TCS AT CLAS12

A. Movsisyan

INFN-Ferrara

clas Collaboration meeting

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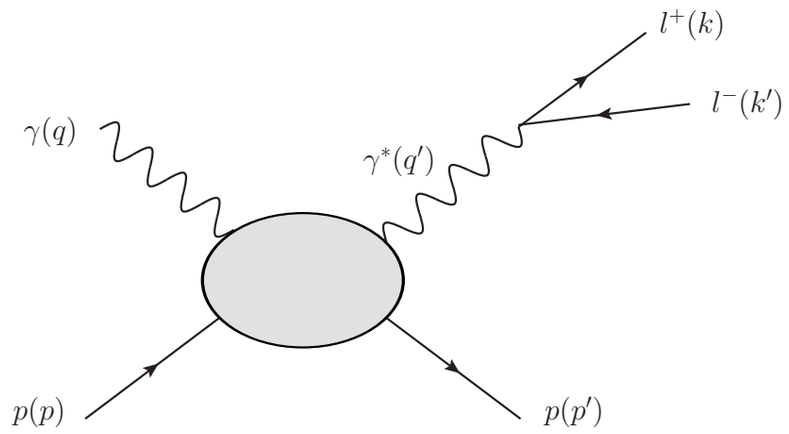
Introduction

Timelike Compton Scattering

Complementary probe of GPDs
Sensitivity to the real part of CFF H
Can be used to test the universality of GPDs



First TCS analysis from e16-e1f data:
R.Paremuzyan PhD Thesis.

Experimental observable

Azimuthal structure of TCS+BH cross section allows to access the Interference term trough cosine moment of weighted cross section

$$R = \frac{2\int_0^{2\pi} d\varphi \, \cos\varphi \, \frac{dS}{dQ'^2 \, dt \, d\varphi}}{\int_0^{2\pi} d\varphi \, \frac{dS}{dQ'^2 \, dt \, d\varphi}}$$

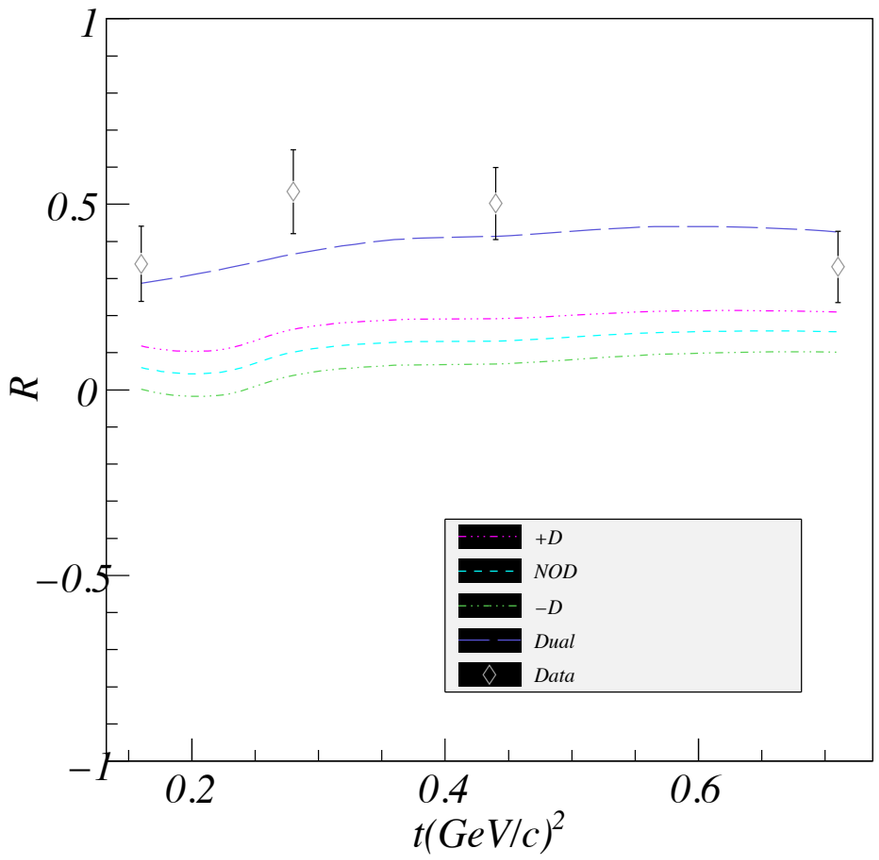


Figure from R.Paremuzyan PhD Thesis

Introduction & Motivation

Approved proposal for CLAS12 on an unpolarized proton

Jefferson Lab PAC 39 Proposal
Timelike Compton Scattering and J/ψ photoproduction on the proton in e^+e^- pair production with CLAS12 at 11 GeV

I. Albayrak,[1] V. Burkert,[2] E. Chudakov,[2] N. Dashyan,[3] C. Desnault,[4] N. Gevorgyan,[3] Y. Ghandilyan,[3] B. Guegan,[4] M. Guidal*,[4] V. Guzey,[2,5] K. Hicks,[6] T. Horn*,[1] C. Hyde,[7] Y. Ilieva,[8] H. Jo,[4] P. Khetarpal,[9] F.J. Klein,[1] V. Kubarovsky,[2] A. Marti,[4] C. Munoz Camacho,[4] P. Nadel-Turonski*†,[2] S. Niccolai,[4] R. Paremuzyan*,[4,3] B. Pire,[10] F. Sabatié,[11] C. Salgado,[12] P. Schweitzer,[13] A. Simonyan,[3] D. Sokhan,[4] S. Stepanyan*,[2] L. Szymanowski,[14] H. Voskanyan,[3] J. Wagner,[14] C. Weiss,[2] N. Zachariou,[8] and the CLAS Collaboration.

Request from Hall C colleagues: T.Horn and V.Tadevosyan
Evaluate the figure of merit for TCS on transversely polarized target

$$Figure\ of\ merit = R \times P_t \times Df$$

$R - rate\ inside\ acceptance$

$P_t - target\ polarization$

$Df - dilution\ factor$

Evaluate the acceptance for TCS, using complete chain of simulation + reconstruction within CLAS12 software (GEMC + COATJAVA)

TCS simulation with CLAS12 software

GEMC -v 4a.1.0
COATJAVA -v 4a.4.0

Calculate acceptance using only information from REC::Particle bank.

Example of an event with 3 reconstructed tracks

```
[Choose (n=next,p=previous, q=quit), Type Bank Name or id : REC::Particle
 SHOWING BANK
------------------------------------------------------------
>>>> GROUP (group=     1) (name=REC::Particle):
------------------------------------------------------------
         pid (      INT) :          0          0          0
          px (    FLOAT) :      1.084     -0.294     -0.787
          py (    FLOAT) :      0.169      0.176     -0.329
          pz (    FLOAT) :      1.927      0.810      2.099
          vx (    FLOAT) :      0.004     -0.196      0.474
          vy (    FLOAT) :     -0.027     -0.327     -1.133
          vz (    FLOAT) :     -0.286      0.604      1.322
      charge (     BYTE) :          1          1         -1
        mass (    FLOAT) :      0.000      0.000      0.000
        beta (    FLOAT) :      0.000      0.000      0.000
     chi2pid (    FLOAT) :      0.000      0.000      0.000
      status (     BYTE) :          1          1          1
------------------------------------------------------------

[Choose (n=next,p=previous, q=quit), Type Bank Name or id : MC::Particle
 SHOWING BANK
------------------------------------------------------------
>>>> GROUP (group=     1) (name=MC::Particle):
------------------------------------------------------------
         pid (      INT) :       2212         11        -11
          px (    FLOAT) :     -0.290     -0.797      1.088
          py (    FLOAT) :      0.175     -0.345      0.170
          pz (    FLOAT) :      0.810      2.121      1.930
          vx (    FLOAT) :      0.000      0.000      0.000
          vy (    FLOAT) :      0.000      0.000      0.000
          vz (    FLOAT) :     -0.528     -0.528     -0.528
------------------------------------------------------------
```

Example of single event (list of banks)

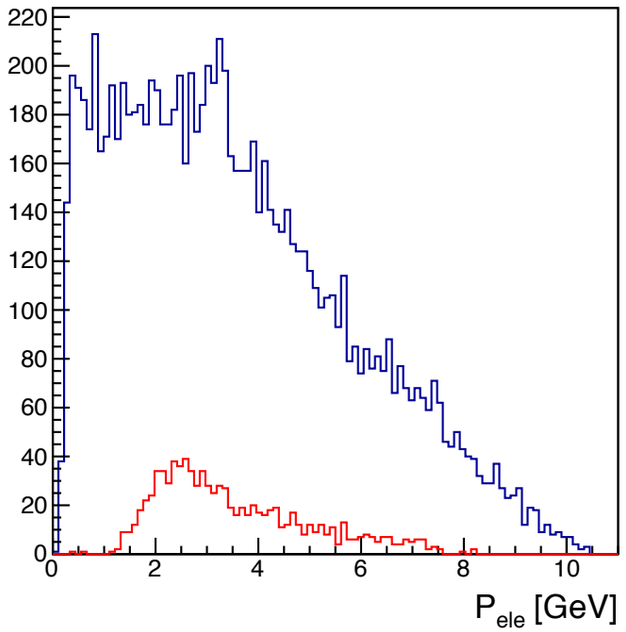
```
************************ EVENT # 16 ************************
+-----+-------------------------+----------+----------+----------+
|  id|                     name|   entries|     group|     items|
+-----+-------------------------+----------+----------+----------+
|   0|                ECAL::adc|       101|       201|         7|
|   1|                ECAL::tdc|       101|       202|         5|
|   2|             RUN::config|         1|        10|        10|
|   3|               ECAL::hits|        72|      1611|         8|
|   4|              ECAL::peaks|        37|      1612|        13|
|   5|           ECAL::clusters|        10|      1613|        18|
|   6|              ECAL::calib|        10|      1614|         9|
|   7|             MC::Particle|         3|        20|         7|
|   8|            REC::Particle|         3|        24|        12|
|   9|                HTCC::adc|         2|       601|         7|
|  10|           REC::Detector|        11|        25|        15|
|  11|       HitBasedTrkg::HBHits|       116|      1311|        17|
|  12|    HitBasedTrkg::HBClusters|        18|      1312|        23|
|  13|    HitBasedTrkg::HBSegments|        10|      1313|        28|
|  14|     HitBasedTrkg::HBCrosses|         9|      1314|        18|
|  15|               HTCC::rec|         2|       610|        17|
|  16|      HitBasedTrkg::HBTracks|         3|      1315|        34|
|  17|               FTOF::adc|        60|       101|         7|
|  18|               FTOF::tdc|        60|       102|         5|
|  19|      TimeBasedTrkg::TBHits|       116|      1321|        17|
|  20|   TimeBasedTrkg::TBClusters|        18|      1322|        23|
|  21|   TimeBasedTrkg::TBSegments|        10|      1323|        28|
|  22|    TimeBasedTrkg::TBCrosses|         9|      1324|        18|
|  23|     TimeBasedTrkg::TBTracks|         3|      1325|        34|
|  24|                 DC::tdc|       118|       302|         5|
|  25|                DC::doca|       118|       303|         5|
|  26|            FTOF::rawhits|        36|      1211|        13|
|  27|               FTOF::hits|        36|      1212|        23|
|  28|           FTOF::clusters|        12|      1213|        16|
|  29|       FTOF::matchedclusters|         4|      1214|        10|
+-----+-------------------------+----------+----------+----------+
```

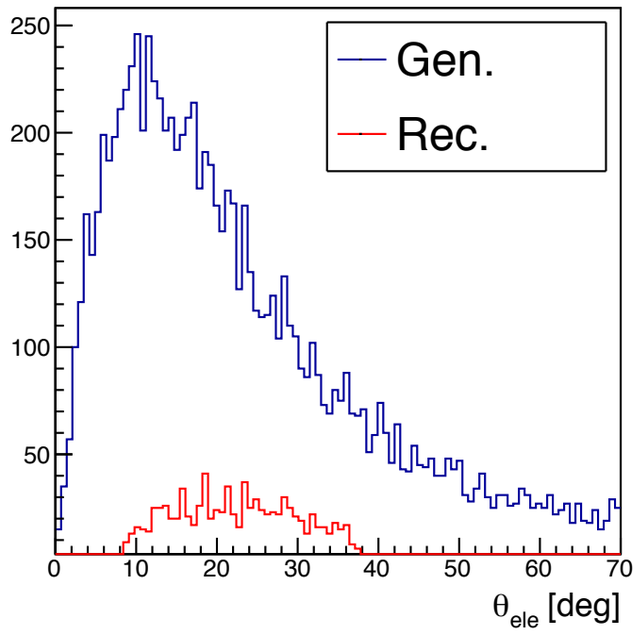
Reconstructed tracks

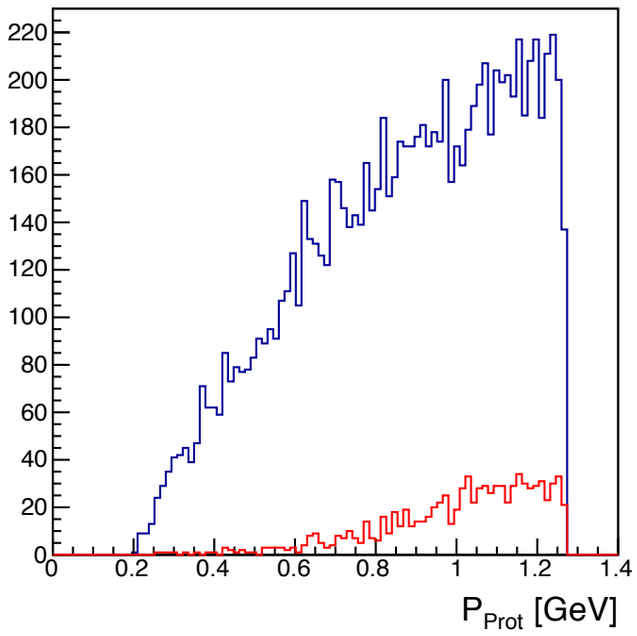
Generated tracks

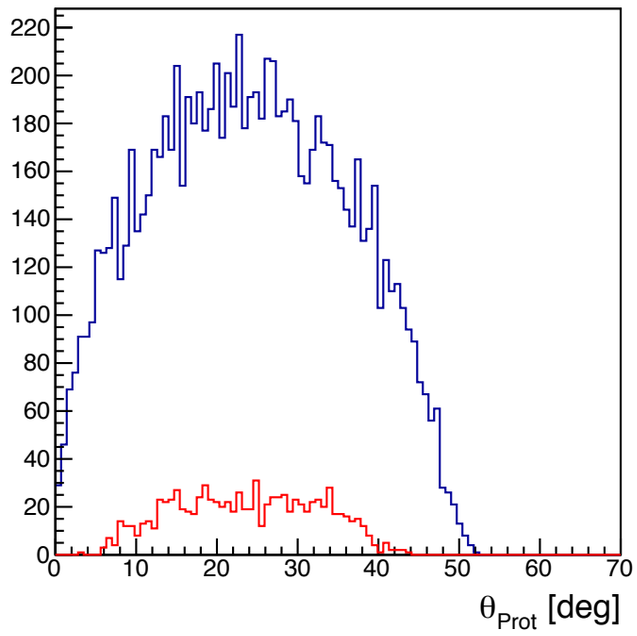
TCS phase space

Generated vs Reconstructed kinematics



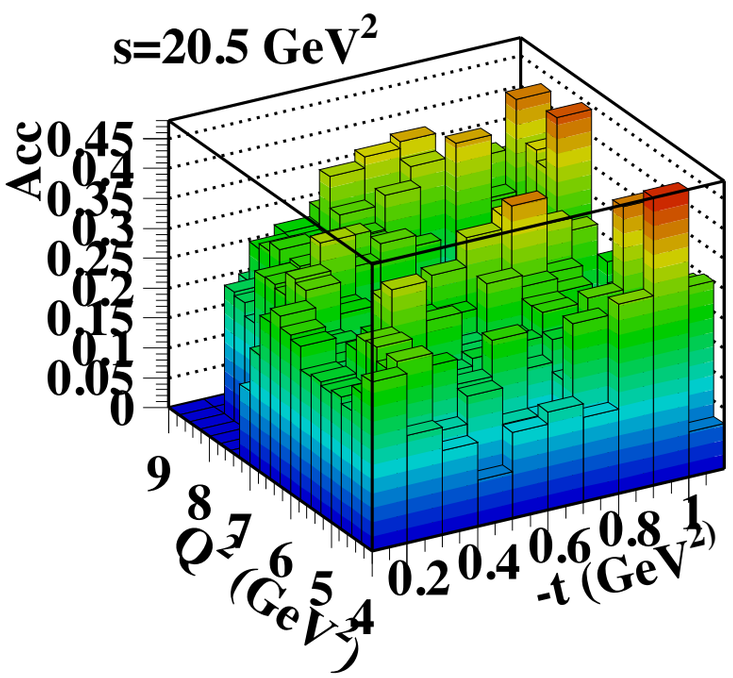




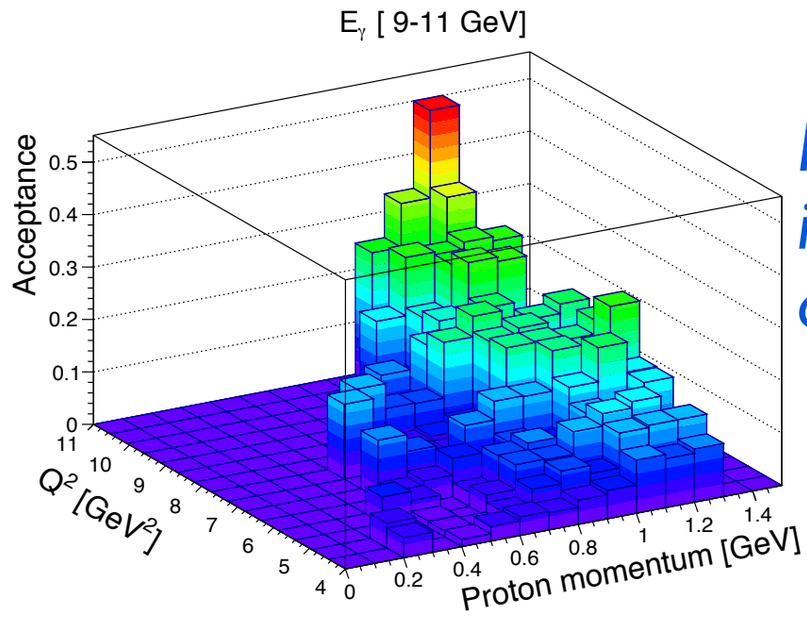


TCS acceptance

Acceptance from PAC 39
s=20.5 GeV



Acceptance for a kinematic bin
E_γ [9-11 GeV]



Results for acceptance calculation in various kinematic bins are consistent with PAC 39.

Conclusion & Outlook

Preliminary studies of Timeline Compton Scattering were performed with CLAS12 software.
Further development of analysis framework with CLAS12 software is in progress.