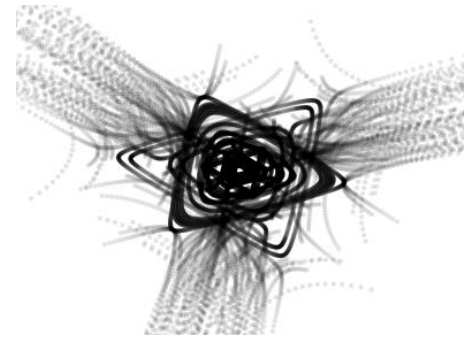




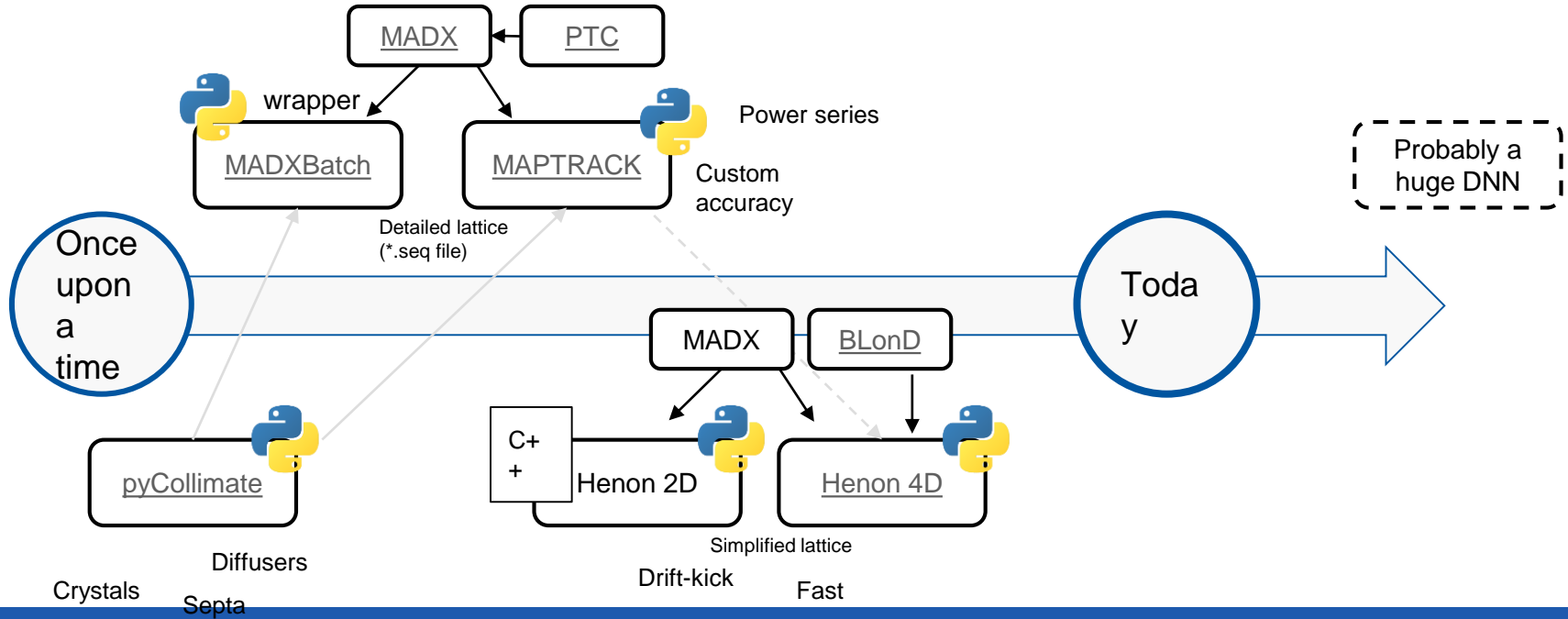
# First look at xsuite for slow extraction

P. Arrutia, T. Bass, M. Fraser, F. Velotti  
iFAST 5.3, October 27th 2022



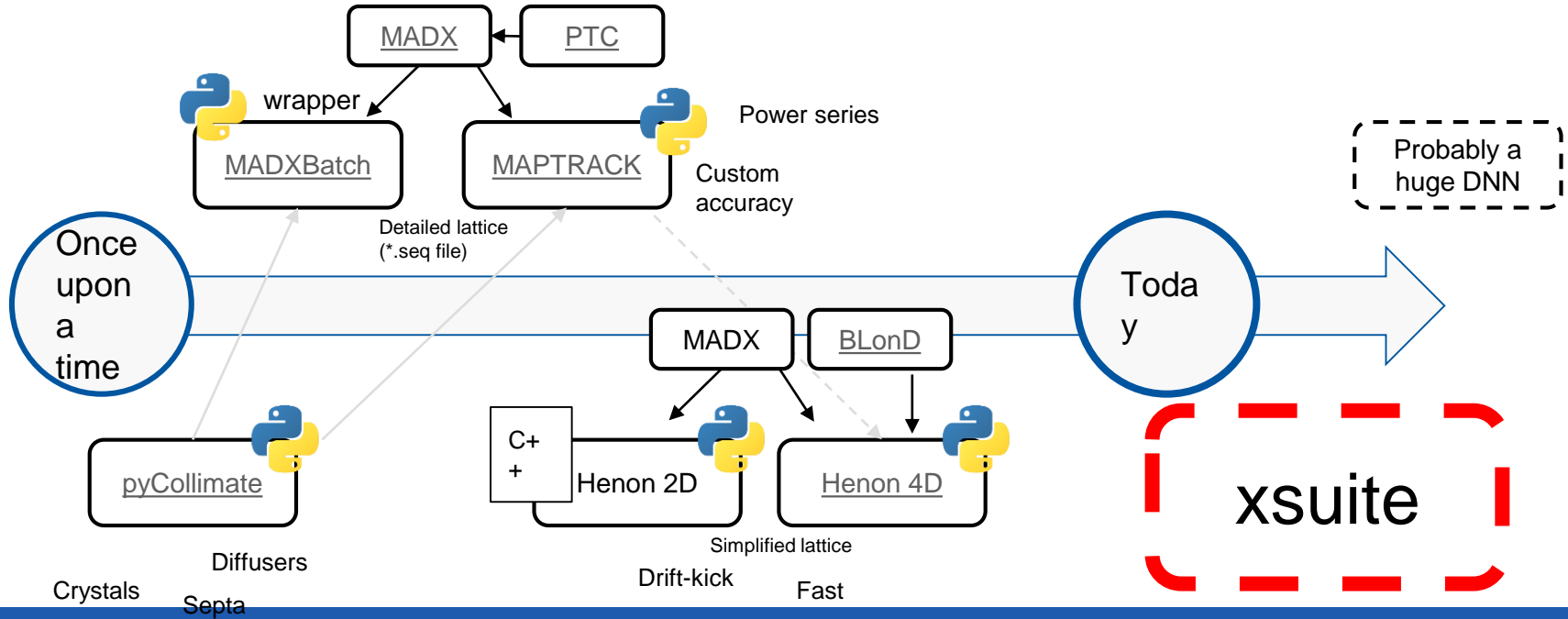
# A (very rough) timeline of our codes

- [Previous presentation](#) browsed the zoo of simulation tools for SX at CERN.



# A (very rough) timeline of our codes

- New powerful specimen has now joined the zoo: xsuite



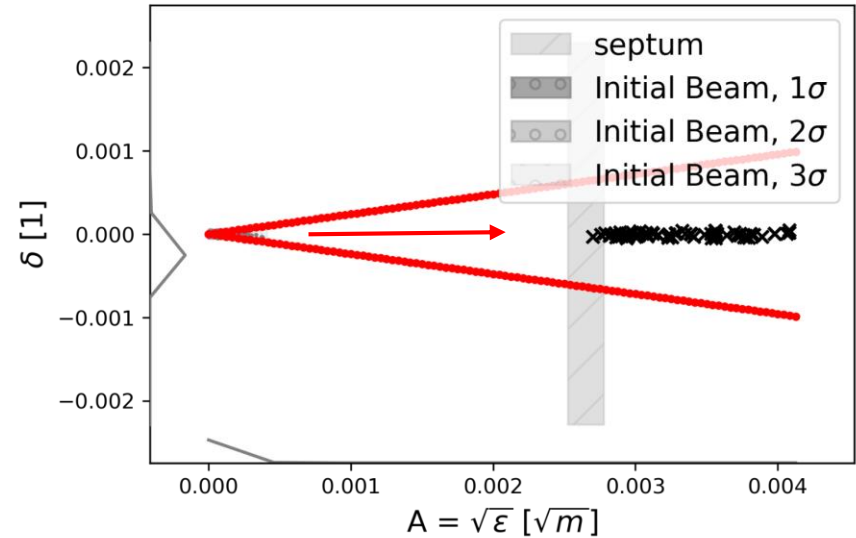
# Key features

- Seamless GPU support (see T. Bass' presentation characterise speed-up and trade-offs).
- Easy time-dependent trims for ripple simulations or RF manipulations (e.g. RFKO).
- Active code development community.
- Possibilities to combine with particle-matter interaction models: crystals, septa blades...

# Benchmarking test

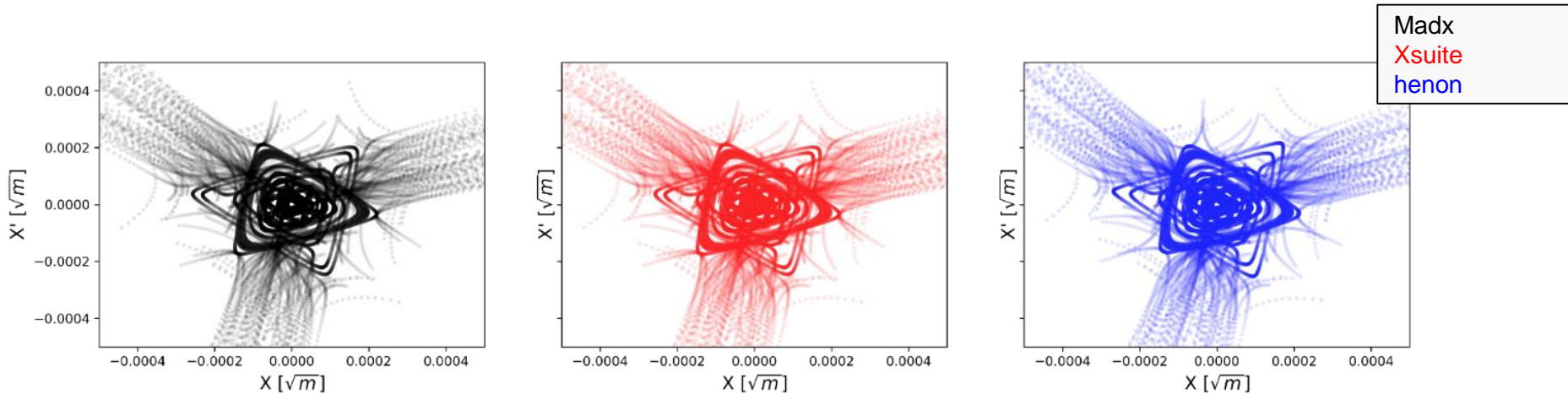
# Setup

- Static simulation of SPS slow extraction performed to compare
  - MADX thintrack
  - Xsuite: lattice directly imported from MADX definition
  - henontrack: linear transport matrix + virtual sextupole.
- Beam distribution:
  - Gaussian  $x, x'$  with typical SPS emittance.
  - Uniform  $pt$  with 1 stopband-width spread
  - $Y, Y'$  was kept at 0



# Stable/Unstable region

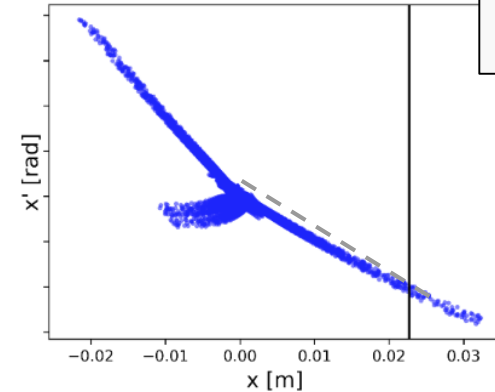
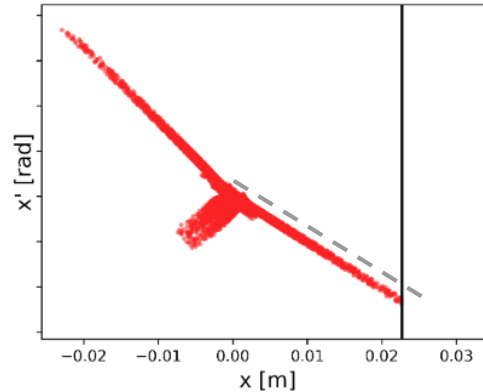
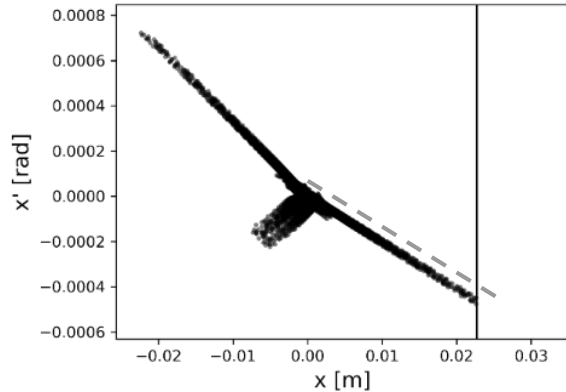
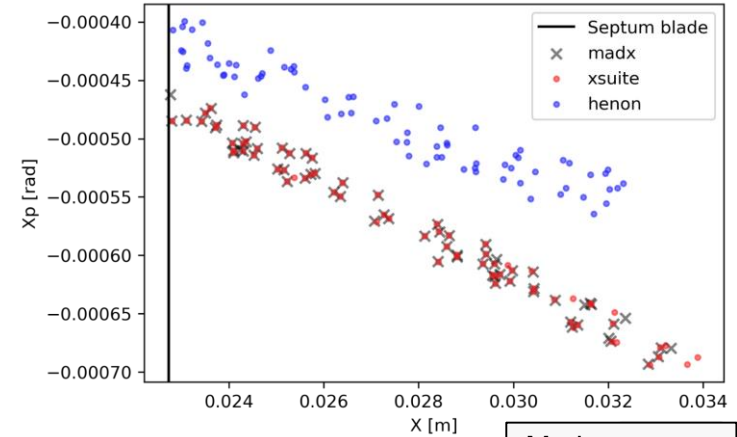
- Small amplitude phase space portraits very similar across codes (even for the very crude henontrack).





# Separatrix arm

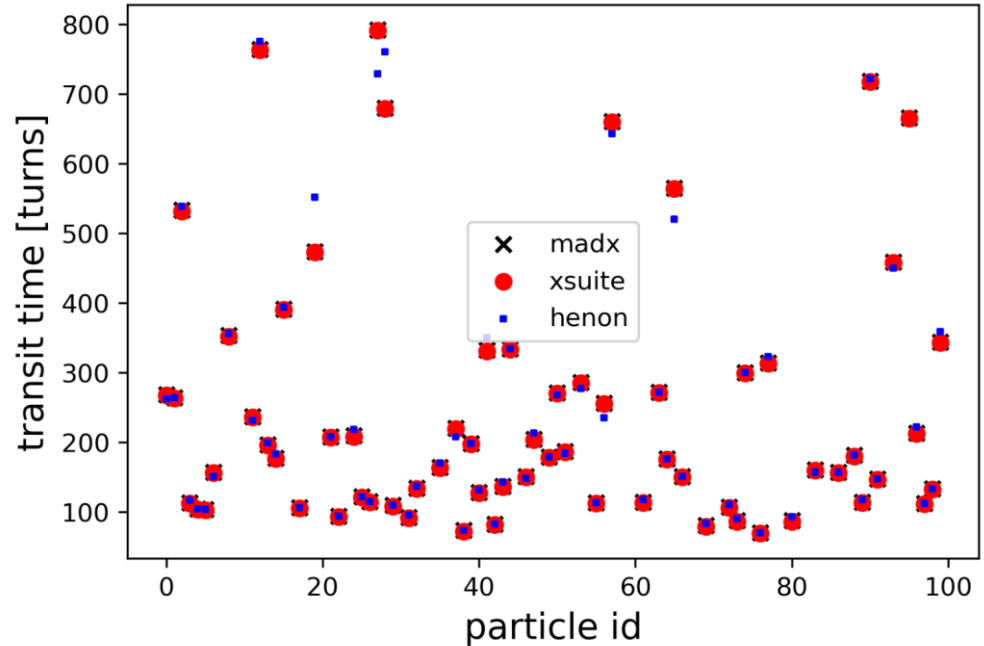
- For loss studies, separatrix representation is crucial.
- Large amplitude separatrix orientations in great agreement between xsuite and MADX.
- Henontrack cannot reproduce amplitude detuning (a few degrees error), as expected



Madx  
Xsuite  
henon

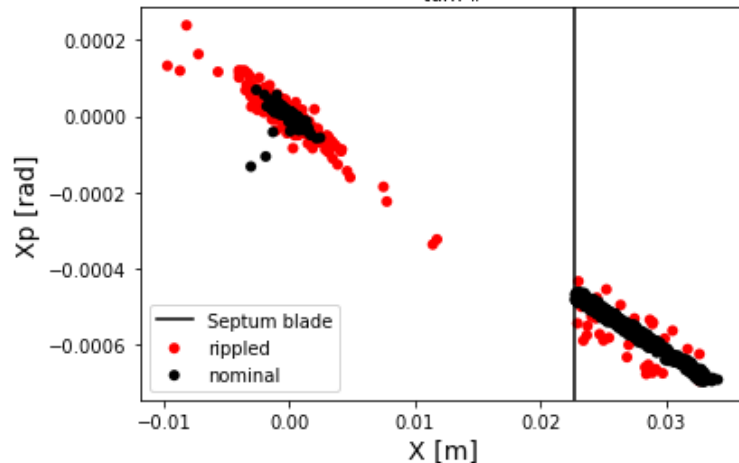
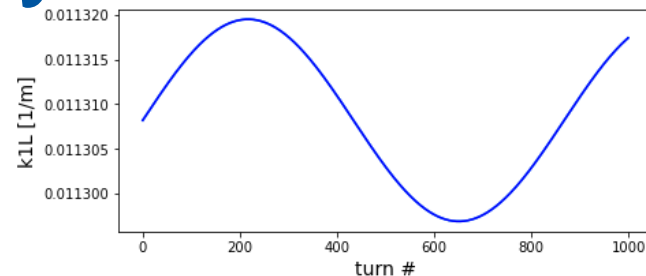
# Transit time

- For spill quality studies transit time distributions are critical.
- Perfect agreement between xsuite and madx.
- Henontrack performs well too, especially for smaller transit times.



# Ripple mock-up study

- Very simple example performed to test time-dependent simulations.
- F-quads rippled at 50 Hz and effect recorded on extracted separatrix.
- Over 400 quads (the entire F-circuit) easily trimmed together.
- Other parameters (e.g. RFKO) trimmable in the same fashion.



# Conclusion & Next steps

- SPS nominal slow extraction simulation was set up in xsuite, easily importing from MADX model.
- Xsuite and MADX results are in great agreement in transverse phase space and transit times.
- Time-dependent parameter variation can be easily implemented in xsuite, demonstrated with a simple F-quad ripple example.
- Need now to integrate pyCollimate for ES particles-matter interaction and crystal interactions.

Thank you!