Integration of the TRACK Beam Dynamics Model to Decrease LINAC Tuning Times*

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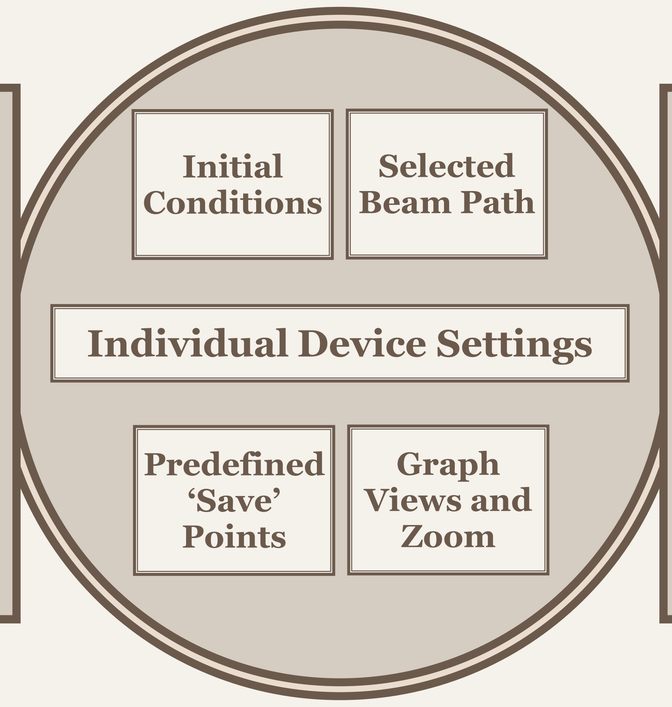
Full Integration of Beam Dynamics Code into the ATLAS Control System

Problem

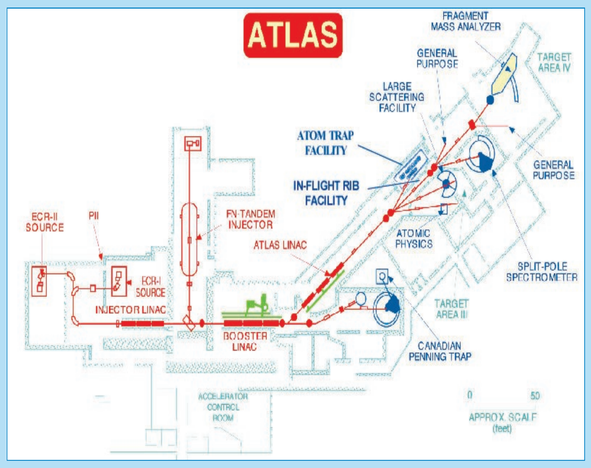
ATLAS delivers a wide range of ion species to 100+ experiments per year. Each experiment requires **individual tuning** of hundreds of devices in a varying configuration of beam paths. Operators don't have a 'birds eye' view of the **beam quality** during the tuning process.



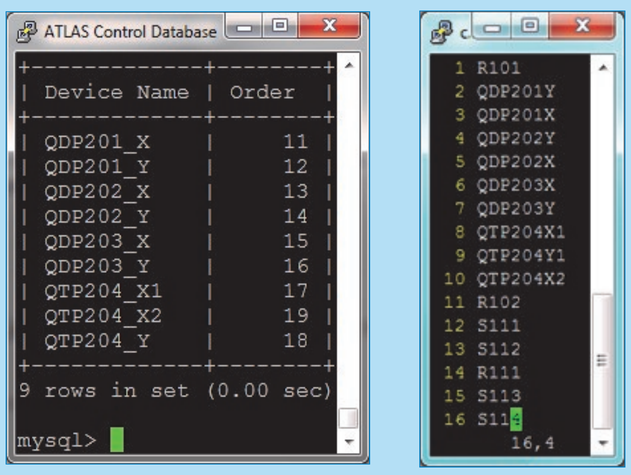
Solution

An in-house **beam simulation model** to display beam size and quality to operators in **real time**, using initial emittance data, individual device field models, and **interactive graphs** which execute quick enough to iterate after each device's adjustment.

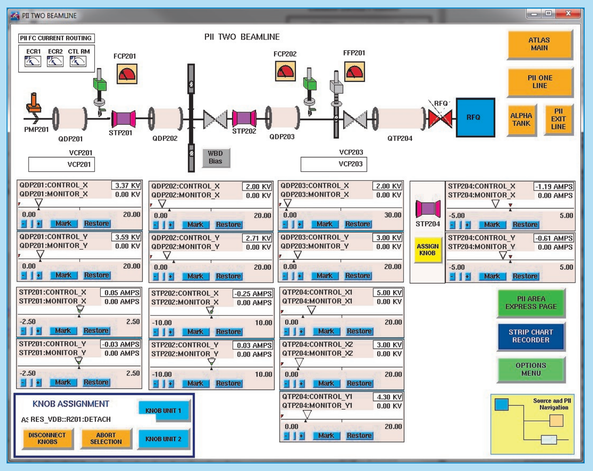
New Pre-Processing Code to Define Beampath and Format Input Files



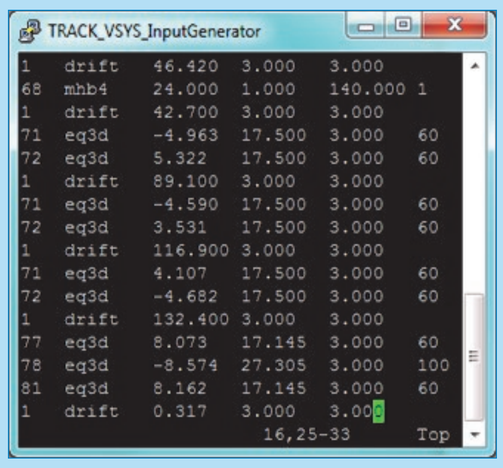
Device and order information is automatically extracted from the control system based on the beamline currently in use.



A SQL query is executed on a database of devices to extract only the devices included in that beamline. Source, injector, and target are included.



The program retrieves current settings for each device, and applies a scale factor to convert control voltages to physical field values.



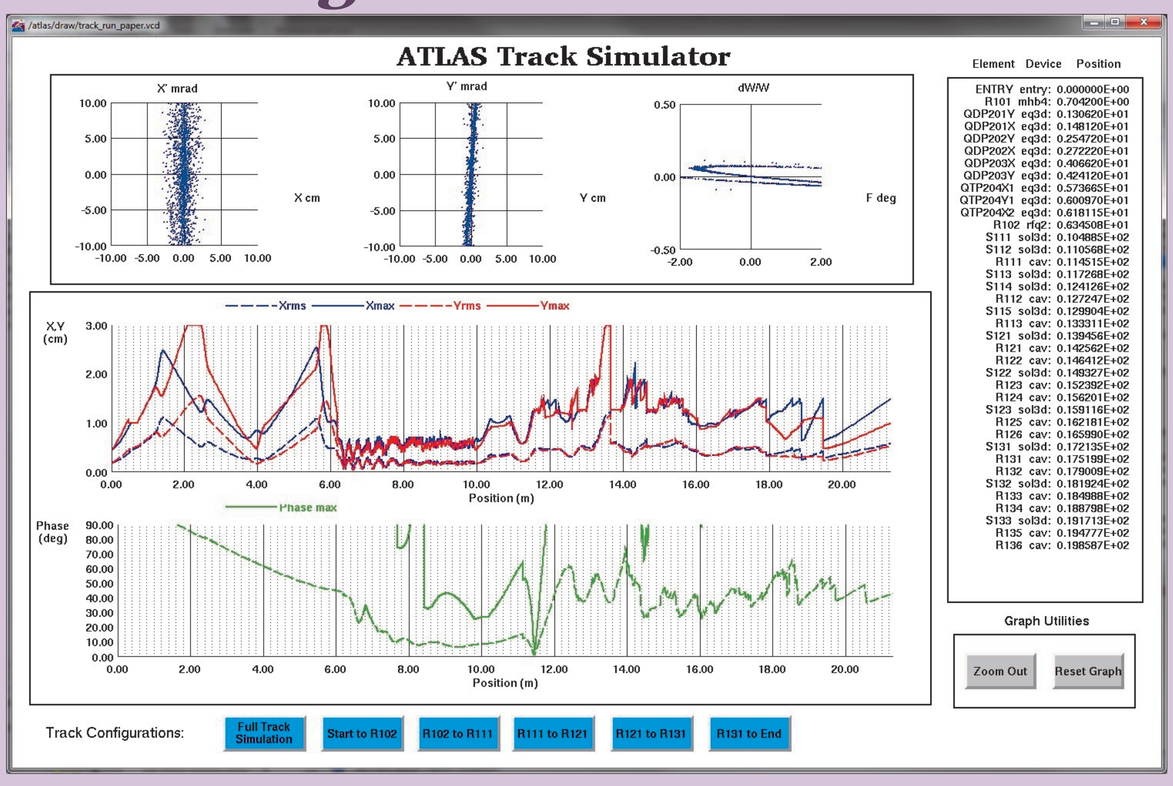
Finally, a fully formatted and scaled TRACK input file is created, with 'save points' that enable rapid re-calculation.

New Post-Processing of TRACK Simulation with Graph Views

Top: three plots are animated in time during the simulation. They depict the emittance ellipses and particle count of the beam as it travels through the accelerator.

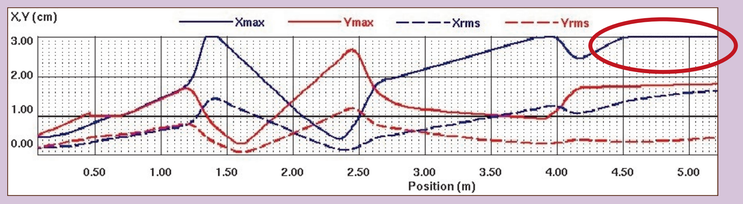
Middle: graph of the transverse (X&Y) average and maximum sizes of the beam. Note the initial injection, a middle linear acceleration, ending with delivery to the next section .

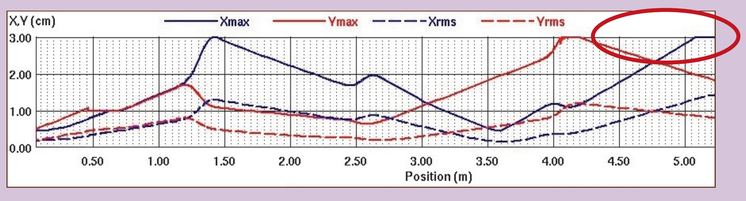
Bottom: longitudinal phase size of the beam. Note in this case, the beam is over-focused near 11.7m on the x-axis. Also note the device position list to the right side.



The result files are automatically parsed into the control system for display. Note the blue buttons which are pre-configured 'save points, where a user could make a change to a device and only simulate a small section of the beamline, thus reducing re-execution time by nearly 90%.

The below two graphs represent the same beamline before and after optimizing the focus. This demonstrates a possible example of comparing a bad tune to a good tune which (due to overfocusing) hits the beam pipe (starting at 4.00m) less often. Changing the focus through the quadrupoles via the normal control system interface resulted in a 5% increase in total beam transmission when compared to the top graph.





*This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357.
This research used resources of ANL's ATLAS facility, which is a DOE Office of Science User Facility.