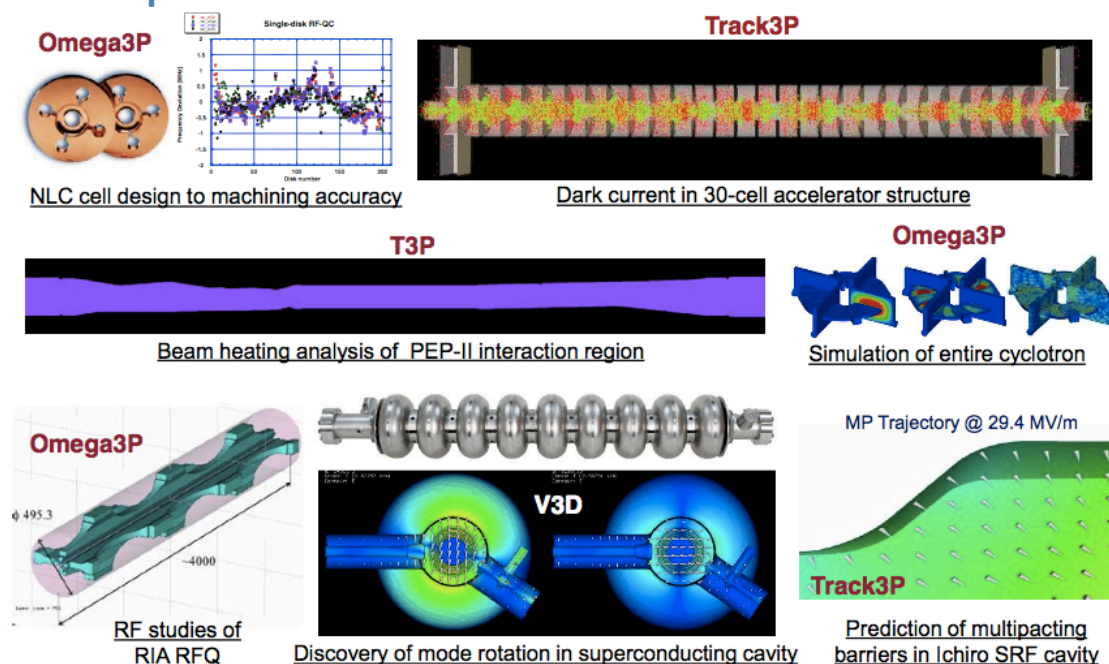## 1 Overview

The Advanced Computational Electromagnetic 3D Parallel – Code (ACE3P) is based on the Finite Element Method (FEM) using higher order Ansatz-functions (up to 6$^{th}$ order) and tetrahedral curved elements. The code consists of the following modules:

- **Omega3P**   Eigenvalue solver
- **S3P**   Frequency domain (S-Parameters) solver
- **T3P**   Time domain solver for wakefield computation
- **Pic3P**   Particle in cell code for the simulation of particle-particle-interaction in RF fields
- **Track3P**   Particle tracker for the simulation of multi-pacting and dark currents
- **TEM3P**   Multi-physics solver for mechanical deformations and thermal problems

ACE3P runs on a super computer in the USA. Both, access and overall computing time are restricted and managed by SLAC.

Geometry preparation, meshing and result visualization, are done by 3$^{rd}$ party software such as CUBIT for the first two and ParaView for the later. Both programs can be installed locally.

## 2 Examples



NLC cell design to machining accuracy

Dark current in 30-cell accelerator structure

Beam heating analysis of PEP-II interaction region

Simulation of entire cyclotron

RF studies of RIA RFQ

Discovery of mode rotation in superconducting cavity

Prediction of multipacting barriers in Ichiro SRF cavity

Source: http://indico.cern.ch/getFile.py/access?contribId=62&sessionId=2&resId=1&materialId=slides&confId=75374

**Tracking** 2011-10-25_ACE3P_Memo.docx

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| Pages: | 3 | Characters: | 2631 | File Size: | 96501 |

## 3 Features

Advantages:

- Parallel approach allows for the solutions of problems many magnitudes more complex than solvable on a desktop PC, e.g. trapped modes in long structures:
- Higher order elements significantly improve the field approximation within the mesh cells allowing for higher accuracy with less cells. Nevertheless, the approach increases the required memory.
- Moving window approach allows to reduce the computation domain of long structures to a minimum or steer the solver accuracy according to the particle presence.
- Complex eigenvalue computation allows for the solution of open or lossy structures.
- Particle tracking allows for the simulation of dark currents and multi-pacting for hundred thousands of particles.
- ParaView allows to post process the fields and offers broad range of display functions

Dis-advantages (or future/necessary extensions):

- No field numerical control over the mesh (adaptive meshing) → requires convergence study for every problem set.
- Missing an optimizer as well as a parameter sweep function.
- No anisotropic or field dependent material properties supported. No frequency dependent material properties implemented.
- No user manual (only user guide with examples)

## 4 Further Information

- Software Information Flyer (attached to this EDMS document)
- User Guide         (attached to this EDMS document)
- Website:
  - https://slacportal.slac.stanford.edu/sites/ard_public/bpd/acd/Pages/acmod.aspx
- Contact:
  - Kwok Ko        kwok@slac.stanford.edu
  - Candel Arno      candel@slac.stanford.edu

## 5 ACE3P at CERN

- ACE3P requires a NERSC computing account. Cubit and acdtool are installed on LX-Plus:
  - /afs/cern.ch/project/parc/cubit/cubit
  - /afs/cern.ch/project/parc/cubit/ace3p/acdtool_serial
- Mailing list for the CERN users of ACE3P codes: ace3p-users@cern.ch
- Users at CERN:
  - Kyrre Ness Sjøbæk   k.n.sjobak@fys.uio.no
  - Andriy Nosych       andrey.nosich@gmail.com
  - Oleksiy Kononenko   Oleksiy.Kononenko@cern.ch

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