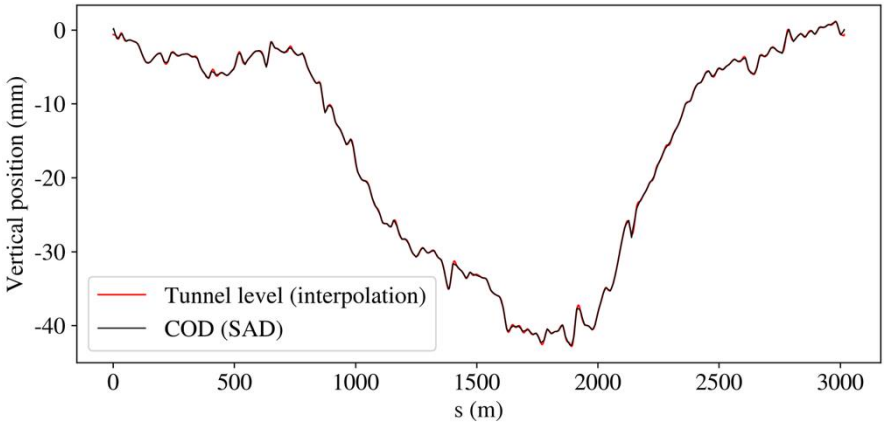
Simulation Study of Tunnel Settlement Effects

- We evaluated the effects of the latest tunnel settlement data on optics distortions and vertical emittance in both the LER and HER.
- The simulations confirmed that the vertical emittance can be reduced to **~5 pm in the LER and ~2 pm in the HER under the following assumptions:**
  - **Ideal orbit/optics corrections can be performed using measured orbit displacements, orbit response and physical dispersions.**
  - **No lattice errors other than tunnel settlement and BPM jitter (2 μm) are considered.**
- However, these results **do not necessarily imply that tunnel settlement is not a source of vertical emittance growth in the actual machine.**
- Rather, the conclusion is that, **in principle, there is no fundamental limitation arising from an insufficient number of measurable observables or available correction knobs** for orbit and optics corrections in the presence of tunnel settlement.

Interpolation of tunnel level data and SAD COD



Summary of results

	HER	LER
Vertical emittance [pm]	**1.8**	**4.9**
BX RMS residual [%]	0.19	0.13
BY RMS residual [%]	0.70	0.56
EY RMS residual [mm]	3.9	4.4