ILC International Linear Collider

INFN Istituto Nazionale di Fisica Nucleare

ILC cryomodule mechanical work at INFN-Pisa

- Ongoing work
- Near term future
- Manpower summary
- Outlook

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Ongoing work (1)

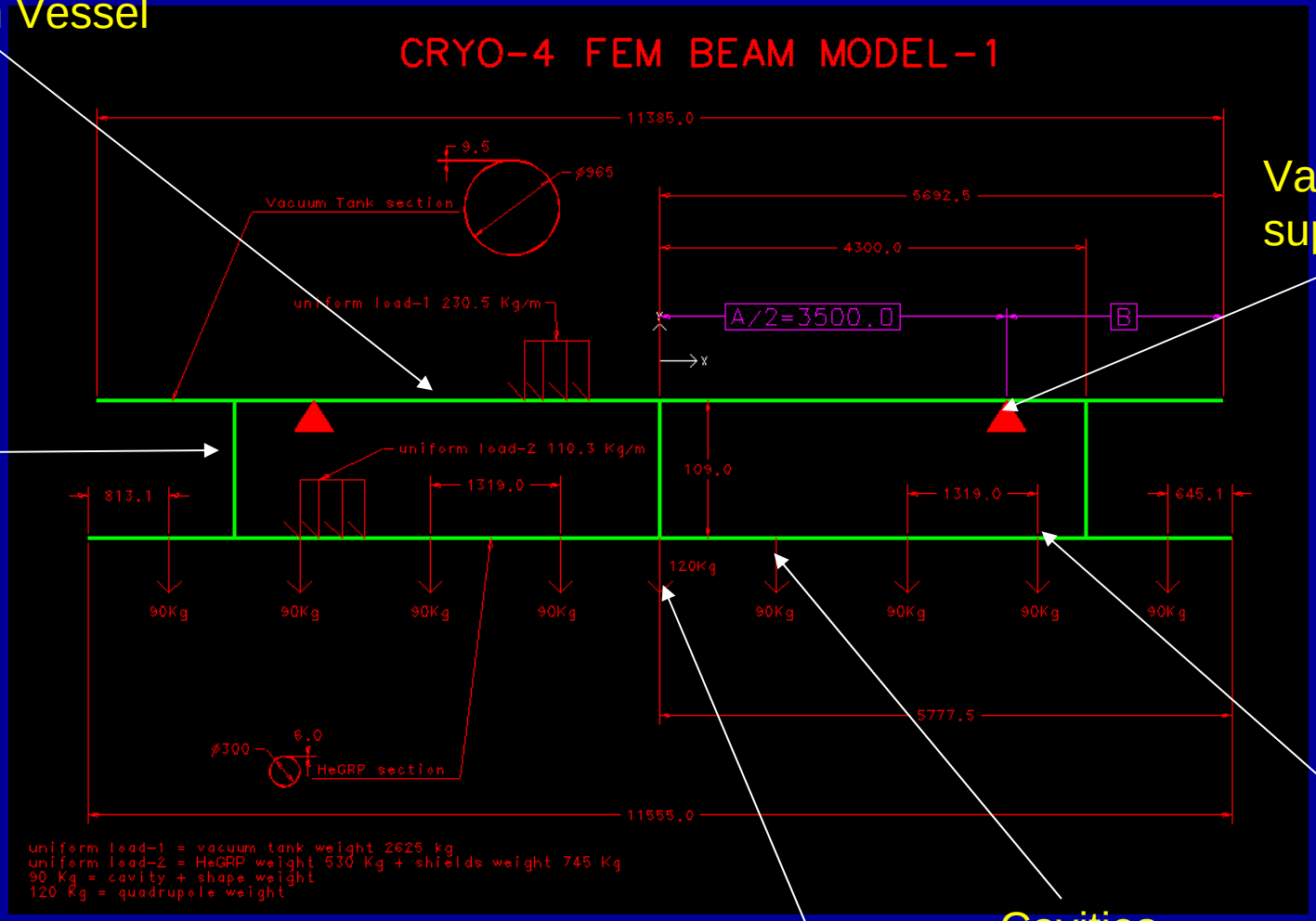
- ASME characterization of components
  - Vacuum vessel:
- Verifications done:
  - Max allowable pressure.
  - Minimum thickness required for Vessel.
  - Nozzle thickness checks.
  - Calculation of the opening reinforcing areas .
  - Stresses from static loads :
    - Reactions from supports (local stress and stress from bending moment).
    - Local loads on Post openings.
    - Local loads from lifting brackets.

Ongoing work (2)

- ASME characterization of components
  - The GRP, cooling pipes, cold mass:
    - design pressure checks at the operating temperatures,
    - verification of external loads,
    - EXPECT COMPLETION BY SEPTEMBER 2006
  - Follow-up:
    - Calculation maintenance.
    - Critical revision of design:
      - Many specs exceed ASME
      - Worth considering reducing some requirements

Ongoing work (3)

- FEM analyses:
  - Simple FEM of CRY-4 module using beam elements.
    - Model used to study:
      - vacuum vessel support positions,
      - POST positions,
      - normal modes of vibrations.



Vacuum Vessel

Vacuum Vessel supports

POST

Cavities

HeGRP

Quadrupole

Y

Z

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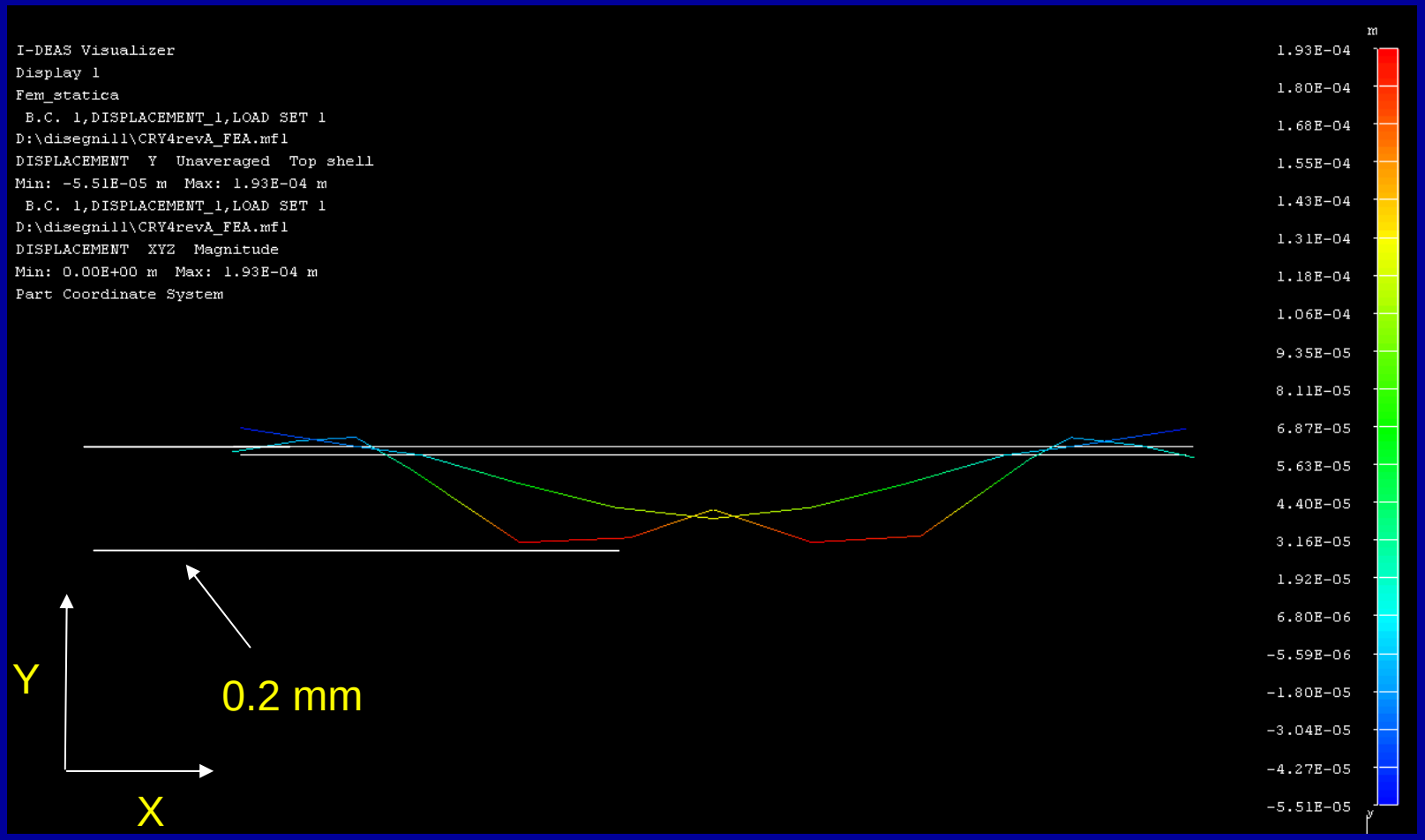
Ongoing work (4)

- Optimization of vacuum vessel supports:
  - Prefer two support isostatic solution

  max GRP deflection = 0.19 mm

- Optimization of POST position:
  - Find solution consistent with analytical model developed at INFN-Mi.

Example of VV support study
Displacements with A/2=3500



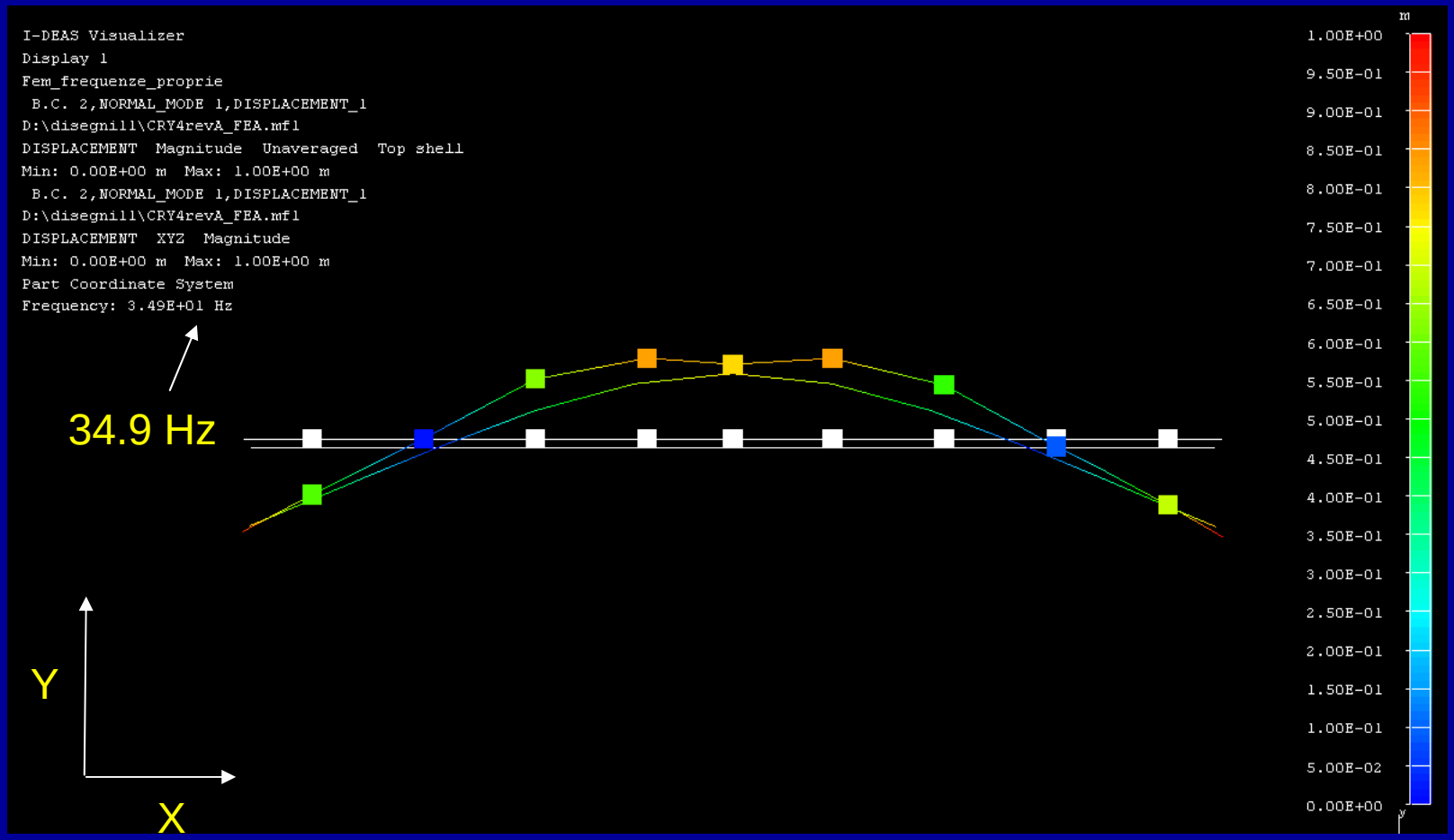
Ongoing work (5) :

- Normal modes of vibration in chosen configuration:
  - two supports (A/2=3500), POST = 4300 mm

- We considered two limits cases to model the POST connection between the vacuum vessel and the GRP:
  - CASE 1) all degrees of freedom fixed between the vacuum vessel nodes and GRP nodes (in the Post positions).
  - CASE 2) rotation along z axis (perpendicular to vessel axis) free between the vacuum vessel nodes and GRP nodes (in the Post position).

Example of FEM results

Normal Mode -1 (Y-X plane) two support points Case-1



	CASE-1	CASE-2
1	34.9 Hz (Y-X plane)	26.1 Hz (Y-X plane)
2	57.2 Hz (X-Z plane)	30.6 Hz (Y- X plane)
3	61.4 Hz (Y-X plane)	46.4 Hz (Y-X plane)
4	61.8 Hz (X-Z plane)	57.2 Hz (X-Z plane)
5	65.0 Hz (Y-X plane)	60.7 Hz (Y-X plane)
6	71.6 Hz (Y-X plane)	61.8 Hz (X-Z plane)
7	86.6 Hz (X-Z plane)	70.1 Hz (Y-X plane)
8	92.2 Hz (X-Z plane)	86.6 Hz (X-Z plane)
9	92.5 Hz (Y-X plane)	91.0 Hz (Y-X plane)
10	98.0 Hz (X-Z plane)	92.2 Hz (X-Z plane)

Normal Frequencies

POST = 4300

Two supports

A/2 = 3500

Near term future work (1)

- Mechanical model (room temperature)
  - Vacuum vessel + POST + simplified cold mass
  - Goals:
    - Experimental verification of FEM models predictions
    - Engineering cable and pipe routing/feed-through
    - Engineering assembly and associated fixtures
  - Model can be instrumented/inspected
    - Available stress analysis equipment in INFN-Pisa
    - Model can be easily modified to test project modifications
  - Should be accessible to all ILC collaborators

Near term future work (2)

- Specific cryomodule R&D:
  - Posts.
  - Vacuum flanges between cavities:
    - Decrease space between cavities.
    - Study “Ultraflex ” low insertion force o-ring.
      - Room/LN temperature tests in Pisa – LHe in Milan

Near term future work (3)

- Participation to cryomodule fabrication at Zanon (with INFN-Milan)
  - Current and future productions
- Participation to cryomodule engineering drawings:
  - Possible parts of major Pisa involvement:
    - Posts.
      - Includes coupling to the GRP
    - Vacuum vessel.
    - Thermal shields with associated pipes.
      - Could include some pipe size calculations
    - Parts of the GRP to be defined.
    - New cavity flange if R&D successful.

Manpower

- A. Basti: project engineer
- F. Raffaelli: consultant
- G. Martinelli, S. Linari, A. Sukhanova: engineers
- S. Bianucci: draftsman

  - Work in progress to procure additional engineering support.

Outlook

- Plan strong participation to cryomodule engineering, design and industrial production.
- Expect major INFN funding for a type 4 cryomodule in 2007 to be produced in Italy.
- Expect INFN involvement in cryomodule production to grow in following years.