

Real-Time Data Reduction Integrated Into Instrument Control Software

Outline

- Setting The Context
- Use-Case
- Solution
- Implementation's Examples
- Evolution

Setting The Context

C++

Server

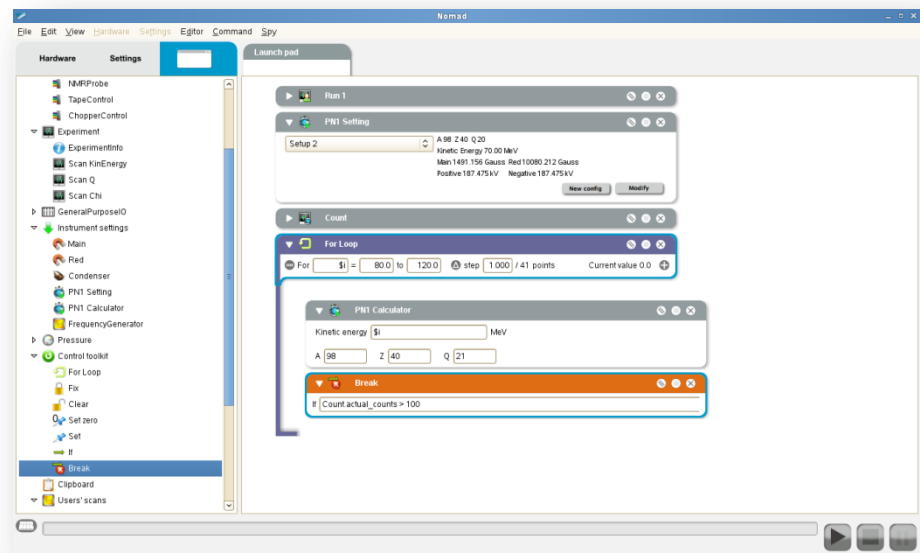
CORBA

Transport Layer

Java

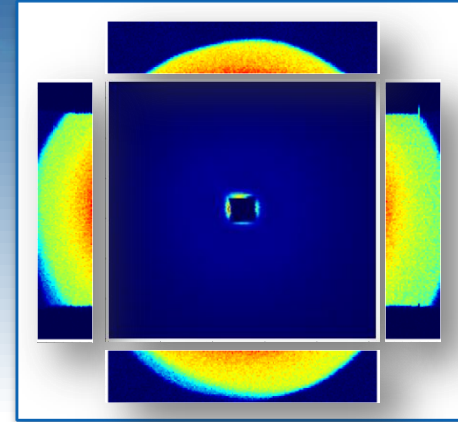
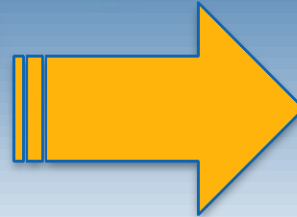
GUI

NOMAD



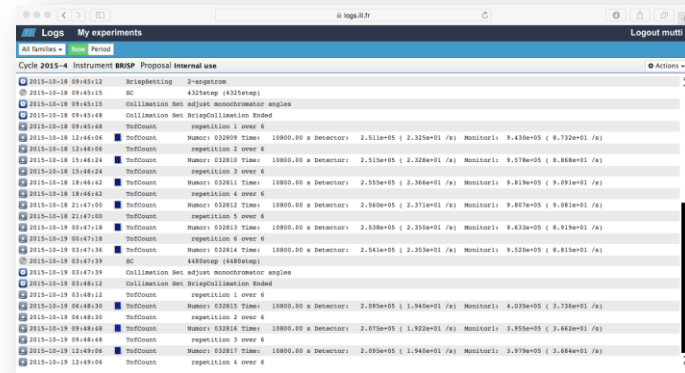
Use-Case

NOMAD



PlotScreen generator

WEB Spy

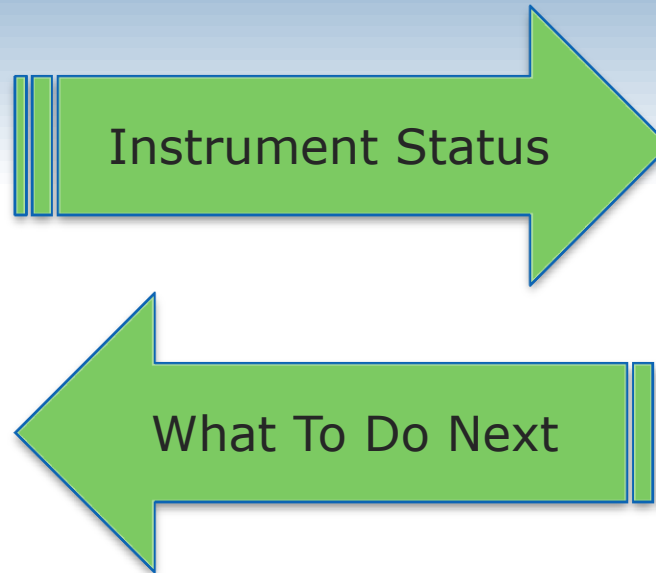



Time	Instrument	Proposal	Internal use
2015-10-18 09:45:13	Neutron	2-Neutron	
2015-10-18 09:45:13	432Step	432Step	
2015-10-18 09:45:13	Collimation Set	adjust monochromator angles	
2015-10-18 09:45:13	Collimation Set	NeutronCollimation Read	
2015-10-18 09:45:13	Neutron	repetition 1 over 6	
2015-10-18 12:44:04	Neutron	Humor: 02809 Time: 1800.00 s Detectors: 2.511e+05 (2.325e+01 /s) Monitor: 9.430e+05 (8.722e+01 /s)	
2015-10-18 12:44:04	Neutron	repetition 2 over 6	
2015-10-18 12:44:04	Neutron	Humor: 02810 Time: 1800.00 s Detectors: 2.515e+05 (2.328e+01 /s) Monitor: 9.578e+05 (8.868e+01 /s)	
2015-10-18 12:44:04	Neutron	repetition 3 over 6	
2015-10-18 12:44:04	Neutron	Humor: 02811 Time: 1800.00 s Detectors: 2.515e+05 (2.346e+01 /s) Monitor: 9.818e+05 (9.091e+01 /s)	
2015-10-18 12:44:04	Neutron	repetition 4 over 6	
2015-10-18 12:44:04	Neutron	Humor: 02812 Time: 1800.00 s Detectors: 2.560e+05 (2.371e+01 /s) Monitor: 9.807e+05 (9.081e+01 /s)	
2015-10-18 12:47:00	Neutron	repetition 5 over 6	
2015-10-18 12:47:00	Neutron	Humor: 02813 Time: 1800.00 s Detectors: 2.558e+05 (2.350e+01 /s) Monitor: 9.433e+05 (8.919e+01 /s)	
2015-10-18 12:47:00	Neutron	repetition 6 over 6	
2015-10-18 12:47:00	Neutron	Humor: 02814 Time: 1800.00 s Detectors: 2.541e+05 (2.353e+01 /s) Monitor: 9.520e+05 (8.818e+01 /s)	
2015-10-18 12:47:00	Neutron	448Step (448Step)	
2015-10-18 12:47:00	Collimation Set	adjust monochromator angles	
2015-10-18 12:47:00	Collimation Set	NeutronCollimation Read	
2015-10-18 12:47:00	Neutron	repetition 1 over 6	
2015-10-18 12:47:00	Neutron	Humor: 02815 Time: 1800.00 s Detectors: 2.090e+05 (1.940e+01 /s) Monitor: 4.035e+05 (3.716e+01 /s)	
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2015-10-18 12:47:00	Neutron	Humor: 02816 Time: 1800.00 s Detectors: 2.077e+05 (1.922e+01 /s) Monitor: 3.950e+05 (3.632e+01 /s)	
2015-10-18 12:47:00	Neutron	repetition 3 over 6	
2015-10-18 12:47:00	Neutron	Humor: 02817 Time: 1800.00 s Detectors: 2.095e+05 (1.940e+01 /s) Monitor: 3.978e+05 (3.684e+01 /s)	
2015-10-18 12:47:00	Neutron	repetition 4 over 6	

Electronic log

Use-Case

Interaction with data reduction/analysis



- Multi-process
- Multi-environment
- Synchronization
- Crash management

Possible Solutions

● Monolithic



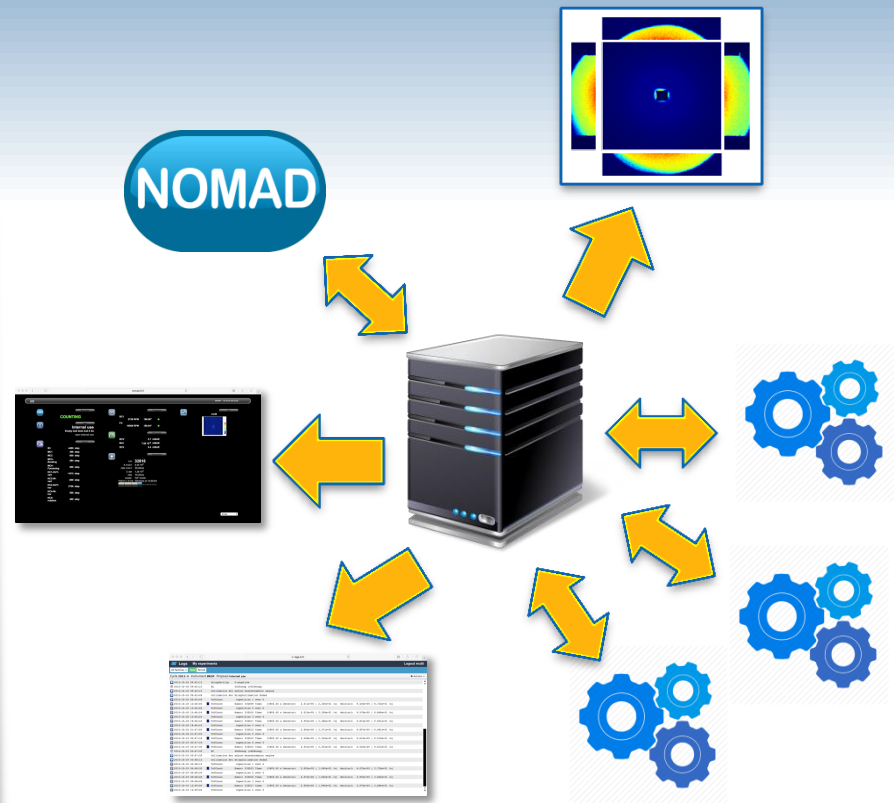
Every single
Scientific method
is included in
NOMAD

Difficult to
maintain

No freedom
and flexibility
for scientists



● Microservices



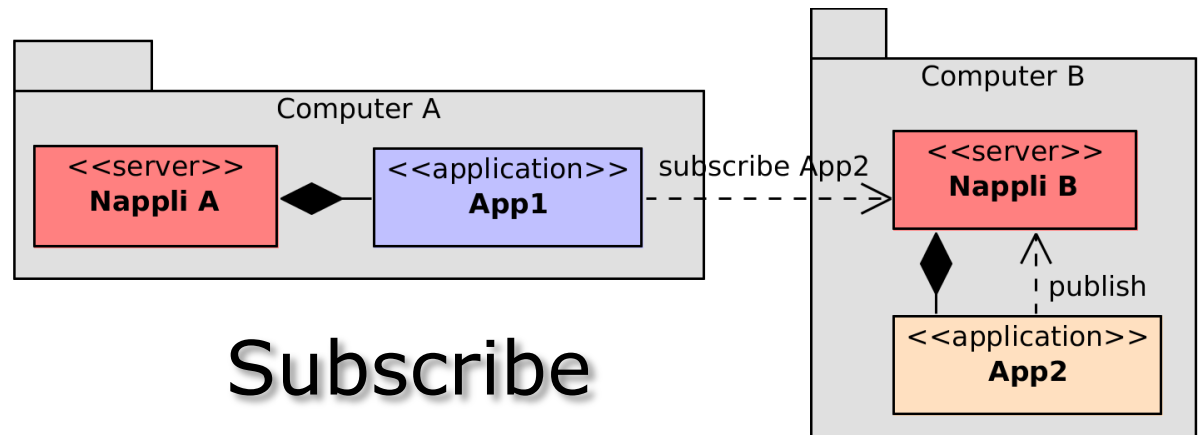
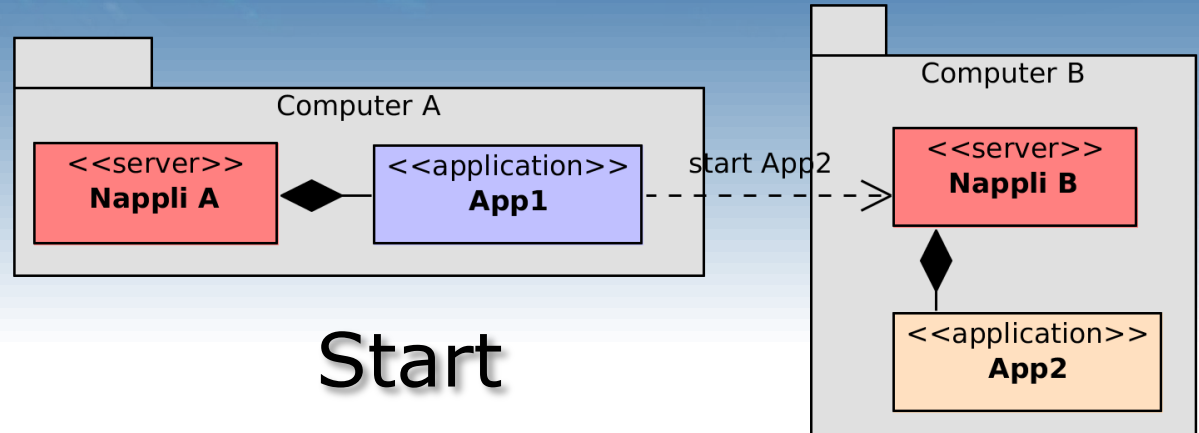
What Is NAPPLI

- Lightweight application server
- Multiplatform (Linux, Mac, Windows)
- Manages the entire application lifecycle
Start/Stop nicely
- Provides client API in C++ and Java
- Implements different communication patterns
 - Request/response
 - Publisher/Subscriber
 - Return value at the end

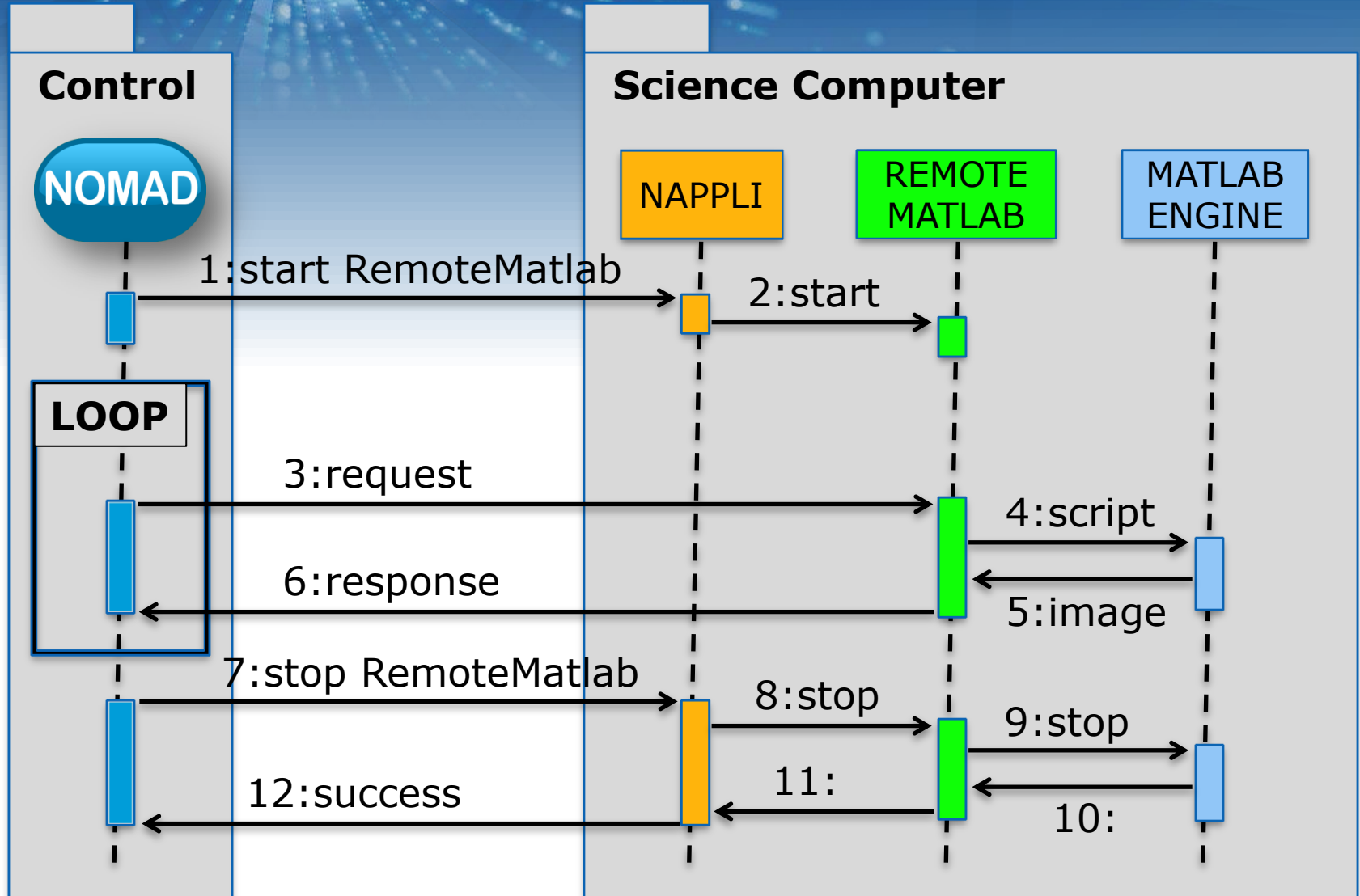
NAPPLI Basics



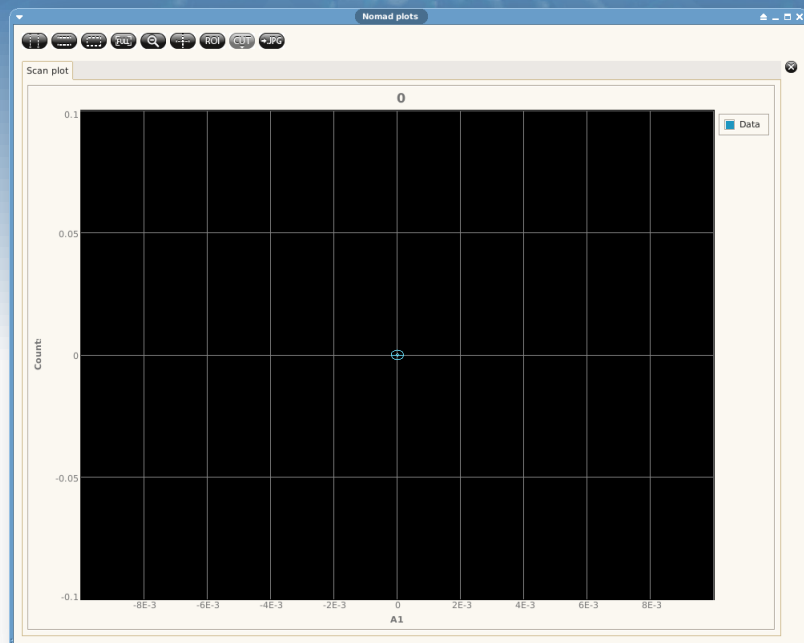
Protocol Buffers



MATLAB Synchronous Server

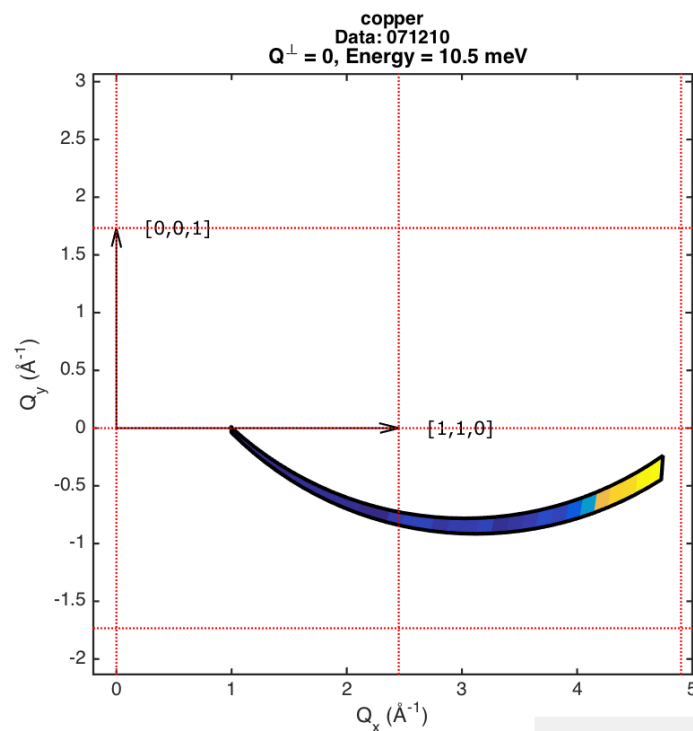


Q Space Transformation



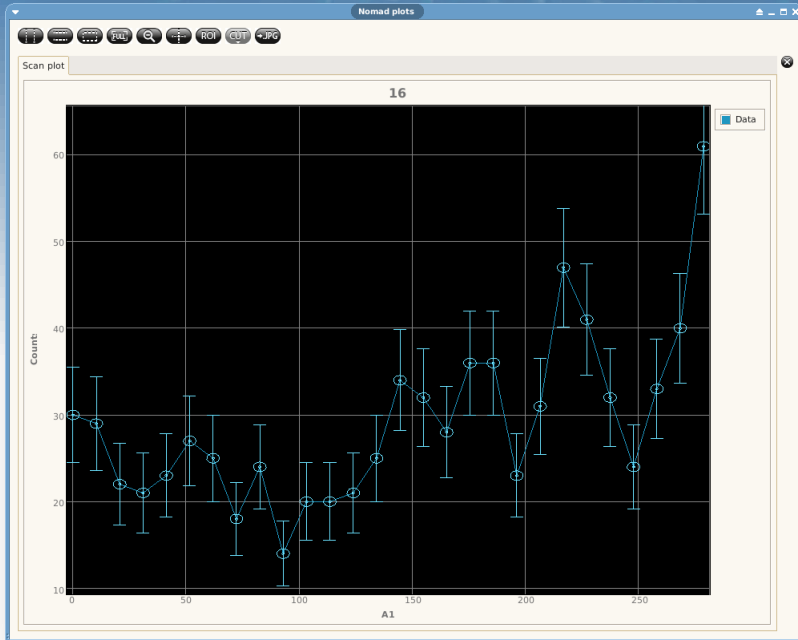
SCAN Raw Data

Q Space



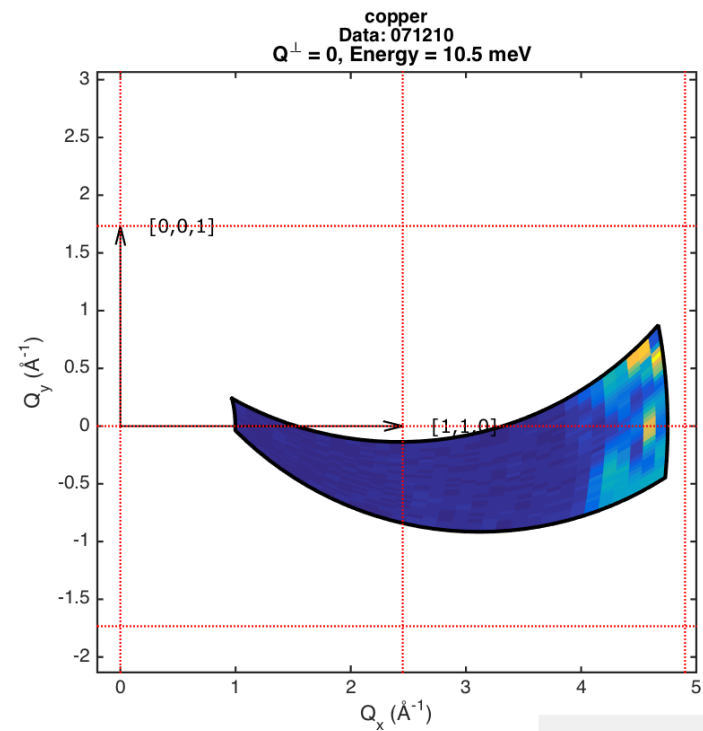
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Q Space Transformation

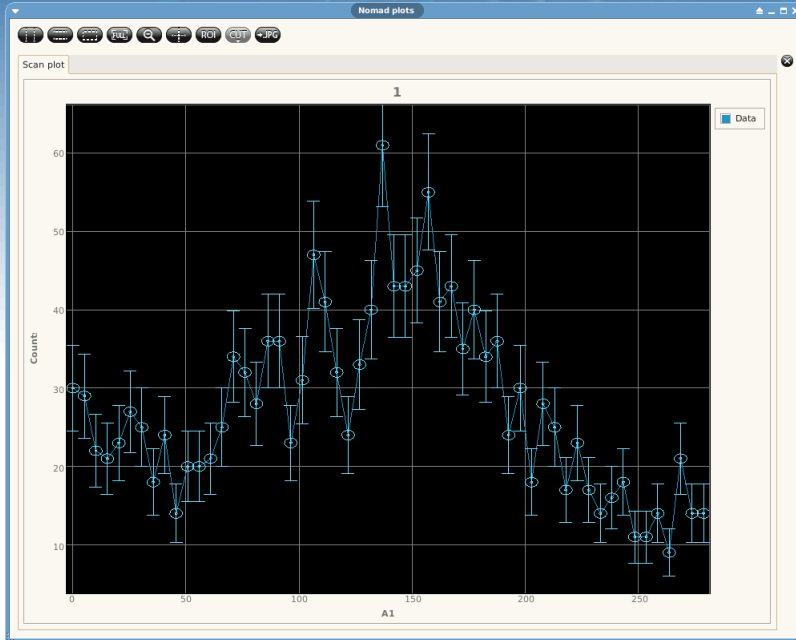


SCAN Raw Data

Q Space

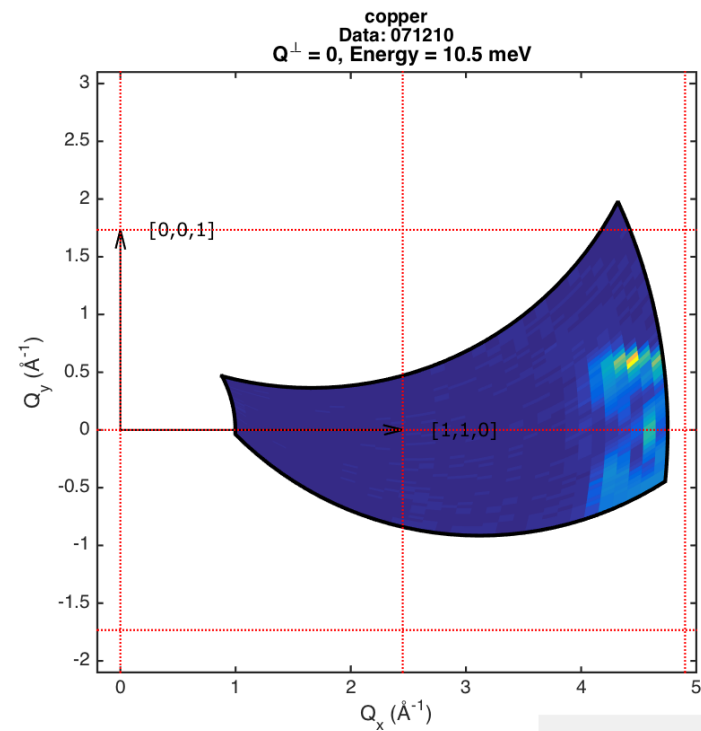


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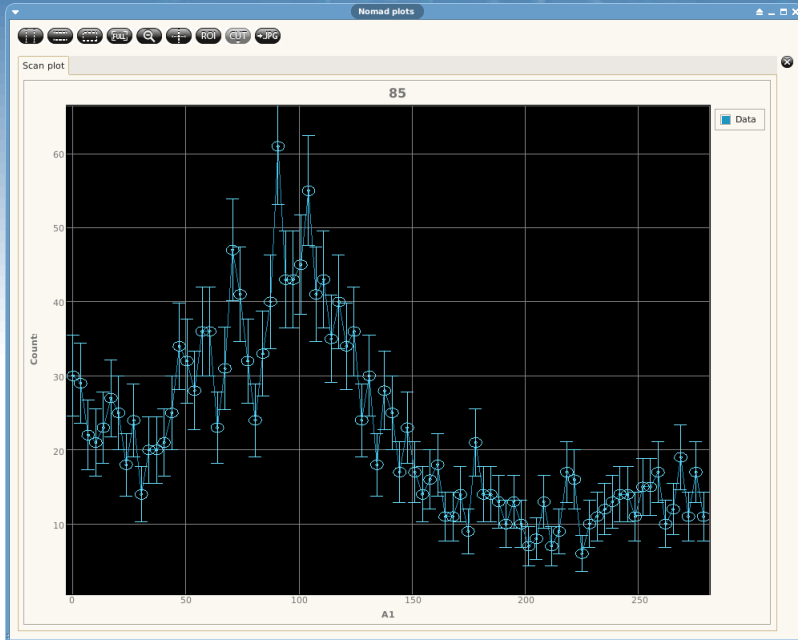


SCAN Raw Data

Q Space

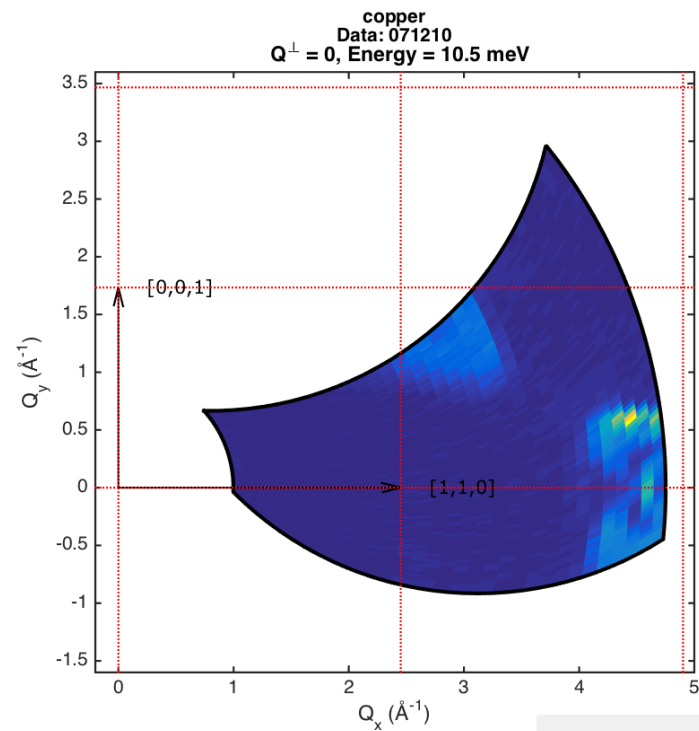


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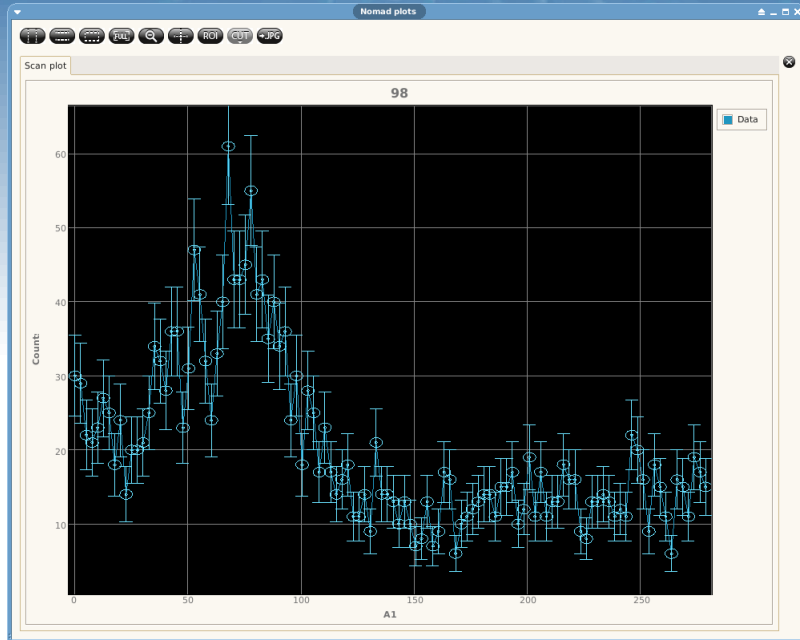


SCAN Raw Data

Q Space

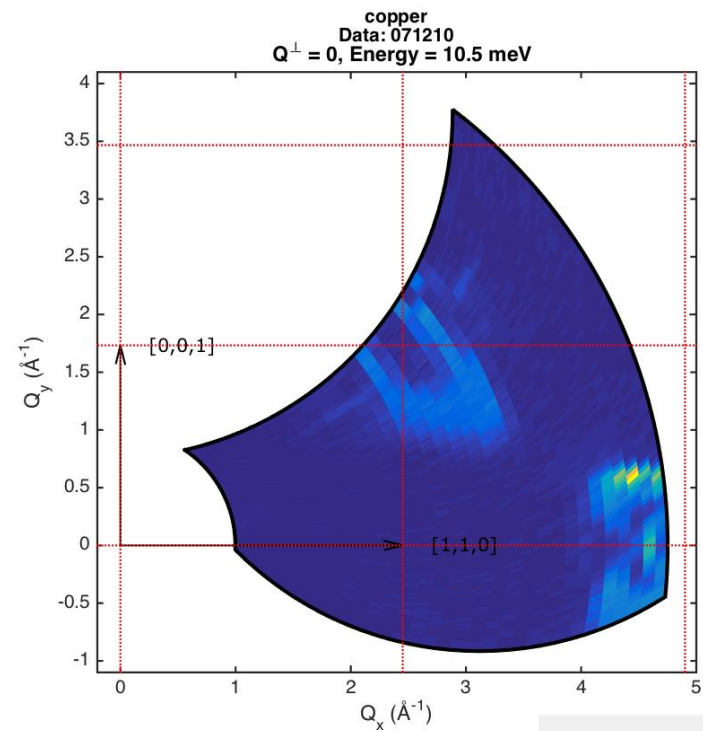


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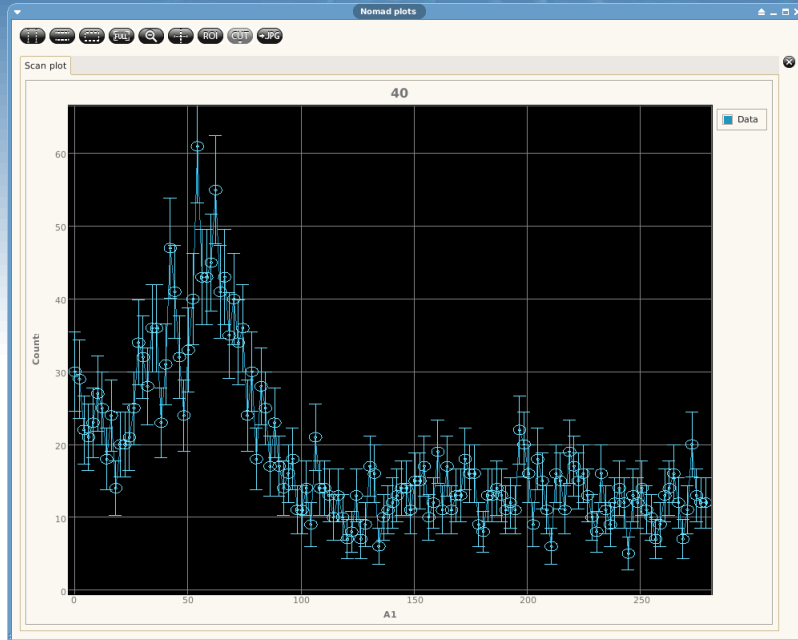


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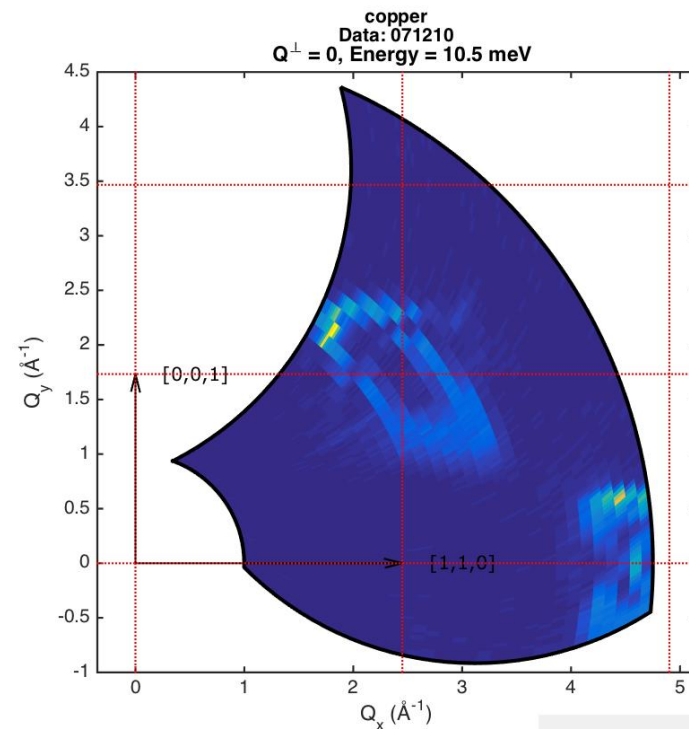


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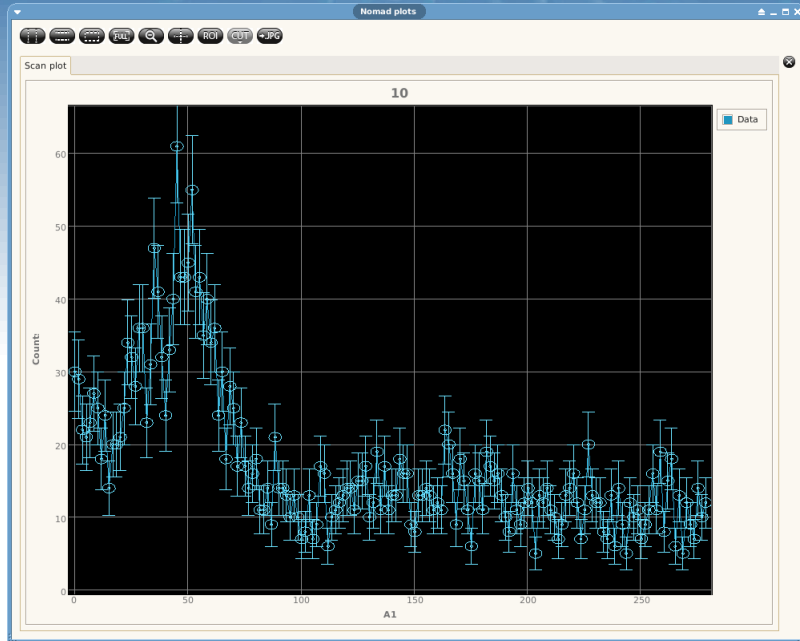


SCAN Raw Data

Q Space

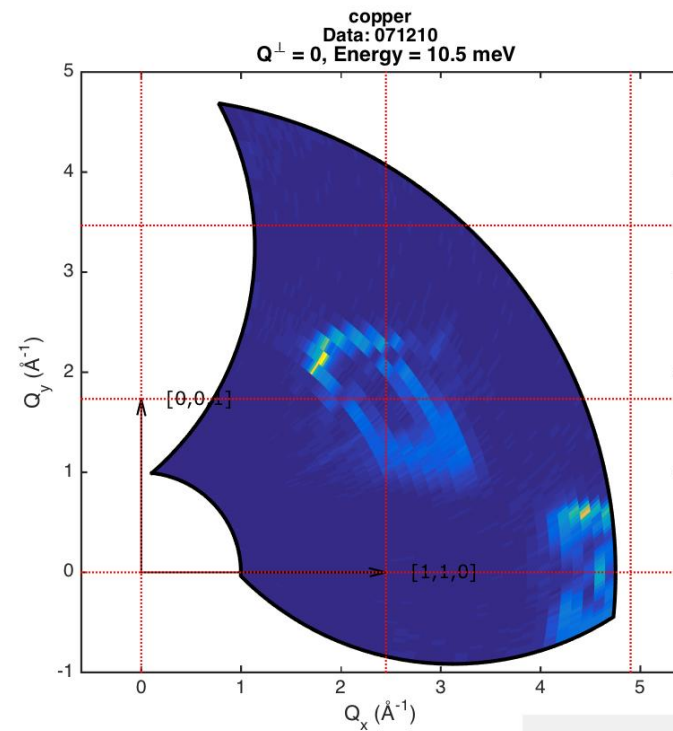


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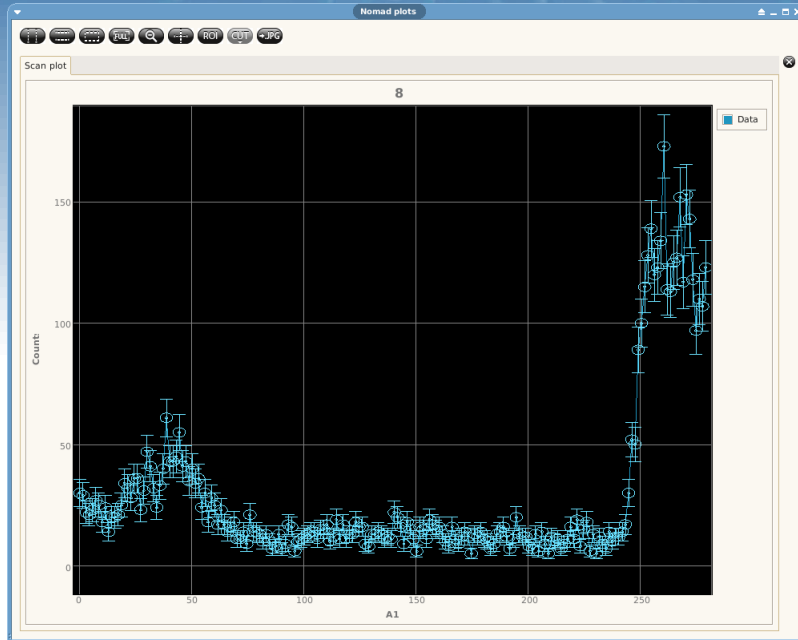
SCAN Raw Data

Q Space



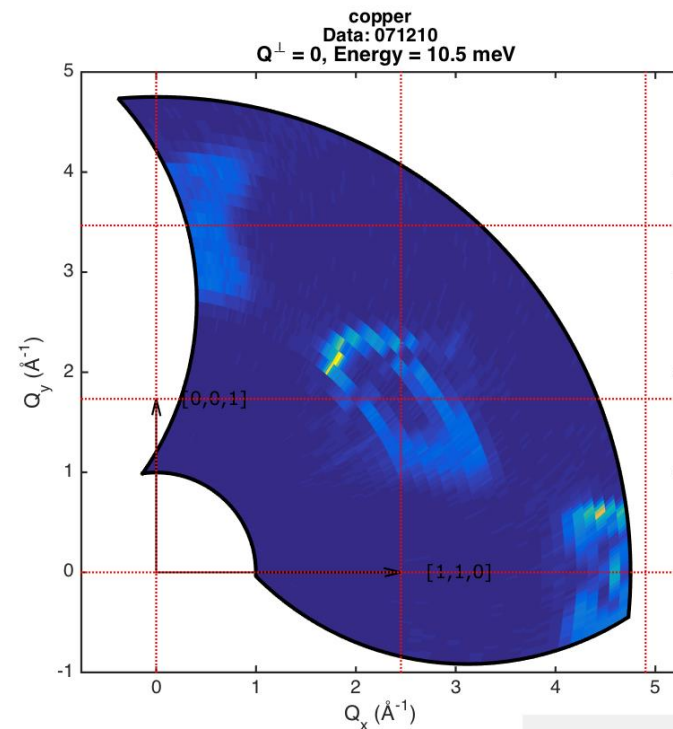
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Q Space Transformation

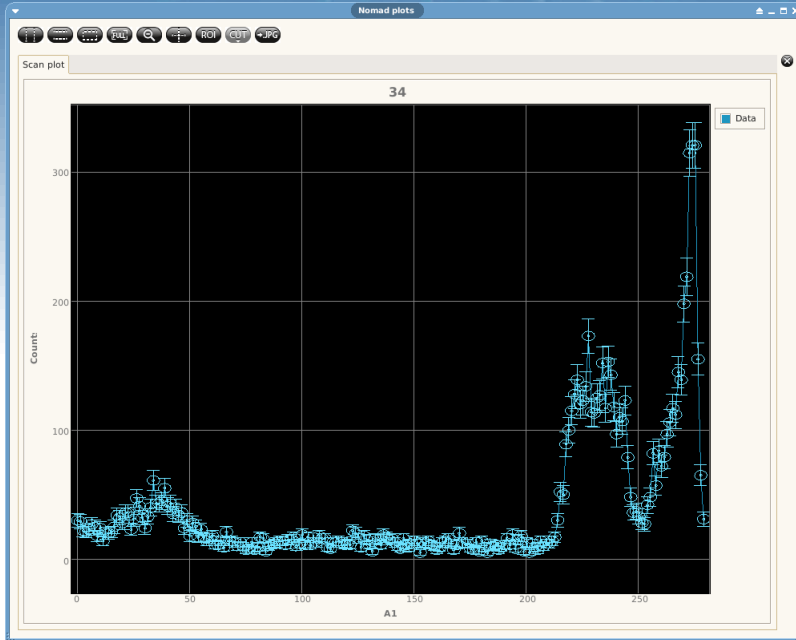


SCAN Raw Data

Q Space

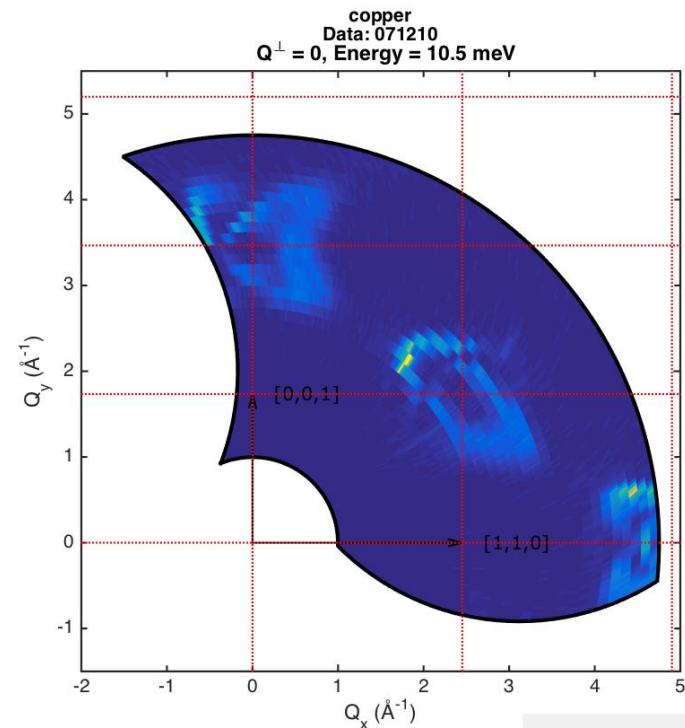


Q Space Transformation



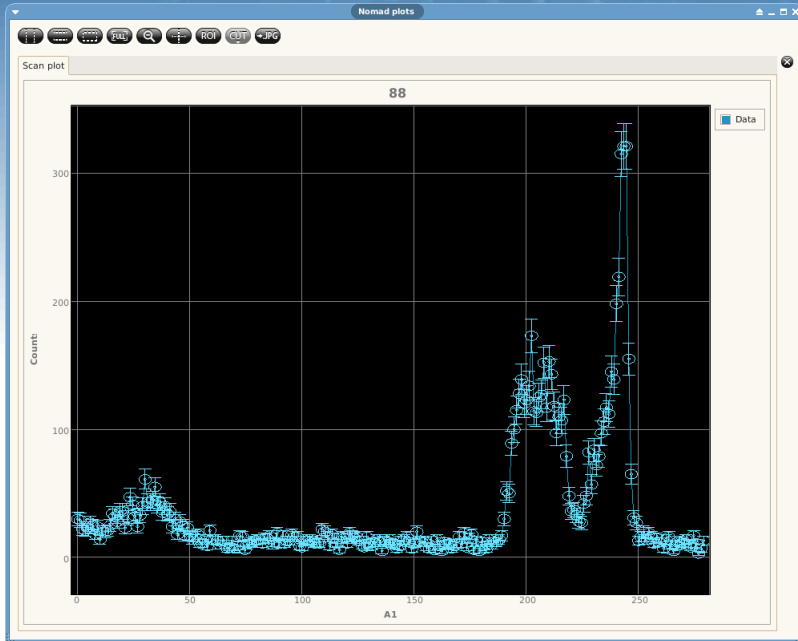
SCAN Raw Data

Q Space



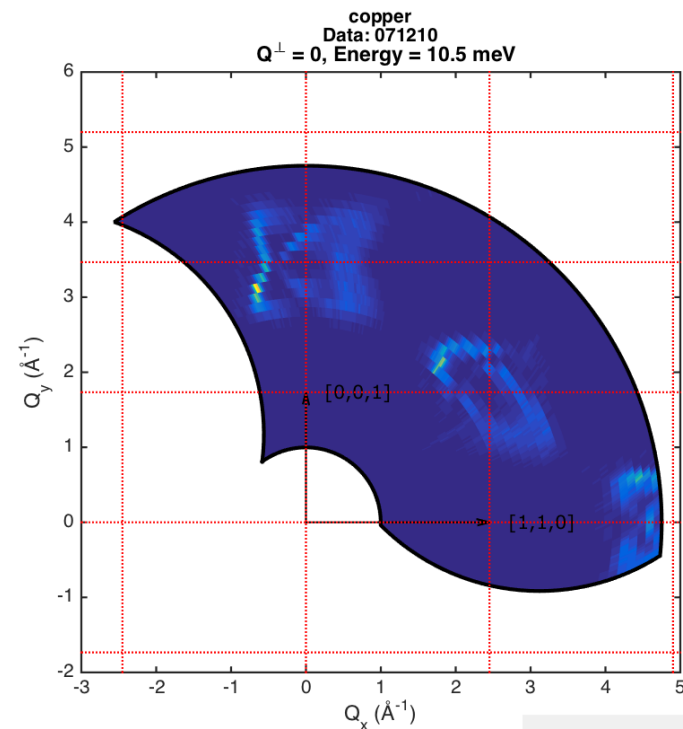
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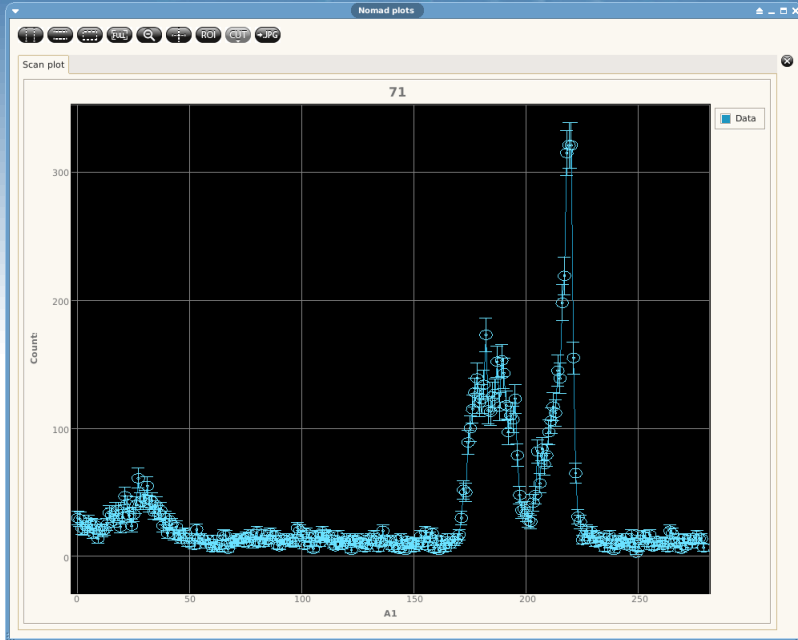


SCAN Raw Data

Q Space

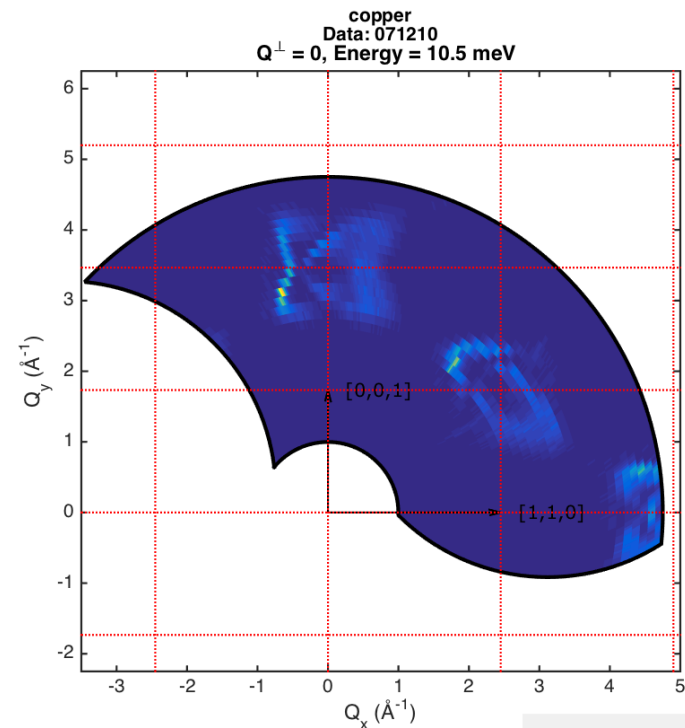


Q Space Transformation



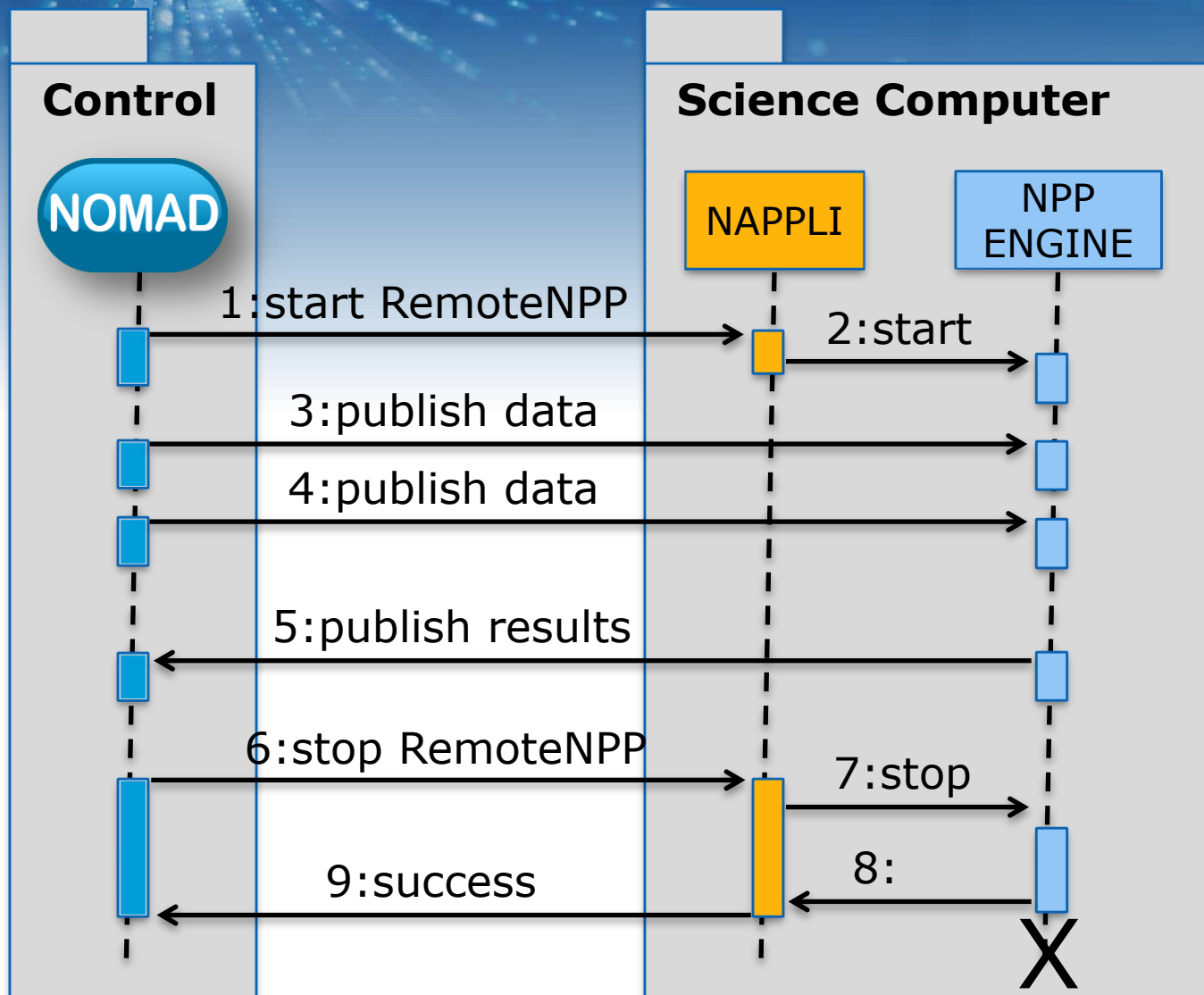
SCAN Raw Data

Q Space

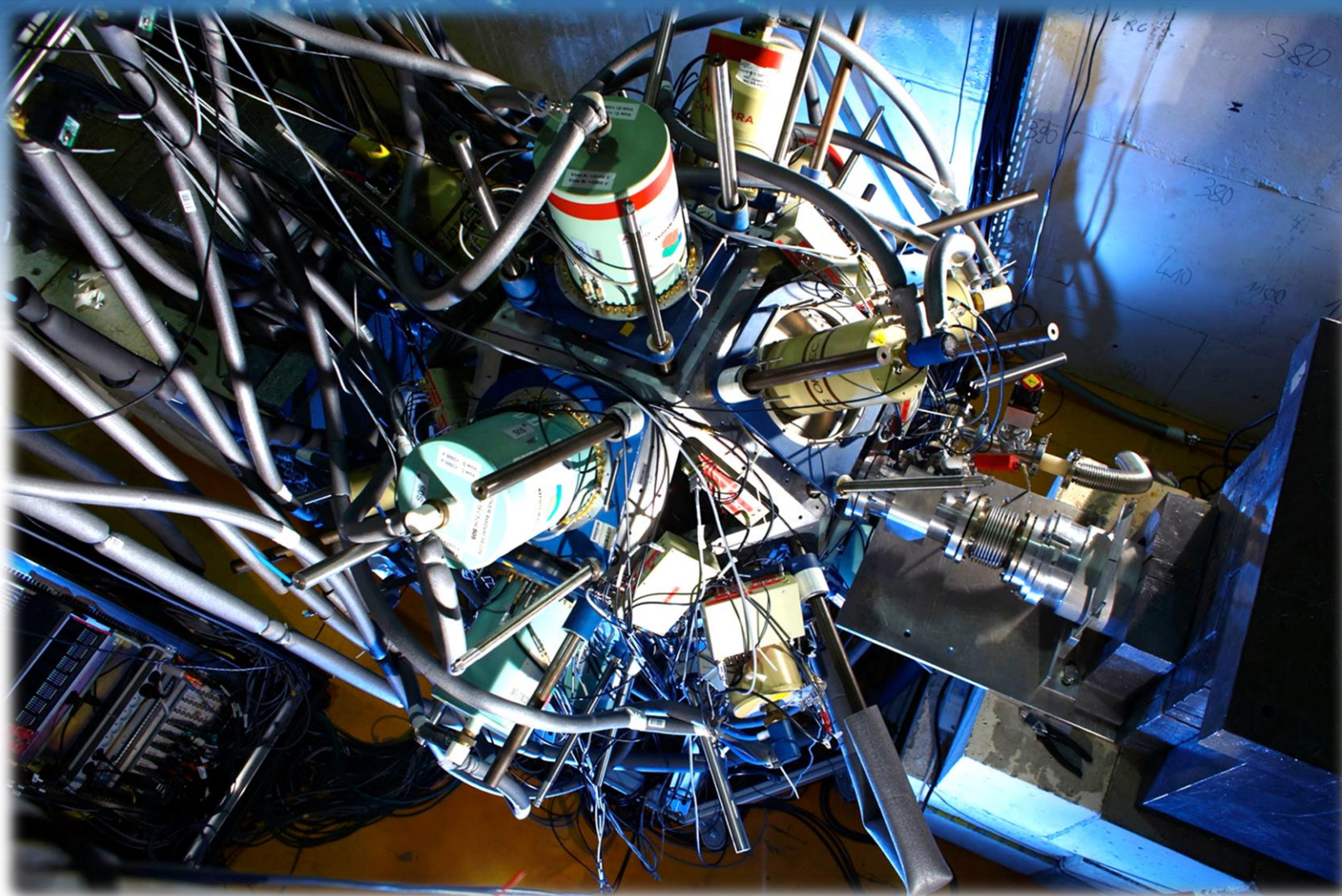


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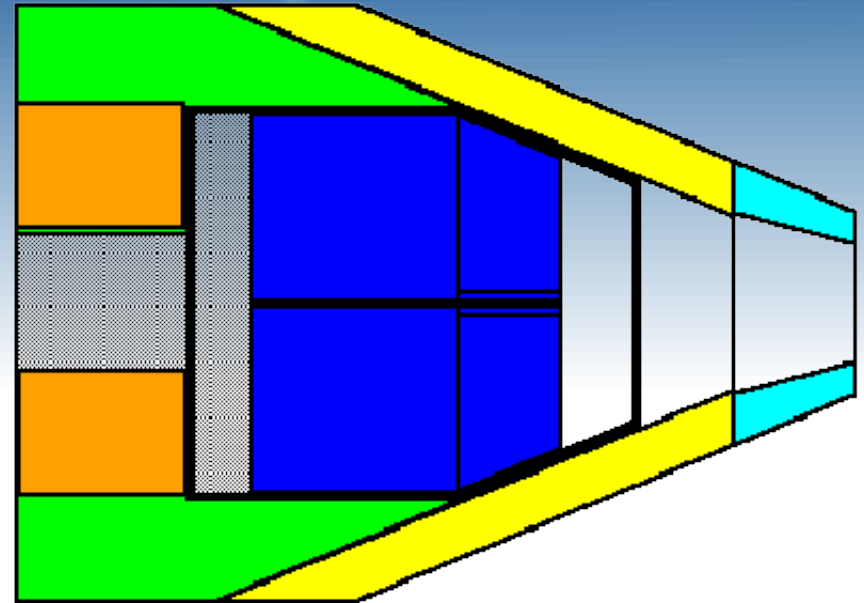
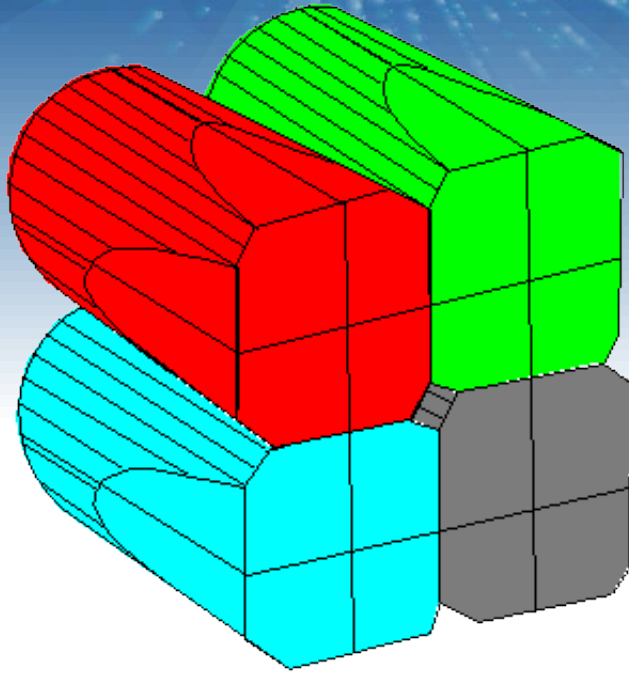
Coincidence Asynchronous Server



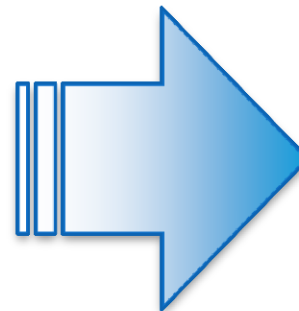
Coincidence Experiment Setup



Detector Layout



- 4 x Ge crystals
- 4 x NaI back-catcher
- 8 x BGO rear side shield
- 8 x BGO side shield



24
correlated
detectors

Coincidence Asynchronous Server

- Average event rate ~ 1 MHz
- Event-mode file ~ 2 GB in less than 5 min.

Detector - Crystal	Raw Rate (kHz)	Clean Rate (kHz)
1	XXX	xxx
1	1-XXX	1-xxx
2	2-XXX	2-xxx
3	3-XXX	3-xxx
4	4-XXX	4-xxx

Coincidence	Raw Rate (kHz)	Clean Rate (kHz)
Single	XXX	xxx
Fold 2	YYY	yyy
.
Fold n	ZZZ	zzz

Conclusion

NAPPLI

- Manage and organize the execution of different applications of the instrument control software
- Easily distribute and run new/existing scientific computations over different computers
- Flexible in term of platform and application's interaction
- Coming soon: decision taking within NOMAD workflow based on data analysis

<http://forge.ill.fr/projects/nappli>