

An abstract graphic on the left side of the slide. It features a central point from which numerous lines radiate outwards. Some lines are solid and colored in shades of yellow, orange, and blue, while others are thin and white. A dashed white line also extends from the center. The lines create a starburst or 'colliding light' effect.

# COLLIDING LIGHT

To make dark matter at the LHC

**International Conference on High Energy Physics**

Poster session | 31 July 2020

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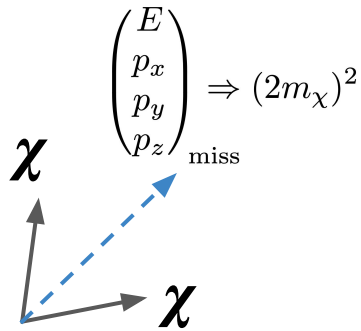
THE UNIVERSITY OF  
**CHICAGO**

*In collaboration with Lydia Beresford (University of Oxford)*

*Based on Phys. Rev. Lett. 123 (2019) 141801*

# Problem: LHC “MET+X” DM searches only use invisible 2-vector

## Dream



## Reality



$E$  and  $p_z$   
“immeasurable”

## Consequence: at least 2 degrees of freedom lost

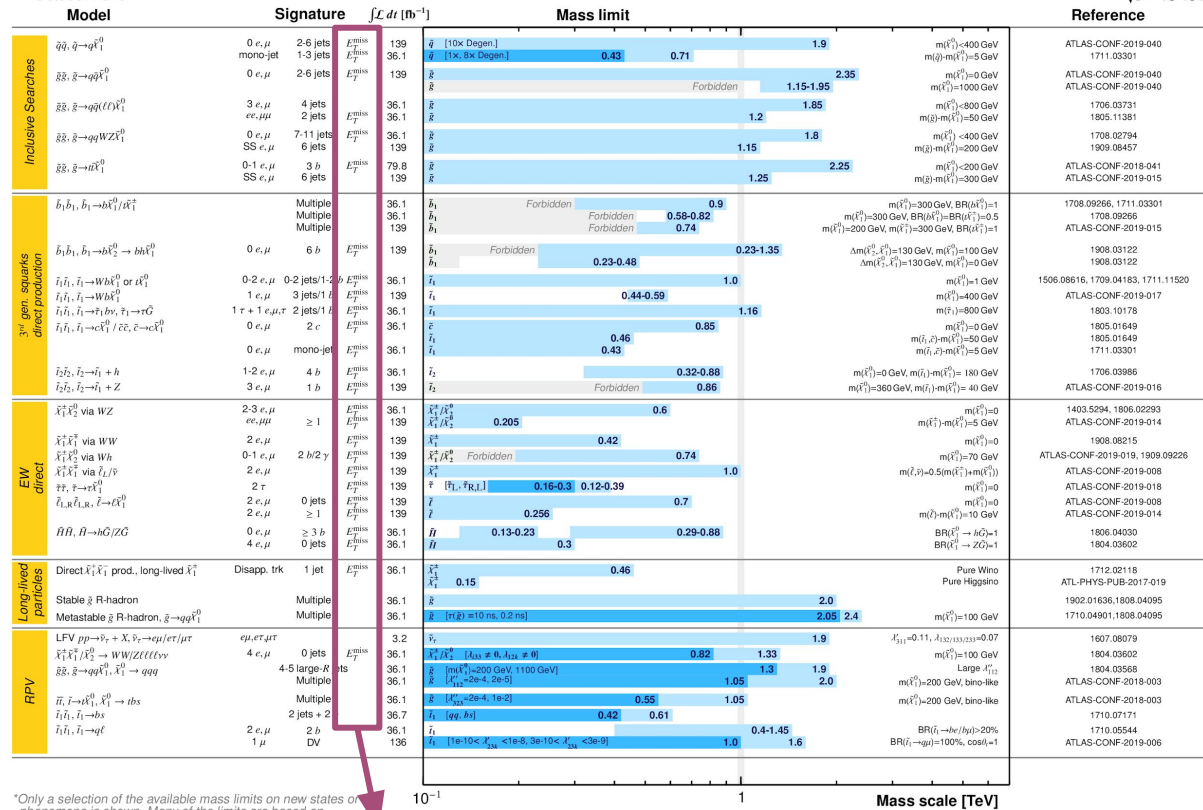
### ATLAS SUSY Searches\* - 95% CL Lower Limits

October 2019

ATL-PHYS-PUB-2019-044

ATLAS Preliminary

$\sqrt{s} = 13 \text{ TeV}$

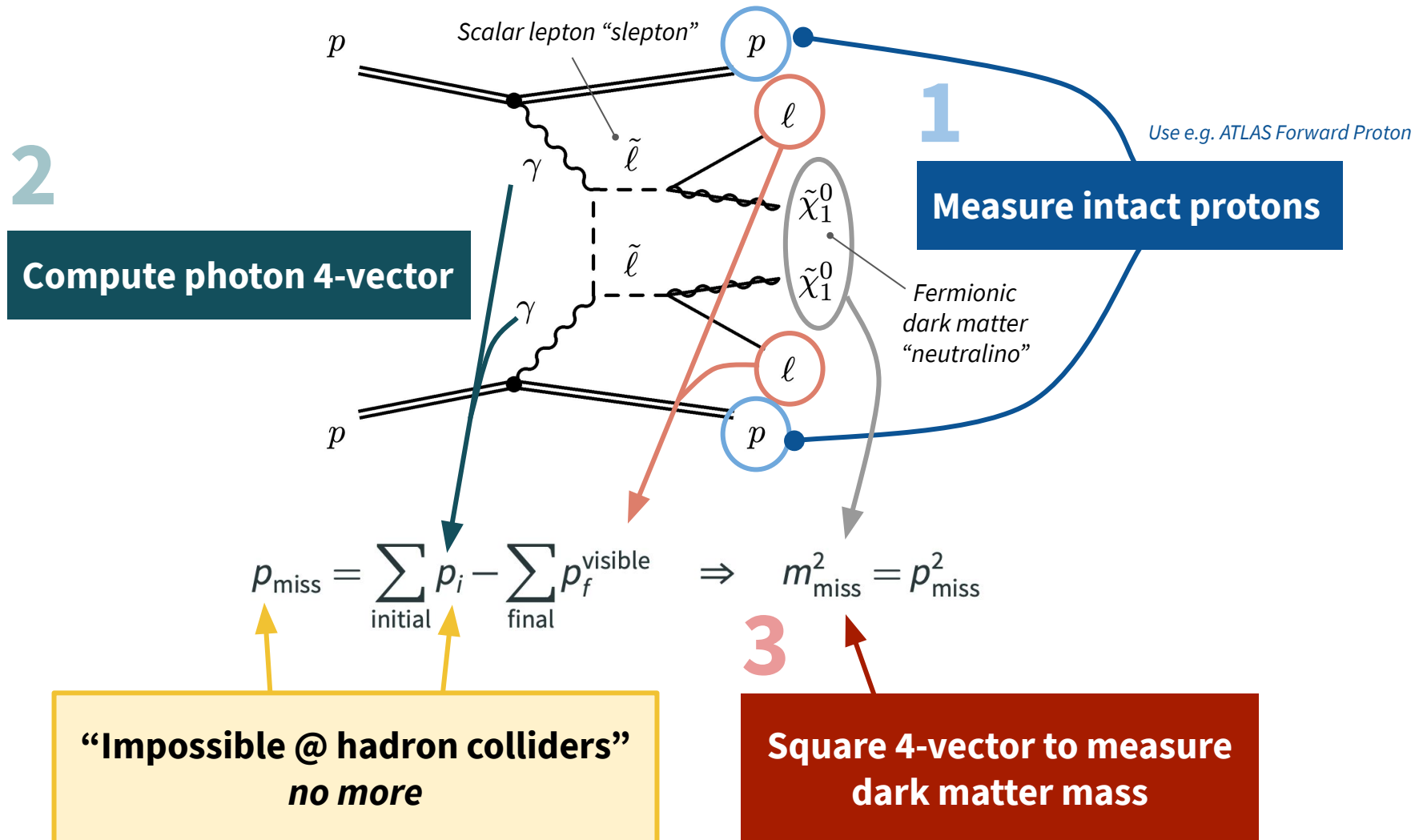


\*Only a selection of the available mass limits on new states or phenomena is shown. Many of the limits are based on simplified models, c.f. refs. for the assumptions made.

$E_T^{\text{miss}}$

Only transverse measured but really desire missing momentum 4-vector

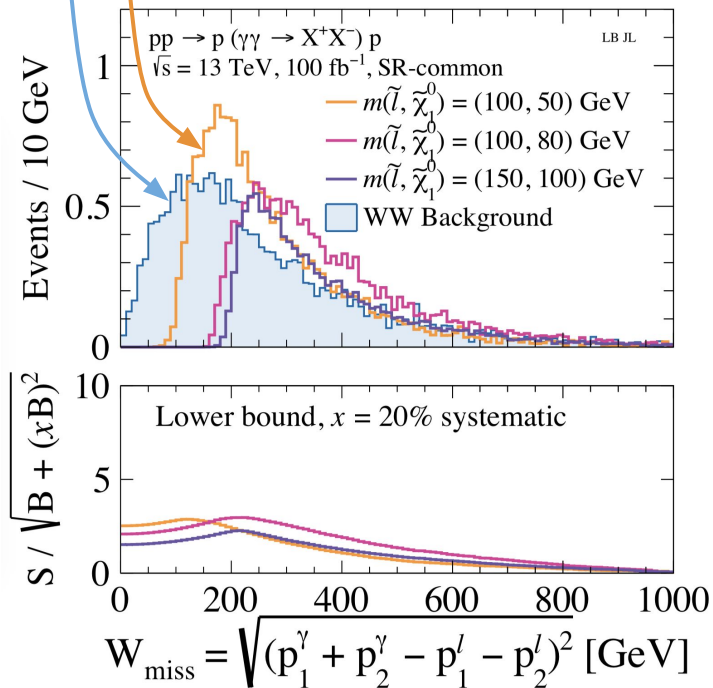
# Solution: collide light & tag protons for 4-vector $p_{\text{miss}}$



# Impact: turn light into dark matter this decade?

$\gamma\gamma \rightarrow WW$  irreducible background

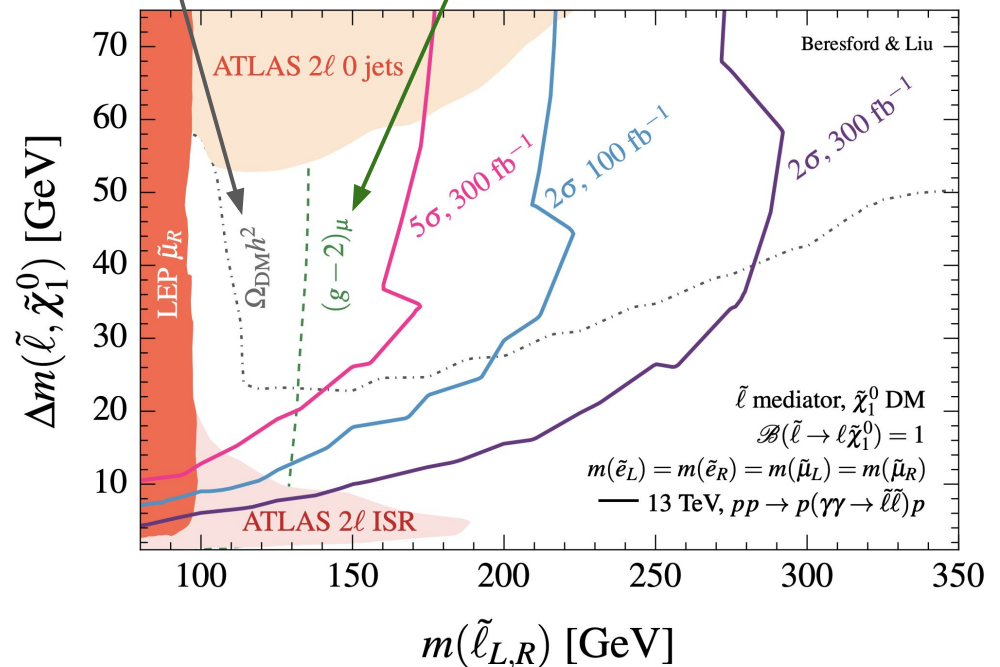
Sharp threshold at  $2 \times m_{DM}$



Missing mass spectrum @ LHC

Favoured by dark matter abundance

Favoured by muon  $g - 2$  tension



Sensitivity to challenging parameter space