

EPICS QT Library for Beamline Interface Development

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Acknowledgments

-Glen Wright - library developer



-David Chevrier - interface developer



-Ru Igarashi - interface developer



Why another interface tool?

- Many suitable EPICS extensions already available
- Requirements were pushing limits of current interface options
 - Some complex or intricate functionality
 - Users prefer 'Windows' like look and feel
 - Scientists wanted development environment
 - Had to move forward to achieve goals



I'm a PC.



I'm a Mac.

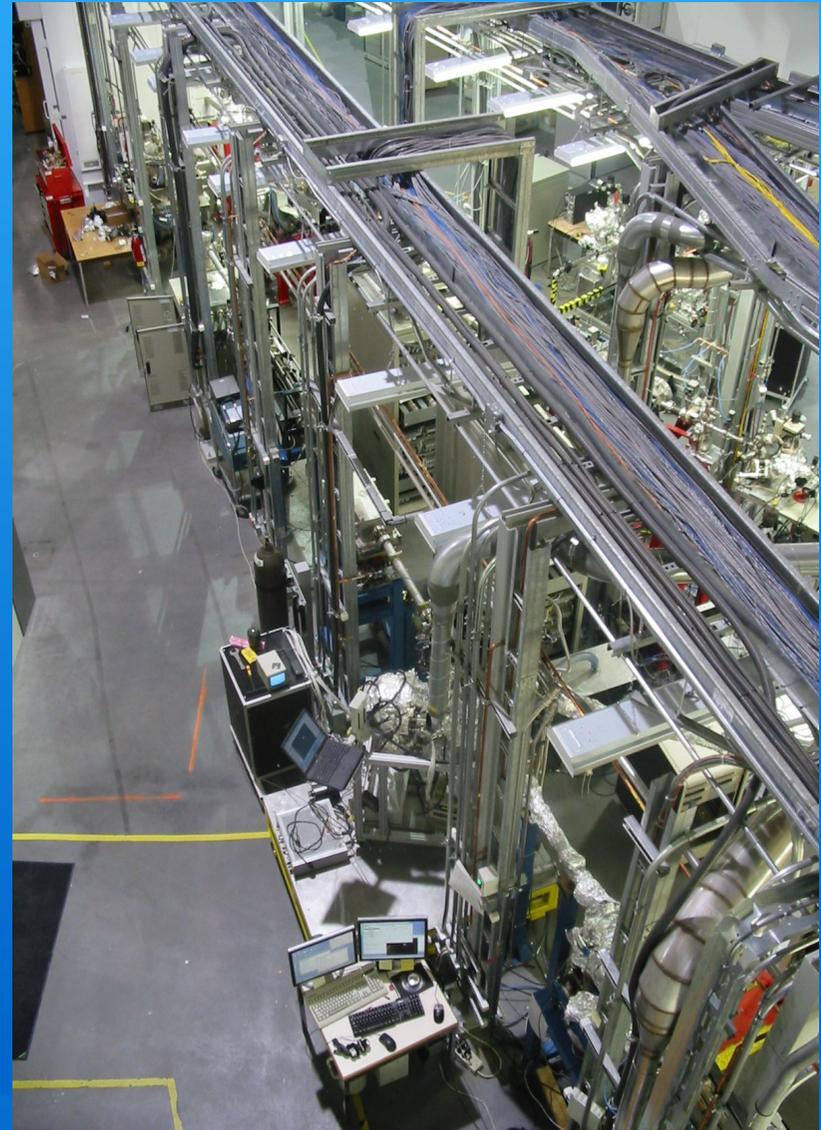


I'm Linux.

Beamline Background

-Spherical Grating Monochromator (SGM) beamline

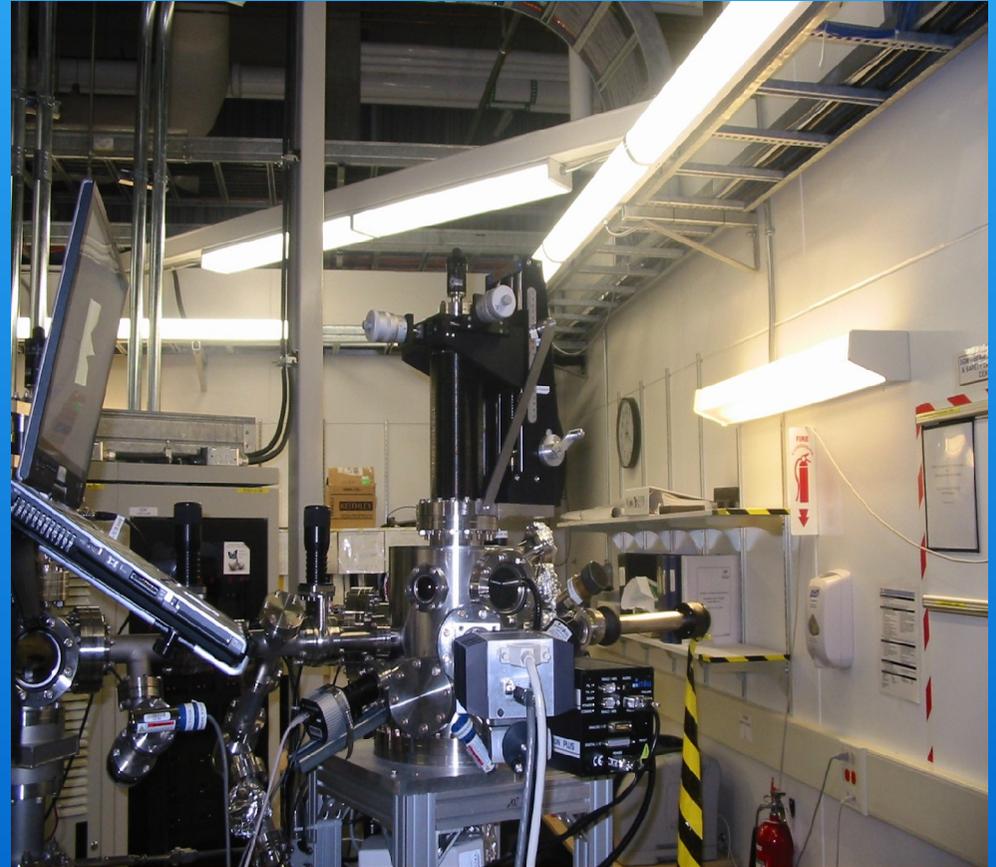
- Soft x-ray spectroscopy beamline
 - scanning energy
- First fully operational beamline at the CLS
- EPICS 3.14.6
- NEXAFS, Photoemission, XEOL, PEEM



Beamline Background

-Spherical Grating
Monochromator (SGM)
beamline

- Modular endstations - utilize endstation 'wrappers'
- Large user group - many novice users



Interface Requirements

-Stability

- Reduce support requirements - late night phone calls

-Simplicity

- Users require little training - no scripting required

-Integration

- Keep everything together

QT

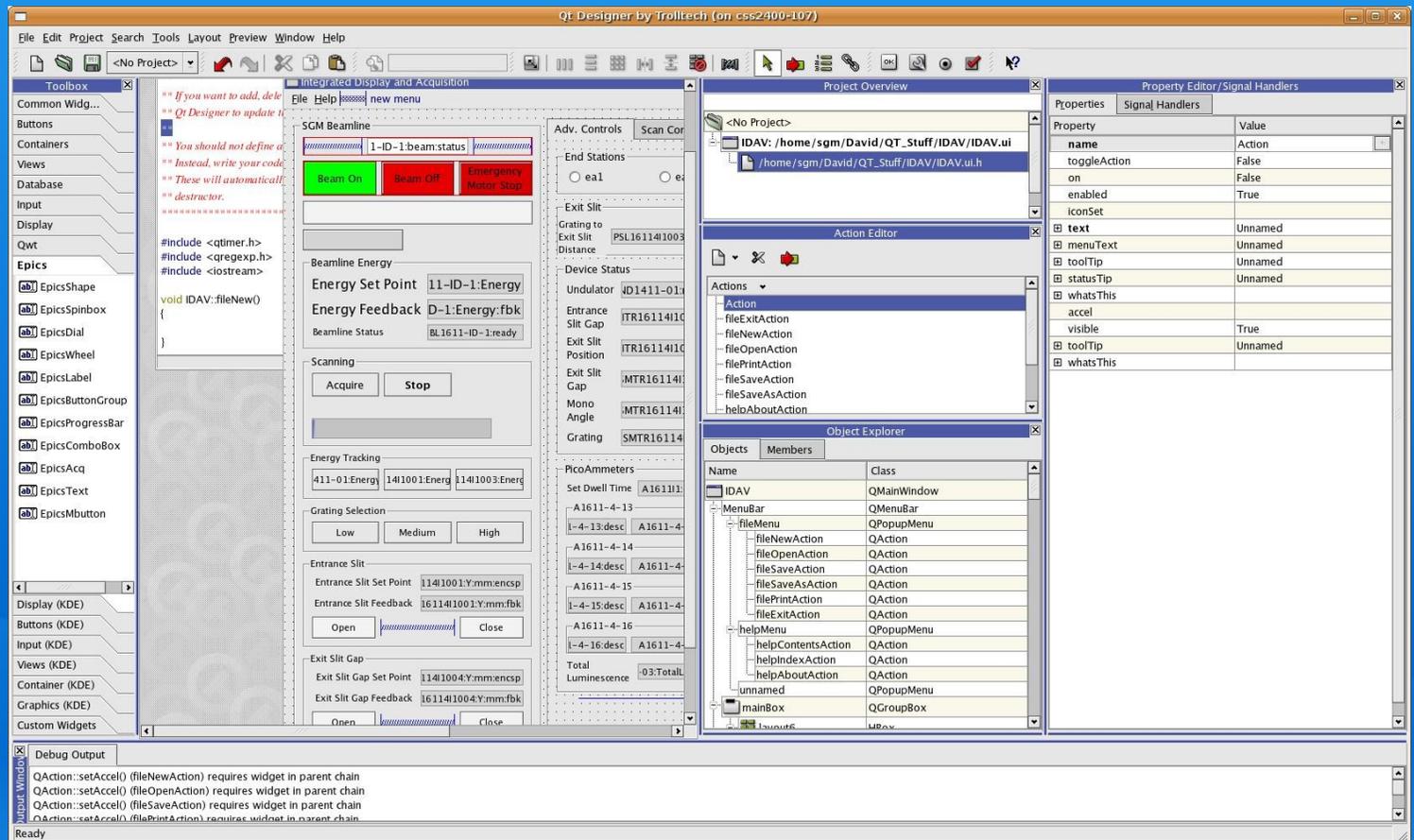


- Cross platform application development framework
- Widely used: KDE, Google Earth, Skype
- Owned by Trolltech (Nokia)
 - Dual licensing system - commercial and GPL
 - Version 3.3 - Windows not supported under GPL - Version 4.x OK

QT

-Features

- Object oriented C++ - support for other languages
- Meta Object Compiler
 - Signals and slots
 - Asynchronous function calls



EPICS QT Library

- QEpicsConnect - Primary class for connecting process variables to QT
 - Utilizes the previously developed *EPICS Connect* library
 - Builds a 'connector' to provide channel access functionality
 - Specific signal and slot methods
 - Reset PV for a given connection
 - Accepts macro for PV name
 - Widget monitor
 - Channel Access can be initialized with or without pre-emptive callbacks
 - Uses a "heart beat" function for timed polling on PV's where pre-emptive callbacks are disabled

EPICS QT Library

Widgets - inherit behaviour from Qt widgets - object oriented widget development

- QEpicsMButton - Button controls and shows status of PV
- QEpicsComboBox - Signals and slots permit dynamic PV assignment, QEpicsComboBox, QEpicsText
- QEpicsAcq - Integrates data acquisition capabilities
 - Separate data acquisition library
 - set and scan PV's
 - nest scans
 - trigger acquisition

SGM Interface Development

- Matlab with labca - 2005
 - used for preliminary commissioning
- GTK - 2006
 - epicsconnect library
 - first user interface
- QT - 2007
 - interface completely rewritten
 - full widget development
 - MKS Source Integrity

Integrated Data Acquisition and Visualization (IDAV)

- First Implementation - GTK+, commissioning interface

Spherical Grating Monochromator Interface (on OPI1611-408)

File Edit View Help

Undulator Front End Fixed Mask VAM M1 M2 M3 Entrance Slits Monochromator Phosphor Exit Slit M4 M5

Manual Motor Control for SGM M4

Co-ordinated Motor Control for SGM M4

Upstream Vertical

Set Point: 0

Feedback: 0

Limits: CCW 0 CW 0

Speed: 4

Downstream Vertical

Set Point: 0

Feedback: 0

Limits: CCW 0 CW 0

Speed: 4

Upstream Horizontal

Set Point: 0

Feedback: 0

Limits: CCW 0 CW 0

Speed: 4

Downstream Horizontal

Set Point: 0

Feedback: 0

Limits: CCW 0 CW 0

Speed: 4

Inboard(+), Outboard(-) Translation

Value: 0.000 mm

Increase(+), Decrease(-) Height

Value: 0.000 mm

Rotate In Horizontal Plane
(+ = ccw, - = cw when viewed from top)

Value: 0.000 dgr

Rotate In Vertical Plane
(+ = ccw, - = cw when viewed from outboard)

Value: 0.000 dgr

Emergency Stop

Beamline Overview

Mode	Energy
	320.000 eV

Operational Status

Storage Ring Status:

Storage Ring Current: 0.005266

Beam Lifetime: 0.000 h

Shutters: PSH1: OPEN PSH2: CLOSE
SSH1: CLOSE PSH3: CLOSE

Blade Currents

GM M:	SGM M4:
GM M:	Photodiode:
GM M:	EA 1.1:
GM M:	Gas Cell:
GM M:	NA:

Water Temperatures

Front End:	25.6 C	PGM M1:	25.5 C
Fixed Mask:	25.5 C	Variable Aperture:	26.1 C
PGM M1 Mask:	25.6 C	SGM M1 Mask:	26.2 C
PGM M1:	25.5 C	SGM M1:	25.6 C

Ion Pump Pressures

FE 1:	5.14e-10 Torr	ST 1:	1.00e-09
FE 2:	7.80e-10 Torr	ExS:	1.30e-09
FE 3:	9.04e-10 Torr	M4:	2.80e-09
PGM M1:	0.00e+00	EA 1:	6.00e-11
PGM M2:	1.60e-09	M5:	3.10e-09
SGM M1:	1.50e-09	DPS:	6.30e-09
SGM M2:	1.50e-09	EA 2:	1.10e-08
SGM M3:	1.50e-09		
EnS:	1.40e-09		
Mono:	7.20e-10		

Process Variable: Process Variable Display Status:

Integrated Data Acquisition and Visualization (IDAV)

- Second Implementation, GTK+, first user interface

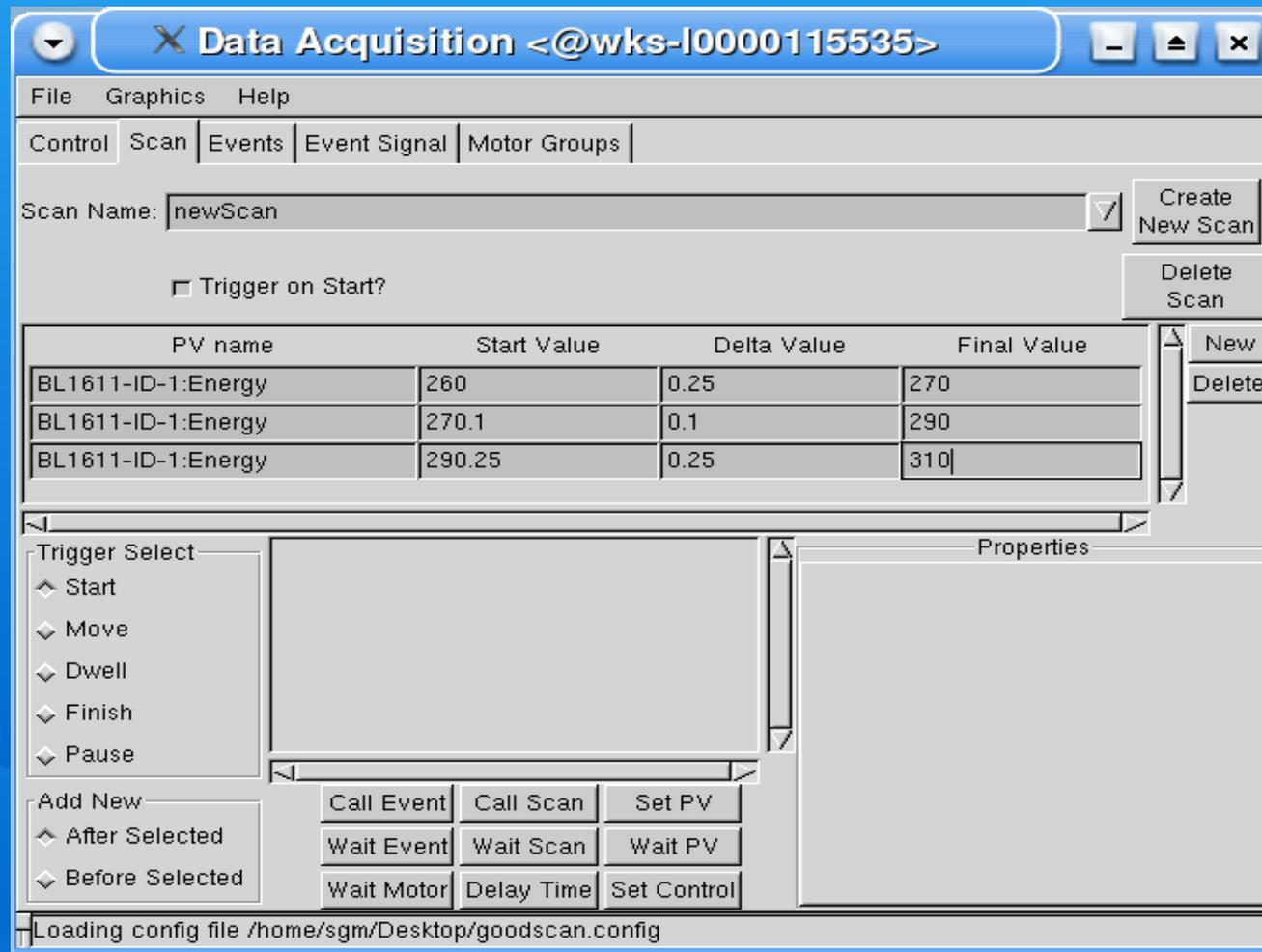
The screenshot displays the SGM Beamline Interface software, which is organized into several functional sections:

- beamline**: Contains controls for beam on/off (BEAM OFF), visible light, endstation selection (ea1, ea2), beamline energy (STOPPED), energy set point (430.000 eV), and energy feedback (430.006 eV).
- diagnostics**: Shows transfer status with warnings (do not transfer, check beam, FLY detector bias, pressure), chamber and transfer arm pressures (ccg, tcg), storage ring status, and picoammeters (EA1 Io, EA2 Io, SGM pA meters).
- devices**: Includes undulator status (STOPPED), entrance slit (open/close, slit setting, exit slit position, grating to exit slit distance), exit slit gap (setpoint, feedback, status, grating), and mirrors (coating, current/change stripes, m3, m5).

At the bottom, there is a status bar: Process Variable: Process Variable Display Status:

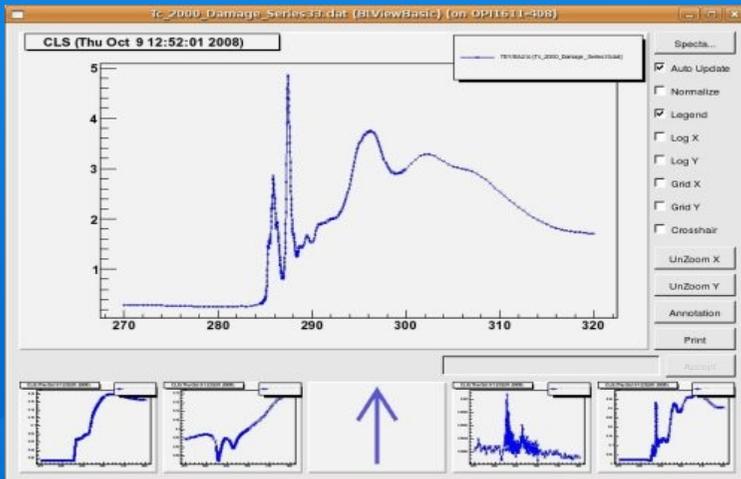
Integrated Data Acquisition and Visualization (IDAV)

- Separate application for data acquisition



Integrated Data Acquisition and Visualization (IDAV)

- Version 1.0, Qt 3.3, first production version



The screenshot shows the Integrated Display and Acquisition (IDAV) software window. The window title is "Integrated Display and Acquisition (on OPI1611-408)". The main interface is divided into several sections:

- SGM Beamline:** Includes buttons for "Beam On" (green), "Beam Off" (red), and "Emergency Motor Stop" (red). Below these are "Visible Light On/OFF" and "HV Group is Off" / "All HV is Off" buttons.
- Beamline Energy:** Shows "Energy Set Point" at 320.000 eV and "Energy Feedback" at 320.002 eV. The "Beamline Status" is "STOPPED".
- Scanning:** Includes "Acquire", "Stop", and "Off" buttons. Below them is a "Finished Scan Run" button.
- Energy Tracking:** Shows "Indulator (ON)", "Grating (ON)", and "Exit Slit (ON)" buttons.
- Grating Selection:** Includes "Low", "Medium", and "High" buttons.
- Entrance Slit:** Shows "Entrance Slit Set Point" at 150.0 um and "Entrance Slit Feedback" at 150.0 um. Includes "Open" and "Close" buttons.
- Exit Slit Gap:** Shows "Exit Slit Gap Set Point" at 10.0 um and "Exit Slit Gap Feedback" at 9.9 um. Includes "Open" and "Close" buttons.

On the right side, there are tabs for "Adv. Controls", "Scan Config", "Diagnostics", "Cameras", "SSA Endstation", and "HV". Below these are "Load Config" and "Save Config" buttons, and a "Set Output" field with the path "/home/sgm/users/NotSet/" and a "change_rne_%d" button. There are also checkboxes for "Use Auto-Suffix" and "Use Auto-Numbering", and a "# of Scans" field set to 1. Below this is a "Scanning Region Table" with "Add Region" and "Delete Region" buttons. The table contains one row:

	Region	Start	Delta	End
Region 1	BL1611-ID-1:Energy	270	0.1	320

At the bottom right, there is a "Recorded PV" list with 9 entries:

- 1 BL1611-ID-1:Energy
- 2 PCT1402-01:mA.fbk
- 3 A1611-4-13:A.fbk
- 4 A1611-4-14:A.fbk
- 5 A1611-4-15:A.fbk
- 6 A1611-4-16:A.fbk
- 7 SMTR161141002:enc.fbk
- 8 BL1611-ID-1:Energy.fbk
- 9 SMTR161141003:enc.fbk

Other Projects using EPICS Qt

-Phase 1

-HXMA - IDA

-Phase 2

-SXRMB

-VESPERS

The image displays two overlapping EPICS Qt control panels. The top-left panel, titled "CLS IDA Motor Scan", features a motor selection dropdown set to "Stage Horizontal" at 66.1 mm. It includes three detector channels: "Idiode" at 4.00 Count, "I0" at -8.00 Count, and "Iup" at 0.000 V. A "MONO Position" is set to 17.073 dgr. The panel includes a graph with a y-axis from 0 to 1000 and an x-axis from 0 to 600, with "firs" and "secon" markers. Control buttons include "Load Setup", "Save Setup", "Start Scan", and "CLOSE".

The top-right panel, titled "CLS IDA Main Control Panel", shows a menu bar (File, Edit, Help) and a toolbar with "Output", "Move Motors", "Scan Motors", "Detectors", "Acquire", and "Quit". It displays real-time values for "Idiode" (0.000 V), "I0" (-0.000 V), "Iup" (0.000 V), and "Idown" (-0.000 V). Status indicators for "Front End Shutter 1" (OPEN), "Front End Shutter 2" (CLOSED), "Safety Shutter" (CLOSED), and "POE Photon Shutter" (CLOSED) are shown. "Current Scan Progress" is at 0%. Buttons for "Pause" and "ABORT" are present.

The bottom-left panel, titled "picoAmmeters", shows a desktop environment with icons for "BeamlineMaster", "shadow-2.3.3-x86-rh7.3.tar...", "Beamline Operations", "Wiggler Status", "Cross Hair Control", "Data Acquisition", "runVarStep", "Saturn DXP", and "Energy Diagnostic Sc...".

The bottom-right panel, titled "Scan Configuration", shows a "File Name" field with "/home/hxma/data" and "NONAME", with checkboxes for "auto-number" and "auto-suffix". It includes a "Comments" section with a disclaimer. The "Region Boundaries" are set to "-200 -30 40 16k", "Region Step Size" to "10 0.5 0.5k", and "Region Integration Times" to "1 1 f". The "Number of Scans" is 1, and "Number of Points" is 0. Estimated scan times are "unknown". Buttons for "Load Scan", "Debug", "Save Scan", "Scan Autopilot", "Pause", and "START SCAN" are visible.

Future Plans for EPICS Qt

- Phase 2 beamline interface development
- Upgrade to Qt 4
 - Integration with Eclipse - extensible build tool
 - More comprehensive GPL
- EDM implemented as a QT widget
- CSS integration?