

## Challenge

CERN operates the world's largest particle accelerator: the Large Hadron Collider. CERN's Beam Dynamics Group recommends accelerator settings from simulations of the space-charge effects of travelling macro-particles. Their **Travel** software, which typically models 1M moving particles, currently takes over 2 days to execute on a PC Desktop. ICT students are collaborating with the Beam Dynamics Group to enhance **Travel's** performance using GPUs (Graphics Processing Units).

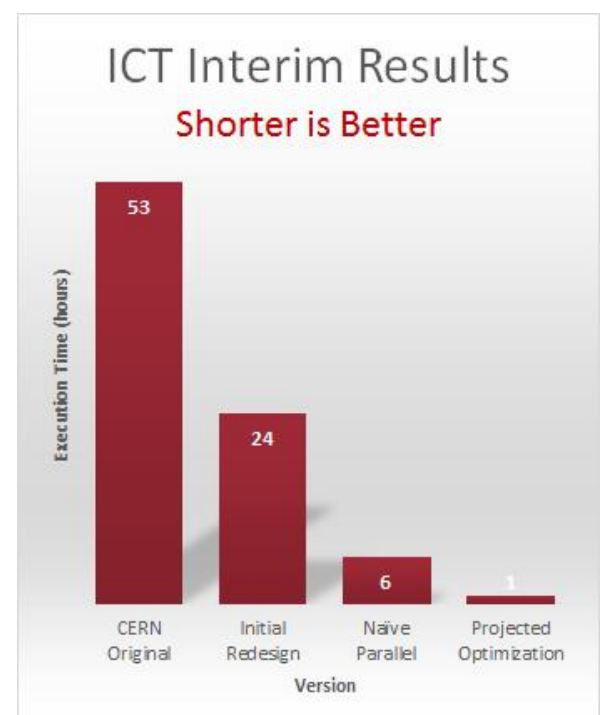
## Methodology

1. profile **Travel** to identify its principal hotspot (**done**)
2. redesign **Travel's** serial algorithm at the hotspot to enhance performance (**done**)
3. design and implement naïve parallel logic to execute **Travel** on a GPU (**done**)
4. tune the parallel logic to optimize performance on the GPU (**work in progress**)

## Findings

Interim results have exceeded initial expectations. The redesigned serial code executed in ~1 day: a 2x speedup of the original CERN code. The naïve parallel code executed in ~6 hours with an installed GPU: a 9x speedup of the original CERN code.

Thanks to ICT students' work, the Beam Dynamics Group will be able to simulate space-charge effects of macro-particles in linear accelerators in just a few hours using a PC desktop with an installed GPU.



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