Sartre Events for Proposal

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June 11, 2021

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Sartre

- Sartre is an implementation of the IPSat (aka bSat) model describing exclusive diffractive vector meson production
  - $e + \mathrm{A} \rightarrow e' + \mathrm{A}' + \gamma, \rho, \phi, J/\psi, \Upsilon$
- Sartre is the only generator that entails saturated and non-saturated scenarios in diffartive e+p and e+A
- The generator goes beyond simple analytic mechanism and adds fluctuations that determine the incoherent spectrum
  - nucleon fluctuations implemented
  - parton fluctuations will be introduced soon
- Sartre was key to diffractive studies in the White Paper and the Yellow Report
- Publications:
  - Exclusive diffractive processes in electron-ion collisions, Phys. Rev. C 87 (2013) 2, 024913 • e-Print: 1211.3048
  - The dipole model Monte Carlo generator Sartre 1, Comput. Phys. Commun. 185 (2014) 1835-1853 • e-Print: 1307.8059
  - Investigating saturation effects in ultraperipheral collisions at the LHC with the color dipole model, Phys. Lett. B 803 (2020) 135277 • e-Print: 1910.02899

Sartre - Details

- Sartre is not a monolithic program but a class library similar to Pythia8.
- An example “main” program provided (sartreMain.cpp) appears to be the most popular implementation
  - It writes out the generated events as ROOT tree for easy analysis or further processing (see next slide)
- Sartre requires large lookup tables that contain the amplitudes. The generation of these tables is very expensive (~ MCPUh).
- Generating events with Sartre is fast due to the lookup tables!
- In principle Sartre produces only the vector meson but provides decay routines that include the proper angular distributions according to measurements at HERA
- NEW: Sartre now allows to write the events in a generally accepted “EIC” format that can be directly read by eic-smear. This is ready but awaits some tests to be concluded (Barak Schmookler/SBU).

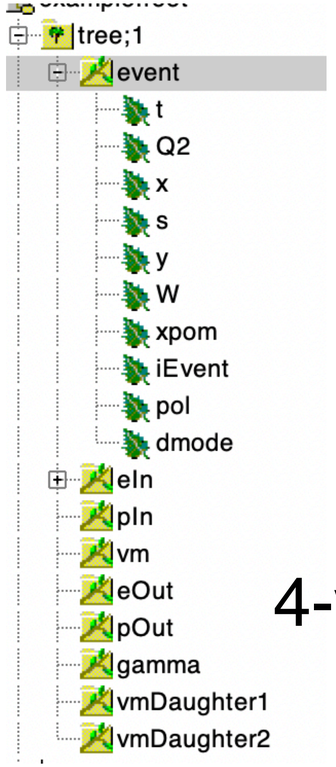
Formats & Printouts

Sartre print-out:

```
evt = 0          Q2 = 1.352          x = 9.641e-04      R = 0.100
                  W = 37.436         y = 0.177
                  t = -0.340      xpom = 8.048e-03
                pol = T          diff = incoherent

 #          id   name       status    parents     daughters        px       py        pz         E             m
 0          11   e-              4    -     -      2     3       0.000    0.000   -18.000    18.000     5.110e-04
 1  1000791970   Au(197)         4    -     -      6     -       0.000    0.000   109.996   110.000         0.938
 2          11   e-              1    0     -      -     -       0.826   -0.656   -14.795    14.833     5.110e-04
 3          22   gamma           2    0     -      4     5      -0.826    0.656    -3.205     3.167        -1.163
 4         443   J/psi           2    3     -      7     8      -0.280    0.853    -2.369     4.001         3.097
 5         990   pomeron         2    3     3      6     -      -0.546   -0.197    -0.836    -0.834        -0.583
 6  1000791970   Au(197)         2    1     5      -     -      -0.546   -0.197   109.160   109.166         0.939
 7          11   e-              1    4     -      -     -      -0.310    1.247    -2.996     3.260     5.110e-04
 8         -11   e+              1    4     -      -     -       0.030   -0.394     0.627     0.741     5.110e-04
```

Root file:



4-vectors

eic-smear readable format (new):

```
Sartre EVENT FILE
=========================================
I, ievent, genevent, t, Q2, x, y, W2, nu, xpom, s, pol, dmod, bup
=========================================
I, K(I,1)  K(I,2)  K(I,3)  K(I,4)  K(I,5) P(I,1)  P(I,2)  P(I,3)  P(I,4)  P(I,5) V(I,1)  V(I,2)  V(I,3)
=========================================
0  0  1  -0.339587 1.35155   0.000964081  0.177011  1401.43   747.068   0.00804765   7920.74   0  1  0
=========================================
1  21 11 0   0  0 0  0  -18 18 0.000510999  0  0  0
2  21 1000791970   0   0  0 0  0  109.996  110 0.93827   0  0  0
3  21 22 0   0  0 -0.825638 0.656225  -3.20497  3.16743   -1.16256  0  0  0
4  1  11 1   0  0 0.825638  -0.656225 -14.795   14.8326   0.000510999  0  0  0
5  21 990 0  0  0 -0.546071 -0.196874 -0.835532 -0.833954 -0.582741 0  0  0
6  1  1000791970    2  0  0 -0.546071 -0.196874 109.16 109.166   0.938679  0  0  0
7  11 443 0  8  9 -0.279566 0.853099  -2.36944  4.00138   3.09692   0  0  0
8  1  11  7  0  0 -0.309981 1.24699   -2.99643  3.26031   0.000510999  0  0  0
9  1  -11 7  0  0 0.0304146 -0.393891 0.626985  0.741071  0.000510999  0  0  0
=
```

Production available on EIC nodes

Diffractive VM production in e+Au: $e + \mathrm{Au} \rightarrow e' + \mathrm{Au}' + \rho, \phi, J/\psi$

Sartre 1.34

/eic/data/ullrich/sartre

sartre/generator: event generator program (plus runcards

sartre/data: 600M events, 200M for each VM where 100M photo, 100M for $1 < Q^2 < 20$ GeV^2
Root files (10M events each) & corresponding log files (cross-section!) and README file

sartre/reader: Example macro to read

More Details

- All events use KMW (Kowalski, Montyka, Watt) IPSat/IPNonSat parameters.
  - most complete set we have
  - not too granular
  - new table production likely to not happen this year (very CPU intensive, many tables)
  - has wiggles in incoherent spectrum - disappear with any realistic t resolution
- Decays only for main channel (decay angles according to HERA measurements)
  - J/psi to e e
  - phi to K K
  - rho to pi pi
- Real part and skewness correction were on if possible. Some datasets could not have them on since they needs ep tables with similar dimensions. Cross-section predictions are only reliable with corrections on (factor ~2)
- Photoproduction is not $Q^2=0$ but approximated by $0.0001 < Q2 < 0.01$ GeV
- Nuclear breakout was not switched on - BeAGLE is more reliable here

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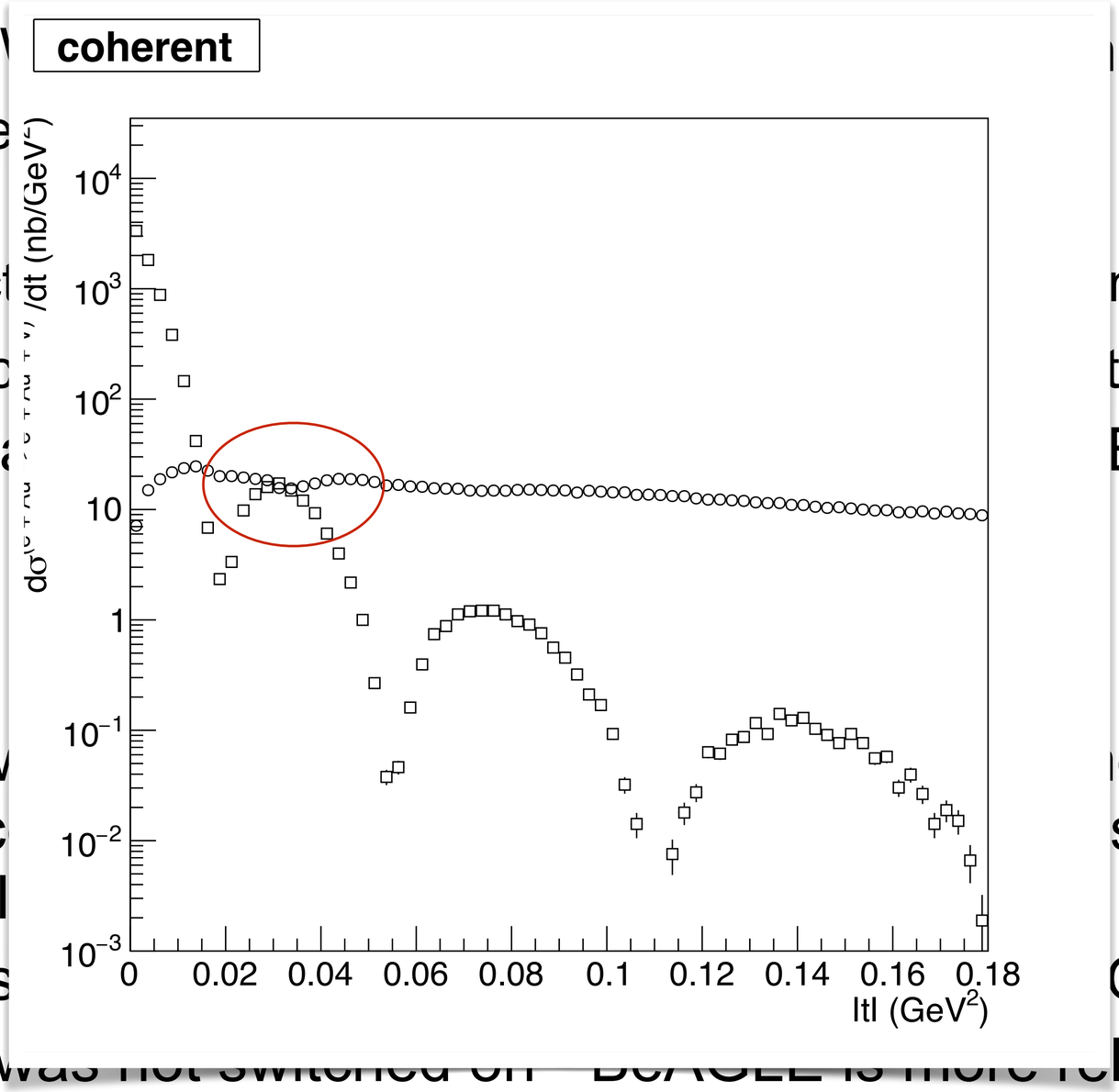

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Production to appear soon on EIC nodes

Diffractive VM production in e+Au: $e + \mathrm{Au} \rightarrow e' + \mathrm{Au}' + \rho, \phi, J/\psi$

Sartre 1.35

Replicate same but also include eic-smear (EIC software) readable files.