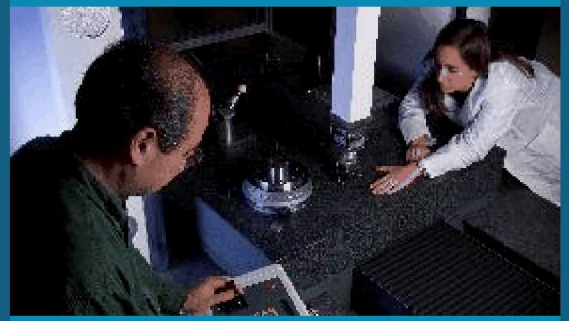
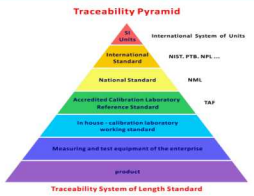
SAND2019-9799C

PJVS at Sandia's Primary Standards Laboratory





Raegan Johnson

8/28/2019

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Introduction – Sandia National Labs

Sandia National Laboratories

- Albuquerque, NM
- Nuclear Security Enterprise (NSE)
  - National Nuclear Security Administration (NNSA) – part of DOE
  - NSE consists of 8 sites across the U.S.
- Mission
  - ***"Sandia develops advanced technologies to ensure global peace"***

Introduction – Primary Standards Lab at SNL

Primary Standards Laboratory

- Function: NIST equivalent for NSE
- Mission:
  - ***"The qualification and reliability of every product in the NSE is based upon measurements traceable to the SI through the PSL"***
- Primary and secondary labs
  - Mechanical, electrical, radiation/optics
- Who are PSL customers?
  - Customers from other NSE sites
  - Internal SNL customers
  - 14,632 calibrations per year
- PSL Strategic Plan
  - Partner and align with NIST
  - Independent means of realizing SI units (V and Ω)

Why does PSL-SNL need DC voltage intrinsic standard?

Why Quantum Standard at PSL?

- Eliminate the need to send items to NIST for calibration
  - Reduce chance of damage
  - Reduce unwanted wear and tear on instruments
  - Reduce down-time for PSL and PSL customer
  - In some cases, reduce risk of battery failure and calibration information being lost

PJVS – Programmable Josephson Voltage Standard

- Quantum Standard for DC Voltage

DC Voltage Standards

- ~90 Fluke 732B DC Voltage Standards that require calibration through PSL
  - Customers:
    - PSL Primary Lab
    - NSE calibration labs
    - SNL customers
- Accuracy → ± 2 μV/V (± 2 ppm) → manufacturer 1 year spec. at 10V

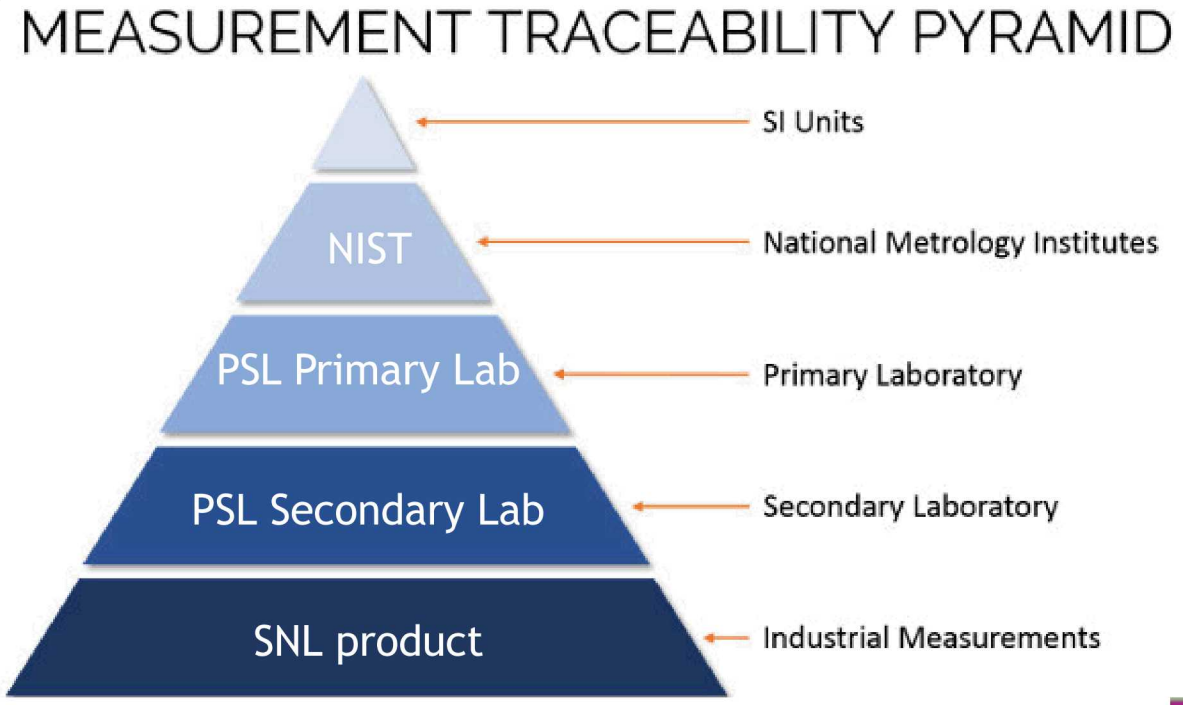
PJVS at PSL

PJVS resides in the DC Electrical Lab at the PSL

Accuracy requirements for Fluke 732B:

- Accuracy → ± 2 μV/V (± 2 ppm)
  - Need standard that meets TUR 4:1 to calibrate Fluke 732B
- SNL product accuracy
  - Must meet TUR 4:1 to Secondary Lab which must meet TUR 4:1 to Primary Lab → TUR 16:1
  - **Many products at SNL have tight tolerances which requires tight tolerances on standards**

PSL conventional JVS for many years (20+ years)



https://www.isobudgets.com/measurement-traceability-complying-iso-17025-requirements/

Timeline of PJVS at PSL

Fall 2017 – PSL purchased PJVS

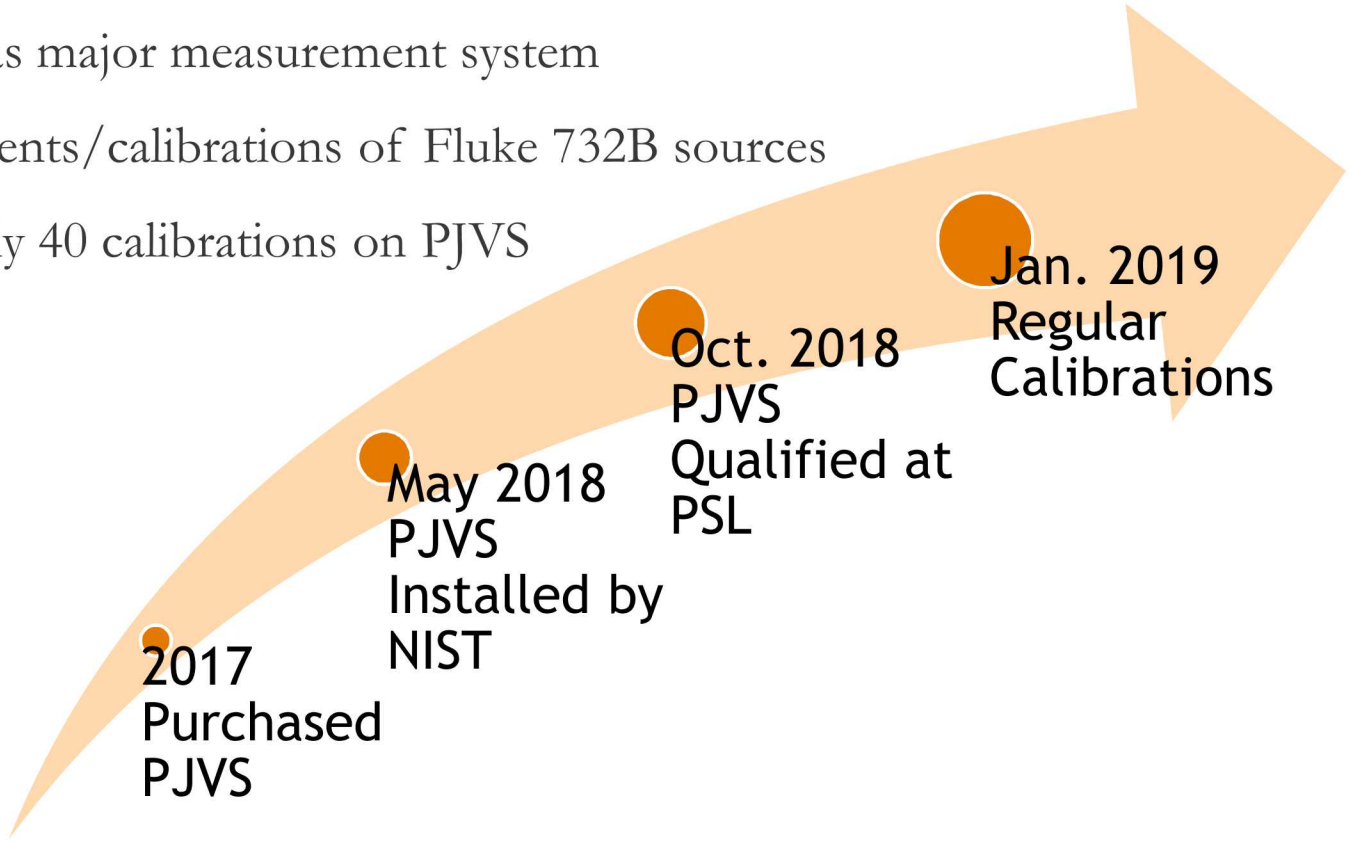
May 2018 – PJVS Installed

May/June 2018 – System qualified by NIST

Fall 2018 – System qualified by PSL as major measurement system

Fall 2018 – Started regular measurements/calibrations of Fluke 732B sources

Jan 2019 – present – Performed nearly 40 calibrations on PJVS



Benefits to PJVS vs. Conventional JVS

Automatic tuning
- Old JVS required manual tuning of microwave frequencies and power requirements (~several hours)
- Shortens measurement setup time (hours vs. minutes)
- Prevents loss of data during overnight measurements ("wandering" optimal microwave frequencies periodically occur)

Automated software – "plug and play"

Runs on closed-cycle refrigerator
- c-JVS required He transfer
  - $10,000 per year in He purchases
  - Caused limited scheduling of JVS use

Safety
- Liquid He transfer
- Frozen air plugs creating cryogenic hazard
- Work stoppage / system stress when JVS electronics have to be warmed up then cooled down in a controlled manner when the system ran out of He due to supply chain issues

Up-to-date equipment
- Old JVS system had an archaic oscilloscope and other old equipment

Smaller footprint

Summary of Benefits of Owning PJVS

Ease of use
- No He transfer
- Automatic tuning
- Easy to follow software
- Short set-up time
- Efficient
- Analysis software included

Reduce the time and cost of calibration
- Multiple hour set-up time with c-JVS down to minutes setup time with PJVS

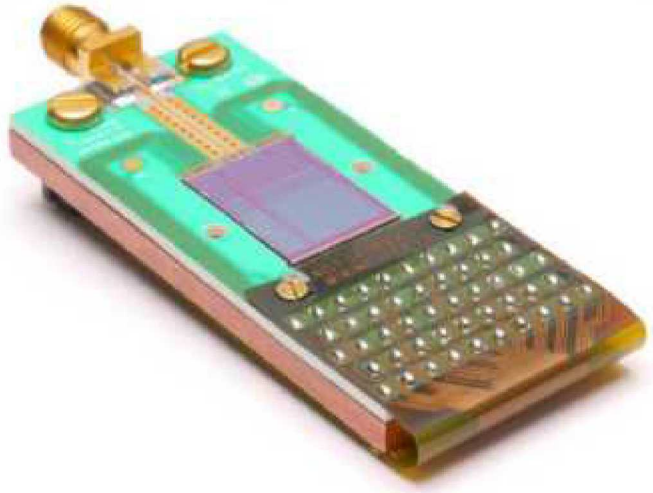
No need to ship artifacts to NIST

PJVS has improved quality and safety in the lab

Excellent communication with NIST
- Knowledgeable and fast response time

PJVS Cryopackage

Top



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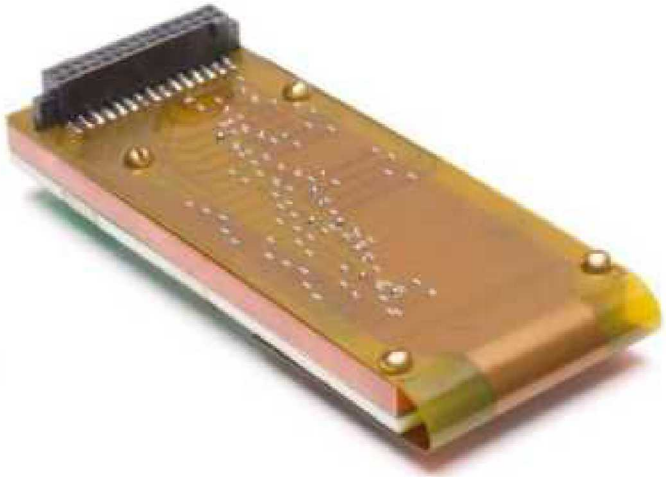


https://www.nist.gov/sites/default/files/documents/2017/03/08/160909_asc2016_annotated_benz_plenary.pdf

Moving forward

PJVS: Expand capabilities to calibrate DVM, calibrators, etc.

PJVS: How do we ensure it is giving correct values?

- Inter Laboratory Comparisons (ILC) and Proficiency Tests (PT)
- Assurance the PJVS is working correctly
- Monitor, control chart, etc.

PJVS: Software improvements

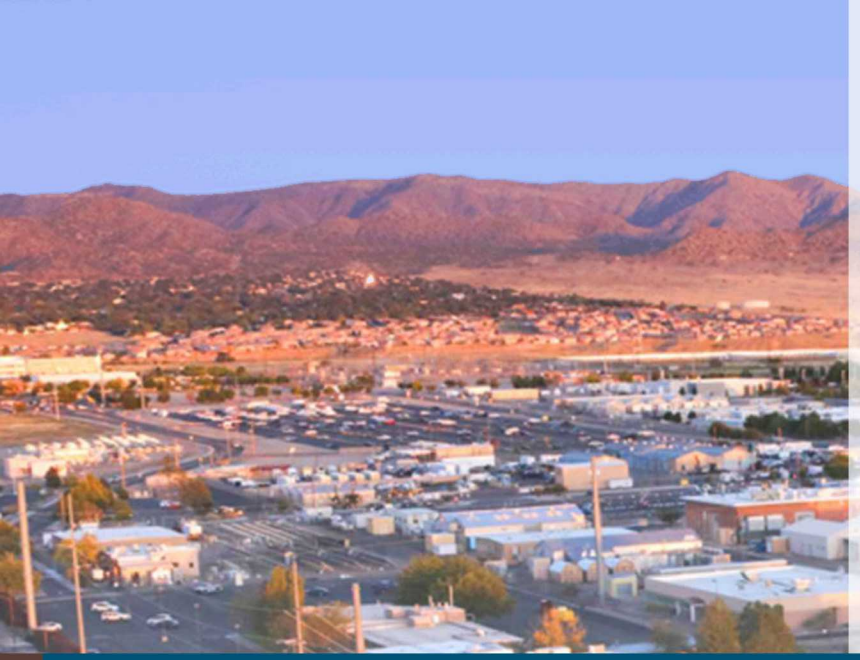
JAWS system

- To be installed Fall 2019
- FY20 and beyond – R&D with NIST
- JAWS/PJVS measurements
- Partnerships with NIST

NIST JAWS system

S.Benz (NIST), Applied Superconductivity Conference, Denver, CO 2016

Certain commercial equipment, instruments, or materials are identified in this paper in order to adequately describe the experimental procedure. Such identification does not imply recommendation or endorsement by the authors or Sandia National Laboratories, nor does it imply that the materials or equipment identified are the only or best available for the purpose.



Questions?