

Hadron Production in Photon-Photon Processes and BSM signatures with small mass differences

Sw-Ana Meeting

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Benchmark Scenario

> Light higgsinos $\tilde{\chi}_1^0$, $\tilde{\chi}_2^0$ and $\tilde{\chi}_1^\pm$ can be discovered/ excluded at ILC - DESY-THESIS-2016-001

> The case was studied at two benchmark scenarios

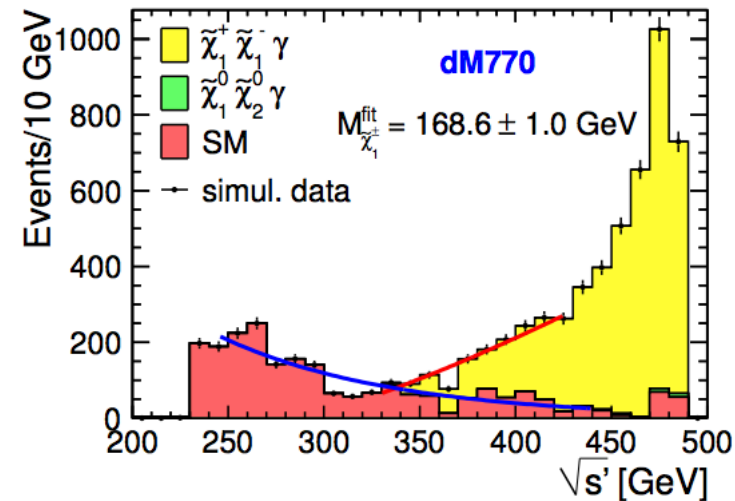
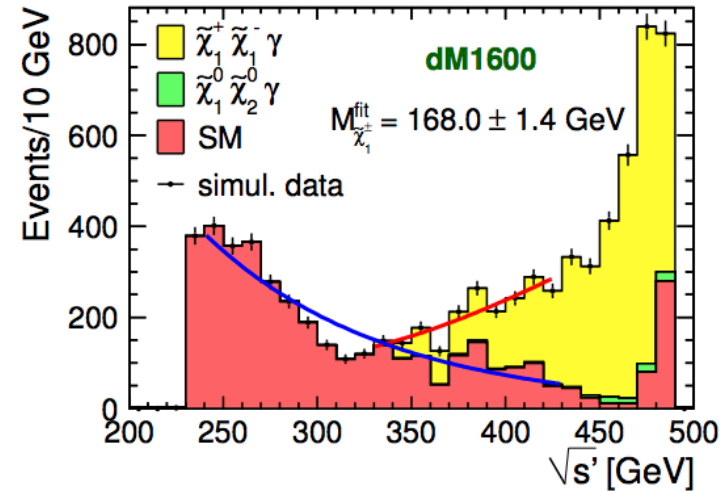
$$\Delta M(\tilde{X}_1^\pm, \tilde{X}_1^0) = 770 \text{ MeV} \Rightarrow \text{dM770}$$

$$\Delta M(\tilde{X}_1^\pm, \tilde{X}_1^0) = 1.6 \text{ GeV} \Rightarrow \text{dM1600}$$

> Charginos decay hadronically and leptonically

> Studied without the inclusion of

- $\gamma\gamma \rightarrow$ low p_T overlay
- Pair background



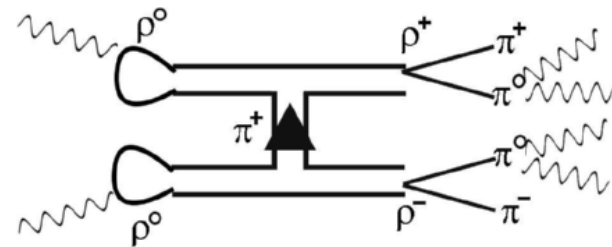
Possible methods to remove $\gamma\gamma \rightarrow$ low pT hadrons

> First Method:

- Displacement of vertices in z direction
- Vertices of $\gamma\gamma$ overlay events displaced from that of signal vertices
- Identifying the tracks coming from such vertices and removing them would be an effective method
- This method cannot be used for purely neutral events like $\gamma\gamma \rightarrow \pi^0\pi^0$

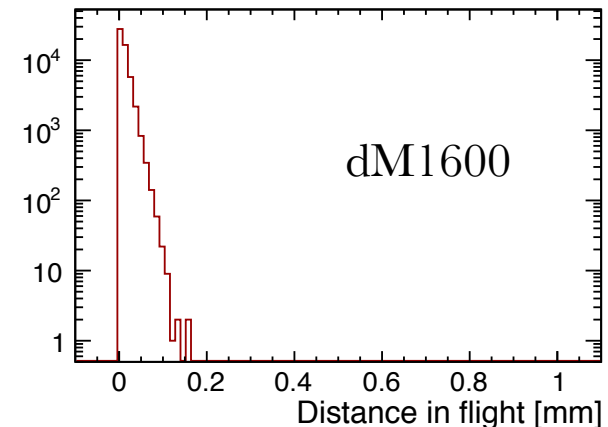
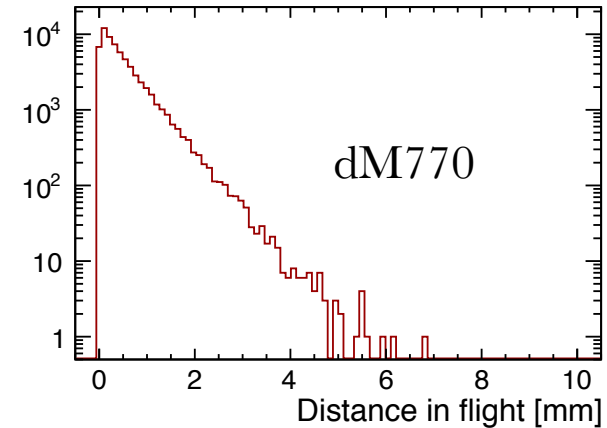
> Second method:

- The invariant mass of decay products of rho meson gives rho mass
- Rho meson used as a tag to remove $\gamma\gamma$ events
- Could be applied on very small event number



Reconstruction level and the track parameters

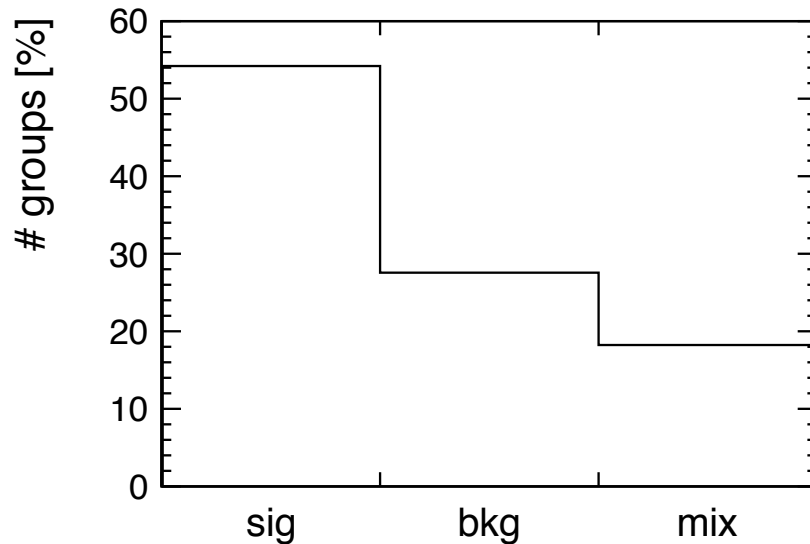
- > Standard vertex finding algorithm reconstructs one single primary vertex for each event
- > More complex algorithm to group the tracks to find different vertices
- > Grouping based on difference in z_0 significance
- > Unlike the particles in $\gamma\gamma \rightarrow$ low pt hadron events, charginos have a finite life time which makes the d_0 parameter important
- > Develop a new algorithm which groups the closest tracks to form vertex positions
- > A new algorithm developed and the results were shown Benchmarking days at Arlington.
- > The algorithm was initially made as a c++ root macro



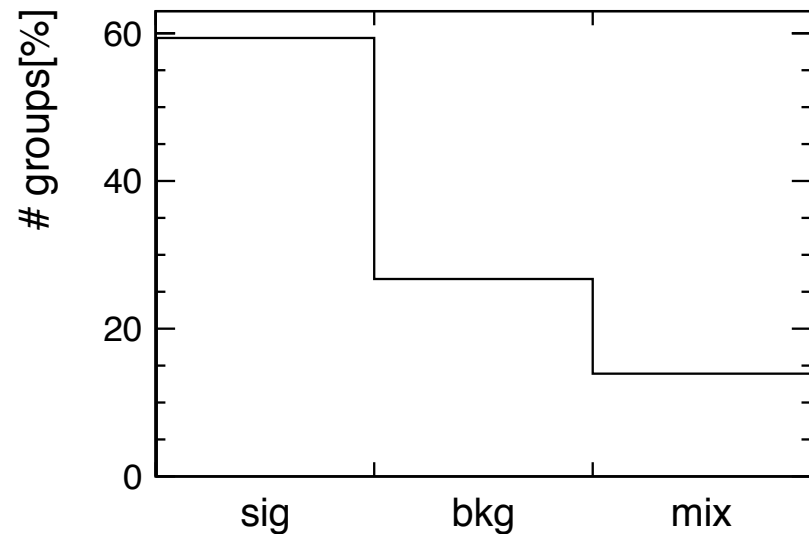
Processor for Algorithm dM1600 without Pair background

- The whole algorithm has been transported into two different processors.
- A processor applying different cuts to the sample as per the given samples
- The main algorithm processor grouping tracks together to form vertices
- Comparison for both the cases are shown

dM1600 - Processor



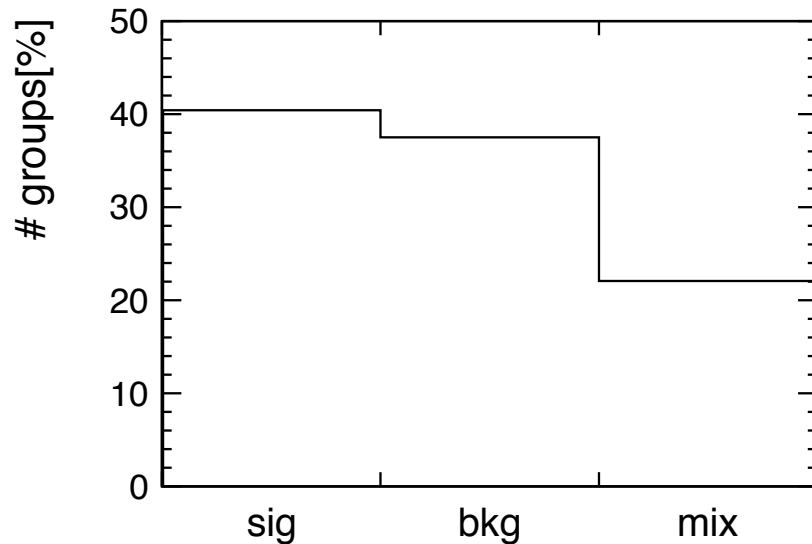
dM1600 - old method



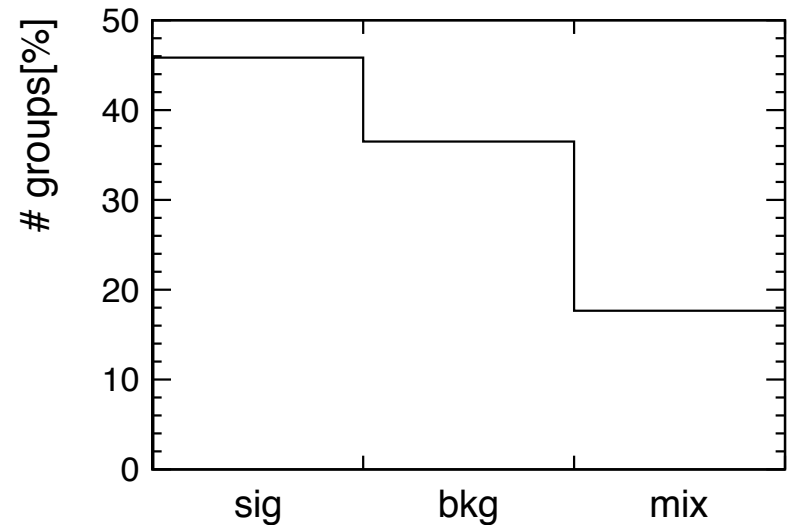
Algorithm Performance for dM1600 (pair background)

- The processor can give similar results as the old algorithm even though the results with old method are slightly better

dM1600 - Processor



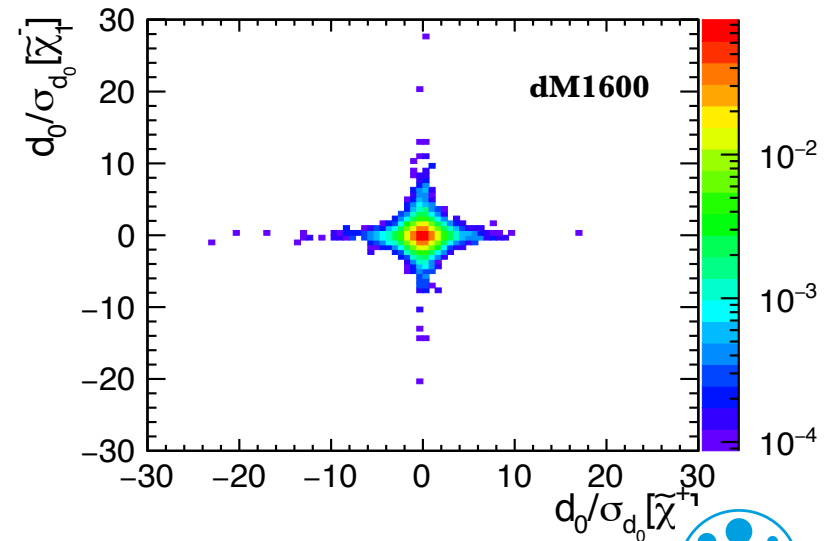
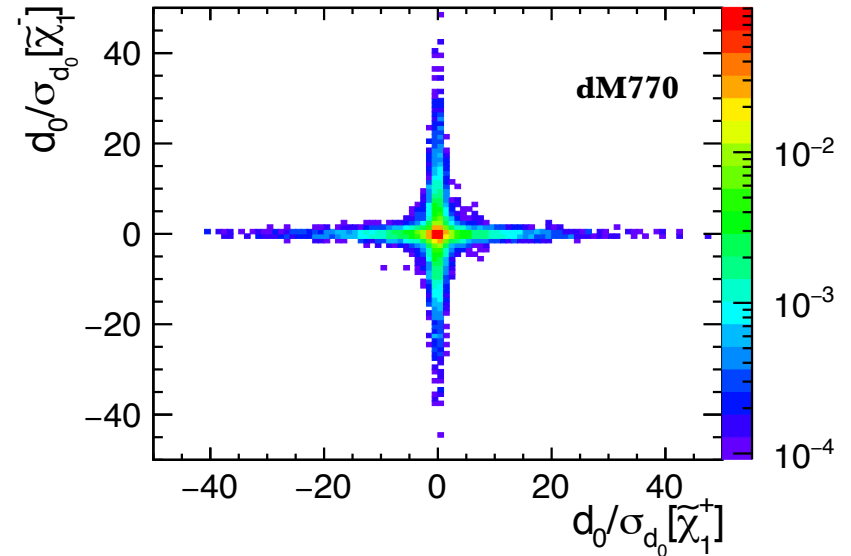
dM1600 - old method



Removal of high d_0 tracks for dM770

- > For dM770 tracks with higher d_0 mostly include signal tracks
- > Among the tracks coming from two charginos - one has higher d_0 other lower
- > For dM770 track with highest d_0 treated separately assuming to be one signal track

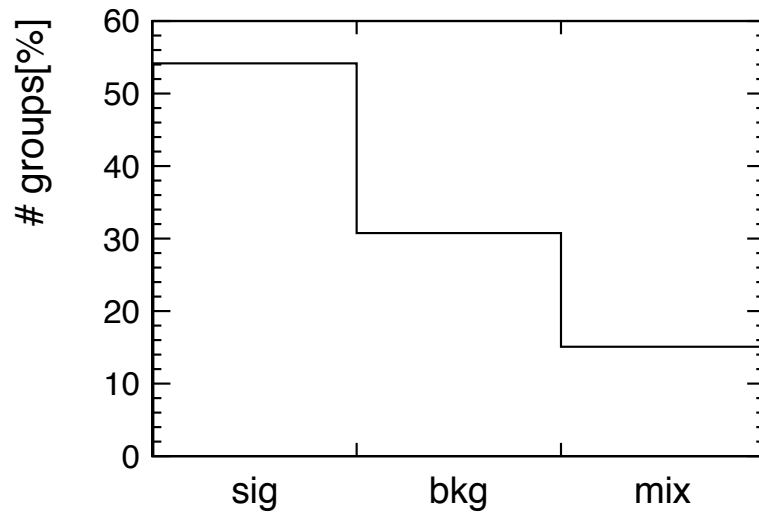
$\tilde{\chi}_1^+$ decay mode	BR(dM770)
$e\nu\tilde{\chi}_1^0$	15.0%
$\mu\nu\tilde{\chi}_1^0$	13.7%
$\pi^+\tilde{\chi}_1^0$	60.4%
$\pi^+\pi^0\tilde{\chi}_1^0$	7.3%
$\pi^+\pi^0\pi^0\tilde{\chi}_1^0$	0.03%



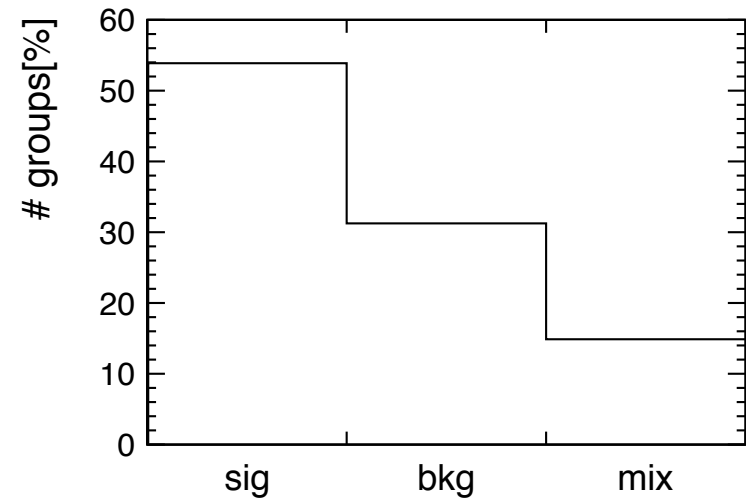
Algorithm Performance for dM770

➤ The processor could reproduce almost similar result as before

dM770 - Processor



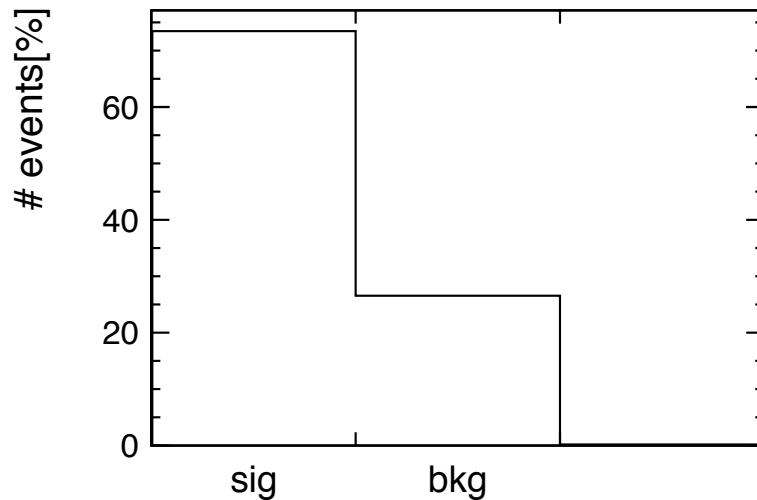
dM770 - old method



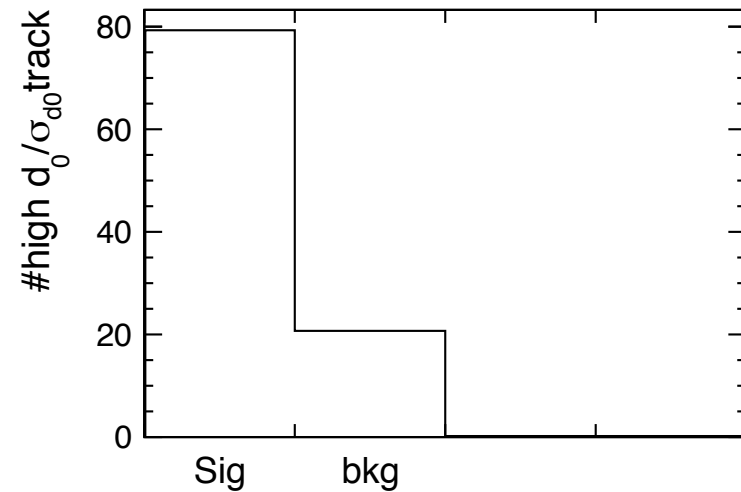
High d_0/σ_{d_0} tracks (No pair background)

- > The processor can give similar results as the old algorithm even though results with old method looks better

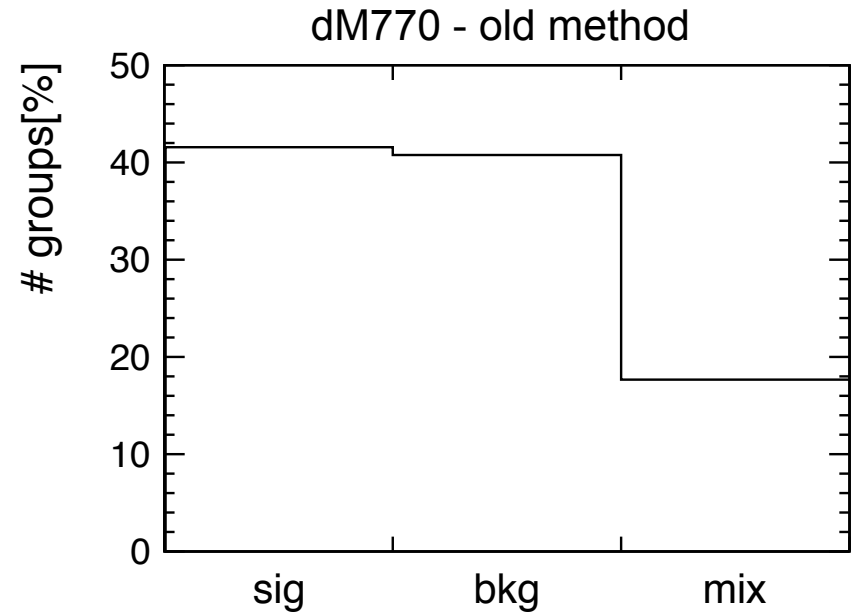
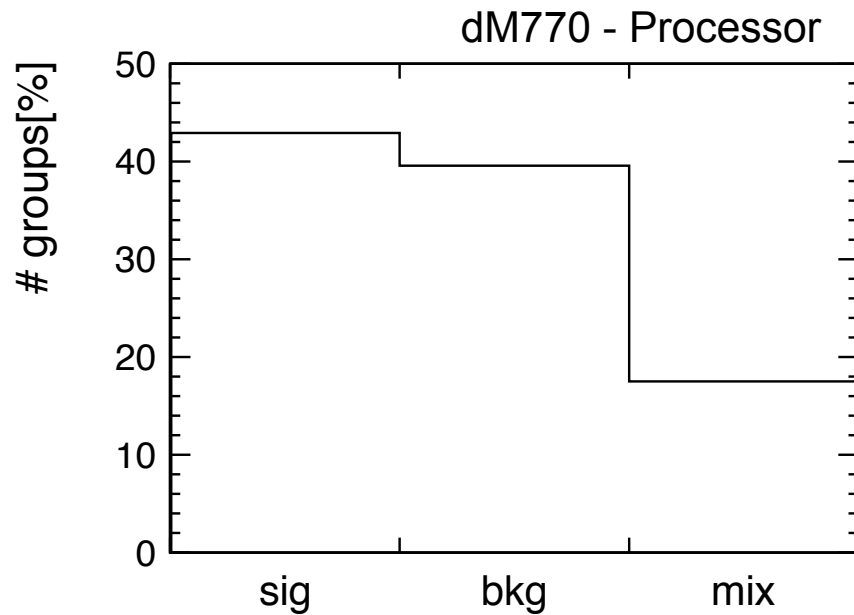
dM770 - Processor



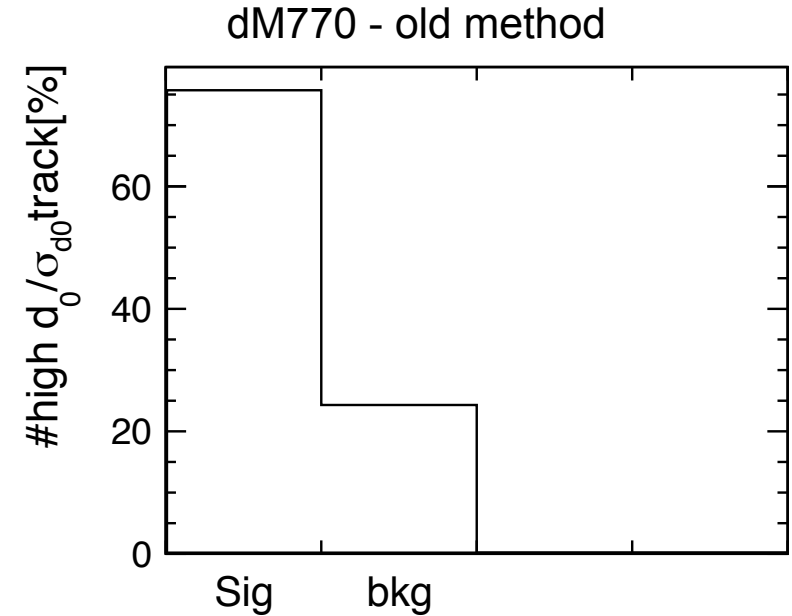
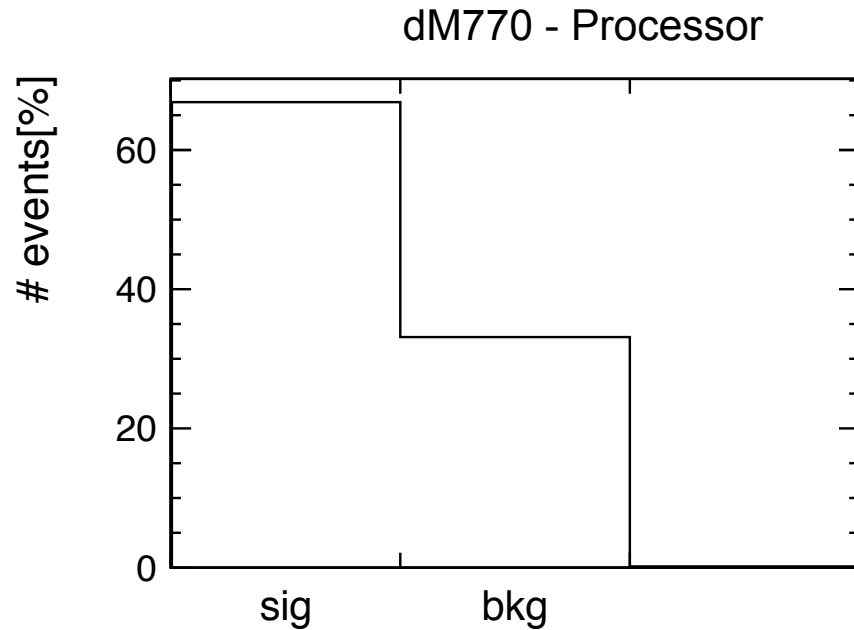
dM770 - old method



Algorithm Performance dM770 (with Pair Background)



High d_0/σ_{d_0} tracks (with pair background)



Conclusion

- > A new processor developed where the old algorithm in root macro status has been transported
- > The processor gives results similar to the old method even though the results from old method are slightly better
- > Investigation on if the results can be made more better with the processor carried on
- > Next Steps:
 - Identification of different groups as signal and background
 - Reconstruction of chargino mass with removal of gamma gamma background

