Searches for supersymmetry in events with photons at CMS

**Supersymmetry**

Introduction of supersymmetry (SUSY) to solve shortcomings of the standard model

Conservation of R-Parity:  
- pair production of SUSY particles  
- stable lightest SUSY particle (LSP) leading to missing transverse momentum ($p_T^{miss}$)

In gauge-mediated SUSY breaking:  
- Gravitino $G$ is LSP  
- Lightest Neutralino $\tilde{\chi}^0_1$ is next-to LSP  
- Enhanced photon production

General signature of interest: At least one photon with large missing transverse momentum

**Signal scenarios**

Electroweak and strong production

**Photon + $\tilde{\chi}^0_1$**

Selection:  
At least one high-energy photon, large $p_T^{miss}$, large transverse mass ($m_T$) of $\gamma$ and $p_T^{miss}$

Main backgrounds:  
- Photon-boson $\gamma$ via MC simulation fitted to data

Search region definition:  
$S_T = p_T^{miss} + \sum p_T^f$

Signals:  
- Electroweak and strong production

**Photon + $H_T^0$**

Selection:  
At least one high-energy photon, large $p_T^{miss}$, large $H_T^0$

Main backgrounds:  
- Vector-boson plus $\gamma$ via MC simulation
- QCD / $\gamma$ jet via data in jet control region

Search region definition:  
$H_T^0 = H_T + p_T^{miss}$

Signals:  
- Strong production

**Combination of four dedicated searches**

**Photon + Lepton**

Selection:  
At least one photon, one charged lepton, $p_T^{miss}$, large $m_T$ of lepton and $p_T^{miss}$

Main backgrounds:  
- Vector-boson plus $\gamma$ via MC simulation fitted to data
- Diboson $\gamma$ processes via MC simulation

Search region definition:  
$S_T = p_T^{miss} + \sum p_T^f$

Signals:  
- Electroweak and strong production

**Diphoton**

Selection:  
Two photons, $p_T^{miss}$, no charged leptons, large invariant diphoton mass,

Main backgrounds:  
- Vector-boson plus $\gamma$ via MC simulation and data
- QCD / $\gamma$ jet via data in fake photon control region

Search region definition:  
$p_T^{miss}$

Signals:  
- Strong production

**Photon + (b-) jets**

Selection:  
- $p_T^{miss} > 100$ GeV and $H_T^0 > 800$ GeV or $p_T^{miss} > 190$ GeV and $H_T^0 > 500$ GeV  
- At least two jets, no charged lepton

Main backgrounds:  
- $p_T^{miss} > 100$ GeV
- $|A(2$ highest $p_T$ jets, $p_T^{miss})| > 0.3$

**Combined search bins**

**Summary**

**Limits**

**Search bins**