

## Physics 499 Winter 2016

Homework Assignment 4

Chi-Square Analysis

Due March 8th

Problem : Analysis of  $Z_0$  resonance

Reference : CERN-EP-2000-148 OPAL PR 328 30 November 2000

a) Write a computer program that will find the best fit to the following electron-positron cross section data at the  $Z_0$  resonance:

C.M. Energy (GeV)	$\sigma$ (nb)
88.251	$4.669 \pm 0.110$
89.251	$8.501 \pm 0.130$
90.249	$18.899 \pm 0.281$
91.244	$30.445 \pm 0.130$
92.235	$21.400 \pm 0.271$
93.238	$12.434 \pm 0.180$
94.235	$7.947 \pm 0.130$

Try and fit the data with a Lorentzian function for the peak plus a constant background:

$$\sigma = \sigma_{max} \frac{(\Gamma/2)^2}{(E - E_0)^2 + (\Gamma/2)^2} + B \quad (1)$$

There are 4 constants to be determined from the fit. The Lorentzian has 3 parameters: peak height  $\sigma_{max}$ , peak center  $E_0$ , and the peak width  $\Gamma$ . The background has one parameter,  $B$ .

Your program should print out the values of the 4 parameters that minimize the  $\chi^2$  function from lecture, as well as the value of  $\chi^2$  for this minimum situation.

b) After finding the fitting parameters, plot the data and the fit.