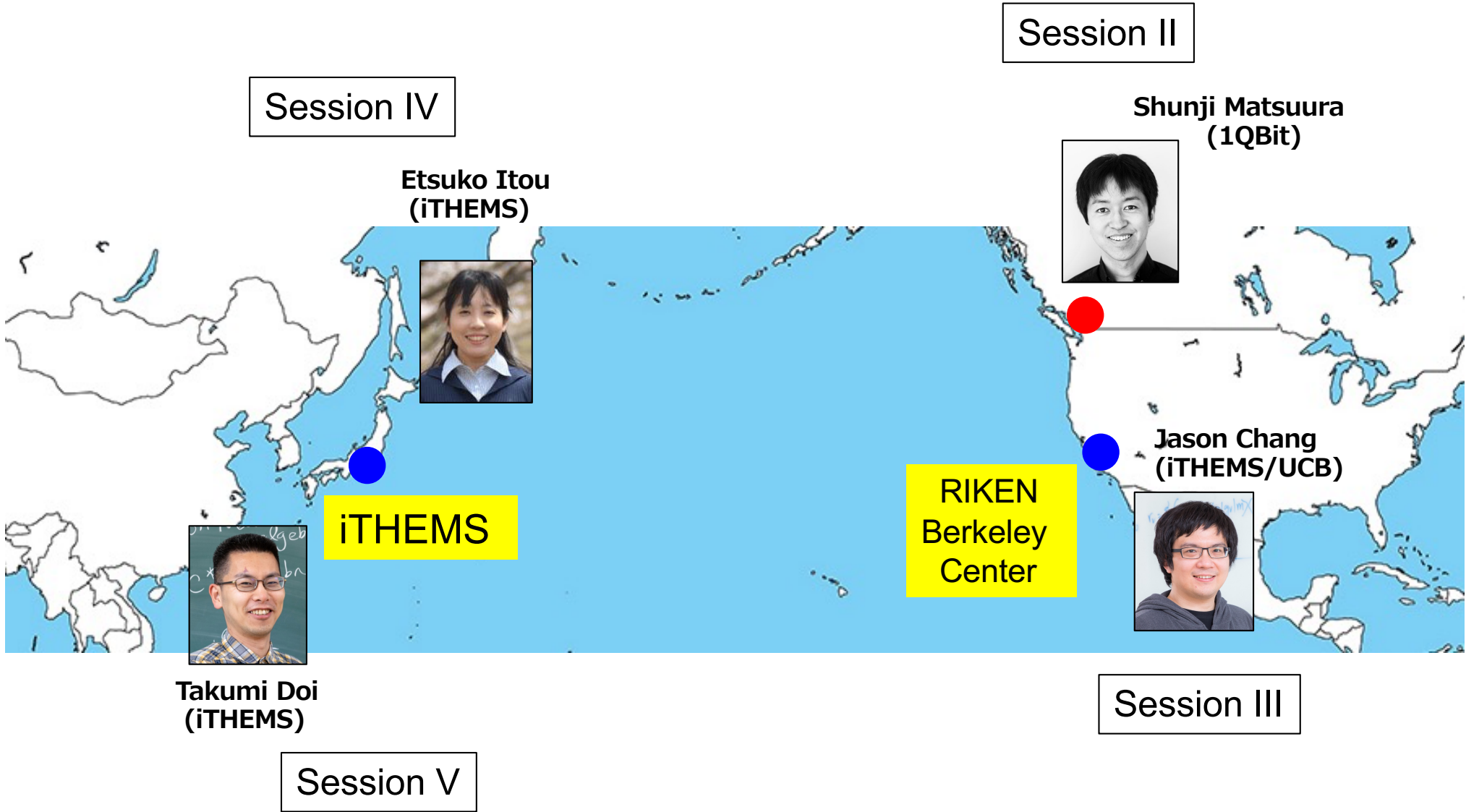
$$\begin{cases} \square \psi = 0 \\ F_A = \sigma(\psi) + i\omega \end{cases}$$

$$\text{Index } \hat{\Psi} = \int_{\mathcal{M}} \text{ch}(E) \hat{A}(M)$$

$$\partial_{\mu} J_{\nu}^{\mu} = 2N_f \frac{e^2}{32\pi^2} F_{\mu\nu} \tilde{F}^{\mu\nu}$$

$$\chi(X) = \sum_{i=1}^n (-1)^i \text{rank } H_i(X)$$

$$\gamma = \sigma(W_0) = (W_0, \dots, \sigma(W, x), \dots)$$



Announcements

- Each scientific talk :
25 min. presentation + 5 min. discussion

- Questions :
Raise your hand at the discussion time

- Breakout rooms after each session:
 - Each speaker will be assigned to a separate room
 - Participants can choose one of the rooms to ask questions.

ENJOY !