Bayesian Optimization for Constrained Beam Transport Line Design in the RAON Injector

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2026.08.18

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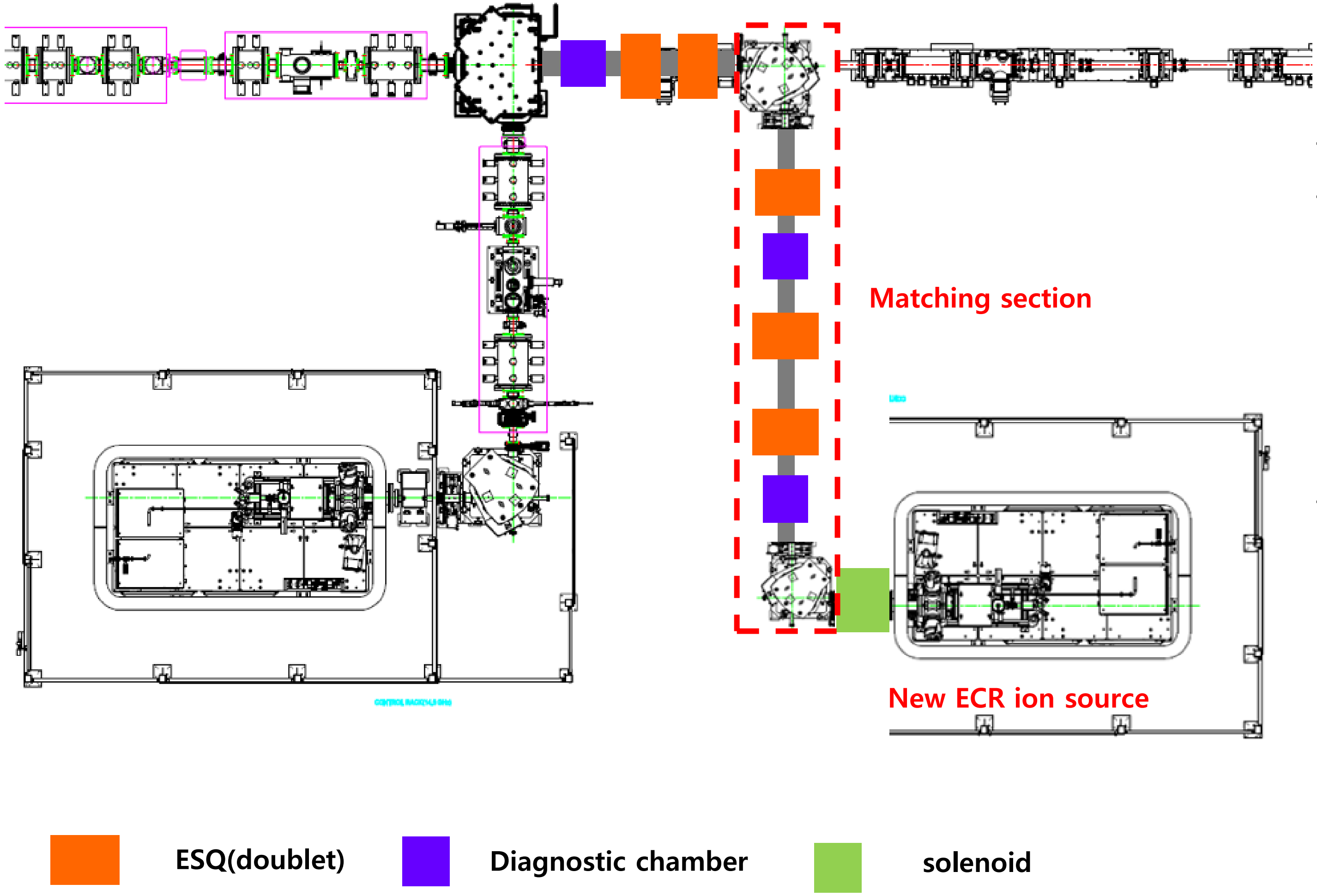
Motivation & Design Problem

- Beam Line Design under Existing LEBT Constraints

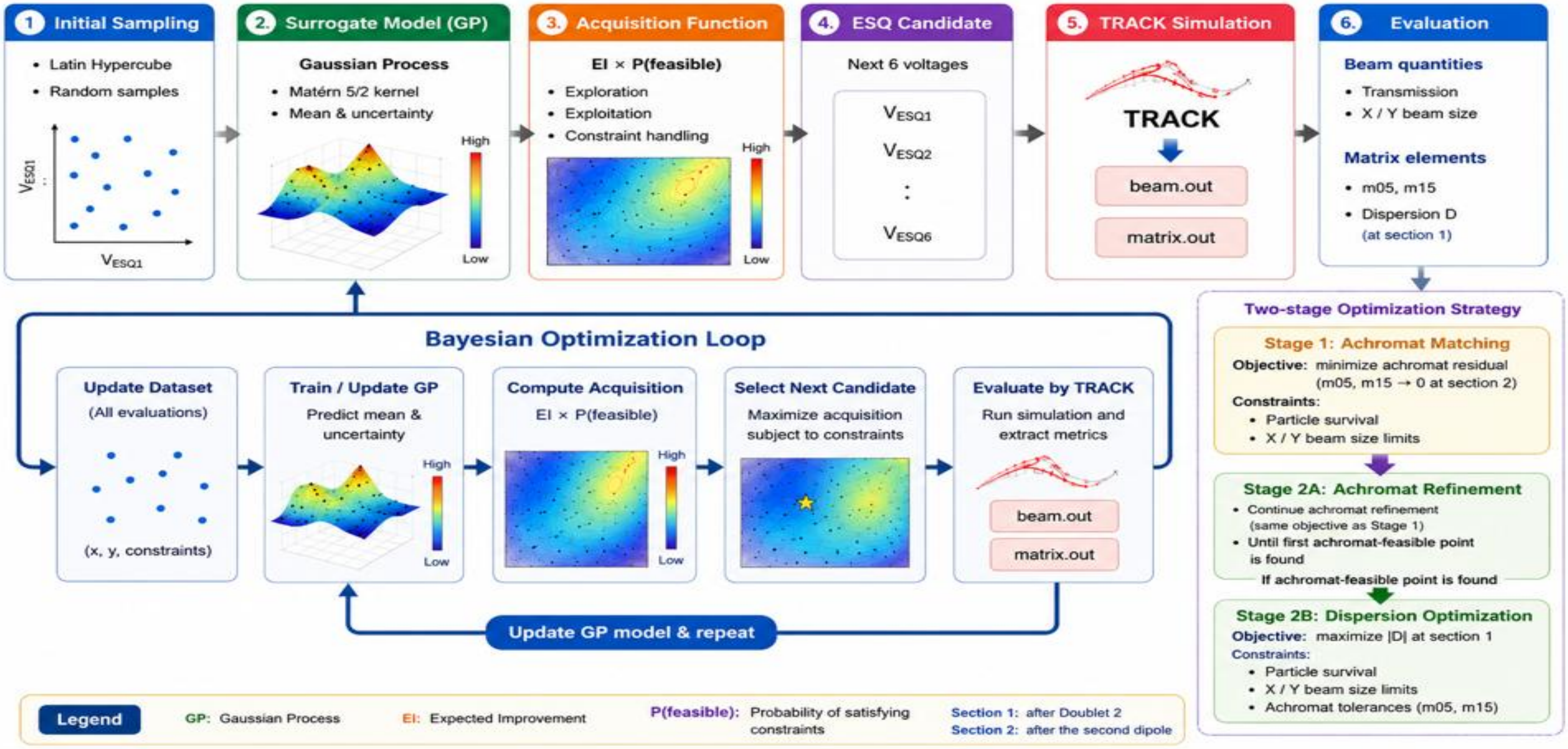


	Optimization setup
Design variables	6 ESQ voltages
Simulation	TRACK
Beam constraints	Particle survival, X/Y beam size
Objective function 1	Achromatic condition after the 2nd dipole
Objective function 2	Dispersion after Doublet 2

The present study focuses on the dipole-to-dipole section, where six ESQ voltages are optimized using TRACK simulations.

Bayesian Optimization Method

- Two-stage Constrained Bayesian Optimization



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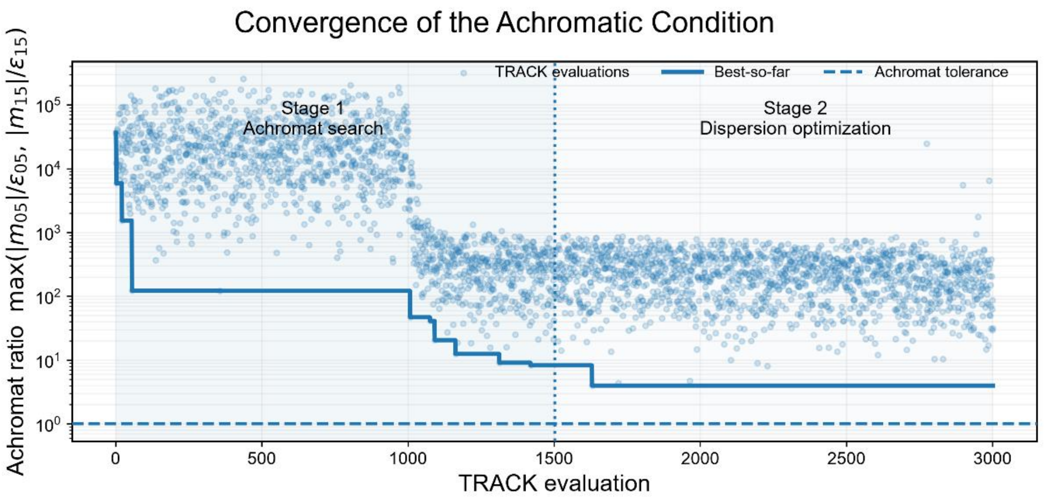
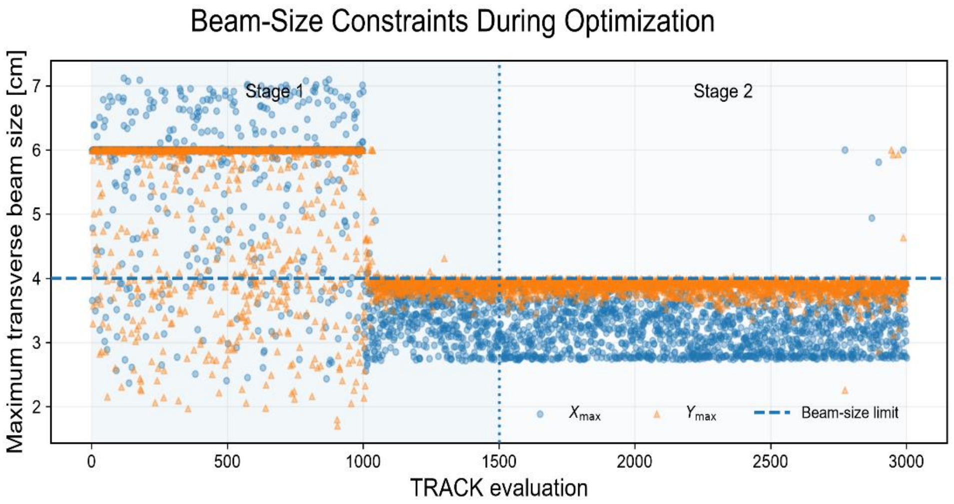
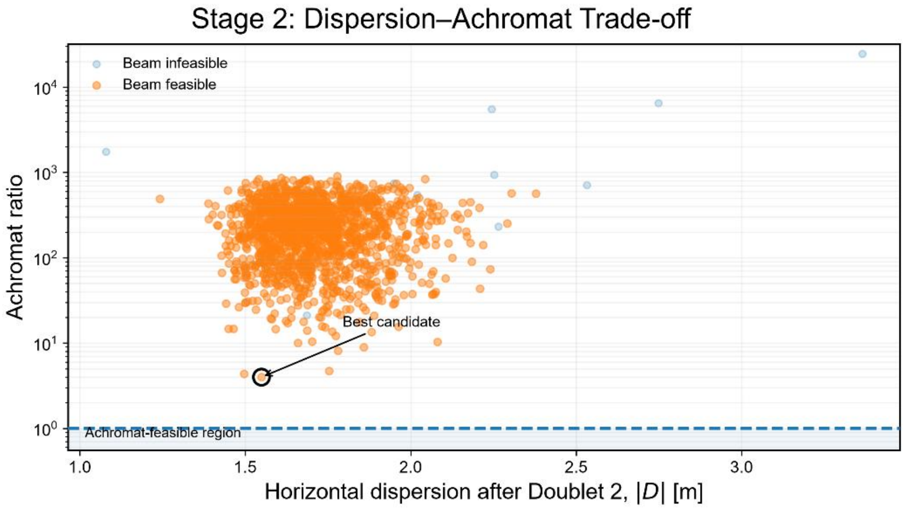
Optimization Results

- Current Optimization Results



- 3000 TRACK simulation
- Beam-feasible configurations were successfully identified.
- The achromatic residual was progressively reduced.
- Target achromat ratio: ≤ 1
- Best achromat ratio: ≈ 3.98



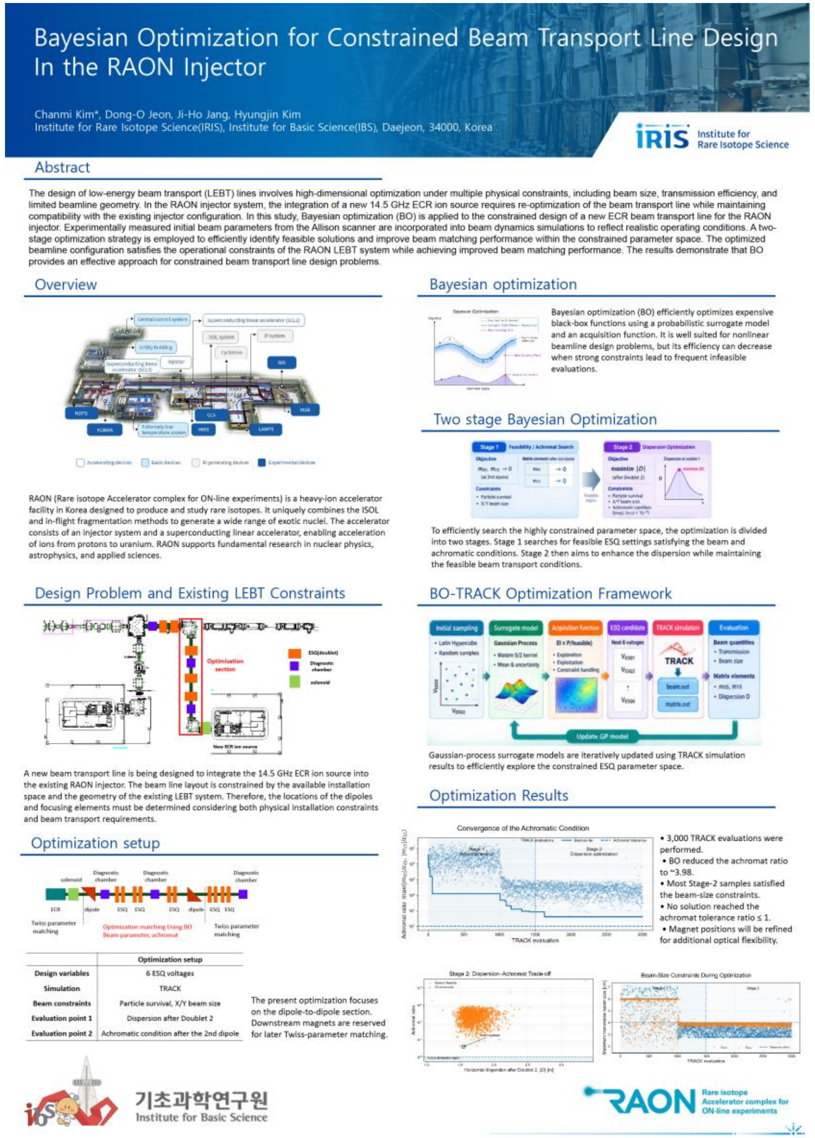


Summary & Next steps

- BO identified beam-feasible configurations in the dipole-to-dipole section.
- The achromat residual was reduced to a best ratio of ~3.98.
- The current lattice does not yet satisfy the achromatic tolerance.
- Next: refine magnet positions, re-run BO, maximize dispersion, and perform downstream Twiss matching.

Poster

Poster number : TUPO003



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Thank you.