# XMGRACE TUTORIAL

- We will be plotting the data points using ***xmgrace*** software.
- The data points for each experiment will be plotted. You will have to fit the obtained data using one of the following:
  - Linear fit
  - Nonlinear fit
  - Quadratic fit
- These will be discussed one by one.

# XMGRACE TUTORIAL

- **SAVE** the project as exp*MN*-p0*A*-S*x*-G*y*.agr, where, *MN* the number of experiment, *A* is the plot number, *x* your section number and *y* is the group number.

# FITTING THE CURVE

# STRAIGHT LINE FIT

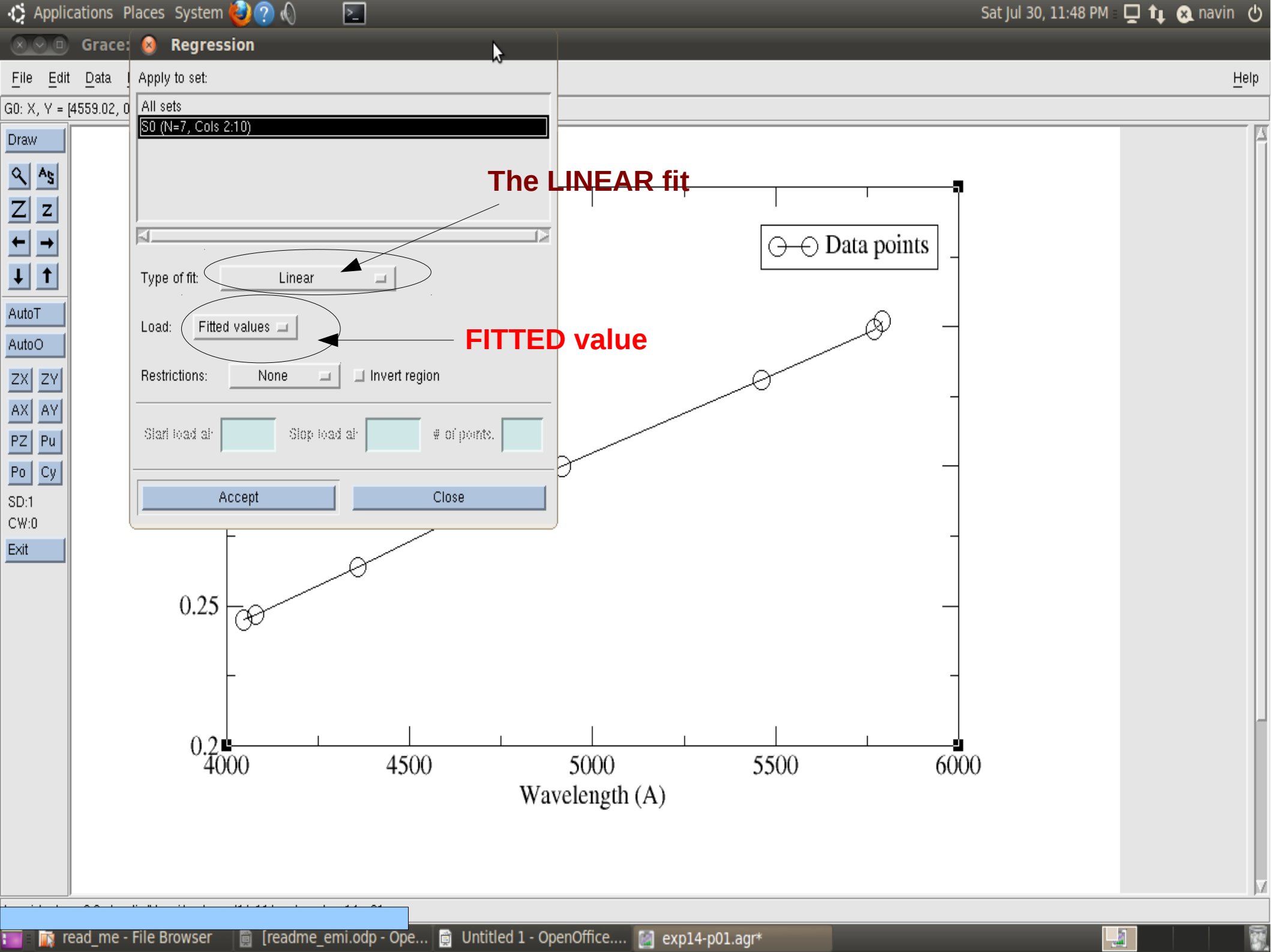
The experiments which requires fitting:

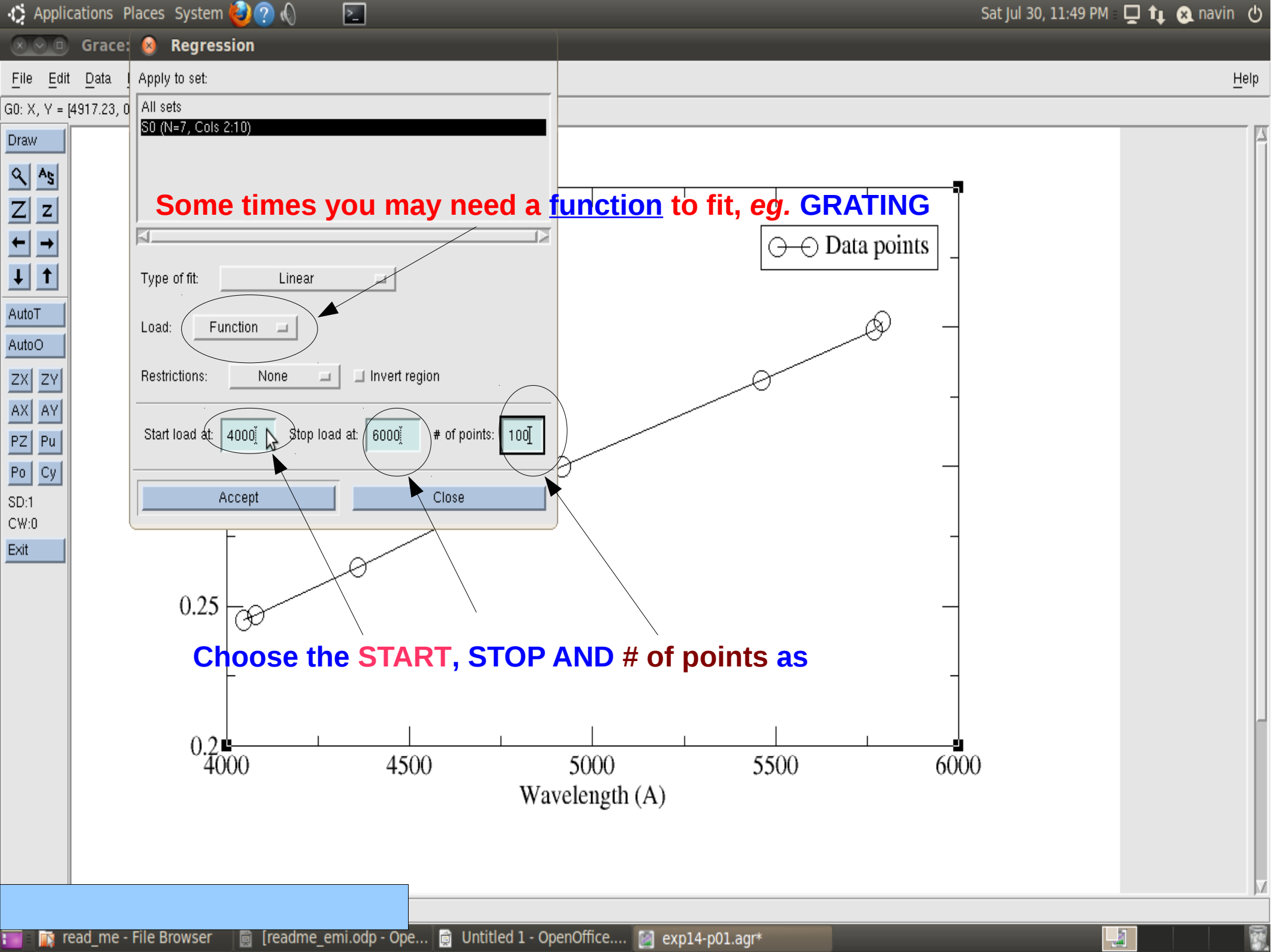
- Couple pendulums
- Electromagnetic induction
- Planck's constant
- Newton's rings
- Diffraction grating

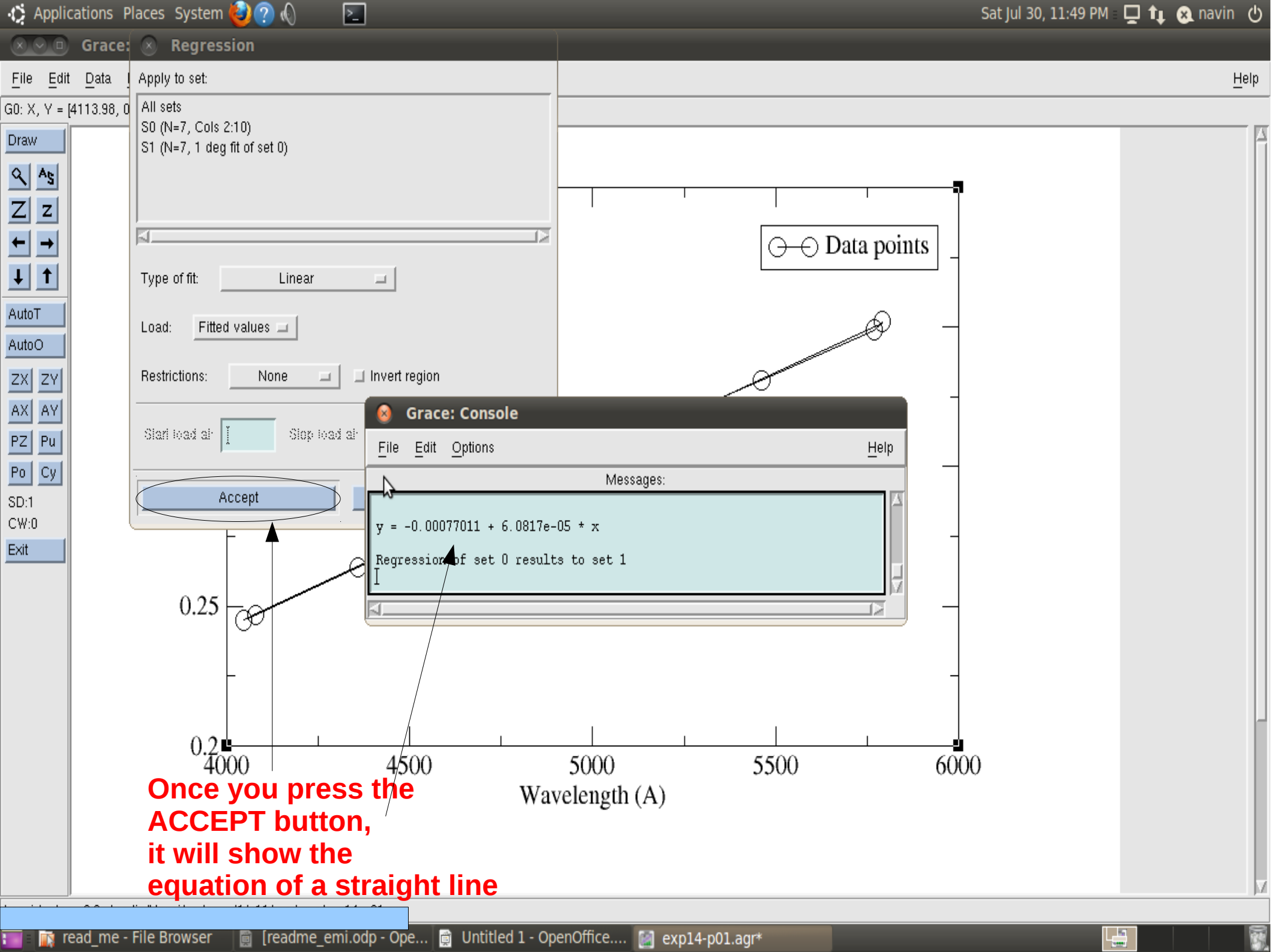
# STRAIGHT LINE FIT

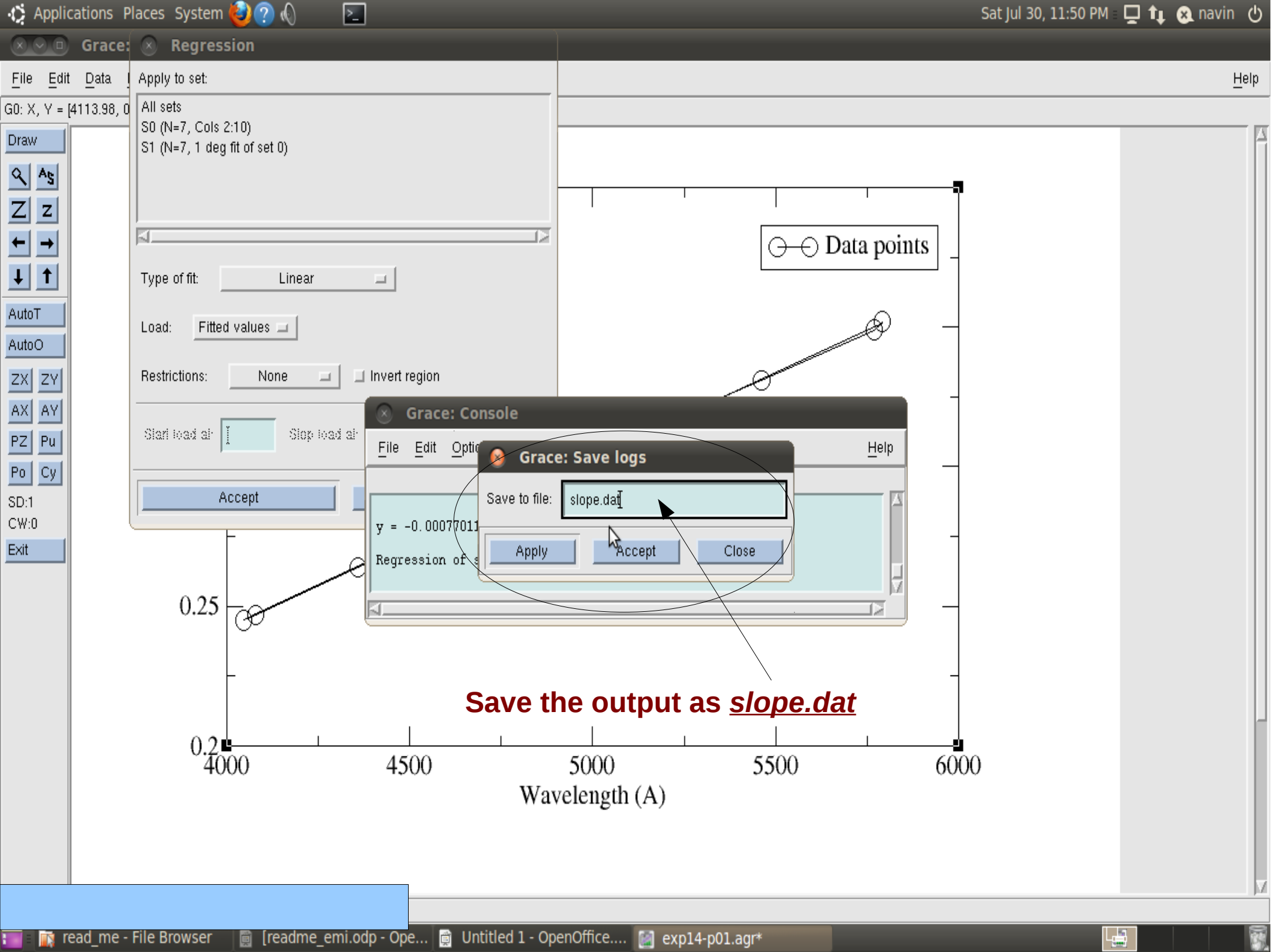
- To get a best fit, follow the following path:

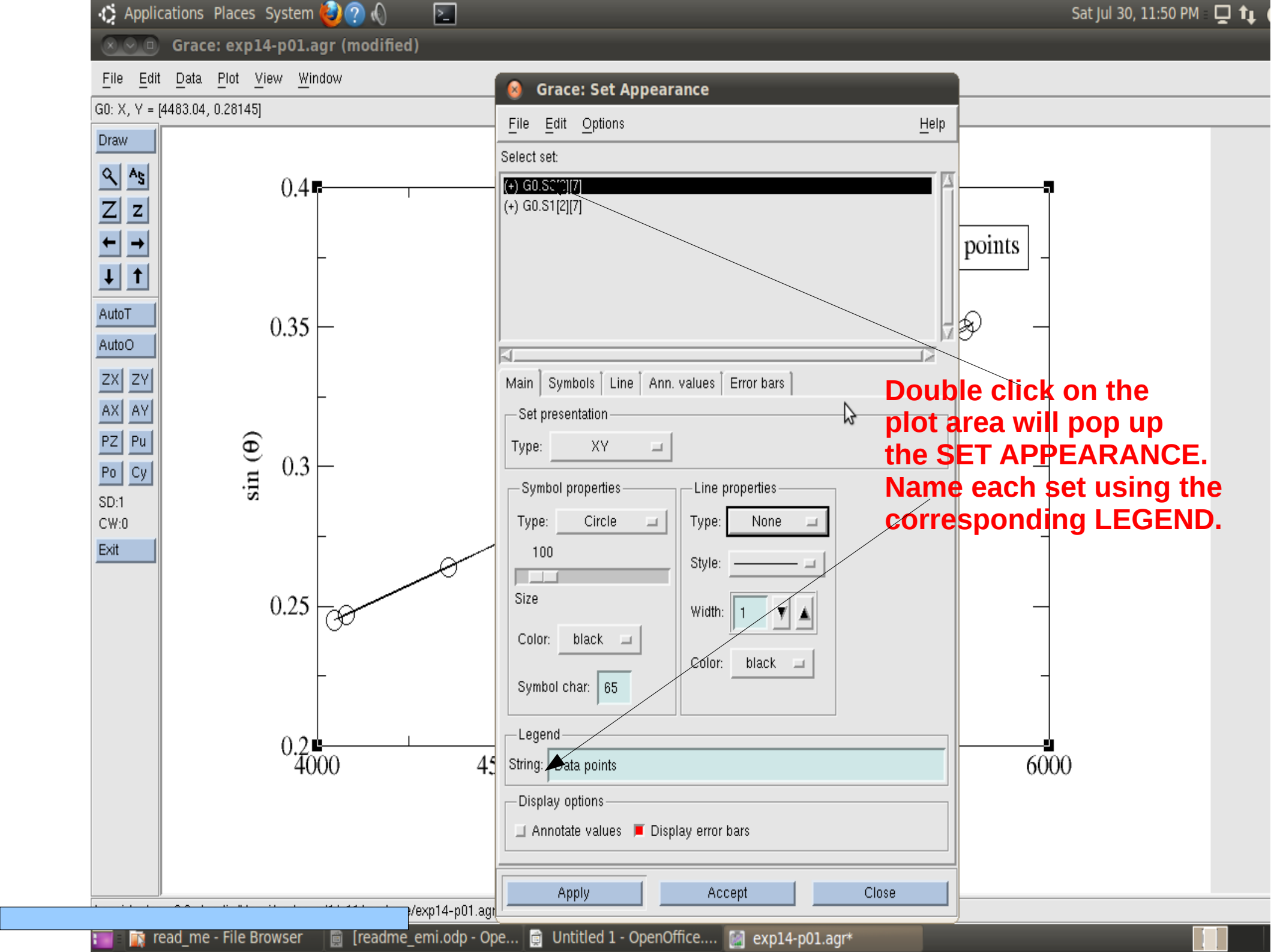
  **DATA ---> TRANSFORMATION ---> REGRESSION**
- Select the **SET**
- Choose **LINEAR** FIT
- Press the **ACCEPT** button
- Save the information about the ***slope*** and ***intercept*** that appear in a blue console as *slope.dat*.
- See the example.....on the next slide....

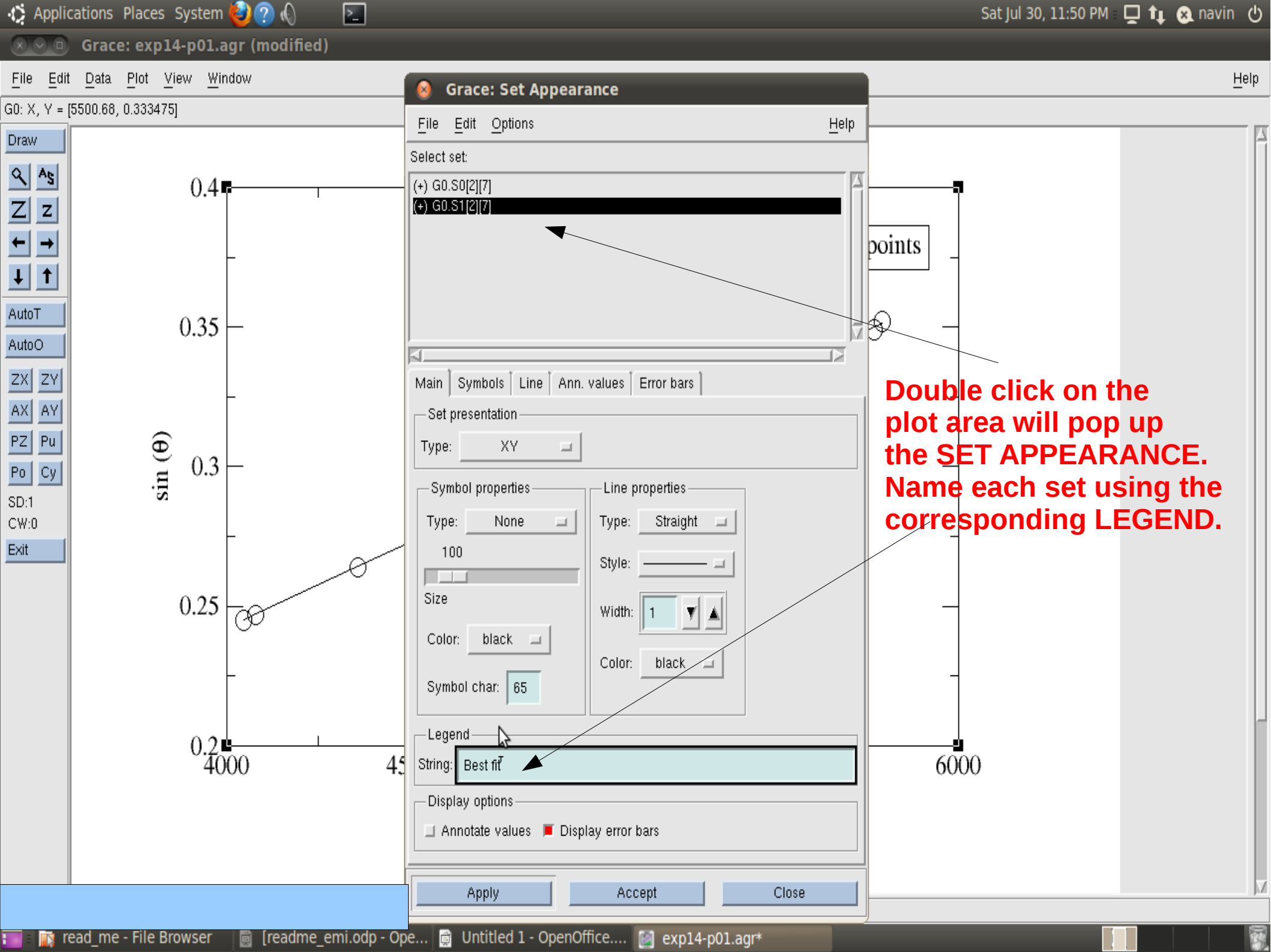

Applications Places System
Sat Jul 30, 11:48 PM navin
Grace:
Regression
File Edit Data
Help
G0: X, Y = [4559.02, 0
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
Apply to set:
All sets
S0 (N=7, Cols 2:10)
The LINEAR fit
Type of fit:
Linear
Load:
Fitted values
FITTED value
Restrictions:
None
Invert region
Start load at:
Stop load at:
# of points:
Accept
Close
Data points
0.25
0.2
4000
4500
5000
5500
6000
Wavelength (A)
read_me - File Browser
[readme_emi.odp - Ope...
Untitled 1 - OpenOffice....
exp14-p01.agr*


Applications Places System
Sat Jul 30, 11:49 PM navin
Grace: Regression
File Edit Data
Help
G0: X, Y = [4917.23, 0
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
Apply to set:
All sets
S0 (N=7, Cols 2:10)
Type of fit: Linear
Load: Function
Restrictions: None
Invert region
Start load at: 4000
Stop load at: 6000
# of points: 100
Accept
Close
Some times you may need a function to fit, eg. GRATING
Data points
0.25
0.2
4000
4500
5000
5500
6000
Wavelength (A)
Choose the START, STOP AND # of points as
read_me - File Browser
[readme_emi.odp - Ope...
Untitled 1 - OpenOffice....
exp14-p01.agr*


Applications Places System
Sat Jul 30, 11:49 PM navin
Grace: Regression
File Edit Data
Help
Apply to set:
All sets
S0 (N=7, Cols 2:10)
S1 (N=7, 1 deg fit of set 0)
Type of fit: Linear
Load: Fitted values
Restrictions: None
Invert region
Accept
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
Grace: Console
File Edit Options
Help
Messages:
y = -0.00077011 + 6.0817e-05 * x
Regression of set 0 results to set 1
Data points
0.25
0.2
4000
4500
5000
5500
6000
Wavelength (A)
Once you press the ACCEPT button, it will show the equation of a straight line
read_me - File Browser
[readme_emi.odp - Ope...
Untitled 1 - OpenOffice....
exp14-p01.agr*


Applications Places System
Sat Jul 30, 11:50 PM navin
Grace: Regression
File Edit Data
Help
Apply to set:
All sets
S0 (N=7, Cols 2:10)
S1 (N=7, 1 deg fit of set 0)
Type of fit: Linear
Load: Fitted values
Restrictions: None
Invert region
Accept
Draw
AutoT
AutoO
Exit
Data points
Grace: Console
File Edit
Help
Grace: Save logs
Save to file: slope.dat
Apply
Accept
Close
y = -0.00077011
Regression of
0.25
0.2
4000
4500
5000
5500
6000
Wavelength (A)
Save the output as slope.dat
read_me - File Browser
[readme_emi.odp - Ope...
Untitled 1 - OpenOffice....
exp14-p01.agr*


Applications Places System
Sat Jul 30, 11:50 PM
Grace: exp14-p01.agr (modified)
File Edit Data Plot View Window
G0: X, Y = [4483.04, 0.28145]
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
0.4
0.35
0.3
0.25
0.2
sin (θ)
4000
6000
points
Grace: Set Appearance
File Edit Options Help
Select set:
(+) G0.S2[7]
(+) G0.S1[2][7]
Main Symbols Line Ann. values Error bars
Set presentation
Type: XY
Symbol properties
Type: Circle
100
Size
Color: black
Symbol char: 65
Line properties
Type: None
Style:
Width: 1
Color: black
Legend
String: Data points
Display options
Annotate values
Display error bars
Apply Accept Close
Double click on the plot area will pop up the SET APPEARANCE. Name each set using the corresponding LEGEND.
read_me - File Browser
[readme_emi.odp - Ope...
Untitled 1 - OpenOffice....
exp14-p01.agr*


Applications Places System
Sat Jul 30, 11:50 PM navin
Grace: exp14-p01.agr (modified)
File Edit Data Plot View Window
Help
G0: X, Y = [5500.68, 0.333475]
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
0.4
0.35
0.3
0.25
0.2
sin (θ)
4000
6000
points
Grace: Set Appearance
File Edit Options Help
Select set:
(+) G0.S0[2][7]
(+) G0.S1[2][7]
Main Symbols Line Ann. values Error bars
Set presentation
Type: XY
Symbol properties
Type: None
100
Size
Color: black
Symbol char: 65
Line properties
Type: Straight
Style:
Width: 1
Color: black
Legend
String: Best fit
Display options
Annotate values
Display error bars
Apply
Accept
Close
Double click on the plot area will pop up the SET APPEARANCE. Name each set using the corresponding LEGEND.
read_me - File Browser
[readme_emi.odp - Ope...
Untitled 1 - OpenOffice....
exp14-p01.agr*

# NON LINEAR FIT

The experiment(s) in which you have to use this:

- Electromagnetic induction

Grace: exp09-p01.agr (modified)

File Edit Data Plot View Window Help

G0: X, Y = [-0.825979, 251.523]

Draw

AutoT

AutoO

ZX ZY

AX AY

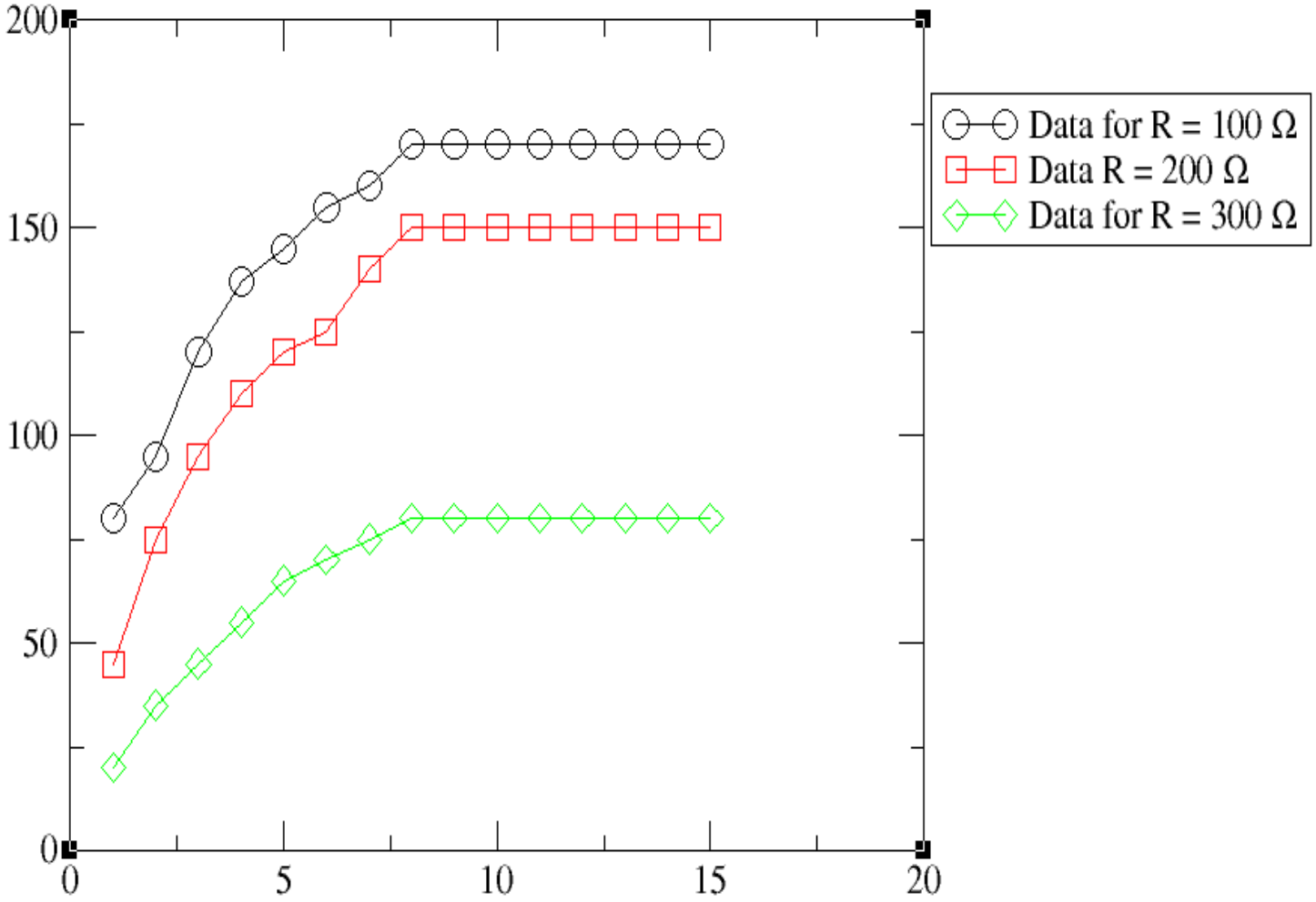
PZ Pu

Po Cy

SD:1

CW:0

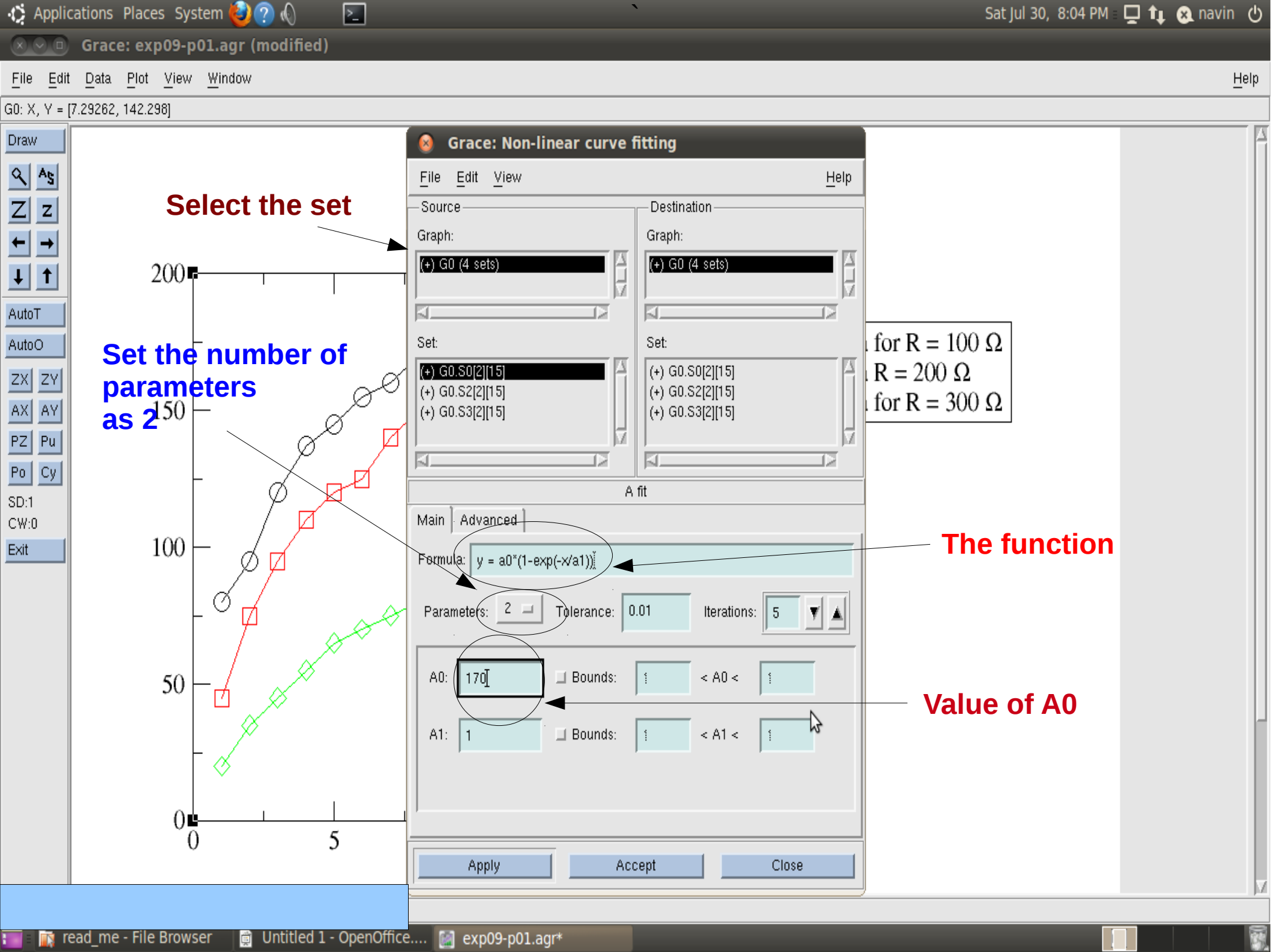
Exit

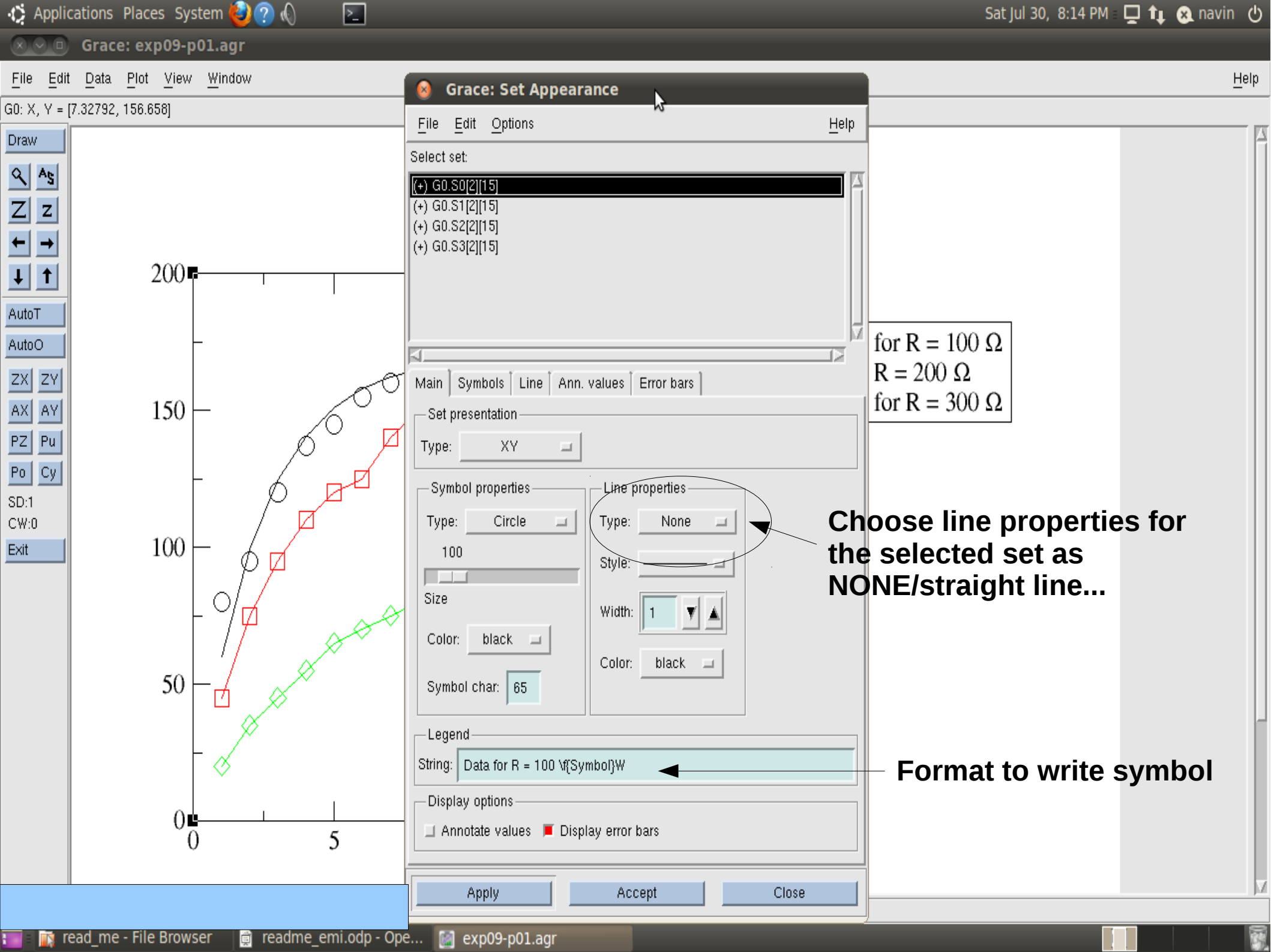


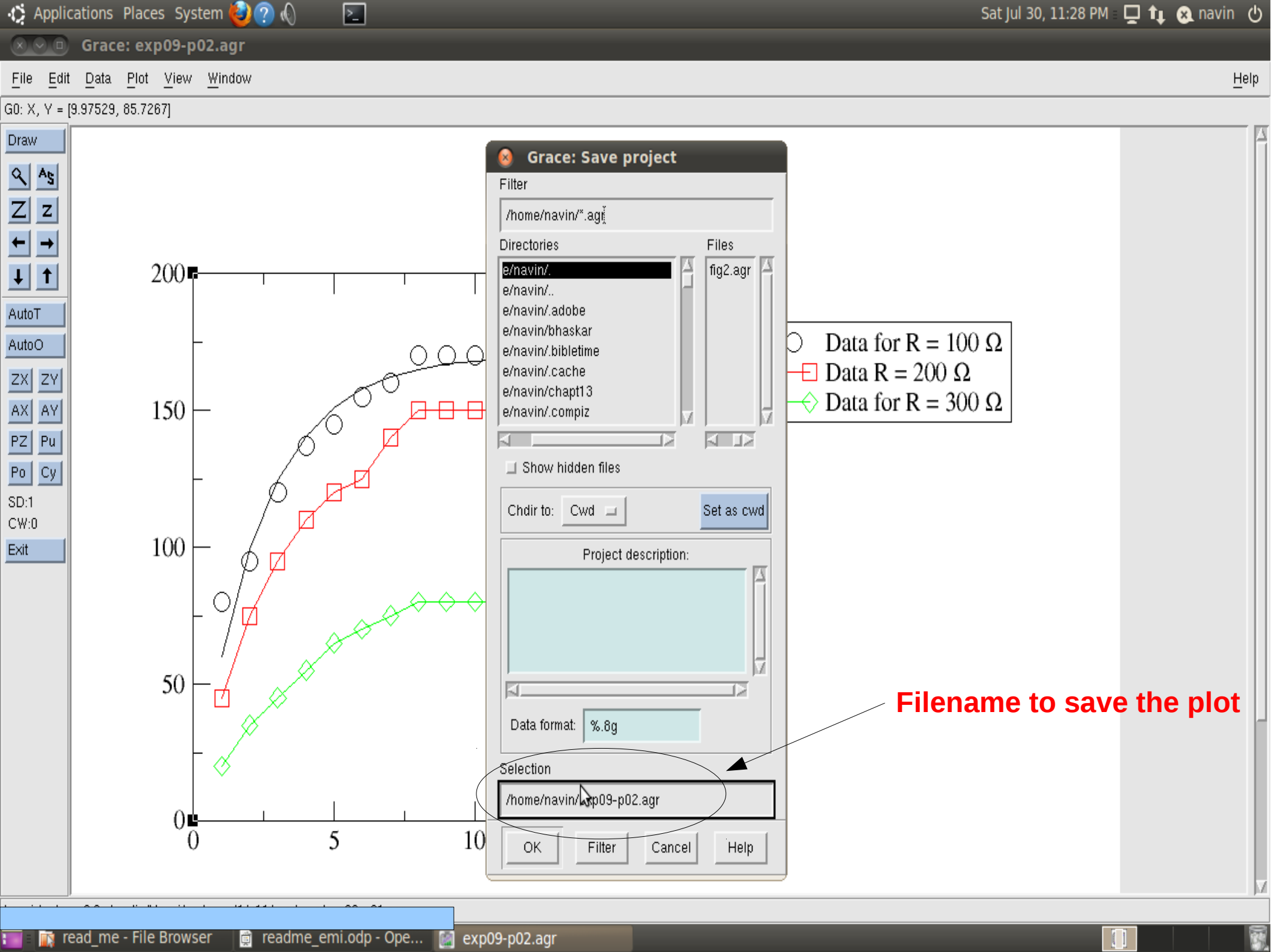
# NON LINEAR FIT

**Follow the path:**

- **DATA ---> TRANSFORMATION ---> NON-LINEAR CURVE FITTING** as shown in the figure.
- Use the equation **y = a0*(1-exp(-x/a1))** to fit the curve.
- Choose number of parameters as **2.**
- Put **A0 = 170** or whatever your **maximum q value is**.
- Put **A1 = 1.**
- Select the set and press **ACCEPT.**


Applications Places System
Sat Jul 30, 8:04 PM navin
Grace: exp09-p01.agr (modified)
File Edit Data Plot View Window Help
G0: X, Y = [7.29262, 142.298]
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
Select the set
Set the number of parameters as 2
200
150
100
50
0
0
5
Grace: Non-linear curve fitting
File Edit View Help
Source
Graph:
(+) G0 (4 sets)
Set:
(+) G0.S0[2][15]
(+) G0.S2[2][15]
(+) G0.S3[2][15]
Destination
Graph:
(+) G0 (4 sets)
Set:
(+) G0.S0[2][15]
(+) G0.S2[2][15]
(+) G0.S3[2][15]
for R = 100 Ω
R = 200 Ω
for R = 300 Ω
A fit
Main Advanced
Formula: y = a0*(1-exp(-x/a1))
The function
Parameters: 2
Tolerance: 0.01
Iterations: 5
A0: 170
Bounds:
< A0 <
Value of A0
A1: 1
Bounds:
< A1 <
Apply
Accept
Close
read_me - File Browser
Untitled 1 - OpenOffice....
exp09-p01.agr*


Applications Places System
Sat Jul 30, 8:14 PM navin
Grace: exp09-p01.agr
File Edit Data Plot View Window
Help
G0: X, Y = [7.32792, 156.658]
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
200
150
100
50
0
0
5
Grace: Set Appearance
File Edit Options
Help
Select set:
(+) G0.S0[2][15]
(+) G0.S1[2][15]
(+) G0.S2[2][15]
(+) G0.S3[2][15]
Main Symbols Line Ann. values Error bars
Set presentation
Type: XY
Symbol properties
Type: Circle
100
Size
Color: black
Symbol char: 65
Line properties
Type: None
Style:
Width: 1
Color: black
Legend
String: Data for R = 100 \f{Symbol}W
Display options
Annotate values
Display error bars
Apply
Accept
Close
for R = 100 Ω
R = 200 Ω
for R = 300 Ω
Choose line properties for the selected set as NONE/straight line...
Format to write symbol
read_me - File Browser
readme_emi.odp - Ope...
exp09-p01.agr


Applications Places System
Sat Jul 30, 11:28 PM navin
Grace: exp09-p02.agr
File Edit Data Plot View Window Help
G0: X, Y = [9.97529, 85.7267]
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
200
150
100
50
0
0
5
10
Data for R = 100 Ω
Data R = 200 Ω
Data for R = 300 Ω
Grace: Save project
Filter
/home/navin/*.agr
Directories
Files
e/navin/.
e/navin/..
e/navin/.adobe
e/navin/bhaskar
e/navin/.bibletime
e/navin/.cache
e/navin/chapt13
e/navin/.compiz
fig2.agr
Show hidden files
Chdir to:
Cwd
Set as cwd
Project description:
Data format:
%.8g
Selection
/home/navin/exp09-p02.agr
OK
Filter
Cancel
Help
Filename to save the plot
read_me - File Browser
readme_emi.odp - Ope...
exp09-p02.agr

# QUADRATIC FIT

# LCR resonance

- Follow the path:

  **DATA ---> TRANSFORMATION ---> INTERPOLATION/SPLINE.**

- Choose the **SET** and then **METHOD** as **CUBIC SPLINE**, **START** at 1, **STOP** AT 10, **LENGTH 500** or **1000** and then **ACCEPT**.

Grace: exp07-lcr-p01.agr (modified)

4:48 PM navin

File Edit Data Plot View Window Help

G0: X, Y = [-0.0908422, 0.241632]

Draw

AutoT

AutoO

ZX ZY

AX AY

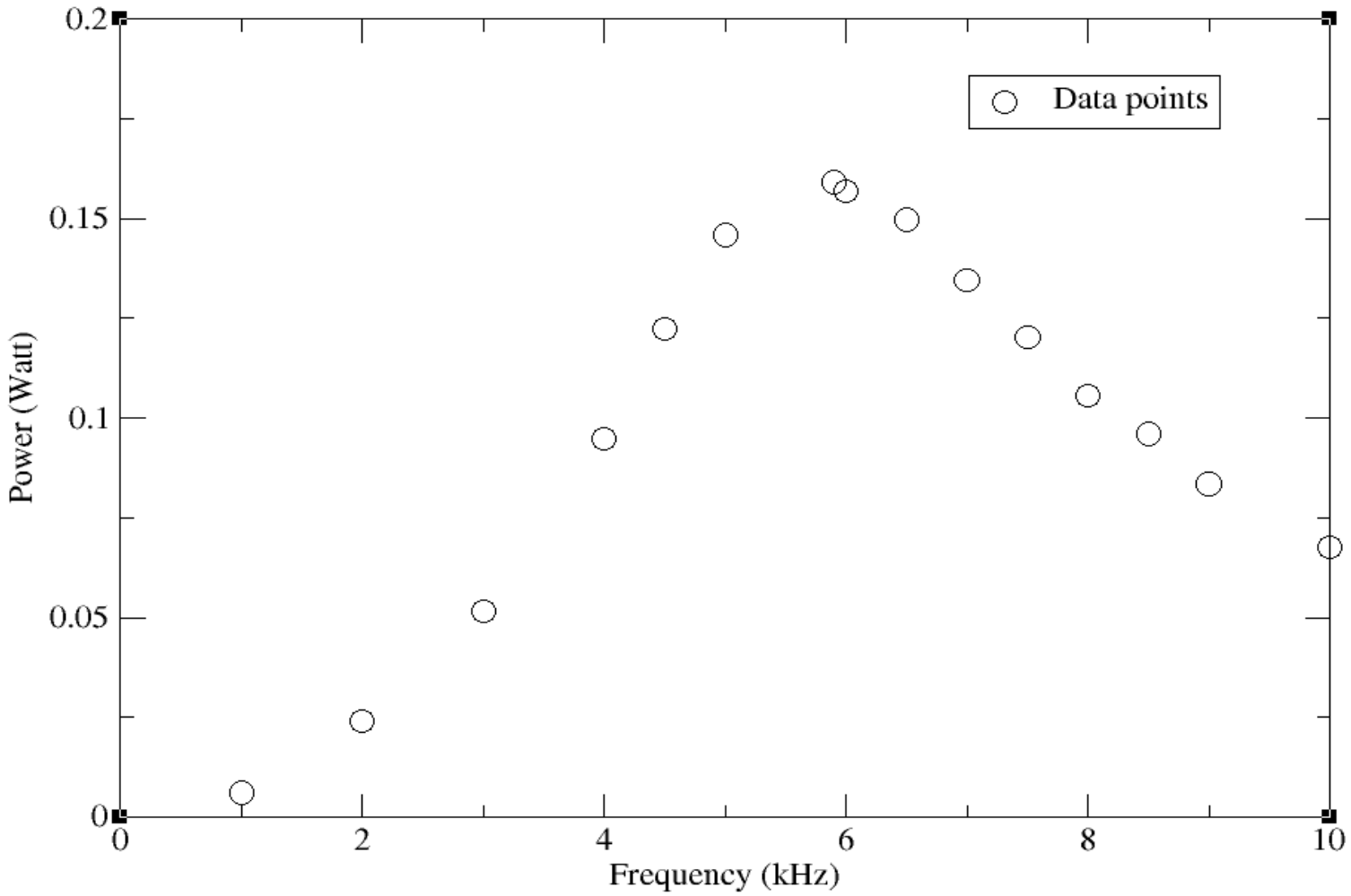
PZ Pu

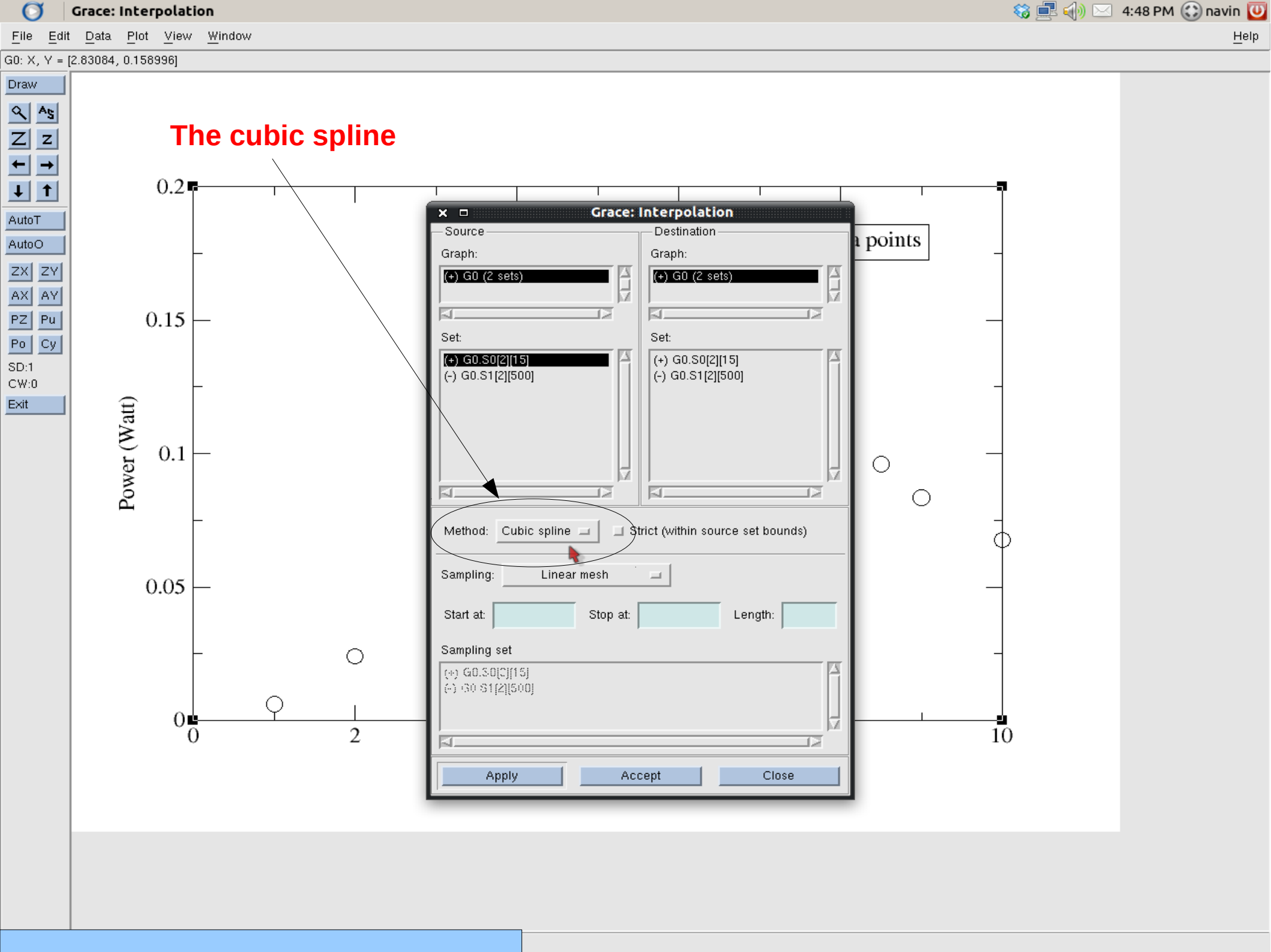
Po Cy

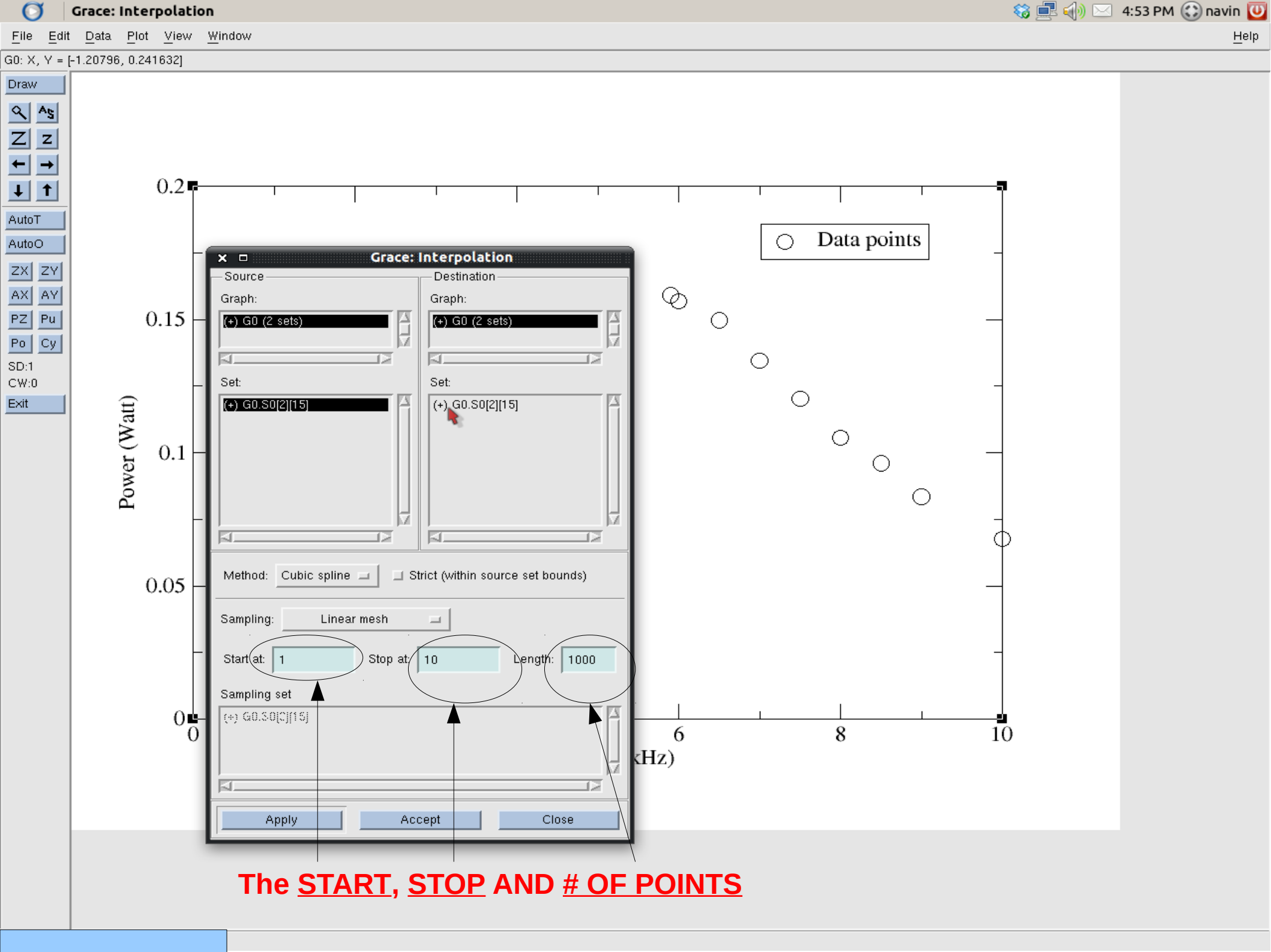
SD:1

CW:0

Exit




Grace: Interpolation
4:48 PM
navin
File
Edit
Data
Plot
View
Window
Help
G0: X, Y = [2.83084, 0.158996]
Draw
AutoT
AutoO
ZX
ZY
AX
AY
PZ
Pu
Po
Cy
SD:1
CW:0
Exit
The cubic spline
Power (Watt)
0.2
0.15
0.1
0.05
0
0
2
10
points
Grace: Interpolation
Source
Graph:
(+) G0 (2 sets)
Set:
(+) G0.S0[2][15]
(-) G0.S1[2][500]
Destination
Graph:
(+) G0 (2 sets)
Set:
(+) G0.S0[2][15]
(-) G0.S1[2][500]
Method:
Cubic spline
Strict (within source set bounds)
Sampling:
Linear mesh
Start at:
Stop at:
Length:
Sampling set
(+) G0.S0[2][15]
(-) G0.S1[2][500]
Apply
Accept
Close


Grace: Interpolation
File Edit Data Plot View Window Help
G0: X, Y = [-1.20796, 0.241632]
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
Data points
Power (Watt)
0.2
0.15
0.1
0.05
0
0
6
8
10
kHz)
Grace: Interpolation
Source
Destination
Graph:
(+) G0 (2 sets)
Set:
(+) G0.S0[2][15]
Method: Cubic spline
Strict (within source set bounds)
Sampling: Linear mesh
Start at: 1
Stop at: 10
Length: 1000
Sampling set
Apply
Accept
Close
The START, STOP AND # OF POINTS

Grace: 1.agr (modified)

4:53 PM navin

File Edit Data Plot View Window Help

G0: X, Y = [5.37196, -0.000348725]

Draw

AutoT

AutoO

ZX ZY

AX AY

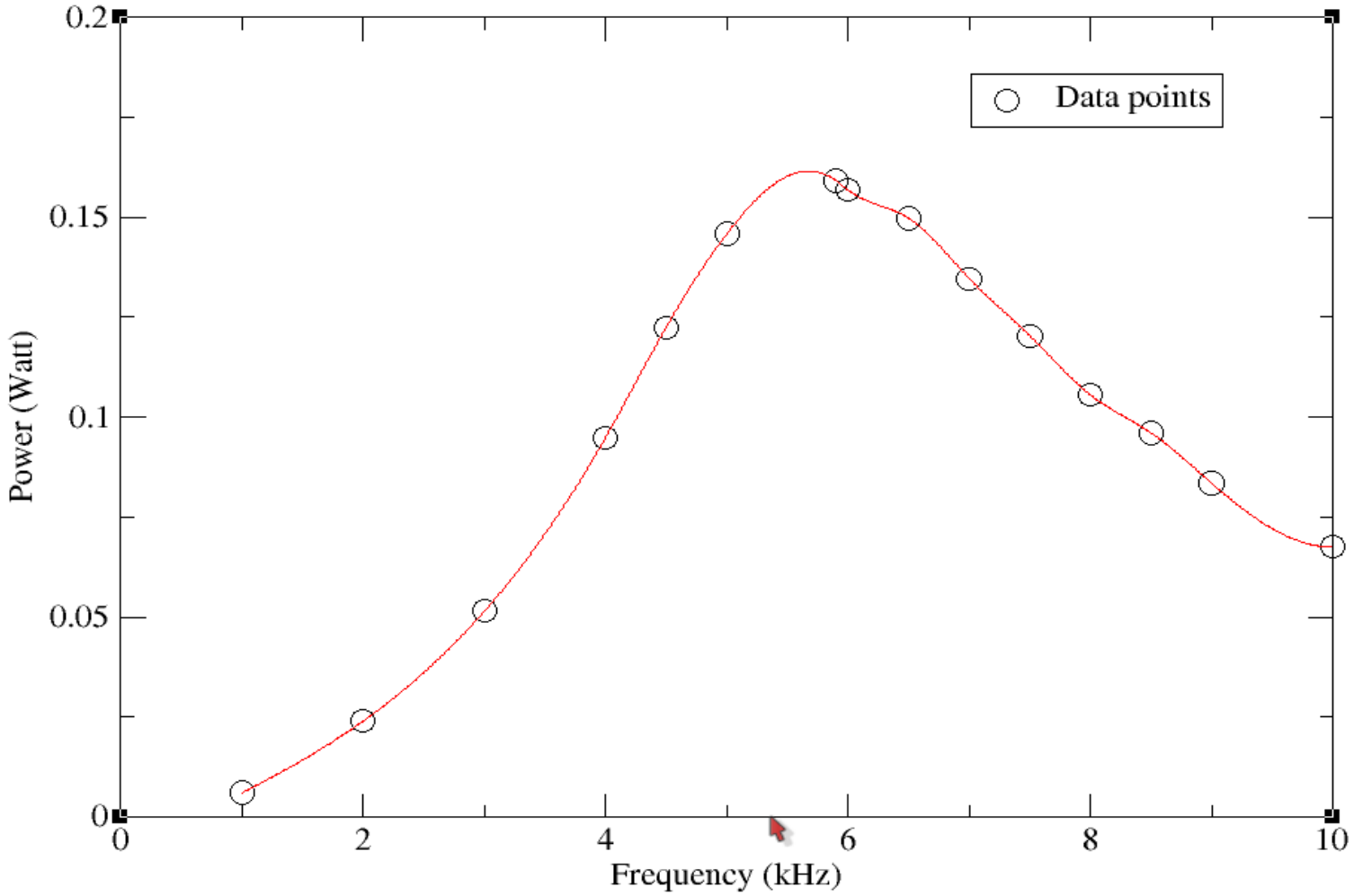
PZ Pu

Po Cy

SD:1

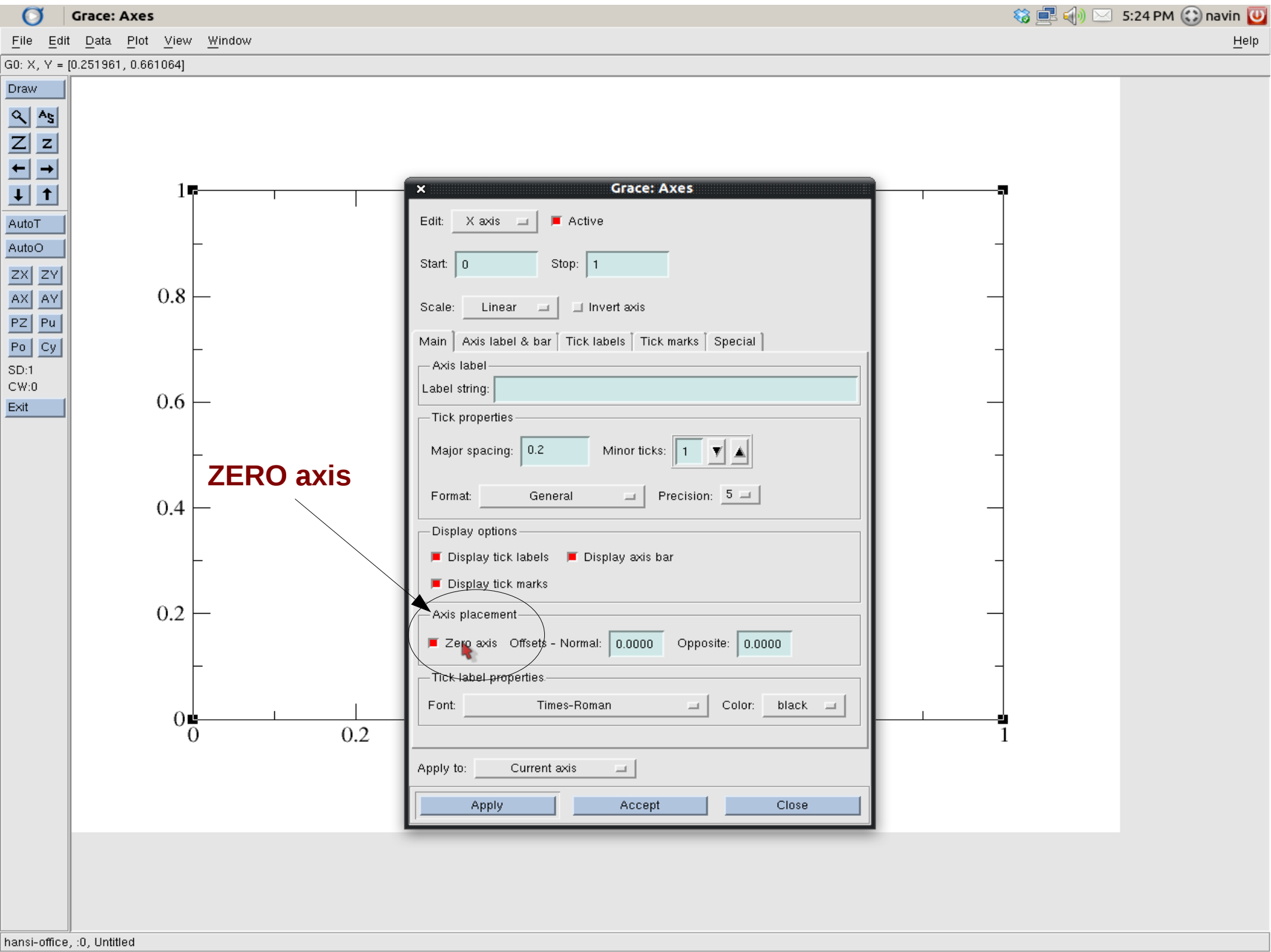
CW:0

Exit



# HYSTERISIS LOOP

- To view plot in proper format, go to **PLOT** and then select **AXIS PROPERTIES**.
- Find **AXIS PLACEMENT**, there put **ZERO AXIS** red for both X and Y axes as shown below.
- No need to fit the curve.


Grace: Axes
5:24 PM
navin
File
Edit
Data
Plot
View
Window
Help
G0: X, Y = [0.251961, 0.661064]
Draw
AutoT
AutoO
ZX
ZY
AX
AY
PZ
Pu
Po
Cy
SD:1
CW:0
Exit
ZERO axis
Grace: Axes
Edit:
X axis
Active
Start:
0
Stop:
1
Scale:
Linear
Invert axis
Main
Axis label & bar
Tick labels
Tick marks
Special
Axis label
Label string:
Tick properties
Major spacing:
0.2
Minor ticks:
1
Format:
General
Precision:
5
Display options
Display tick labels
Display axis bar
Display tick marks
Axis placement
Zero axis
Offsets - Normal:
0.0000
Opposite:
0.0000
Tick label properties
Font:
Times-Roman
Color:
black
Apply to:
Current axis
Apply
Accept
Close
0
0.2
0.4
0.6
0.8
1
0
0.2
1
hansi-office, :0, Untitled

# XMGRACE TUTORIAL

- **SAVE** the project as exp*MN*-p0*A*-S*x*-G*y*.agr, where, *MN* is the number of experiment, *A* is the plot number, *x* is your section number and *y* is the group number.
- Upload the *exp*-Sx-Gy.zip* file on *NALANDA* server.

# DO'S & DON'T

- Download the mannual and read it carefully before coming to  the lab.
- Discuss among your group members about the experiment and its modality.
- Do not disturb the alignment of instruments, computers, etc.
- Do not touch the monitor screen using pen, pencil, etc.
- Do not insert any USB drive in the Pcs. If found to do so, will lead to penalisation in marks for the corresponding experiment.