Hunting New Physics with ATLAS

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for the ATLAS Collaboration

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Why going beyond the Standard Model?

- SM provides an excellent description of the experimental data so far
  - QCD and hadronic structure
  - precision EW physics
  - top quark
  - flavour physics
- yet... it does not provide an answer to:
  - hierarchy / fine tuning problem
  - matter-antimatter asymmetry
  - dark matter & dark energy
  - neutrino masses
  - unification of EW interactions & QCD
  - gravitation
  - more than one fermion generation

An extension of the Standard Model is needed
(some) ideas beyond Standard Model

![Diagram showing big ideas and big questions related to dark matter, origin of EWSB, naturalness, unification, origin of matter, origin of flavor, new forces, and elementary vs. composite structure.]

- Multiverse
- SUSY
- Compositeness, Extra dimensions
- Extended Higgs Sector
- Top Partner
- W/Z'
- Minimal Dark Matter
- Hidden Sector

Big Questions:
- ???
ATLAS at the LHC

- Spectacular LHC performance
- Run 2: 2015 – ongoing
  - $\sqrt{s} = 13$ TeV
  - 2015-2016: $\sim 40$ fb$^{-1}$ pp collisions recorded by ATLAS
  - 2017: $\sim 16$ fb$^{-1}$ recorded so far
Beyond-SM searches strategy

① Pursue signature-driven analyses:
   ▫ resonances: dileptons, jets, photons, ...
   ▫ non-resonant: tails in kinematic distributions
   ▫ special particles: slow-moving, long-lived, ...
   ▫ ...

② Search for excess of events over the expected SM background
   ▫ in one or more Signal Regions (SRs)

③ If no significant excess is observed
   ▫ set cross-section upper limits
   ▫ interpret in specific models to obtain limits on masses, couplings, ...

(summary)

- **Background estimate**: data-driven techniques for main; MC for smaller
  ▫ measurement with data in Control Regions (CRs), extrapolated to SRs
  ▫ method validated in Validation Regions (VRs)

- **Blind analysis**: first define and validate analysis, then open signal box
Signatures probing models

- Resonances
  - dileptons: $Z' \rightarrow \ell\ell$, ...
  - $W' \rightarrow \ell\nu$
  - dibosons: $WW$, $WZ$, $\gamma\gamma$, ...
  - top/bottom: VLQs
  - BSM Higgs, ...
  - leptons+jets: leptoquarks, ...
- dijets

- Non-resonant final states
  - dileptons
  - leptons+jets
  - mono-$X + E_T^{\text{miss}}$, dark matter, ...
  - ...

- Long-lived particles
  - high ionisation
  - disappearing tracks
  - displaced lepton jets, vertices

- SUSY-specific signatures: $E_T^{\text{miss}} + X$
  - strong production
  - 3$^{\text{rd}}$-generation squarks
  - electroweak production
  - ...

Signature-based searches cover multitude of theoretical scenarios

See talks by:
- Pawel Bruckman’s talk
- Yoram Rozen’s talk
- Cristiano Sebastiani’s poster
- André Sopczak
- Shunsuke Adachi
- Nicolas Koehler
- Athina Kourkoumelis
Looking for resonances & tails in distributions

- Non-SUSY searches only presented here
- Detailed reviews for SUSY in other talks
Dileptons (1/3)

- **Selection**
  - 2 opposite-sign (OS) isolated electrons OR muons with $p_T > 30$ GeV

- **Background**
  - Drell-Yan (DY), diboson, top (pair & single)
    - DY fitted to data at Z-peak
  - fakes (QCD jets & W+jets) → data-driven matrix method

- **Reconstruction of dilepton invariant mass** $m_{\ell\ell}$

- Looking for narrow resonances OR broad excesses in the invariant mass distribution
  - Data consistent with SM expectation

36.1 fb$^{-1}$ at 13 TeV

arXiv:1707.02424
Dileptons (2/3)

- **Z’ resonances**: spin-1 neutral gauge bosons
  - Sequential SM (SSM): Z’ with same couplings as SM Z
  - GUT models based on $E_6$ gauge group predict two additional U(1) gauge fields: $Z'_\psi$, $Z'_\chi$
  - Observable as narrow resonances in dilepton invariant mass spectrum

- **Contact Interactions (CI)**
  - Probes quark and lepton compositeness, with binding energy scale $\Lambda$
  - Different chiral structures considered
  - Detectable as broad excess in dilepton invariant mass spectrum

arXiv:1707.02424

36.1 fb$^{-1}$ @ 13 TeV
Dileptons (3/3)

- **Minimal Z’ models** are characterized by three parameters:
  - Z’ boson mass
  - $\gamma’$: strength of Z’ boson coupling relative to SM Z
  - $\theta_{\text{Min}}$: mixing angle between the generators of B-L (Baryon minus Lepton number) and the weak hypercharge gauge groups

<table>
<thead>
<tr>
<th>Model</th>
<th>$\gamma'$</th>
<th>$\tan \theta_{\text{Min}}$</th>
<th>Lower limits on $M_{Z'_{\text{Min}}}$ [TeV]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$cc$</td>
</tr>
<tr>
<td>$Z'_{X}$</td>
<td>$\sqrt{\frac{41}{24}} \sin \theta_{\text{Min}}$</td>
<td>$-\frac{4}{5}$</td>
<td>3.7</td>
</tr>
<tr>
<td>$Z'_{3R}$</td>
<td>$\sqrt{\frac{7}{8}} \sin \theta_{\text{Min}}$</td>
<td>$-2$</td>
<td>4.0</td>
</tr>
<tr>
<td>$Z'_{B-L}$</td>
<td>$\sqrt{\frac{5}{12}} \sin \theta_{\text{Min}}$</td>
<td>0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

- Also obtained generic upper limits on visible $\sigma$ in fiducial lepton $p_T$ & $\eta$ and mass-window for various widths *(not shown here)*

arXiv:1707.02424

36.1 fb$^{-1}$ @ 13 TeV
Diphotons

- Search for heavy resonant and non-resonant BSM physics decaying into diphoton final states
- Event selection
  - ≥ 2 isolated photons with $E_T > 40$ GeV & 30 GeV
  - different kinematic selections applied for spin-0 vs. spin-2
  - narrow-width approximation (NWA) bump in $m_{\gamma\gamma}$
  - non-resonant: counting experiment for $m_{\gamma\gamma} > 2240$ GeV
  
  ➡ No significance excess observed up to diphoton masses of 2.7 TeV

Limits set in various scenarios
- Spin-0 resonance: exclusion limits for NWA signal $\sigma \times \text{BR}(\gamma\gamma)$ range from 11.4 fb @ 200 GeV to about 0.1 fb @ 2.7 TeV
- Spin-2 resonance: Randall-Sundrum (RS) graviton with $k/M_{Pl}=0.1$ excluded below $m_{G^*}=4.1$ TeV
- Spin-2 non-resonant: lower limit on $M_S$ placed between 5.7 TeV and 8.6 TeV on ADD model depending on formalism used and number of extra dimension assumed

36.7 fb⁻¹ @ 13 TeV
Dibosons: \( V' \rightarrow VH \rightarrow q\bar{q}^{(*)}b\bar{b} \) (1/2)

- Search for boosted heavy resonances decaying to VH in all-hadronic channel
  - final state composed of two large-R jets, J
  - narrow-width bumps at di-jet (\( m_{jj} \)) invariant mass for \( m_{jj} > 1 \) TeV
- Event selection
  - lepton veto; \( E_T^{\text{miss}} \) veto
  - \( \geq 2 \) large-R jets with \( p_T > 250 \) GeV; leading \( p_T > 450 \) GeV
  - larger mass is H-jet; smaller is V-jet
  - \( W/Z \) and H mass window
- Background estimated by side band and/or no-b-tag

➡ Data compatible with SM hypothesis

Largest deviation in ZH channel at \( m_{jj} \approx 3 \) TeV with local (global) significance of 3.3\( \sigma \) (2.1\( \sigma \))

arXiv:1707.06958
Dibosons: $V' \to VH \to q\bar{q}(t)bb$

- Candidate signal models:
  - **Heavy Vector Triplet (HVT) $W'$ and $Z'$**
  - Model A: comparable BRs to fermions and gauge bosons
  - Model B: suppressed couplings to fermions
- Upper limits on $\sigma \times {BR}$ set for $W'$ and $Z'$ resonances:
  - HVT Model B resonances excluded in mass range 1100 - 2500 GeV for WH, and 1100 - 2600 GeV for ZH
  - HVT Model A resonances excluded in mass range 1100 - 2400 GeV for WH, and 1100 - 1480 GeV and 1700 - 2350 for ZH

Note: there is a ~60% overlap of data between the WH and ZH selections, for both 1-tag and 2-tag regions

arXiv:1707.06958
Dibosons: $X \rightarrow WV \rightarrow \ell\nu q\bar{q}$

- Motivation:
  - Spin 0: Composite Higgs (ggF or VBF)
  - Spin 1: Heavy Vector Triplet (q\bar{q} or VBF)
  - Spin 2: RS graviton (ggF production)
- Consider both resolved (jj) and “merged” (J), if highly boosted, dijet system
- Events categorisation:
  - VBF or DY (includes ggF & q\bar{q})
  - (i) merged high purity (HP);
    (ii) merged low purity (LP);
    (iii) resolved
  - WW or WZ (overlap)
- Search for bump in $m(\ell\nu jj)$ or $m(\ell\nu J)$ distributions

⇒ No significance excess observed
⇒ limits set in resonance masses for considered models

ATLAS-CONF-2017-051
Dibosons – summary

σ×BR upper limits for Heavy Vector Triplets decaying to dibosons for different final states

ATLAS Preliminary
\( \sqrt{s} = 13 \text{ TeV}, 36.1 \text{ fb}^{-1} \)

95% C.L. exclusion limits

- ATLAS - Preliminary
- \( \sqrt{s} = 13 \text{ TeV}, 36.1 \text{ fb}^{-1} \)
- 95% C.L. exclusion limits

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CombinedSummaryPlots/EXOTICS/
**Vector-Like Quarks (VLQs): T→Wb**

- VLQs proposed to cancel quadratic divergences in Higgs mass
- Predicted in Little/Composite Higgs
- Production: pair (QCD) or single (EW)
- Decays:
  - $T \rightarrow Wb / Zt / Ht$
  - $B \rightarrow Wt / Zb / Hb$

- **T→Wb analysis**
  - 1 lepton, MET, $\geq 3$ jets, $\geq 1$ b-jet
  - $\geq 1$ W-tagged large-R jet, no overlap with b-jet
- Full event reconstruction by minimising $|\Delta m_T|$
- Profile likelihood fit to improve BG modelling
  - $\Delta R(\ell, \nu)$ & $S_T$ cut to define SR/CR
  - discriminating variable: $m_{T,\text{lep}}$

- **36.1 fb⁻¹ @ 13 TeV**

No significant deviation from SM expectation is observed

**ATLAS**

$\sqrt{s} = 13$ TeV
36.1 fb⁻¹

<table>
<thead>
<tr>
<th>$m_T$ [GeV]</th>
<th>Events (SR)</th>
</tr>
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<tbody>
<tr>
<td>$500$</td>
<td></td>
</tr>
<tr>
<td>$700$</td>
<td></td>
</tr>
<tr>
<td>$900$</td>
<td></td>
</tr>
<tr>
<td>$1100$</td>
<td></td>
</tr>
<tr>
<td>$1300$</td>
<td></td>
</tr>
</tbody>
</table>

**Simulation**

$\sqrt{s} = 13$ TeV
36.1 fb⁻¹

<table>
<thead>
<tr>
<th>$m_T$ [GeV]</th>
<th>Event fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>$500$</td>
<td>0.1</td>
</tr>
<tr>
<td>$700$</td>
<td>0.2</td>
</tr>
<tr>
<td>$900$</td>
<td>0.3</td>
</tr>
<tr>
<td>$1100$</td>
<td>0.4</td>
</tr>
<tr>
<td>$1300$</td>
<td>0.5</td>
</tr>
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</table>
VLQs: $T \rightarrow Wb$ results

- **Uncertainties**
  - dominated by low statistics
  - main systematics: $t$ & $t\bar{t}$ modelling

- **Significantly improved limits w.r.t. Run I**
  - $m_{T/Y} (BR_{Wb}=100\%) > 1350 \ (782) \ GeV$
  - $m_T$ (singlet) $> 1170 \ GeV$
  - $m_{B/X} (BR_{Wt}=100\%) > 1250 \ GeV$
  - $m_B$ (singlet) $> 1180 \ GeV$

36.1 fb$^{-1}$ @ 13 TeV
VLQ summary

• All decays of vector-like T quark considered: $W_b / Z_t / H_t$
• Vector-like B decays not yet fully covered: only $W_t / H_b$ included
• Analyses make use of boosted decays at 13 TeV
... in a nutshell

### ATLAS Exotics Searches - 95% CL Upper Exclusion Limits

**Status:** July 2017

<table>
<thead>
<tr>
<th>Model</th>
<th>$\ell$, $\gamma$</th>
<th>Jets†</th>
<th>$E_{\text{T}}^{\text{miss}}$</th>
<th>Limit</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD $G_{\text{uk}}$ + $g/s$</td>
<td>$0, e, \mu$</td>
<td>1–4</td>
<td>Yes</td>
<td>$M_{\text{Momentum}}$</td>
<td>$7.75$ TeV</td>
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<tr>
<td>ADD non-resonant $\gamma\gamma$</td>
<td>$2\gamma$</td>
<td>-</td>
<td>-</td>
<td>$M_{\text{Momentum}}$</td>
<td>$8.6$ TeV</td>
</tr>
<tr>
<td>ADD $BH$</td>
<td>$2\gamma$</td>
<td>-</td>
<td>-</td>
<td>$M_{\text{Momentum}}$</td>
<td>$9.3$ TeV</td>
</tr>
<tr>
<td>ADD BH high $p_T$</td>
<td>$\geq 1,e, \mu, \geq 2\gamma$</td>
<td>-</td>
<td>-</td>
<td>$M_{\text{Momentum}}$</td>
<td>$8.2$ TeV</td>
</tr>
<tr>
<td>ADD BH multijet</td>
<td>-</td>
<td>$\geq 3\gamma$</td>
<td>-</td>
<td>$M_{\text{Momentum}}$</td>
<td>$9.55$ TeV</td>
</tr>
<tr>
<td>RS1 $G_{\text{uk}}$ + $\gamma\gamma$</td>
<td>$2\gamma$</td>
<td>-</td>
<td>-</td>
<td>$M_{\text{Momentum}}$</td>
<td>$4.1$ TeV</td>
</tr>
<tr>
<td>Bulk RS $G_{\text{uk}}$ + $W^+W^-$</td>
<td>$1, e, \mu$</td>
<td>1</td>
<td>Yes</td>
<td>$M_{\text{Momentum}}$</td>
<td>$1.75$ TeV</td>
</tr>
<tr>
<td>2UED/RPP</td>
<td>$1, e, \mu$</td>
<td>$\geq 2,b, \geq 3\gamma$</td>
<td>Yes</td>
<td>$M_{\text{Momentum}}$</td>
<td>$1.6$ TeV</td>
</tr>
</tbody>
</table>

**Extra dimensions**

| SSM $Z^\pm \to \ell\ell$ | $2\,e, \mu$ | - | - | $M_{\text{Momentum}}$ | $4.5$ TeV | ATLAS-COM-2017-027 |
| SSM $Z^\pm \to \ell\ell$ | $2\tau$ | - | - | $M_{\text{Momentum}}$ | $2.4$ TeV | ATLAS-COM-2017-050 |
| Leptophobic $Z^\pm \to b\bar{b}$ | - | $2\gamma$ | - | $M_{\text{Momentum}}$ | $1.5$ TeV | 1603.08671 |
| Leptophobic $Z^\pm \to \ell\ell$ | $1, e, \mu, \geq 1\,b, \geq 1\,\ell$ | Yes | $M_{\text{Momentum}}$ | $2.0$ TeV | ATLAS-COM-2016-014 |
| SSM $W^\pm \to e\nu$ | $1, e, \mu$ | - | Yes | $M_{\text{Momentum}}$ | $5.1$ TeV | CERN-EP-2017-147 |
| HVT $V^+ \to W^+\nu\nu$ model B | $0, e, \mu$ | 2 $\gamma$ | - | $M_{\text{Momentum}}$ | $3.5$ TeV | ATLAS-COM-2017-055 |
| HVT $V^+ \to WH/ZZ$ model B | - | 2 $\gamma$ | - | $M_{\text{Momentum}}$ | $2.93$ TeV | 1410.4103 |
| LRSM $W^\pm_{\nu\ell}$ | $1, e, \mu$ | $\geq 2\,b, 0\,\ell$ | Yes | $M_{\text{Momentum}}$ | $1.92$ TeV | 1405.0866 |
| LRSM $W^\pm_{\nu\ell}$ | $1, e, \mu$ | $\geq 1\,b, 1\,\ell$ | - | $W_{\text{Momentum}}$ | $1.76$ TeV | 1703.09217 |

**DM**

| Cl $q\bar{q}$q | - | $2\,j$ | - | $A_{\text{Momentum}}$ | $218$ TeV | $\sqrt{s} = 8, 13$ TeV |
| Cl $q\bar{q}$ | $2\,e, \mu$ | - | - | $A_{\text{Momentum}}$ | $60.1$ TeV | $\sqrt{s} = 8, 13$ TeV |
| Cl suit | $2(5S)\geq 3\,e, \mu \geq 1\,b, \geq 1$ | Yes | $A_{\text{Momentum}}$ | $4.9$ TeV | $\sqrt{s} = 8, 13$ TeV |

**QCD**

| VLOY $T^+ \to H^+ + X$ | $0, e, \mu \geq 2\,b, 2\,\ell$ | Yes | $M_{\text{Momentum}}$ | $1.2$ TeV | ATLAS-COM-2017-060 |
| VLOY $T^+ \to Z^+ + X$ | $1, e, \mu \geq 2\,b, 2\,\ell$ | Yes | $M_{\text{Momentum}}$ | $1.16$ TeV | 1703.09217 |
| VLOY $T^+ \to W^+ + X$ | $1, e, \mu \geq 2\,b, 2\,\ell$ | Yes | $M_{\text{Momentum}}$ | $1.33$ TeV | 1703.09217 |
| VLOY $T^+ \to H^+ + X$ | $0, e, \mu \geq 2\,b, 2\,\ell$ | Yes | $M_{\text{Momentum}}$ | $790$ GeV | $\sqrt{s} = 8, 13$ TeV |
| VLOY $H^\pm_1 \to Z^\pm + X$ | $2\,e, \mu \geq 2\,b, 2\,\ell$ | Yes | $M_{\text{Momentum}}$ | $790$ GeV | $\sqrt{s} = 8, 13$ TeV |
| VLOY $W^\pm_1 \to W^\pm + X$ | $1, e, \mu \geq 2\,b, 2\,\ell$ | Yes | $M_{\text{Momentum}}$ | $1.25$ TeV | $\sqrt{s} = 8, 13$ TeV |
| VLOY $W^\pm_2 \to W^\pm + X$ | $1, e, \mu \geq 4\,\ell$ | Yes | $M_{\text{Momentum}}$ | $690$ GeV | $\sqrt{s} = 8, 13$ TeV |

**Heavy quarks**

| Excited quark $q' \to qg$ | - | $2\,j$ | $\gamma$ | $M_{\text{Momentum}}$ | $6.0$ TeV | Only $u'$ and $d'$, $\Lambda = m(q')$ |
| Excited quark $q' \to q\gamma$ | $\gamma$ | - | - | $M_{\text{Momentum}}$ | $5.3$ TeV | Only $u'$ and $d'$, $\Lambda = m(q')$ |
| Excited quark $q' \to qh$ | $h$ | $b, 1\,\ell$ | - | $M_{\text{Momentum}}$ | $2.3$ TeV | 1702.09127 |
| Excited quark $q' \to qW^\pm$ | $1, e, \mu \geq 2\,b, 2\,\ell$ | Yes | $M_{\text{Momentum}}$ | $1.5$ TeV | 1510.02664 |
| Exotically excited lepton $e^*$ | $e, \mu^*$ | $\gamma$ | - | $M_{\text{Momentum}}$ | $3.9$ TeV | 1411.2921 |
| Exotically excited lepton $\nu^*$ | $e, \mu^*$ | $\gamma$ | - | $M_{\text{Momentum}}$ | $1.4$ TeV | 1411.2921 |

**Other**

| NLO Majorana $\nu$ | $2, e, \mu$ | $2\,j$ | Yes | $M_{\text{Momentum}}$ | $2.80$ TeV | $\sqrt{s} = 8, 13$ TeV |
| Higgs triplet $H^{+\pm}$ | $2, e, \mu$ | $2\,j$ | Yes | $M_{\text{Momentum}}$ | $970$ GeV | $\sqrt{s} = 8, 13$ TeV |
| Higgs triplet $H^{+\pm}$ | $2, e, \mu$ | $2\,j$ | Yes | $M_{\text{Momentum}}$ | $400$ GeV | $\sqrt{s} = 8, 13$ TeV |
| Monotop (non-res prod) | $1, e, \mu$ | $1\,b$ | Yes | $M_{\text{Momentum}}$ | $557$ GeV | 1411.2921 |
| Multi-charged particles | - | - | - | $M_{\text{Momentum}}$ | $789$ GeV | $\sqrt{s} = 8, 13$ TeV |
| Magnetic monopoles | - | - | - | $M_{\text{Momentum}}$ | $1.34$ TeV | $\sqrt{s} = 8, 13$ TeV |

*Only a selection of the available mass limits on new states or phenomena is shown.
†Small-radius (large-radius) jets are denoted by the letter $\ell$ ($j$).
Long-lived particles

- Most recent results @ 13 TeV presented here
- Searches for supersymmetric particles
- Many more searches for non-SUSY are underway with 13 TeV data
Stable or metastable particles

- Long-lived decays of spartners possible in several frameworks, including:
  - nearly conserved symmetry
    - e.g. long lived gluinos or squarks that hadronise before decaying → R-hadrons in Split SUSY
  - low coupling between the particle and the final state
    - e.g. weak R-parity violating (RPV) couplings in SUSY
  - mass degeneracy between the particle and the final state

- Depending on the lifetime, different detection techniques involving various objects: tracks, photons, leptons, ...

![Diagram showing different track types and their lifetimes]

(1) Slow, large dE/dx ~ 1000 mm
(2) Slow, stopped ~ 100 mm
(3) Disappearing track ~ 10 mm
(4) Kinked track
(5) displaced track

Longer lifetime
Displaced vertices (1/2)

- Metastable particles decaying in the Inner Detector
  - predicted in models of RPV SUSY or split-SUSY
  - benchmark signal: gluino hadronising into an R-hadron

• Large-radius tracking: re-running standard track and vertex reconstruction improves signal efficiency at large radii

• Backgrounds: instrumental and estimated from data
  - high track multiplicity hadronic interactions
    - DV in regions with high material density vetoed
  - merged DV extrapolated from low-n_{trk} region

• Background estimate validated in signal-depleted regions

32.7 fb⁻¹ @ 13 TeV
Displaced vertices (2/2)

- SR defined as a DV with mass $> 10$ GeV and high track multiplicity ($> 5$ tracks)
- No event is observed in the SR, compatible with a bkg. expectation of $0.2 \pm 0.2$ events

- Limits are set on gluino R-hadrons as a function of masses and lifetime
- For a lifetime of 1 ns, gluino masses up to 2.2 TeV are excluded
Disappearing track (1/2)

- Decays to invisible products in the Inner Detector
  - chargino and neutralino nearly degenerate, the soft pions in the decay are not reconstructed
  - for wino LSP generic prediction of ~160 MeV splittings, or lifetimes of ~0.2 ns \(\geq 6\) cm
- **Pixel tracklets (≡ pixel-only tracks):** 10× increase in acceptance over standard tracks for low lifetimes
- Backgrounds estimated by a simultaneous fit to the tracklet \(p_T\) distribution

Background configurations

36.1 fb\(^{-1}\) @ 13 TeV

ATLAS-CONF-2017-017
Disappearing track (2/2)

- No significant excess is observed
- EWK production limits significantly improved at low lifetimes ($c\tau \lesssim 12$ cm)
  - thanks to new insertable pixel B-layer (IBL) installed during long shutdown ($r \sim 3$ cm)
- Strong production: reaching $1.4 \,(1.1)$ TeV in chargino mass for lifetimes of $1.0 \,(0.2)$ ns

36.1 fb$^{-1}$ @ 13 TeV
Long-lived particles in SUSY - summary

8-TeV results on R-hadrons
Split SUSY with metastable $\tilde{g} \rightarrow g/qq \tilde{\chi}_1^0$

Summary 8-TeV & 13 TeV on disappearing track
Long lived chargino, $\tilde{\chi}_1^\pm \rightarrow \pi^\pm \tilde{\chi}_1^0$

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CombinedSummaryPlots/SUSY/
Summary

• Standard Model limitations imperatively call for Physics beyond it, extending and complementing it
• ATLAS has searched for physics BSM at TeV scale in a variety of signatures inspired by a multitude of theoretical scenarios
• No significant deviation from SM expectations observed so far
• LHC Run 2 new data may reveal hints of New Physics
  ▫ ATLAS is well-prepared to make the most of them
  ▫ analysis continuously improved with new trigger and/or reconstruction techniques

Continuously updated public results:
https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ExoticsPublicResults
Thank you for your attention!