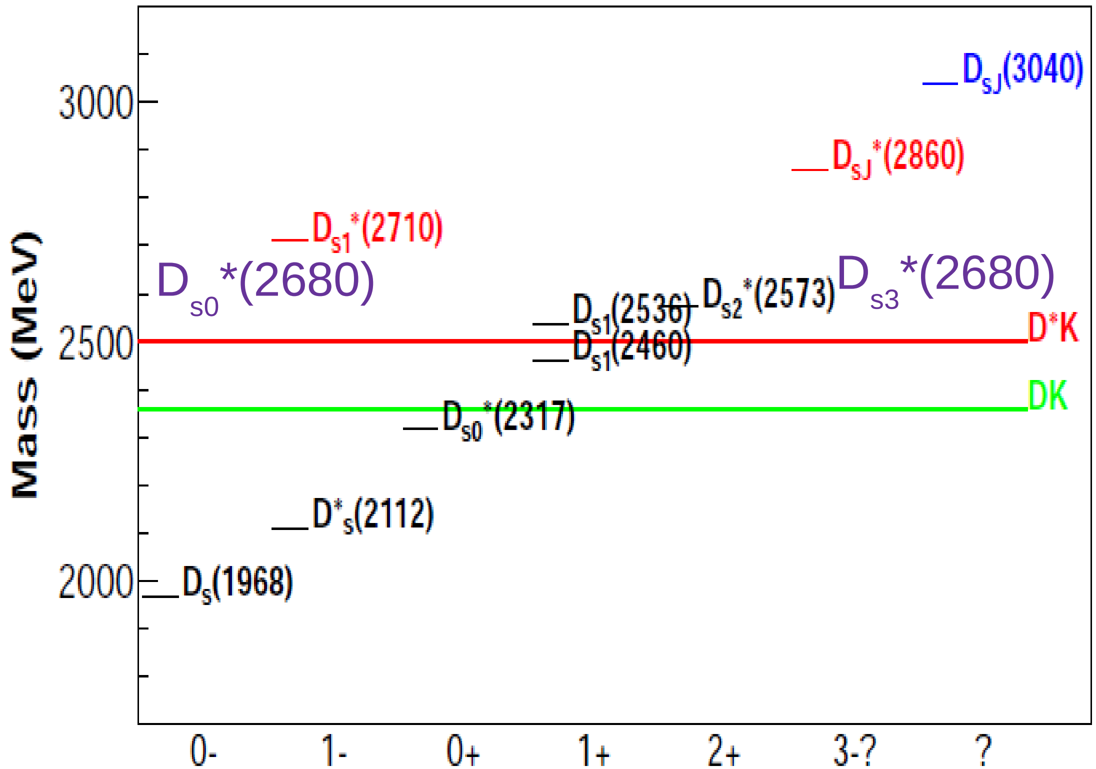
Open-charm Physics: study of $\bar{p}p \rightarrow D_s^- D_{sJ}^{(*)+}$

December 10th, 2014 | Elisabetta Prencipe, Forschungszentrum Jülich | PANDA Collaboration meeting

Motivation



- Many excited D_s states have been found:
  some of these not in agreement with potential models (→below the DK threshold);
  the identification of $D_{s0}^*(2317)$ and $D_{s1}(2460)$ states as 0^+ or 1^+ $c\bar{s}$ states is difficult to accommodate in the potential models.
- LHCb recently performed amplitude analyses: $D_{s2}(2573)$ confirmed with J=2;
  new $D_{s1\text{-}3}^*(2680)$ analyses: for the first time a heavy flavored J=3 state is observed.

Experimental overview of D_{s0}*(2317) and D_{s1}(2460)

Decay Channel	$D_{sJ}^*(2317)^+$	$D_{sJ}(2460)^+$
$D_s^+\pi^0$	Seen	Forbidden
$D_s^+\gamma$	Forbidden	Seen
$D_s^+\pi^0\gamma$ (a)	Allowed	Allowed
$D_s^*(2112)^+\pi^0$	Forbidden	Seen
$D_{sJ}^*(2317)^+\gamma$	—	Allowed
$D_s^+\pi^0\pi^0$	Forbidden	Allowed
$D_s^+\gamma\gamma$ (a)	Allowed	Allowed
$D_s^*(2112)^+\gamma$	Allowed	Allowed
$D_s^+\pi^+\pi^-$	Forbidden	Seen

(a) Non-resonant only

- Most of theoretical works treat *c$\bar{s}$-systems* as the hydrogen atom (potential models, c=heavy quark):
- $D_{s1}(2326)^+$ and $D_{s2}(2573)^+$ are predicted, found with good accuracy

<u>but</u>:

m(D_{s0}*$(2317)^+$) found 180 MeV lower
m($D_{s1}(2460)^+$) found 70 MeV lower
than predicted by potential models

- $D_{s0}^*(2317)^+$ is found below the DK threshold:
- $D_{s0}^*(2317)^+$ can in principle decay
  - electromagnetically (no exp. evidence); or
  - through isospin-violation $D_s^+\pi^0$ strong decay

Is D_{s0}^* the missing 0^+ state of the *c$\bar{s}$-spectrum*?

- $D_{s1}(2460)^+$ is found in the inv. mass $D_s^+\gamma$
- Spin <u>at least</u> 1
- We can exclude the hypothesis 0^+, only, because $D_{s1}(2460)^+ \rightarrow D_s^+\gamma$

Is D_{s1} the missing 1^+ of the *c$\bar{s}$-spectrum*?

Do these 2 particles belong to the same family of exotics?

D_{S0}^* and D_{s1} theoretical overview: Hadronic width

M. Cleven, H. W. Griesshammer, F.-K. Guo, C. Hanhart, Ulf-G. Meissner, Eur. Phys. J. A(2014) 50, 149

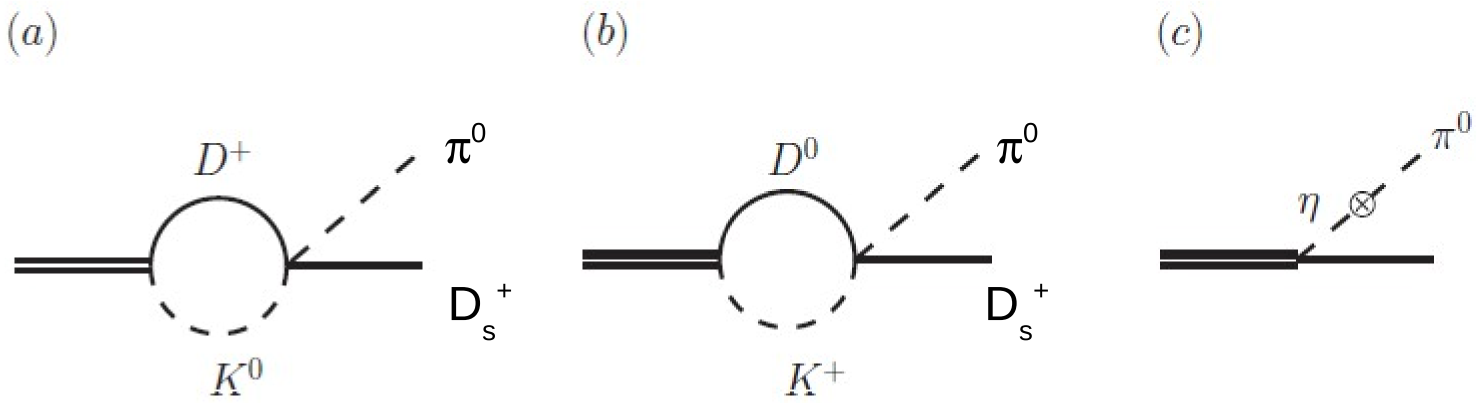


Figure 2: The two mechanisms that contribute to the hadronic width of the D^*_{s0}. (a) and (b) represent the nonvanishing difference for the loops with D^+K^0 and D^0K^+, respectively. (c) depicts the decay via π^0-η mixing.

- Contribution (a) – (b) non-zero for $m_{D+} \neq m_{D0}$, $m_{K+} \neq m_{K0}$; this applies to molecular states

Table 2: Hadronic decay widths from different mechanisms.

Decays	loops	π^0-η mixing	full result
$D^*_{s0} \to D_s\pi^0$	(26 ± 3) keV	(23 ± 3) keV	(96 ± 19) keV
$D_{s1} \to D^*_s\pi^0$	(20 ± 3) keV	(19 ± 3) keV	(78 ± 14) keV

D_{s0}^* and D_{s1} theoretical overview: Radiative width

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M. Cleven, H. W. Griesshammer, F.-K. Guo, C. Hanhart, Ulf-G. Meissner, Eur. Phys. J. A(2014) 50, 149

Table 3: The decay widths (in keV) calculated only from the coupling to the electric charge (EC), from the magnetic moments (MM) and from the contact term (CT), respectively, compared to the total (including interference). The CT strength for the transitions to odd parity mesons is fixed to data, while that to even parity states, marked as '?', is undetermined and part of the uncertainty.

Decay Channel	EC	MM	CT	Sum	[1]	[2]	[3,4,5]
$D_{s0}^* \to D_s^* \gamma$	2.0	0.03	3.3	9.4	$4-6$	1.94(6.47)	0.55-1.41
$D_{s1} \to D_s \gamma$	4.2	0.2	11.3	24.2	$19-29$	44.50(45.14)	2.37-3.73
$D_{s1} \to D_s^* \gamma$	9.4	0.5	10.3	25.2	$0.6-1.1$	21.8(12.47)	–
$D_{s1} \to D_{s0}^* \gamma$	–	1.3	?	1.3	$0.5-0.8$	0.13(0.59)	–

[1] P. Colangelo, F. De Fazio, A. Ozpineci. PRD 72, 074004 (2005);
[2] M. F. M. Lutz, M. Soyeur, Nucl. Phys. A 813, 14 (2008);
[3] A. Faessler, T. Gutsche, V. E. Lyubovitskij and Y. L. Ma, PRD 76, 014005 (2007);
[4] A. Faessler, T. Gutsche, V. E. Lyubovitskij and Y. L. Ma, PRD 76, 114008 (2007);
[5] A. Faessler, T. Gutsche, V. E. Lyubovitskij and Y. L. Ma, PRD 77, 114013 (2008).

- **Only hadronic decays are sensitive to a possible molecular component of D_{s0}^* and D_{s1}**
- **Hadronic width of ≥ 100 KeV: unique feature for molecular state**
- **Demand for a new generation machine: Δm ~100 keV, 20 times better than attained at B factories**

Challenges in D_s meson spectroscopy

shown at summer conf 2014, arXiV:1410.5201 [hep-ex], submitted to EPJ Web of Conf

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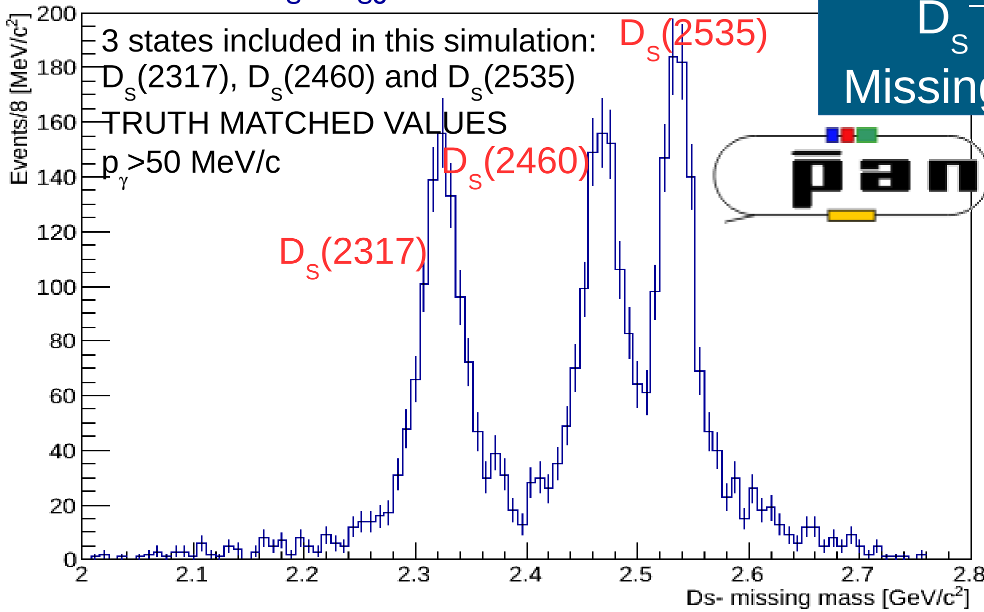
- $p\bar{p} \rightarrow D_s^- D_{sJ}^+$

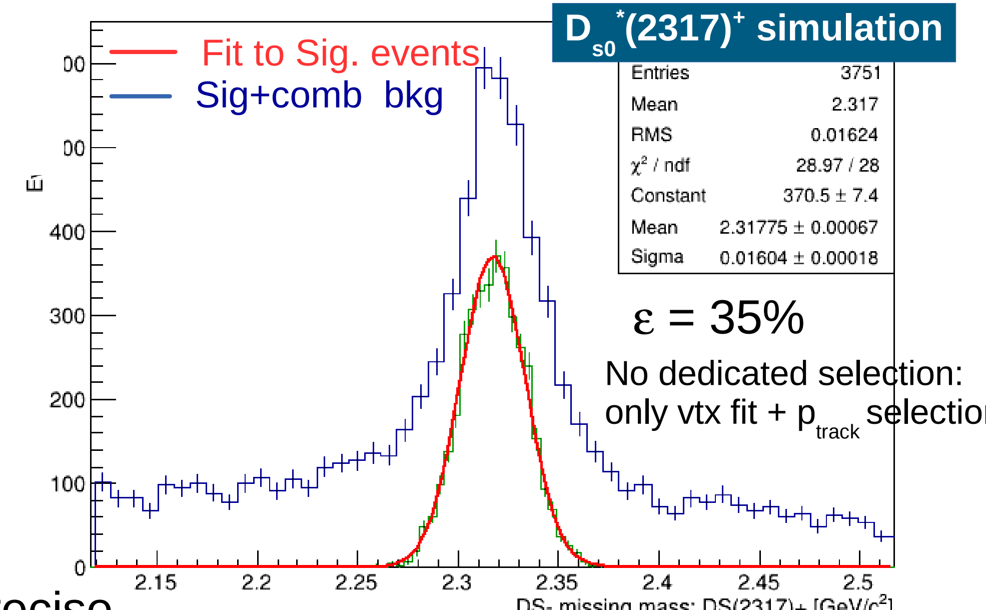


D_s^- Missing M

- Missing mass of D_s^-: improve mass resolution and efficiency
- D_{SJ} reconstructed exclusively to evaluate the width
- Bkg cross section > thousand times than expected on signal
- Expected ~$(10^3$-$10^5) \cdot \varepsilon$ events/day

high res. mode

$D_{s0}^*(2317)^+$ simulation



ε = 35%

No dedicated selection: only vtx fit + p_{track} selection

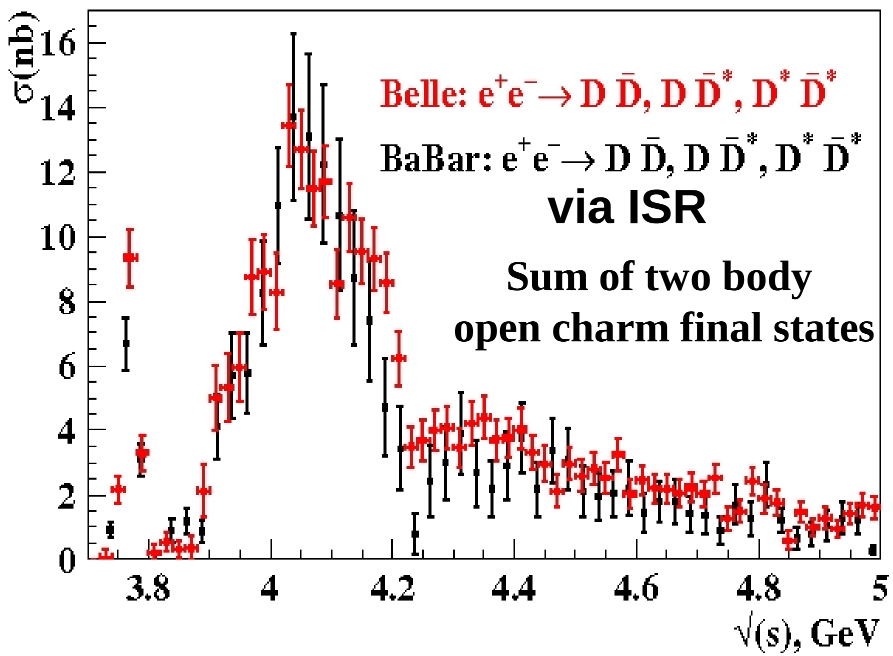
- Goals:

1. Cross section measurement in $p\bar{p}$ (unknown, difficult predictions: 1-100 nb)
2. Measurement of the width with mass scan and the excitation function of cross section
3. Mixing between D states with same spin, e.g. D_{S1}(2460) and D_{S1}(2535)
4. Chiral symmetry breaking, involving very precise mass measurement: D_{S0}(2317) and D_{S1}(2460) can be interpreted as chiral partners of the same heavy-light system

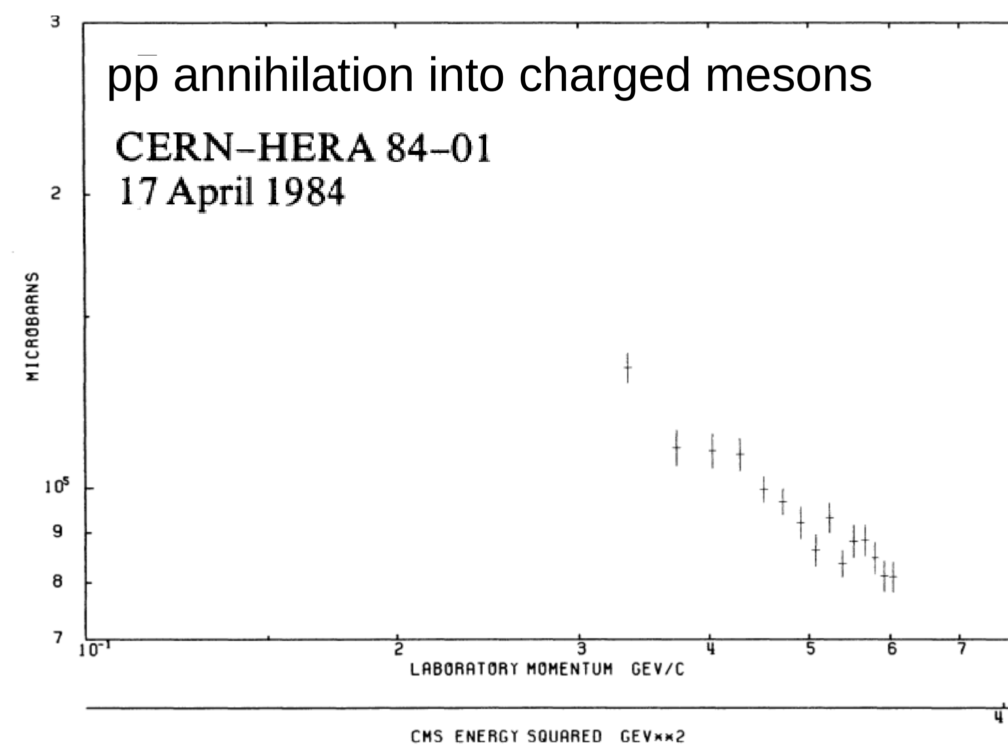
1. Cross section

- Predictions are complicated due to presence of s-quark in D_{sJ} mesons:
  $\sigma(p\bar{p} \to \bar{D}D)$ expected <100nb
- Inclusive search: better for cross section measurement, but higher background. Challenge!
- Exclusive cross section measurement: feasible, but theoretical predictions are difficult

Phys. Rev. Lett. 98, 092001 (2007)
Phys.Rev. D79, 092001(2009)



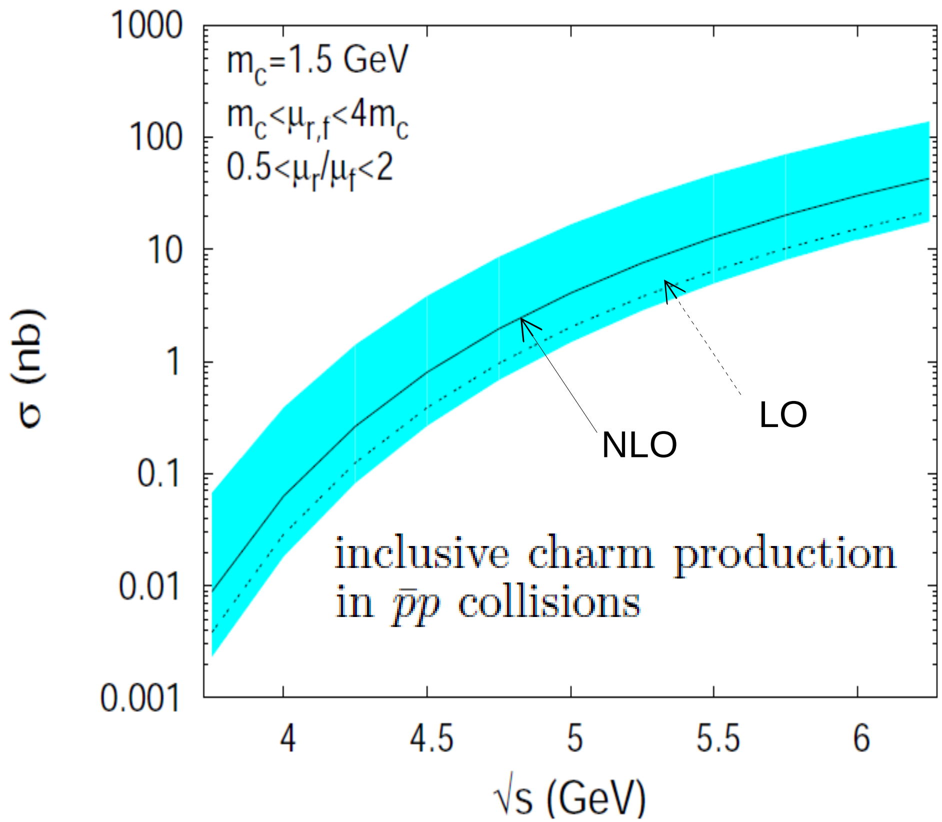
V. Flaminio, W.G. Moorhead, D.R.O. Morrison, N. Rivoire



- Our simulations in $\overline{P}ANDA$ for the D_{s0}* and D_{s1} cross section: p > 8.8 GeV/c

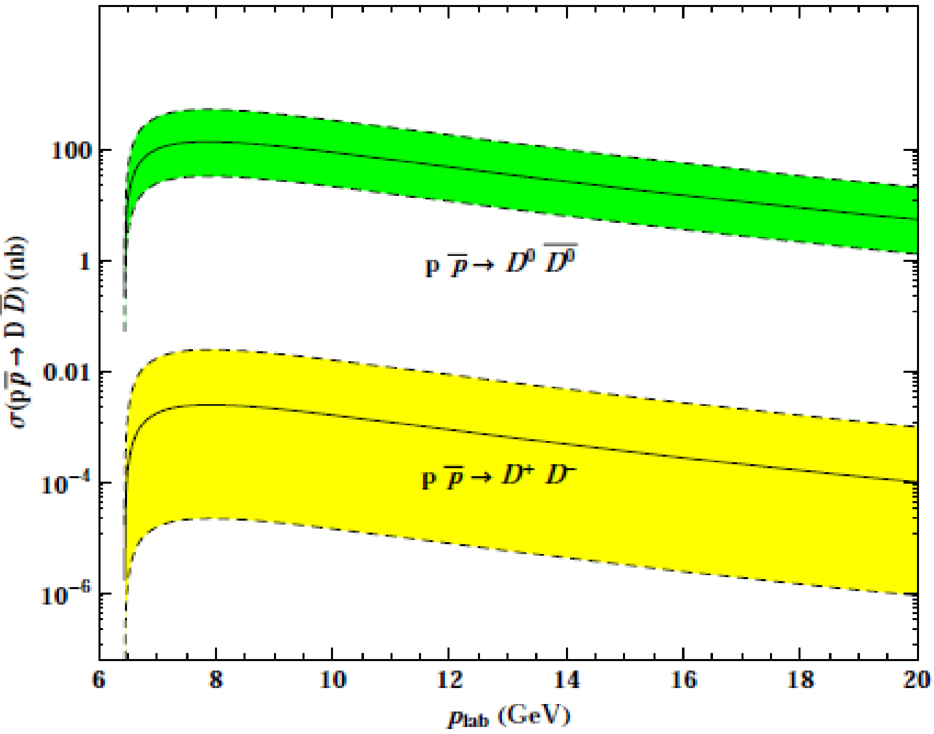
1. Cross section

- Theoretical predictions for the charmed ground states (D^+, D^0).
- In the D_J sector (no s-quark), calculations for excited D states are difficult: calculations in perturbative regime can under-estimate the real cross section



Phys. Rev. D 79 (2009) 114005

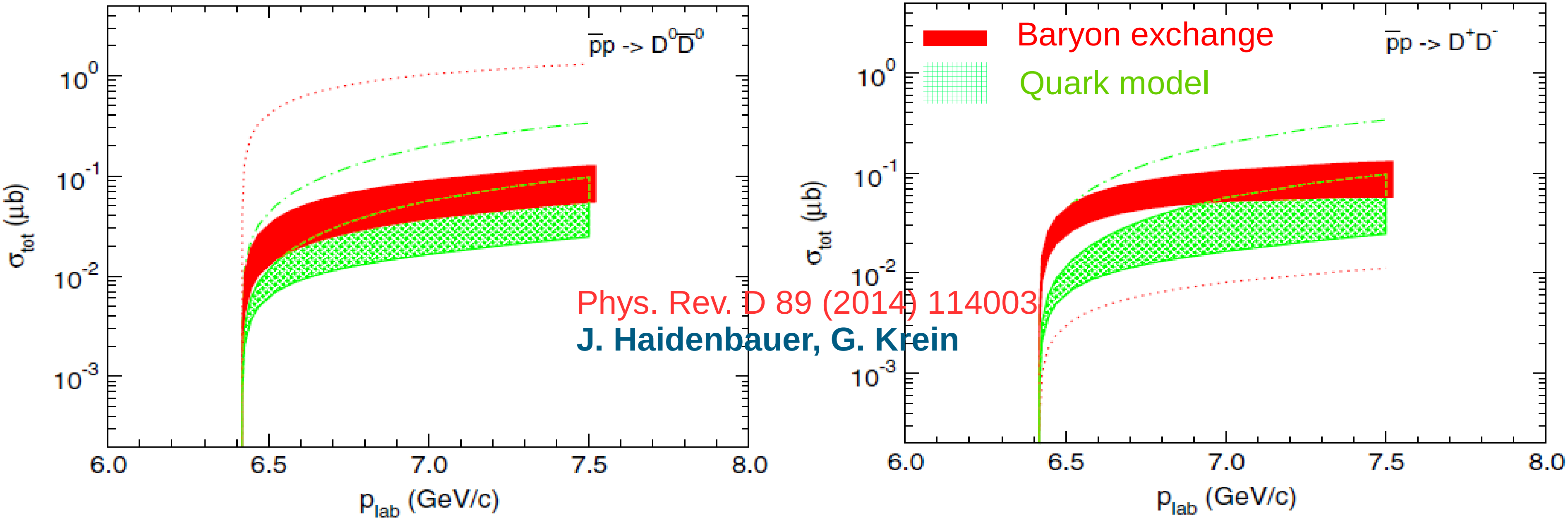
E. Braaten, P. Artoisenet



Eur. Phys. J. A 48 (2012) 31

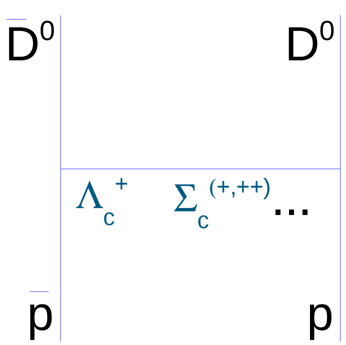
A. Khodjamirian, C. Klein, T. Mannel, Y.M. Wang

1. Cross section

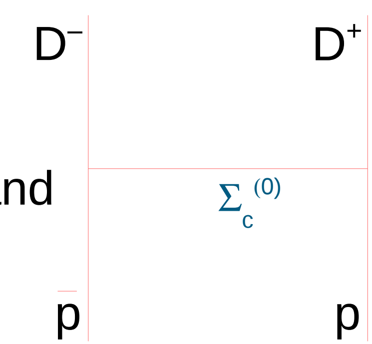


Phys. Rev. D 89 (2014) 114003
J. Haidenbauer, G. Krein

- Cross section predictions described in the PRD 89 (2014) 114003 are higher than in the paper cited as EPJ A 48 (2012) 31
  → different assumption: here (PRD paper) they rely in SU(4); coupling constant is fixed

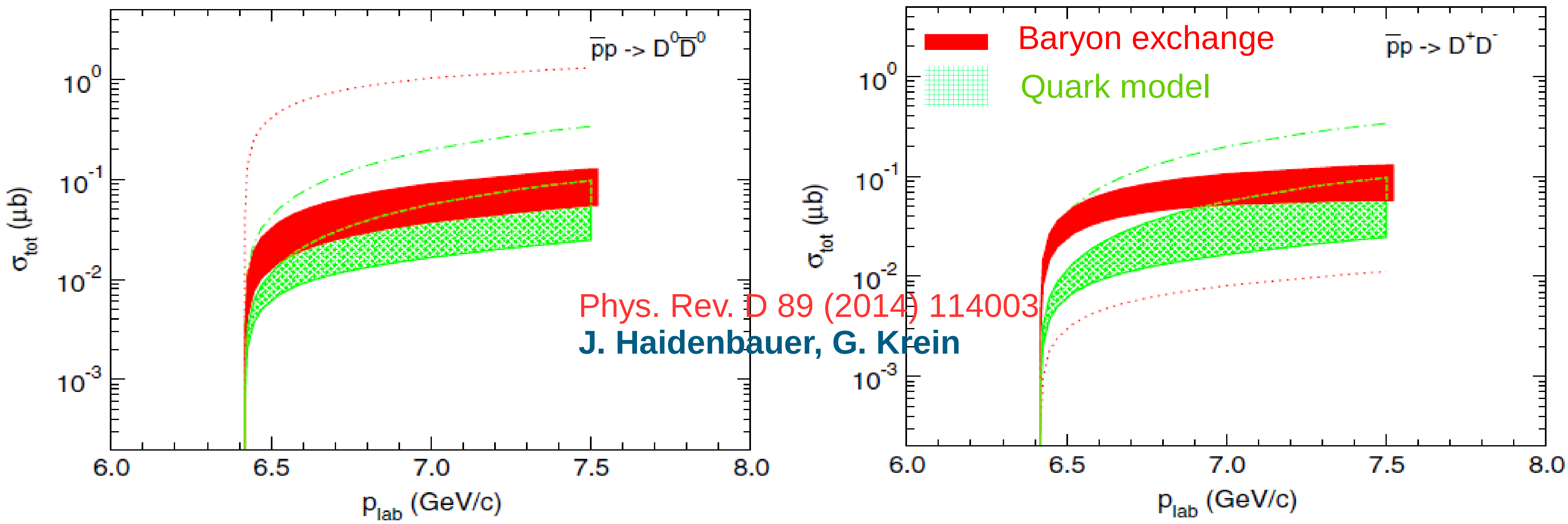


, and



This contribution this contribution

1. Cross section



Phys. Rev. D 89 (2014) 114003
J. Haidenbauer, G. Krein

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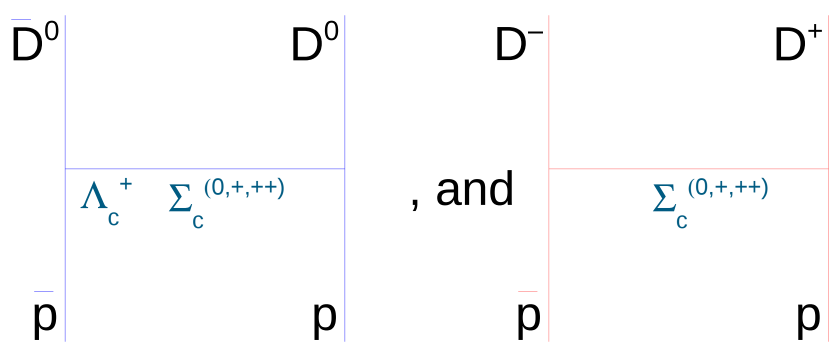
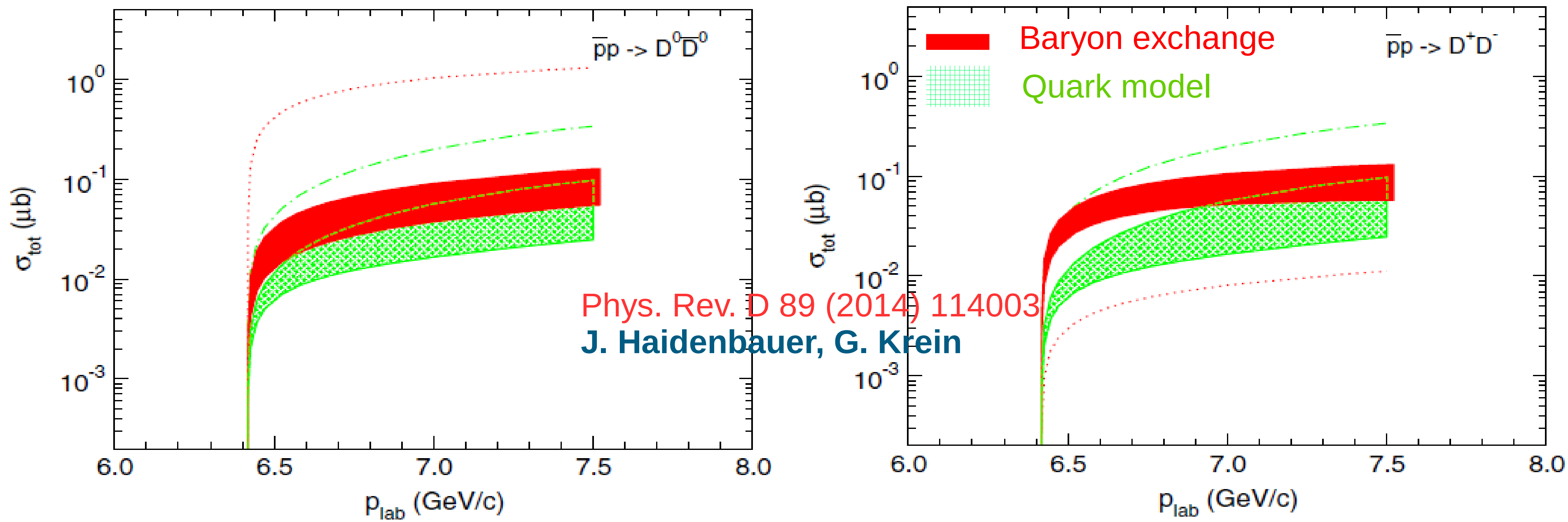


This contribution is ≫10 larger than this contribution

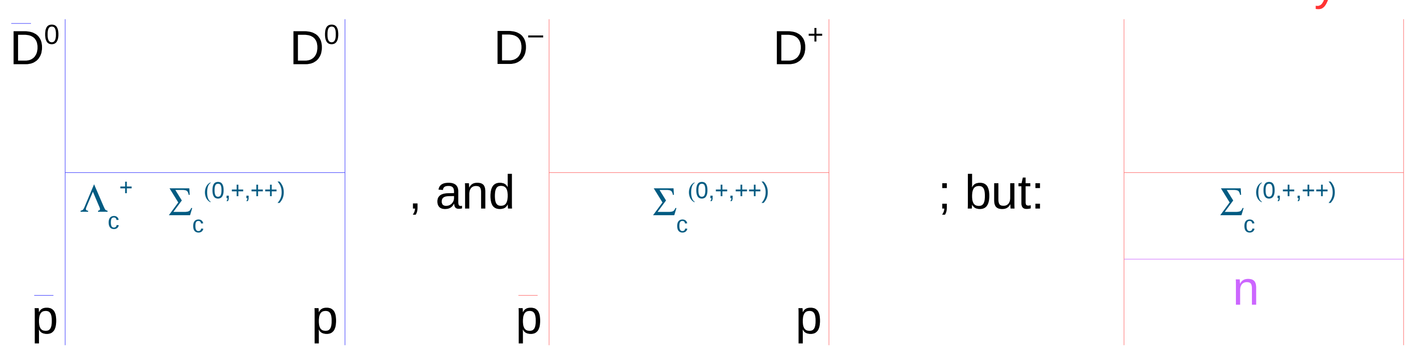
1. Cross section



Phys. Rev. D 89 (2014) 114003
J. Haidenbauer, G. Krein

- Cross section prediction in the PRD 89 (2014) 114003 are higher than in EPJ A 48 (2012) 31 → different assumption: here (PRD paper) they rely in SU(4); coupling constant is fixed

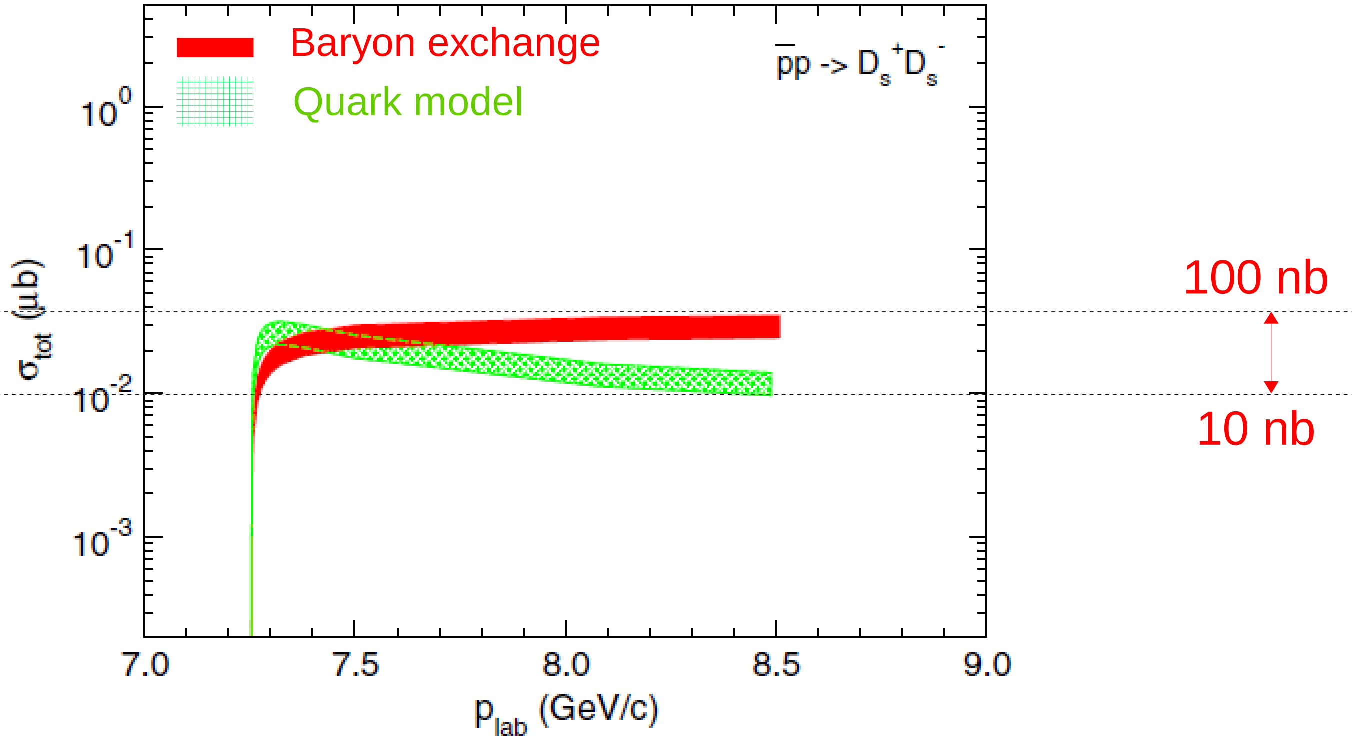
Can we rely in SU(4)?



This contribution is >10 larger than this contribution; but a neutron in the loop as intermediate state can rise up the $\sigma(p\bar{p} \to D^+D^-)$ at same level as $\sigma(p\bar{p} \to \bar{D}^0D^0)$

1. Cross section

Phys. Rev. D 89 (2014) 114003
J. Haidenbauer, G. Krein



- With the approach described in slide 11, $\sigma(\bar{p}p \to D_s^+ D_s^-)$ should be more feasible

What about the cross section of $\bar{p}p$ to excited **D_s** state?

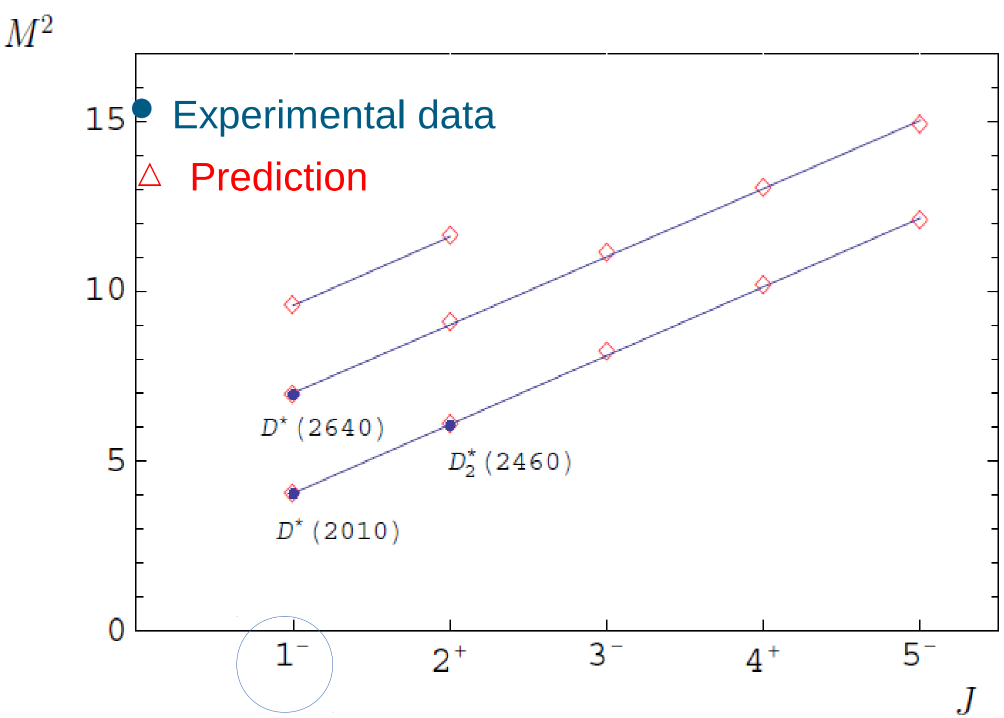
It is more complicated!

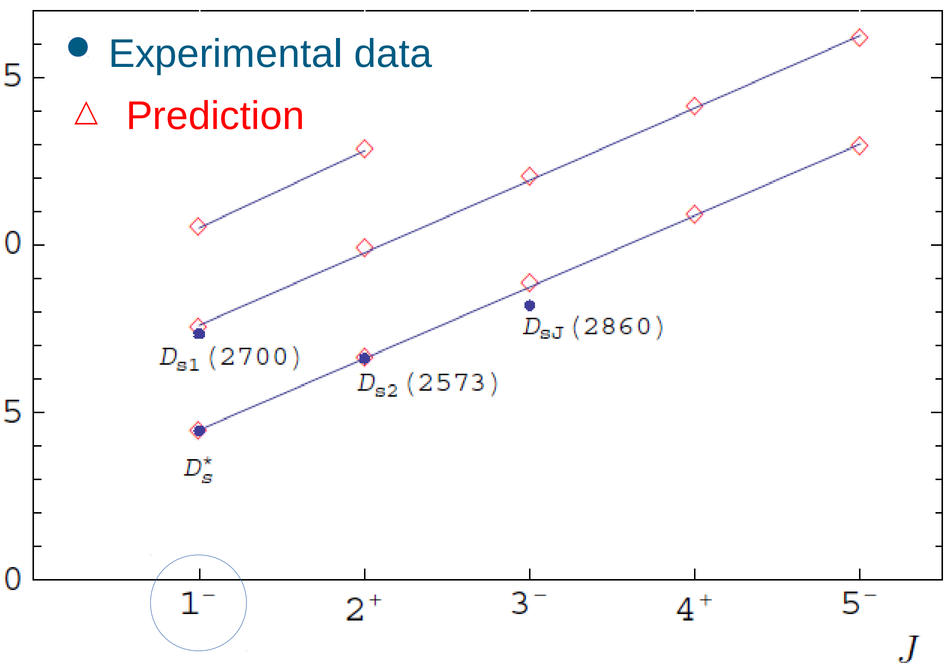
We do not know anything about the coupling constant for D_s^* ⇨ we need REAL data!
Coupling constant are not fixed....

1. Cross section

- In the theoretical calculation for the cross section of $\bar{p}p \rightarrow \bar{D}D$ states, vector states could be involved in the loop, but technical problems occur.
- There are divergences difficult to cure.
- *Ragge trajectories* are introduced for this purpose (α).

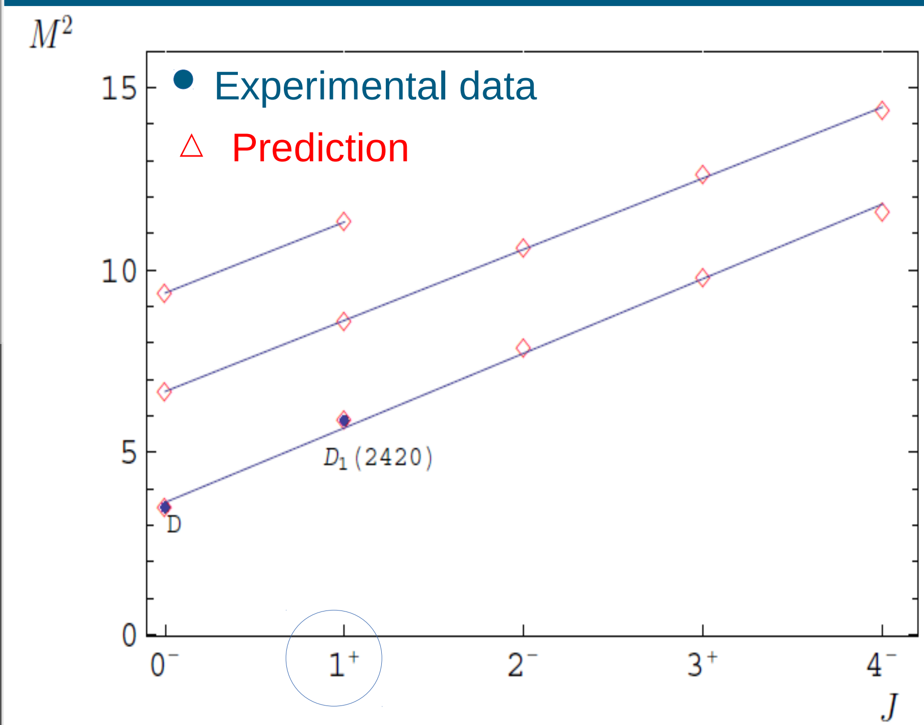
D. Ebert, R. N. Faustov, V. O. Galkin
Eur.Phys.J.C66:197-206,2010

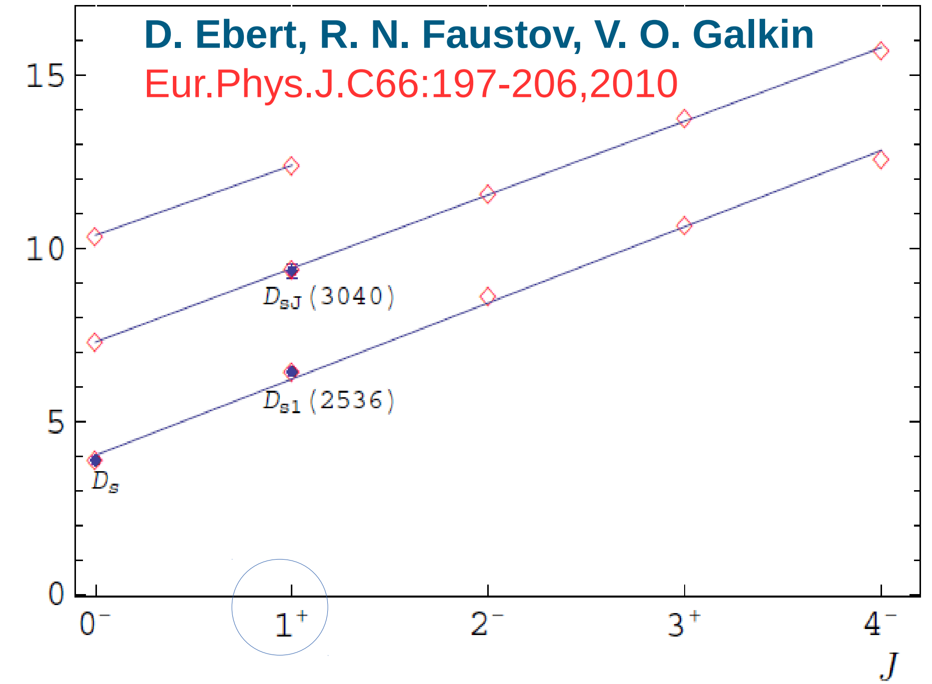




- Ragge trajectories for D(s) mesons with natural parity
- Both light (q=u,d,s) and heavy (Q=c,b) quarks are treated fully relativistically without application of the heavy quark $1/m_Q$ expansion.

1. Cross section





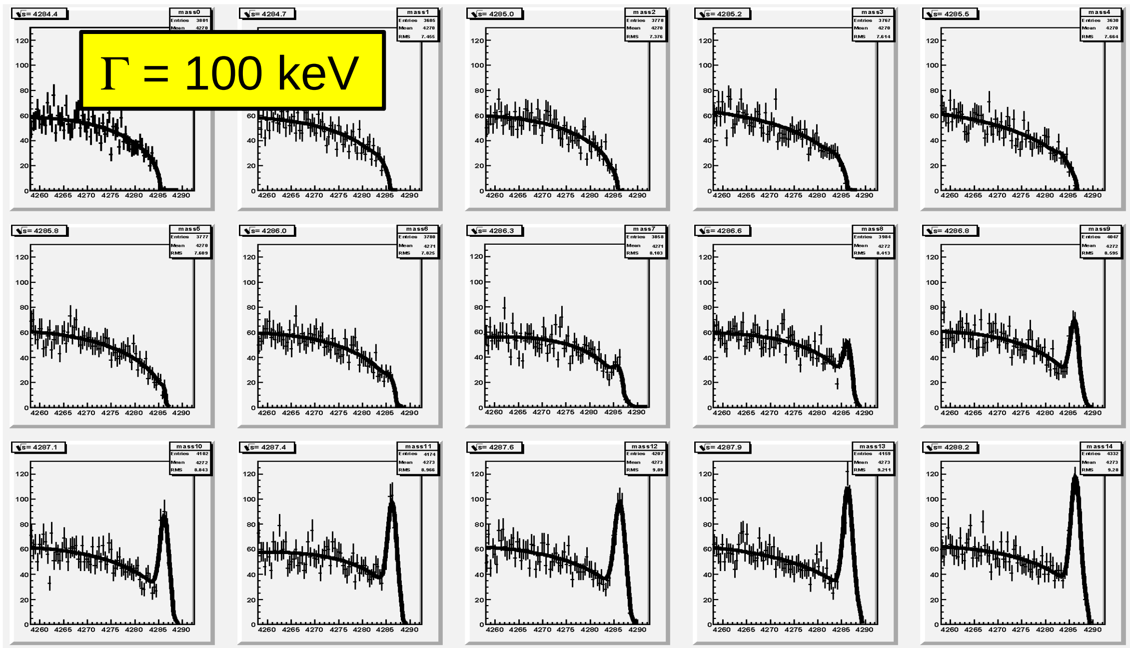
- Ragge trajectories for D(s) mesons with unnatural parity

We calculated the masses of ground, orbitally and radially excited heavy-light mesons up to rather high excitations. This allowed us to construct the Regge trajectories both in (J, M^2) and (n_r, M^2) planes. It was found that they are almost linear, parallel and equidistant. Most of the available experimental data nicely fit to them. Exceptions are the anomalously light $D^*_{s0}(2317)$, $D_{s1}(2460)$ and $D^*_{sJ}(2860)$ mesons, which masses are 100-200 MeV lower than various model predictions. The masses of the charmed-strange $D^*_{s0}(2317)$, $D_{s1}(2460)$ mesons almost coincide or are even lower than the masses of the partner charmed $D^*_0(2400)$ and $D_1(2427)$ mesons. These states thus could have an exotic origin. It will be very important to find the bottom counterparts of these states in order to reveal their nature.

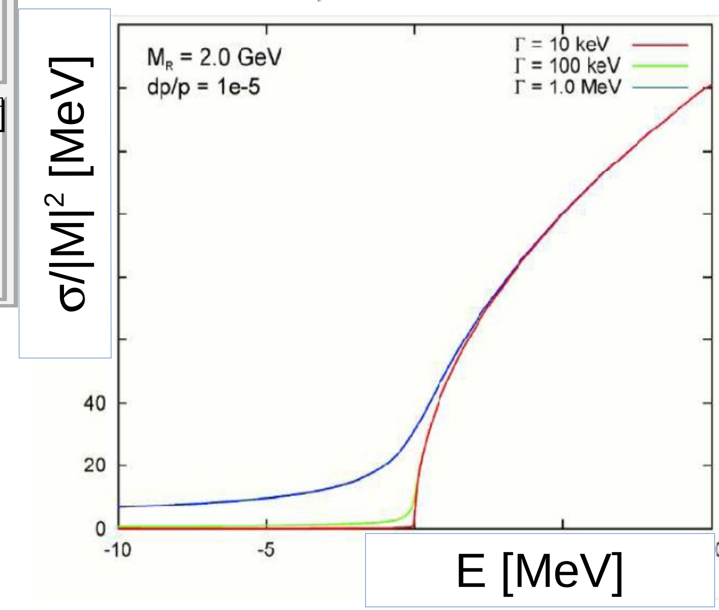
2. Scan of $D_{s0}^*(2317)^+$

- $D_{s0}^*(2317)^+ \rightarrow D_s^+ \pi^0$

M. Mertens



What do we want to measure?



We need to perform this simulation with full PandaRoot simulation tools

- PDG: Γ <4.6 MeV at 90% c.l.
- Excitation function of the cross section:

$$\sigma(\lambda) = \sqrt{m_R \Gamma}\,|M^2|\,\frac{1}{\pi}\int_{-\infty}^{\lambda} \mathrm{d}x,\ \frac{\sqrt{\lambda - x}}{x^2+1}$$

$$\sigma(0) = \sqrt{\frac{m_R \Gamma}{2}}\,|M^2|$$

$$\lambda = (\sqrt{s} - 2M_R)/\Gamma$$

2. Scan of $D_{s0}^{*}(2317)^{+}$

Process: $\bar{p}p \rightarrow D_s^- D_s(2317)^+$ [antiproton against proton (fix target)]

$$\sqrt{s} = \sqrt{2m_p^2 + 2E_p m_p}$$

- m_p = proton mass
- $\sqrt{s}$ = energy c.m. of the system $D_s^- + D_s(2317)^+$
- E_p = energy of the antiproton beam

- At threshold of [$D_s^- + D_s(2317)^+$] production:

$\sqrt{s} = 4.28629$ GeV/c^2

$$\lambda = \sqrt{s} - m[D_s^-] - m[D_s(2317)^+]$$

$m_p = 0.938272$ GeV/c^2
$m[D_s^-] = 1.96849$ GeV/c^2
$m[D_s(2317)^+] = 2.3178$ GeV/c^2

$$\sigma(\lambda=0) = \sqrt{\frac{m[D_s(2317)^+] \cdot \Gamma}{2}} \cdot |\mathcal{M}^2|$$

Cross section at the threshold of the process

Getting started...

- Process: $\bar{p}p \rightarrow D_s^- D_s^*(2317)^+$
- 3000 generated signal events/ scan point
- Mass scan every 100 keV in [4285.59 – 4286.99] MeV/c^2
- Total scan plan: 15 points ⇒ 45 000 generated signal events
- Signal events: EvtGen MC generator, with DS_DALITZ model
- Reconstruction: $D_s^- \rightarrow K^- K^+ \pi^-$; $D_s^*(2317)^+ \rightarrow D_s^+ \pi^0$; $\pi^0 \rightarrow \gamma\gamma$;
- $D_s^*(2317)^+$ reconstructed as missing mass of the event (for now!):

  $\rightarrow p^\mu_{Ds(2317)} = p^\mu_{ini} - p^\mu_{Ds}$

  →better efficiency reconstruction due to problems still in EMC and FST software implementation. This is a single tag measurement
- Background study: DPM MC generator

  Process: $pp \rightarrow K^- K^+ \pi^- K^- K^+ \pi^+ \pi^0$, $\pi^0 \rightarrow \gamma\gamma$ [6 charged + 2 neutral tracks]

  $\sigma(\bar{p}p \rightarrow \text{hadrons})$ = **40 mb** at p = 8.8 GeV/c; need to generate: 3B events/scan point, assuming a cross section = **40 nb** for $\bar{p}p \rightarrow D_s^- D_s(2317)^+$

  NOTE: $\sigma(\bar{p}p \rightarrow D_s^- D_s(2317)^+)$ is unknown. Here is an assumption

- Efficiency evaluation for every point of the mass scan
- Mass and momentum resolution check

Pre-selection cuts

Photon momentum	p_γ>100 MeV/c
Charged particle momentum	p_{TRACK}>100 MeV/c
χ^2 PndKinVertex fit	$0.<\chi^2<19.$
PID	"best"
D_s^- mass pre-cut	$\lvert m(K^+K^-\pi^-) - 1.96849\rvert<500$ MeV/c^2
$D_s(2317)^+$ mass pre-cut	$\lvert m(D_s^+\pi^0) - 2.3178\rvert<500$ MeV/c^2

- Release: oct-14
- The package "rho" is used for this simulation
- Selection cuts will be explained later in detail

D_s^- reconstruction after pre-selection

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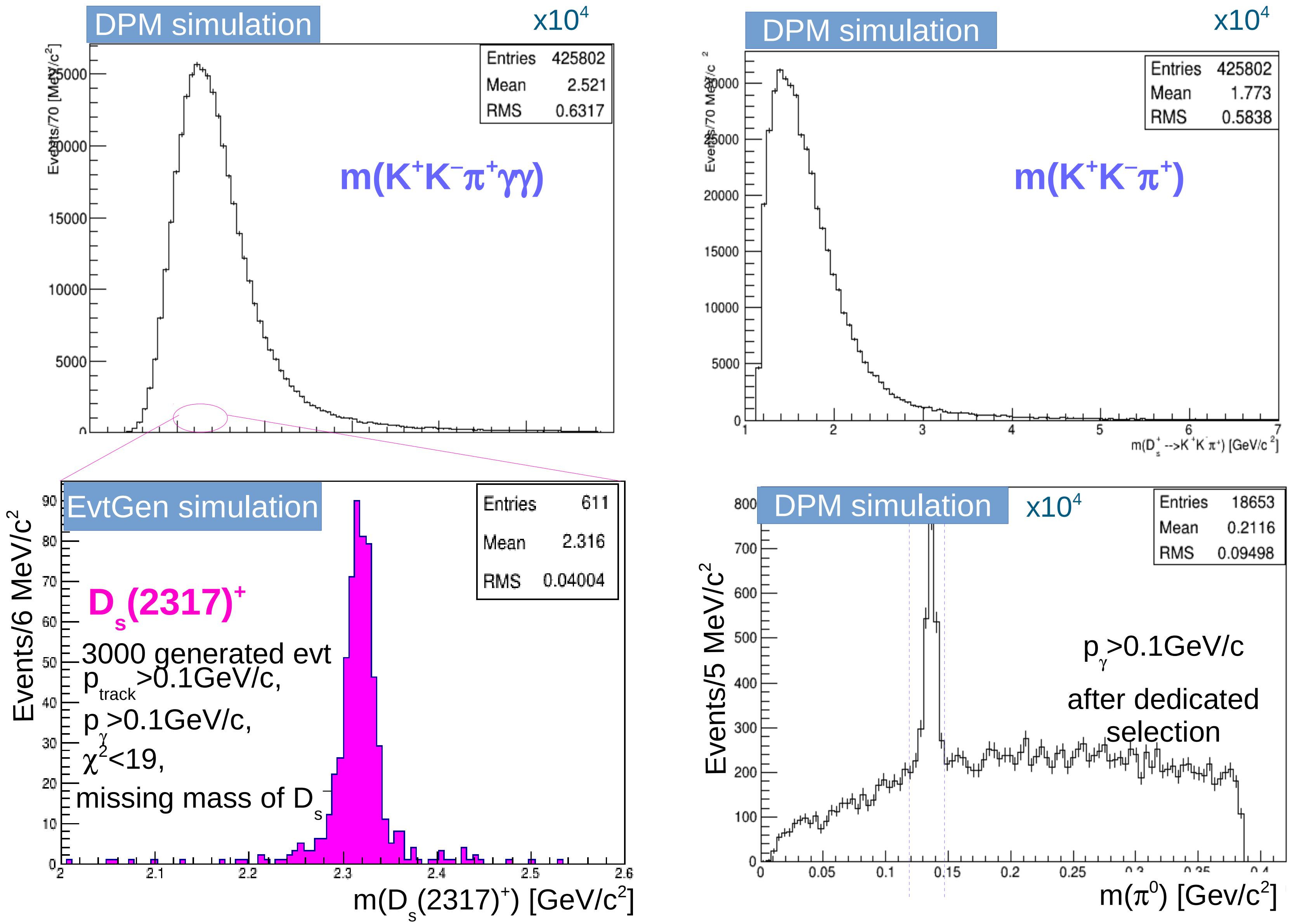
P_{ini}/ MeV/c	E. point/ MeV	Mass/ MeV/c^2	Efficiency/ %	Mass Res./ MeV/c^2	Px Res./ MeV/c	Py Res./ MeV/c	Pz Res./ MeV/c
8802.35	9790.49	4286.29	21.00± 0.74	15.62± 0.57	13.40± 0.59	12.69± 0.55	42.9± 1.8
8802.81	9790.94	4286.39	22.60± 0.76	15.58± 0.72	13.42± 0.54	12.17± 0.67	48.3± 2.1
8803.27	9791.40	4286.49	20.67± 0.74	15.50± 0.79	13.37± 0.53	12.51± 0.51	54.5± 2.8
8803.73	9791.86	4286.59	20.70± 0.74	15.91± 0.81	14.35± 0.63	12.54± 0.51	54.3± 2.3
8804.19	9792.32	4286.69	21.57± 0.75	15.66± 0.69	13.91± 0.65	12.77± 0.69	49.7± 2.2
8804.65	9792.77	4286.79	22.57± 0.76	15.14± 0.61	14.42± 0.65	12.57± 0.56	48.4± 2.1
8805.11	9793.23	4286.89	22.07± 0.76	14.34± 0.59	13.13± 0.53	12.86± 0.62	47.4± 2.2
8805.57	9793.69	4286.99	20.67± 0.74	14.98± 0.70	13.37± 0.58	12.38± 0.58	50.3± 2.7

$D_s(2317)^+$ reconstruction after pre-selection

P_{ini}/ MeV/c	E. point/ MeV	Mass/ MeV/c^2	Efficiency/ %	Mass Res./ MeV/c^2	Px Res./ MeV/c	Py Res./ MeV/c	Pz Res./ MeV/c
8802.35	9790.49	4286.29	21.00± 0.74	14.90± 0.59	15.49± 0.54	14.30± 0.50	45.4± 2.1
8802.81	9790.94	4286.39	22.60± 0.76	15.79± 0.57	15.23± 0.52	15.58± 0.55	48.5± 2.2
8803.27	9791.40	4286.49	20.67± 0.74	14.87± 0.68	15.64± 0.58	14.58± 0.50	48.8± 2.8
8803.73	9791.86	4286.59	20.70± 0.74	15.88± 0.72	15.85± 0.57	14.74± 0.50	51.3± 2.3
8804.19	9792.32	4286.69	21.57± 0.75	14.37± 0.60	15.69± 0.59	15.69± 0.59	48.9± 2.3
8804.65	9792.77	4286.79	22.57± 0.76	14.72± 0.65	15.83± 0.57	15.89± 0.60	48.4± 2.1
8805.11	9793.23	4286.89	22.07± 0.76	13.79± 0.59	14.59± 0.49	15.29± 0.52	47.4± 2.3
8805.57	9793.69	4286.99	20.67± 0.74	14.22± 0.71	15.74± 0.58	14.44± 0.51	50.8± 2.5

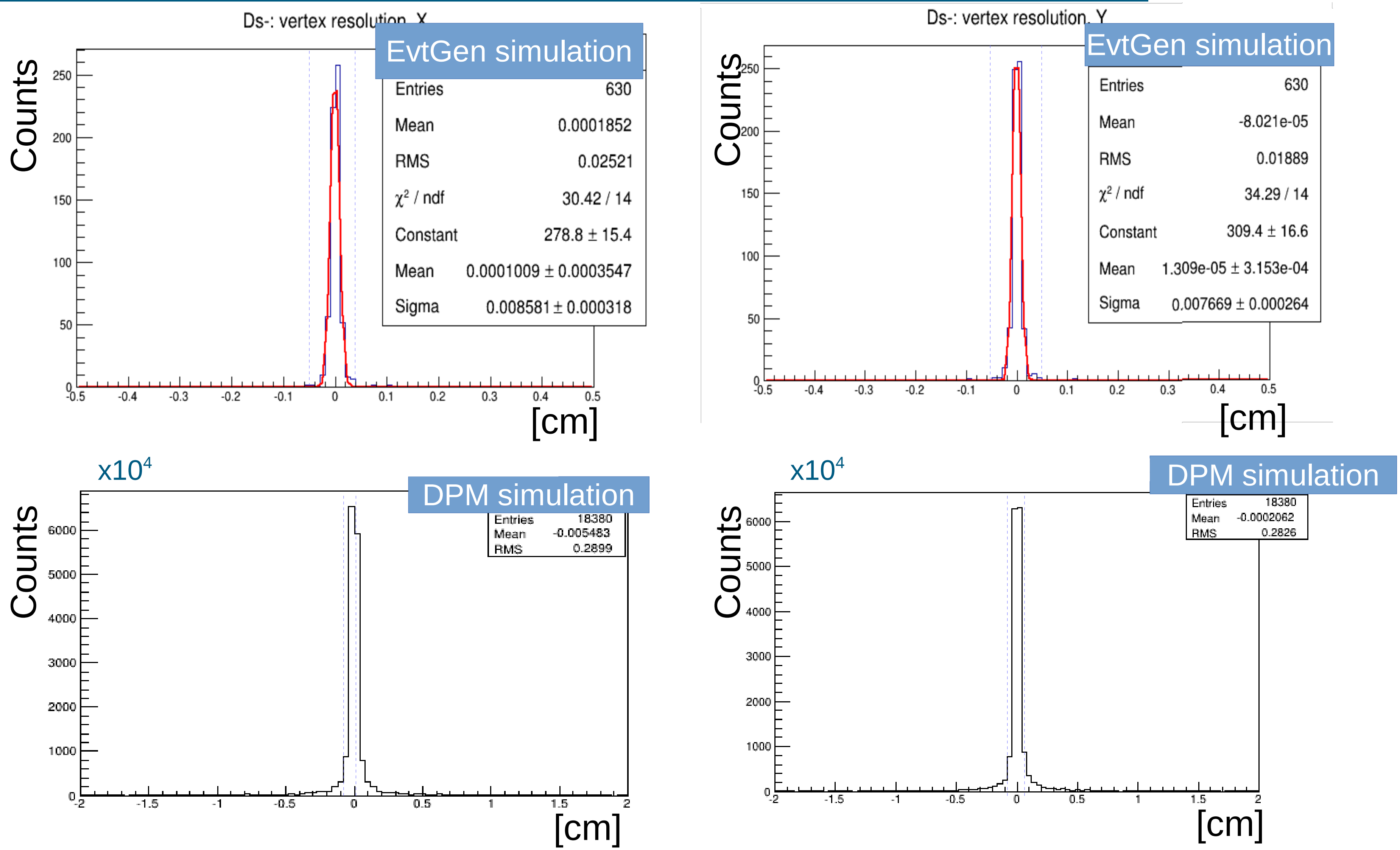
$D_s(2317)^+$ reconstruction: bkg study

After pre-selection cuts:



Bkg here is **NOT** scaled to the n. of events generated by EvtGen

Vertex selection: D_s^-

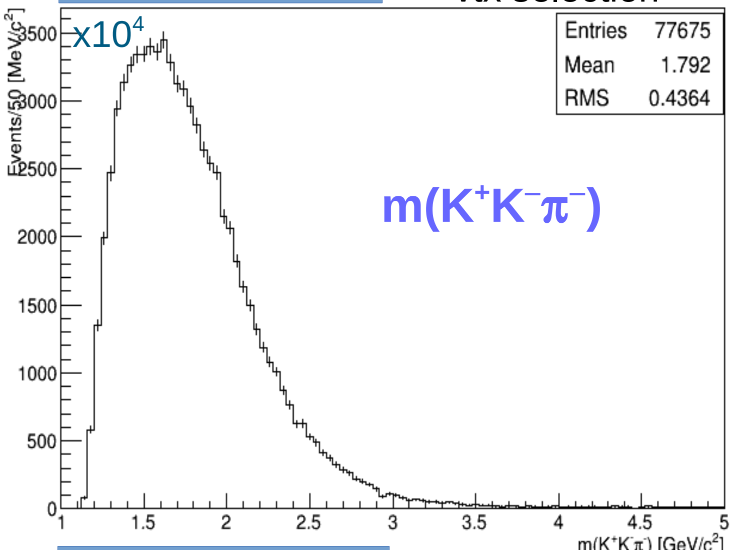


- Proposed cut: |Vtx X|<48 μm; |Vtx Y|<43 μm

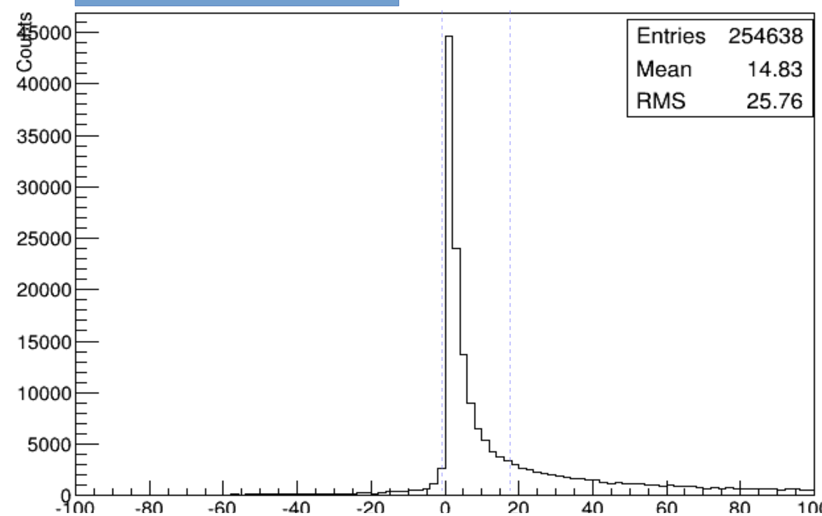
Post-fit selection: χ^2 of the D_s^- fit

After pre-selection cuts: p_{track}>0.1GeV/c,
χ^2<19,
vtx selection

DPM simulation

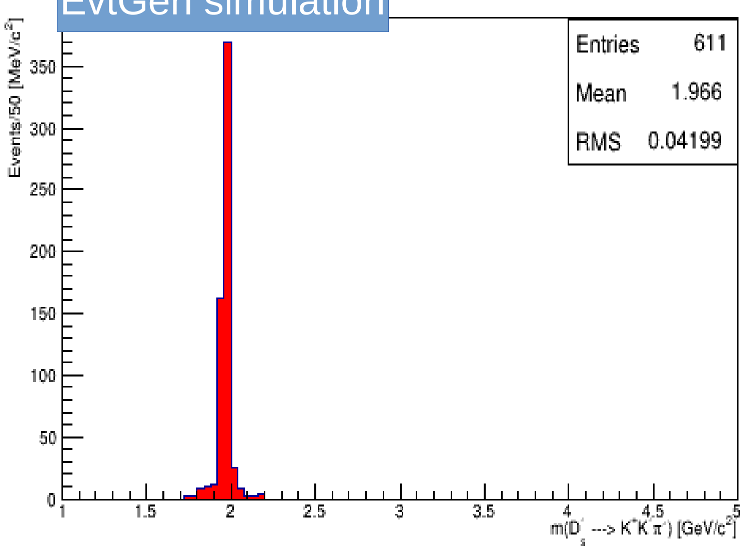


DPM simulation

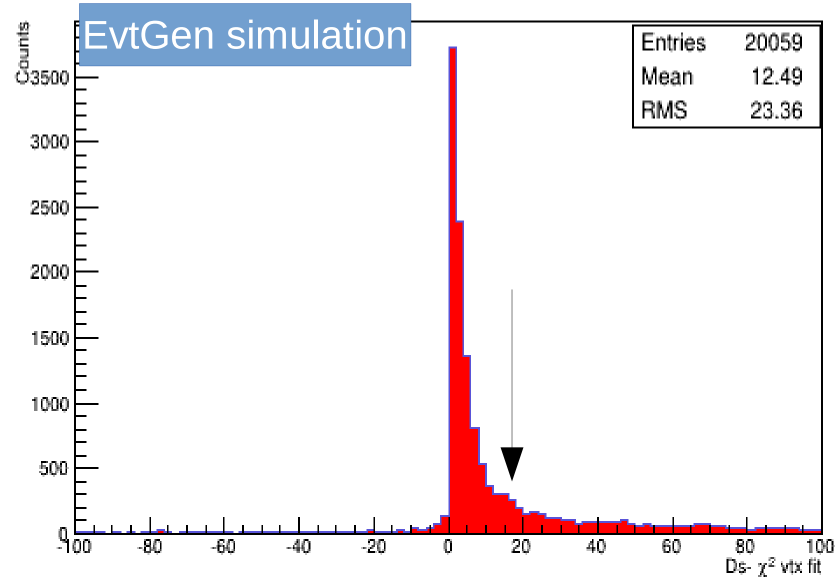


Bkg here is **NOT** scaled to the n. of events generated by EvtGen

EvtGen simulation



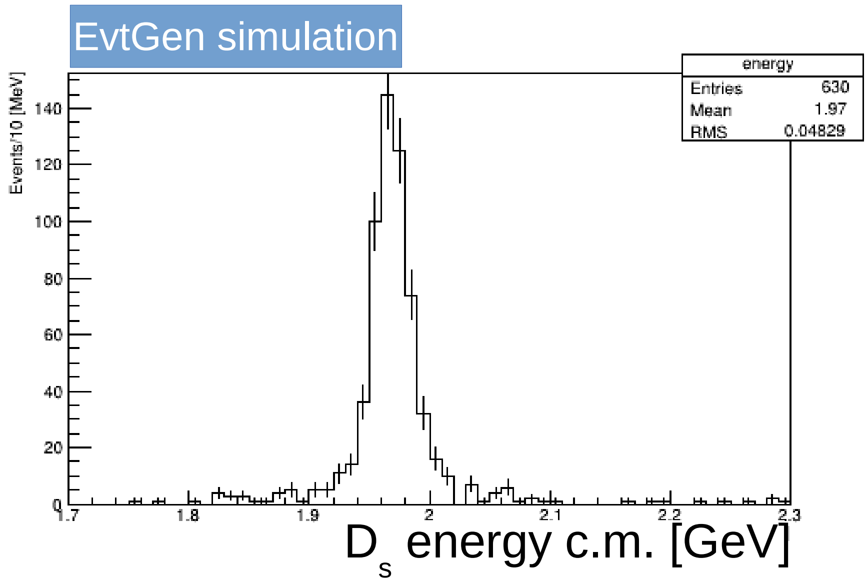
EvtGen simulation

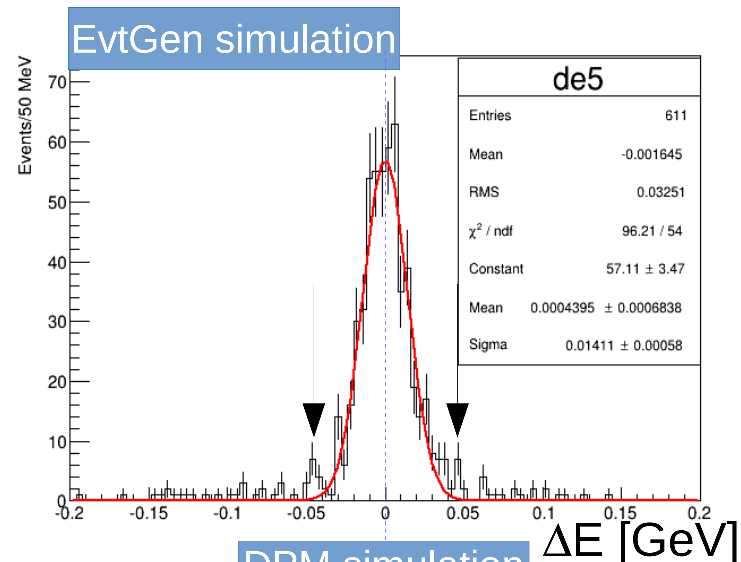


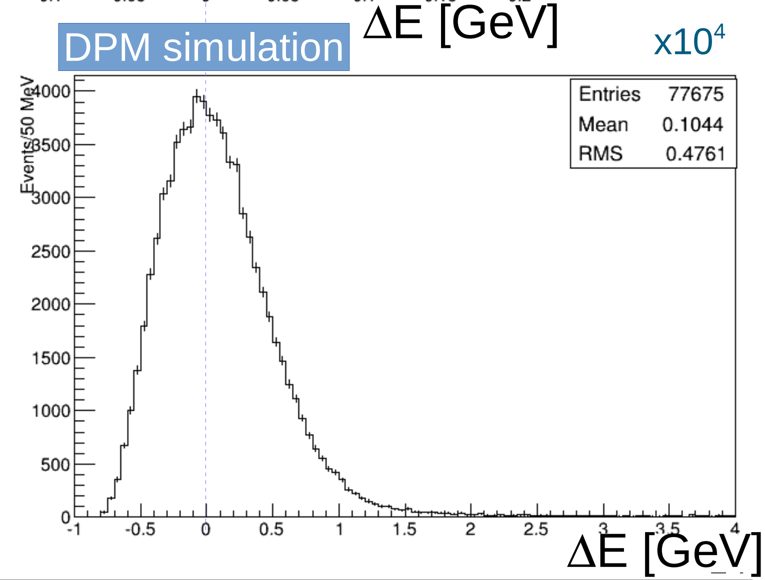
Post-fit selection: ΔE variable

- In the center of mass system of D_s^-:

$E^*_D = m_D \Rightarrow$ **$\Delta E_D = E^*_D - m_{D(PDG)}$** → It is a Gaussian centered in 0







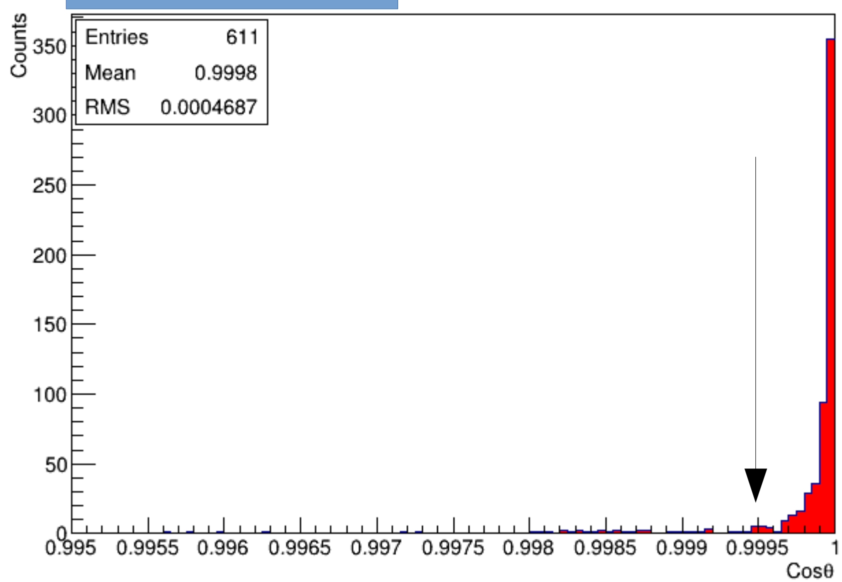
- An opportune ΔE selection can reject mostly the $q\bar{q}$ background

❶Loose cut: $|\Delta E|<0.07$ GeV

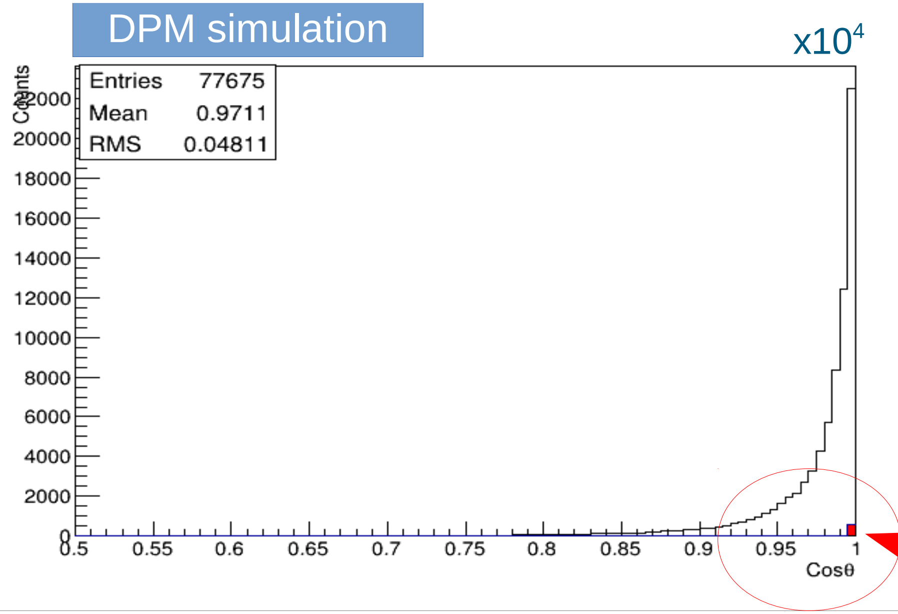
❷Tight cut: $|\Delta E|<0.05$ GeV

Post-fit selection: Cosθ_{Ds-}

EvtGen simulation



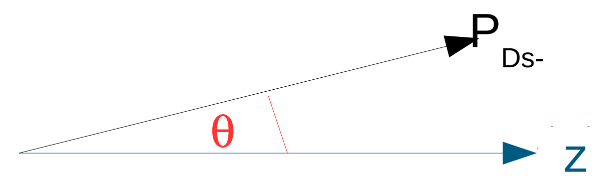
DPM simulation



SIGNAL

- D_s^- mesons are emitted at very small angle, at threshold, due to the Lorentz boost

E~9.8 GeV ⇨ β ~ 0.9



- Proposed cut: Cos θ>0.9995

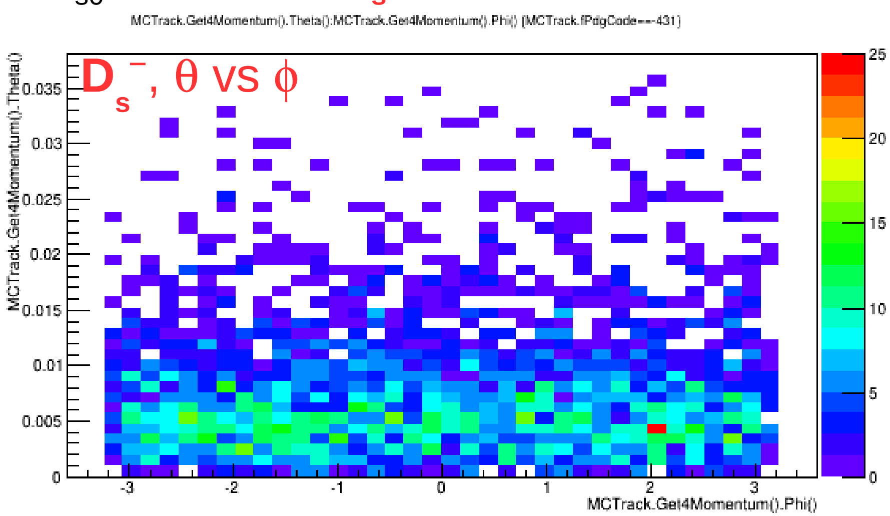
Simulated events: θ vs φ

Study of simulated events, with **EvtGen**:

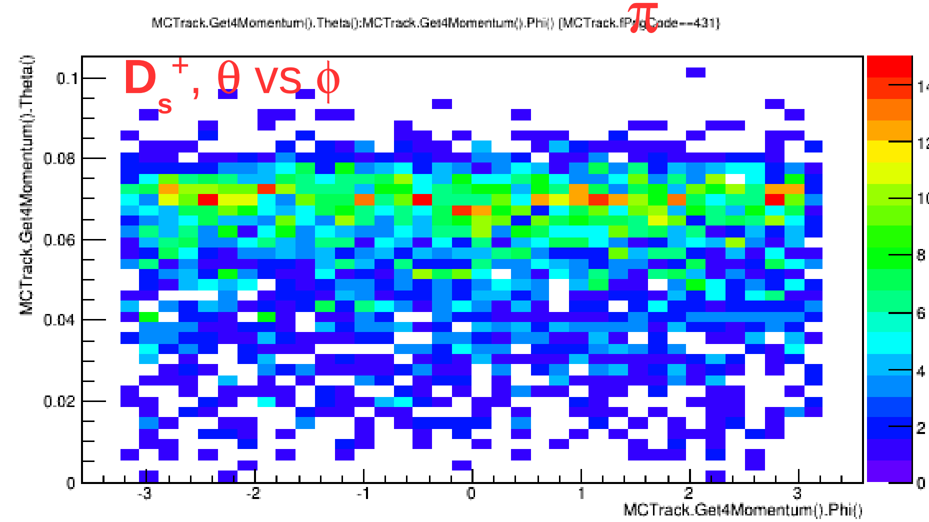
- ▸**D_s^-** to 3 charged tracks, DS_DALITZ
- ▸$D_{s0}^*(2317)^+$ to **D_s^+**π^0, PHSP

- $p\bar{p} \rightarrow$ **D_s^-** $D_s(2317)^+$

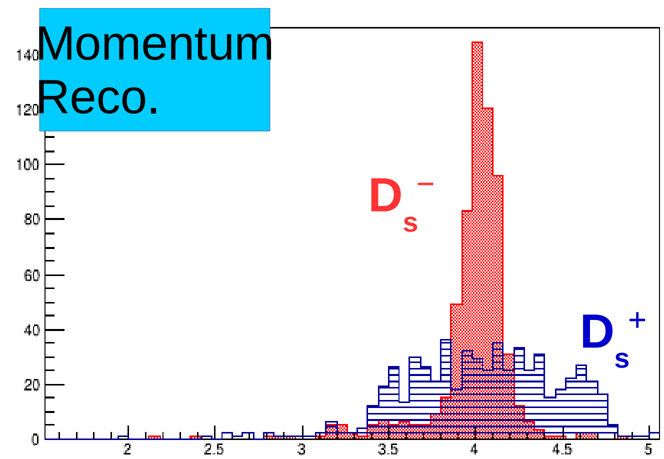
D_s^- $\rightarrow K^- K^+ \pi^-$



Polar angle in a few degrees;
φ uniformly distributed



Polar angle in a larger range;
φ uniformly distributed

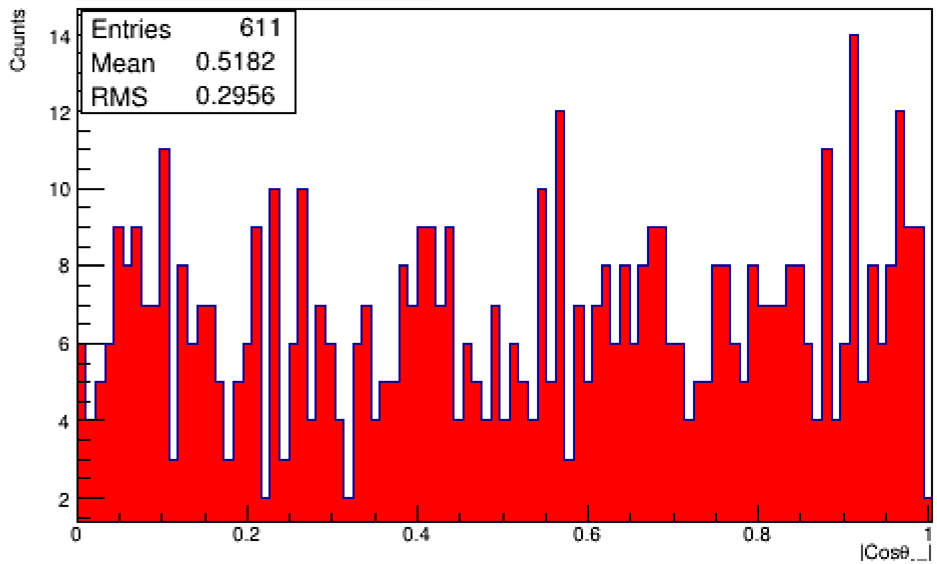


pp $\rightarrow$ **D_s^-** $D_s(2317)^+$

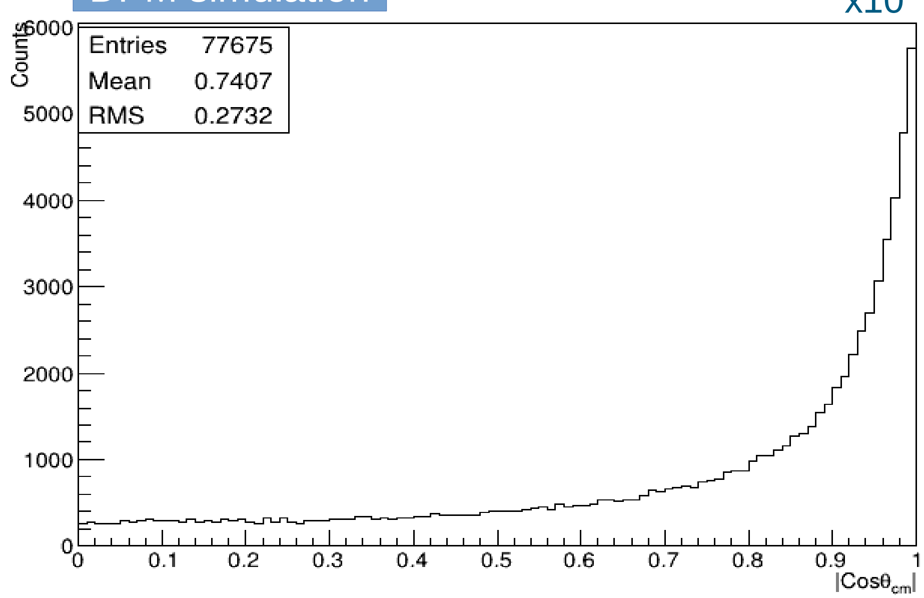
$D_s^*(2317)^+ \rightarrow$ **D_s^+** π^0

Post-fit selection: $|Cos\theta_{Ds-}|$ (c.m.)

EvtGen simulation



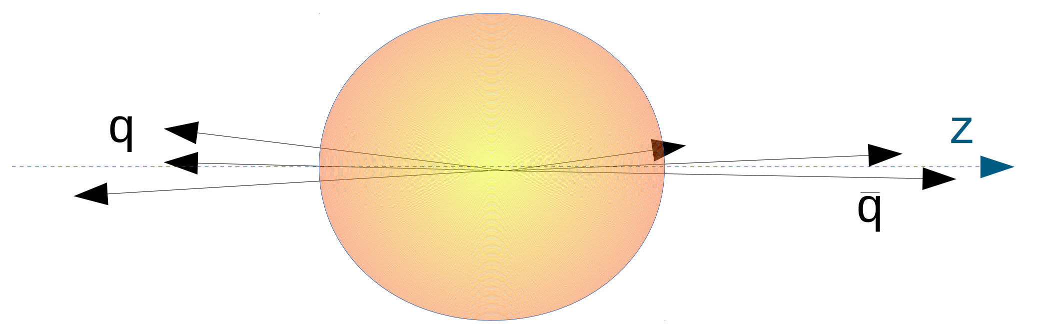
DPM simulation



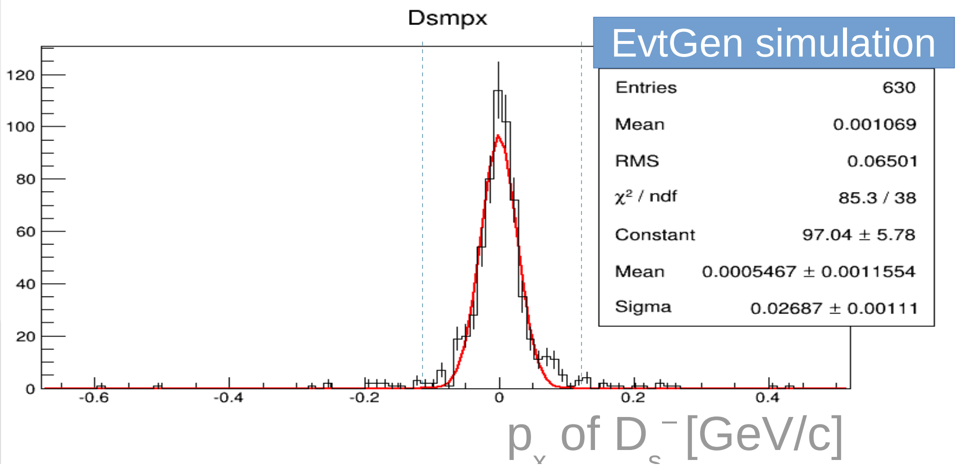
- Distribution of the cosin of the polar angle in the c.m. frame of the D_s^- is homogeneous for signal events, while it is stretched to ±1 for background events (u, d, s quark comb.)

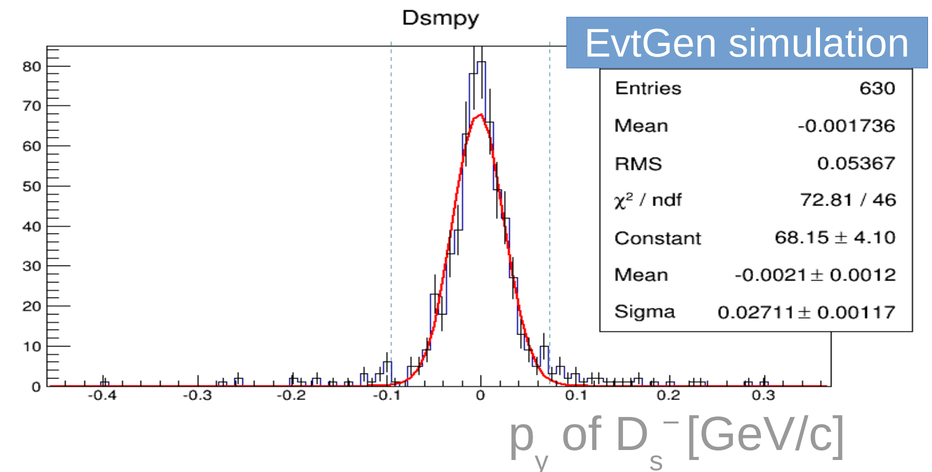
$D_s^- = |\bar{c}s>$

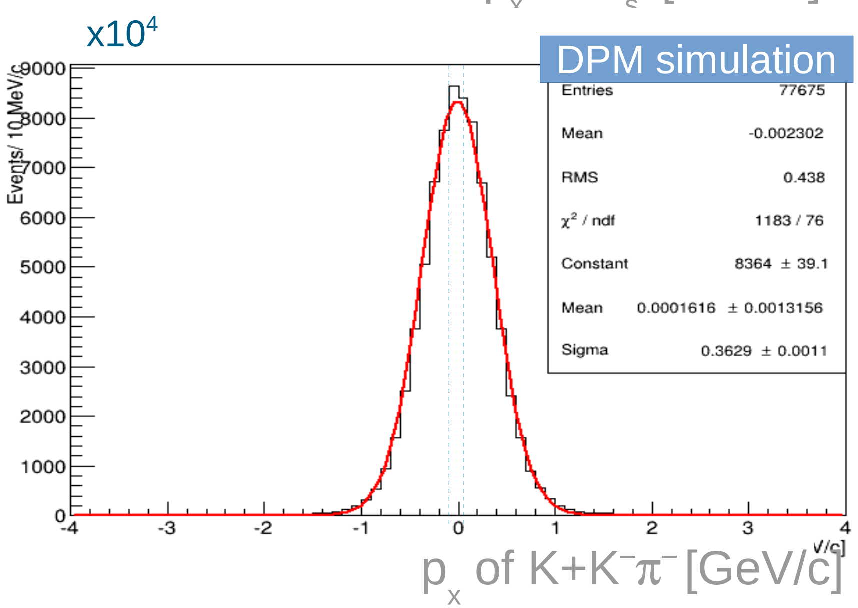
D_s^- c.m system

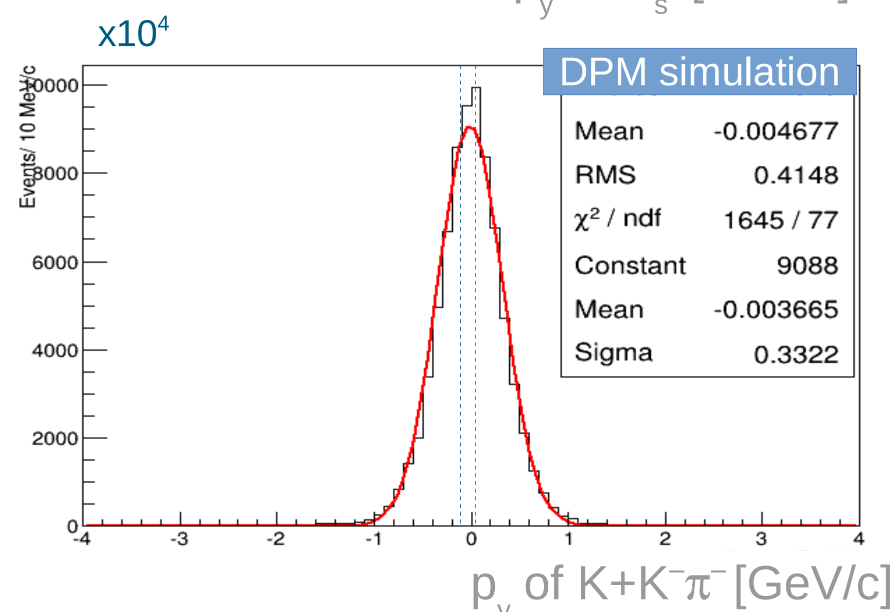


Post-selection cuts: p_x, p_y of D_s^-





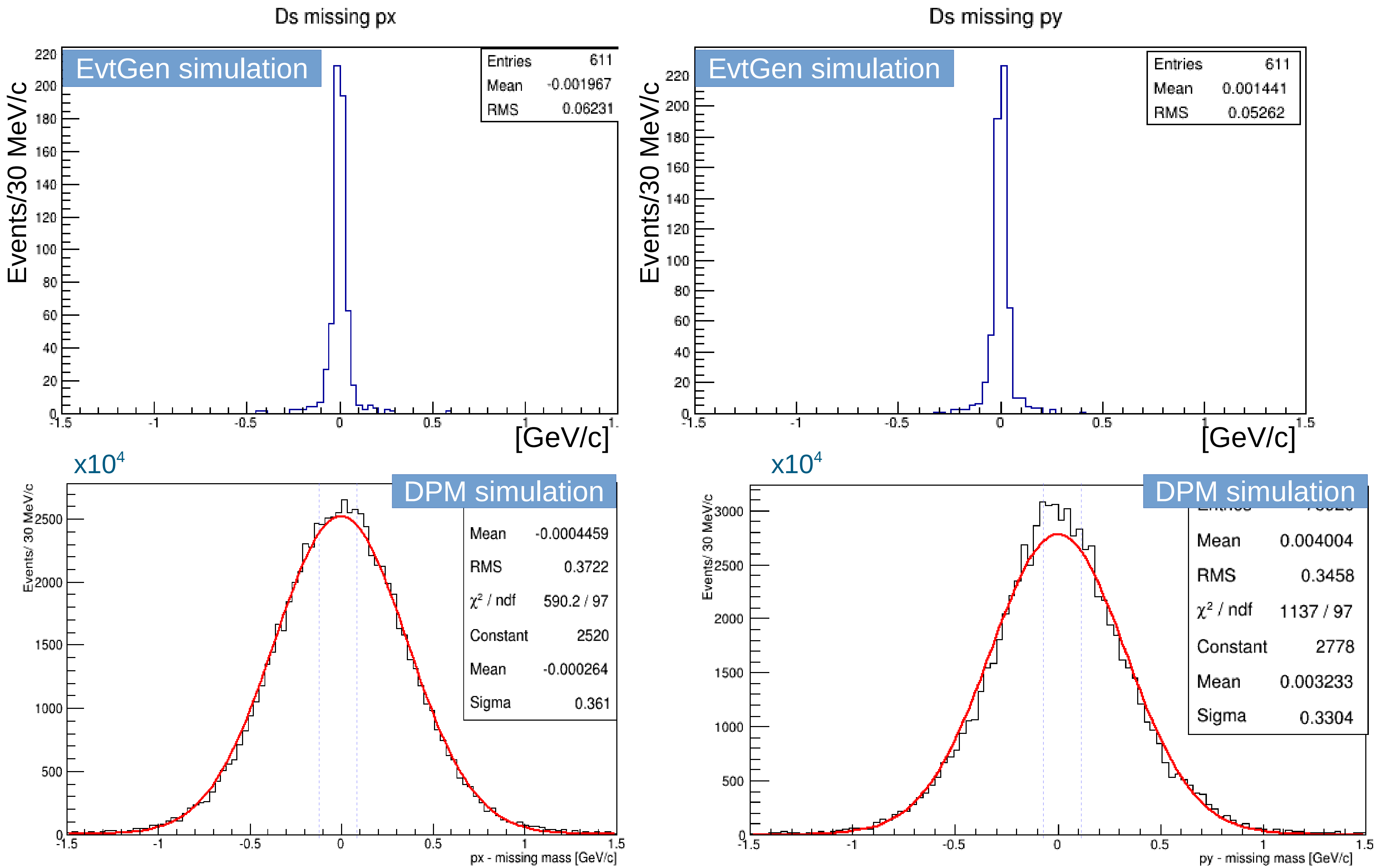




Proposed selection:
❶Very Loose cut: |px|, |py| <0.2 GeV/c
❷Tight: |px|, |py| <0.1 GeV/c

With a double-gaussian fit, px, py resolution ~14 MeV/c. A safe window: 5σ ⇨ |px|, |py| < 70 MeV/c ⇨ the tight cut is still a safe cut.

Post-fit selection: $D_s(2317)^+$



Post-fit selection: summary

- Test performed on 3000 signal events and a reduced sample of total DPM background
- Study of kinematic variables is performed, to identify those rejecting the DPM background

Loose post-fit selection cuts

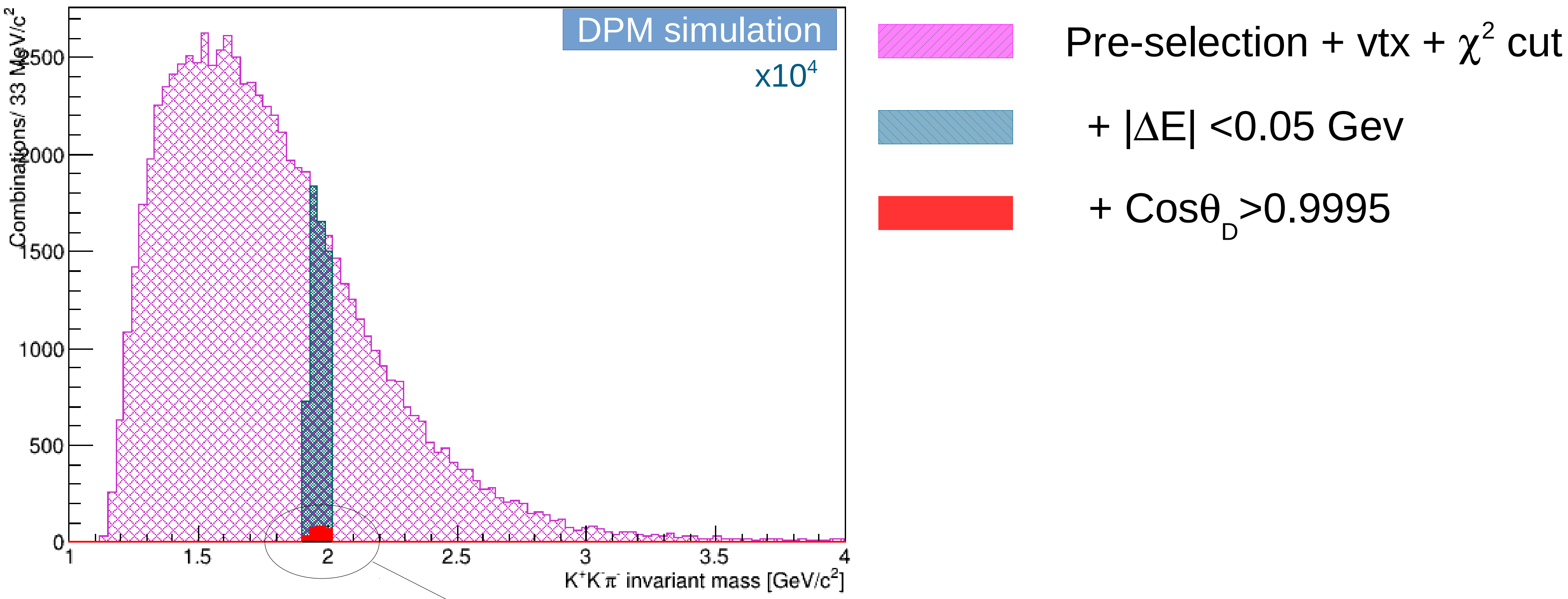
Variables	Signal	Bkg – arbitrary sample
Pre-selection	630	112143
$77<V_x<95$ μm $68<V_y<86$ μm	611	77675
$\|\Delta E\|<0.07$ GeV	568	10738
$\cos\theta>0.999$	558	803
$\|p_{x,y}\|<0.2$GeV/c	558	648
$p^*_D<0.3$ GeV/c	558	248
$\|p^*_{Dx,y}\|<0.1$GeV/c	540	122
$\|p^*_{Dz}\|<0.15$ GeV/c	536	39
$\cos\theta_D*$		

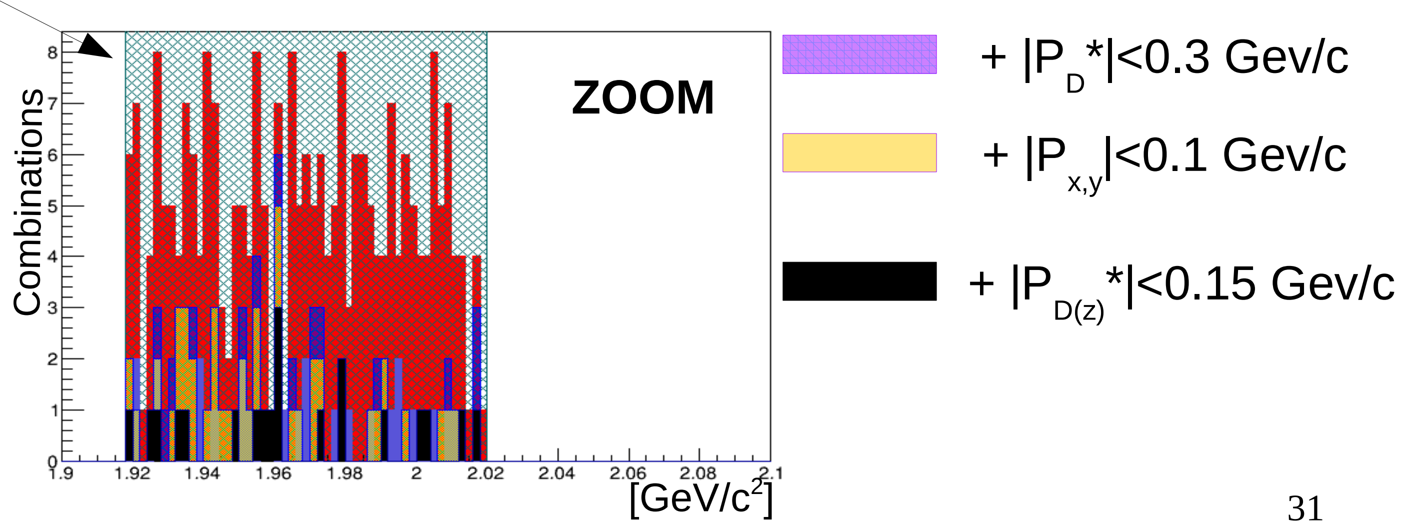
Tight post-fit selection cuts

Variables	Signal	Bkg – arbitrary sample
Pre-selection	630	112143
$77<V_x<95$ μm $68<V_y<86$ μm	611	77675
$\|\Delta E\|<0.05$ GeV	557	7702
$\cos\theta>0.9995$	550	551
$\|p_{x,y}\|<0.1$GeV/c	533	254
$p^*_D<0.3$ GeV/c	533	60
$\|p^*_{Dx,y}\|<0.1$GeV/c	533	60
$\|p^*_{Dz}\|<0.15$ GeV/c	526	18
$\cos\theta_D*$		

Signal efficiency: from **21.00%** to **17.87%**... ...or **17.53%**

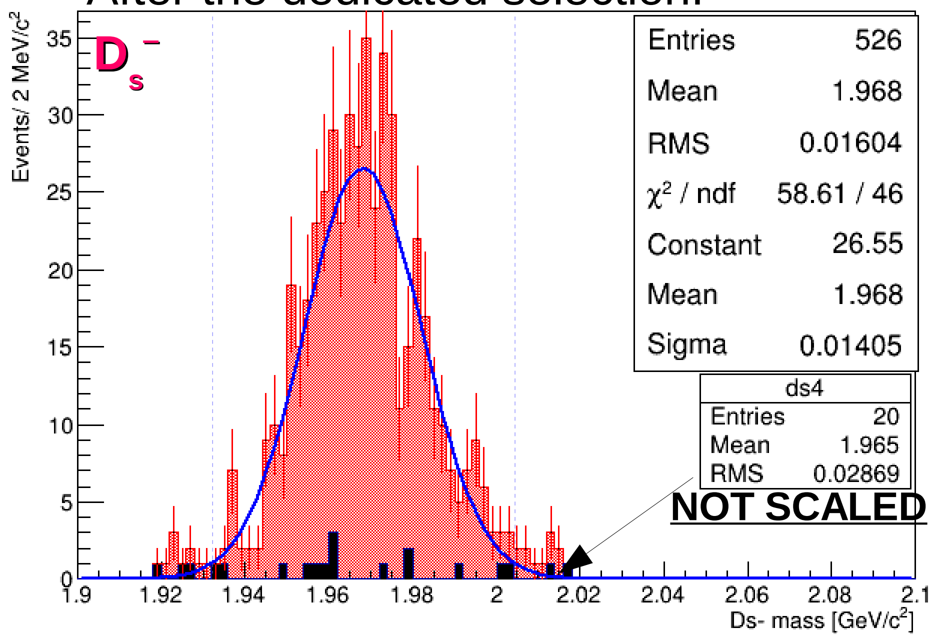
Post-fit selection: proposed cuts



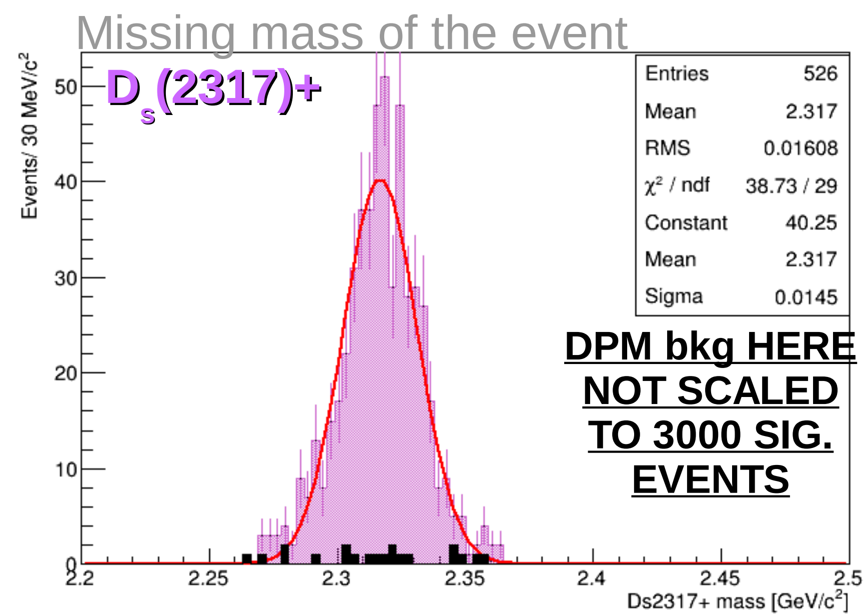


Post-fit selection: summary

After the dedicated selection:



- **Efficiency: (17.53± 0.69)%**
- **Full PandaRoot simulation**
- Figure of merit: D_s mass
- Bkg sample for this study: arbitrary
  It is useful to study the variable distributions
  Bkg needs STILL TO BE SCALED by the proper factor: work in progress (jobs in run...)



- **Plan:**

❶to identify the most effective variables to reject the background ✓
❷to build a Fisher discriminant
❸maximize the ratio S/B when selecting variables
❹assumption for the calculation:
σ(signal) = 40 nb; σ(bkg) = 40 mb.

Mass scan of $D_s(2317)$ in PANDA

JÜLICH FORSCHUNGSZENTRUM

- Calculations are performed with: ΔM_{STEP} = 100 keV/c^2.

  By design (high resolution mode): $\Delta p/p = 4 \cdot 10^{-5} \Rightarrow \Delta M \cong 80$ keV/c^2

If we run in high-resolution mode,
a mass scan in 100-keV-steps can be feasible.

how long time do we need to run?

Momentum limit, if we run in high resolution mode: p = 8.9 GeV/c.
For this analysis: p<8.9 GeV/c.

For comparison:

E760, with $\Delta p/p \leqslant 2\cdot10^{-4}$ measured $\Gamma(J/\psi)$ = (99±12±6) keV

Summary

- Renewed interest on $D_s(2317)$.

  The analyses $\bar{p}p \rightarrow D_s^- D_s(*)^+$ are work in progress in rel-oct14;

  EventFilter is used simulate events: it works fine!
- Missing mass of the event is used to reconstruct $D_s(*)$:

  still problems with fitter χ^2, EMC, π^0 reconstruction...

  ...but it is easy reconstruct D_s^- to charged tracks.
- Feasibility studies on the bkg rejection are ongoing: need billions events. Identification of some kinematic variables for bkg-rejection has been presented.
- Reconstruction efficiency is still high after the main selection cuts: ~ 17.5%, and bkg is efficiently reduced.
- In the new rel-oct14 a double gaussian function is needed to parameterize the momentum resolution, after pre-selection (different from rel: scrut-14).
- An analysis note is planned to report on this work: 3000 events/scan point correspond to ~ 12 hours/ point (using the numbers obtained from this talk, e.g. assuming σ = **40 nb**, ε = **17.5%** and $\mathscr{L}$= **0.86** pb^{-1}/day).

  But we need to scale by $BR(D_s \rightarrow KK\pi)\sim$ 6% ⇨ **8 days/scan point!**
- Evaluation is still a way too optimistic: efficiency will be reduced when selection is finalized. **Need the full DPM simulation before quoting any number!**

"The greatest danger for most of us lies not in setting our aim too high and falling short; but in setting our aim too low, and achieve our mark." (Michelangelo, 1475 - 1564)

THANK YOU for your attention!