

ROOT: Graphs

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Outline

- Creating and drawing 1D and 2D graphs
- Graphs with error bars
- Graphs with asymmetric error bars
- Fitting a graph

Creating and drawing graphs

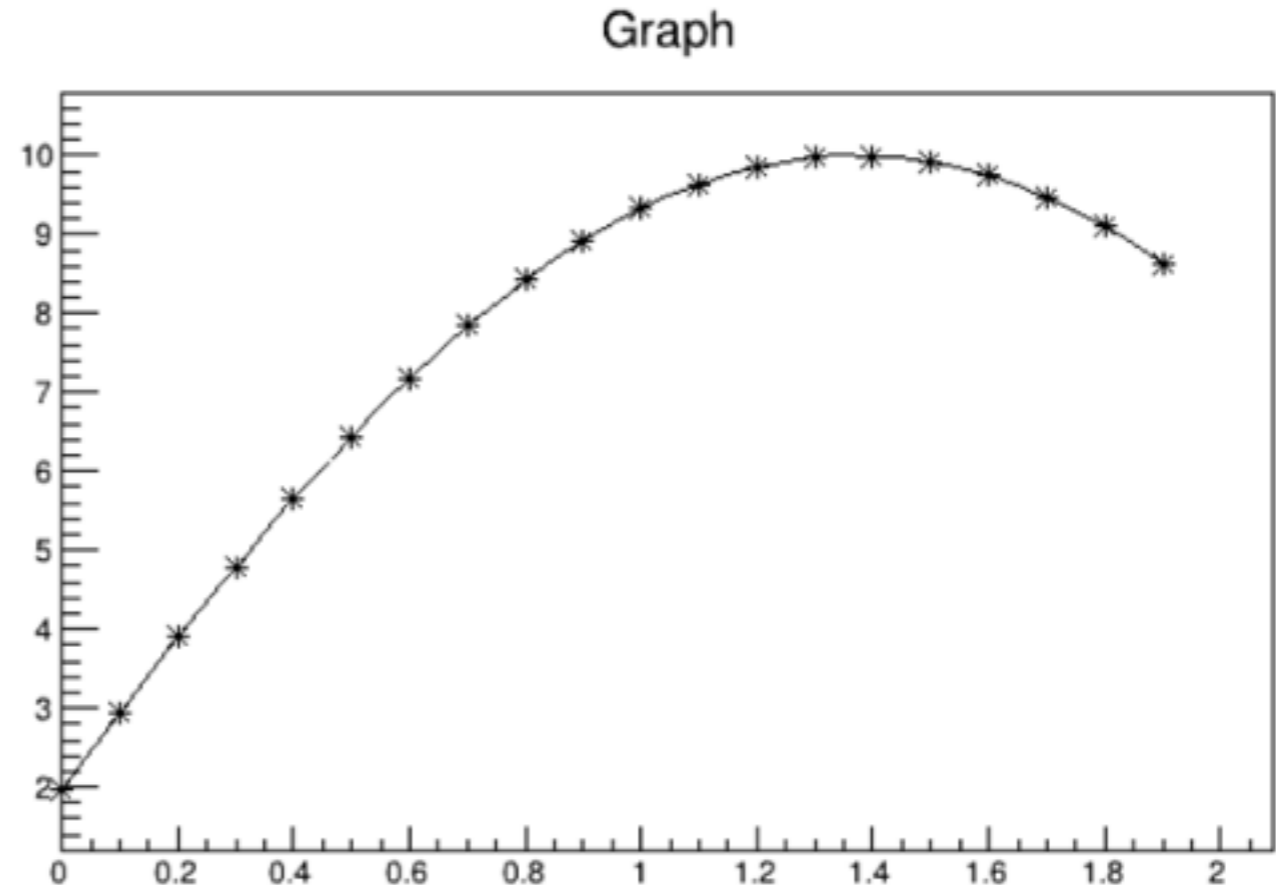
```

{
  Int_t n = 20;
  Double_t x[n], y[n];
  for (Int_t i=0;i<n;i++) {
    x[i] = i*0.1;
    y[i] = 10*sin(x[i]+0.2);
  }

  // create graph
  TGraph *gr = new TGraph(n,x,y);
  TCanvas *c1 = new TCanvas("c1","Graph Draw Options",
                           200,10,600,400);

  // draw the graph with axis, continuous line, and put
  // a * at each point
  gr->Draw("AC*");
}

```



Drawing options	Meaning
L	Simple poly-line between every points
F	Fill area
A	Axis around the graph
C	Smooth curve
*	Star is plotted at each point

Marker options

```
{
  Int_t n = 20;
  Double_t x[n], y[n];

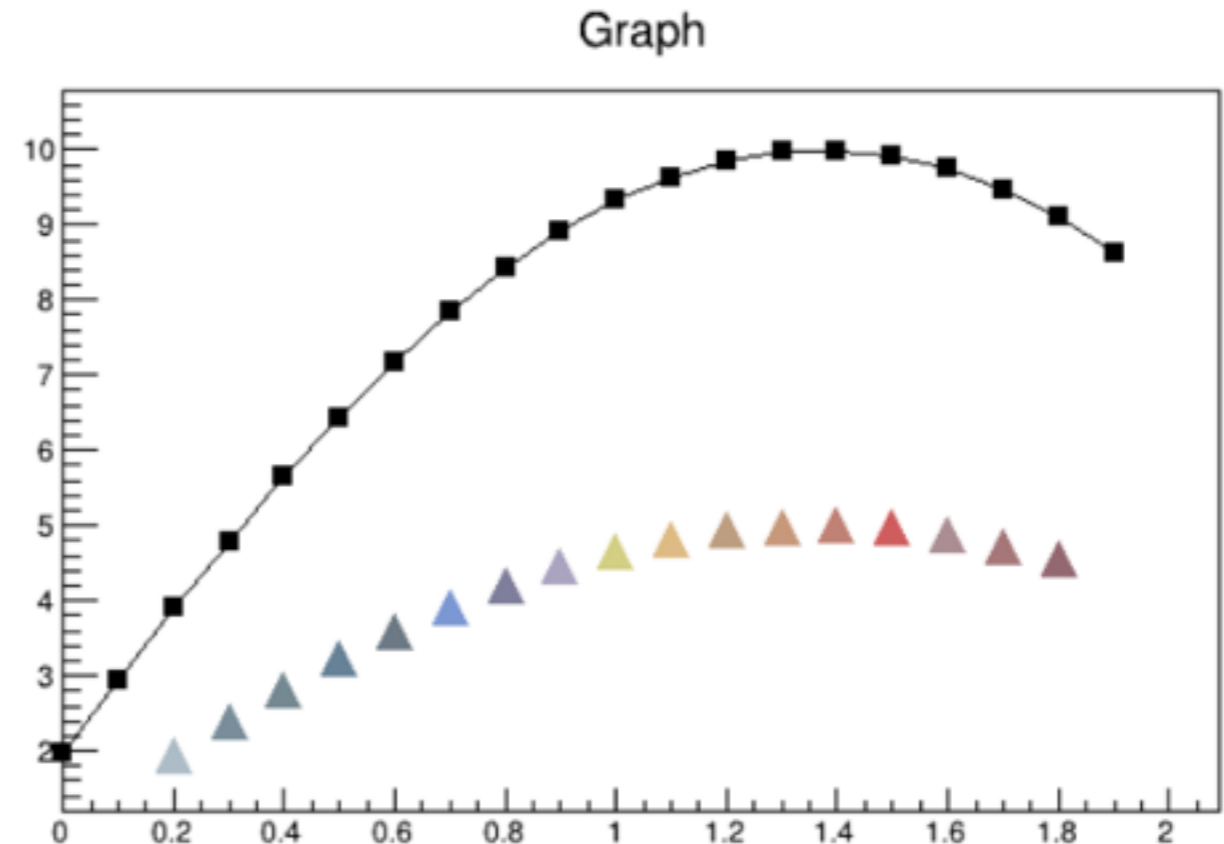
  // build the arrays with the coordinate of points
  for (Int_t i=0; i<n; i++) {
    x[i] = i*0.1;
    y[i] = 10*sin(x[i]+0.2);
  }

  // create graphs
  TGraph *gr3 = new TGraph(n,x,y);
  TCanvas *c1 = new TCanvas ("c1","Graph Draw Options",
                             200,10,600,400);

  // draw the graph with the axis, contineous line, and put
  // a marker using the graph's marker style at each point
  gr3->SetMarkerStyle(21);
  c1->cd(4);
  gr3->Draw("APL");

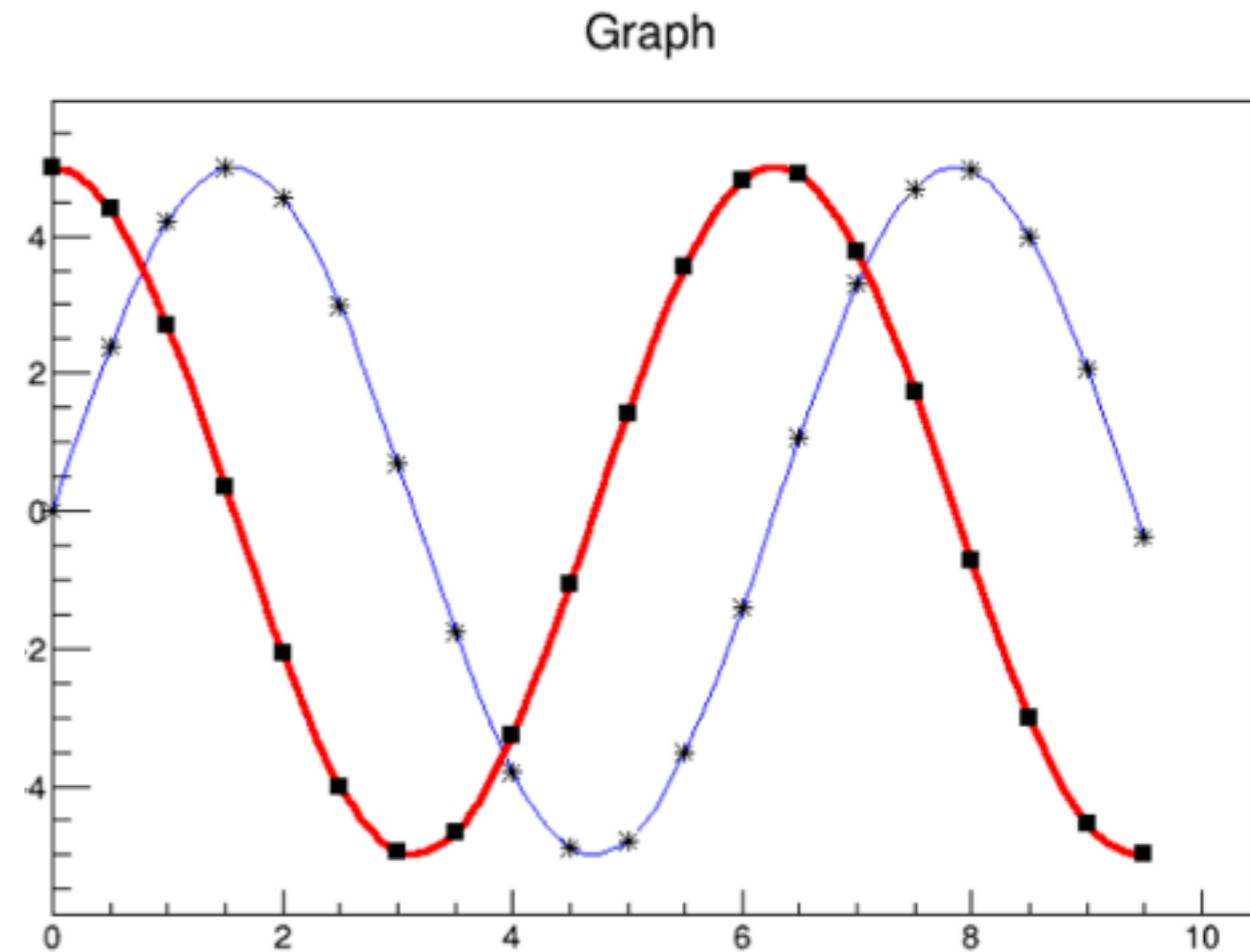
  // get the points in the graph and put them into an array
  Double_t *nx = gr3->GetX();
  Double_t *ny = gr3->GetY();

  // create markers of different colors
  for (Int_t j=2; j<n-1; j++) {
    TMarker *m = new TMarker(nx[j], 0.5*ny[j], 22);
    m->SetMarkerSize(2);
    m->SetMarkerColor(31+j);
    m->Draw();
  }
}
```



Superimposing two graphs

```
{  
  Int_t n = 20;  
  Double_t x[n], y[n], x1[n], y1[n];  
  
  // create a blue graph with a cos function  
  
  gr1->SetLineColor(4);  
  gr1->Draw("AC*");  
  
  // superimpose the second graph by leaving out the axis option "A"  
  gr2->SetLineWidth(3);  
  gr2->SetMarkerStyle(21);  
  gr2->SetLineColor(2);  
  gr2->Draw("CP");  
}
```



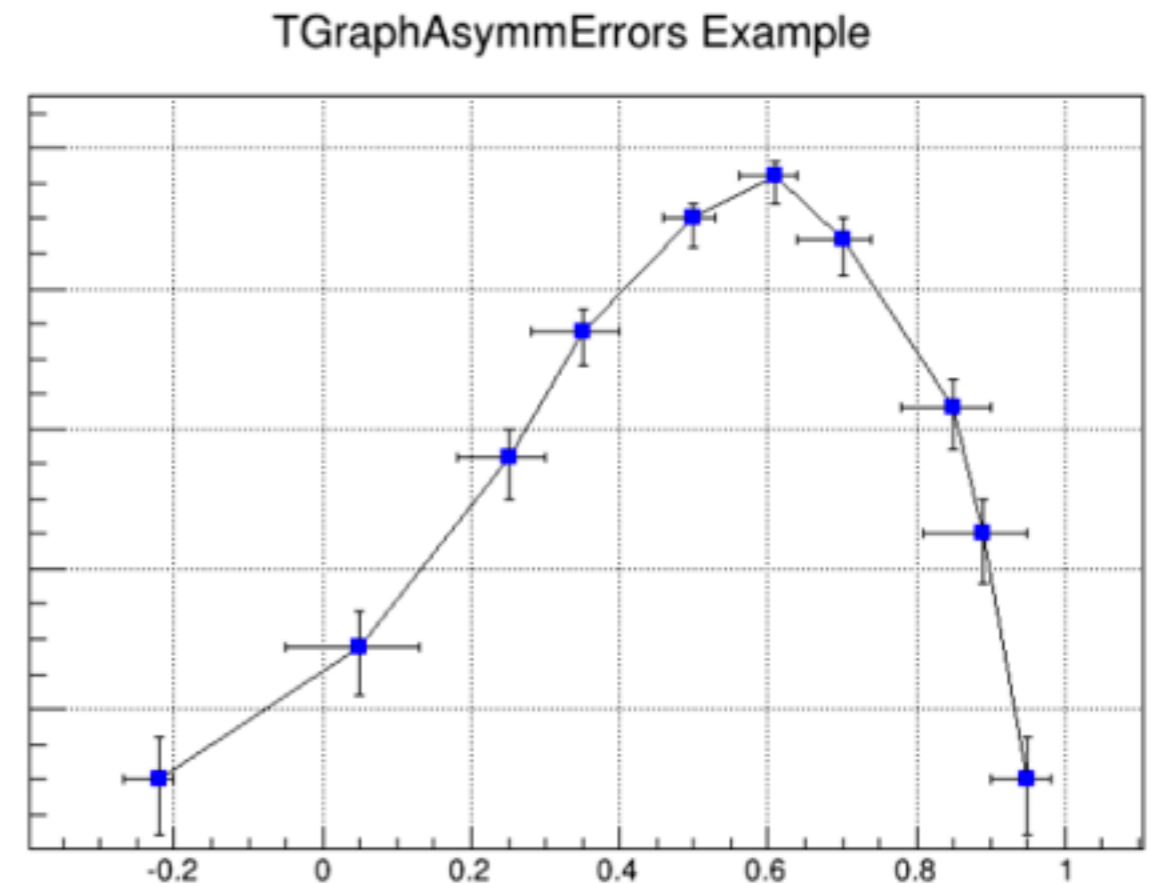
Graphs with error bars

```
{
  c1 = new TCanvas("c1","A Simple Graph with error bars",
                  200,10,700,500);
  c1->SetGrid();

  // create the arrays for the points
  Int_t n = 10;
  Double_t x[n] = {-.22,.05,.25,.35,.5, .61,.7,.85,.89,.95};
  Double_t y[n] = {1,2.9,5.6,7.4,9,9.6,8.7,6.3,4.5,1};

  // create the arrays with high and low errors
  Double_t exl[n] = {.05,.1,.07,.07,.04,.05,.06,.07,.08,.05};
  Double_t eyl[n] = {.8,.7,.6,.5,.4,.4,.5,.6,.7,.8};
  Double_t exh[n] = {.02,.08,.05,.05,.03,.03,.04,.05,.06,.03};
  Double_t eyh[n] = {.6,.5,.4,.3,.2,.2,.3,.4,.5,.6};

  // create TGraphAsymmErrors with the arrays
  gr = new TGraphAsymmErrors(n,x,y,exl,exh,eyl,eyh);
  gr->SetTitle("TGraphAsymmErrors Example");
  gr->SetMarkerColor(4);
  gr->SetMarkerStyle(21);
  gr->Draw("ALP");
}
```



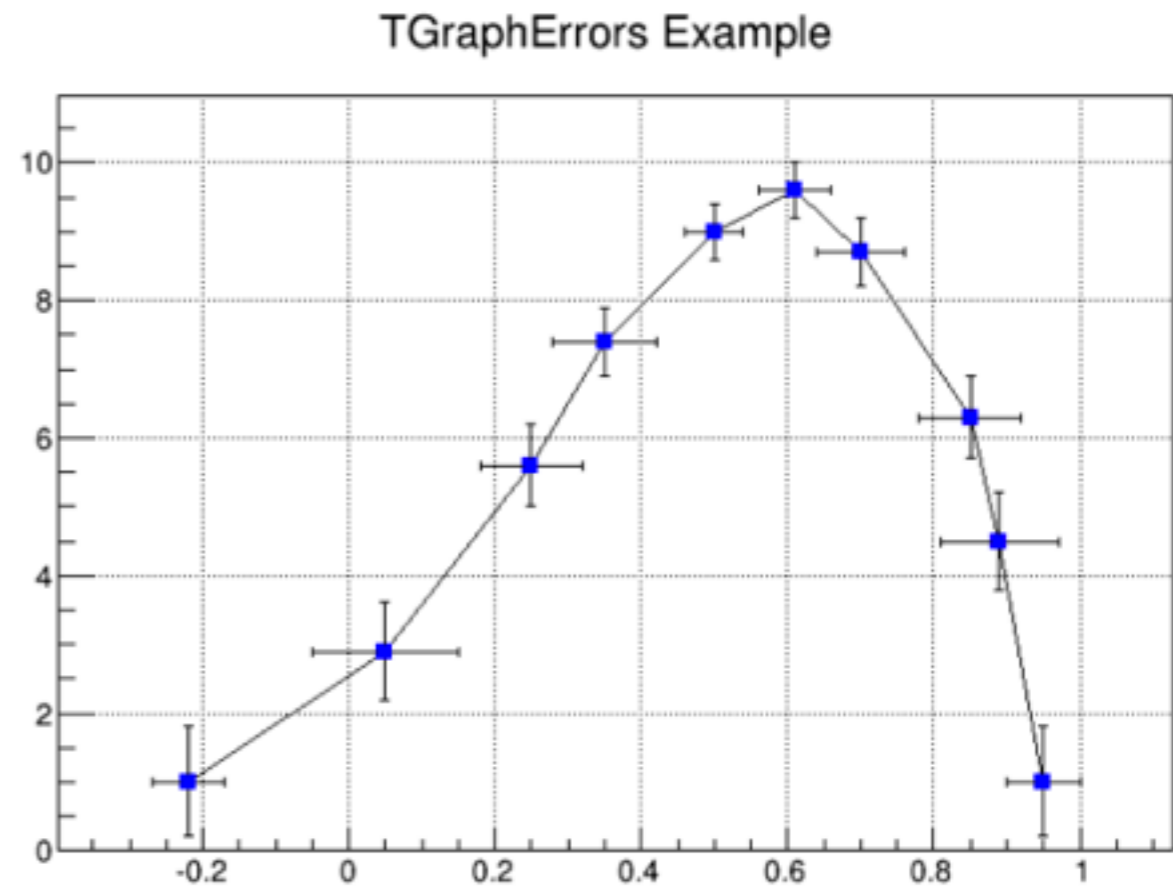
Graphs with asymmetric error bars

```
{
c1 = new TCanvas("c1","A Simple Graph with error bars",200,10,700,500);
c1->SetGrid();

// create the coordinate arrays
Int_t n = 10;
Float_t x[n] = {-.22,.05,.25,.35,.5,.61,.7,.85,.89,.95};
Float_t y[n] = {1,2.9,5.6,7.4,9,9.6,8.7,6.3,4.5,1};

// create the error arrays
Float_t ex[n] = {.05,.1,.07,.07,.04,.05,.06,.07,.08,.05};
Float_t ey[n] = {.8,.7,.6,.5,.4,.4,.5,.6,.7,.8};

// create the TGraphErrors and draw it
gr = new TGraphErrors(n,x,y,ex,ey);
gr->SetTitle("TGraphErrors Example");
gr->SetMarkerColor(4);
gr->SetMarkerStyle(21);
gr->Draw("ALP");
c1->Update();
}
```

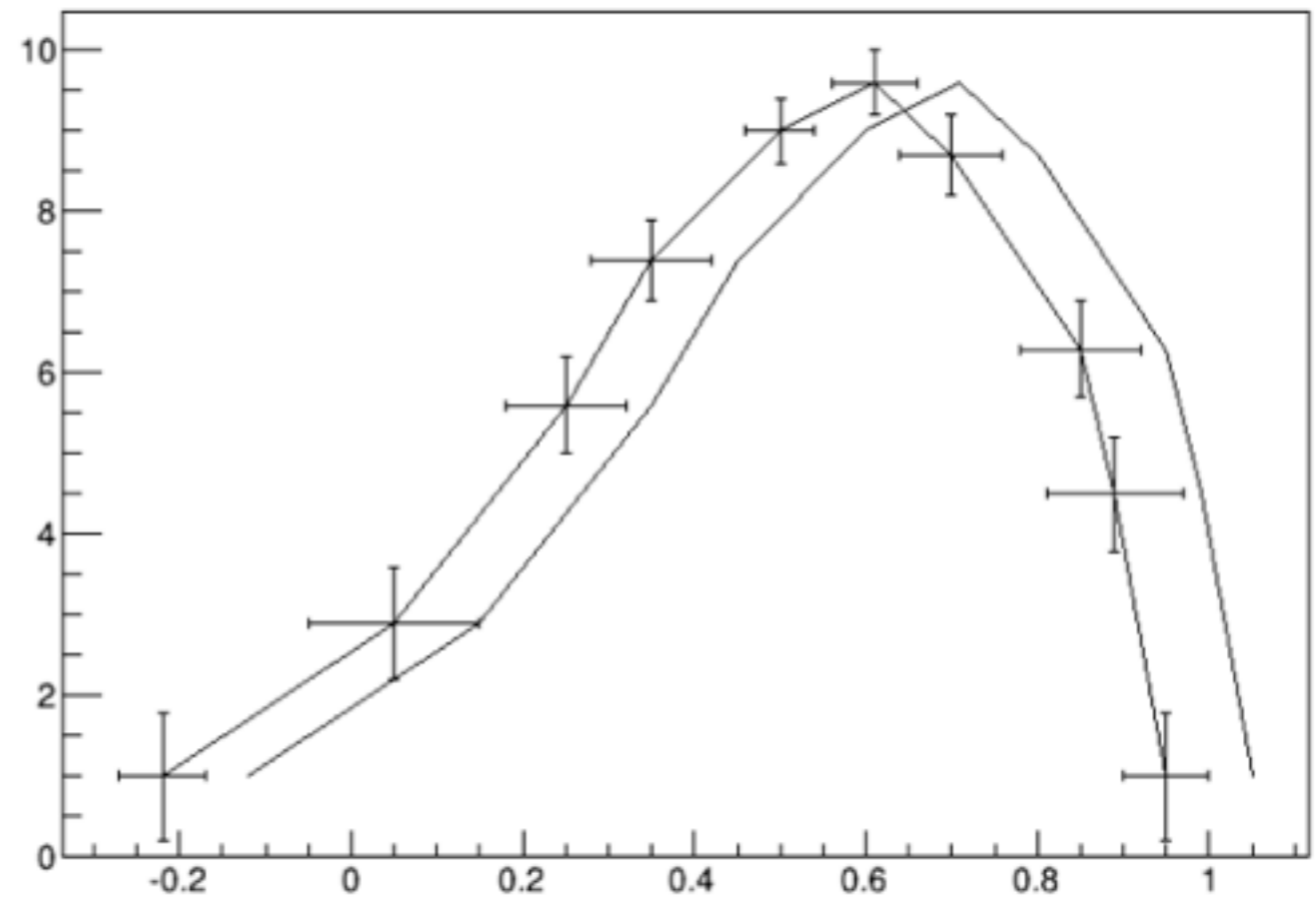


Fitting a graph

- The graph Fit method in general works the same way as the TH1::Fit.

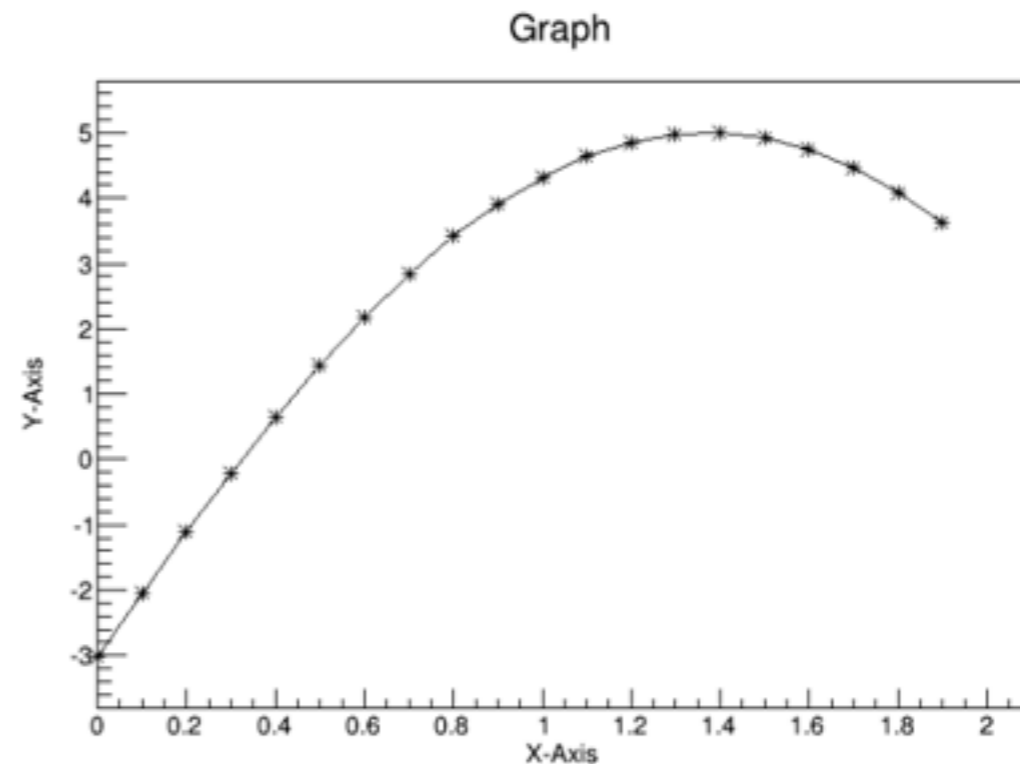
TMultiGraph

```
{  
  // create the points  
  Int_t n = 10;  
  Double_t x[n] = {-.22,.05,.25,.35,.5,.61,.7,.85,.89,.95};  
  Double_t y[n] = {1,2.9,5.6,7.4,9,9.6,8.7,6.3,4.5,1};  
  Double_t x2[n] = {-.12,.15,.35,.45,.6,.71,.8,.95,.99,1.05};  
  
  Double_t y2[n] = {1,2.9,5.6,7.4,9,9.6,8.7,6.3,4.5,1};  
  
  // create the width of errors in x and y direction  
  Double_t ex[n] = {.05,.1,.07,.07,.04,.05,.06,.07,.08,.05};  
  Double_t ey[n] = {.8,.7,.6,.5,.4,.4,.5,.6,.7,.8};  
  
  // create two graphs  
  TGraph *gr1 = new TGraph(n,x2,y2);  
  TGraphErrors *gr2 = new TGraphErrors(n,x,y,ex,ey);  
  
  // create a multigraph and draw it  
  TMultiGraph *mg = new TMultiGraph();  
  mg->Add(gr1);  
  mg->Add(gr2);  
  mg->Draw("ALP");  
}
```



Setting Axis titles and zooming

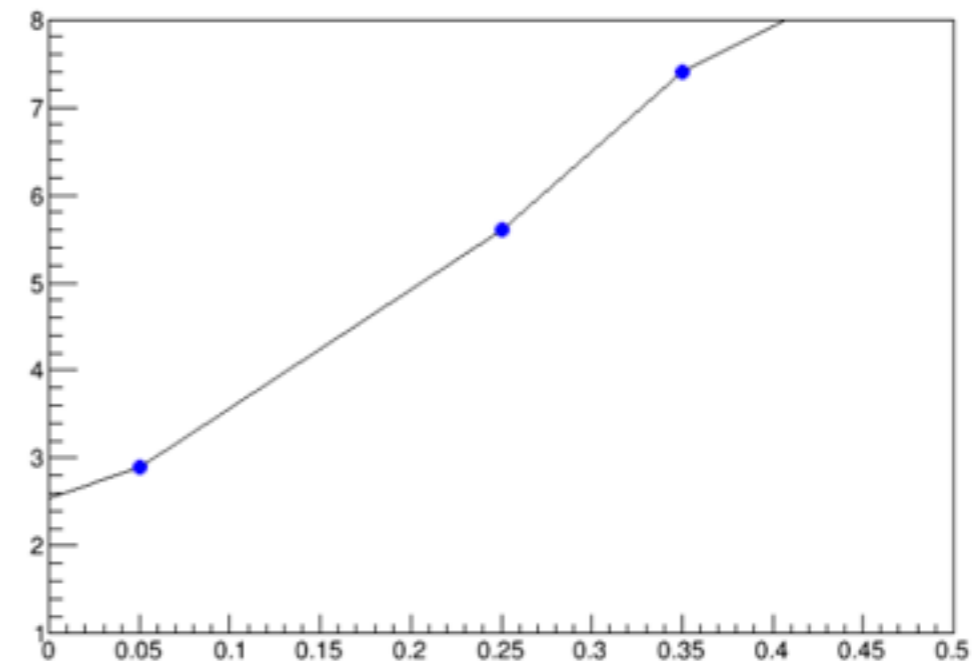
```
root[] gr5 = new TGraph(n,x,y)
root[] gr5->Draw()
<TCanvas::MakeDefCanvas>: created default TCanvas with name c1
root[] gr5->Draw("ALP")
root[] gr5->GetXaxis()->SetTitle("X-Axis")
root[] gr5->GetYaxis()->SetTitle("Y-Axis")
root[] gr5->GetXaxis()->CenterTitle()
root[] gr5->GetYaxis()->CenterTitle()
root[] gr5->Draw("ALP")
```



```
{
c1 = new TCanvas("c1","A Zoomed Graph",200,10,700,500);
hpx = new TH2F("hpx","Zoomed Graph Example",10,0,0.5,10,1.0,8.0);

hpx->SetStats(kFALSE); // no statistics
hpx->Draw();
Int_t n = 10;
Double_t x[n] = {-.22,.05,.25,.35,.5,.61,.7,.85,.89,.95};
Double_t y[n] = {1,2.9,5.6,7.4,9,9.6,8.7,6.3,4.5,1};
gr = new TGraph(n,x,y);
gr->SetMarkerColor(4);
gr->SetMarkerStyle(20);
gr->Draw("LP");// and draw it without an axis
}
```

Zoomed Graph Example



Reference

- <https://root.cern.ch/root/html534/guides/users-guide/ROOTUsersGuideChapters/Graphs.pdf>