

Triggers for dark and low-multiplicity analyses

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Dark sector and low multiplicity

Basically, three kinds of analyses:

- Low-multiplicity Standard Model measurements
 - Mostly (but not only) $g-2$ related

- Low-multiplicity dark searches

- Dark searches in B decays

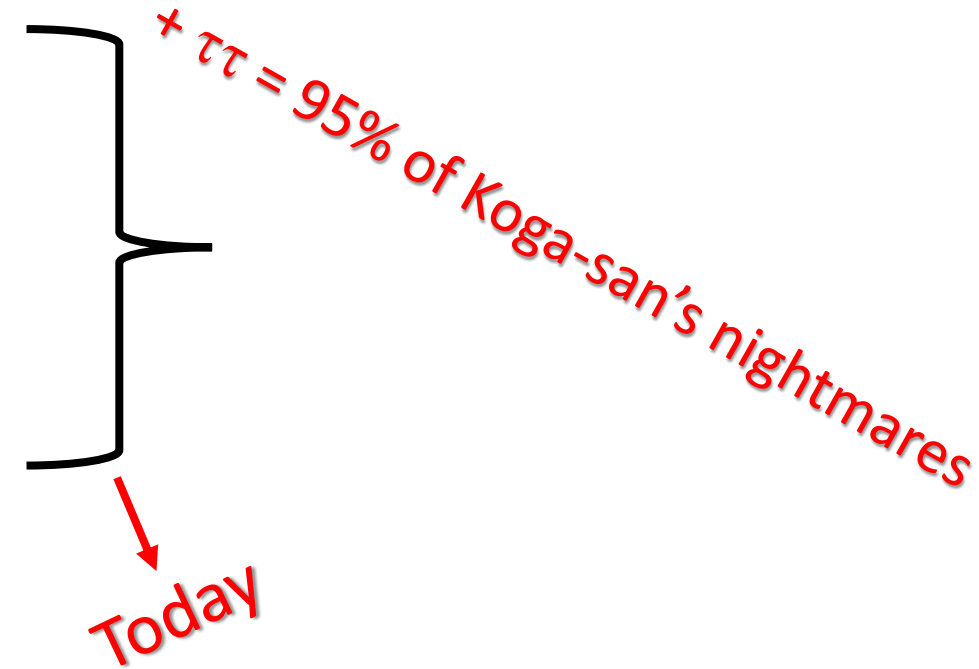
Dark sector and low multiplicity

Basically, three kinds of analyses:

- Low-multiplicity Standard Model measurements
 - Mostly (but not only) g-2 related

- Low-multiplicity dark searches

- Dark searches in B decays
 - **Do not suffer from trigger issues**



muons

- Dark Higgs
- Z' invisible
- $Z' \rightarrow \tau\tau, \mu\mu$
- A' visible without γ
- A' visible + γ
- $\mu\mu(\gamma)$ control sample (for invisible A' + ...)
- Dark showers

Displaced vtx's

- IDM + Dark Higgs
- Dark showers

Analyses

tracks

- Z' invisible, dark Higgs
- $Z' \rightarrow \tau\tau, \mu\mu$
- A' visible without γ
- A' visible + γ
- $\pi\pi\gamma$ for HVP

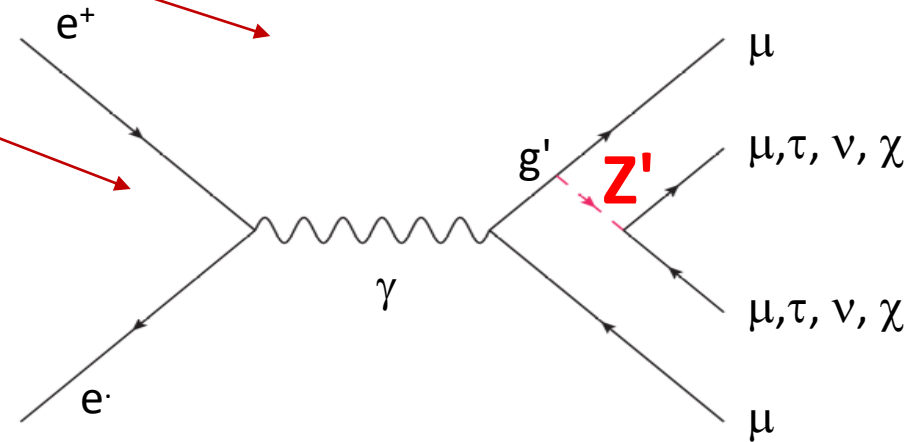
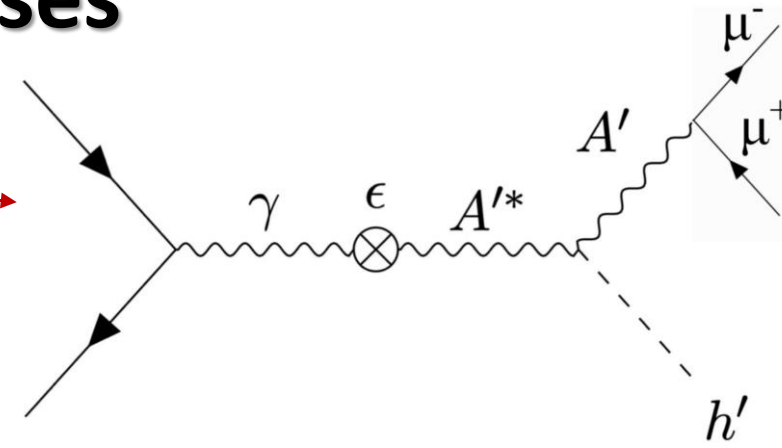
γ / e^\pm

- A' invisible (single γ)
- ALP $\rightarrow \gamma\gamma$ (3 γ final state)
- ALP $\rightarrow \gamma\gamma$ fusion ($ee \rightarrow \gamma\gamma e$)
- X17/ A' visible + γ
- Single $\pi^0/\eta/\eta'$ ($ee \rightarrow \gamma\gamma e$)
- $\pi\pi\gamma$ for HVP
- $\pi\pi\pi^0\gamma$ for HVP
- IDM + Dark Higgs

muons

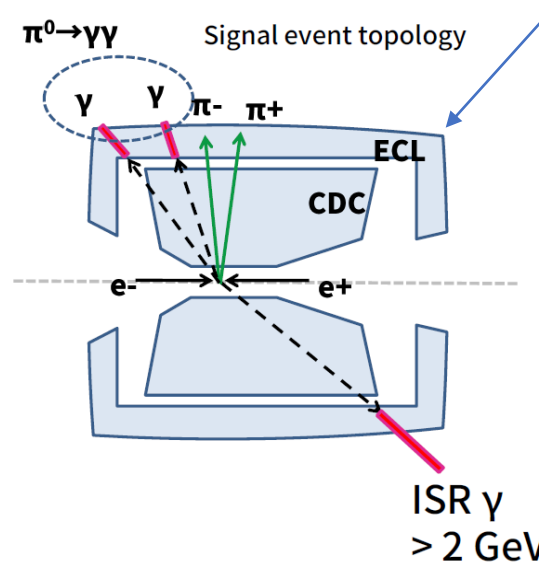
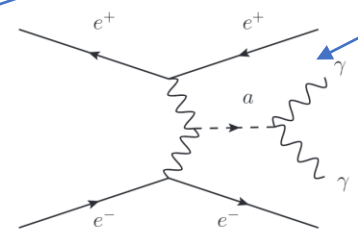
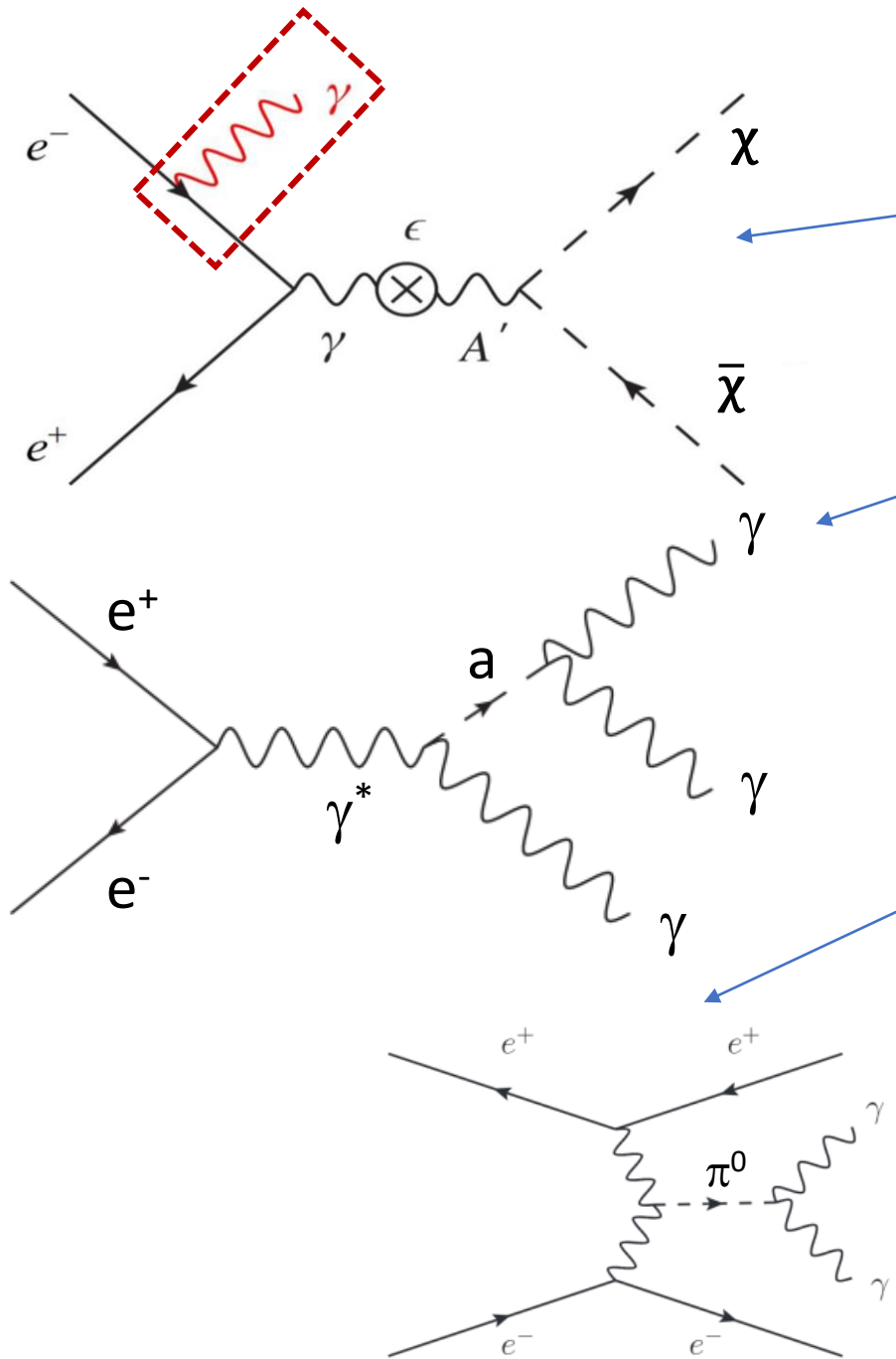
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Analyses



Analyses

γ / e^\pm



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- $\pi\pi\pi^0\gamma$ for HVP
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Triggers

Analyses	triggers
Z' invisible, dark Higgs	fy30, cdcklm, stt
$Z' \rightarrow \tau\tau, \mu\mu$	fff/ffy, cdcklm, stt (fy30, fyo)
A' invisible (single γ)	hie, lml6, lml16 (lml1, prescaled)
A' visible without γ	stt, fyo, hie
X17/ A' visible + γ	dpee (lml,,hie, c2hie)
$ALP \rightarrow \gamma\gamma$ (3 γ final state)	hie (high mass) , ggssel (low mass)
$ALP \rightarrow \gamma\gamma$ fusion ($ee \rightarrow \gamma\gamma e$)	lml2, hie (stt, lml1 barrel)
Single $\pi^0/\eta/\eta'$ ($ee \rightarrow \gamma\gamma e$)	hie (stt)
$\mu\mu(\gamma)$ control sample (for invisible A' + ...)	stt, beklm, cdcklm (fyo, syo)
IDM + Dark Higgs	hie (lml12, stt [stt4/5])
$\pi\pi\gamma$ for HVP	hie, (ff, stt)
$\pi\pi\pi^0\gamma$ for HVP	hie, bha3d (lml1)
Dark showers	stt, stt-ecl, hie for electrons (displaced VTX)

—	CDC
—	ECL
—	KLM

Considerations

hie is widely used, both as main trigger and as a reference to measure the efficiency of other lines
stt is gaining more and more popularity

Invisible A' == single γ

- lml16 (0.5 GeV single γ) introduced knowing already that at some time would have been prescaled
- lml7 (1 GeV in endcap): no plans to extend the search down there

hie

A' visible without γ

- hie fw is fundamental (low angle ee, where CDC triggers are not optimal)

Single $\pi^0 + \text{ALP} \rightarrow \gamma \gamma$ fusion ($ee \rightarrow \gamma \gamma e$)

- Low-energy γ , trigger mostly on isolated forward electron
- \rightarrow hie fw is fundamental (Q^2)
- Worries about a tightened Bhabha veto that forbids events with single fw high-energy clusters
- lml2 (2 GeV cluster in endcap) would make the job

Applies also to **visible A' with no γ** and partly to **HVP**
Extending stt to lower angles would be useful

$\pi\pi\gamma$ for HVP

- hie is fundamental
- Trigger is one of the main systematics
- CDC+ECL would break the scheme of measuring hie with an orthogonal trigger
- Some prescaling of CDC is acceptable

X17

- Deeply based on dpee
- If dpee is suppressed/prescaled, the search would be based on bits monitoring Bhabha/background

Z's + DH + other muon-based

- Final state with muons are golden channels since ever
- Single μ trigger must be preserved (cdcklm or ideally KLM only)
- No objections for cdcklm \rightarrow ycdcklm
- Actually, transitions to γ lines have always been smooth in the past

Summary

- hie is widely used, both as main trigger and as a reference to measure the efficiency of other lines
- stt is gaining more and more popularity
- Preserving single-muon trigger is a priority
 - No a priori objections for cdcklm → ycdcklm
- ECL-CDC match
 - Serious problem for some analyses
 - ❑ Drop of efficiency (eg muons)
 - ❑ Hard to measure efficiencies with combined ECL-CDC. Matching should anyway be accompanied by non-matched unprescaled lines (not clear if this is enough)
 - ❑ Some measurements ($\pi\pi\gamma$ for HVP) are crucially affected by uncertainties on the trigger efficiency (one of the main systematics)
- A tighter Bhabha veto, vetoing isolated endcap clusters, is problematic for some measurements/searches
- Even more if applied on lml2 or, worse, if lml2 is suppressed/prescaled
- Some lml lines were introduced with the idea they could not survive high luminosity: lml7, lml16, lml9

Please, let's implement relevant (restrictive) changes only when really needed