



Συnergία

Synergia code development status & plans

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- Status
- Plans
 - Goals
 - Solutions
 - Work plan



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Status: Synergia

- My friends, the state of Synergia is strong
 - Demonstrably workable user interface
 - Successfully built and run by several outside users
 - Usefully applied to model FNAL Booster
 - First outside users have started trying the code



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Goals

(roughly in order of importance)

- New Physics
- Larger/more accurate simulations
- Better diagnostics
- More realistic simulation conditions
- Build system improvements
- Easier management of runs and results



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Goal: New Physics

- Beam-beam (strong-strong, weak-strong)
 - Important for Tevatron
 - Already committed to producing results
- Impedance effects
 - General importance
- Electron Cloud, electron cooling
 - Relevant to the LHC (cloud) and Fermilab (cooling)



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Goal: New Physics (2)

Fermilab *Today*

Monday, November 1, 2004

- Gravity?
 - Large-scale structure code MC^2 is a fork of IMPACT
 - A refactored IMPACT could accommodate MC^2

Rocky Kolb to Direct New Fermilab Particle Astrophysics Center

Michael S. Witherell, Director of Fermilab, today announced the establishment of the Fermilab Particle Astrophysics Center, and named the renowned Fermilab and University of Chicago cosmologist Edward "Rocky" Kolb as its director.





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Goal: Larger/more accurate simulations

- Larger simulations, e.g. larger portion of Booster Cycle
- More accurate simulations, i.e., better resolution
- Current limiting factors
 - Performance
 - Memory usage
 - Parallel scaling



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Goal: Better Diagnostics

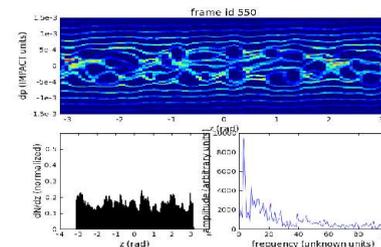
- Two ways to extract physics currently
 - simple internal diagnostics
 - save data for later analysis
 - enormous disk usage
- Strong motivation to allow for user diagnostics at run time
 - natural parallelism
 - avoids storage issues



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Goal: Better Diagnostics (2)

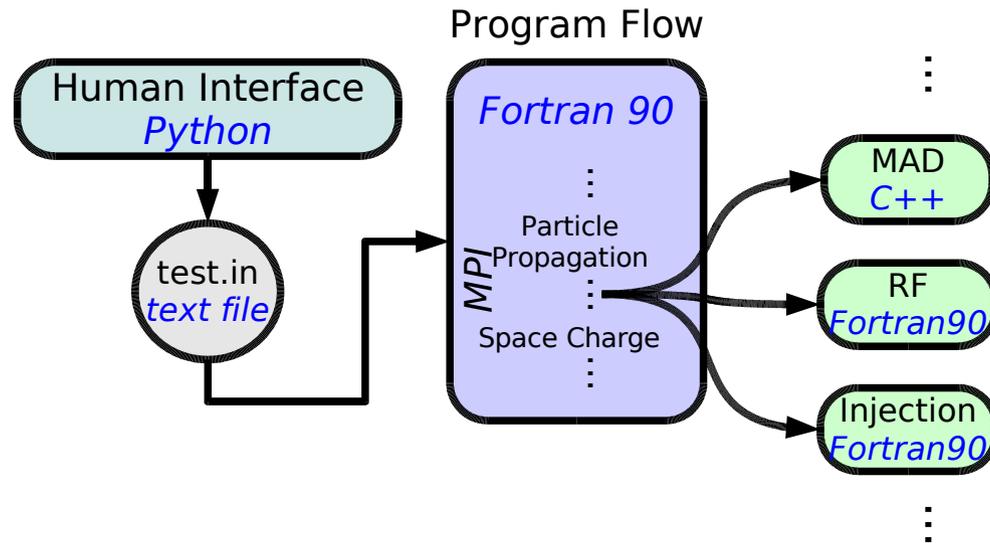
- Graphics
 - Sophisticated graphics have proved useful, even when we have created them for show purposes only
 - load balancing issues made obvious in SC2003 demos
 - two-stream plasma instability “discovered” in longitudinal movie





Goal: More realistic simulation conditions

- IMPACT's main loop is too inflexible for many possible applications



- example: currently no way to simulate multiple injection including effects of injection line



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Goal: Improve Build System

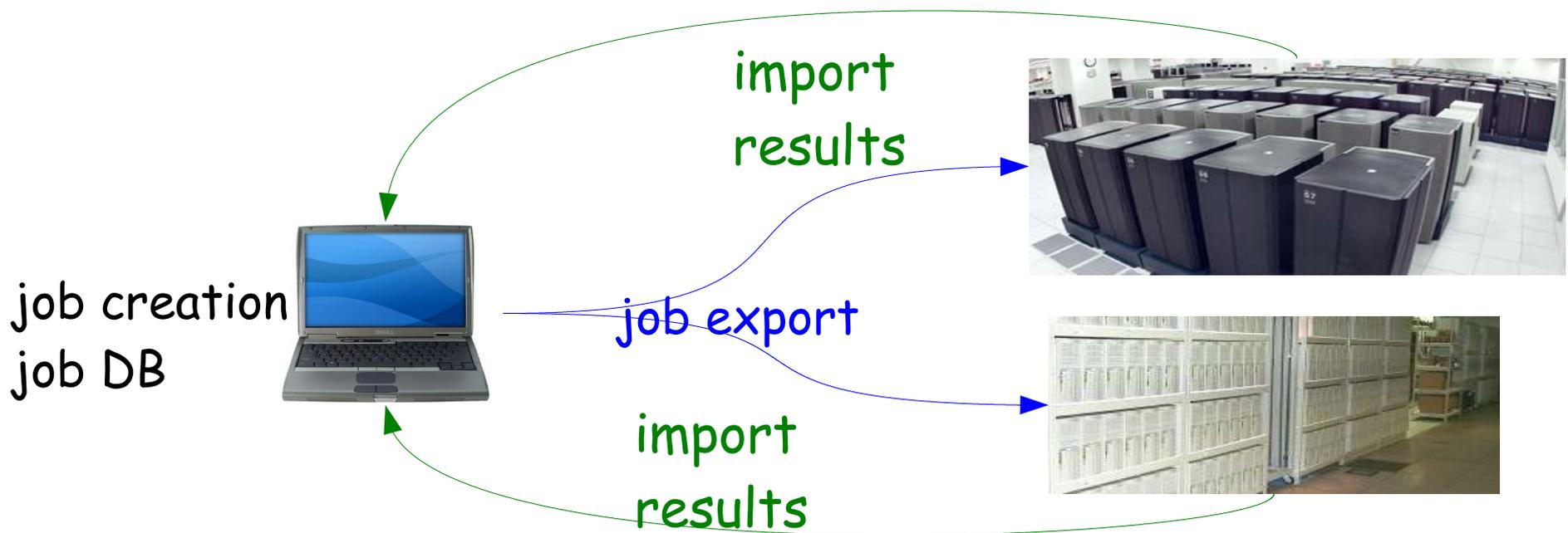
- Build system has now been used by several customers
 - Incorporate feedback for less confusing system
- New features will require more components
 - Ensure outside users can deal with compilation of entire system



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Goal: Better Simulation Management

- Current system powerful, but *ad hoc*
 - *Better job management means better physics throughput (Miron Livny would be proud)*





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Solutions: Impact Refactoring

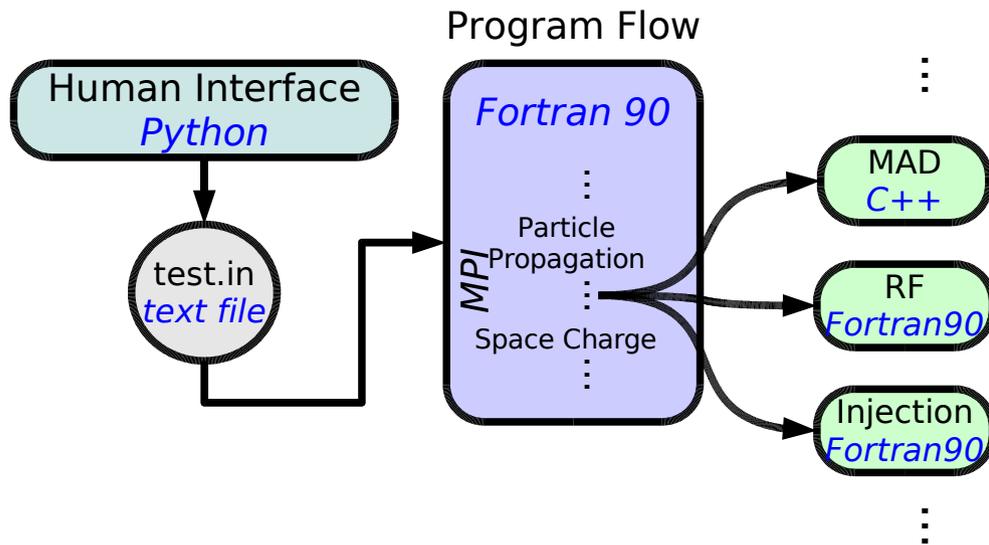
- The most important portion of Synergia development strategy
- Impact refactoring already started with Tech-X, SBIR I
- Major contributor: Doug Dechow, Tech-X, SBIR II
- Modularize components
 - Allows substitutions, additions
- Advanced steering
 - Requires modularization

6 FTE months

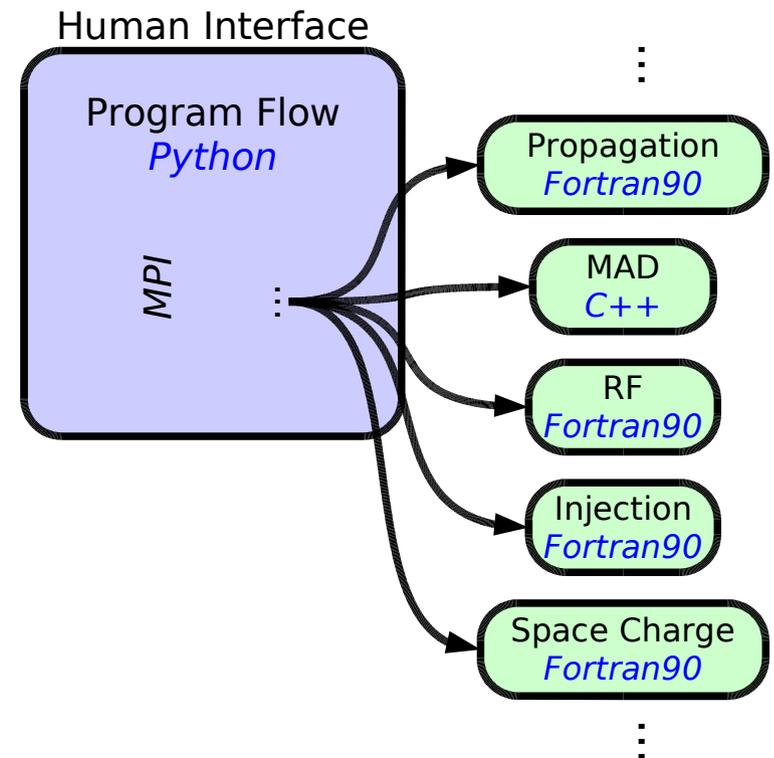


Solutions: Impact Refactoring (2)

old way: inflexible



new way: flexible,
extensible





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Solutions: BeamBeam3D

- BeamBeam3D from Ji Qiang (primary IMPACT author)
- Start by applying to Tevatron
- Incorporate into Synergia framework
 - after gaining experience
 - after Synergia is ready
- J. Amundson, P. Spentzouris, Applications Physicist to be hired



Work plan

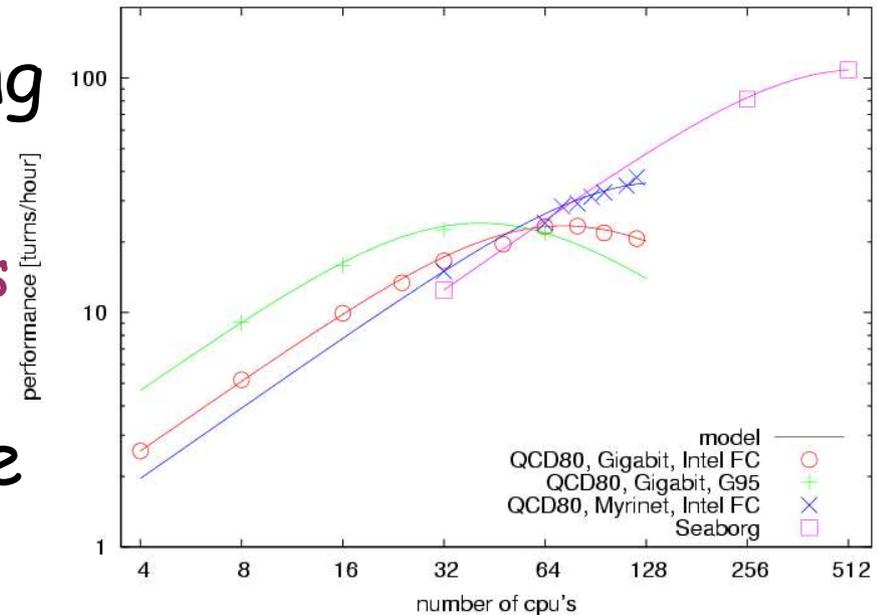
- Goal: New Physics
 - Plan: Incorporate impedance module from Roman Samulyak 2 FTE months
 - Plan: Run/incorporate BeamBeam3D 1 FTE year (physics driven)
 - Plan: Use experience to incorporate more physics modules in future open-ended
 - Plan: Look at incorporating MC² changes 1 FTE month
 - Greatly simplified by IMPACT refactoring



Work Plan (2)

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- Goal: Larger/more accurate simulations
 - Plan: improve memory management with new steering **1 FTE month**
 - Plan: algorithmic research **1 FTE month + 12 FTE months**
 - with CS collaborators
 - Plan: faster cluster with more memory
 - Progress in understanding perf.





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Work Plan (3)

- Goal: Better diagnostics 1 FTE months
 - Straightforward exercise with refactored IMPACT
- Goal: More realistic simulations physics driven
 - Straightforward exercise with new steering
- Goal: Improve build system 1 FTE month
 - Straightforward exercise (extrapolation of existing system)



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Work Plan (4)

- Goal: Easier simulation management
 - Formalize existing setup 1 FTE month
 - Adapt to Grid tools 1 FTE month for feasibility study



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Conclusions

- Synergia is currently a firm foundation for future growth
- Many concrete goals for development
 - CS
 - Refactoring, job management, build systems, algorithmic improvements
 - Physics
 - Beam-beam, electron cloud, electron cooling, gravity
 - CS and Physics efforts are highly complementary