Research School of Physical Sciences and Engineering

Thin SRF Films at ANU

N. Lobanov

Nuclear Physics Department,

Research School of Physical Sciences and Enginering,

Australian National University

Canberra, ACT 0200 AUSTRALIA

Acknowledgements

D. Weisser

A. Muirhead

A. Cooper

J. Heighway

R. Turkentine

- Nb: 2QWRs with magnetron sputering
  - SB Q= 10^8@6 W in 1996
  - TEL Q=10^7@6 W in 1997 (low Q but acceptable due to accidental scratch in high current area)

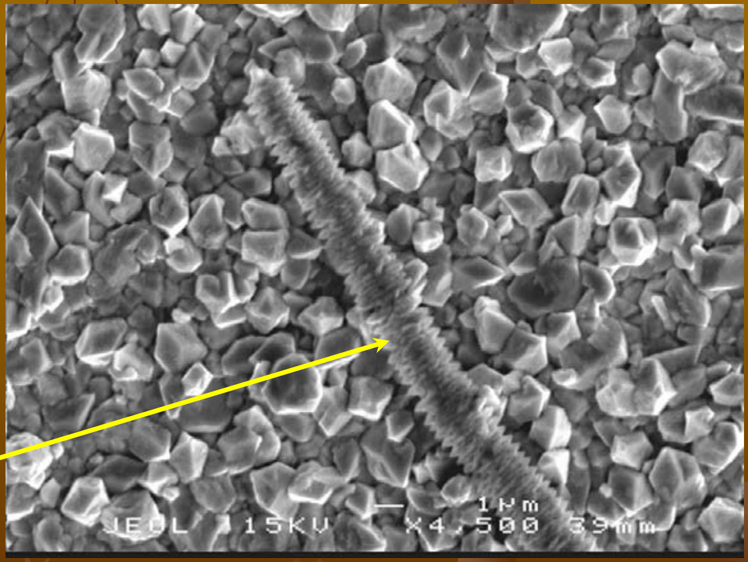
- Pb-Sn: from fluoboric/shinol till 1999 to Methanesulfonic (MSA) till present re-plated 12 SLRs Q>10^8@6 W

  MSA lead plating process for SRF cavities pioneered by John No➔

Pb-Sn Plating SLRs: Problems

Low melting point metals like Pb and Sn take a long time to solidify and the corresponding surface diffusion distance becomes long resulting in formation of large grains.

At some plating condition a dendrite can be generated.



Pb-Sn Plating SLRs

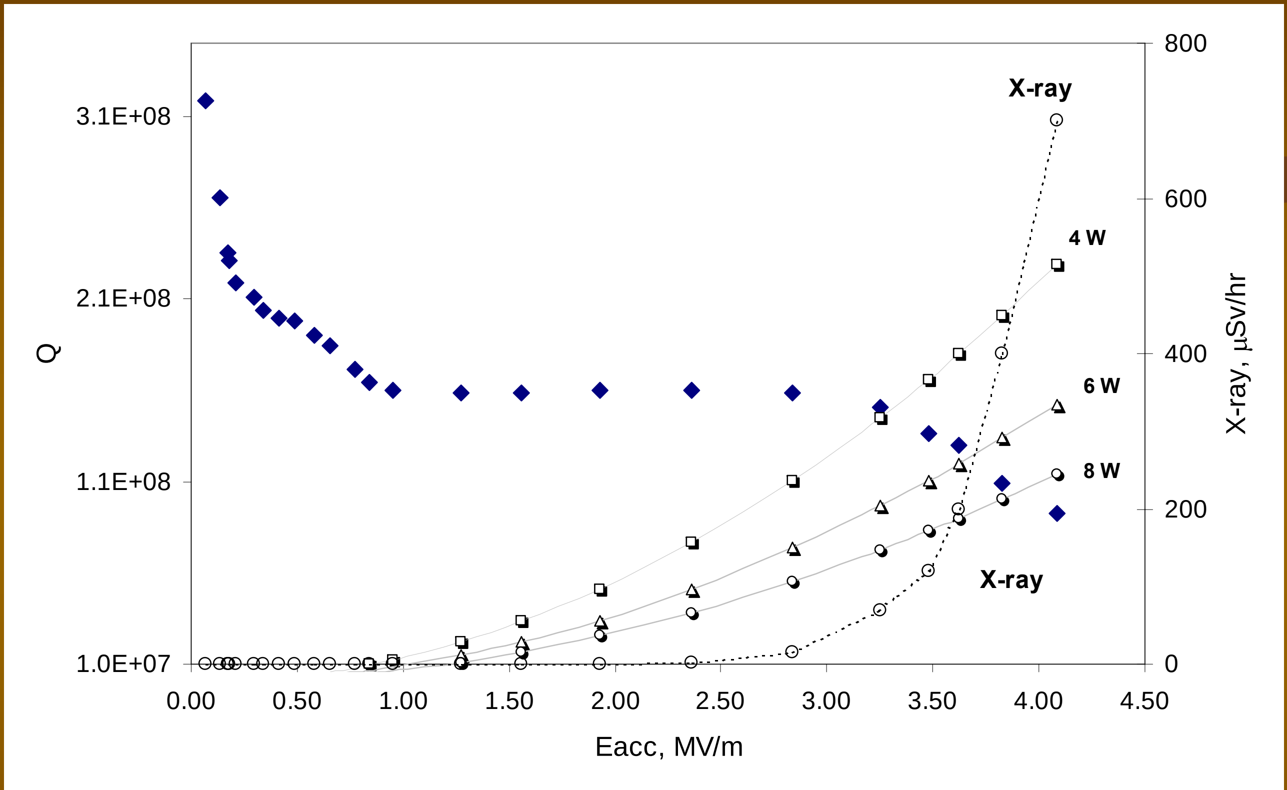
The crucial steps of MSA process were:

- Lead-tin film is deposited at 2.5 mA/cm^2 for a film thickness of 1.5 μ;
- Hand polishing of existing or freshly deposited lead with wipes and alcohol instead of stripping the Pb;
- Water rinse thoroughly with de-ionized, high pressure water;
- 15 second soak in plating solution;
- De-plating at 1.5 mA/cm^2 for 30 seconds;
- Immediately reverse pulse plating at 2.5 mA/cm^2 for 7 minutes. Forward time is 5 seconds and Reverse time is 0.5 seconds.

Pb-Sn Plating SLRs: Results

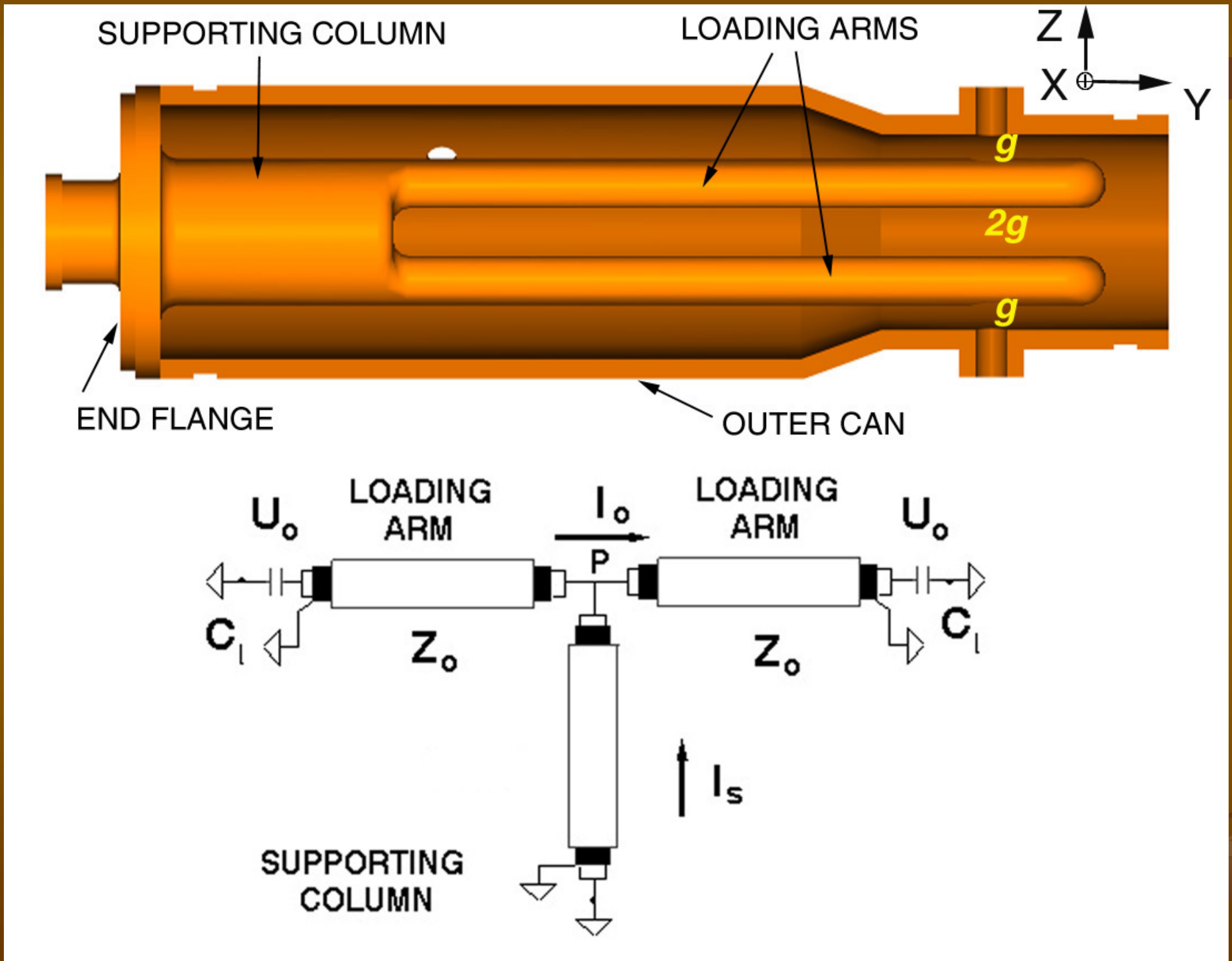
This procedure has proven to be successful in re-plating 12 ANU SLRs including 4 resonators with cracks in electron-beam weld.

Pb-Sn Plating SLRs: Performance

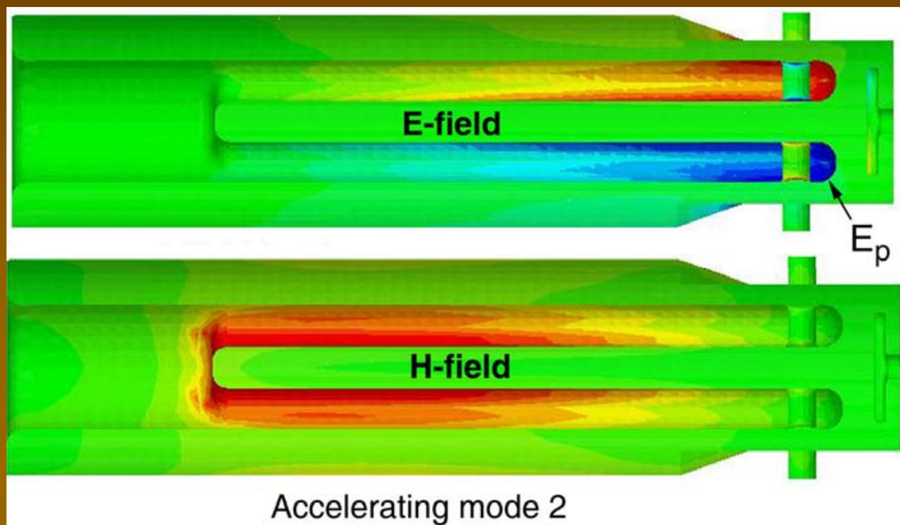


The Q's at 6 watts are at or above 10^8. The best resonator, achieved E_{acc} about 3.9 MV/m at 6 Watts on-line. The Q falls at low power levels from 0.2 to 2 Watts due to RF losses in gasket.

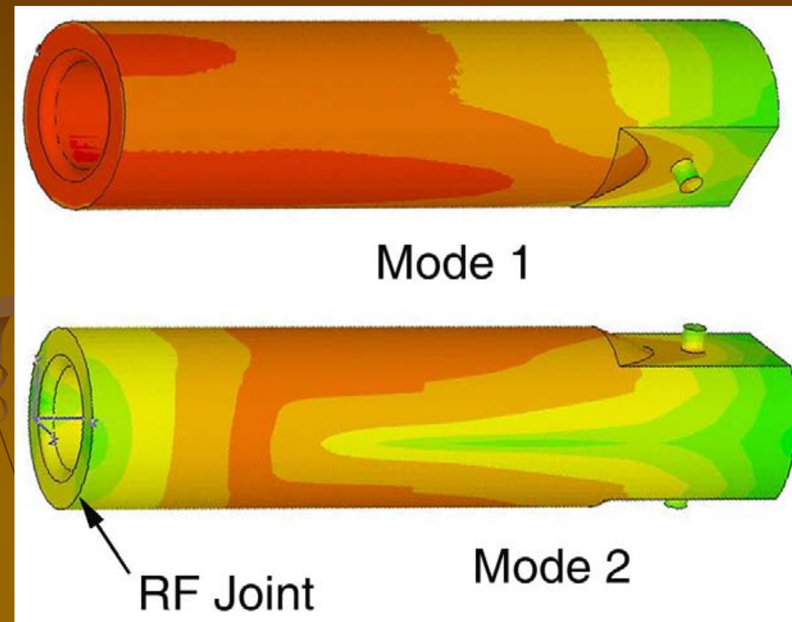
DVOIKA: 2 stub β=5 % cavity for LINAC Upgrade. PbSn or Nb Coating



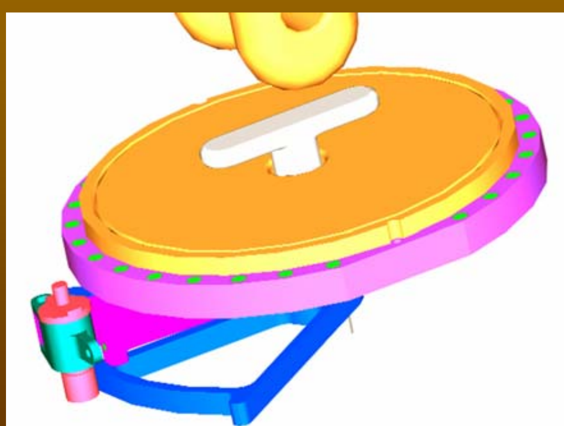
DVOIKA: RF Properties



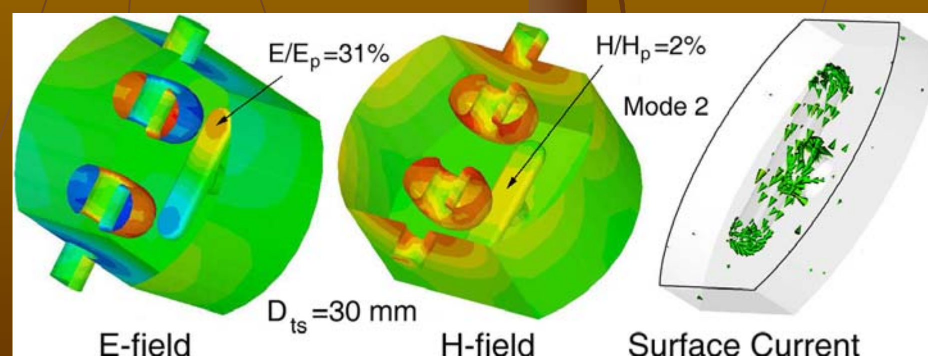
E, H field distribution



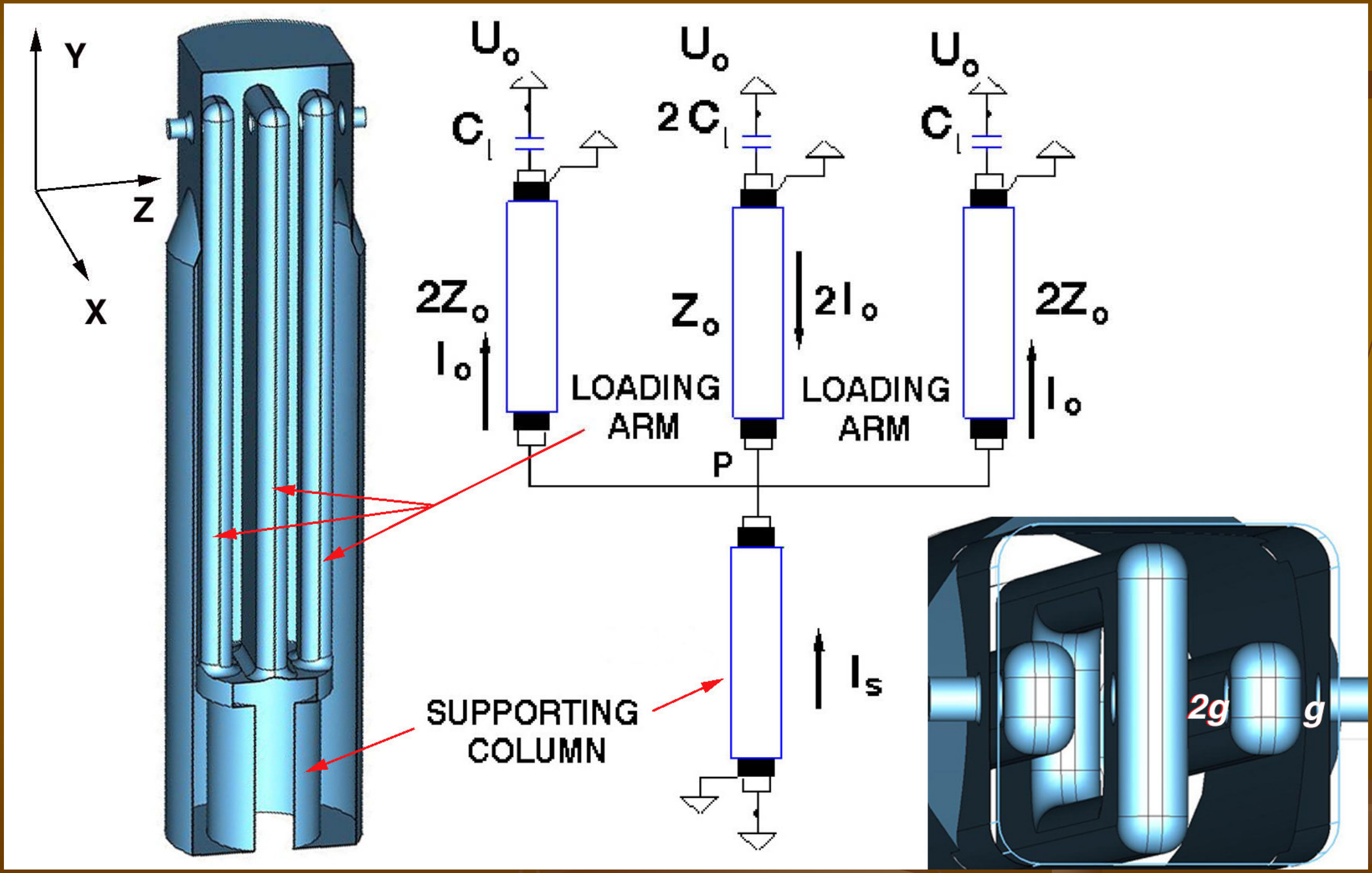
H-field in Outer Can



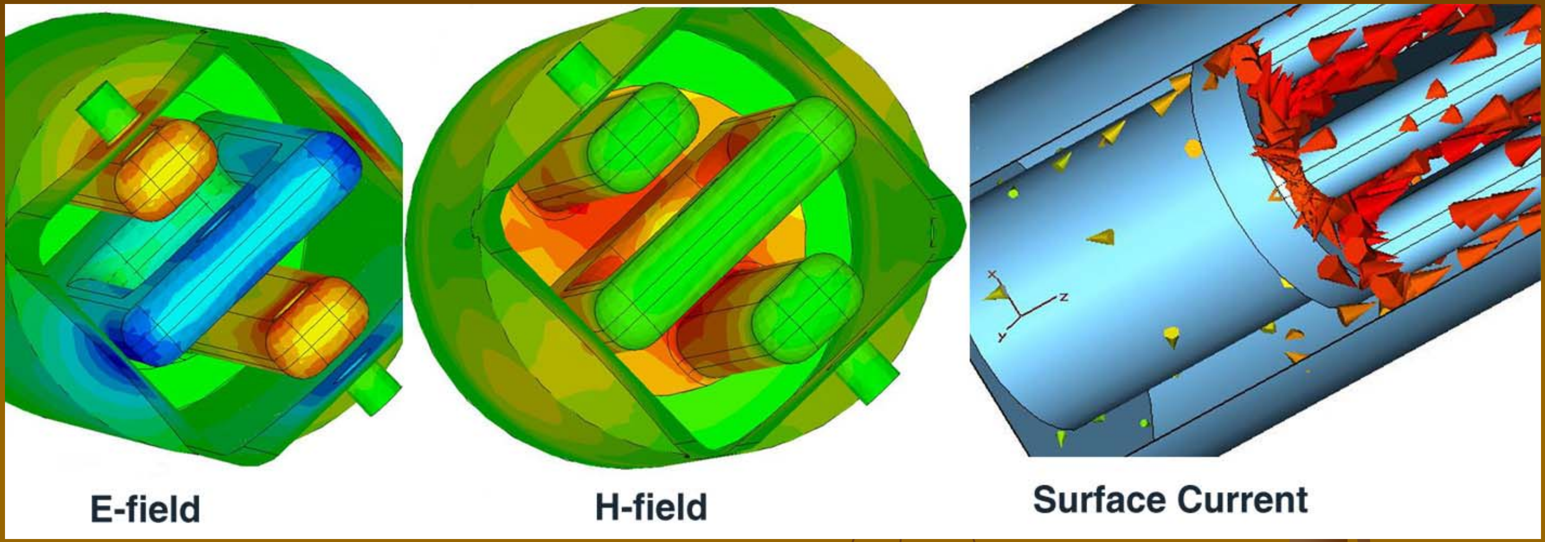
Rotary Tuner

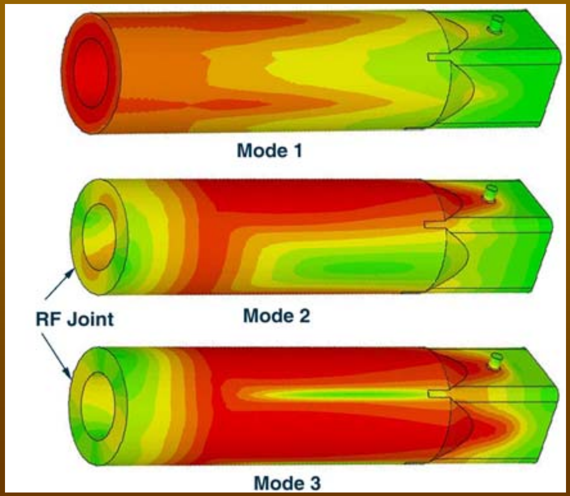


TROIKA: 3 stub β=2.5 % cavity

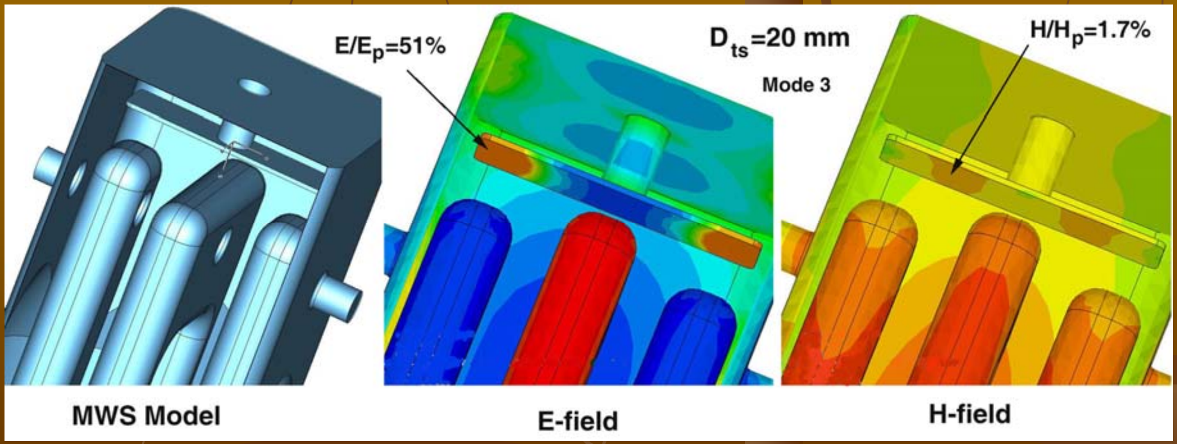


TROIKA: RF Properties





H-field in Outer Can



Displacement tuner

Pushing Pb-Sn Technology to Limit

- Ultimate B-quench in SLRs @E_{acc}~5.5 MV/m can be achieved via: HV baking/ Annealing, He and High Power Processing, Ultrasound Cleaning of substrate/film and plating at over-potential
- Fundamental Properties of Pb film shall be further investigated
- ANU offers SRF Community MSA PbSn plating
- Plating of two stub cavity is anticipated during the next 6 months

CONCLUSION

- Pb-Sn offers non-expensive alternative to Nb
- Pb-Sn Technology is affordable by small labs
- Employed in real machines
- Good object for fundamental SRF research
- Pb-Sn could be a supplement to Nb for non-critical application
- DVOIKA and TROIKA are good “open” substrates for Nb and HTS technologies. However RF losses in gasket should be addressed