

4-й семестр, lesson4.

ROOT and simple functions

- Several useful commands with vi editor
- Movement in buffer, “ :10 “ means move to 10th line
- Go to Insert mode : command I (insert) or R (replace)
- Return from Insert mode – command “ ^[“
- Save result end exit – edit from input mode, then command ZZ
- Exit without save – command :q!
- Movement in buffer: use arrows or letters: j – down , k – up, h – left, l - right
- Delete 3 lines – 3dd; deleted lines are taken into buffer which can be used with commands : P – insert above current line; or p –insert after current line
- Open other file – command “ :e! file2”, if a buffer was filled in work with file1, it can be used now in work with file2
- The “substitute” command: Replace “text1” to “other” in all lines -> :1,\$s?text1?other? Carriage return
- :u it cancels the last command
- :↑ just calls the previous command

Simple functions in ROOT script

- Let's consider decay $\eta \rightarrow \pi^+ \pi^- \pi^0$ with known 4-vectors for π -mesons $(px1, py1, pz1, e1), (px2, py2, pz2), (px3, py3, pz3, e3)$, respectively, and 4-momentum vector of η -meson $(pxsum, pysum, pzsum, esum)$. All components are measured in the laboratory frame.
- Function `loren4` can be used for transformation of 4-vector from laboratory frame to the η rest frame.

Library function loren4

- `void loren4(double* dir, double* p4in, double* p4out)`
- `{`
- `double done = 1.0;`
- `double pcm2 = dir[0]*dir[0] + dir[1]*dir[1] + dir[2]*dir[2];`
- `double tmp = dir[3]*dir[3] - pcm2;`
- `double tmp2 = TMath::Sqrt(tmp);`
- `double onmcm = done/tmp2;`
- `double onmcm = done/TMath::Sqrt(dir[3]*dir[3] - pcm2);`
- `double epbeta = p4in[0]*dir[0] + p4in[1]*dir[1] + p4in[2]*dir[2];`
- `double prod = epbeta*(dir[3]*onmcm - done)/pcm2 - p4in[3]*onmcm;`
- `p4out[3] = onmcm*(p4in[3]*dir[3] - epbeta);`
- `for(int i=0; i<3; i++) {`
- `p4out[i] = p4in[i] + dir[i]*prod;`
- `}`
- `}`

Example 3

- `double dir;`
- `dir[0] =pxsum;`
- `dir[1]=pysum;`
- `dir[2]=pzsum;`
- `dir[3]=esum;`
- `double dp1lab[4];`
- `double dp1scm[4];`
- `dp1lab[0]=px1;`
- `dp1lab[1]=py2;`
- `dp1lab[2]=pz1;`
- `dp1lab[3]=e1;`
- `loren4(dpsum, dp1lab, dp1scm);`

Exercise 4:

- Make software link to input NTuple
- `ln -s /nfs/lfi.mipt.su/data/nikola/ves/run42/ntbeam_cher_r17_1_v15.root ntbeam_cher_r17_1_v15.root`
- Copy file `/nfs/lfi.mipt.su/data/nikola/ves/run42/ my_test_8.C` .
- Input file reading, loop over events, calculation of $m(3\pi)$ system and call of “loren4” is available.
- Edit `my_test_8.C`, to do:
- select events in η peak ($0.543 < m_{3\pi} < 0.553$) [mass $m(\eta) = 548$ Mev]
- Calculate total moments $p_{1scmtot}$, $p_{2scmtot}$, $p_{3scmtot}$ in the (3π) rest frame.
- Check that sums of p_x , p_y and p_z components are close to zero (histograms `h_006`, `h_007`, `h_008`).
- Since spin of all particles in this case = 0 and orbital moment in this decay = 0 also, the density of points on Dalitz plot should be uniform.

Exercise 4 cont.

- Select events in the ω peak, i.e. ($0.763 < m_{\pi^+\pi^-\pi^0} < 0.803$) and produce previous distributions with this selection (mass $m(\omega) = 783$ MeV)
- ω -meson has spin-parity $J^P = 1^-$
- Table of particle properties is available at <http://pdg.lbl.gov/>
- The matrix element for $\omega \rightarrow \pi^+\pi^-\pi^0$ decay is proportional to squared of pseudo-vector which can be constructed from the decay momenta in the ω -meson rest frame
- detailed description of amplitudes for meson decays into 3 pions can be found in Zemach "Three-Pion Decays of Unstable Particles" Phys.Rev. 133 (1964) V.5B B1210
- A description of Dalitz plot proportions can be found of book by Byckling and Kajantie, "Kinematics of elementary particles" in Russian, http://ikfia.ysn.ru/images/doc/Atomic_and_Nuclear_Physics/BycklingKajantie1975ru.pdf

Exercise 5

- Let's prepare distributions on the normal to the decay plane for η and ω decays into $\pi^+\pi^-\pi^0$.
- We need a function which gives the vector products of two vectors:
- `void cross(double* v1, double* v2, double* v3)`
- `{`
- `v3[0] = v1[1]*v2[2] - v1[2]*v2[1];`
- `v3[1] = v1[2]*v2[0] - v1[0]*v2[2];`
- `v3[2] = v1[0]*v2[1] - v1[1]*v2[0]; }`
- The maximum length of vector v_3 is reached at the center of the Dalitz plot. Neglecting the difference between masses of charged and neutral π , this $A_{\max} = \sqrt{3}/2 \cdot (M_{\text{tot}}^2 - m_{\pi}^2)$.
- The calculated amplitude (i.e. the normal vector) is divided by A_{\max} and taken in quadrature.

Exercise 5

- Copy file `/nfs/lfi.mipt.su/data/nikola/ves/run42/ my_test_8.C` .
- Fill the section for eta region and run.
- Compare histograms for ω and for η regions.

Backup

- {
- TFile *_file0 = TFile::Open("ntuple_test_9.root");
- TF1 *myfit2 = new TF1("myfit2","gaus(0)+pol1(0)",0.0,0.999);
- h_003->Fit("myfit2","eR+");
- }