

Stepper Motor Control, PLC vs VME



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Step2 Driver



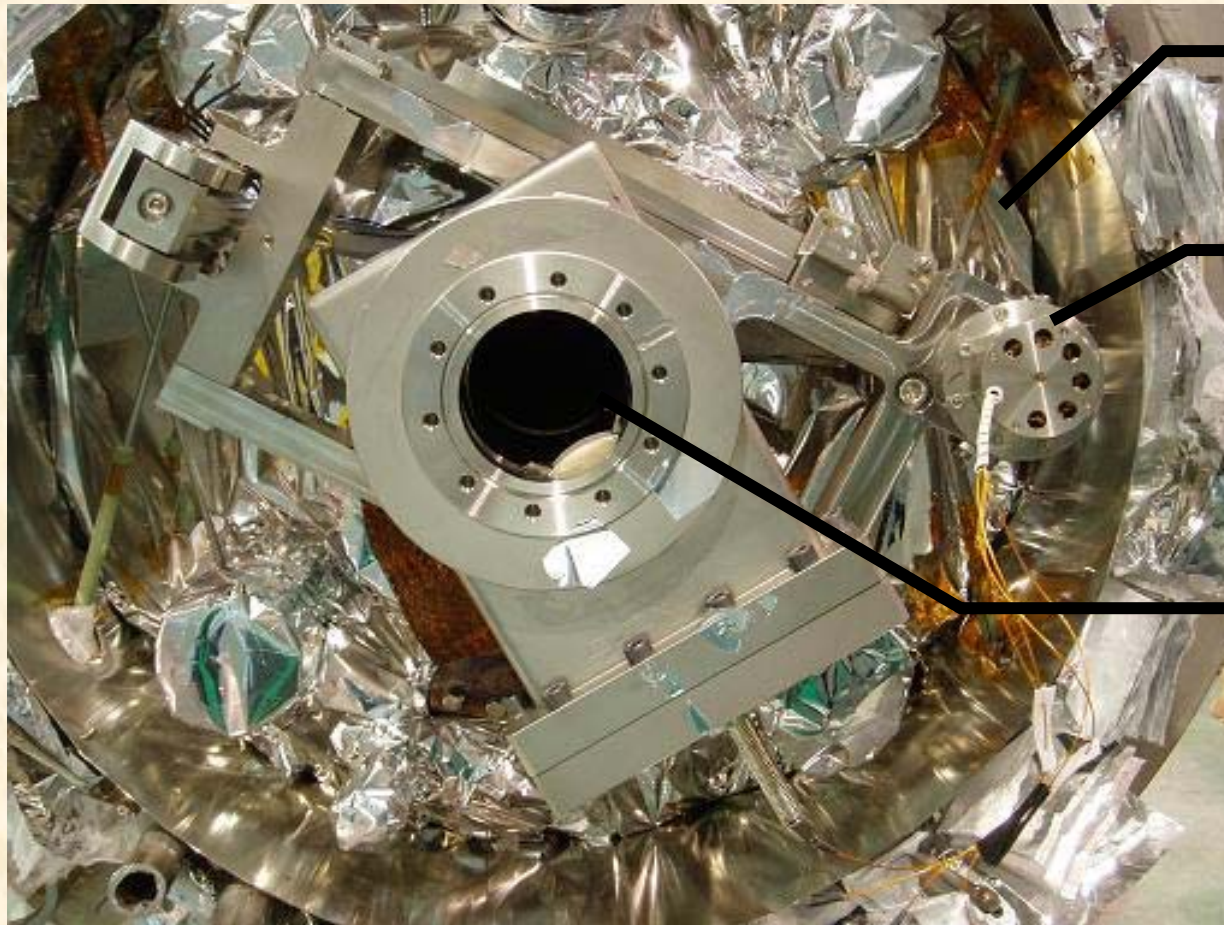
Step 2

Driver

VME-Based Stepper Motor Usage

- **Cryomodule Cavity Tuner Controls**
 - Implemented by Los Alamos National Lab
 - Pro-Dex (OMS) VME 58-8 stepper motor controller
 - EPICS driver and motor record
 - Motor inside cryomodule near 2 K cavity
 - Minimize heat released inside cryomodule
 - Wiring near silicon diodes
 - Minimize electrical noise
 - Phytron SINCOS stepper motor drives
 - Custom interface boards

SNS Cryomodule Cavity Tuner



Cavity

Tuner Motor

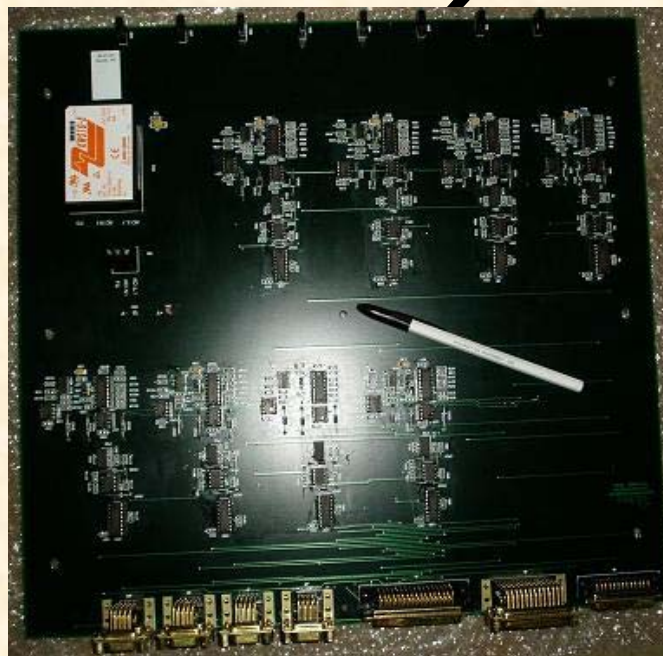
Beam Line

SNS Tuner Custom Boards



Rear of VME
Chassis

Motor Driver
Interface Chassis



VME-Based Stepper Motor Usage

- **Foil and Scraper Motion Control**
 - Implemented by Brookhaven National Lab
 - Pro-Dex (OMS) VME 58-8 stepper motor controller
 - EPICS driver and motor record
 - Accurately position foils and scrapers
 - Scrape part of the beam
 - Strip electrons
 - Position feedback potentiometer
 - Position limit switches
 - Custom interface board

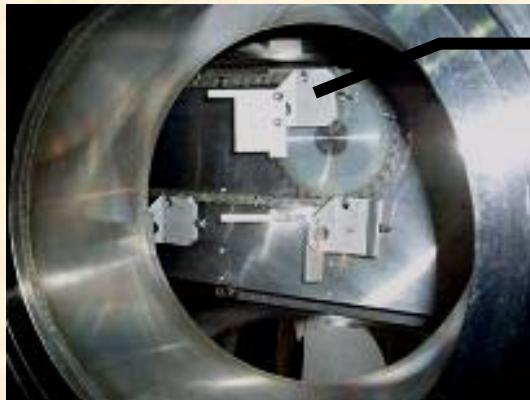
SNS Foil and Scraper Drive



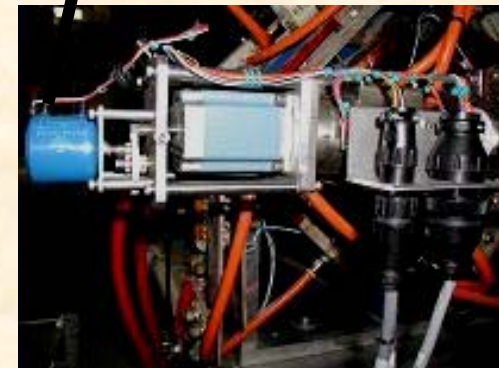
Beam Line

Foil Position
Limit Switches

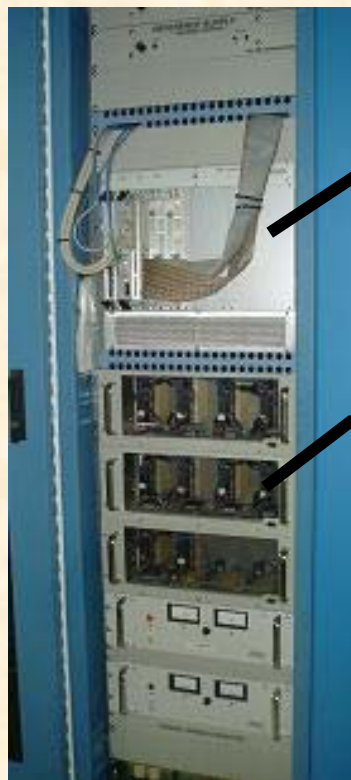
Scraper
Potentiometer



Chain and
dummy foils



SNS Motion Control Rack



VME
Chassis

Motor
Drives

Front



Relays to
interface limit
switches

Lots of
interconnection
wiring

Rear

PLC-Based Stepper Motor Control

- **Many problems with initial operation of VME based stepper motors**
- **No existing VME crate to house VME modules**
- **Cryomodule Test Facility Cavity Tuner Controls**
 - Implemented by SNS
 - AMCI 3204 stepper motor controller
 - PLC based driver
 - EPICS records
 - Motor inside cryomodule near 2 K cavity
 - Wiring near silicon diodes
 - Phytron SINCOS stepper motor drives

PLC-Based Stepper Motor Driver

- **Initialize AMCI module on power-up**
- **Initialize channels**
- **Check module status**
- **Check for errors**
- **If position error, update present position**
- **If limit switch activated, switch to manual mode**
 - **AMCI module assumes limit switch activation is not an expected event.**

PLC-Based Stepper Motor Driver (cont)

- **Check for new status commands**
 - Motor Enable
 - Reset
 - Preset
 - Control Mode Auto/Manual
- **Check for new movement commands**
 - Jog
 - Absolute
 - Relative
- **Format commands and send to AMCI module**

PLC-Based Stepper Motor Screen

AMCI MotorDet.edf v4+
 NOV 08, 2006 12:40:50 **AMCI 3204 Stepper Motor Details** **EXIT**

RFTF_Tun:Mot00b Position **5.000 rev** **Notes**

Motor Enable **Enabled** **ENA** **DIS** Error Status **ALARM** **Reset**

Control Mode **Manual** **Auto** **Man** Position Preset **5.000** **Preset**

Position Cmd (rev) **5.000** **0.000** Move Speed **0.000**

Move **Abs** **Rel** **STOP** Dead Band **0.000**

Manual Jog **CW** **CCW**

AMCI 3204 Command Words		AMCI 3204 Status Word	
Absolute Move	-	Moving CW	-
Relative Move	-	Moving CCW	-
Hold	-	Hold Sts	-
Resume	-	Stopped Sts	-
Immediate Stop	-	At Home Sts	-
Find Home CW	-	Accelerating Sts	-
Find Home CCW	-	Decelerating Sts	-
Manual CW	-	Move Sts	-
Manual CCW	-	Blend Sts	-
Preset	-	Position Sts	ok
Reset Errors	-	Input Sts	ok
Blend Move +	-	Command Sts	ok
Blend Move -	-	Config Sts	ok
Acceleration	Constant	Home Err Sts	ok
Accel Shape	Triangle	Profile Sts	ok
Home Prox Sw	-	Home Limit	-
Cnd Mode	Command	E Stop Sts	ok
Steps / Rev	1000	CW Limit	CW Limit
Program Speed	0.000	CCW Limit	CCW Limit
Acceleration	0.000	Channel Sts	Enabled
Deceleration	0.000	Module Sts	ok
Starting Speed	0.100	Mode Sts	Command

PLC-Based Stepper Motor Rack

Front



Rear



Custom Interface Board

Comparison

- **PLC Advantages**

- Fewer custom modules
- Less cabinet wiring
- Accepts 24 vdc limit switch signals
- Simplifies integration of motion control and interlock logic
- ‘Safer’ limit switch response

- **VME advantages**

- More complete and flexible software driver
- Higher density modules (8 channel vs. 4)
- Faster EPICS updates
- Auxiliary outputs on VME module

Summary

- **Both VME and PLC motion control solutions work well**
- **Availability of PLC and/or VME chassis is a big cost driver**
- **Trade off custom hardware for the VME module vs. custom software for the PLC module**
- **Stand-alone motion control equipment with ethernet interface should be considered**