

MSCA PF 2024 - PHYS

Free electron laser quantum optics (FELQO)

Something about myself

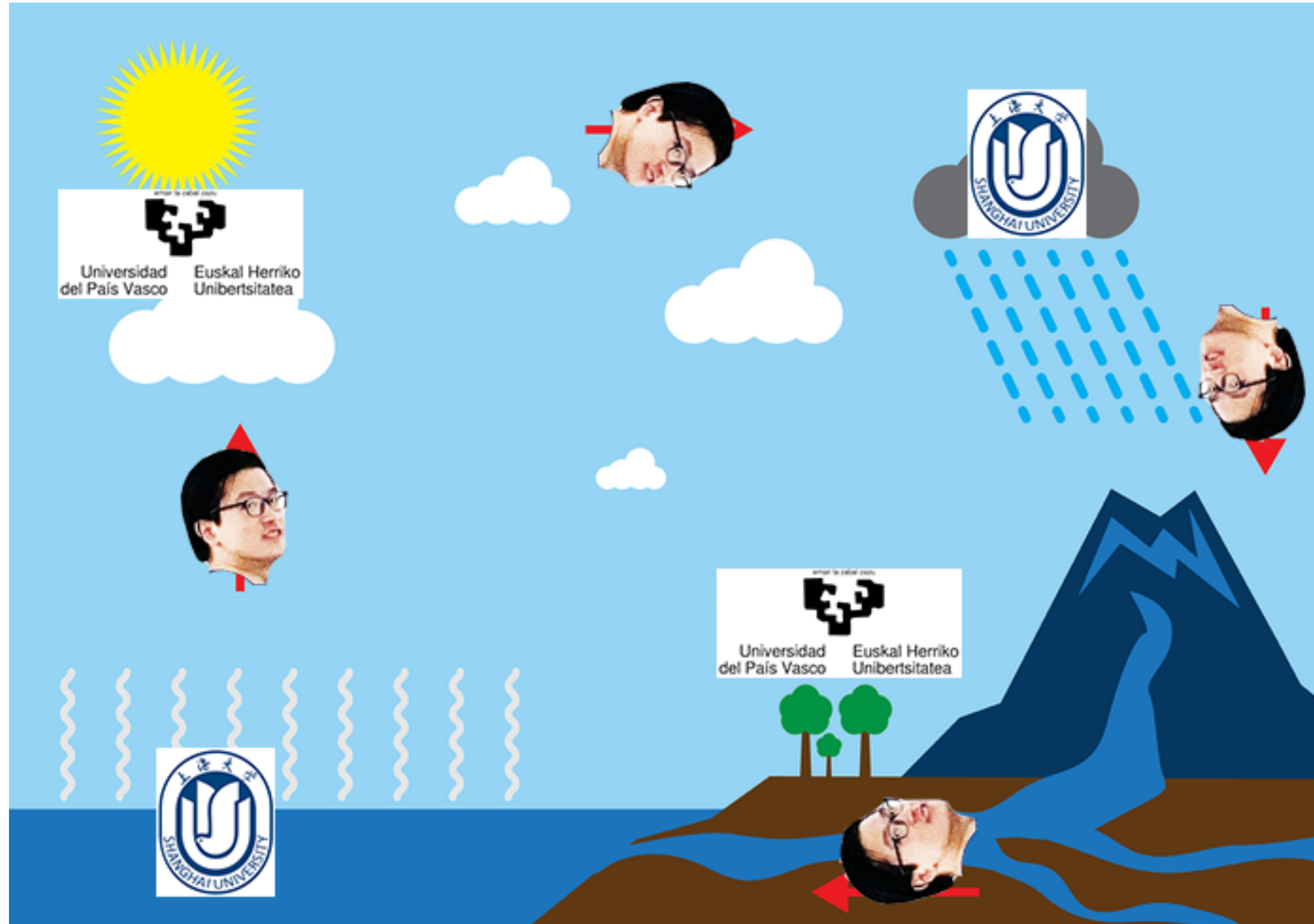
Timeline and metrics

- June 2024, Shanghai, PhD
- June 2024, vacation/academic visit in Bilbao till October
- August 2024, Mikel: MSCA 2024 call due in September
- Aste Nagusia, wrote the proposal
- September 2024, Submitted before deadline
- Chilling in Shanghai till February
- February 2024, won the lottery
- April 2024, first day

By the day I applied MSCA 2024

- Fresh PhD
- Worked in quantum control, quantum machine learning, and a little bit quantum foundation
- 20+ papers and preprints, 70+ % first author, 1 last author.
- PRLs and Q1 journals
- 500+ citations
- My proposal was **NOT RELATED TO** what I did during my PhD time.

Why NQUIRE and EHU?



Institution and host

- Long collaboration history, from QUTIS era (2017) to NQUIRE era (2020)
- Host: Mikel Sanz, collaborating since I was an undergraduate and he was a postdoc
- Quantum computing and architectures (Mikel Sanz)
- Quantum designs and nanoscale technologies (Jorge Casanova)
- ~~Quantum control and quantum optics (Xi Chen)~~

The goal of this grant

Free electron laser quantum optics

- Quantum theory for free electron laser and photon-induced near-field electron microscopy (PINEM)
- Quantum theory for high harmonic generation
- Quantum control of PINEM spectrum
- Quantum simulation with free electrons
- Quantum computing with free electrons
- Make NQUIRE great again and rebuild the third line

Results

- Quantum simulation of topological bound state and fractional charge (NatComm)
- Stern-Gerlach regime and anomalous Bragg regime in electron diffraction (PRL under review)
- Cavity-free quantum gates with free electron qubits (PRL under review)
- Optimal control and Law-Eberly control of PINEM spectrum (PRX Quantum under review)
- Other papers about quantum foundation (JHEP, PRAs)
- One new 3-year grant awarded, I hope more in the near future

Two-way transfer

- From Mikel's group: I had deeper understanding of digital-analog paradigm for quantum computing, leading to one of the gate design in my single author paper. I got more experience by co-supervising PhD students.
- From me: now there are two new PhD students working on quantum optics and quantum foundations. Step by step we are indeed rebuilding the third line. They both know the theory better as their new research interest. One long quantum control paper first authored by Alatz. Miriam is now happy with her new quantum foundation topics, coming up with elegant work soon.

Txoko Marie Curie



My advice

- It is a lottery, keep calm and carry on
- Talk with lottery winners, check their proposals if possible
- Keep doing good work
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