ACCELERATING BEAM DYNAMIC SIMULATIONS

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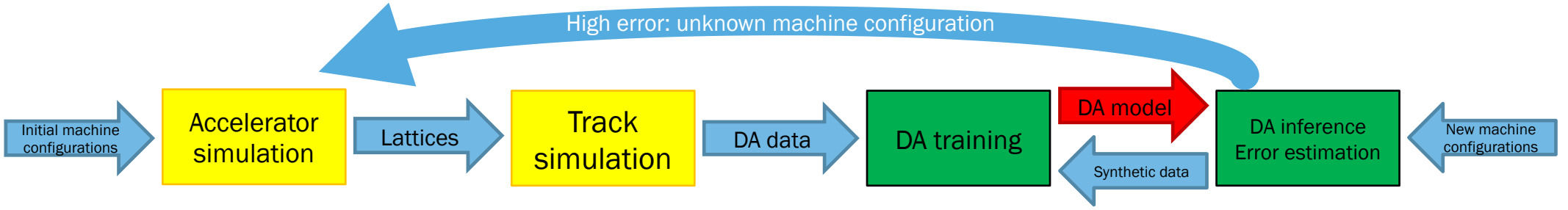
JUN 8, 2023 | FCC–*ee* ACCELERATOR: CODE DEVELOPMENT

This work was carried out under the auspices and with the support of the Swiss Accelerator Research and Technology programme (CHART) and the Swiss Data Science Centre (SDSC)

MACHINE LEARNING 4 FUTURE CIRCULAR COLLIDER

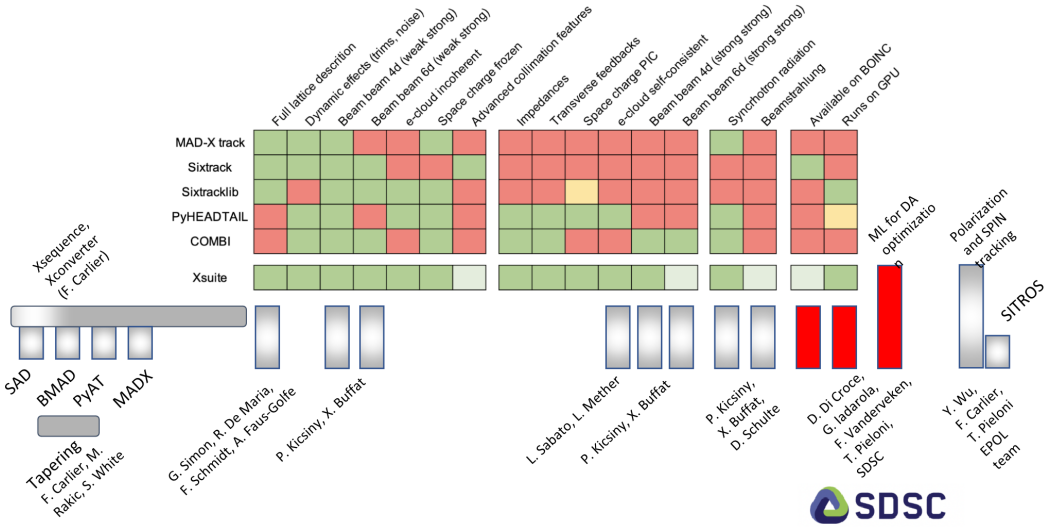
- The ML4FCC project (epf.ch/labs/lpap/machine-learning-applied-to-accelerators) is a collaboration between EPFL, CERN, and SDSC. We are working towards implementing an Active Deep Learning framework that provides an FCC model and tuning knobs for machine design and optimization based on particle tracking simulations.
- Currently, we have developed a first Active Learning framework that incorporates machine learning tools to accelerate DA simulation using HL-LHC data (presently available). This framework includes smart sampling of machine parameters and particle phase-space for specific machine configurations, as well as the implementation of a Deep Neural Network for DA regression.
- Check the poster on Active Learning for DA simulations later today!



- To keep the active framework functional, we continuously submit tracking simulations to generate new data for the ML model.

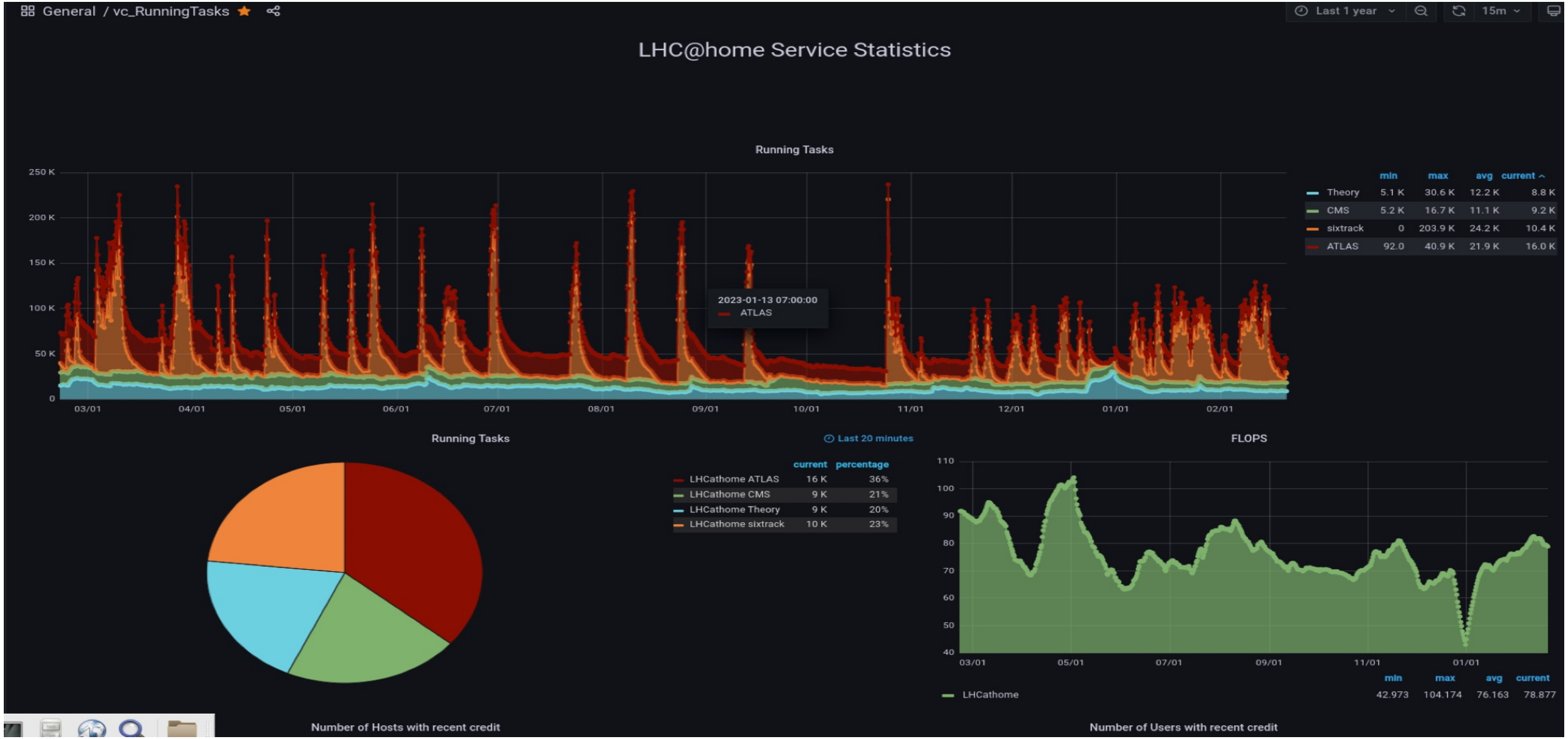
BEAM DYNAMICS SIMULATIONS FOR FCC

- To expedite this process, we are also implementing xtrack as a BOINC application for accelerated tracking simulations as a package of XSUITE framework: xboinc.
- BOINC is an open-source middleware system which supports volunteer computing, and it aims to enable sharing the enormous processing resources of multiple personal computers among the world in order to accelerate scientific computations (https://boinc.berkeley.edu).
- LHC@Home is the BOINC-based project at CERN for volunteer computing. Volunteers routinely run applications by LHC experiments (ATLAS and CMS event reconstruction), by the Theory group, and SixTrack: particle beam simulations to design and optimise the performance of circular colliders (https://lhcathome.web.cern.ch/).
- Higher computational complexity for FCC: higher number of lattice elements, synchrotron radiation, 6D beam-beam interactions… but many of these effects are not implemented in SixTrack
- As Leon presented, XSUITE is a complete framework is best suited to perform FCC studies.
- BOINC system ideal to submit XSUITE jobs for FCC simulations!
- xboinc is implemented as native BOINC app.
- Also implemented as LHC@Home application.



LHC@HOME PERFORMANCE

- SixTrack is implemented as native BOINC app (LHC@home) able to submit up to 350K jobs in parallel



FIRST XBOINC RESULTS ON DEV SERVER

- First xboinc app deployed in the LHC@home dev server
- First test with xboinc using legacy xsuite version v0.1.1 (16th October 2022) to simulate FCC-hh particle survival
- Some ingredients are still missing for user release:
  - We are implementing user-friendly environment: improving setup, usage and result format
  - To test other FCC study cases to identify potential user requirements
  - To conduct tests on various volunteer architectures in order to anticipate any potential issues
  - Benchmarking tests to assess the performance of xboinc

LHCathome-dev: Results

log in

Query: **select * from result where appid = '16' and mod_time > '20230530085455' and server_state = '5' order by mod_time desc limit 20,20**

53 records match the query. Displaying 21 to 40.

Previous 20 | Next 20

Summary | More detail | Return to main admin page

result ID	WU ID	server state	outcome	client state	validate state	delete state	exit status	host (user)	app ver	received *or* deadline *or* created	CPU hours	granted credit
3218418	2310551	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4675 (mikey)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 13:14:42 UTC	0.8	18.751
3218419	2310551	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4796 (Vato)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 12:38:10 UTC	0.3	18.751
3218424	2310554	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4675 (mikey)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 13:13:24 UTC	0.7	17.514
3218425	2310554	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4796 (Vato)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 12:28:45 UTC	0.3	17.514
3218398	2310540	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4675 (mikey)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 13:10:55 UTC	0.7	17.781
3218399	2310540	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4796 (Vato)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 12:09:45 UTC	0.3	17.781
3218408	2310546	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4936 (mikey)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 12:33:21 UTC	0.8	19.056
3218409	2310546	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4796 (Vato)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 12:44:53 UTC	0.4	19.056
3218410	2310547	Over [5]	Success [1]	Done [5]	Valid [1]	Deleted	0 (0x00000000)	4936 (mikey)	Xtrack beam simulation v0.11 x86_64-pc-linux-gnu (739)	5 Jun 2023, 12:33:21 UTC	0.8	18.714

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- Volunteers are very welcome in supporting the dev server now, where the test on the xboinc are being performed.
- Volunteers from home can help also designing the FCC colliders soon!

FCC NEEDS YOU!

JOIN LHC@HOME TODAY!

HTTPS://LHCATHOME.WEB.CERN.CH/JOIN-US