Coverage with CLs

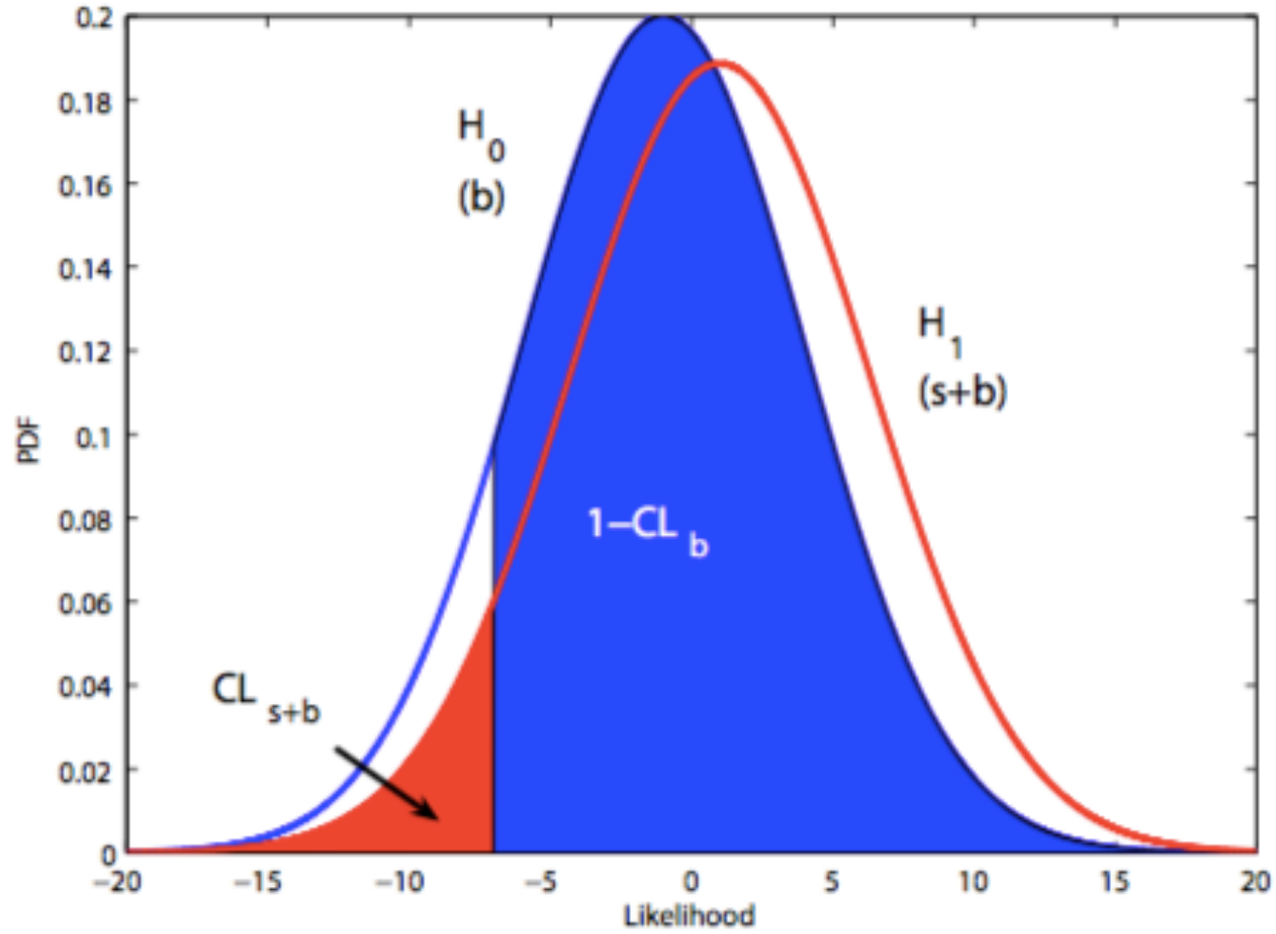

Fig. 2: An illustration showing the reasoning of the CL_s method. In this situation a signal+background hypothesis might be rejected though the experiment has no sensitivity to observe that particular signal.

Taken from:

LHC Statistics for Pedestrians

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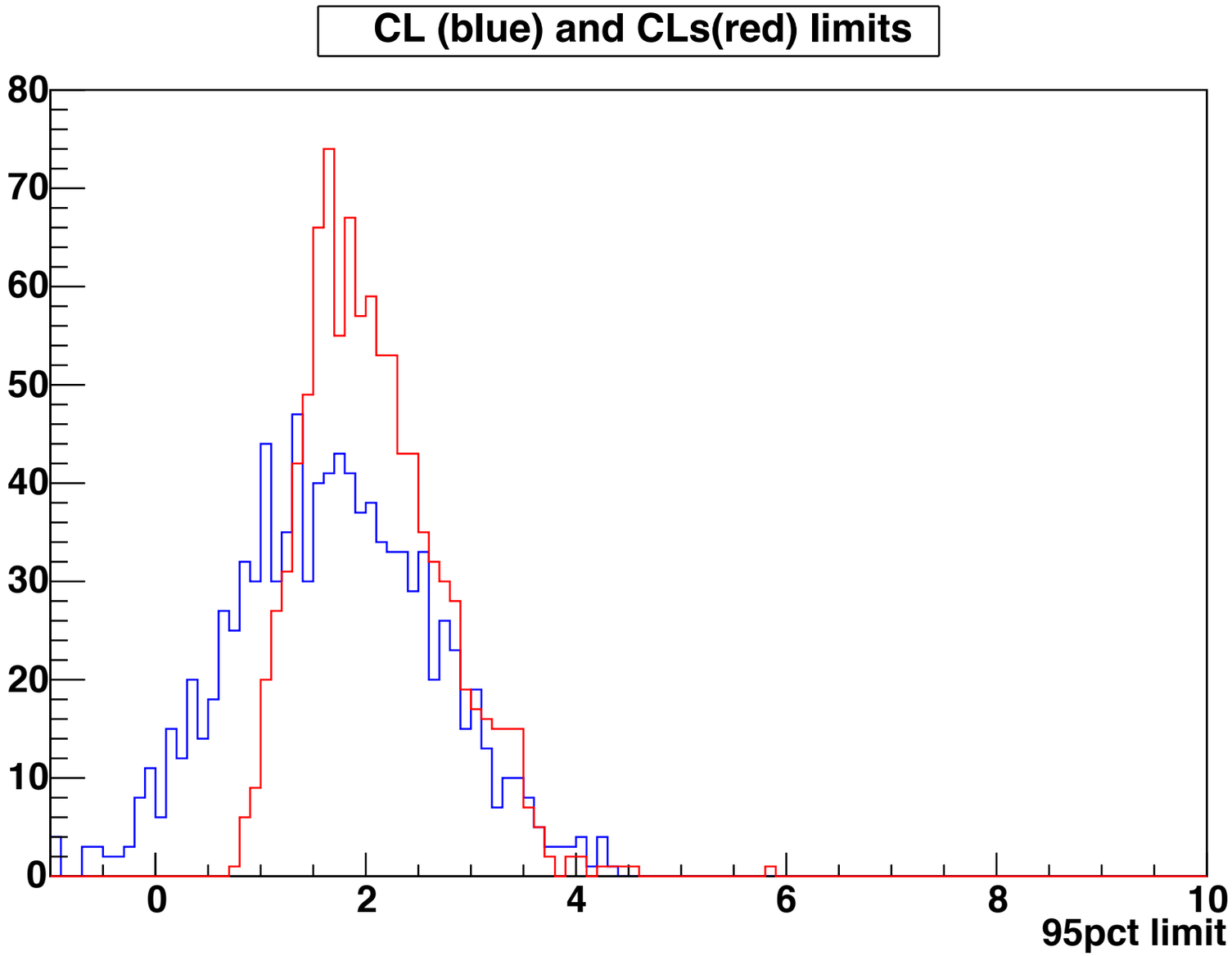
Weizmann Institute, Rehovot, Israel

Upper Limit:

$$\mathrm{CL_s} = \frac{CL_{s+b}}{CL_b} = \frac{p_{s+b}}{1-p_b} = \frac{CDF_{s+b}(x)}{CDF_b(x)} = \alpha$$

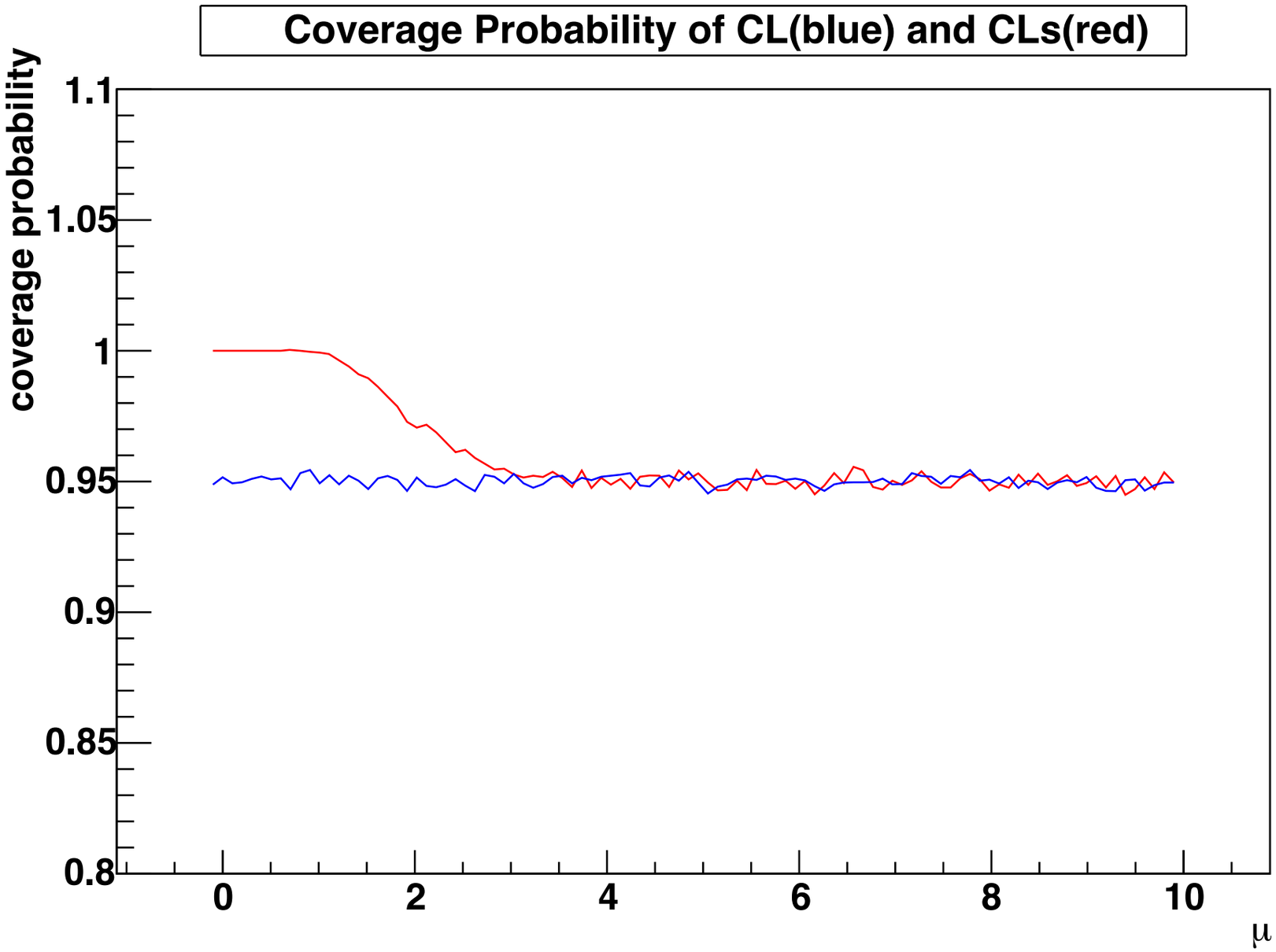
```
 $ root
ROOT v5.34/22

root [0] .L CLs.cpp
root [1] TH1D* h1 = CLLimitHistogram(
TH1D* CLLimitHistogram(double mu = 0., double alpha = 0.05, int nrep =
1000)
root [1] TH1D* h1 = CLLimitHistogram(0,0.05,1000);
root [2] TH1D* h2 = CLsLimitHistogram(0,0.05,1000);
Warning in <TROOT::Append>: Replacing existing TH1: ret (Potential memo
ry leak).
root [3] h1->SetLineColor(kBlue);
root [4] h2->SetLineColor(kRed);
root [5] h1->Draw("HIST")
Info in <TCanvas::MakeDefCanvas>:  created default TCanvas with name c1
root [6] h2->Draw("SAME")
```



Upper Limits with CL and CLs

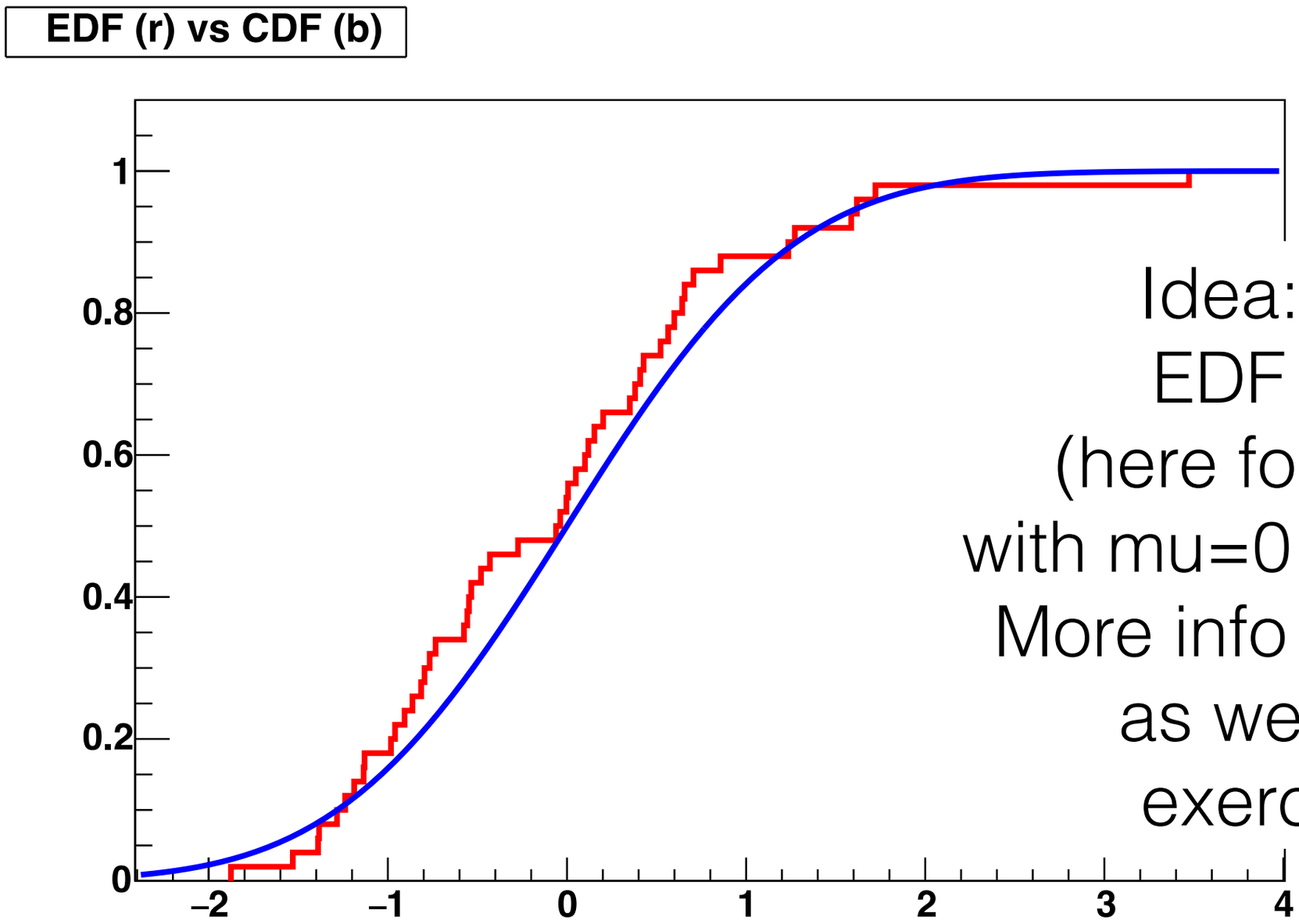
Using TH1D* CLLimitHistogram to make 1000 CL and CLs limits, with true mu=0

```
root [15] TGraph* g1=CLCoverageProbabilityGraph(0,10,100,10000,0.05);
root [16] TGraph* g2=CLsCoverageProbabilityGraph(0,10,100,10000,0.05);
root [17] g1->SetLineColor(kBlue);
root [18] g2->SetLineColor(kRed);
root [19] g2->Draw("AL")
Info in <TCanvas::MakeDefCanvas>:  created default TCanvas with name c1
root [20] g1->Draw("L SAME")
```



Coverage Probability

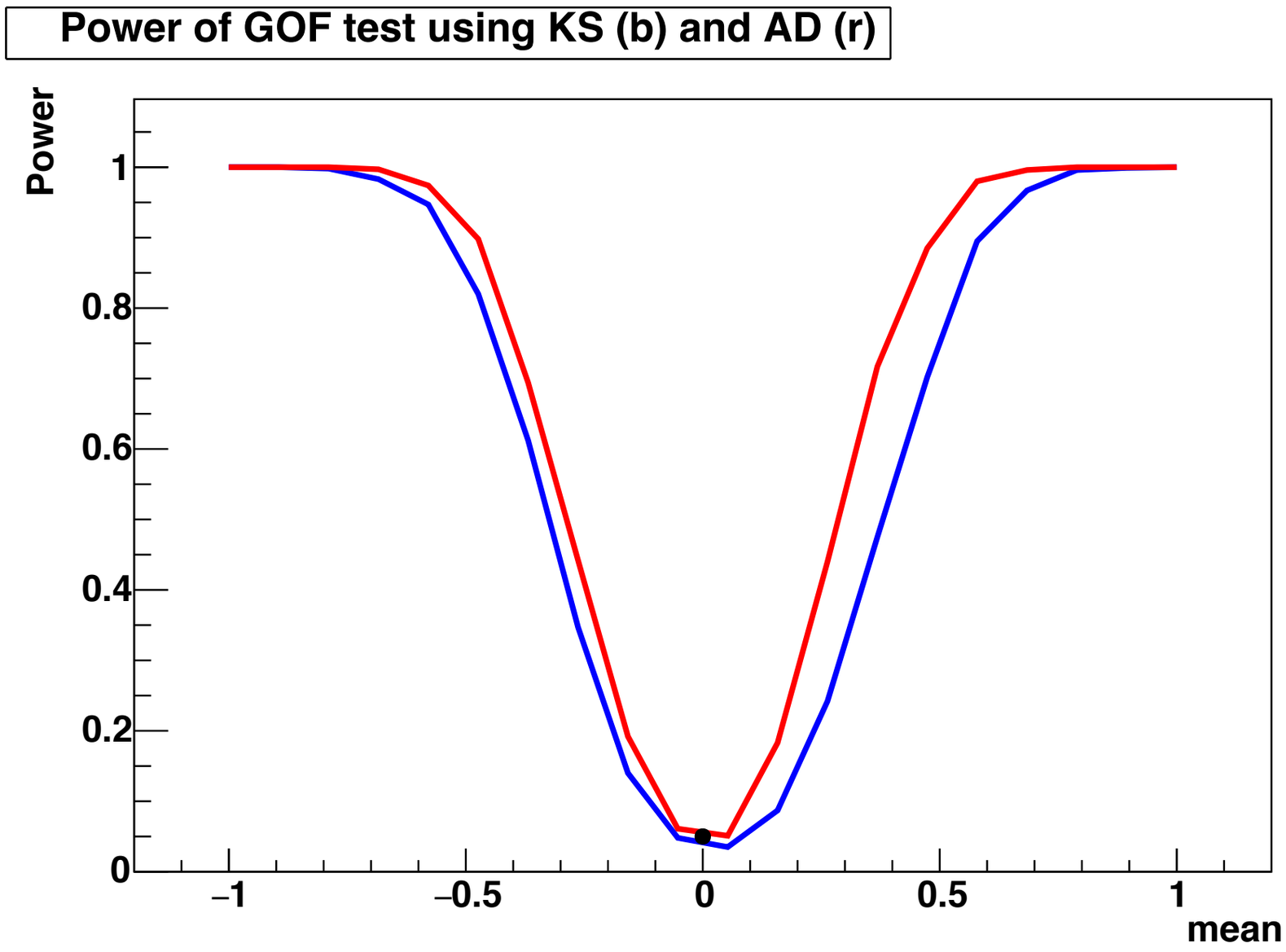
Power of Kolmogorov Smirnov



Idea: compare
EDF and CFD
(here for a gaussian
with mu=0 and sigma=1=
More info in Jan's slides
as well as in the
exercise notes

```
root [0] .L gof_root.cpp
root [1] exampleEDFPlot(

void exampleEDFPlot(double m, double s, double a, int nvalues, string p
lotname)
root [1] exampleEDFPlot(0,1,2,50,"exampleEDF2.pdf")
```

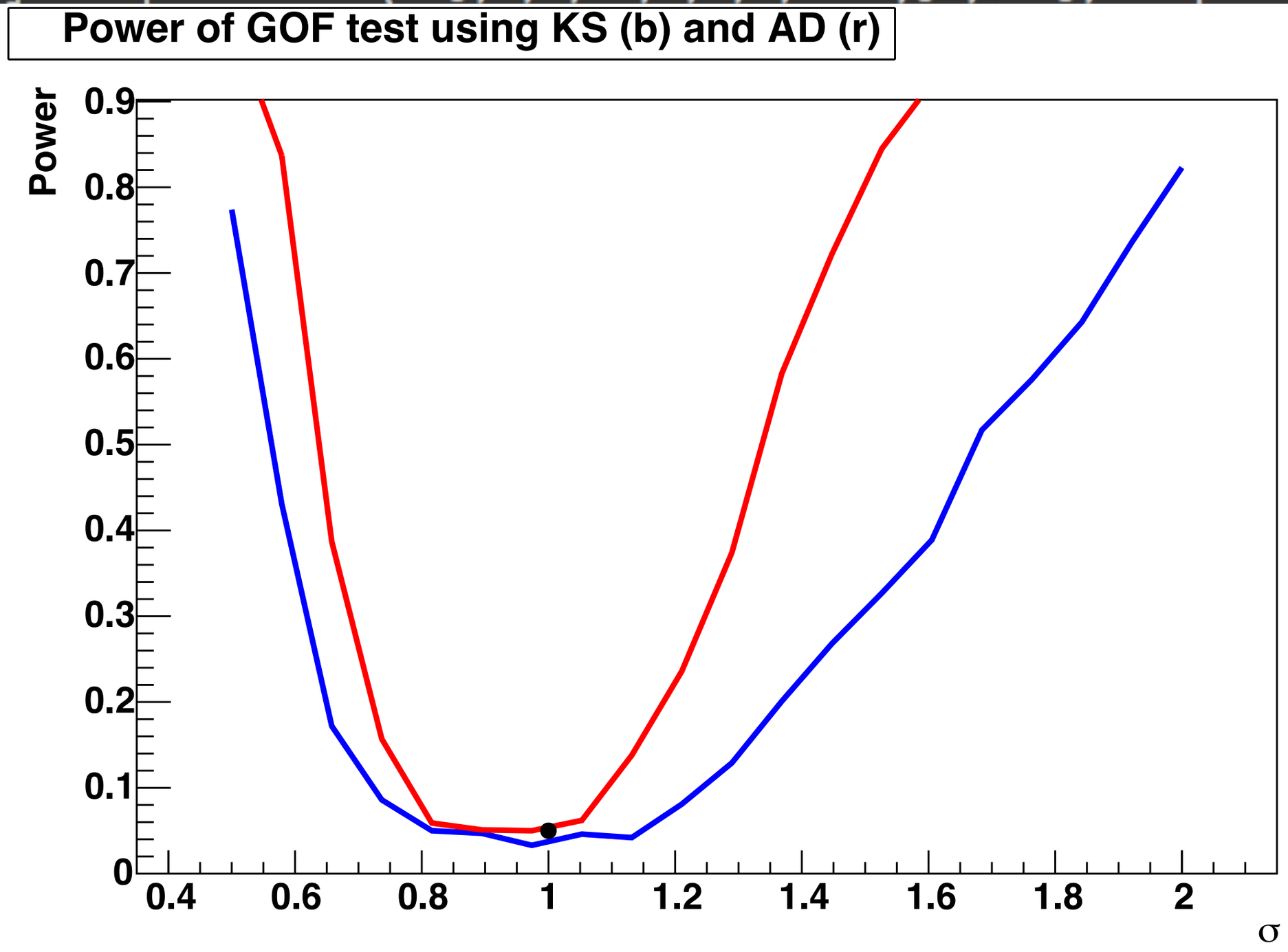
```
root [5] exampleGOFPlot(-1,1,0,20,0,1,2,1000,50,0.05,"GOFpowermu.pdf")
```



Power of KS and AD versus mu !=0

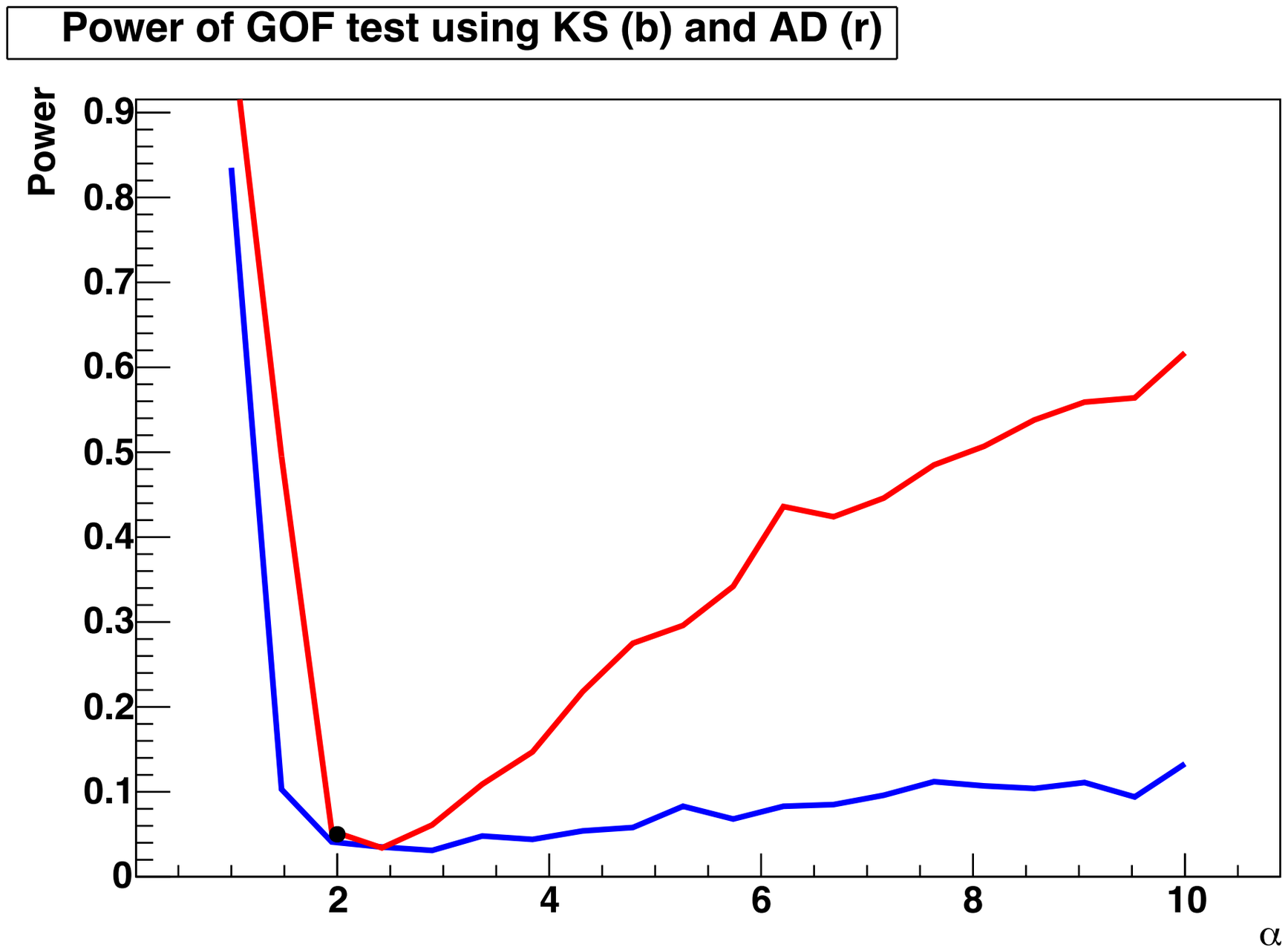
50 samples, 1000 repetitions

```
root [6] exampleGOFPlot(0.5,2,1,20,0,1,2,1000,50,0.05,"GOFpowersigma.pdf")
```



Power of KS and AD versus sigma !=1

50 samples, 1000 repetitions



Power of KS and AD versus alpha !=2

50 samples, 1000 repetitions