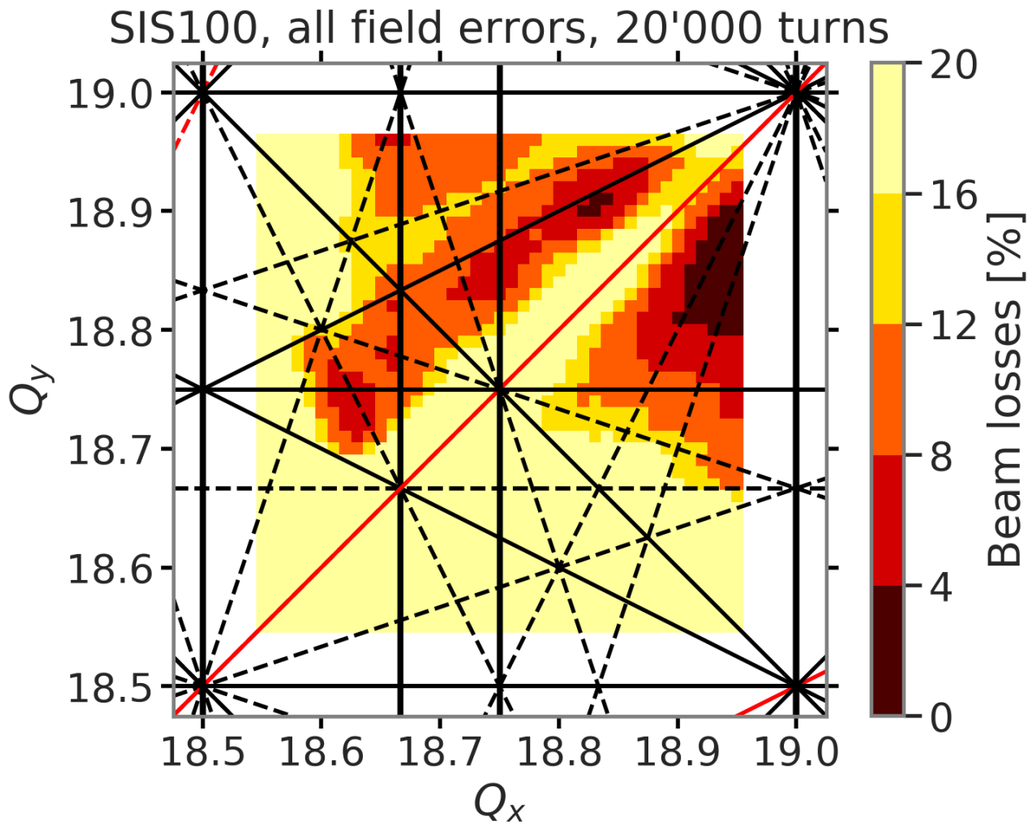
GSI Proposal:
AI Assisted Loss Prevention

Critical to minimize beam loss in superconducting FAIR SIS100 machine:

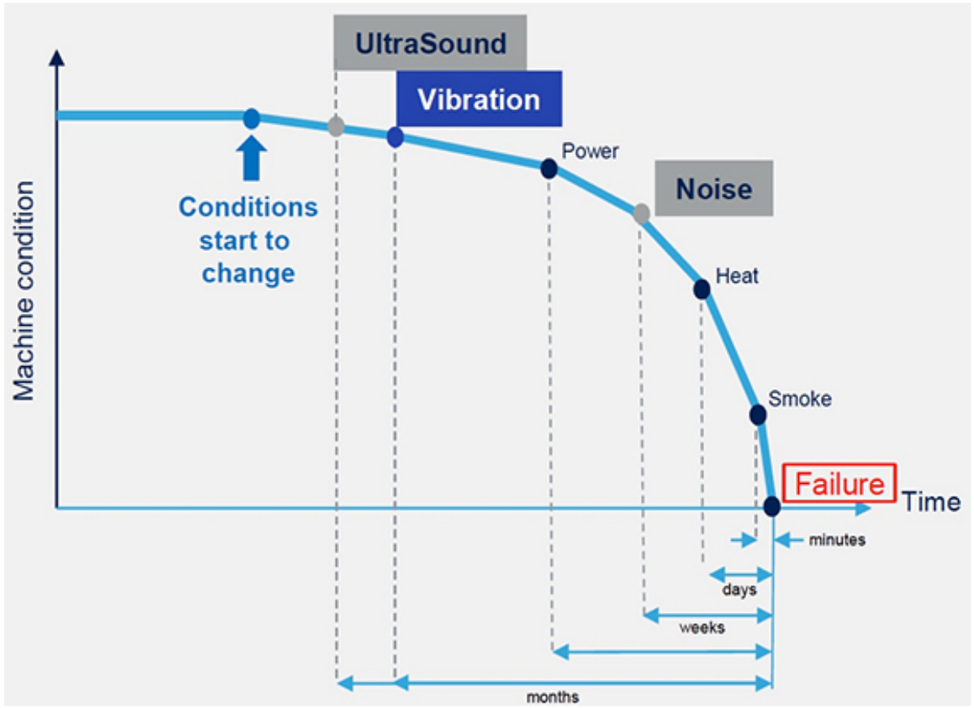
- Beam dynamics dominated by space charge
  - ➢ Computationally demanding simulations!
- Now implemented fast and approximate GPU-enabled simulation models
- Next steps:
  - Establish surrogate model with ML
  - Build prediction tool on top of surrogate model (e.g. for specification optimization, control room operation)
  - Test by applying this newly developed tool to running SIS18 for machine adjustment and online optimization



Computation time:
40 x 40 x 9 x 3 min = 30 day

GSI Proposal:
AI Assisted Failure Forecasting

- <u>Project goal / vision:</u>
- Forecasting undesired machine state
- Apply ML to reduce complexity and supporting human decision making.
- Leverage current industry trends („IoT“, „industry 4.0“, „predictive maintenance“).



- <u>Next Steps:</u>
- Define data model and identify ML algorithms
- Implement, test and enable model for productive use

- <u>Current state:</u>
- Prototype for data acquisition and provisioning established at CRYRING@ESR.
- ML-assisted automated machine optimization has been applied successfully.