# Dark matter searches with the ATLAS detector



Luigi Sabetta on behalf of the ATLAS collaboration

### Phenomenology 2021 Symposium 24-26 May 2021







### Talk safety instructions

This talk will cover some of the most recent results by ATLAS, touching Simplified Models and 2HDM models



- Mono-Jet
- VBF Higgs +  $E_T^{miss}$
- VBF Higgs +  $E_T^{miss}$  +  $\gamma$

#### arXiv:2102.10874

### Mono-Jet

The analysis aims to find an excess in the  $E_T^{miss}$  spectrum

- Sensitive to a broad range of different models thanks to its general signature •
- Dominant irreducible background:  $Z(\rightarrow vv) + jets$ ٠
- SM predictions constrained using orthogonal CRs •
- NNLO QCD & nNLO EW corrections to V+jets processes ٠





### Mono-Jet



- ATLAS Events / GeV 10<sup>7</sup> Data  $\sqrt{s} = 13 \text{ TeV}, 139 \text{ fb}^{-1}$ Standard Model w. unc  $Z(\rightarrow vv) + jets$ Signal Region  $0^{6}$ VBF Z( $\rightarrow$  II / vv) + jets  $p_{\tau}(j) > 150 \text{ GeV}$  $W(\rightarrow lv) + jets$ 10<sup>5</sup> VBF W( $\rightarrow$  lv) + jets tt + single top 10<sup>4</sup> Diboson Multijet + NCB 10<sup>3</sup>  $m(\tilde{t}, \tilde{\chi}^{0}) = (600, 580) \text{ GeV}$ m(χ, Z<sub>4</sub>) = (1, 2000) GeV 10<sup>2</sup> •••• DE, M<sub>2</sub> = 1486 GeV 10 Data/SM 1.1 Uncertaint 0.8F 1200 p<sub>r</sub><sup>recoil</sup> [GeV] 800 200 400 600 1000 bkg uncertainty reached in SR (1.2-4%) No significant excess observed
- Simultaneous likelihood fit to  $p_T^{recoil}$  distributions in CR to estimate SR total background



.. But many other interpretations! (backup)



The analysis aims to find an excess in the  $m_{ii}$  spectrum

- Dominant irreducible background:  $Z(\rightarrow vv) + jets$
- SM predictions constrained using orthogonal CRs

 $Z(\rightarrow vv) + jets$  $W(\rightarrow l_{lost}v) + jets$ 

 $\sim$ 



### $VBFH \rightarrow invisible$

• Simultaneous likelihood fit to  $m_{ij}$  distributions in CRs to estimate SR total background





### **VBF** $H \rightarrow invisible + \gamma$



• Simultaneous likelihood fit to  $DNN \ score$  (or  $m_T$ ) distributions in CR to estimate SR total background No significant excess is observed.

Observed (expected) 95% CL limits:

CMS result: 0.029



ATLAS-CONF-2021-004

Luigi Sabetta | 22 May 2021 | Dark matter searches with the ATLAS detector

### $H \rightarrow inv.$ combination



Run2 analysis:

• ttH

Many others not included yet (e.g. Mono-Jet, Mono-Z(ll))

• **VBF**  $H \rightarrow invisible$ 

Combination of Run1+2 set a limit on the  $BR_{H \rightarrow inv}$  = 0.11



Scalar  $\sigma_{WIMP-N}$ : down to  $10^{-45} cm^2$ Fermion Majorana  $\sigma_{WIMP-N}$ : down to  $10^{-47} cm^2$ 

#### arxiv:2104.13240

### Mono- $H \rightarrow \gamma \gamma$

Look for an excess in the  $m_{\gamma\gamma}$  spectrum

• Normalization and shape of nonresonant background obtained fitting the  $m_{\gamma\gamma}$  sidebands

 $(105 < m_{\gamma\gamma} < 160 \, GeV)$ 



- No leptons
- At least 2 photons
- $E_T^{miss} > 90 \ GeV$ 
  - $120 < m_{\gamma\gamma} < 130 \; GeV$
  - $\Delta E_T^{miss} < 30 \ GeV$

Score

BDT

Di-photon trigger

Difference beetween  $E_T^{miss}$  from NN selected vertex and  $E_T^{miss}$  from hard scatter vertex

4 Signal regions defined using  $E_T^{miss}$  and a BDT trained with :

 $S_{E_{T}^{miss}}$ •  $p_T^{\gamma\gamma}$ 

 $S_{E_T^{miss}} = E_T^{miss} /$ 

arxiv:2104.13240

### **Mono-** $H \rightarrow \gamma \gamma$



SM resonant Higgs contribution ~30% of total background, mostly from WH and ZH production modes



#### ATLAS-CONF-2021-006

### Mono- $H \rightarrow bb$

#### Key Events selections:

**Resolved region** 



Look for an excess in  $m_h$  spectrum

Dominant backgrounds:  $t\bar{t}$ , W/Z +HF

Normalization corrected using CRs •

#### Merged region Large-R jet • At least 2 b-tagged jets (R = 1) • $min\Delta \varphi_{jE_t^{miss}} > 20^{\circ}$ Variable-R Jets 0.02 < R < 0.4Loose $m_h$ selection • $E_T^{miss} > 500 \ GeV$

2b tagged  $/ \ge 3b$  tagged jets



•  $E_T^{miss} > 150 \, GeV$ 

No leptons

•

### Mono- $H \rightarrow b\overline{b}$



• Simultaneous likelihood fit to all regions (SR binned in  $m_{\rm H}$ )

No excess observed



#### ATLAS-CONF-2021-006

• Z' masses up to 3.1 TeV excluded for A masses of 300 GeV at 95% CL

Limits on the visible cross section are set with minimal assumption

Luigi Sabetta | 24 May 2021 | Dark matter searches with the ATLAS detector

#### ATL-PHYS-PUB-2021-009

.....

### Conclusions

- A brief summary in the field of DM searches as been presented, touching Simplified Models and 2HDM models
- So much done and still on-going!

Status: March 2021 $\int C dt = (3.6 - 139) (b^{-1} \sqrt{5}) Model (I, \gamma, Jets' E mis f2 dt(b^{-1}) Limit F Model (I, \gamma, Jets' E mis f2 dt(b^{-1}) Limit F Model (I, \gamma, Jets' E mis f2 dt(b^{-1}) Limit F Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H M H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H M H Model (I, -2) (Jets' E mis f2 dt(b^{-1}) F H M H M H H H H H H H H H H H H H H H$	S Prelimina	AILA		- 95% CL Opper	es - 957	s Search	AILAS EXULICS
Model $\ell, \gamma$ Jets'r $\Gamma_{m}$ $f_{c}$ Limit         F           Model $0 e_{d,t}, r_{1}$ $1 - 4$ Yes         1 $0 = 3 + 2 + 3 - 4 = 3 + 2 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 +$	$\sqrt{s} = 8, 13 \text{ Te}$	(3.6 – 139) fb <sup>-1</sup>	$\int \mathcal{L} dt = (S_{t})^{T} dt = (S_{t})^{$				Status: March 2021
Bit         Display         Description         Display         <	Reference		Limit	$\frac{E_{T}^{miss}}{T} \int \mathcal{L}  dt[fb^{-1}]$	Jets† E <sub>T</sub> <sup>miss</sup>	<i>ℓ</i> ,γ	Model
SSM $T' \to (l')$ $2 e, \mu$ $  138$ $2 e rass$ $2 e 2 e V$ SSM $T' \to r$ $2 r$ $ 361$ $2'$ mass $2.42 e V$ $r/m = 1.2\%$ SSM $T' \to r'$ $0 e, \mu$ $2 h \ge 2 J$ $V = 3$ $2.1 e V$ $r/m = 1.2\%$ $r/m = 1.2\%$ SSM $W' \to r'$ $1 e, \mu$ $ 2 h \ge 2 J$ $V = 3$ $0 = 7$ <	2102.10874 1707.04147 1703.09127 1512.02586 2102.13405 1808.02380 2004.14636 1804.10823 1803.09678		11.2 Te 8.6 TeV 8.9 TeV 9.55 TeV 4.5 TeV 2.3 TeV 2.0 TeV 3.8 TeV 1.8 TeV	j Yes 139 Mo - 36.7 Ms - 37.0 Mm - 3.6 Mm - 139 Grk mass J Yes 139 Grk mass LJ/2j Yes 36.1 Srk mass 3 Yes 36.1 Krmass	$\begin{array}{cccc} 1-4j & \text{Yes} \\ \hline & & - & - \\ 2j & - & - \\ \geq 3j & - & - \\ \hline & & - & - \\ el & & \\ 2j/1J & \text{Yes} \\ \geq 1b, \geq 1J/2j & \text{Yes} \\ \geq 2b, \geq 3j & \text{Yes} \end{array}$	$\begin{array}{c} 0 \ e, \mu, \tau, \gamma \\ 2\gamma \\ - \\ 2\gamma \\ multi-channe \\ \gamma qq \qquad 1 \ e, \mu \\ 1 \ e, \mu \\ 1 \ e, \mu \end{array}$	$\begin{array}{llllllllllllllllllllllllllllllllllll$
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	1903.06248 1709.07242 1805.09299 2005.05138 1906.05609 1801.06992 2004.14636 ATLAS-CONF-2020-04 2007.05293 1807.10473 1904.12679	$\Gamma/m = 1.2\%$ $g_V = 3$ $g_V = 3$ $g_V = 3$ $m(N_R) = 0.5 \text{ TeV}, g_L = g_R$	5.1 TeV 2.42 TeV 2.1 TeV 4.1 TeV 6.0 TeV 3.7 TeV 4.3 TeV 3.2 TeV 3.2 TeV 3.2 TeV 3.2 TeV 5.0 TeV	- 139 Z' mass - 36.1 Z' mass - 36.1 Z' mass 2 J Yes 139 Z' mass Yes 139 W' mass Yes 36.1 W' mass J Yes 139 W' mass 2 J Yes 139 W' mass 2 J	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c} 2 \ e, \mu \\ 2 \ \tau \\ - \\ 0 \ e, \mu \\ 1 \ e, \mu \\ 0 \ c, \mu \end{array}$	$\begin{array}{c} \text{SSM } Z' \rightarrow \ell\ell \\ \text{SSM } Z' \rightarrow \tau\tau \\ \text{Leptophobic } Z' \rightarrow tt \\ \text{SSM } W' \rightarrow \tau\tau \\ \text{SSM } W' \rightarrow \ell\nu \\ \text{SSM } W' \rightarrow \ell\nu \\ \text{SSM } W' \rightarrow \tau\nu \rightarrow \ell\nu qq \text{ mod} \\ \text{HVT } W' \rightarrow WZ \rightarrow \ell\nu qq \text{ mod} \\ \text{HVT } W' \rightarrow WH \text{ model } B \\ \text{LRSM } W_R \rightarrow tb \\ \text{LRSM } W_R \rightarrow tN_R \\ \end{array}$
ModelAxial-vector med. (Dirac DM) Pseudo-scalar med. (Dirac DM) 0 e, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (Dirac DM) 0 e, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (Dirac DM) (De, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $\tau$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $Z'=2D$ , $\pi$ , $\pi$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $Z'=2D$ , $\pi$ , $\pi$ , $\gamma$ , $1-4j$ Vector med. $Z'=2MDM$ (De, $\mu$ , $Z'=2D$ , $\pi$	1703.09127 2006.12946 ATLAS-CONF-2021-01 ATLAS-CONF-2021-01 1811.02305	$\begin{array}{c c} \textbf{21.8 TeV} & \eta_{\bar{t}L} \\ \hline \textbf{35.8 TeV} & g_s = 1 \\ g_s = 1 \\  \textbf{C}_{4t}  = 4\pi \end{array} \qquad $	1.8 TeV 2.0 TeV 2.57 TeV	- 37.0 Λ - 139 Λ - 139 Λ - 139 Λ 1 j Yes 36.1 Λ	$\begin{array}{cccc} 2 \ j & - & - \\ - & - & - \\ 1 \ b & - & \\ 1 \ b & - & \\ \geq 1 \ b, \geq 1 \ j & Yes \end{array}$	_ 2 e,μ 2 e 2 μ ≥1 e,μ	$ \begin{array}{c} CI \ qqqq \\ Cl \ \ell l qq \\ Cl \ eebs \\ Cl \ \mu bs \\ Cl \ ttt \end{array} $
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	2102.10874 2102.10874 ATLAS-CONF-2021-00 ATLAS-CONF-2021-00 1812.09743	$\begin{array}{l} g_q\!=\!0.25,g_{\chi}\!=\!1,m(\chi)\!=\!1~{\rm GeV}\\ g_q\!=\!1,g_{\chi}\!=\!1,m(\chi)\!=\!1~{\rm GeV}\\ \tan\beta\!=\!1,g_{\chi}\!=\!0.8,m(\chi)\!=\!100~{\rm GeV}\\ \tan\beta\!=\!1,g_{\chi}\!=\!1,m(\chi)\!=\!10~{\rm GeV}\\ y\!=\!0.4,\lambda\!=\!0.2,m(\chi)\!=\!10~{\rm GeV} \end{array}$	2.1 TeV 376 GeV 3.1 TeV 520 GeV 3.4 TeV	j Yes 139 mmed j Yes 139 mmed Yes 139 mmed yes 139 mmed 1 J Yes 36.1 mø	1-4j Yes 1-4j Yes 2b Yes 2b Yes 1b, 0-1J Yes		Axial-vector med. (Dirac DM) Pseudo-scalar med. (Dirac DM) Vector med. Z'-2HDM (Dirac Pseudo-scalar med. 2HDM+a Scalar reson. $\phi \rightarrow t\chi$ (Dirac D
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	2006.05872 2006.05872 ATLAS-CONF-2021-00 2004.14060 2101.11582 2101.12527	$\begin{array}{l} \beta = 1 \\ \beta = 1 \\ \mathcal{B}(\mathrm{LQ}_3^{\prime\prime} \to b\tau) = 1 \\ \mathcal{B}(\mathrm{LQ}_3^{\prime\prime} \to t\nu) = 1 \\ \mathcal{B}(\mathrm{LQ}_3^{\prime\prime} \to t\tau) = 1 \\ \mathcal{B}(\mathrm{LQ}_3^{\prime\prime} \to b\nu) = 1 \end{array}$	1.8 TeV 1.7 TeV 1.2 TeV 1.24 TeV 1.43 TeV 1.43 TeV	Yes         139         LO mass           Yes         139         LO mass           Ves         139         LO <sup>a</sup> mass           2 b         Yes         139         LO <sup>a</sup> mass           1 b         -         139         LO <sup>a</sup> mass           2 b         Yes         139         LO <sup>a</sup> mass           2 b         Yes         139         LO <sup>a</sup> mass	$ \begin{array}{c c} \geq 2 \ j & \mbox{Yes} \\ \geq 2 \ j & \mbox{Yes} \\ 2 \ b & \mbox{Yes} \\ \geq 2 \ j, \geq 2 \ b & \mbox{Yes} \\ \tau \geq 1 \ j, \geq 1 \ b & - \\ \tau \ 0 - 2 \ j, 2 \ b & \mbox{Yes} \end{array} $	$\begin{array}{c} 2 \ e \\ 2 \ \mu \\ 1 \ \tau \\ 0 \ e, \mu \\ \ge 2 e, \mu, \ge 1 \tau \\ 0 \ e, \mu, \ge 1 \tau \end{array}$	G Scalar LQ 1 <sup>st</sup> gen Scalar LQ 2 <sup>nd</sup> gen Scalar LQ 3 <sup>rd</sup> gen Scalar LQ 3 <sup>rd</sup> gen Scalar LQ 3 <sup>rd</sup> gen
gExcited quark $q^* \rightarrow qg$ -2 j-139 $q^*$ mass6.7 TeVonly $u^*$ and $d^*$ , $\Lambda = m(q^*)$ gExcited quark $q^* \rightarrow qg$ -1 j-36.7 $q^*$ mass6.7 TeVonly $u^*$ and $d^*$ , $\Lambda = m(q^*)$ Excited quark $q^* \rightarrow qg$ -1 b, 1 j-36.7 $q^*$ mass2.6 TeVonly $u^*$ and $d^*$ , $\Lambda = m(q^*)$ Excited lepton $l^*$ 3 e, $\mu$ , $\tau$ 20.3 $l^*$ mass3.0 TeV $\Lambda = 3.0 TeV$ Excited lepton $v^*$ 3 e, $\mu$ , $\tau$ 20.3 $l^*$ mass1.6 TeV $\Lambda = 1.6 TeV$ Type III Seesaw1 e, $\mu \geq 2j$ Yes139N <sup>0</sup> mass790 GeV $M_{emass}$ $M_{em$	1808.02343 1808.02343 1807.11883 1812.07343 ATLAS-CONF-2018-02 1509.04261	$ \begin{array}{l} \mathrm{SU}(2) \text{ doublet} \\ \mathrm{SU}(2) \text{ doublet} \\ \mathcal{B}(T_{5/3} \rightarrow Wt) = 1, \ c(T_{5/3}Wt) = 1 \\ \mathcal{B}(Y \rightarrow Wb) = 1, \ c_R(Wb) = 1 \\ \mathrm{singlet}, \ \kappa_B = 0.5 \end{array} $	1.37 TeV 1.34 TeV 1.64 TeV 1.85 TeV 1.21 TeV 690 GeV	36.1         T mass           36.1         B mass           1 j         Yes         36.1           1 j         Yes         36.1           1 j         Yes         36.1           1 j         Yes         36.1           1 j         Yes         79.8           Mass         Yes         20.3	$ \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \\ \end{array} \end{array} \\ \begin{array}{l} \begin{array}{l} \\ \end{array} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \begin{array}{l} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \begin{array}{l} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \begin{array}{l} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \begin{array}{l} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \begin{array}{l} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \begin{array}{l} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \begin{array}{l} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \begin{array}{l} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{l} \end{array} \\ \end{array} $	$ \begin{array}{c} X & \text{multi-channe} \\ & \text{multi-channe} \\ + X & 2(SS)/\geq 3 \ e, \mu \\ & 1 \ e, \mu \\ & 0 \ e, \mu \\ & 1 \ e, \mu \end{array} $	$ \begin{array}{c} \begin{array}{c} \mbox{Suppose} \\ \mbox{Suppose} \\ \mbox{Suppose} \\ \end{array} \end{array} \\ \begin{array}{c} \mbox{VLQ} \ TT \rightarrow Ht/Zt/Wb + X \\ \mbox{VLQ} \ BB \rightarrow Wt/Zb + X \\ \mbox{VLQ} \ T_{5/3} \ T_{5/3} \ T_{5/3} \rightarrow Wt + \lambda \\ \mbox{VLQ} \ B \rightarrow Hb + X \\ \mbox{VLQ} \ B \rightarrow Hb + X \\ \mbox{VLQ} \ Q \rightarrow WqWq \end{array} $
Type III Seesaw $1 e, \mu \ge 2j$ Yes     139     N <sup>0</sup> mass     790 GeV       LRSM Majorana $\nu$ $2\mu$ $2j$ $-$ 36.1     N <sub>R</sub> mass     3.2 TeV       Hints triplet $H^{\pm\pm} \rightarrow \ell \ell$ $2.3 4 e, \mu$ $5.3 - e, \mu$ $-$ 36.1     N <sub>R</sub> mass	1910.08447 1709.10440 1805.09299 1411.2921 1411.2921	only $u^*$ and $d^*, \Lambda = m(q^*)$ only $u^*$ and $d^*, \Lambda = m(q^*)$ $\Lambda = 3.0$ TeV $\Lambda = 1.6$ TeV	6.7 TeV 5.3 TeV 2.6 TeV 3.0 TeV 1.6 TeV	- 139 q*mass - 36.7 q*mass j - 36.1 b*mass - 20.3 v*mass	2 j – 1 j – 1 b, 1 j – – –	- 1 γ 3 e,μ 3 e,μ,τ	Excited quark $q^* \rightarrow qg$ Excited quark $q^* \rightarrow q\gamma$ Excited quark $b^* \rightarrow bg$ Excited lepton $\ell^*$ Excited lepton $\nu^*$
Higgs triplet $H^{\pm\pm} \rightarrow \ell\tau$ 3 e, $\mu, \tau$ 20.3 Multi-charged particles 36.1 Magnetic monopoles 34.4 Magnetic monopole 34.4 Multi-charged particle mass 1.22 TeV Magnetic monopole	20008.07949 1809.11105 1710.09748 1411.2921 1812.03673 1905.10130	$\begin{split} m(W_R) &= 4.1 \text{ TeV}, g_L = g_R \\ \text{DY production} \\ \text{DY production}, \mathcal{B}(H_L^{\pm\pm} \to \ell\tau) = 1 \\ \text{DY production},  q  &= 5e \\ \text{DY production},  g  &= 1g_D, \text{ spin } 1/2 \end{split}$	790 GeV 3.2 TeV 870 GeV 400 GeV icle mass 1.22 TeV 2.37 TeV	Yes 139 - 36.1 N <sub>R</sub> mass - 36.1 H <sup>±±</sup> mass - 36.1 multi-charged pr - 36.1 multi-charged pr - 34.4 monopole mass	$\geq 2j$ Yes 2j - -	$1 e, \mu$ $2\mu$ $2,3,4 e, \mu$ (SS $3 e, \mu, \tau$ - - - - - - - -	Type III Seesaw LRSM Majorana $\nu$ Higgs triplet $H^{\pm\pm} \rightarrow \ell \ell$ Higgs triplet $H^{\pm\pm} \rightarrow \ell \tau$ Multi-charged particles Magnetic monopoles

ATLAC Evention Conversion (Conversion Lineity)

†Small-radius (large-radius) jets are denoted by the letter j (J).

Luigi Sabetta | 24 May 2021 | Dark matter searches with the ATLAS detector

### Backup

### Mono-jet Event Display



Luigi Sabetta | 24 May 2021 | Dark matter searches with the ATLAS detector

### Mono-jet results – WIMP nucleon $\sigma_{SD}$



### Mono-jet results – squark pair production



### Mono-jet results – HL-LHC



### Mono-jet mono-photon combination



#### ATLAS-CONF-2021-004

### **VBF** $H \rightarrow invisible + \gamma$

Discriminating variables for the final fit

The analysis aims to find an excess in the *DNN score spectum* for the invisible decay, in the  $m_T$  spectrum for the  $\gamma \gamma_d$  decay





### $H \rightarrow b\overline{b} - a-2HDM$







### Mono- $H \rightarrow \gamma \gamma$ – a-2HDM



### Mono- $H \rightarrow \gamma \gamma$ – a-2HDM



Mono- $H \rightarrow \gamma \gamma - Z'_B$ 



## Mono- $H \rightarrow \gamma \gamma / b \overline{b}$ - 36 f $b^{-1}$ combination

