

Seed Grant to Full Proposal

FOA DE-PS02-09ER09-05: *Fundamental Research in Superconducting RF Cavity Design* (Bill Weng, DOE HEP)

A LABORATORY-UNIVERSITY COLLABORATION TO UNDERSTAND PERFORMANCE LIMITS OF SRF CAVITIES

With Initial Scope on

UNDERSTANDING ORIGINS OF DEFECTS COMMONLY FOUND IN THE HEAT-AFFECTED ZONES OF WELDS AND THEIR EFFECTS ON SUPERCONDUCTIVITY

A proposal to the Office of High Energy Physics, United States Department of Energy
(Attention Dr. Wu-Tsung Weng)

In Response to Program Announcement DE-PS02-09ER09-05

At a cost of \$1.5 million for 3 years

From Principal Investigators

Dr. Lance Cooley (Fermi National Accelerator Laboratory),
Prof. Steven Sibener (The University of Chicago),
Prof. David Larbaestier and Dr. Peter Lee (Florida State University),
Prof. David Seidman (Northwestern University),
And Prof. John Zasadzinski (Illinois Institute of Technology),

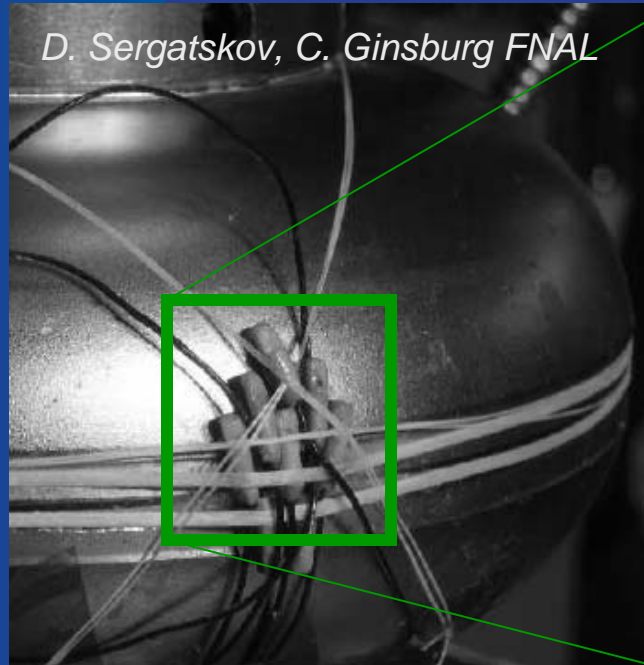


NORTHWESTERN
UNIVERSITY

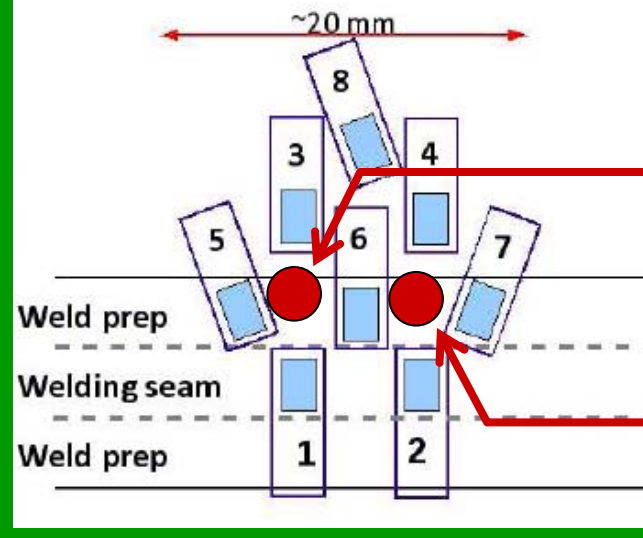


- FNAL + UC + Florida State + Northwestern + IIT
- \$1.5 M / 3 years
- Submitted 15 Jan 09

Recent Developments in SRF



Thermometry locates hot spots



Hayano group, Kyoto
Image enhanced by FSU

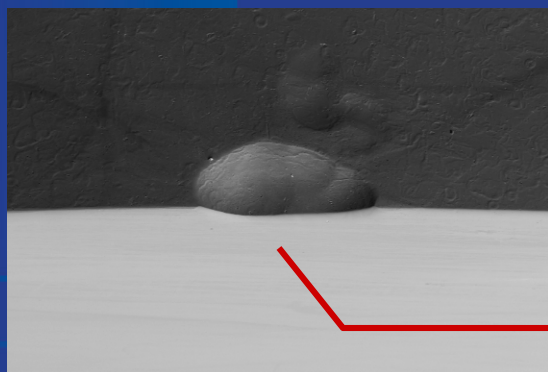
Hot spots
correlate with
location of
defects (pits)

~60% of hot spots have been correlated with defects such as these in the past year!

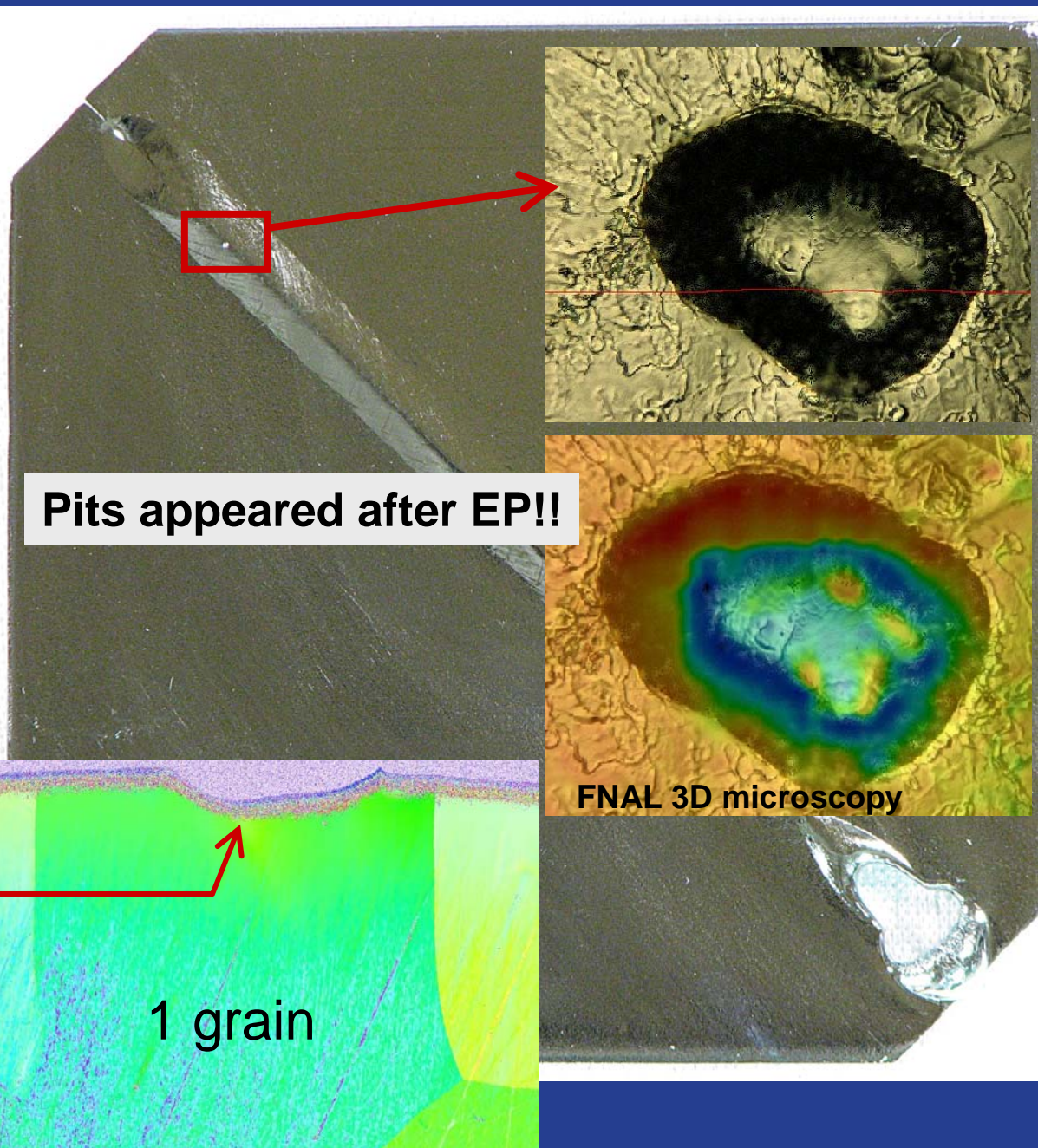
Breakthroughs in cavity imaging systems (Kyoto) reveal, for the first time, defects that are directly responsible for quenching of cavities.

New opportunity — Materials R&D can now be more directly applied to understand and solve cavity performance limitations!

FNAL succeeded at making weld defects in the lab. This achievement dramatically widens the range of characterization that is possible and increases the information gain.



Cross-section of defect cut, polished, and imaged by orientation microscopy at Florida State



Pits appeared after EP!!

FNAL 3D microscopy

1 grain

Proposal overview

- Two Themes
 - **Origin of weld defects**
 - **Effect of weld defects on superconductivity**
- Scientific issues – origins
 - Mechanical conditions left behind by forming, deep-drawing, annealing
 - Improper management of gases during welding, coalescence at boundaries, bubbles
 - Locally accelerated material removal, oxidation, dislocation pitting
- Scientific issues – effects
 - Topography, geometric enhancements of fields
 - Physical and chemical modifications that harm SC
- Deliverables
 - Model welds for all conditions
 - Extracted defects for study
 - Ideal, controlled processing
 - 3D reconstruction
 - Structure and chemistry across surface and depth
 - Local SC properties for above
 - Influence of processing on above