



ADVANCES IN AUTOMATIC PERFORMANCE OPTIMIZATION AT FERMI

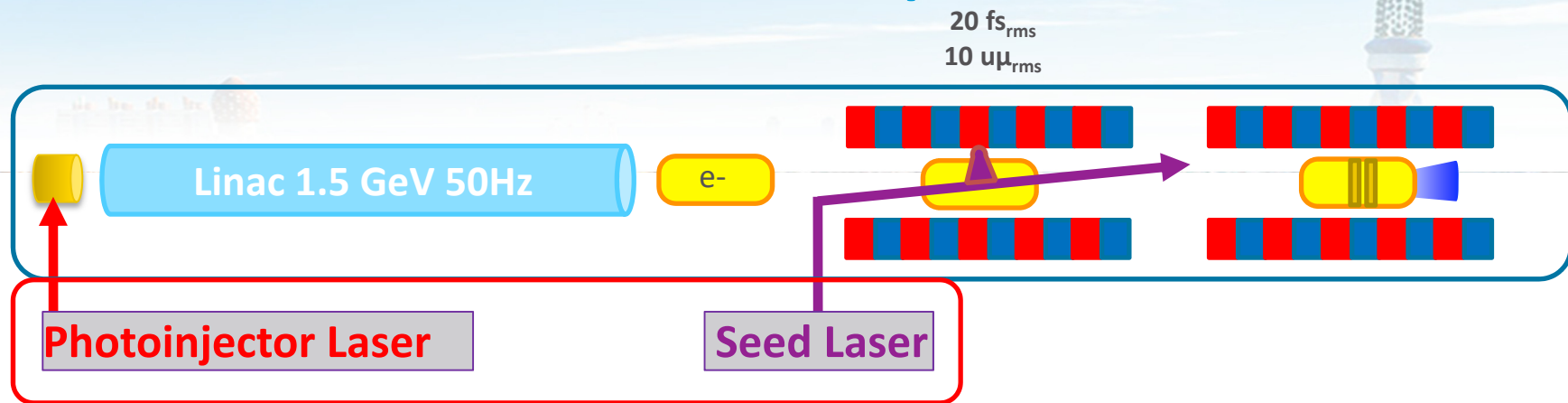
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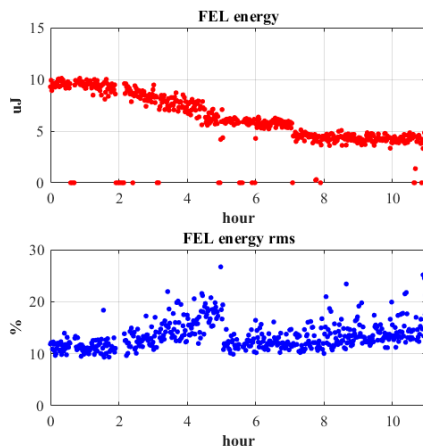
Seeded FEL main technical problem: overlap between electron bunch and seed laser pulse



- 7 electron beam based feedbacks
- 16 laser beam based feedbacks
- The only diagnostic of a good overlap (transverse and temporal) is the FEL radiation.

Short term vs. long term performance

- In the short term the feedbacks are effective to guarantee FEL radiation stability.
- In the long term, sporadic drifts of non observable / controllable variables (ex: thermal drifts, technological limits) could compromise the FEL stability.



- From a model based feedback to data driven optimization.

Data driven optimization

- Define an index, the *FEL Quality Factor*, which summarizes in a number the quality of FEL radiation.
- Correlate the fluctuations of the *FEL Quality Factor* with the machine variables .
- Modify transparently to the experiments the machine parameters in order to minimize their correlation with the *FEL Quality Factor*.



- **Improved FEL stability in the range of days of continuous machine operation.**

