

Two-photon processes with early data:

$$\gamma\gamma \rightarrow \tau\tau$$

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GEFÖRDERT VOM



Bundesministerium
für Bildung
und Forschung

- **Why exclusive dilepton processes?**
- **Event Signature**
- **Trigger selection**
- **Backgrounds**
- **Offline selection**
- **Summary / Outlook**



Exclusive dilepton production

- **Signal process:**

- **two central leptons:**

- back-to-back
- balanced in p_T
- opposite charge

- **protons escape down beamline**

- **assuming zero pileup: clean events w/ two central taus and little else**

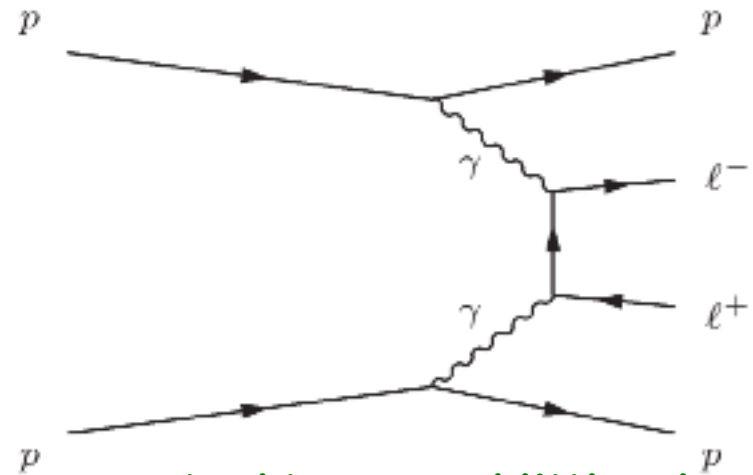
- **LHC as a “photon collider”:**

- **QED two photon processes: small theoretical uncertainties (cross section known to $< 1\%$)**

- **Low luminosity (+low pileup) phase:**

- **Luminosity monitoring ($\gamma\gamma \rightarrow \mu\mu$)**

- **Useful for tau lepton ID performance studies?**



Monte Carlo samples

- **LPAIR for elastic (and inelastic) two-photon processes**
 - not part of the ATLAS MC Generator suite
 - generate events with LPAIR standalone, pass output ASCII to ATHENA
- **LPAIR cross section estimates**

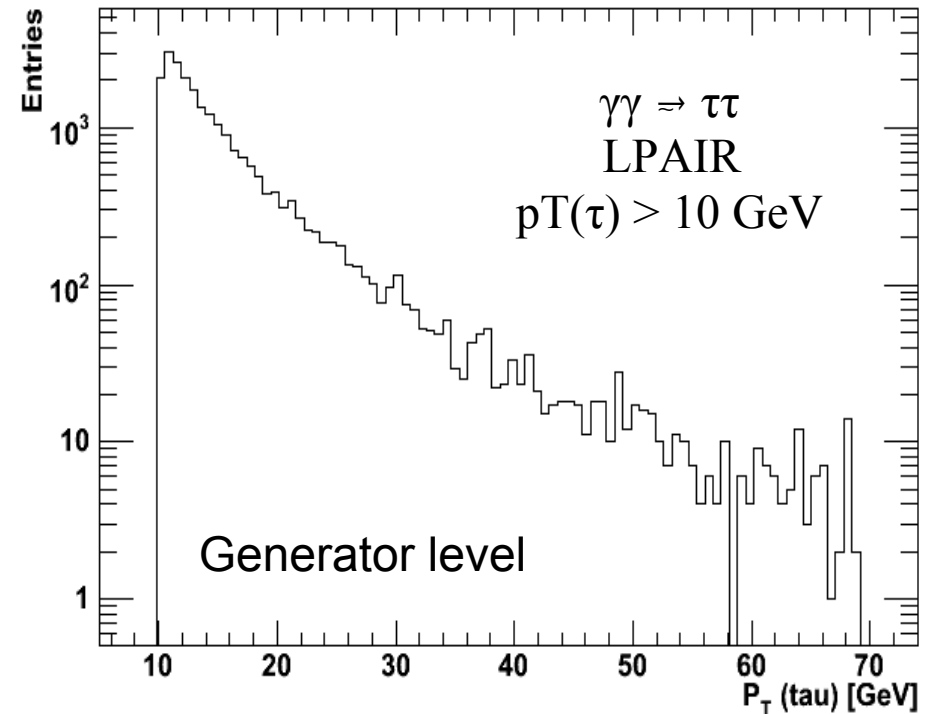
	10 TeV	10 TeV
Pt(τ_1, τ_2)	Cross section (pb)	Cross Section (pb) $ \eta < 2.5$
0 GeV	186.2	60.6
10 GeV	1.7	1.0
20 GeV	0.3	0.2

Trigger selection

- Signal strongly peaked at low pT:
 - need low trigger thresholds
 - first pass: HLT trigger dump
 - 7944 / 7950 events passed the EF:
 - EF_tauNoCut: 3528
 - EF_tau12: 1102

Requires more detailed studies...

- dedicated trigger required?
 - low pT thresholds
 - exactly two “objects”
 - acoplanarity + Et-balance useful?



Backgrounds

- **Signal:**
 - ideally, two isolated, back-to-back tau candidates

- **Backgrounds:**

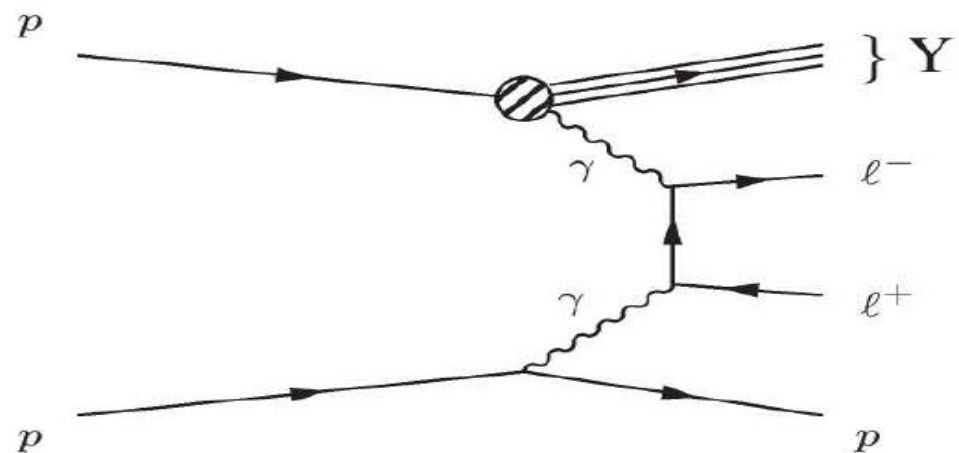
- **NON-EXCLUSIVE**

- $Z^0/\gamma \rightarrow l^+l^-$
- $J/\Psi \rightarrow l^+l^-$
- $\Upsilon \rightarrow l^+l^-$
- $W+W \rightarrow l^+l^-$
- b/c jets $\rightarrow l^+l^-$
- QCD

additional detector activity?

- **INELASTIC PHOTON-EXCHANGE**

- one proton dissociates
- cross section similar to elastic signal
- large theoretical uncertainties

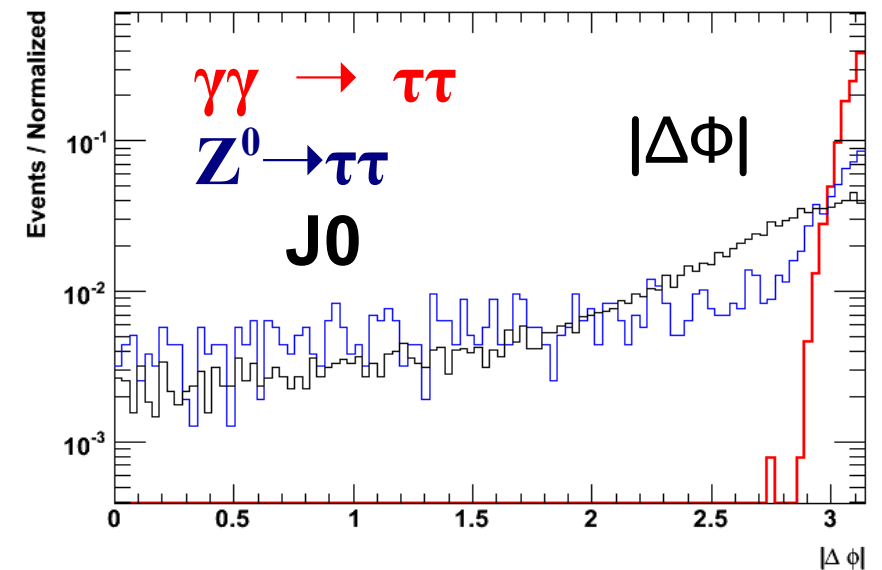
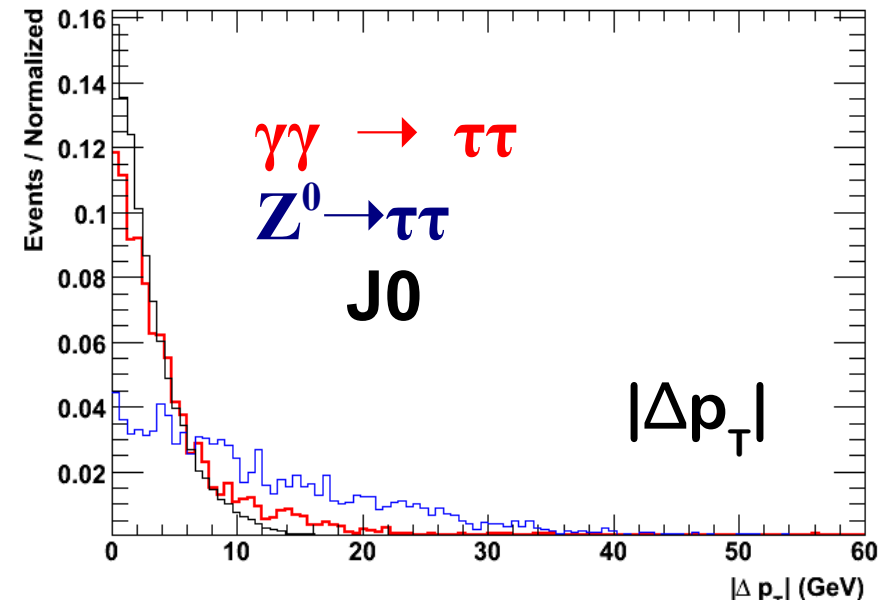


Offline selection

- Require exactly two leptons
 - two taus, 1 tau + 1 electron/muon ?
 - opposite charge?
- Kinematic cuts
 - $|\Delta p_T|$: expected to peak around 0
 - $|\Delta\Phi|$: expected to peak around π
- CMS: veto additional activity to reduce “non-exclusive” backgrounds
- Inelastic backgrounds might be harder control

Nov 2008

Require exactly two “PanTau” seeds



Summary / Outlook

- **Two-photon processes might provide a clean source of low-pT taus with early data**
 - **cross sections non-negligible**
 - **clean events:**
 - pure QED: well understood
 - non-exclusive backgrounds small and controllable (CMS)
 - **significant number of ditaus appear to pass Event Filter**
 - more detailed trigger study required
 - **full-fledged study with backgrounds required to establish feasibility**
 - results from CMS involving dielectrons and dimuons look promising
- **Possibly a useful complement to existing studies:**
 - **useful process to study low-pT tau ID performance?**