Search for invisible objects in CT-PPS
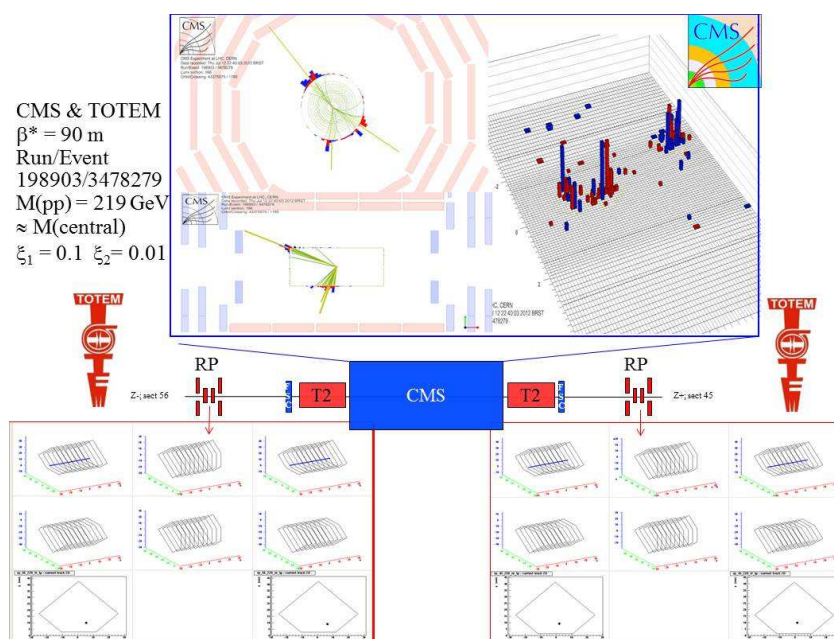
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LHC Forward Physics WG meeting, March 21-22 2017

CMS & TOTEM
$\beta^* = 90$ m
Run/Event
198903/3478279
$M(pp) = 219$ GeV
$\approx M(central)$
$\xi_1 = 0.1$ $\xi_2 = 0.01$

- Invisible objects in CMS and the advantahe of CT-PPS

- Backgrounds

- Detector improvement needed

This talk is more to open discussions and benefits from discussions/collaborations with Rafal Staszewski, Simone Giani, Ken Osterberg, Valery Khoze...

Invisible objects in CMS

- Production of pairs of magnetic monopoles

- Production of pairs of dark matter particles

- Signature: nothing in ATLAS/CMS, 2 protons of high mass in CT-PPS, AFP....

- A few issues: Trigger rate, background? (we do not see anything in CMS/ATLAS and any quasi-elastic event is a background)
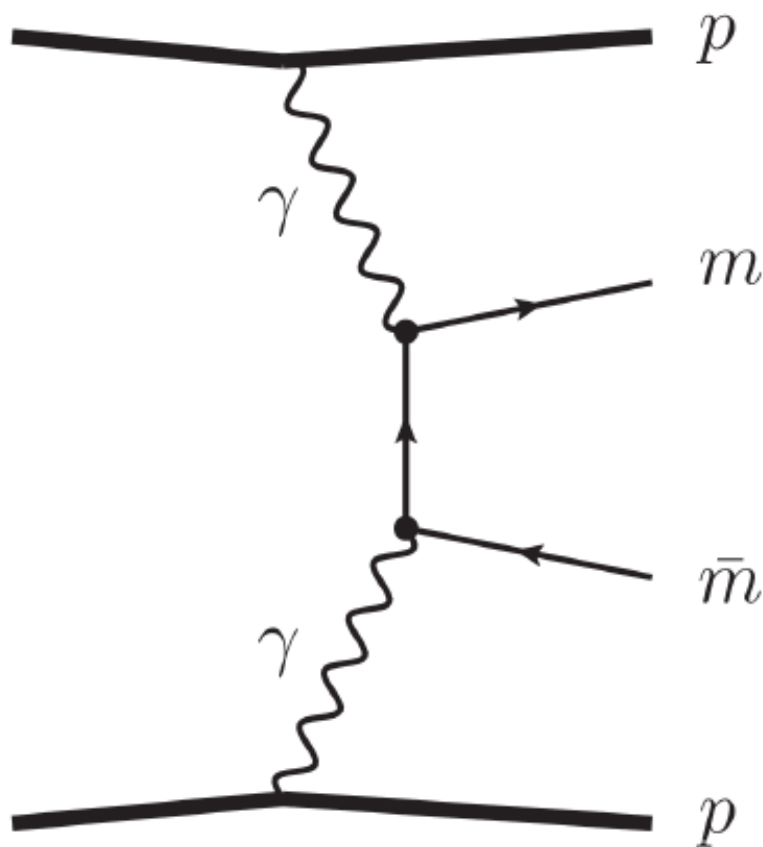
Monopole production cross section (from Rafal)

- Order of magnitude for monopole production in the AFP acceptance (Rafal)

- Check the importance of going beyond the EPA approximation for high mass object production
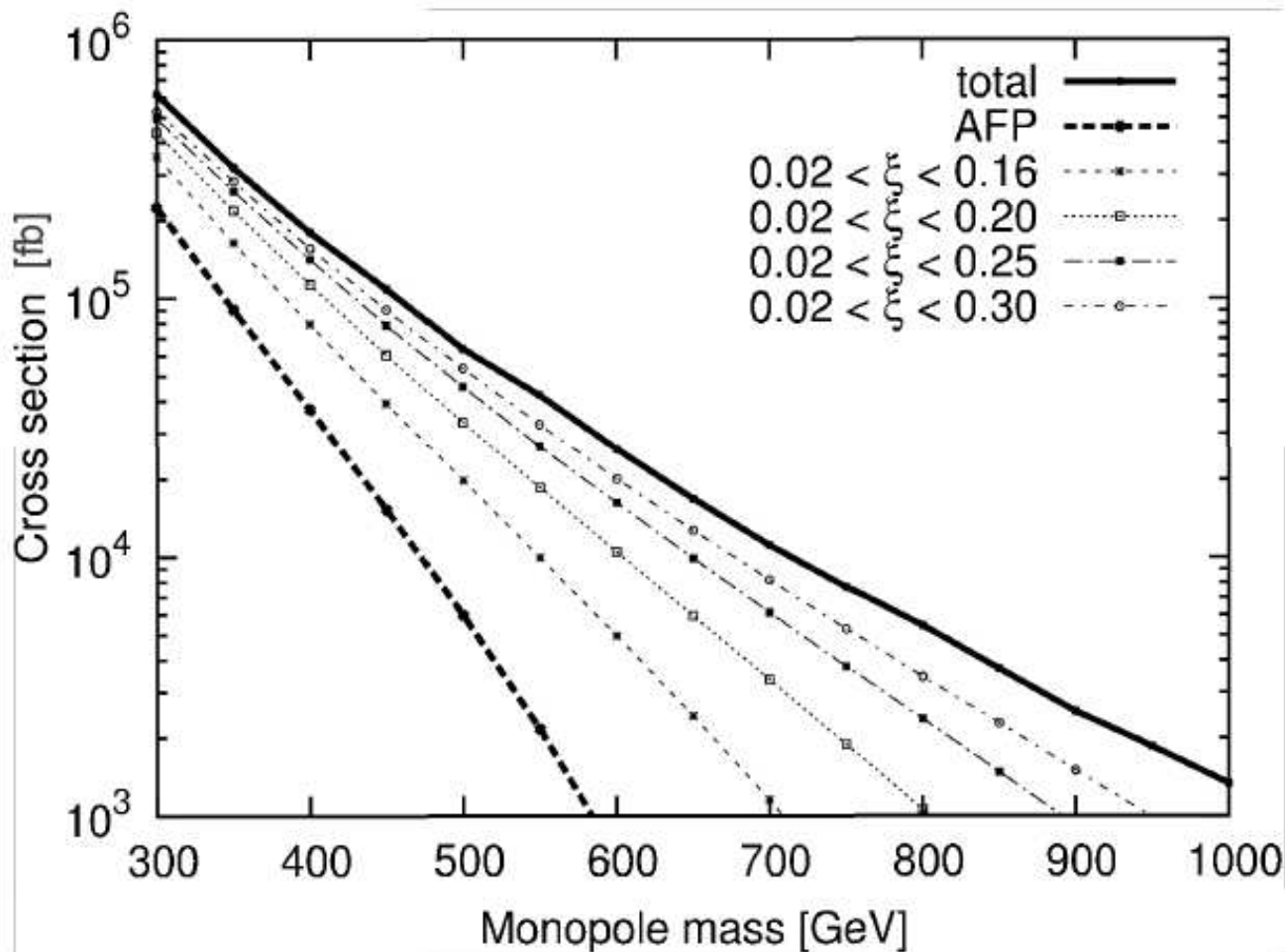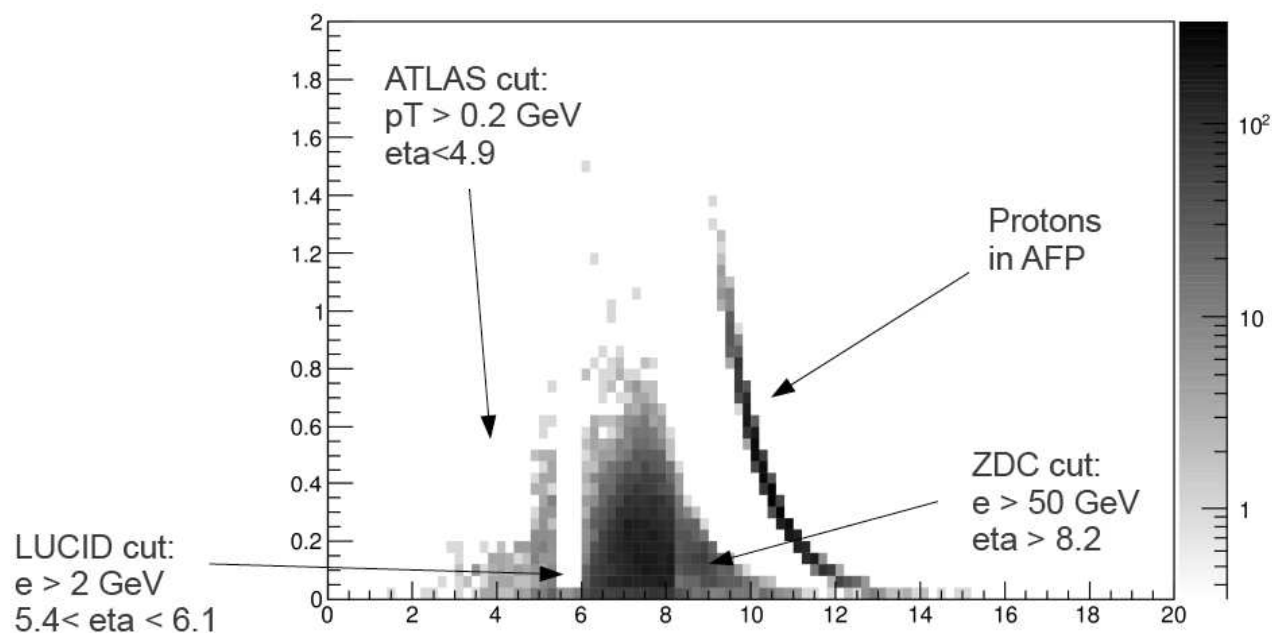
Background studies (from Rafal)

- Main background due to double diffractive events: large cross section and not perfectly known

- Recent paper by Khoze, Martin, Ryskin on the large background

- Second background: pile up, if one wants to perform measurements at high luminosity

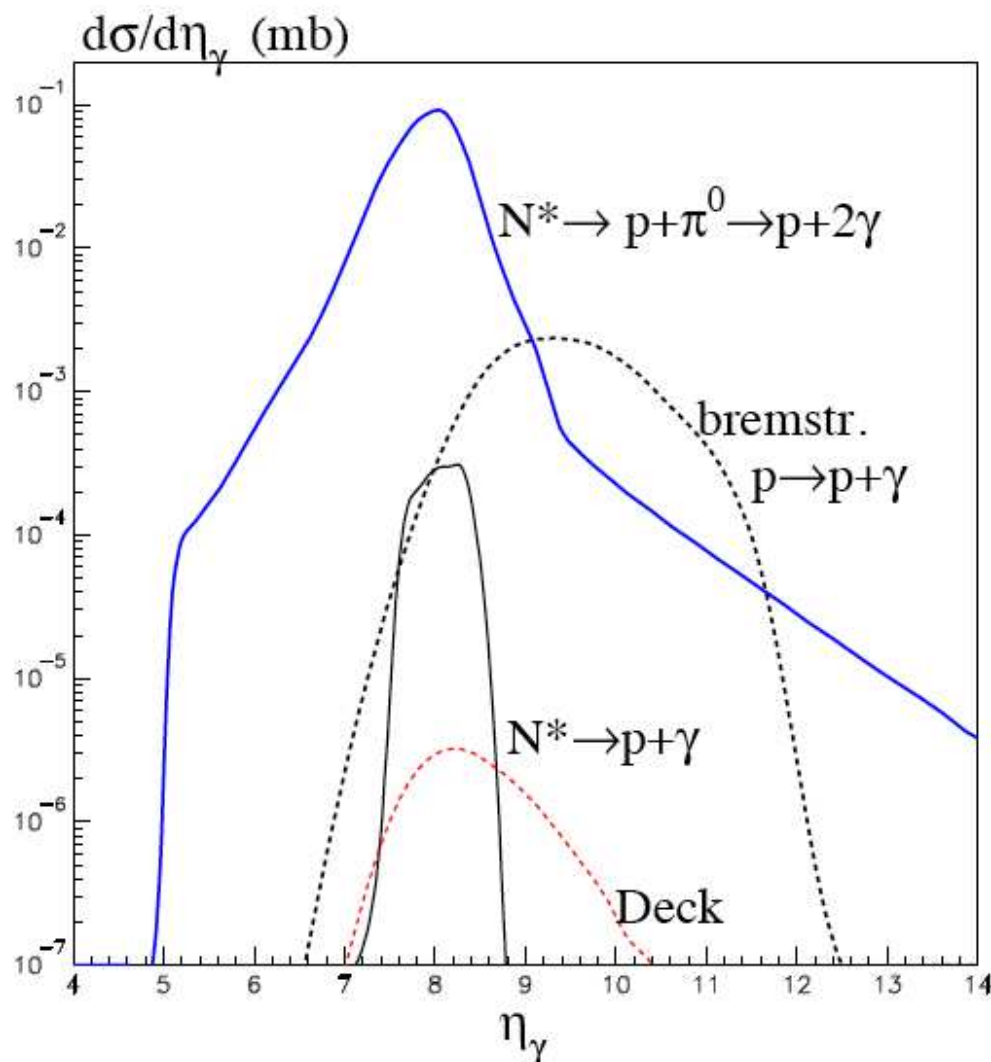- Veto on particles produced in very forward detectors (results from Rafal): ZDC...
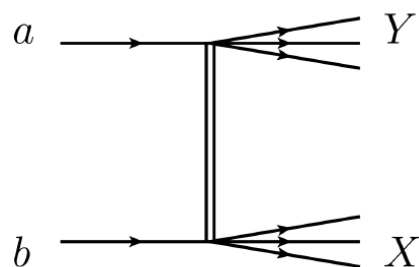

eta vs pT

Recent background studies (from KMR)

- Recent detailed beackground studies by KMR

- Background due to proton dissociation in the forwrad region

- Needs more studies as a function of p_T, η to see if these particles can be measured in the very forward detectors (ZDC...)

How to see invisible events? Some ideas...

- The vertex where dark matter particles, monopoles are produced is not known

- We assume that the two protons originate form that vertex and we measure the time of floght of produced particles

- We now assume that we measure the time-of-flight of all particles produced in the very forward region (ZDC...) and we can get that information at trigger level; this means that we know from which vertex these particles are originating

- We need to request that there is incompatibility between the two proton vertex (found using time detectors) and the vertex found using particles in very forward region

- This requires few upgrades: timing measurements in forward detectors, possibility of triggering on high mass proton pairs

eta vs pT
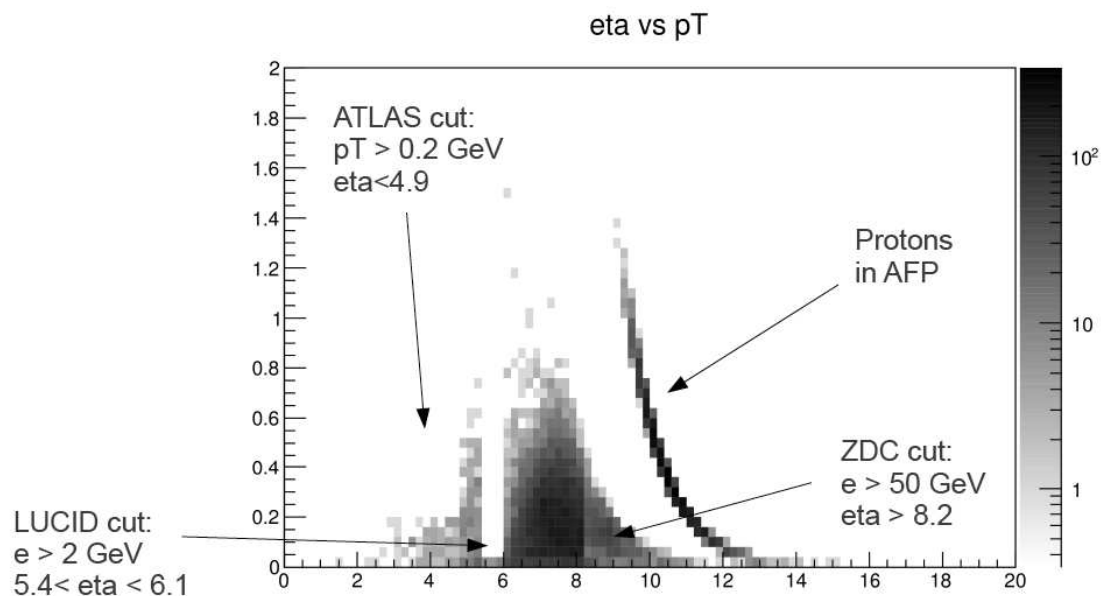
Conclusion

- Looking for invisible objects in AFP/CT-PPS

- Large background originating from pile up and quasi-elastic events

- This search would require an upgrade of the detector installing timing detectors in ZDC

- We need also to be able to trigger on intact protons in the final state (high level trigger)