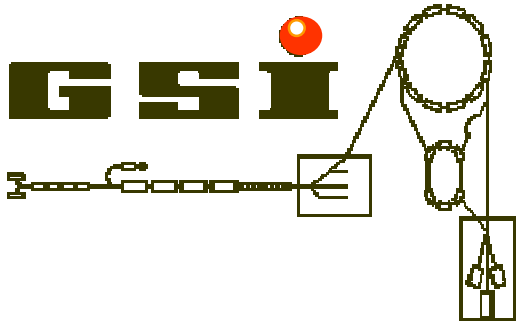
CHEP 2001

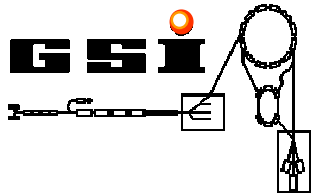


Go4

GSI
Online
Offline
Object
Oriented

Multithreaded Inter-Task Communication with ROOT - writing non-blocking GUIs

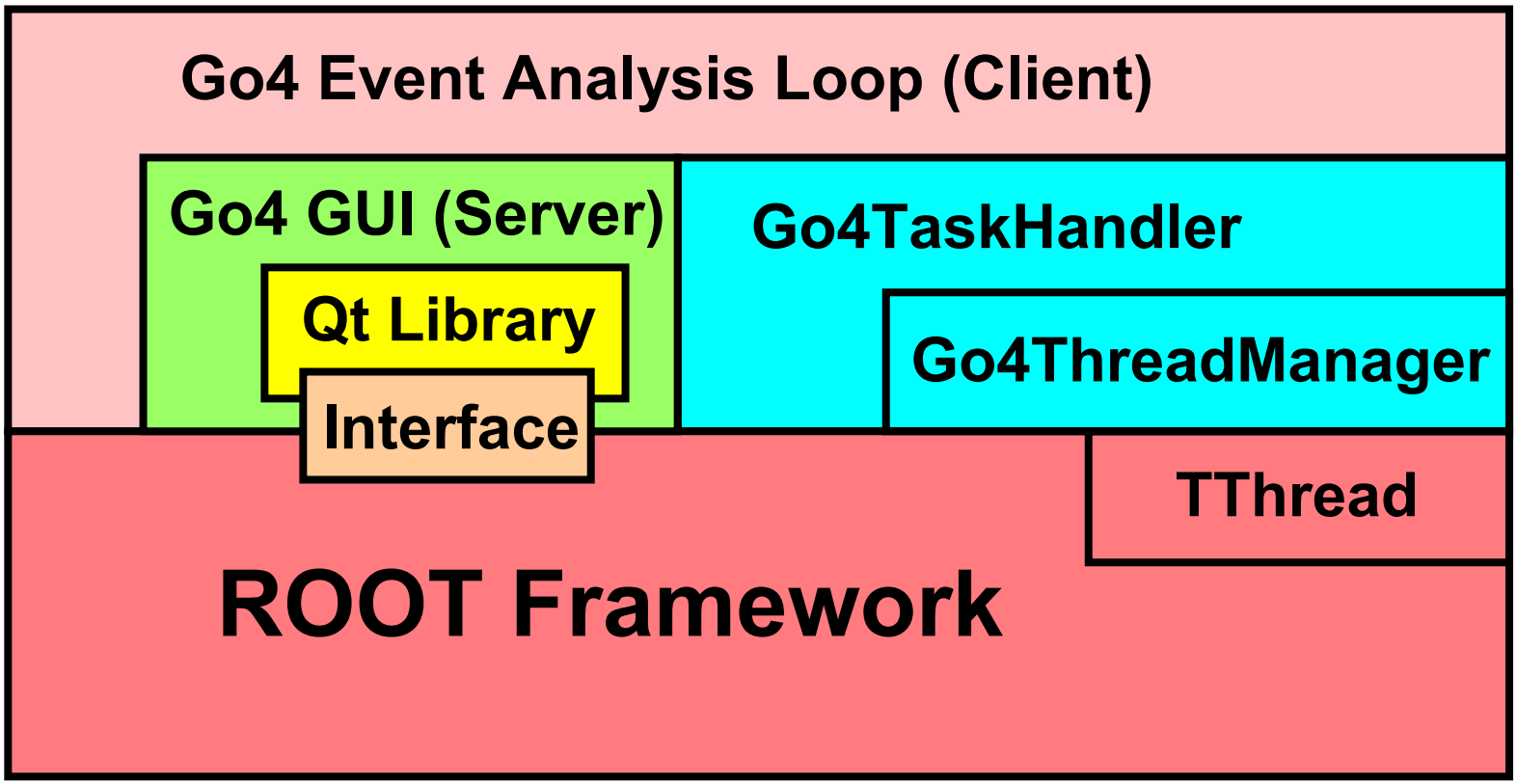
J. Adamczewski, M. Al-Turany, D. Bertini, H.G.Essel



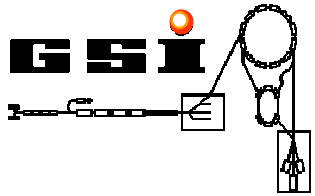
Contents

- Go4: Software layers and architecture
- Go4 Requirements
- Multithreading (threadmanager library)
- Inter task communication (taskhandler library)
- Example: GUI task and analysis task
- GUI implemetation with ROOT-Qt Interface
- Demo (movie)
- Summary

Go4 Package Layers



Requirements of Go4

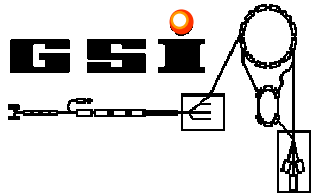


On-line Analysis with non blocking GUI

- Analysis based on ROOT
- Analysis runs permanently
- Analysis updates graphics asynchronously
- GUI is never blocked
- GUI controls and steers analysis

Problems to solve

- Multithreading necessary — Threadmanager library
- ROOT classes not inherently thread save
  - ⇒ lock object creation and ROOT services
  - ⇒ nonblocking GUI and analysis: different tasks
- Communication between tasks — Taskhandler library



Go4 Multitasking system

- Only one working thread per task

  (object creation, memory allocation, ROOT system calls)

- Analysis and GUI in separate tasks

  (non blocking GUI, continuous analysis)

- Communication:

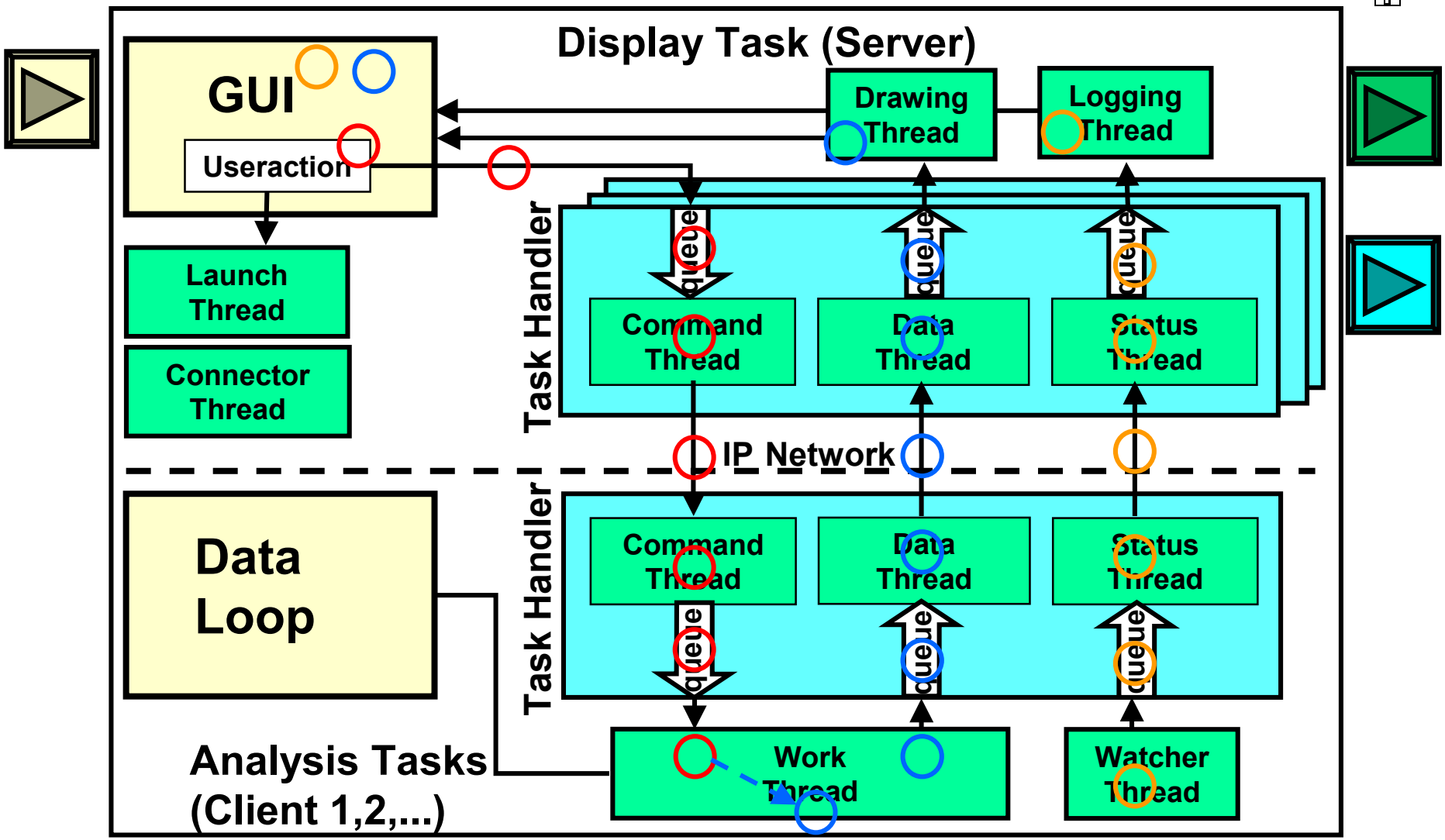
  - raw socket transport

    (dedicated threads with TBuffer fields in TGo4Socket)

  - Object streaming by ROOT

    (working thread uses TGo4Queue methods)

Functional overview



Go4 GUI

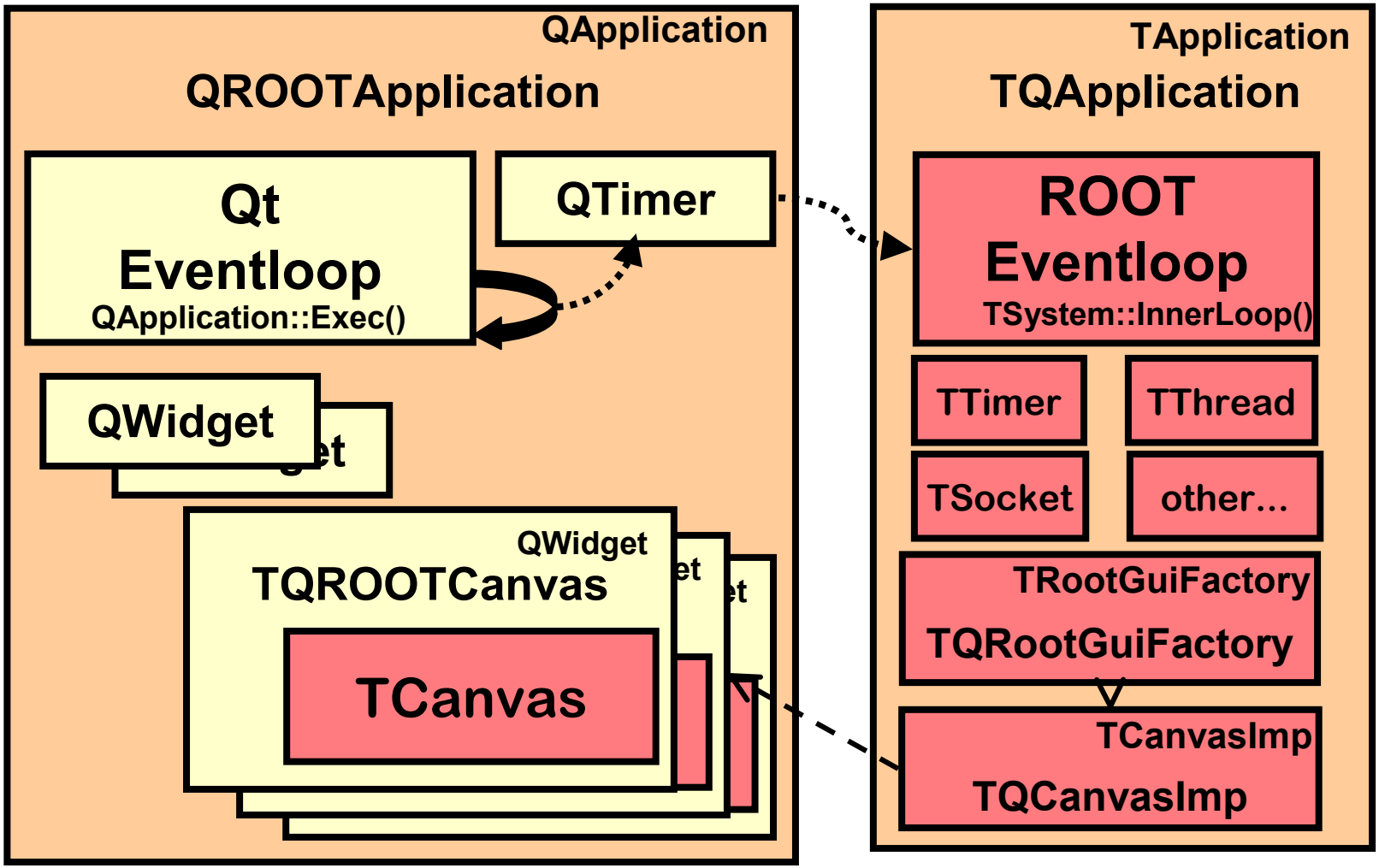
- Complex GUI
- Rapid prototyping

} Qt graphics library
professional, powerful, free,
tools (QtDesigner), well documented

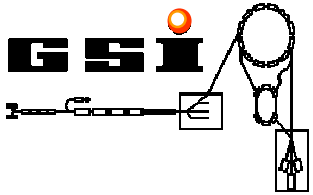
- Use ROOT and Qt together!
  no changes to ROOT sources

- Go4 GUI architecture:
  - signal-slot mechanism (both Qt and ROOT)
  - gui singleton: registry + dispatcher (modified mediator pattern)
  - persistent status objects per window

Go4 GUI: ROOT Qt interface to ROOT

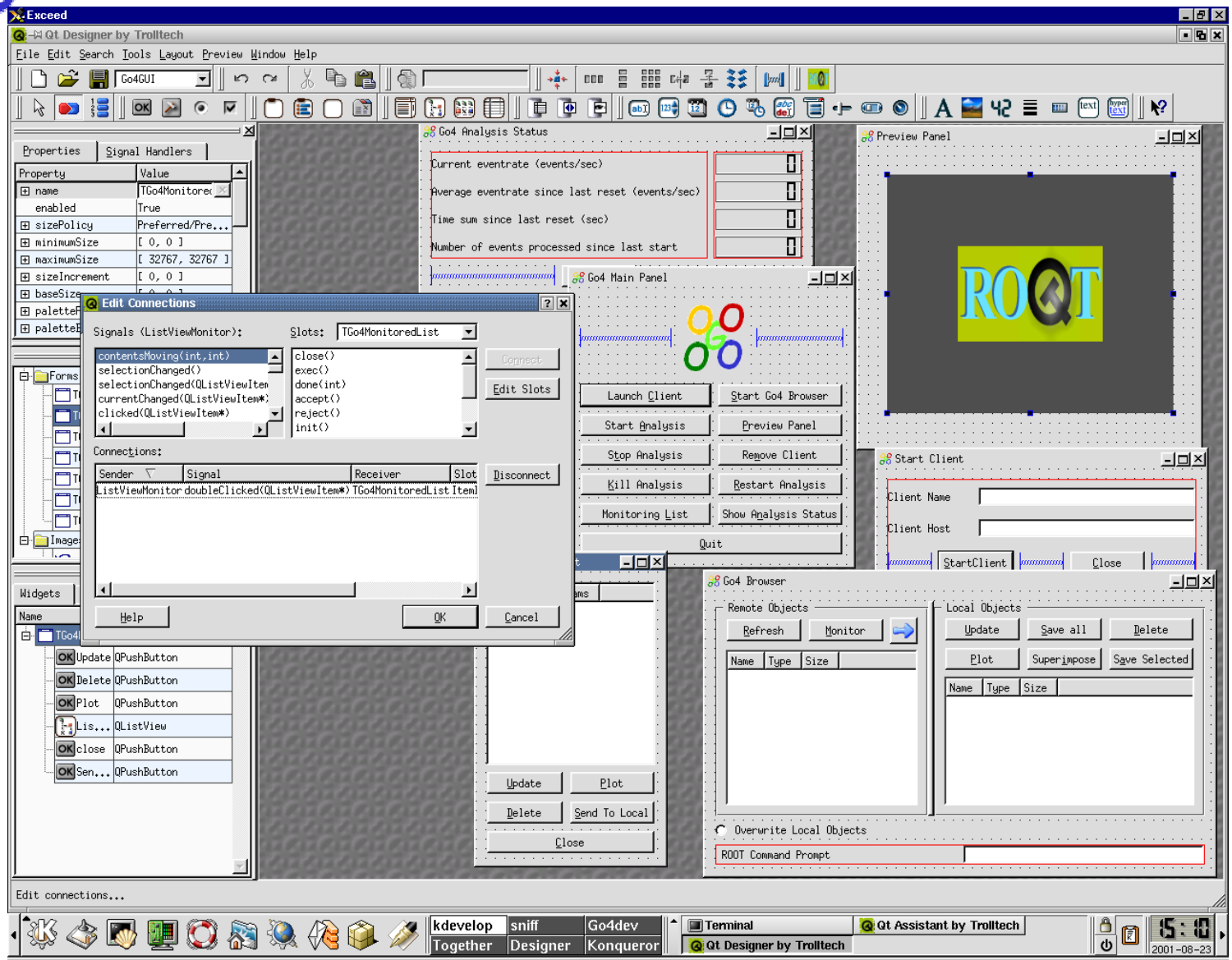


Go4 GUI: ROOT Qt interface to ROOT

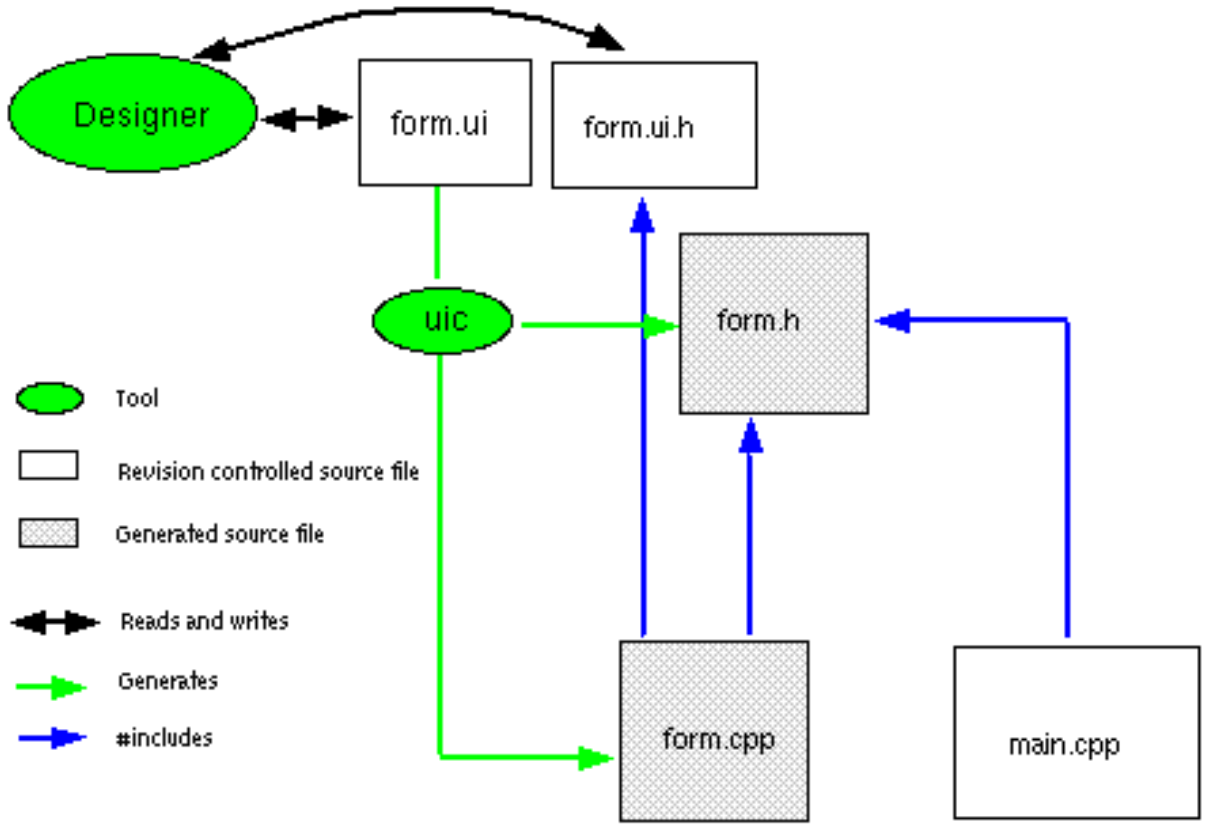


- Follows the general ROOT GUI ABC
  - no changes in ROOT source necessary
- Inheritance from ROOT base classes
  - TQRootGuiFactory (TRootGuiFactory)
    - Qt Factory GUI components
  - TQCanvasImp (TCanvasImp)
    - creates a Qt independent main window (QMainWindow)
    - sets TQRootCanvas as a central widget
  - TQApplication (TApplication)
    - ROOT environment set with a Qt GUI factory
- Inheritance from Qt base class
  - QRootApplication (QApplication)
    - enable Qt evt-loop to drive Qt based GUI applications
    - call ROOT inner loop repeatedly to enable ROOT system events

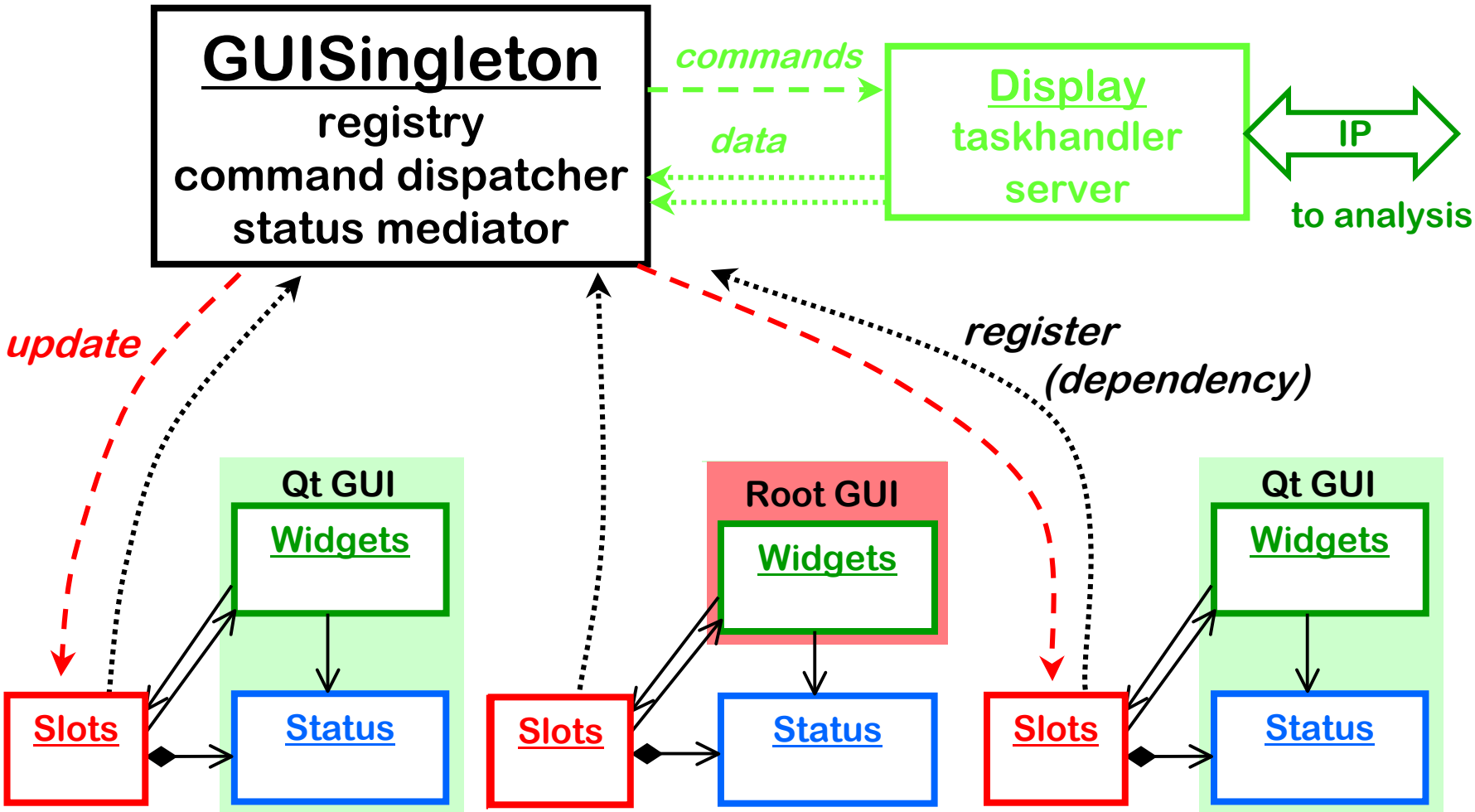
Qt Designer screenshot



Using Qt designer



Go4 GUI design



Summary

- Go4 thread manager package ✓
- Go4 task handler package ✓
- Go4 Qt-ROOT interface ✓

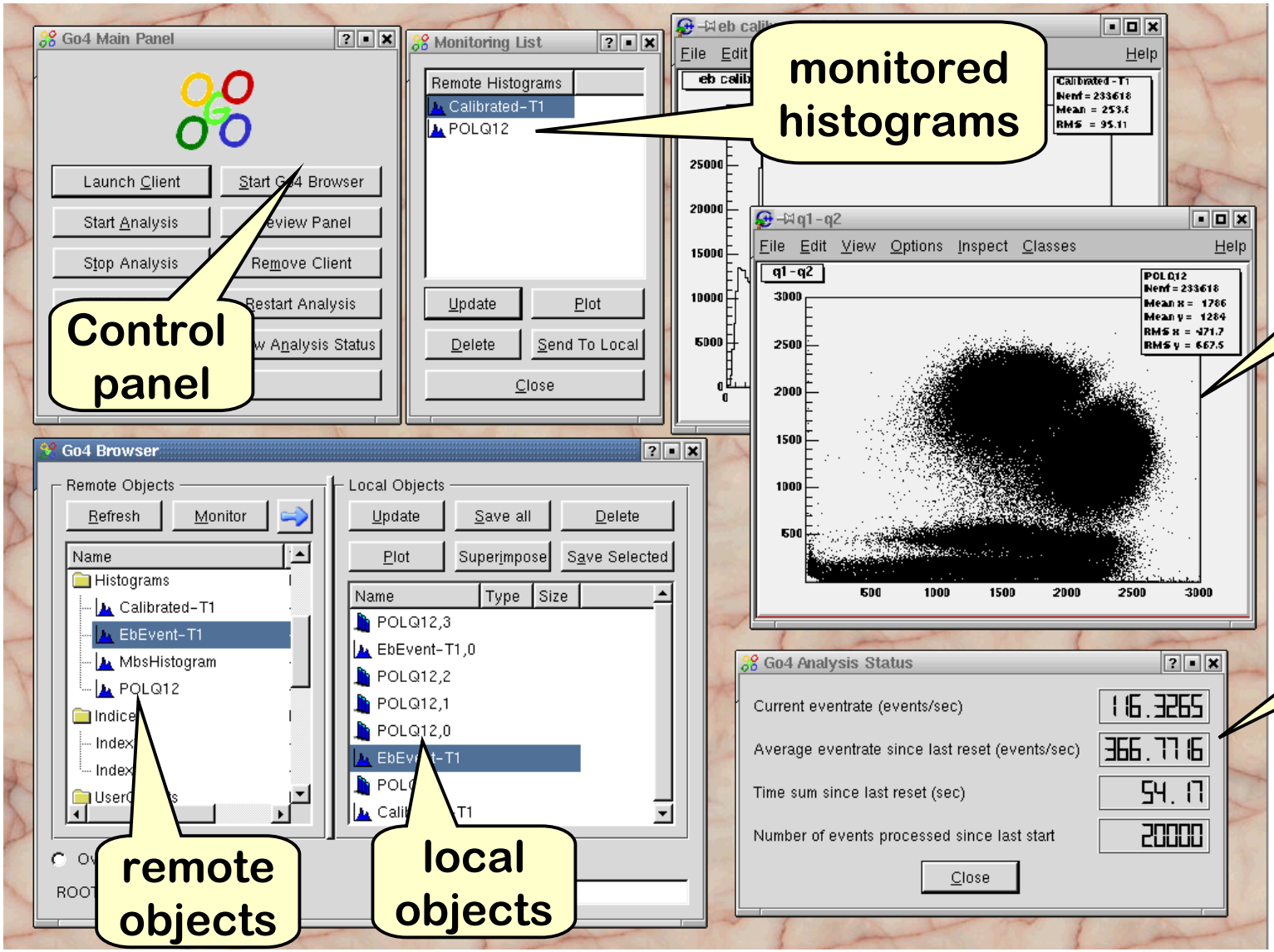
ready to use for any ROOT application

  - Client task could be analysis framework, slow ctrl,...
  - GUI task can use Qt graphics library

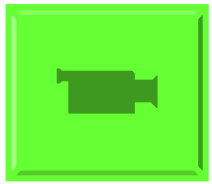
- Go4 analysis framework and GUI
  is being under development...

http://go4.gsi.de

Go4 demo

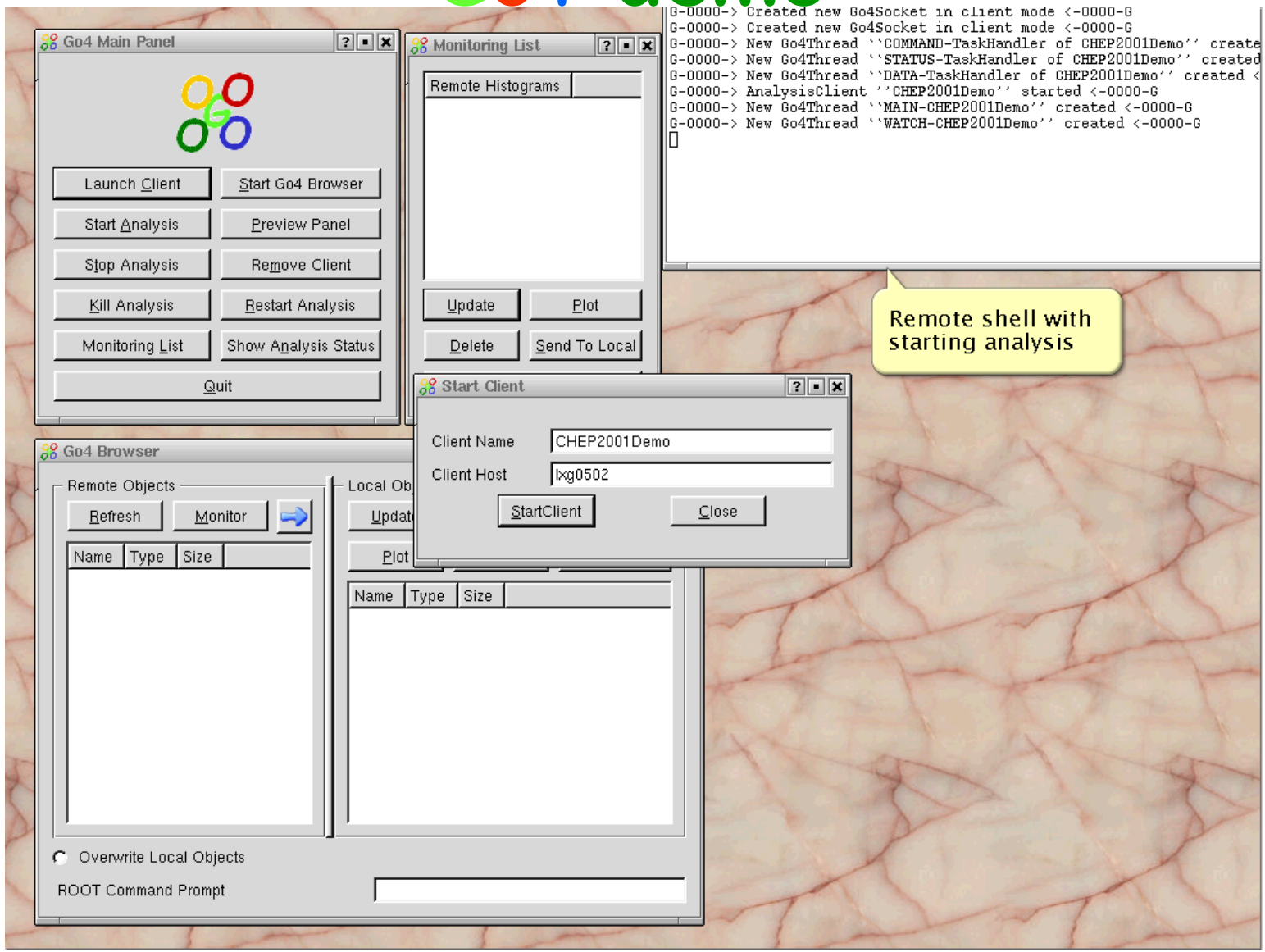

Go4 Main Panel
Launch Client
Start Go4 Browser
Start Analysis
Stop Analysis
Remove Client
Monitoring List
Remote Histograms
Calibrated-T1
POLQ12
Update
Plot
Delete
Send To Local
Close
monitored histograms
Control panel
q1-q2
File Edit View Options Inspect Classes Help
ROOT canvas
Go4 Browser
Remote Objects
Refresh
Monitor
Name
Histograms
Calibrated-T1
EbEvent-T1
MbsHistogram
POLQ12
Local Objects
Update
Save all
Delete
Plot
Superimpose
Save Selected
Name
Type
Size
POLQ12,3
EbEvent-T1,0
POLQ12,2
POLQ12,1
POLQ12,0
Go4 Analysis Status
Current eventrate (events/sec)
116.3265
Average eventrate since last reset (events/sec)
366.7716
Time sum since last reset (sec)
54.17
Number of events processed since last start
20000
Close
analysis status
remote objects
local objects

Go4 demo

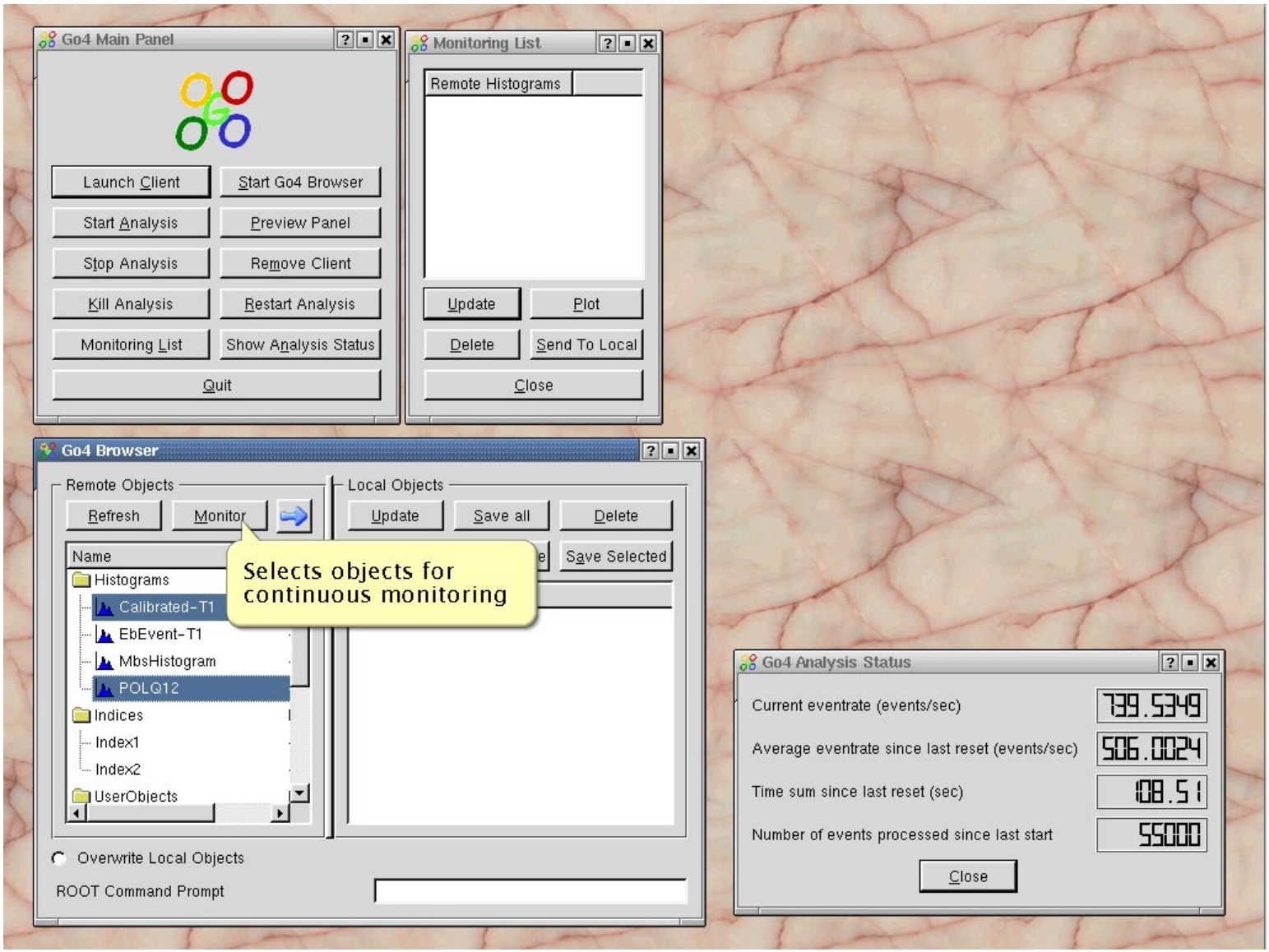


- Initializing a remote analysis
- Control of analysis: run status, list object folders
- Monitor remote histograms continuously
- Get and update local object copies
- Working on local histograms (fit panel, save)
- ROOT TBrowser works in parallel
- Go4 Browser plots: superimpose, multiwindow

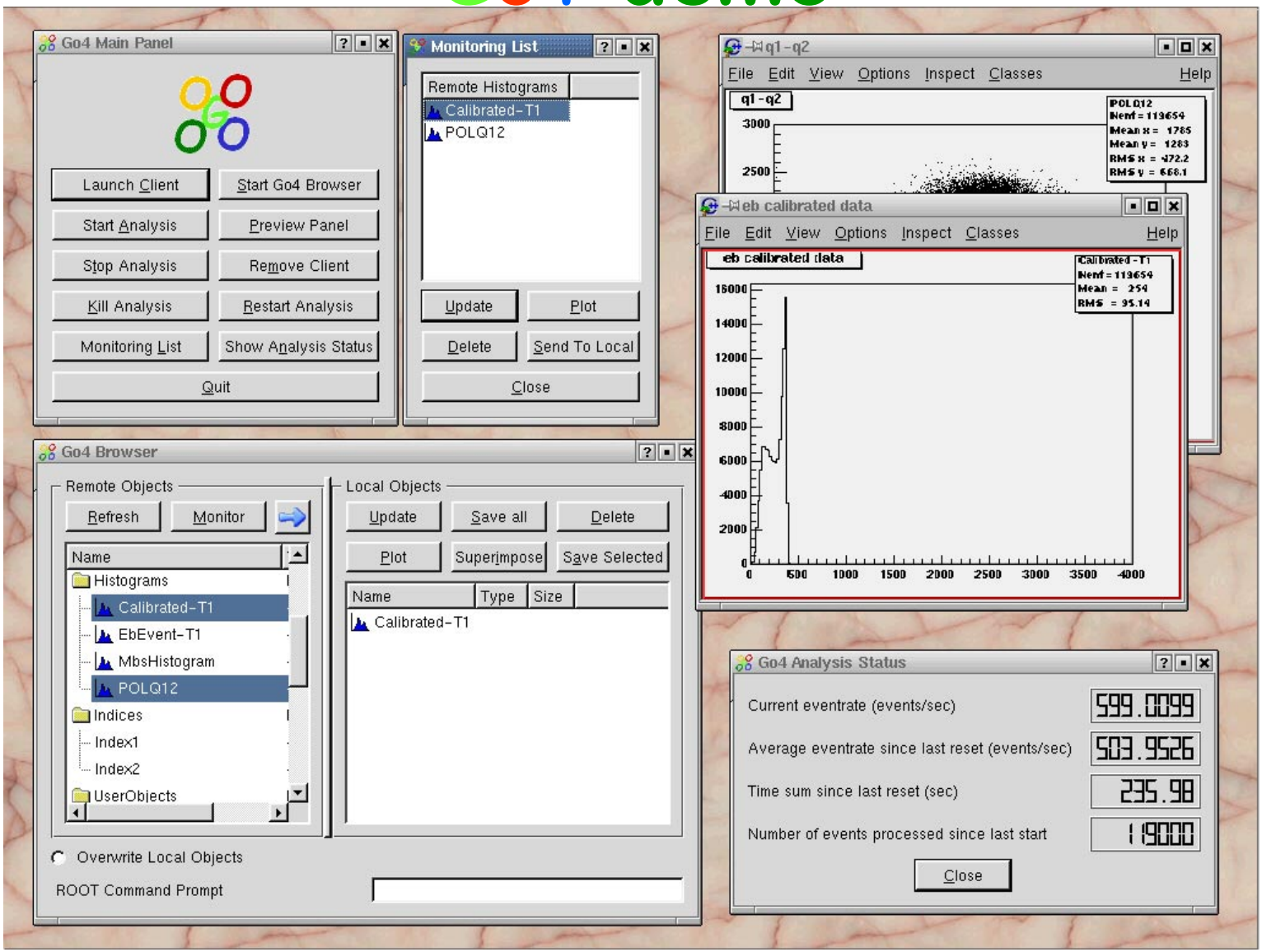
Go4 demo


Go4 Main Panel
Launch Client
Start Go4 Browser
Start Analysis
Preview Panel
Stop Analysis
Remove Client
Kill Analysis
Restart Analysis
Monitoring List
Show Analysis Status
Quit
Monitoring List
Remote Histograms
Update
Plot
Delete
Send To Local
G-0000-> Created new Go4Socket in client mode <-0000-G
G-0000-> Created new Go4Socket in client mode <-0000-G
G-0000-> New Go4Thread ``COMMAND-TaskHandler of CHEP2001Demo'' create
G-0000-> New Go4Thread ``STATUS-TaskHandler of CHEP2001Demo'' created
G-0000-> New Go4Thread ``DATA-TaskHandler of CHEP2001Demo'' created <
G-0000-> AnalysisClient ''CHEP2001Demo'' started <-0000-G
G-0000-> New Go4Thread ``MAIN-CHEP2001Demo'' created <-0000-G
G-0000-> New Go4Thread ``WATCH-CHEP2001Demo'' created <-0000-G
Remote shell with starting analysis
Start Client
Client Name
CHEP2001Demo
Client Host
lxg0502
StartClient
Close
Go4 Browser
Remote Objects
Refresh
Monitor
Name
Type
Size
Plot
Overwrite Local Objects
ROOT Command Prompt

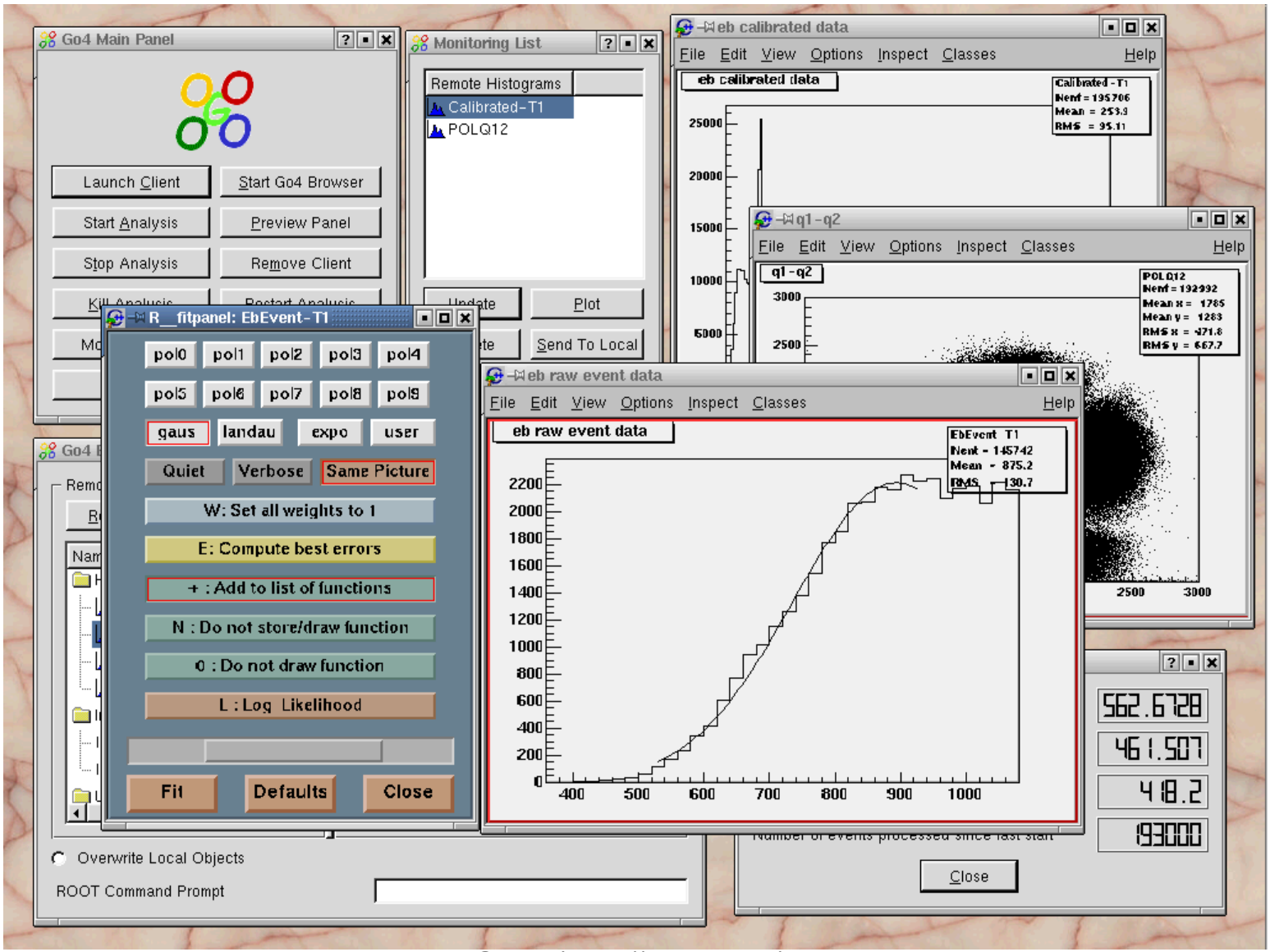
Go4 demo


Go4 Main Panel
Launch Client
Start Go4 Browser
Start Analysis
Preview Panel
Stop Analysis
Remove Client
Kill Analysis
Restart Analysis
Monitoring List
Show Analysis Status
Quit
Monitoring List
Remote Histograms
Update
Plot
Delete
Send To Local
Close
Go4 Browser
Remote Objects
Refresh
Monitor
Local Objects
Update
Save all
Delete
Save Selected
Name
Histograms
Calibrated-T1
EbEvent-T1
MbsHistogram
POLQ12
Indices
Index1
Index2
UserObjects
Selects objects for continuous monitoring
Overwrite Local Objects
ROOT Command Prompt
Go4 Analysis Status
Current eventrate (events/sec)
739.5349
Average eventrate since last reset (events/sec)
506.0024
Time sum since last reset (sec)
108.51
Number of events processed since last start
55000
Close

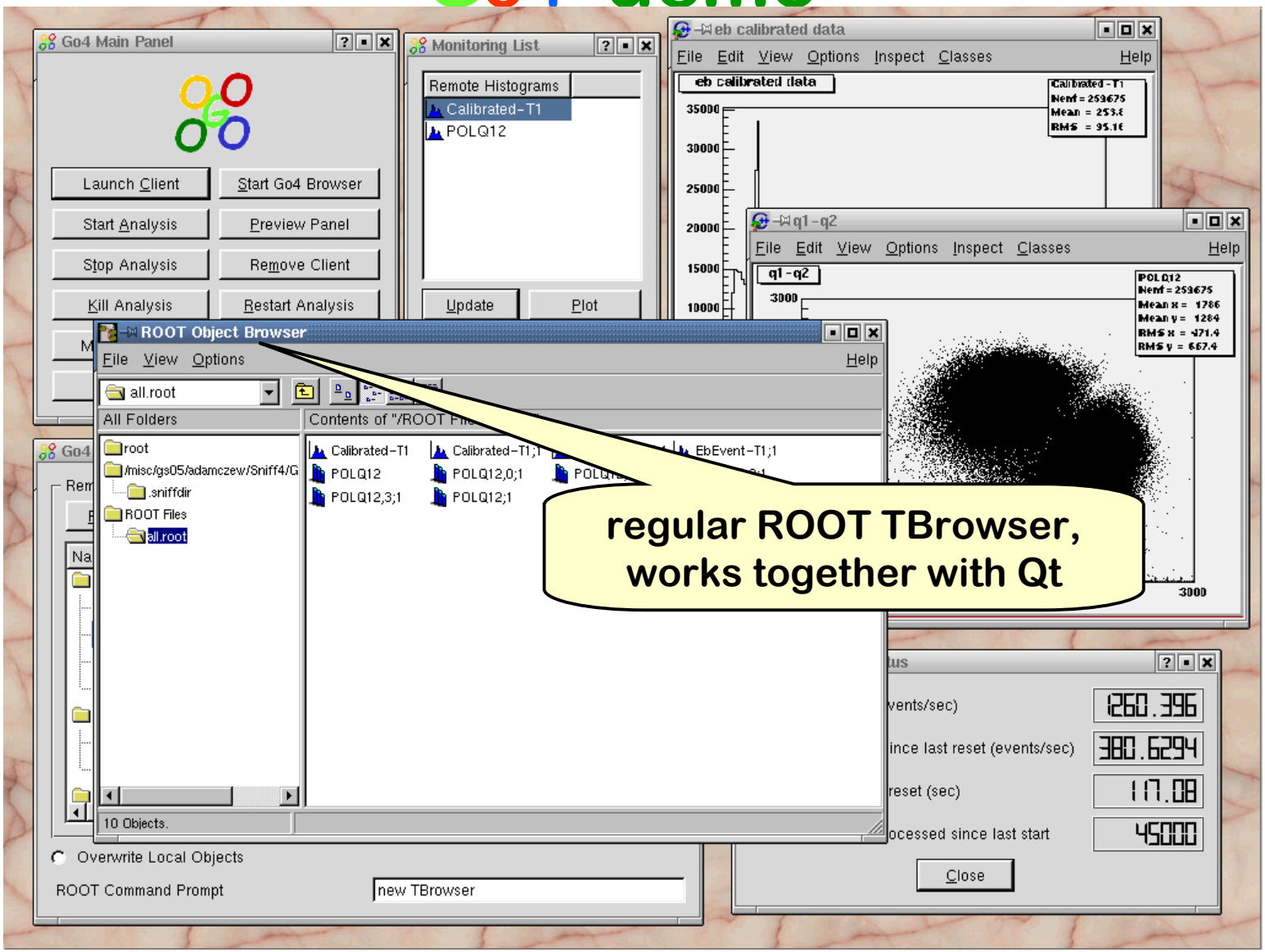
Go4 demo


Go4 Main Panel
Launch Client
Start Go4 Browser
Start Analysis
Preview Panel
Stop Analysis
Remove Client
Kill Analysis
Restart Analysis
Monitoring List
Show Analysis Status
Quit
Monitoring List
Remote Histograms
Calibrated-T1
POLQ12
Update
Plot
Delete
Send To Local
Close
q1-q2
File Edit View Options Inspect Classes Help
POLQ12
eb calibrated data
File Edit View Options Inspect Classes Help
Calibrated-T1
Go4 Browser
Remote Objects
Refresh
Monitor
Name
Histograms
Calibrated-T1
EbEvent-T1
MbsHistogram
POLQ12
Indices
Index1
Index2
UserObjects
Local Objects
Update
Save all
Delete
Plot
Superimpose
Save Selected
Name
Type
Size
Calibrated-T1
Overwrite Local Objects
ROOT Command Prompt
Go4 Analysis Status
Current eventrate (events/sec)
599.0099
Average eventrate since last reset (events/sec)
503.9526
Time sum since last reset (sec)
235.98
Number of events processed since last start
119000
Close

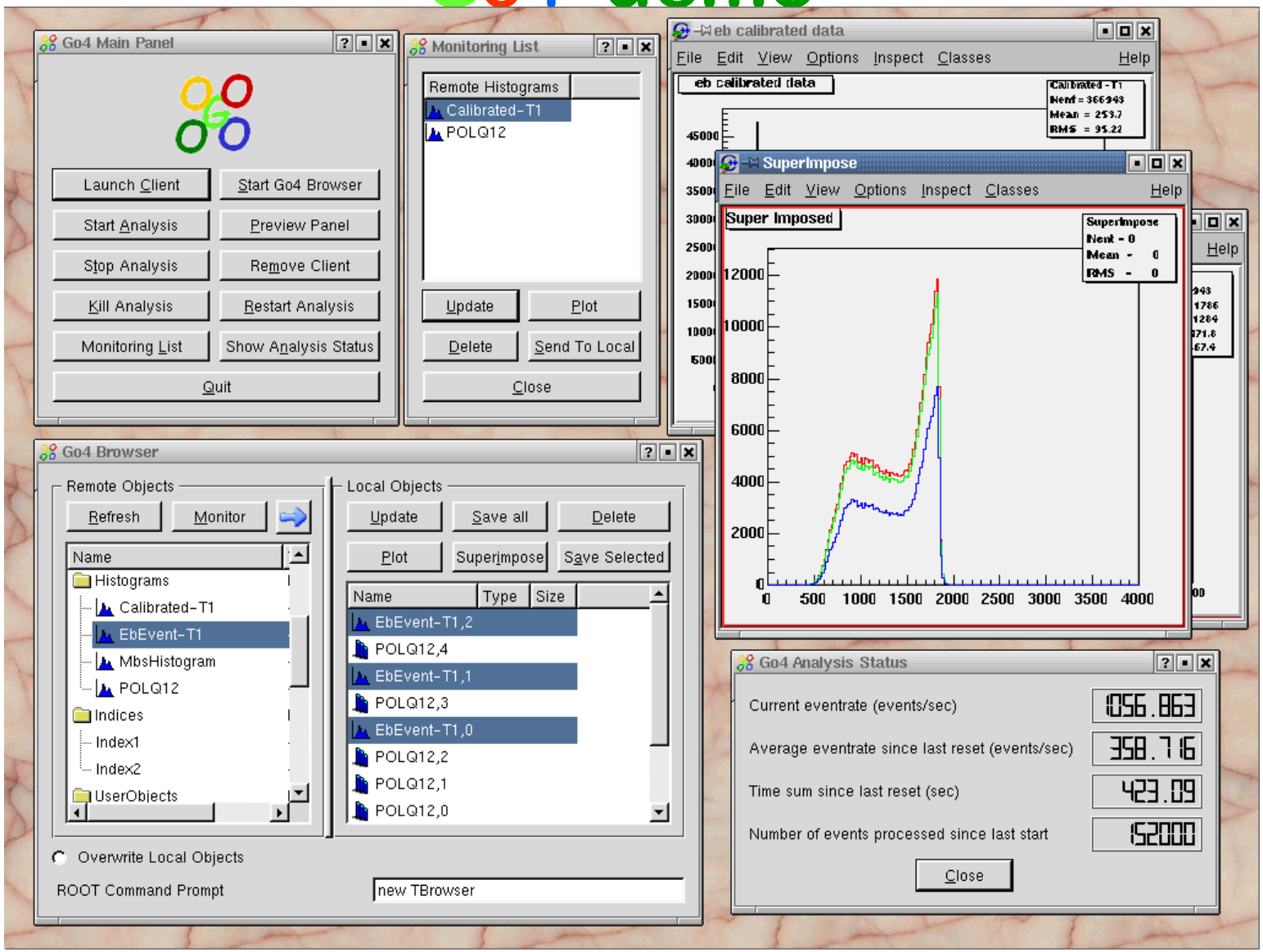
Go4 demo


Go4 Main Panel
Launch Client
Start Go4 Browser
Start Analysis
Preview Panel
Stop Analysis
Remove Client
Monitoring List
Remote Histograms
Calibrated-T1
POLQ12
Update
Plot
Send To Local
eb calibrated data
File Edit View Options Inspect Classes Help
eb calibrated data
q1 - q2
File Edit View Options Inspect Classes Help
q1 - q2
R__fitpanel: EbEvent-T1
pol0 pol1 pol2 pol3 pol4
pol5 pol6 pol7 pol8 pol9
gaus landau expo user
Quiet Verbose Same Picture
W: Set all weights to 1
E: Compute best errors
+ : Add to list of functions
N : Do not store/draw function
0 : Do not draw function
L : Log Likelihood
Fit Defaults Close
eb raw event data
File Edit View Options Inspect Classes Help
eb raw event data
EbEvent T1
Nent = 145742
Mean = 875.2
RMS = 130.7
562.6728
461.507
418.2
193000
Close
Overwrite Local Objects
ROOT Command Prompt

Go4 demo


Go4 Main Panel
Launch Client
Start Go4 Browser
Start Analysis
Preview Panel
Stop Analysis
Remove Client
Kill Analysis
Restart Analysis
Monitoring List
Remote Histograms
Calibrated-T1
POLQ12
Update
Plot
eb calibrated data
File Edit View Options Inspect Classes Help
q1-q2
ROOT Object Browser
File View Options Help
all.root
All Folders
root
/misc/gs05/adamczew/Sniff4/G
.sniffdir
ROOT Files
all.root
Calibrated-T1
Calibrated-T1;1
EbEvent-T1;1
POLQ12
POLQ12,0;1
POLQ12,3;1
POLQ12;1
10 Objects.
regular ROOT TBrowser,
works together with Qt
Overwrite Local Objects
ROOT Command Prompt
new TBrowser
1260.396
380.6294
117.08
45000
Close

Go4 demo


Go4 Main Panel
Launch Client
Start Go4 Browser
Start Analysis
Preview Panel
Stop Analysis
Remove Client
Kill Analysis
Restart Analysis
Monitoring List
Show Analysis Status
Quit
Monitoring List
Remote Histograms
Calibrated-T1
POLQ12
Update
Plot
Delete
Send To Local
Close
eb calibrated data
File Edit View Options Inspect Classes Help
SuperImpose
Super Imposed
Go4 Browser
Remote Objects
Refresh
Monitor
Name
Histograms
Calibrated-T1
EbEvent-T1
MbsHistogram
POLQ12
Indices
Index1
Index2
UserObjects
Local Objects
Update
Save all
Delete
Plot
Superimpose
Save Selected
Name
Type
Size
EbEvent-T1,2
POLQ12,4
EbEvent-T1,1
POLQ12,3
EbEvent-T1,0
POLQ12,2
POLQ12,1
POLQ12,0
Overwrite Local Objects
ROOT Command Prompt
new TBrowser
Go4 Analysis Status
Current eventrate (events/sec)
1056.863
Average eventrate since last reset (events/sec)
358.716
Time sum since last reset (sec)
423.09
Number of events processed since last start
152000
Close