

Examples of Successful Collaboration Between CPI and DOE Labs

Todd Treado
CPI
December 2013



Overview

- CPI has successfully collaborated with US DOE labs to develop and / or manufacture products for DOE use and for use in other high energy physics facilities throughout the world
- These efforts have resulted in US jobs and have advanced high energy physics research worldwide
- These efforts are worth highlighting at this meeting as both results are equally laudable
- We believe that DOE should continue to proactively support both of these outcomes



Home

Search Website

Communications & Power Industries

Divisions | Company Info | News & Events | Contact Us

Choose a product

Radar | Electronic Warfare | Communications | Medical | Industrial | **Scientific**

Scientific



CPI products are used to generate high levels of microwave or radio frequency energy for equipment and accelerators used in the study of high-energy particle physics.

APPLICATIONS

High-energy Particle Physics:

CPI is a leading provider of high-power, high-frequency microwave, millimeter wave and power grid devices - as well as components such as microwave windows, window couplers and filters - for high-energy particle physics, which explores the structure of matter. CPI has the technology and production experience necessary to produce very high-power, high-frequency products that are customized for the scientific community's specialized needs.

Particle Accelerators:

CPI's high-power klystron products are used to generate microwave energy for a multitude of particle accelerators that are used in scientific research and, at an increasing rate, industrial applications. CPI's klystrons are used in traditional electron accelerators and in state-of-the-art facilities, such as lepton-proton colliders and synchrotron light sources. CPI is a major technology contributor to a number of particle accelerator programs throughout the world. Recently, CPI's inductive output tubes (IOTs) have also been used in accelerators, and CPI's gyrotrons have been used as a high-energy, advanced ion source for various accelerators.

Magnetic Fusion Reactors:

CPI's high-power, high-frequency gyrotron products provide the energy required to heat plasmas to the temperatures necessary to produce controlled and sustainable fusion reactions. By delivering the millimeter-wave power required for electron cyclotron heating and current drive in fusion experiments around the world, CPI's megawatt-class gyrotrons serve as a key enabling technology for magnetic fusion, which holds the promise of a new and inexhaustible source of energy for the planet.

CPI products available in this market segment:

- Composite Reflectors and Accessories
- Extended Interaction Klystrons (EIKs)
- Gyrotrons
- Inductive Output Tubes (IOTs) - Klystrodes®
- Klystrons
- Microwave Switches
- Power Couplers
- Power Grid Devices Econco
- Power Grid Devices Elmec
- Pressure Windows
- Radant Lens
- Radomes
- Solid State Products

CPI is a Major Supplier of a Variety of Products for Scientific Programs



CPI Collaboration with Oak Ridge on High Power Klystrons

- CPI has built three 805 MHz klystron designs for the US Spallation Neutron Source (SNS)
- CPI first built the VKP-8290A when SNS was planned to be a room temperature accelerator
- The accelerator was later changed to be super-conducting with lower RF power needs
- Initially, 81 of the VKP-8291A model were delivered
- Later, ORNL ordered higher power versions that were required to fit in the same electromagnet
- The VKP-8291B was developed and 38 more klystrons were delivered



CPI Collaboration with SLAC on High Power Klystrons

- SLAC has developed very high power klystrons for its own use and has the necessary test equipment required to operate these klystrons
- Other accelerator facilities want to use these klystrons
- No US commercial manufacturer builds these klystrons
- In 2011, CPI worked with Norbert Holtkamp at SLAC on a collaborative agreement and signed an MOU on SLAC's S-band klystron
- In 2013 CPI fabricated a copy of the SLAC-designed 5045 klystron, designated as CPI part VKS-8245A.
- The first unit has been processed to the full power of 65 MW at SLAC and is now being prepared for insertion into the accelerator for LCLS.
- CPI anticipates significant future business for this klystron for accelerators worldwide



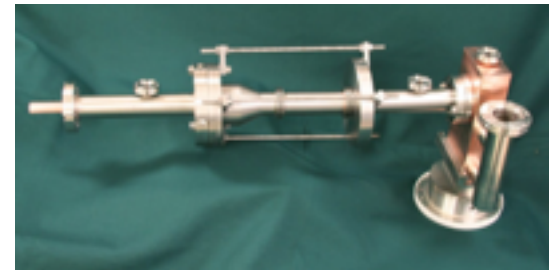
CPI Collaboration with SLAC on High Power Klystrons

- In 2012 CPI contracted with CERN to build a 50 MW klystron operating at 11.998 GHz.
- A Work-for-Others Agreement was put in place with SLAC in August 2012 to test the VKX-8311A, CPI's version of the SLAC XL5 klystron.
- The first VKX-8311A klystron has been initially tested and processed at SLAC to 50 MW peak output power and full average power.
- It should be delivered to CERN by February 2014.
- A second klystron will be delivered to CERN in the spring of 2014.
- CPI anticipates additional future business for these klystrons for use in accelerators throughout the world.



CPI Collaboration with Fermi Lab on Fundamental Power Couplers

- In 2006 Fermi Lab approached CPI BMD to assist with the collaborative design of a 3.9 GHz power coupler
- The resulting power coupler, the VWP3088, uses a waveguide window from a CPI magnetron as well as a custom-designed coaxial window assembly
- In 2007 CPI manufactured these couplers which were conditioned at Fermi Lab and installed on a cryomodule supplied to DESY
- CPI is currently manufacturing 18 more VWP3088 power couplers for Fermilab and DESY for use in the XFEL



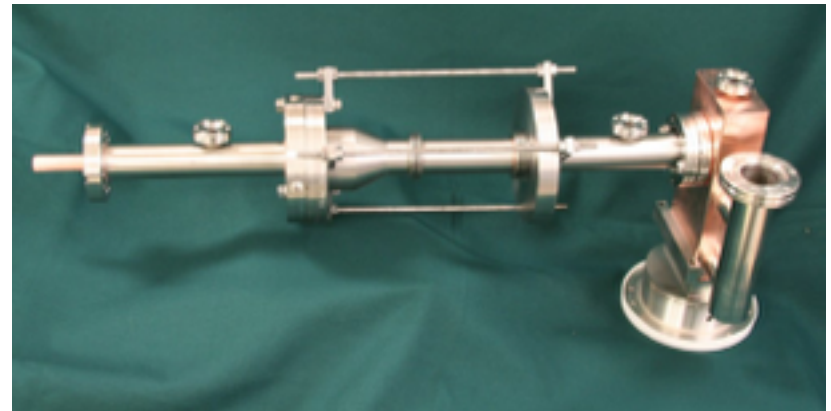
CPI Power Couplers for Superconducting Accelerators



**VWP1137, VWP-3049 Power Couplers
TTF3 Power Couplers**



VWP3032 Power Coupler



VWP3088 Power Coupler

Summary

- CPI has years of experience building klystrons, gyrotrons, and IOTs and associated power modulators for scientific accelerators
- CPI has built over 190 power couplers over the last 10 years for superconducting accelerators
- Many of our scientific products are a result of collaboration between CPI and scientific labs, both in the US and abroad
- All of these scientific activities complement our overall business which also provides products for military radar, communication, medical, and industrial applications
- These activities provide high tech manufacturing jobs in the US
- Proactive US DOE support is very important