

Overview of SLAC cavity simulation and beam interaction program packages

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University of London

(With thanks to the SLAC ACD group)



SLAC Advanced Computations Group

- Many people to thank:

- Physicists

- Arno Candel
- Andreas Kabel
- Kwok Ko
- Zenghai Li
- Cho Ng
- Liling Xiao

- Computational Scientists:

- Lixin Ge
- Lie-Quan Lee
- Vineet Rawat
- Greg Schussman



SLAC Advanced Computations Group

- 1998 DOE “Grand Challenge”
 - “Develop advanced tools for high fidelity modelling of large, complex, accelerator structures
- Aim to allow for “virtual prototyping”
 - Parallel, finite-element, high res, high accuracy
- ACE3P
 - “Advanced Computational Electromagnetics 3D Parallel”
 - Cavity design
 - Wakefields
 - Dark current & multipacting
 - Multi-physics (RF, thermal, mechanical)



ACE3P code suite

	Module Name	Description
Frequency Domain	Omega3P	Eigen-solver for resonant modes
	S3P	S-Parameters
Time Domain	Pic3P	PIC code for space-charge dominated devices
	Track3P	Particle tracking for multipacting & dark current
Multi-physics	TEM3P	EM, thermal, mechanical



Code Workshop at SLAC

CW09 @ SLAC

ICAP09 CODE WORKSHOP

SLAC NATIONAL ACCELERATOR LABORATORY

Home

Agenda

Attendees

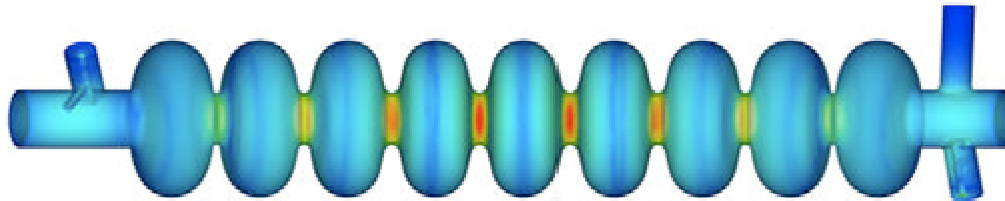
Software

ACD Talks

Code Survey

SLAC Computer Accounts

Online Input and Feedback



ICAP09 Code Workshop (CW09) at SLAC - hosted by the Advanced Computations Department (ACD)

Date — September 4th, 2009
Time — from 8:00 am to 5:00 pm
Place — SLAC SCCS Computer, Building 50
SLAC National Accelerator Laboratory
Menlo Park, California

Contact — ACD-CW09@slac.stanford.edu
650-926-2864
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SLAC ACCESS

All visitors must have a valid photo ID to enter the Laboratory. The SLAC Main Gate is open 24 hours a day, 7 days a week.

MAPS AND DIRECTIONS

» [More Information](#)

SLAC GUEST HOUSE

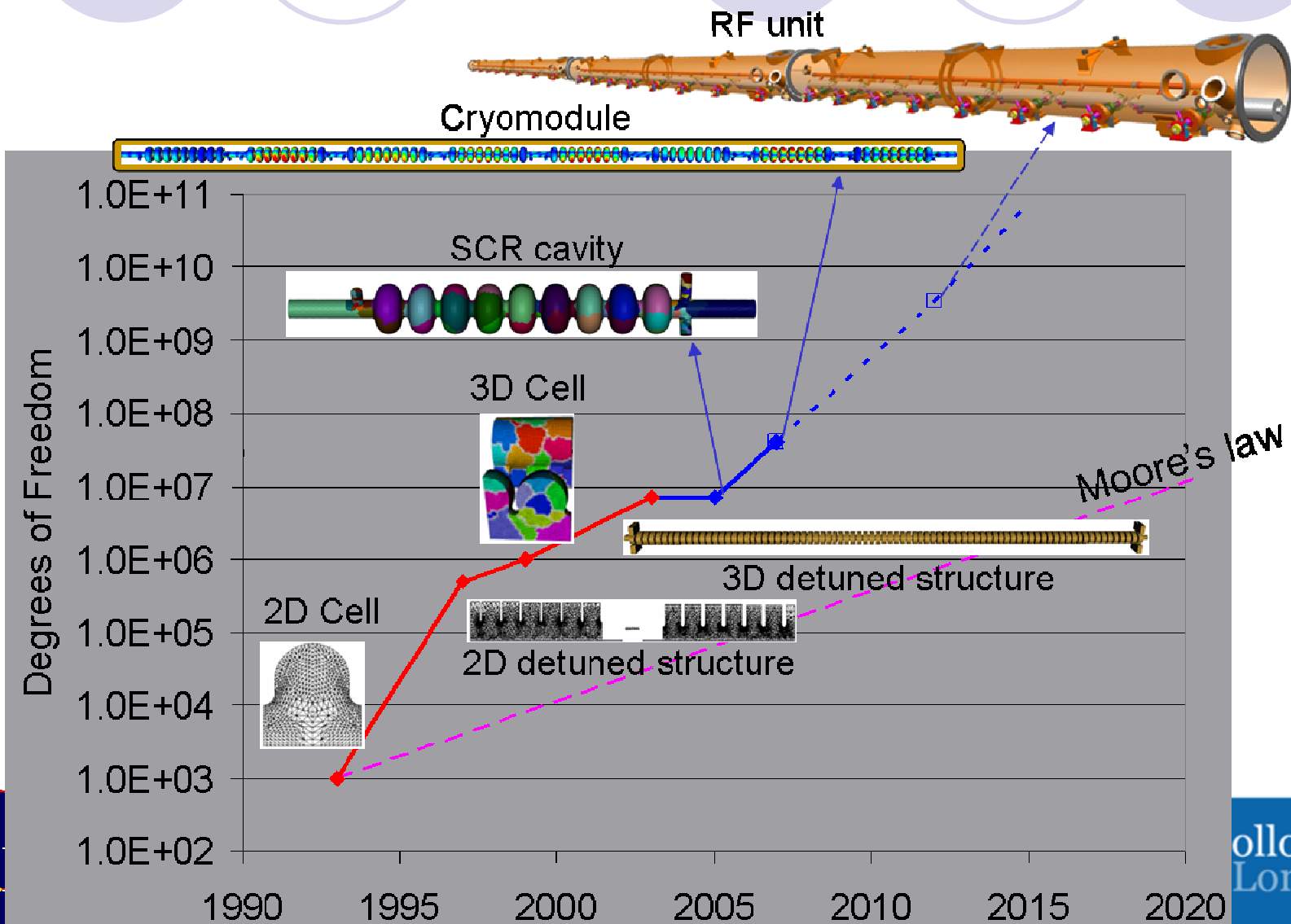
» [More Information](#)

Time	Description	Discussion Leads
8:00am - 8:10am	Introduction	
8:10am - 10:00am	CUBIT (ACDTool)	Z. Li
10:00am - 10:15am	Break	
10:15am - 11:00am	Omega3P, S3P	R. Lee, Z. Li
11:00am - 12:00pm	ParaView (rfpost)	Z. Li, G. Schussman
12:00pm - 1:00pm	Lunch	
1:00pm - 1:20pm	TEM3P	R. Lee
1:20pm - 1:40pm	Track3P	L. Ge
1:40pm - 2:00pm	T3P	R. Lee, C. Ng
2:00pm - 2:20pm	PIC3P	A. Candel
2:20pm - 2:30pm	Break	
2:30pm - 6:00pm	Breakout for Applications <ul style="list-style-type: none"> - Cavity Design - Wakefields - Multipacting - Thermal modeling 	ACD Staff

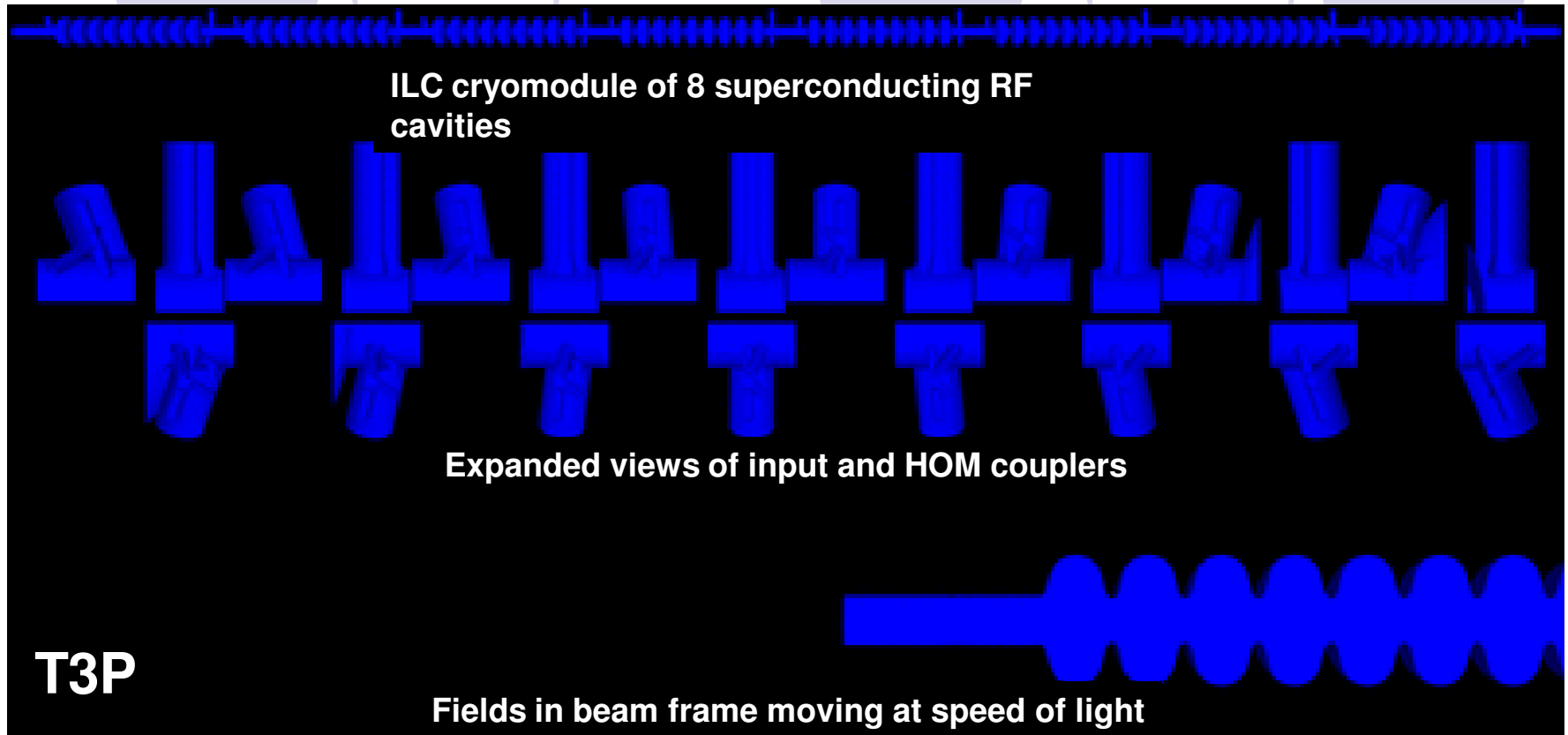
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Omega3P



T3P



The LARGEST problem for time-domain analysis

80 million-element mesh, ~500 million DOFs, 4096 CPUs (Jaguar), 4 seconds per time-step.

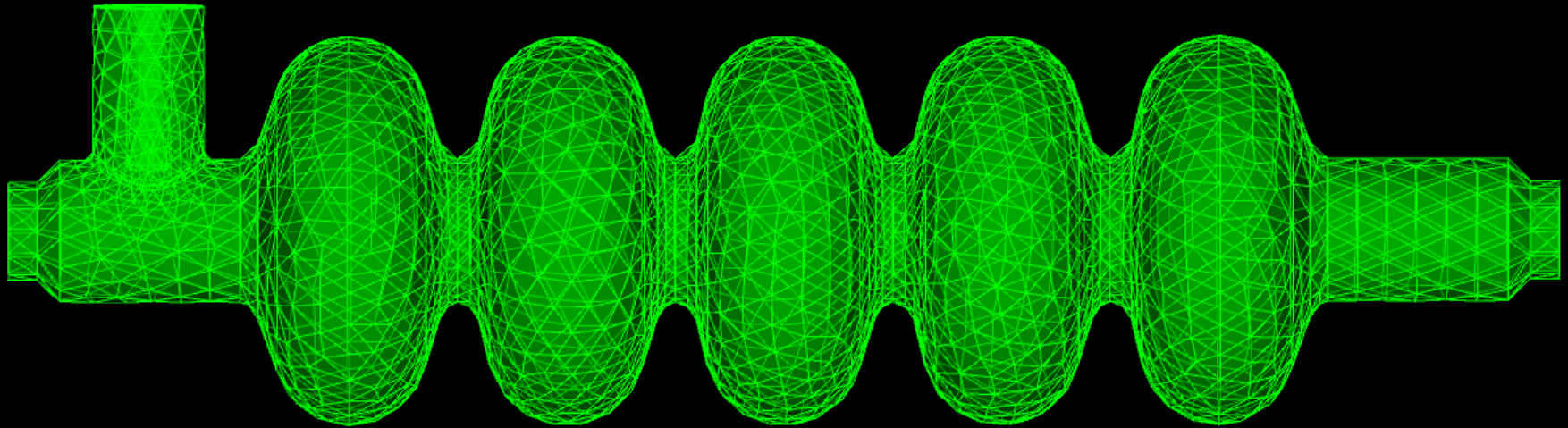
Frequency domain solve - 3 million-element mesh, ~20 million DOFs, 1024 CPUs (Seaborg),

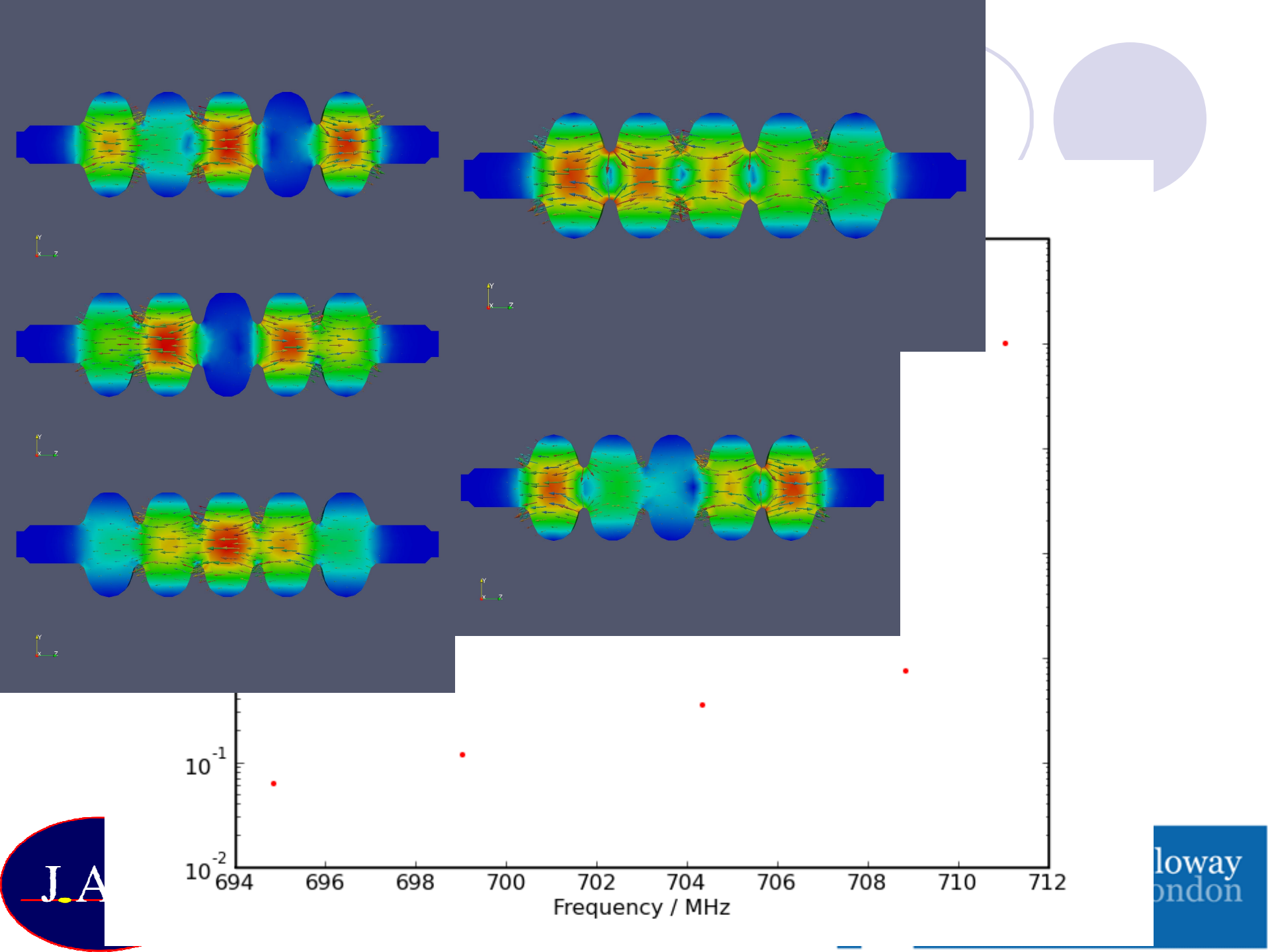
300 GB memory, 1 hour per mode.



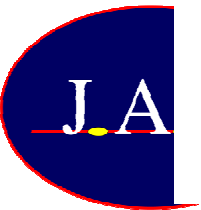
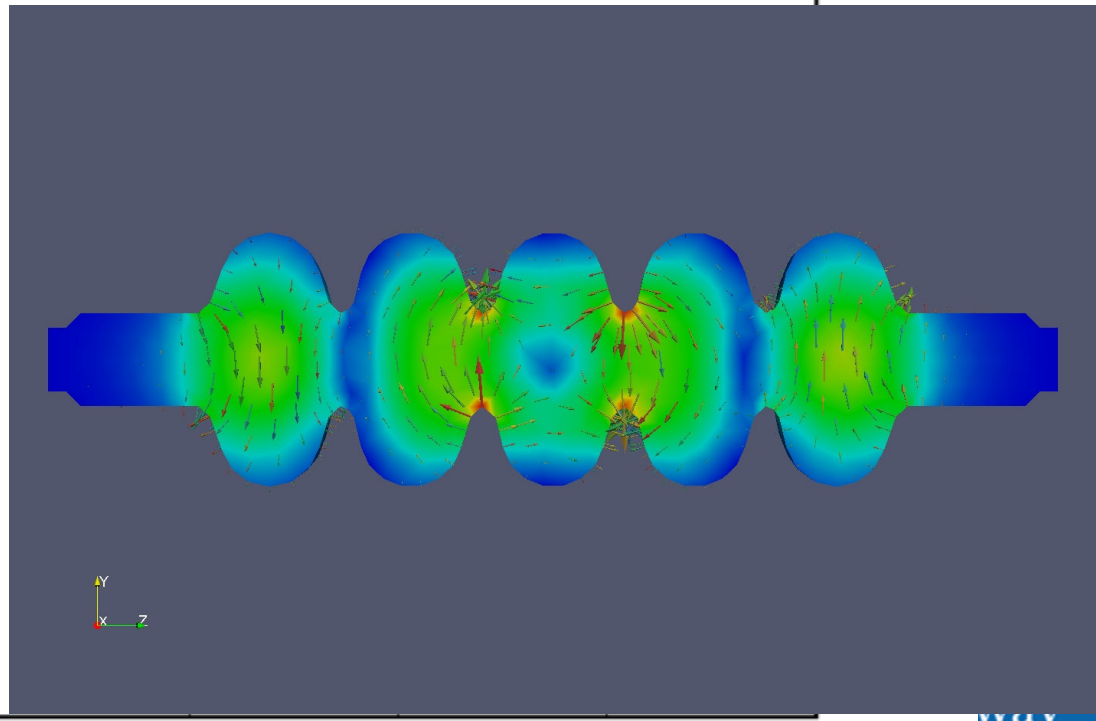
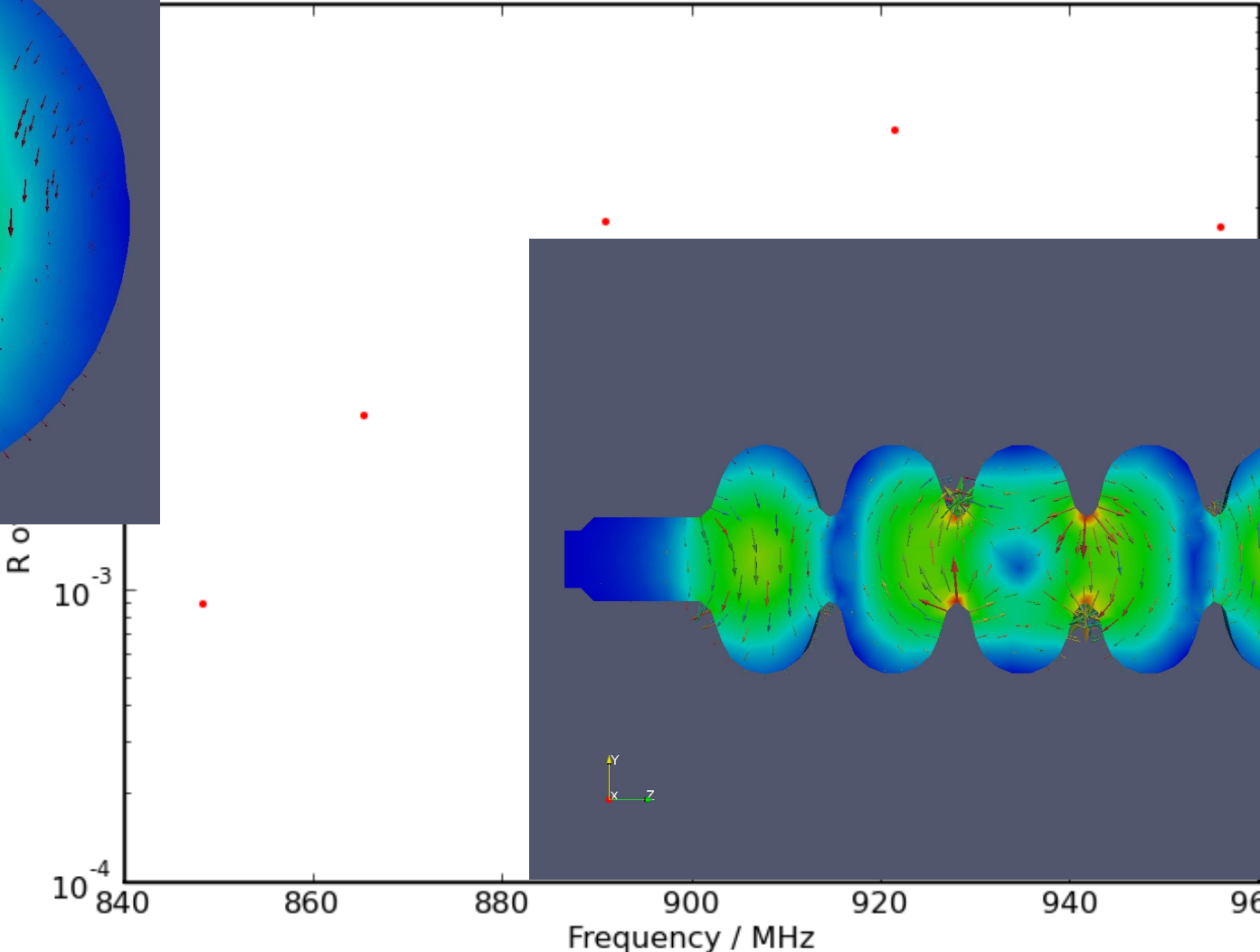
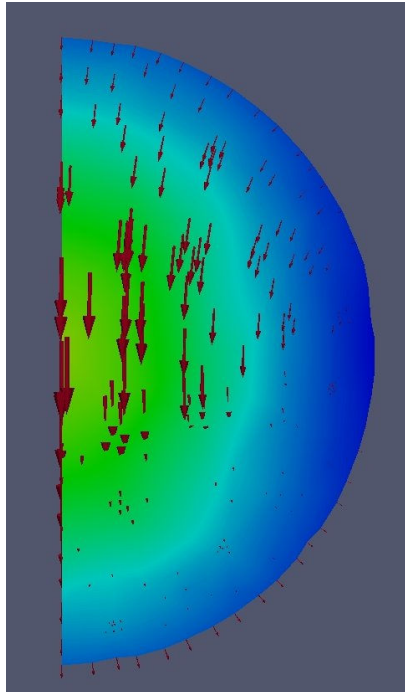
Building a Cavity – Cubit (Sandia Lab)

POSITION (FT) DIMENSIONS (IN) COORDINATE (IN) MASS (G)

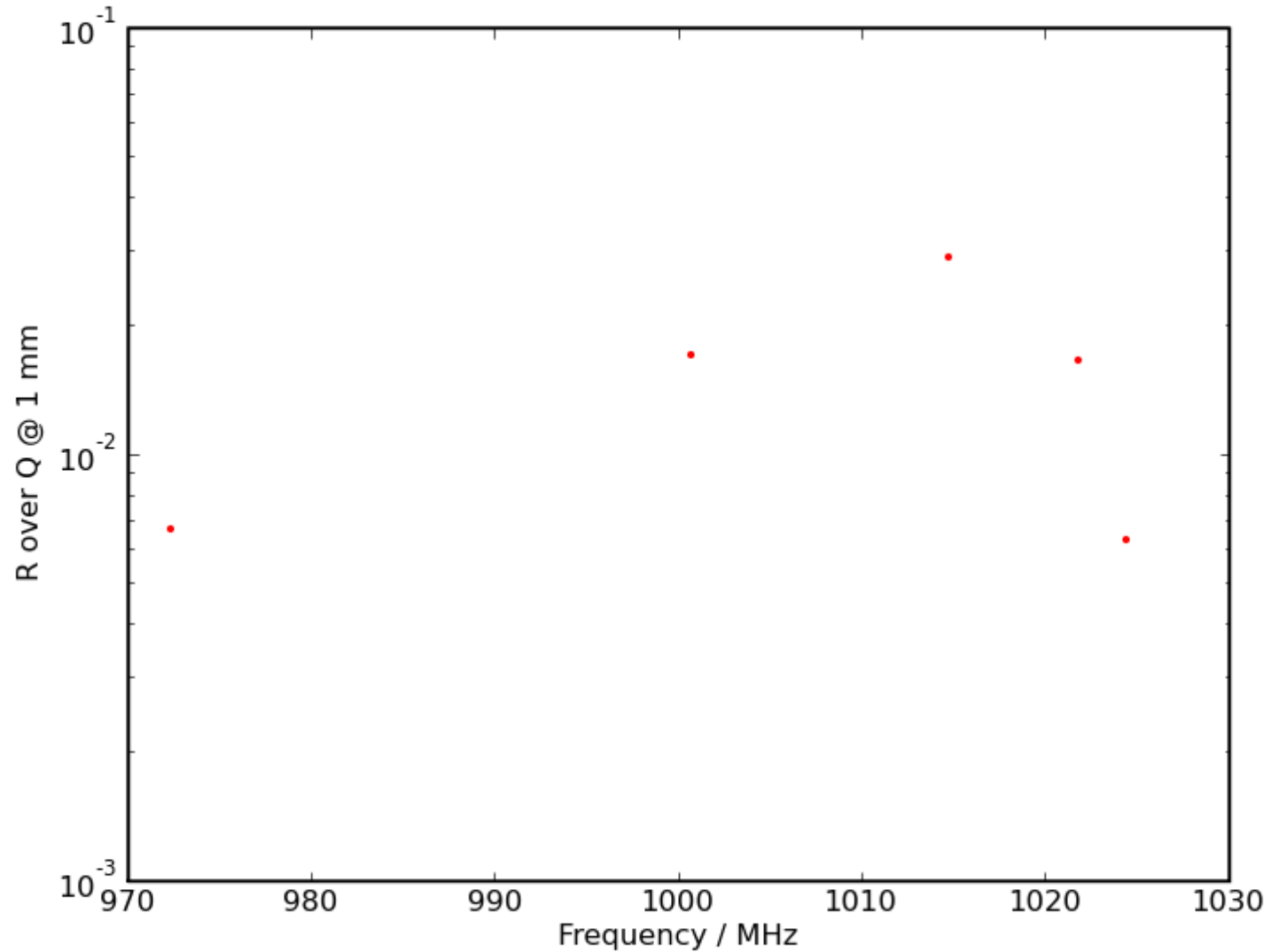




Early Results

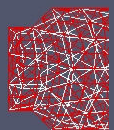


Early Results



Tuning Cavity Errors

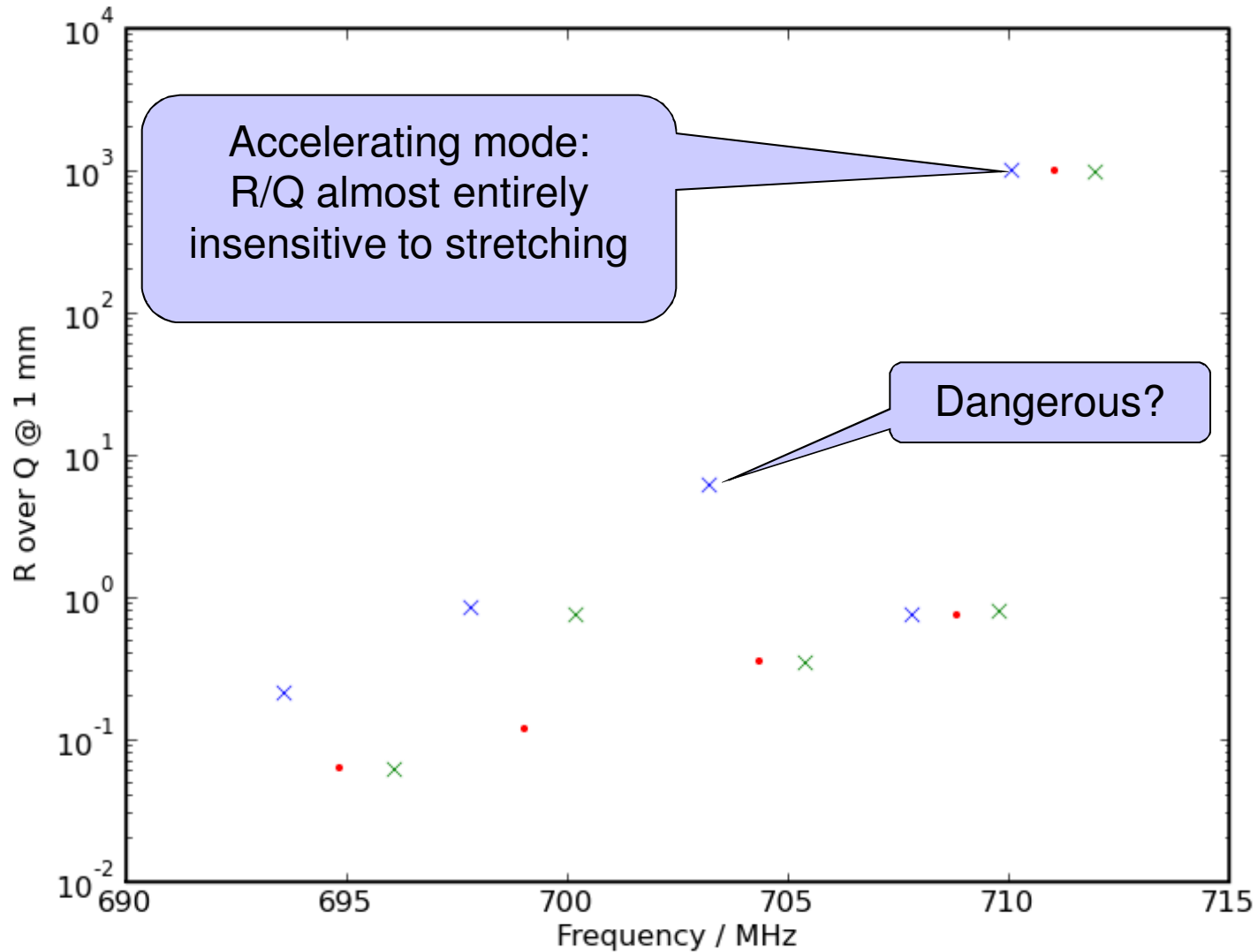
Each cell stretched by 2mm



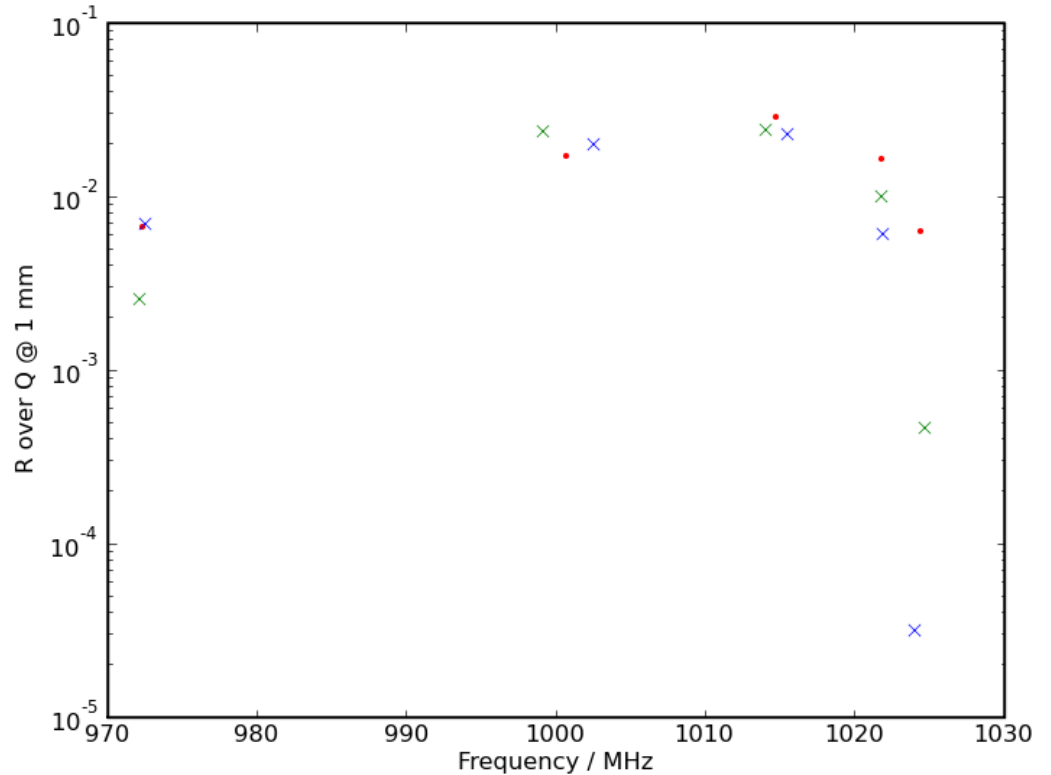
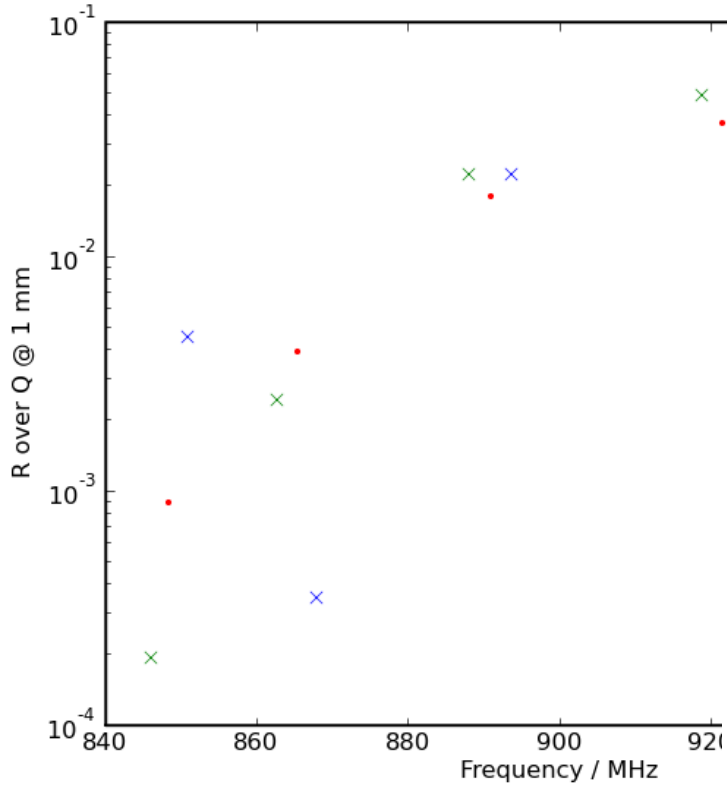
JA



Tuning Cavity Errors



Tuning Cavity Errors



Conclusions

- ACE3P code suite has been released
 - ACE3P code suite released and accessible via DOE's NERSC allocation
 - (Usage outside US under export limitations)
- Work has started on $\beta=1$ cavities
 - Bug discovered when working with couplers
 - R/Q spectrum calculated for nominal + stretched cavities
 - 'Stretching' not very realistic – needs to be refined
 - Dangerous modes may be determined
- Further work
 - Tuning of possible fabrication errors
 - Field flatness in coupler region
 - Lorentz detuning

