

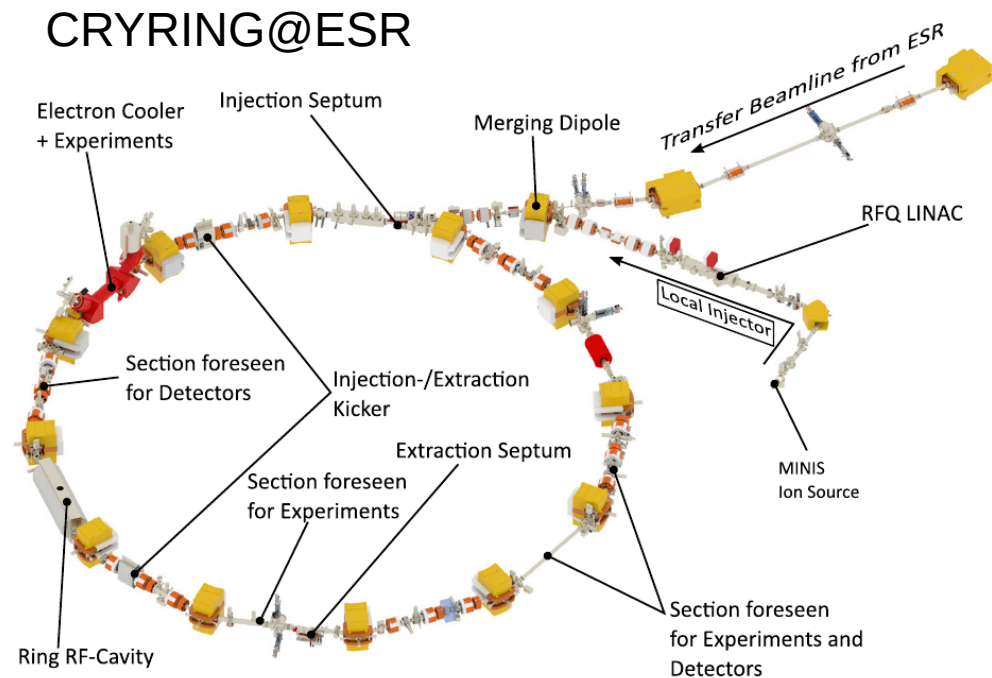
Development of Neural Networks for Accelerator Control



TECHNISCHE
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DARMSTADT

Neural Networks for the Enhancement of Beam Transport Adjustment and Operational Performance of Particle Accelerators

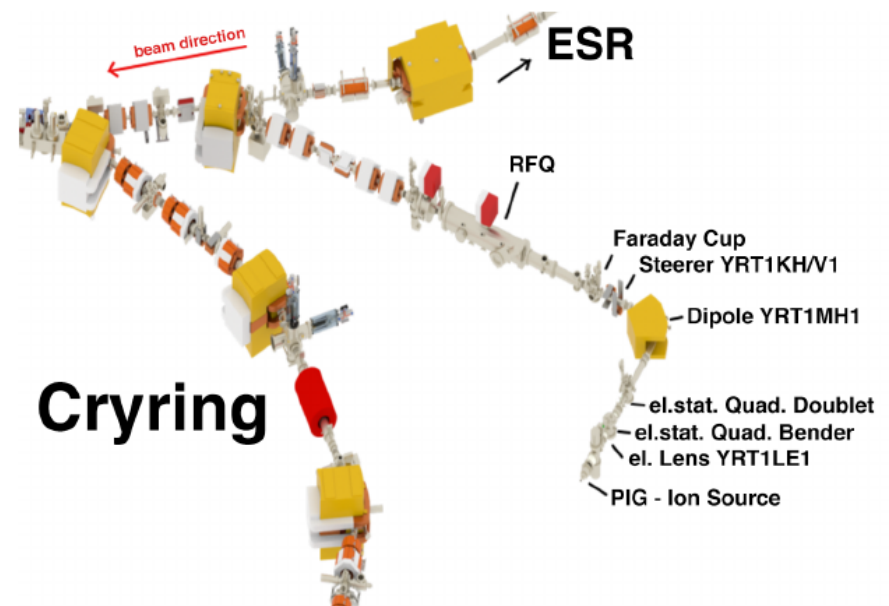
Support of
Parameter Evolution Project
(PEP) @ FAIR



Geithner W. et al., Status and outlook of the [CRYRING@ESR](#) project, Hyperfine Interact (2017) 238:13

Automized Optimization of Beam Lines using Evolutionary Algorithms¹

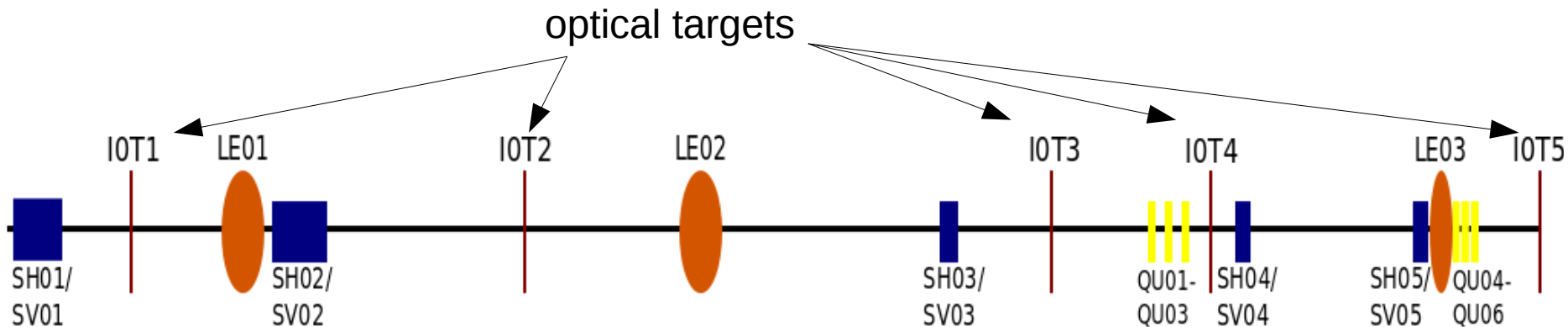
- Successful simulation of optimizing multi-turn injection and beam line
- Successful test of automatic „Parameter Estimation Project“ version at [CRYRING@ESR](#) injector
- Needs:
 - Testing [different algorithms](#)
 - Improving algorithms
 - Optimizing [parameter control](#)
 - Evaluating [limitations](#) due to huge amount of feedback devices



¹S. Appel et al., Proceedings of IPAC2017, Copenhagen, Denmark, THPAB096

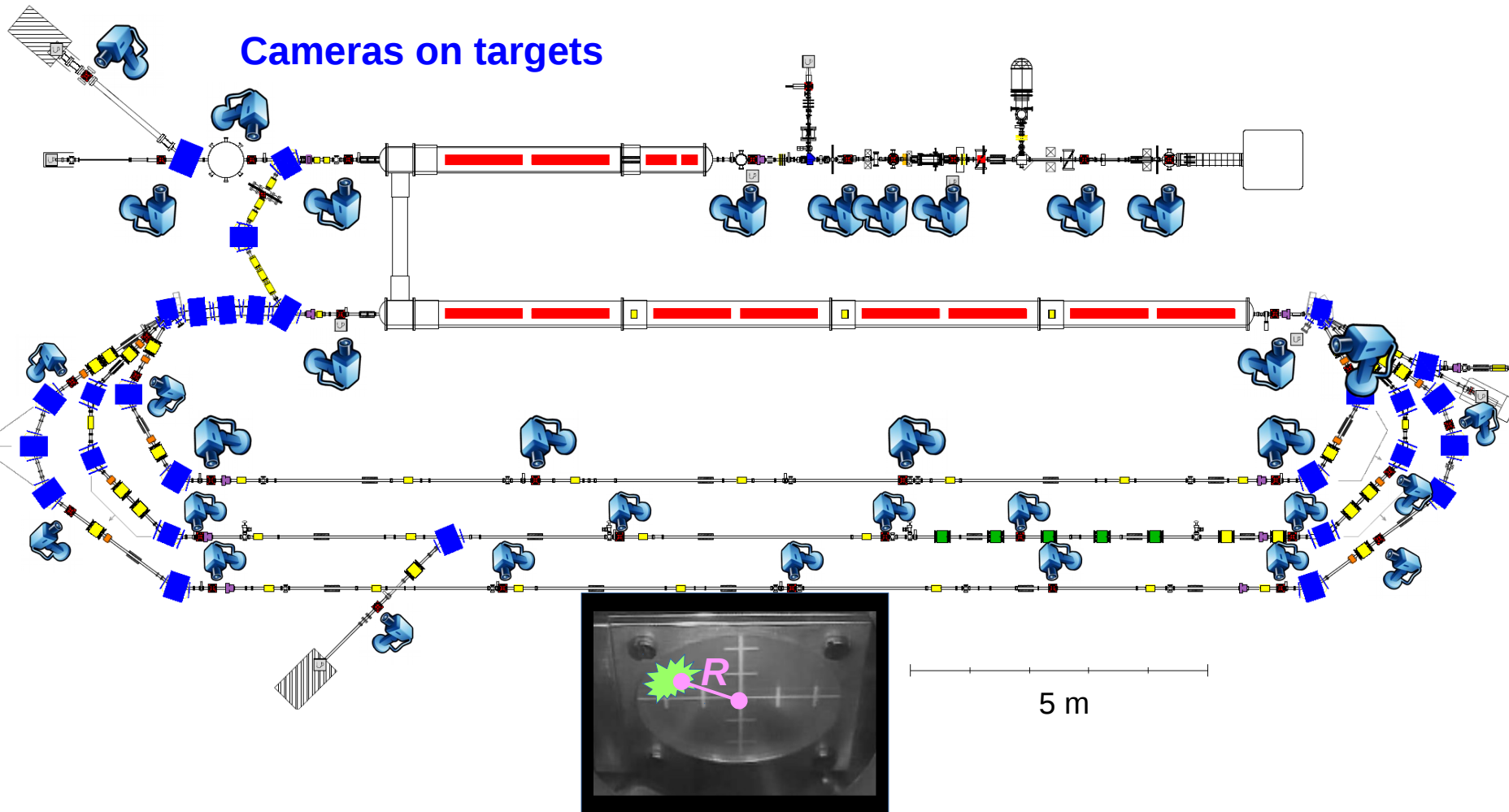
Optimisation of the Injector Beam Transport at the S-DALINAC

- Already done:
 - ✓ Successful simulation of **Marquard-Levenberg optimization** combined with ***elegant*¹** to **optimize beam position on target and maximize transmission**
- Next steps:
 - **Integration of digitized video signals** for feedback optimisation loop
 - **Online-Test**



¹M.Borland, elegant: A flexible SDDS-Compliant Code for Accelerator Simulation, Advanced Photon Source LS-287, 2000.

Beam Diagnostic Elements for Feedback Loops at the S-DALINAC

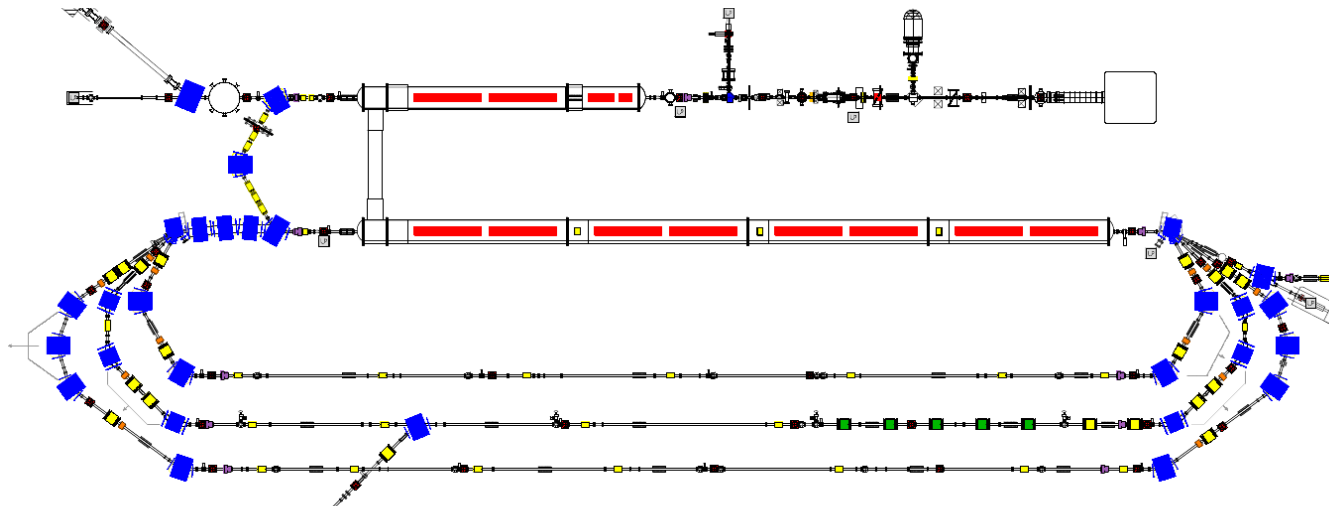


Optimisation of the Beam Transport at the S-DALINAC using NN and GA

Support plans:

Automatic beam adjustment through recirculation arcs/ERL mode using Neural Networks (NN) and Genetic Algorithms (GA)

- Testing / improving different algorithms
- Optimizing parameter control
- Evaluating limitations due to huge amount of feedback devices



Resource Plan (3 year period)

- 1 doctoral position (2/3) 40 kEUR/a
- Travel costs 3 kEUR/a
- Computational hardware (parallel computing with GPU) 20 kEUR
- New beam loss monitors 45 kEUR

- Human resources (3 a): 120 kEUR
- Travel costs (3 a): 9 kEUR
- Hardware : 65 kEUR

194 kEUR
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