MATLAB
and
EPICS Channel Access Interface
"Deployment for SNS Controls"

EPICS Collaboration Meeting

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Outline

- Current/Known Implementations
- MATLAB's use in the SNS Control Room
- Matlab Channel Access (MCA) in a "Nut Shell"
- MCA and Large Array support in EPICS 3.14
- Collaboration with original author (SLAC)
- Future Work

Extant Implementations

- SLAC version provided to SNS (6.0)
  - » Win32 only
  - » Some reliability and array support problems
- SNS Current Version
  - » Linux only
  - » Survives heavy usage
    - – Guards ca pend thread
    - – Some memory issues fixed
    - – Better CA connection support
- SLAC version 6.1
  - » Win32 only
  - » New memory model

Current version

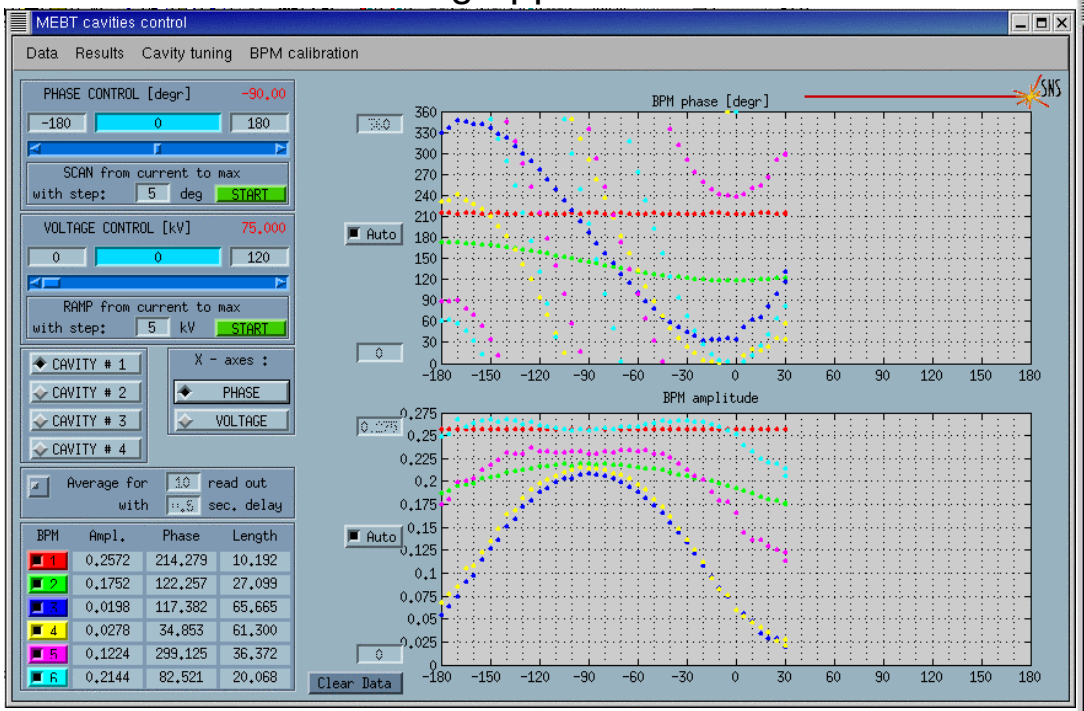
- **Current Collaboration Version**
  - » **Work in progress, available soon.**
  - » **Win32 and Linux, ifdef's in code**
  - » **New SLAC memory model plus SNS enhancements**
  - » **Still EPICS 3.13 compatible**

MATLAB's use in the SNS Control Room

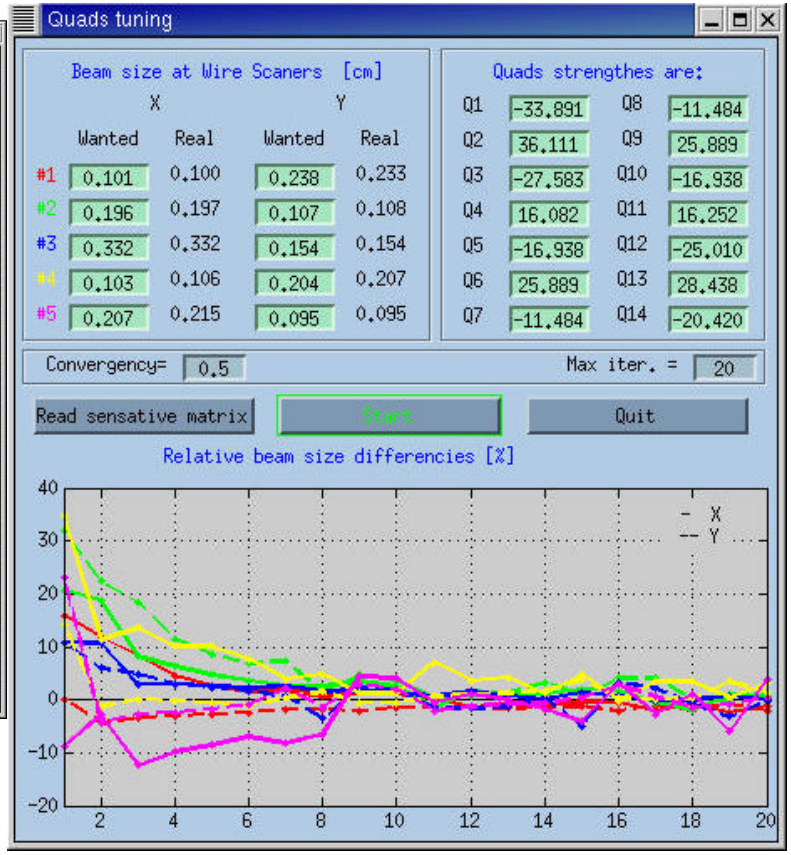
- **Rapid Visualization**
  - » **X-Y Plots**
  - » **Waterfall Plots**
- **Rapid Programming via matlab scripting**
- **"What if" analysis online.**
- **Complements Operator Display Tools (e.g. EDM)**

MATLAB's use in the SNS Control Room

•RF setting application



•Quad setting application



MEBT Quad and RF Setting apps *(V. Aleksandrov and S. Aleksandrov)*

MCA in a Nutshell

- Library of Matlab functions
  - » written in C++
  - » Accessable as typical Matlab functions
    - – can take variable length arrays of arguments and return same number of result elements to the variable they are assigned to.
    - – Also take comma-separated lists of arguments with same output characteristics
    - – Useable in matlab scripts or from matlab command shell.
  - » Usually no error return values – use “try – catch” mechanism
- mcaopen(‘pvname’[,…]), mcacon(‘pvname’[,…])
  - » Return positive integer handles used by other mca calls
  - » Differ in handle validation
    - – Mcaopen returns 0 if immediate connection not possible
    - – Mcacon returns handle even if ca can’t find the PV

MCA in Nutshell (continued)

- mcacheck(handle[s])
  - Returns 1 if connected, 0 otherwise
- mcaget(handle[s])
  - One-time ca_get() with built-in ca_pend()
  - Each return element may be an array or a scalar
- mcaput(list of alternating handles, put values)
  - Returns integer array of status after put callback and ca_pend()
- Mcamon([handle, [matlab command]])
  - No argument: return info on installed monitors
  - 1 argument: establish monitor with data update only
  - 2 args: monitor will also perform matlab command when monitor arrives

MCA in Nutshell (continued)

- **Other capabilities available:**
  - **Get info on known handles**
  - **Adjust ca timeouts**
  - **Stop monitors**
  - **Clear channels**
  - **Exit ca**
  - **Explicit ca_poll request**

MCA and Large Array support in EPICS 3.14

- Current array size limit in EPICS R3.13.X is 2000 double precision floating point numbers.
- Beam Diagnostics at the SNS requires large array support in channel access.
  - » Typical ---- 40 Msamp/sec in 2 msec
    - – This corresponds to ~80K samples
    - – Since worst case is double precision floating, need 8bytes per sample. (therefore size is ~640Kbytes)
  - » Will need to ship 2-D data around the network as well
- IOC memory consumption is an issue
  - » Embedded targets typically don't have a lot of RAM
  - » Host-based IOCs have an abundance of inexpensive RAM
- Current Network Bandwidth is abundant

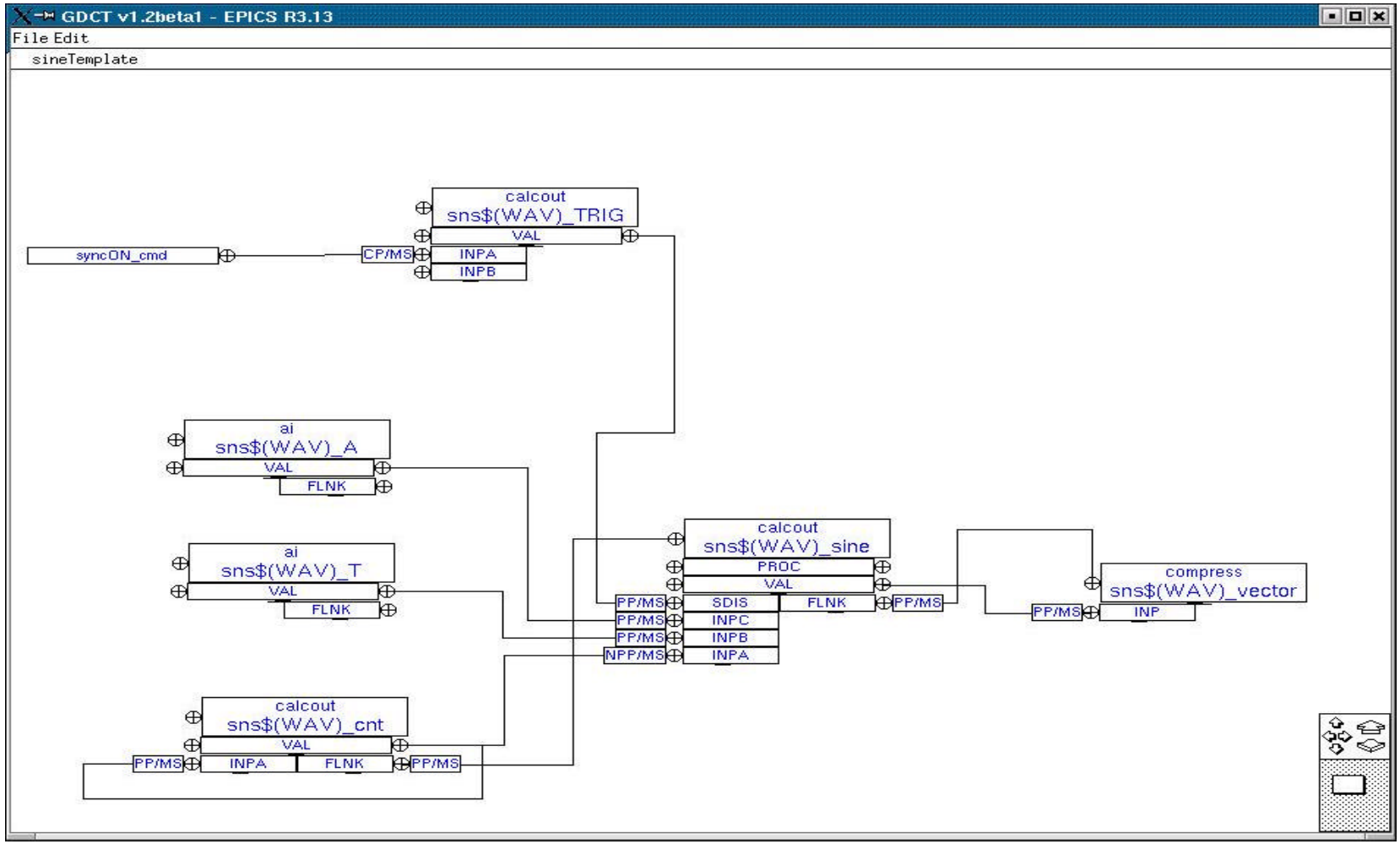
MCA and Large Array support in EPICS 3.14

Getting Set-up For the Test

- **Hardware Used**
  - **IOC: MVME2101 PowerPC 603e {250MHz w/64 Meg RAM}**
  - **Target OS: vxWorks 5.4.2 with APS patches**
  - **EPICS: Release R3.14.0beta1**
- **Create large array database**
  - **Use Compress record to make array from scalar**
  - **8 sine wave vectors {each array is 131,072 samples}**
- **Set environment variable on host and IOC.**
  - **EPICS_CA_MAX_ARRAY_BYTES**
  - **Build EPICS CA Clients against R3.14.0beta1**
- **Compile MCA against EPICS R3.14.0beta1**
  - **Modify mexopts.sh for EPICS related compiler/linker flags**
  - **mex –v mcamain.cpp**

MCA and Large Array support in EPICS 3.14

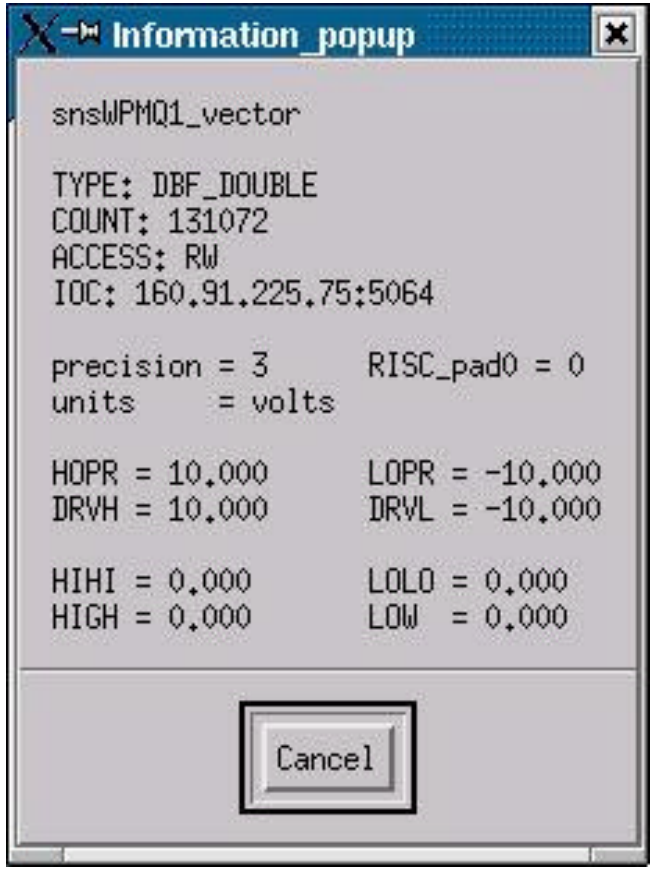
Large Array Generating Database (sineTemplate.db)



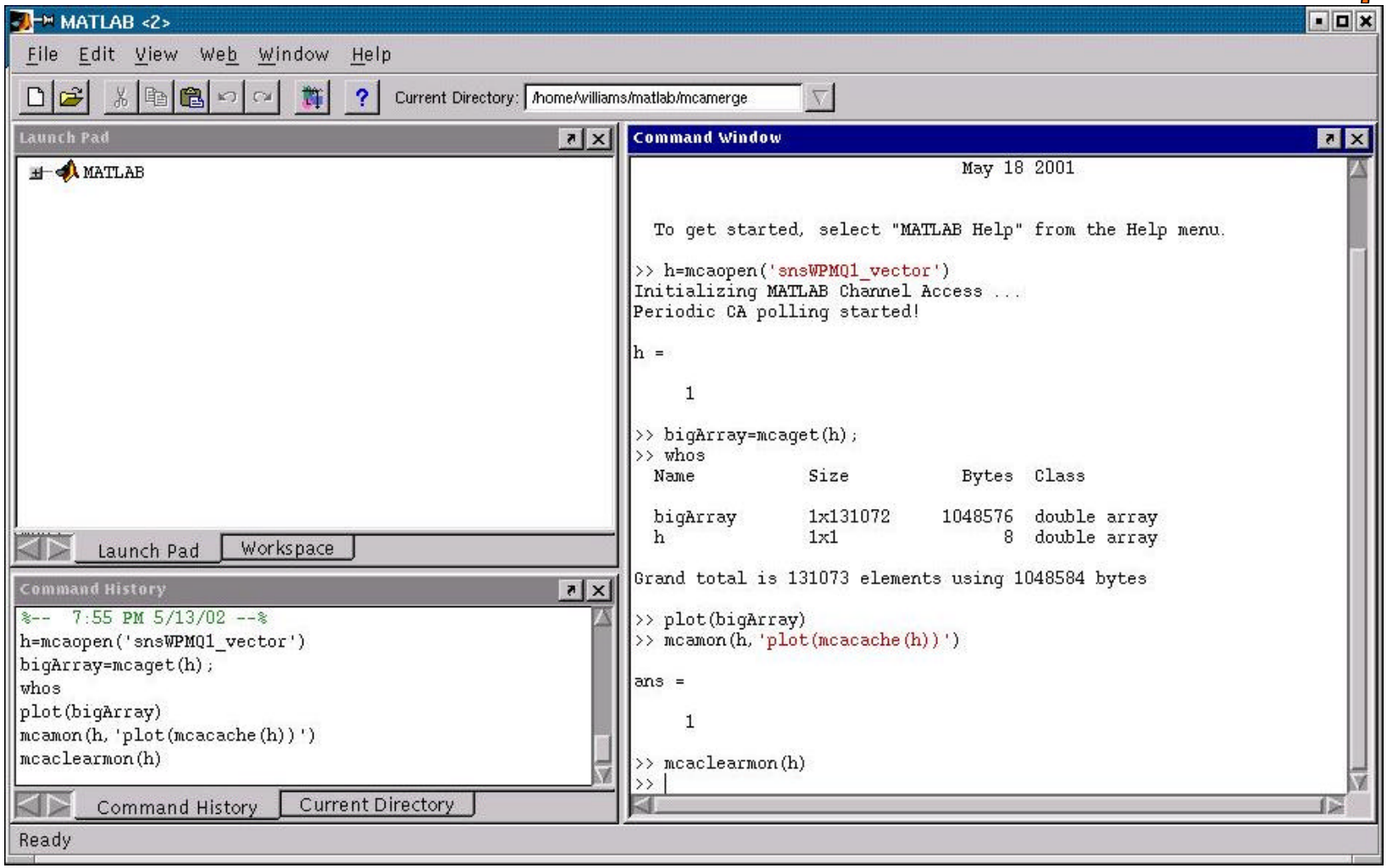
MCA and Large Array support in EPICS 3.14

Probe Channel Access Client

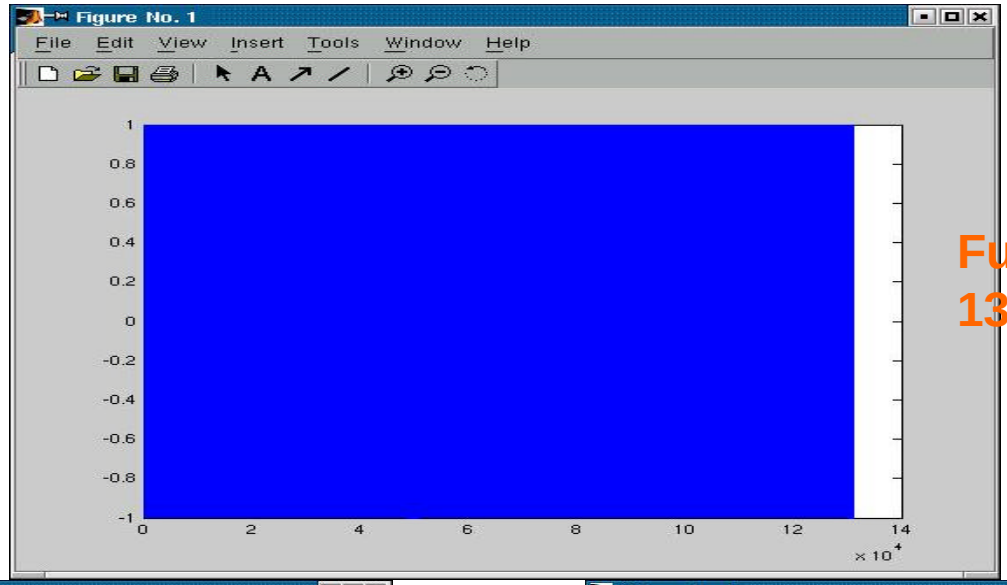
- **CA probe compiled for EPICS R3.14.0beta1.**
- **Probe shows us the element count and data type**
- **We need to implement an Array Probe (w/scroll-bar)**



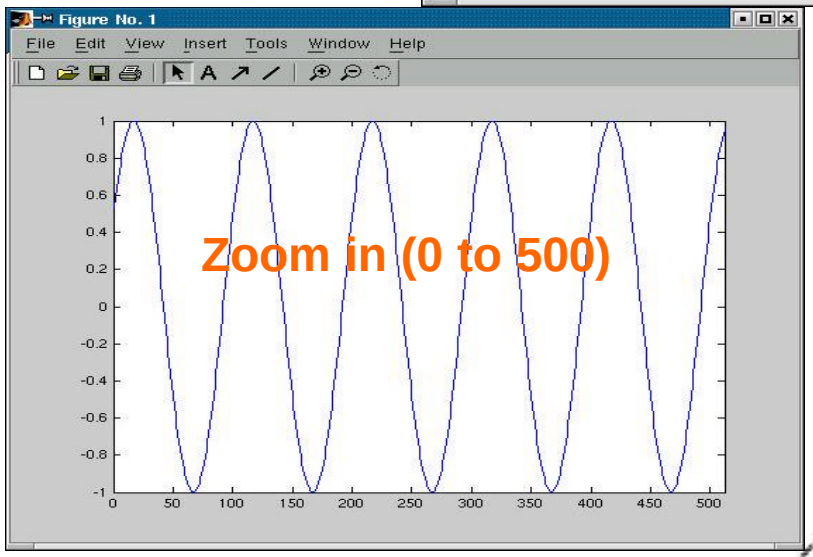
MCA and Large Array support in EPICS 3.14



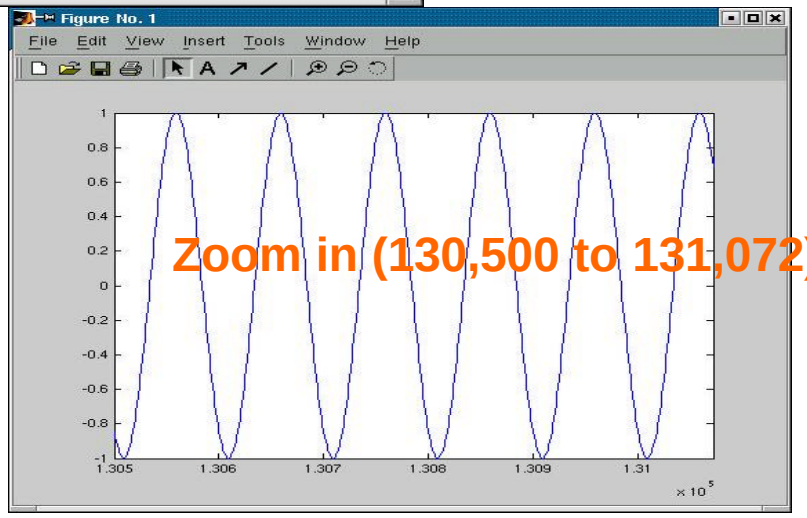
MCA and Large Array support in EPICS 3.14



Full Data Set
131,072 Samples



Zoom in (0 to 500)



Zoom in (130,500 to 131,072)

Collaboration Intentions

- **Generate and maintain a common version**
  - » **Working on the “generate” part now.**
  - » **A service to EPICS community**
- **Relieve SLAC of most maintenance responsibilities**
  - » **SNS plans to support for several years**
- **Relieve SNS of win32 platform maintenance responsibilities for MCA**
  - » **SNS platform of choice is Linux but some win32 usage appears unavoidable.**

Future Work for MCA

- **Future Possible Collaboration Version**
  - » **Require 3.14**
    - – **Thread-safe CA with large array support**
    - – **use libCom OSI functions**
  - » **Portable, no ifdefs**
- **Add EPICS time-stamp support**
- **Extend MCA to be a portable Channel Access Server**
  - » **Interface MCA to Xcas**
- **Improve Reliability/Robustness**

Acknowledgements

- **Many Thanks**
  - **Andrei Terebilo**
    - **original author**
    - **module maintainer for WIN32 port**
  - **Delphy Nypaver**
    - **initial import to LINUX**
    - **Integration/Reliability Testing**
  - **Carl Lionberger**
    - **core improvements under LINUX**
    - **current module maintainer for the LINUX port**
  - **Sasha Alexandrov**
    - **Applications Physicist (i.e. USER)**
    - **“Guinea Pig”**