



Συνεργεία

Advanced Accelerator Simulation Project Briefing

J. Amundson & P. Spentzouris

11/2/04

Outline

- Project status
 - development, applications, resources
 - Plans
 - Applications
 - Synergia code development status & plans
- } PGS
- } JFA



Συνεργεία

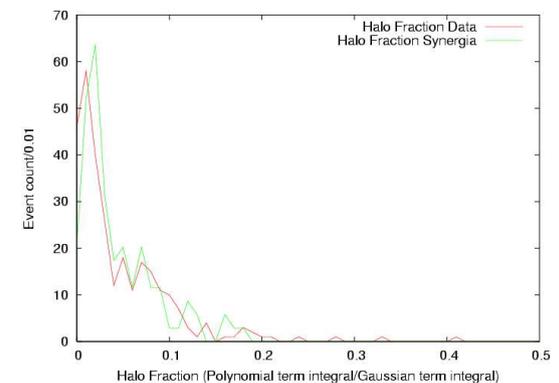
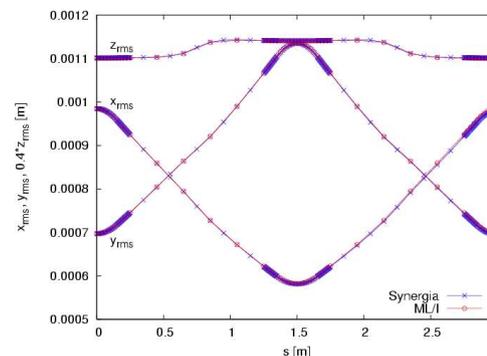
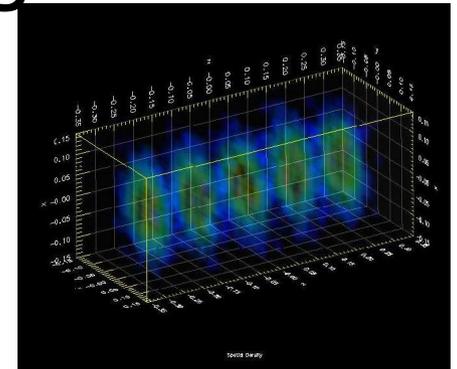
Status

(last briefing March '04 & discussion in
accelerator activity coordination meeting Aug
'04)



Physics

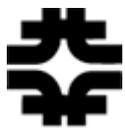
- Fully functional & tested space charge module
 - First multi-bunch 3D code for circular machines
 - Applied to Fermilab Booster modeling
 - Tested against other codes and theory





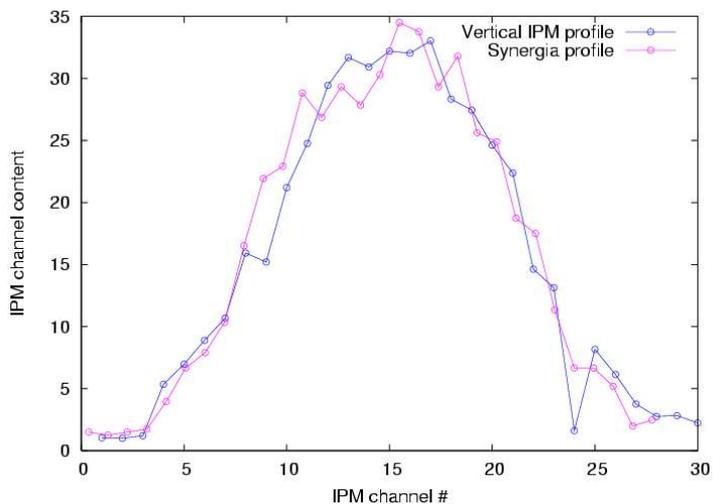
Booster Application

- Emphasis on use of realistic parameters & impact on operations
 - Beam studies & measurements
 - Calibration of beam detectors
 - Development of analysis tools
 - Work closely with AD machine & operations personnel

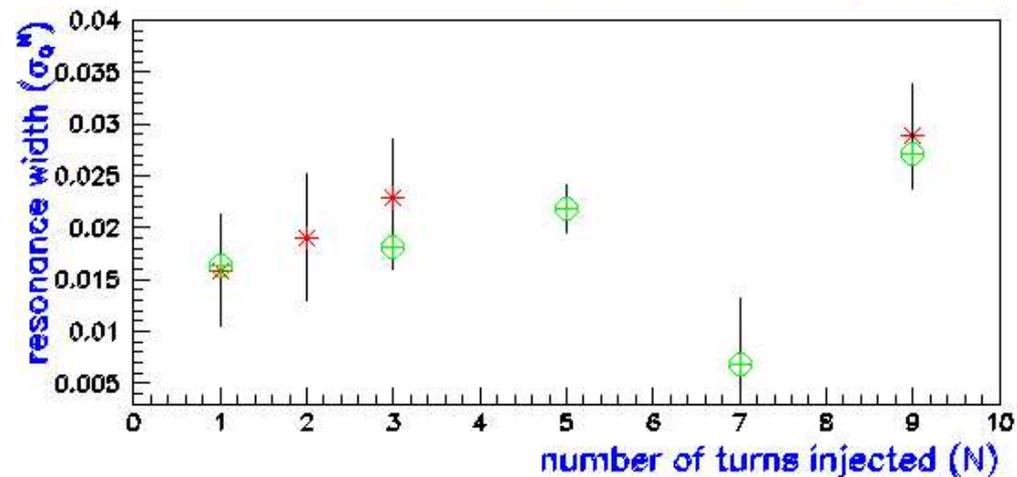
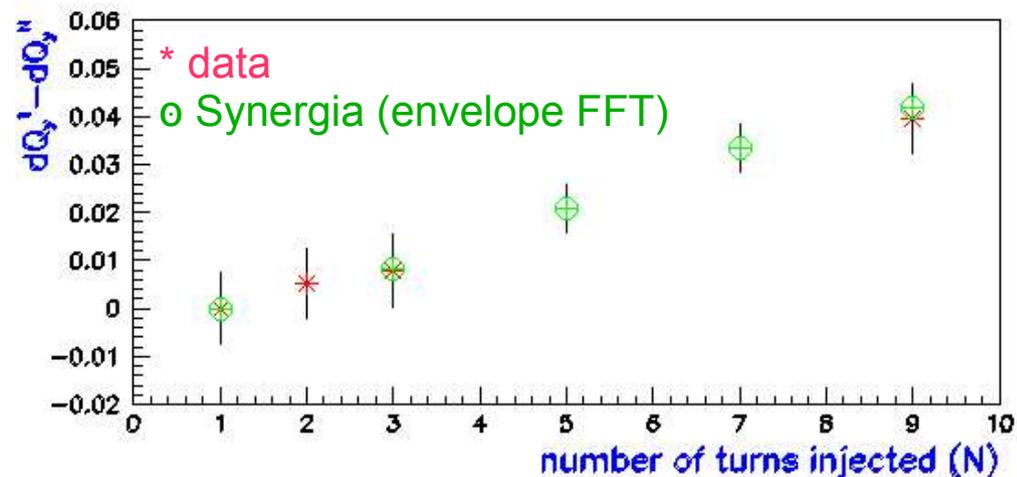
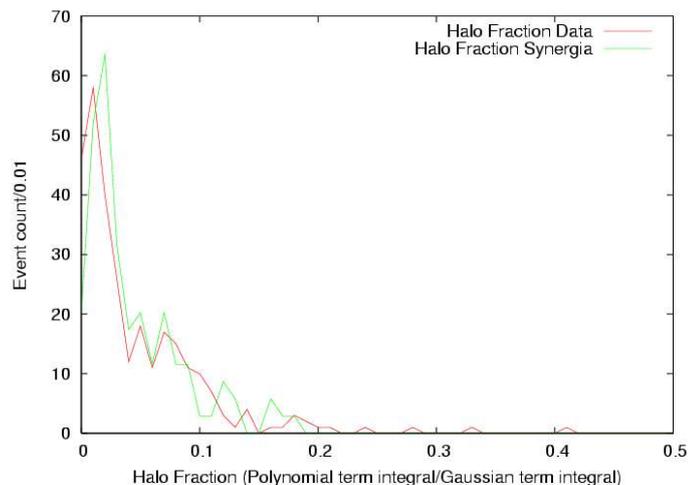


Application Examples

Συνεργεία



Smearred Synergia vs data profiles





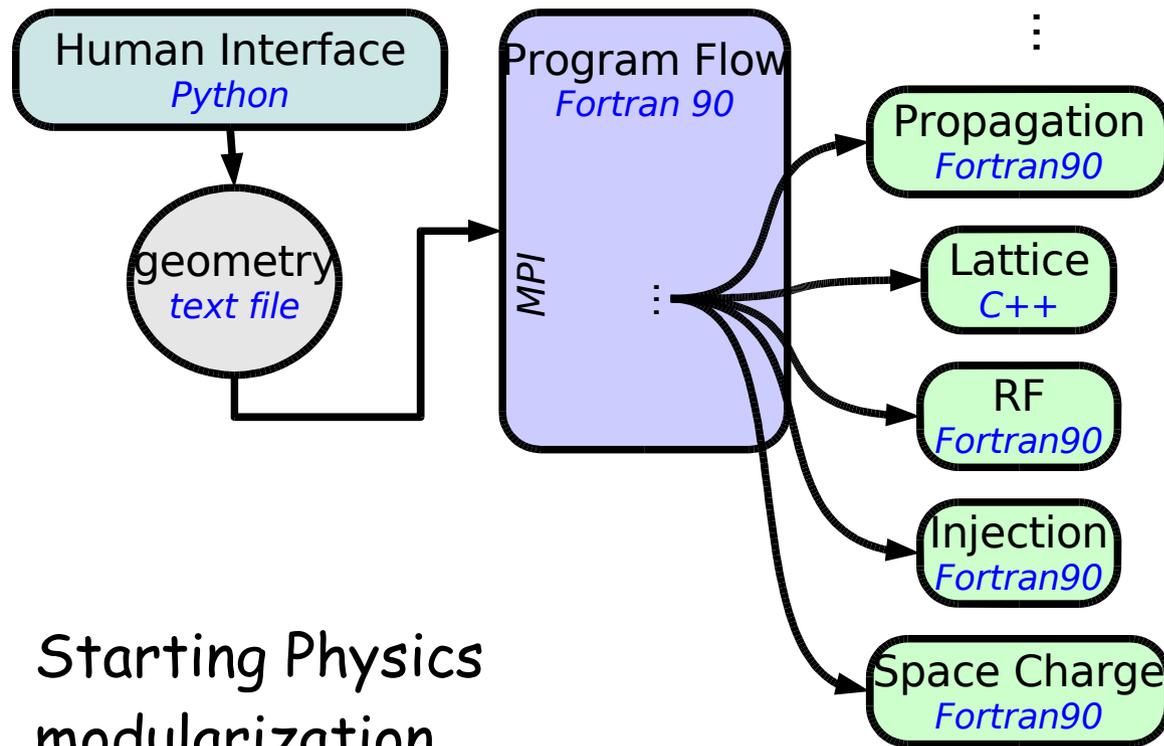
Impact (subjective metric)

- Substantial beam physics conference participation (including invited talks)
- Publications (2 plus one submitted)
 - also, conference proceedings & FNAL memos
- Specific requests for modeling (Booster, Tev, A0, CERN PSR)



Συνεργεία

Framework Status



Starting Physics modularization with help from TechX SBIR

- User interface: flexible geometry and program flow
- Internal geometry representation constrained by F90 program flow module
 - complicates addition of new physics modules
 - Jim's talk



Συνεργεια

Synergia framework

- Fully functional job management system (**Python**)
- Portable build system (**GNU Autotools**)





Συνεργεία

http://cepa.fnal.gov/psm/aas/Advanced_Accelerator_Simulation.html

- Updated web pages but still a lot of work on documentation
- Test suite but need expansion



Συνεργεία

Resources: funding direct and indirect

- ✓ SciDAC -- 2 more years (funding increase)
- ✓ TechX SBIR phase II - 2 years
- x NSF proposal with DePaul -- rejected
 - will try again
- ? Support NSF CS IIT career proposal (pending)
- ✓ Collaboration with IIT (grad student) 4-5 years
- ✓ Collaboration with AD (Leo, Francois, Booster group, TeV???)



Συνεργεία

Resources: manpower

- So far it's been JFA (100%) & PGS (60%)
 - and leveraging AD (Booster group) and SciDAC (Ryne, Qiang) resources
- ➔ limited our ability to respond to new application needs/requests
- ➔ limited physics output
- 😊 but things are changing!



Συνεργεία

Resources: current manpower

- Fermilab CD
 - old guard: JFA, PGS
 - application physicist (position posted)
- TechX - possible new CP/mentorship
 - 1 FTE for 2 years (welcome Dr. Dechow)
 - P. Stoltz (manager), S. Kruger (consultant)
- IIT
 - D. McCarron (thesis on Booster space charge)
- IMSA (Matt Drake, student)



Συνεργεία

Friends (manpower in kind)

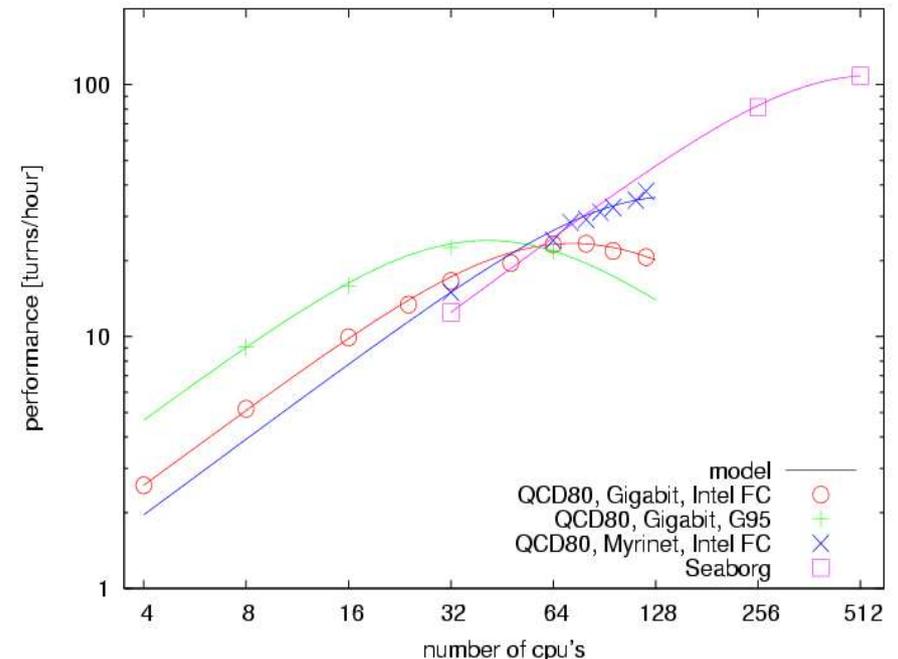
- Fermilab AD:
 - Leo, Francois (single particle optics libraries maintenance)
 - Tev liaison (TBA), V. Lebedev (contact)
 - Booster group (B. Pellico, contact)
- IIT
 - L. Spentzouris
- SciDAC: Ryne, Qiang, Samulyak



Συνεργεία

Resources (computing)

- So far we have used the old lqcd cluster and NERSC
 - with additional manpower **enhanced needs**: “multi-tasking” and production modes
- **need more resources**



“multi-tasking” == more than one physics projects
production == more than one application per project



Options

- NERSC: not mid-size job friendly
- IQCD (any flavours) cluster:
 - cannot survive in parasitic mode
- ➔ Dedicated cluster at FNAL (FY05 budget)
 - leverage IQCD expertise
 - maximize physics output & code development
 - Create Fermilab's multi-particle beam dynamics modeling "center"



Συνεργεία

Multi-particle effects modeling group

Management: 15% P. Spentzouris

Code development

J. Amundson
D. Dechow, 30% Apl. Physicist, CP(?), 20% PGS
(Leo, Francois)

Applications

P. Spentzouris
50% Apl. Physicist, D. McCarron, other students
(AD contacts)

Code modularization,
optimization, new
physics implementation
(TechX, SciDAC,
DePaul (?), IIT(?))

Booster space-charge
(Dan's thesis)
TeV strong-strong beam-
beam effects (Apl.P.),
other (electron cooling?)
TechX (?)



Συνεργεία

Plans & possible opportunities



Συνεργεία

New Physics & applications

- First step: implement strong-strong beam-beam effects [FNAL relevance: Tevatron]
 - Important to apply beam-beam @ Tevatron using the same approach as with space charge @ Booster: **studies, validation, realistic parameters**
 - Requires AD collaboration (V. Lebedev)
 - ➔ Code development: multi-species simulation
 - ➔ Re-use LBNL code



Συνεργεία

New physics & applications, cont

- Impedance effects (general purpose)
 - Re-use R. Samulyaks code (SciDAC, BNL)
 - Multi-physics code development
- Next step: electron **cooling**, electron **cloud**
 - relevance for **Fermilab** and **LHC**
 - Potential SBIR with TechX



Συνεργεία

Funding opportunities (future)

- Next SciDAC-like cycle (in 2 years)
 - Already asked to prepare to participate
 - White paper in '05, proposal '06
- SBIR with TechX (additional physics)
- NSF (with DePaul, IIT)
 - Optimization, algorithm development
- Grid (???)
- Astrophysics (not so crazy)



Συνεργεία

Issues

- CP/mentorship hire (replacing hire lost to AD gymnastics)
- Office space, especially for our “permanent” visitors



Summary: target objective

- Establish Fermilab's "collective beam effects" modeling effort
 - Unique expertise high performance accelerator modeling
 - Leveraging IQCD experience
 - Partnership with AD
 - Attract more funding and possibly expand to other physics if necessary or desirable