Overseas Travel Report (Computational Science Alliance Support)

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Program: NQSTI International School – Advances in Atomic and Photonic Quantum Technologies
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With support from the Computational Science Alliance, I attended the NQSTI International School “Advances in Atomic and Photonic Quantum Technologies” in San Benedetto del Tronto, Italy, from 1 to 5 September 2025. This summer school is an intensive international program for graduate students and early-career researchers, offering lectures, tutorials, and poster sessions on topics ranging from AMO physics to quantum sensing, metrology, and their connections to quantum information. I joined in order to broaden my knowledge beyond quantum error correction, to present my current research and receive feedback, and to build an international network for future collaboration.

To reach the venue, I first arrived at Rome Fiumicino Airport (FCO), where the arrivals hall looked like a shopping mall with numerous restaurants and clothing stores. From there I took a pre-booked express coach to San Benedetto del Tronto. The bus did not pass through Roma Termini, which I had hoped to see, but the wide countryside views from the window were a pleasant compensation. At my Airbnb I quickly discovered a cultural difference: in Europe the ground floor is counted as floor zero, so the “second floor” indicated by the host actually corresponded to what is the third story in Japan. When I finally reached the correct door, I also had to learn its peculiar opening method. After turning the key clockwise, I needed to pull the handle once and then push, something a kind neighbor showed me. On my first evening I shared pizza with my German roommate at a local restaurant, which helped me settle in.

During the school I attended lectures on Fermi liquids, atom interferometry, quantum sensing and metrology with atomic systems, and applications of machine learning to quantum systems. These sessions gave me valuable perspectives from outside my own research field. On 3 September I joined a tour of Ascoli Piceno, where the preserved stone architecture and the solemn atmosphere of a church made a deep impression on me. When a local participant asked what I thought of the town, I said it felt like being in *Dragon Quest*. This sparked a lively conversation, and to my surprise he immediately recognized the reference and mentioned also playing Pokémon. Another participant added that they watch anime every day, and soon the discussion turned to Japanese subculture. I was especially amused to hear that “Jiji” from *Dandadan* is very popular. These conversations reminded me how cultural references can create instant connections across different backgrounds.

On 4 September I presented a poster explaining how a diffusion model can be applied to error decoding for Floquet codes. I also reported numerical results on logical error scaling with threshold and code distance, as well as on decoding time. A researcher who had given a lecture

on applying machine learning to physics expressed strong interest in my work, and we discussed training methods and evaluation conditions in detail. This was a particularly valuable exchange. From these discussions, my next tasks became clear: I need to further optimize the machine learning algorithm to improve the accuracy of scaling for logical error rates and decoding time with respect to code distance, while also developing more realistic datasets and performing careful comparisons with baselines such as MWPM.

Overall, the school expanded my international network, clarified the direction of my research, and strengthened my motivation to pursue the design of quantum error-correcting codes and decoders that can adapt to many different types of quantum computers. My ambition is to develop methods that are applicable across a wide range of qubit modalities, including atomic and photonic platforms as well as others. I am sincerely grateful to the Computational Science Alliance for making this valuable opportunity possible.