

Advancing Measurement for Breakthrough Science

A Company Overview

Lake Shore is committed to
our customers' **pursuit** of the
science that **benefits**
mankind

Advancing Research



Reliable Measurements
for Breakthrough Science

Advancing Testing



Reliable Testing for
Dependable Quality Control

Advancing Aerospace



Reliable Performance
Under Extreme Conditions

Company Profile

Established and dependable

- Over 45 years in operation
 - HQ near Columbus, OH, USA
- ISO 9001 quality system



Readily available technical expertise to support your work

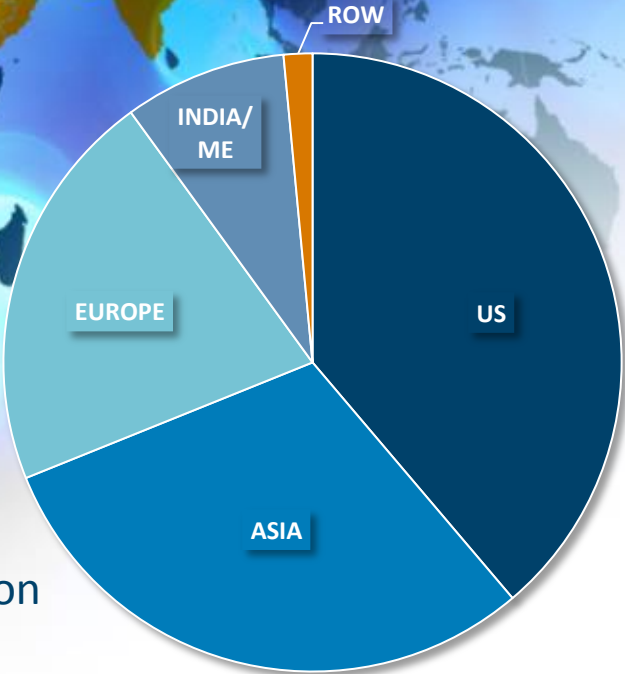
Over half of our employees have degrees in physics, engineering, or materials science



Advancing Science Globally

Over 60%
of sales are
Exports

Local technical
experts globally



Sales by Region

Core Competencies

Precision sensors, instruments, and measurement systems for science & research



Temperature Measurement

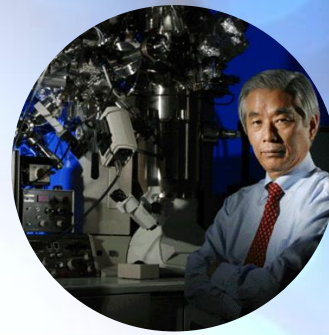


Magnetic Field Measurement



Material Characterization Systems

Supporting Significant Scientific Accomplishments



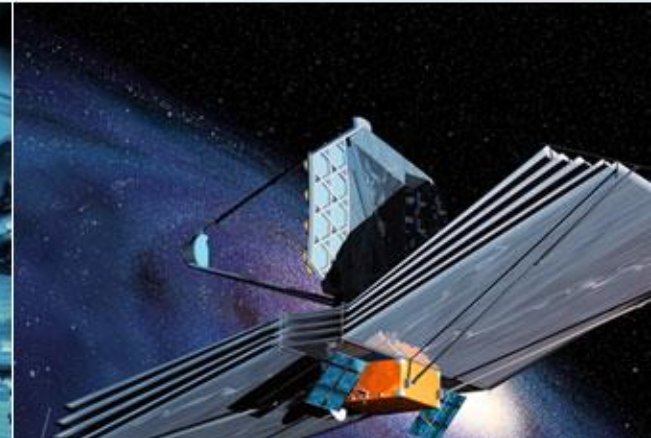
Dr. Sumio Iijima
Inventor of the carbon nanotube



CERN LHC
Particle Accelerator



National Ignition Facility



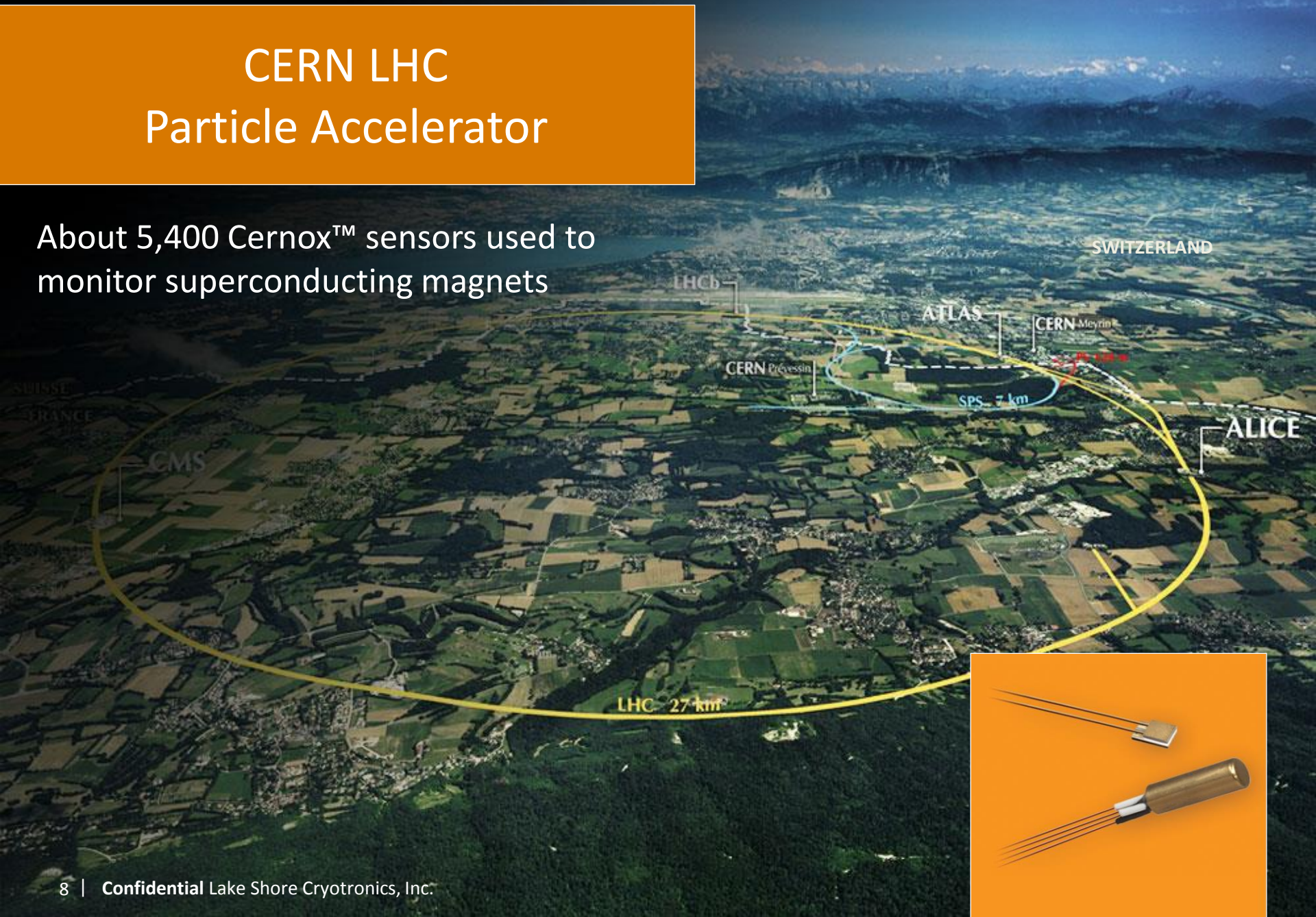
NASA James Webb
Space Telescope



Alex Mueller & Georg Bednorz
Nobel Prize in Physics in 1987 for work
in high temperature superconductivity

CERN LHC Particle Accelerator

About 5,400 Cernox™ sensors used to monitor superconducting magnets



Cryogenic Temperature Sensors



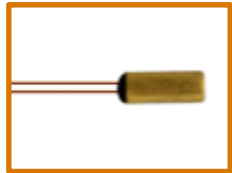
0.03 0.05 0.1 0.3 1 1.4 3 4.2 10 30 77 100 300 325 500 800 1000 1550 K



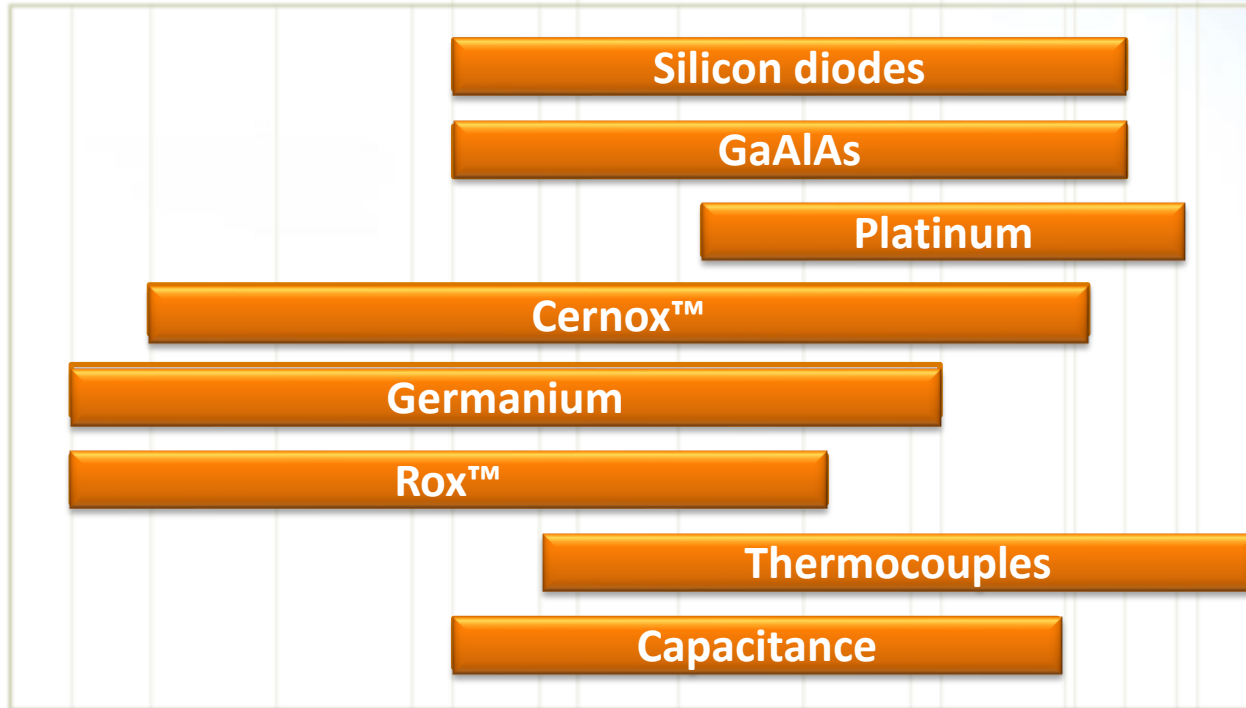
GaAlAs Diodes



Germanium



Capacitance



Silicon Diodes



Platinum



Cernox



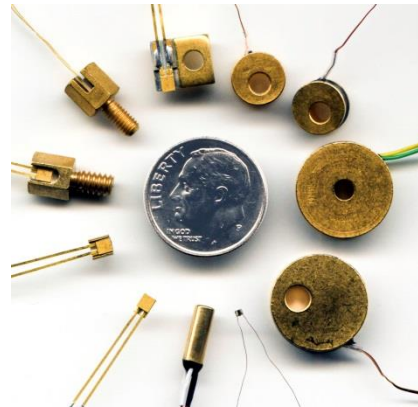
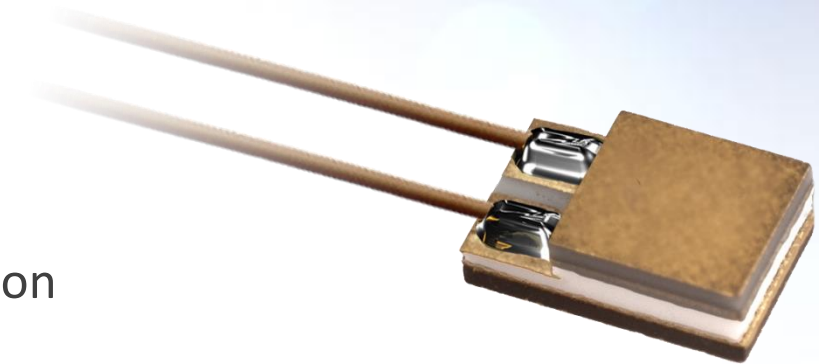
Ruthenium Oxide



Thin film cryogenic RTDs

- Small size
- Fast thermal response
- Low magnetic field induced errors
- Excellent resistance to ionizing radiation
- High sensitivity at low temperatures
- Excellent stability
- Variety of packaging options

Proven and trusted globally



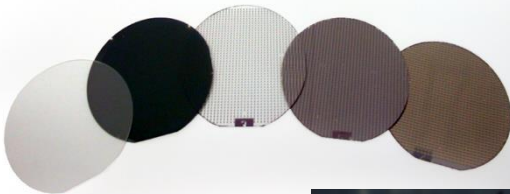
Sensor Manufacturing



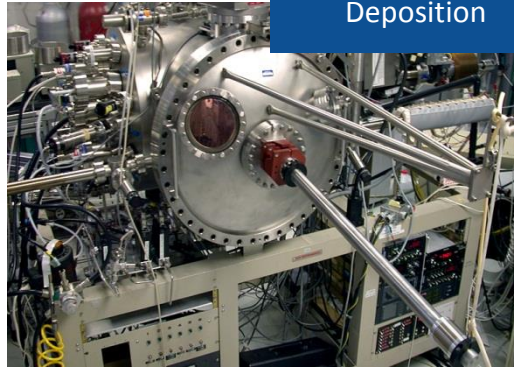
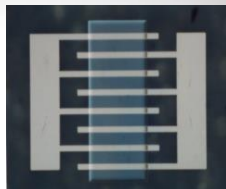
Extensive in-house thin-film sensor development and production capability

Device Fabrication

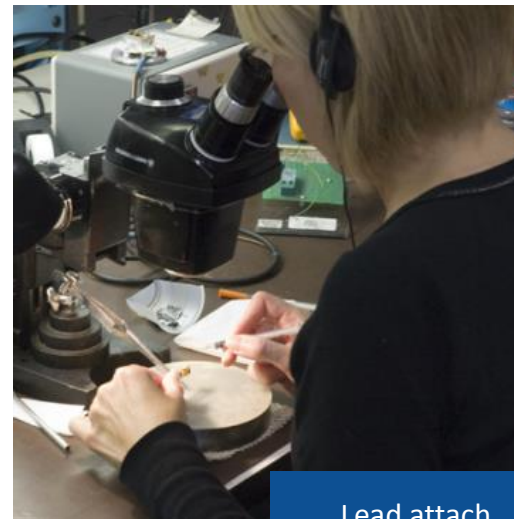
- ◆ Thin film deposition
- ◆ Wafer characterization
- ◆ Lithography
- ◆ Dicing, wire bonding
- ◆ Packaging, hermetic sealing
- ◆ Lead attachment
- ◆ QC and calibration
- ◆ High reliability screening
- ◆ Customization



Lithography



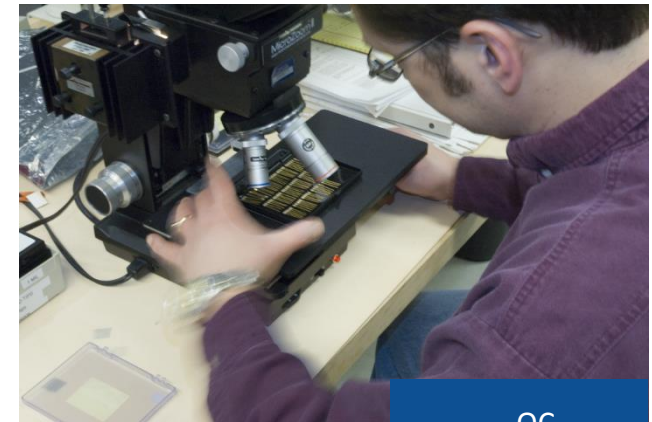
Deposition



Lead attach



Packaging



QC

Calibration Services



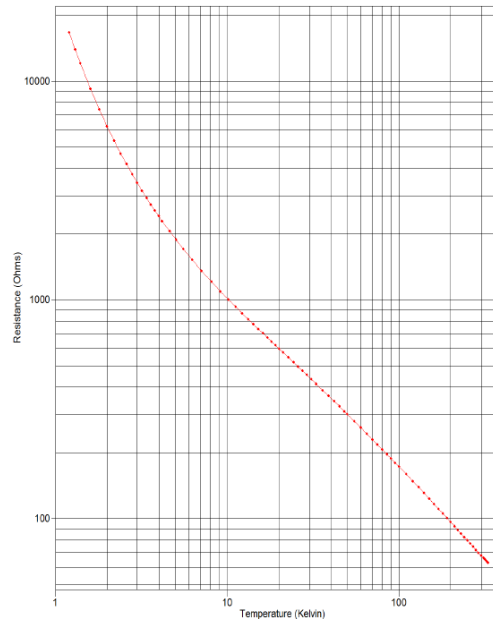
Lake Shore operates one of the most advanced temperature sensor calibration facilities in the world

- Cryogenic Capability
 - Dilution refrigerators for sub 20 mK calibration
 - Referenced to NIST, NPL, & PTB standards
- High Temperature Capability
 - Up to 900 K

- ITS-90 and PLTS-2000 standards maintained on standard platinum (PRT), rhodium-iron (RIRT), and germanium (GRT) resistance thermometers
- Standards calibrated directly by an internationally recognized national metrology institute (NIST, NPL, PTB) for $T < 330$ K or an ISO 17025 accredited metrology laboratory for 330 K $< T < 800$ K.
- A nuclear orientation thermometer is also used for temperatures less than 50 mK.

DATA PLOT
Calibration Report: 827416
Sensor Model: CX-1050-AA-1.4L
Sensor Type: Cernox Resistor

Sales Order: 102575
Serial Number: X102406
Temperature Range: 1.40 K to 325 K



Sensor Calibration Facility

Dilution Refrigerators



Cryogenic Temperature Controllers & Monitors



Model 325
Low Cryogenic
Temperature Controller



Model 350
Ultra-Low Cryogenic
Temperature Controller



Model 372
AC Resistance Bridge and
Temperature Controller



Model 335 & Model 336
Advanced Low Cryogenic
Temperature Controllers



Model 224
12-Channel Cryogenic
Temperature Monitor



Model 218 and transmitters
8-Channel Cryogenic Temperature
Monitor and Transmitter Cards

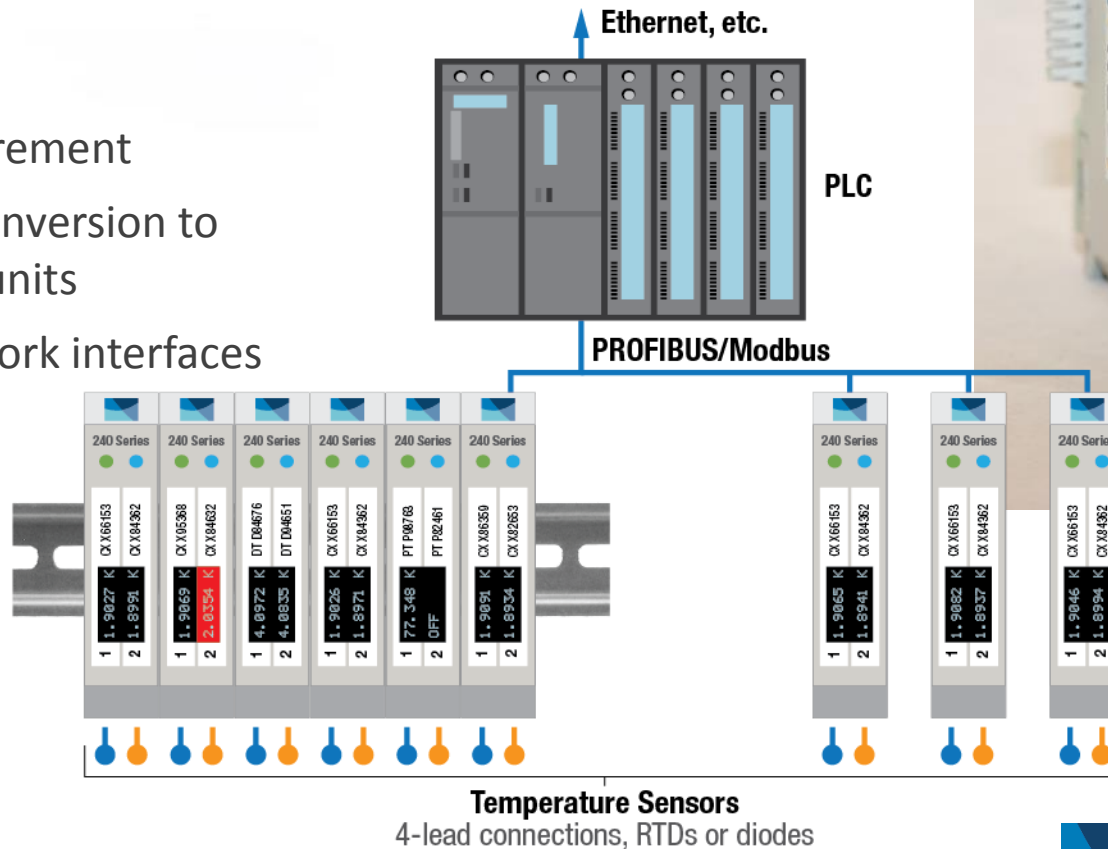
NEW—Cryogenic Sensor Input Modules



Distributed temperature measurement for large applications

- DIN rail mountable modules
- 2 sensor inputs/module
 - Cernox™ RTDs
 - Diodes
 - Platinum RTDs
- 4-wire measurement
- On-module conversion to temperature units
- Fieldbus network interfaces
 - PROFIBUS-DP
 - Modbus

**Lake Shore
240 Series
Cryogenic Sensor
Input Module**



Reference “Big Physics” Projects

■ Accelerators

- LHC at CERN – Switzerland (about 5,400 Cernox™)
- SNS at Oakridge National Lab – U.S.
- SLAC at Stanford – U.S.
- LCLS and others at Fermilab – U.S.
- Advanced Photon Source at Argonne National Lab – U.S. (Cernox)
- FAIR – Germany
- SRF LINAc at IFMIF (about 60 Cernox)
- STF at KEK – Japan (about 80 Cernox)
- FEL at DESY – Germany (Cernox)
- CEBAF Linac at Thomas Jefferson Nat’l Lab – U.S. (Cernox, diodes)
- Superconducting Ring Cyclotron at Riken – Japan (Cernox)



■ Fusion Reactors

- ITER – France
- NIF at Lawrence Livermore National Lab – U.S.
- KSTAR – Korea (about 400 Cernox)
- W7x at Max Plank – Germany (Cernox)

■ Other

- ALMA radio telescope – Chile
- Dozens of unmanned research satellites (NASA, etc.)

- www.lakeshore.com
 - Detailed product and application information
 - Local contacts
- sales@lakeshore.com
 - Tell us what you need
- Lake Shore Blog
 - Recent happenings, new products, customer papers
- 2015 Conferences
 - All of the major cryogenics, magnetics, and physics conferences— check our website for upcoming events

