DARK MATTER & LOCALIZED FERMIONS ON SPHERICAL ORBIFOLDS ?

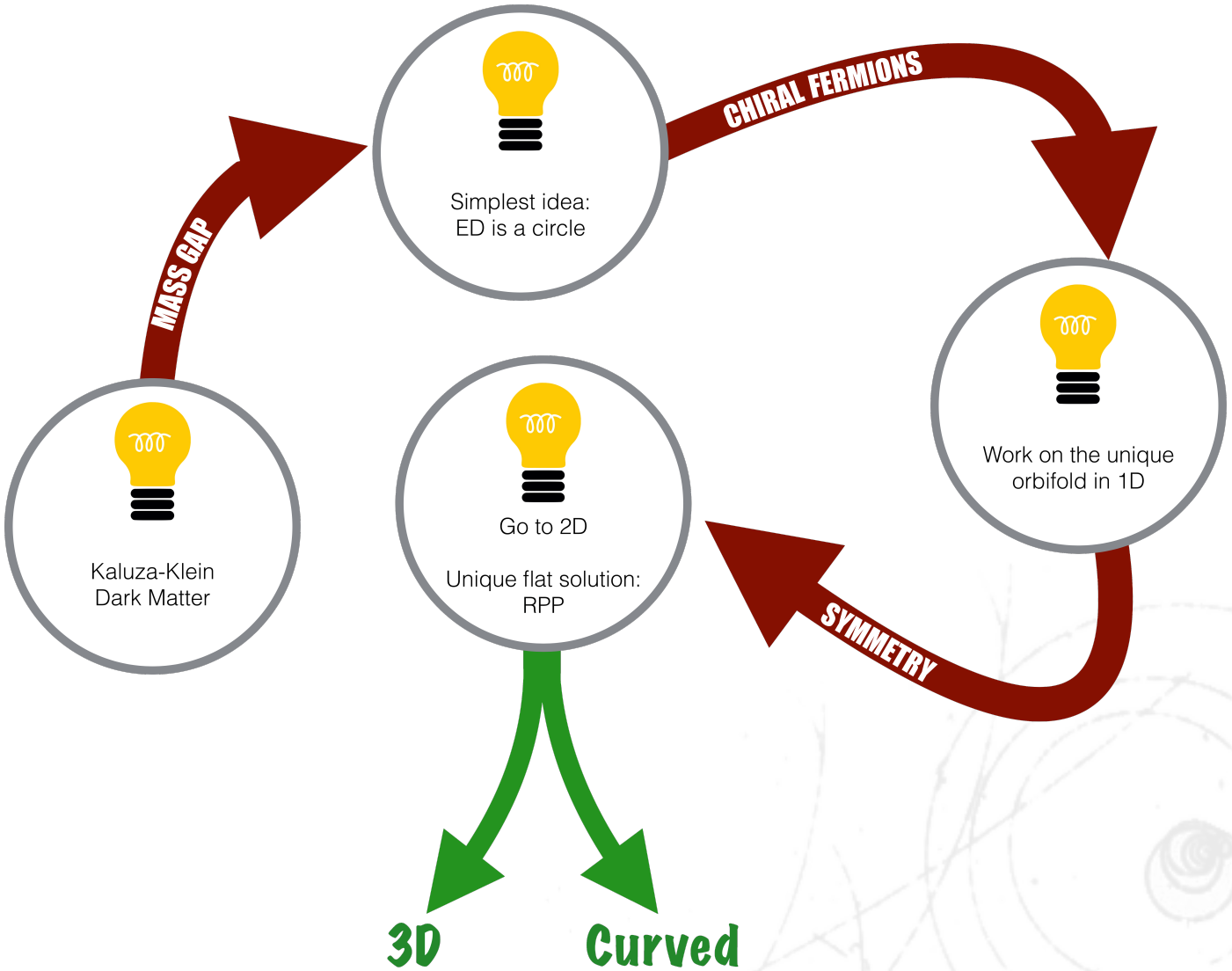
Nicolas Deutschmann

Based on [1601.00081]

with **Giacomo Cacciapaglia** and **Aldo Deandrea**

Rencontres de Physique des Particules
January 26, 2016

A brief history of a nice idea



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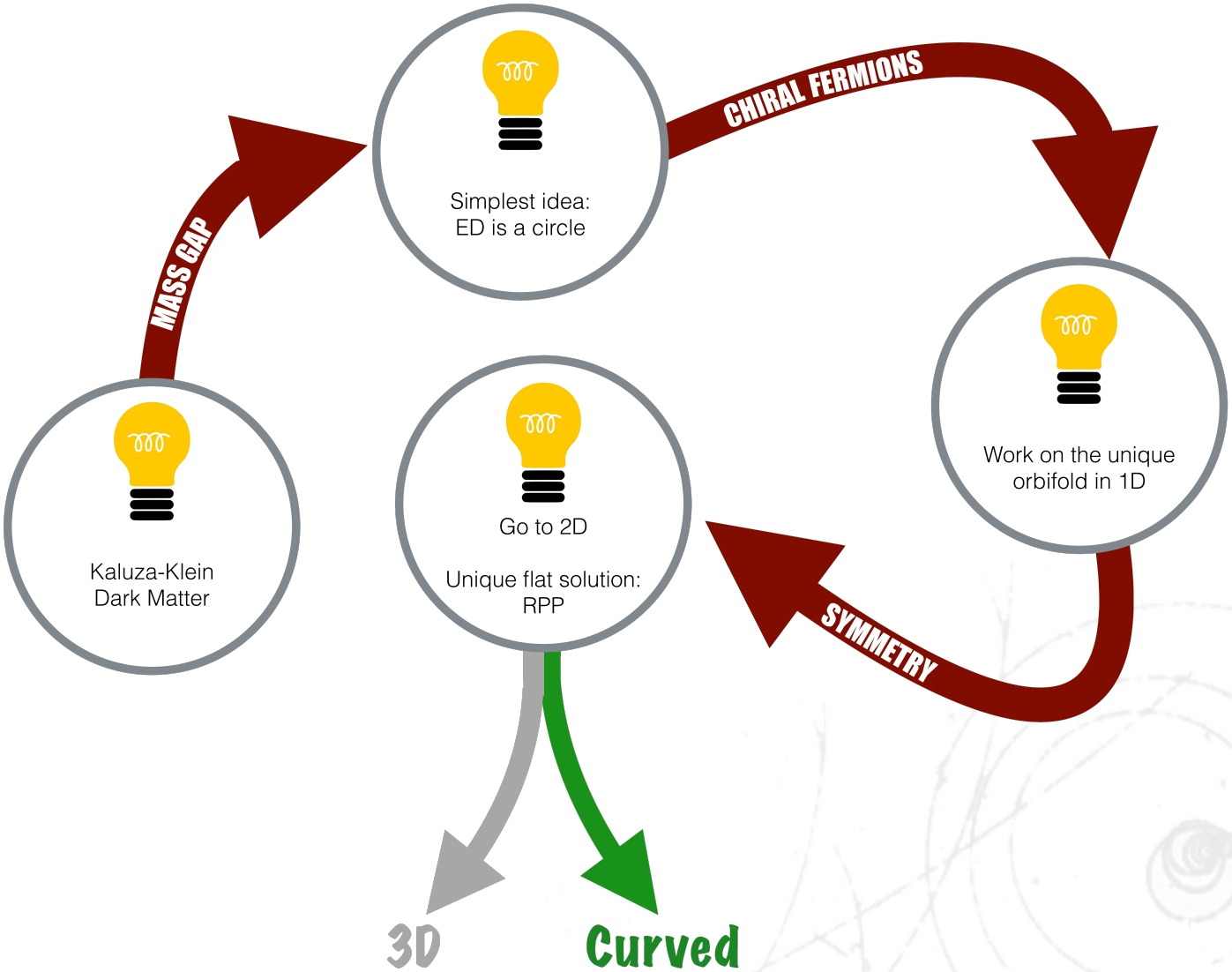

An organizing principle for 2D spaces

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There are many compact 2D manifolds !

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Theorem *(a real one)*

All possible topologies for 2D spaces are realized by spaces of the form

$$\mathbb{R}^2/G,\ S^2/G,\ \mathbb{H}^2/G$$

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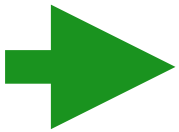
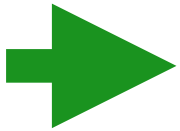
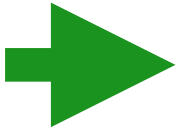
The spherical world

No chiral fermion modes







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Actual realizations have issues
Dohi *et al.* [1406.1954] [1004.3722]
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Dynamical mechanism
Good fermion masses
No dark matter
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The simplest such model

Model specifications

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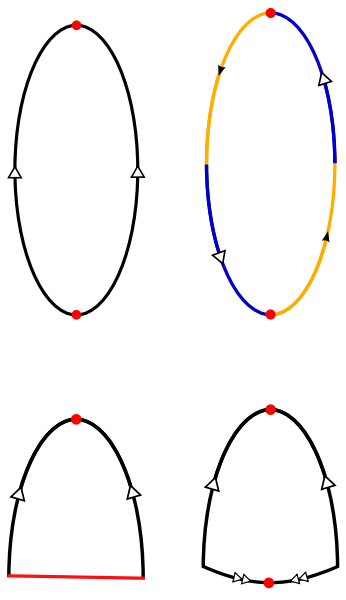
Fixed points



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Model specifications
Symmetry
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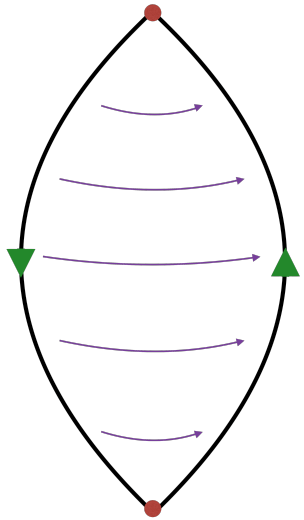
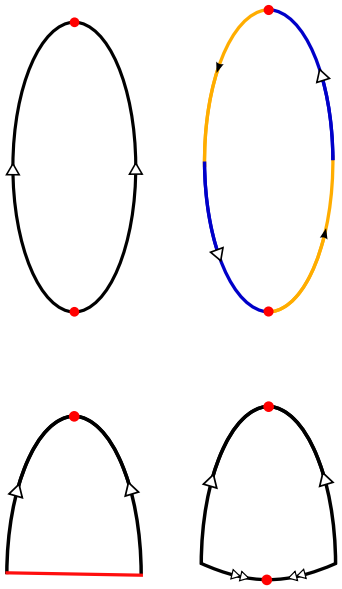
Only one fixed point



S_n



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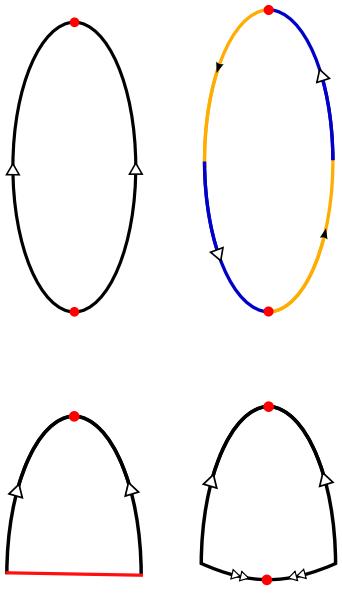

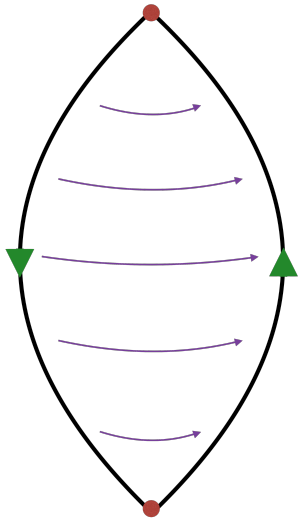

S_4

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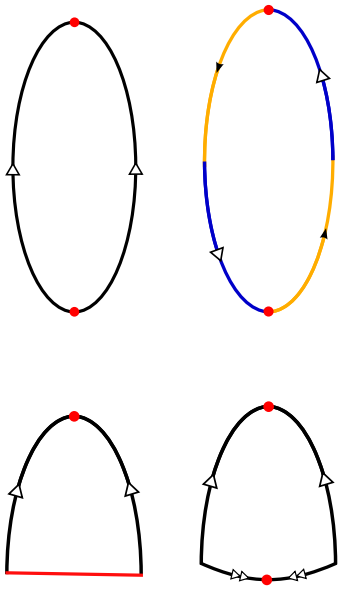

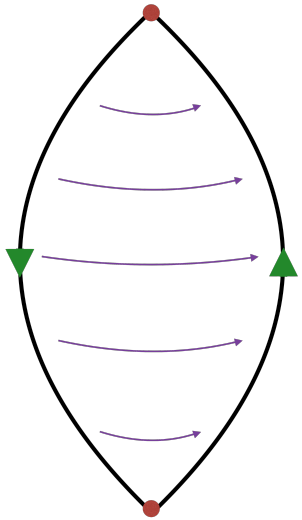

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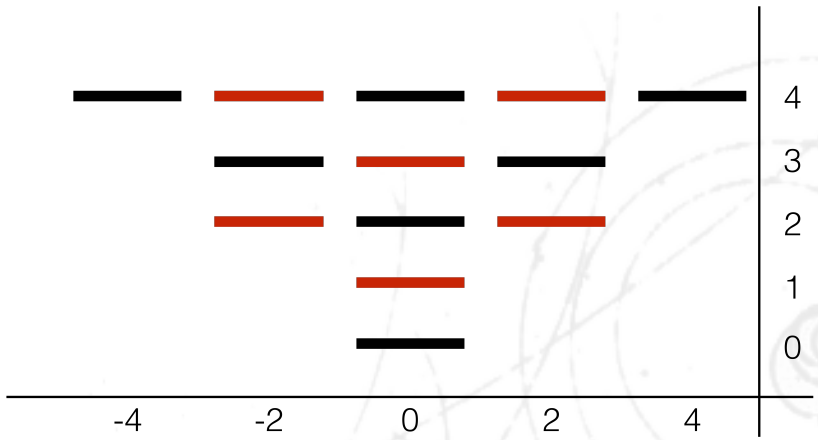

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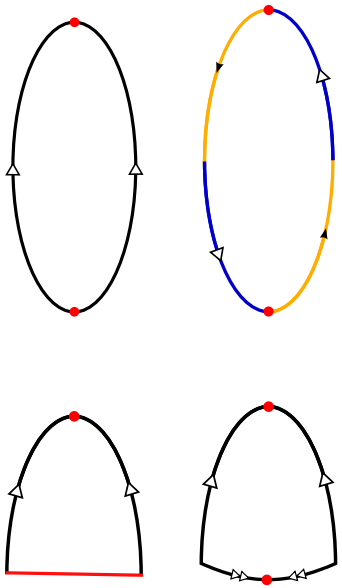

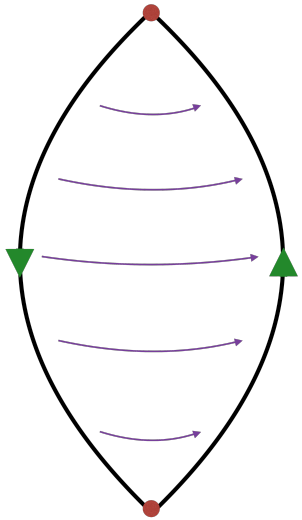

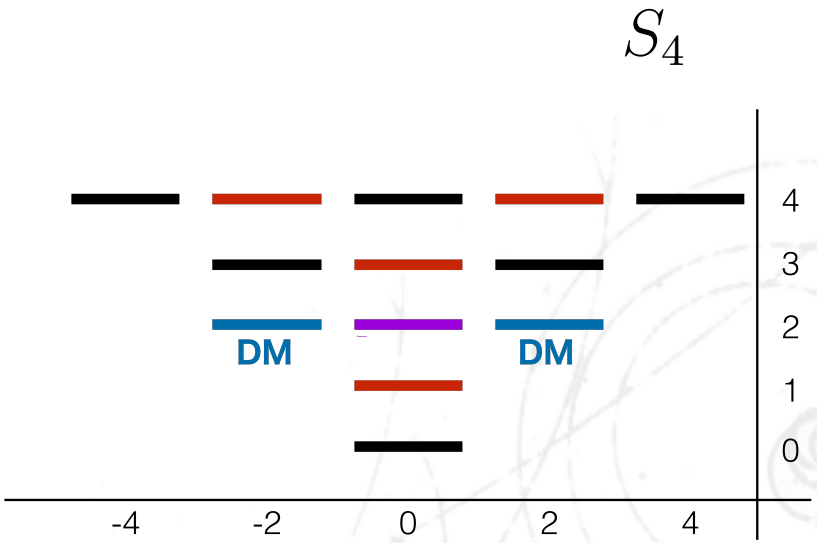

Ruling out the bulk of the model

Dilepton resonances

Relic abundance

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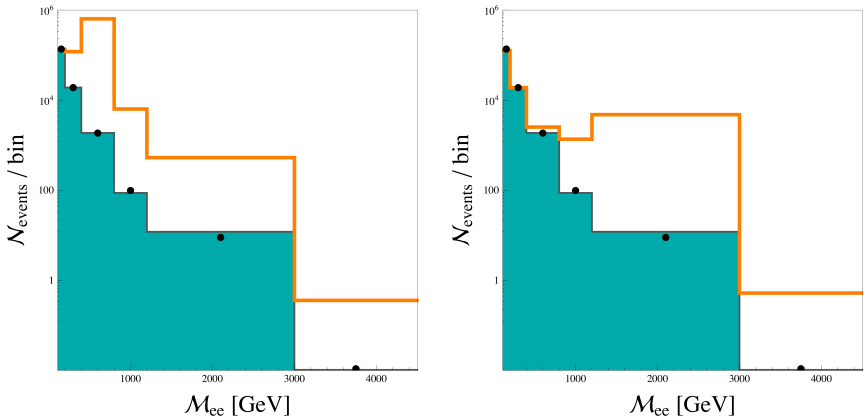
Dilepton resonances

ATLAS analysis [1405.4123]

Recast using MA5



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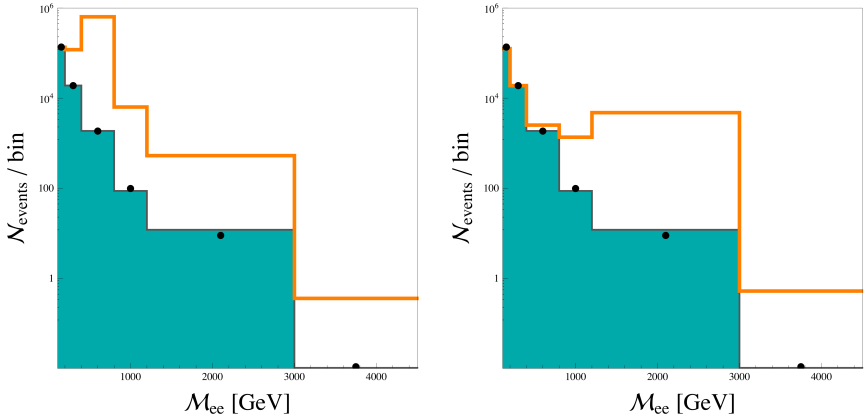

Relic abundance

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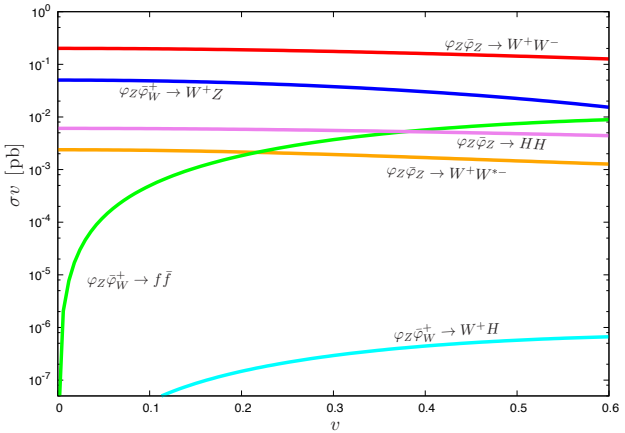

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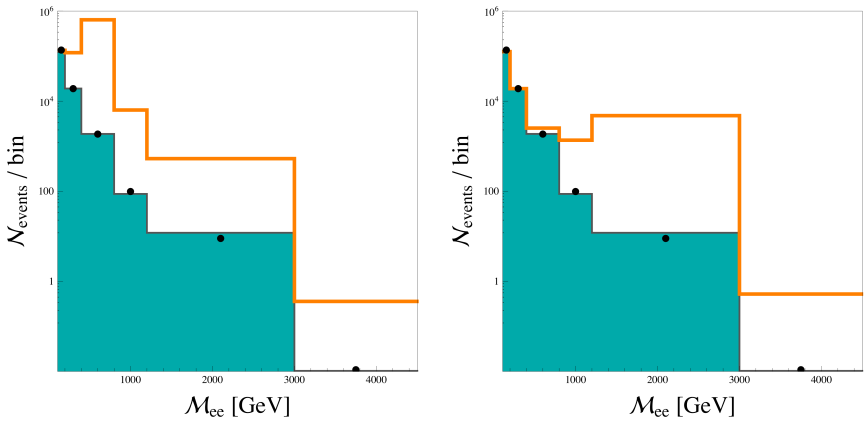

Lower bound

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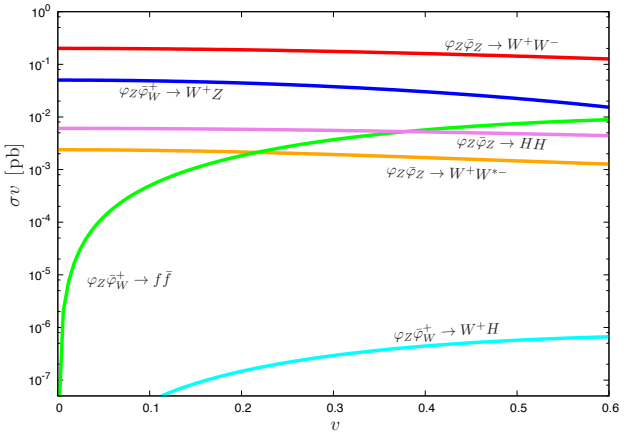

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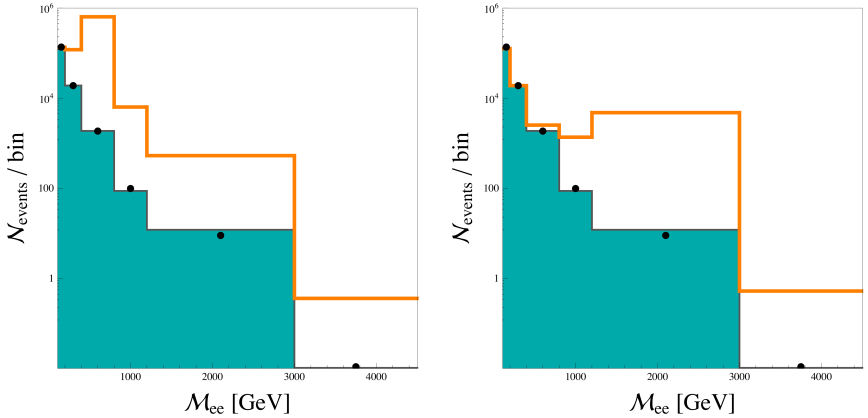

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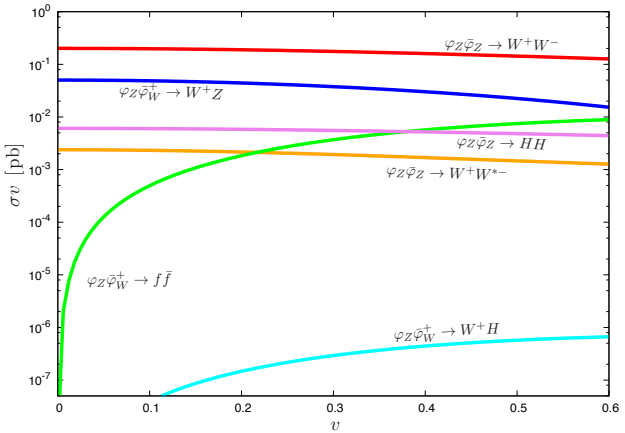

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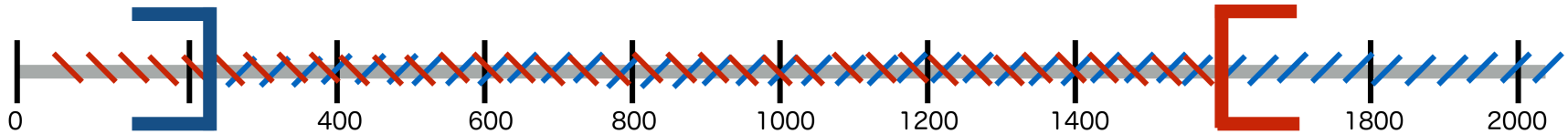
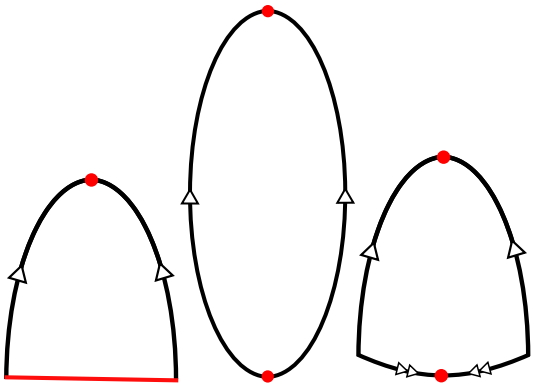
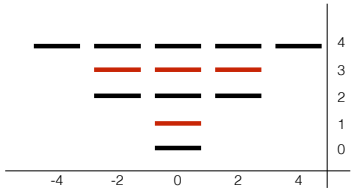
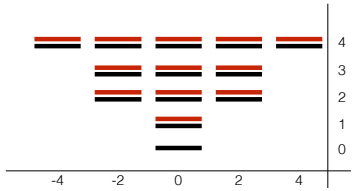


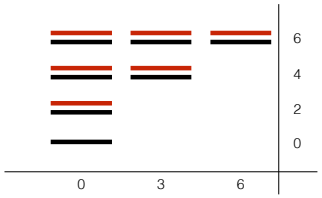
$1/R$

Full strike!









- General features of S^2/G

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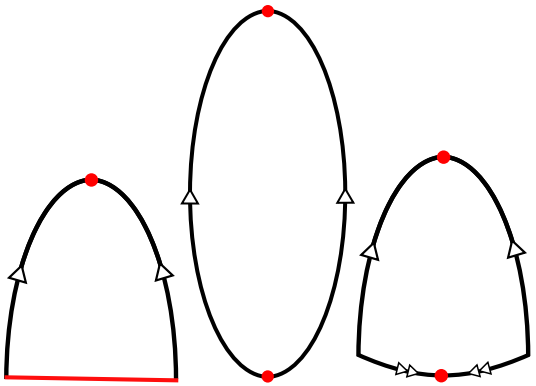

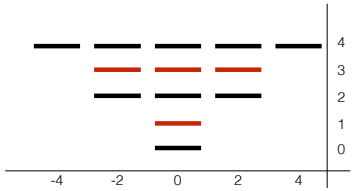

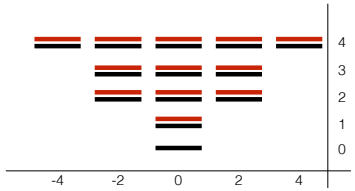

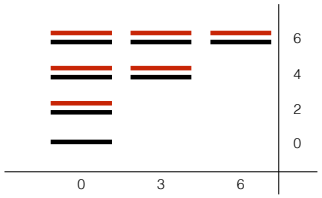

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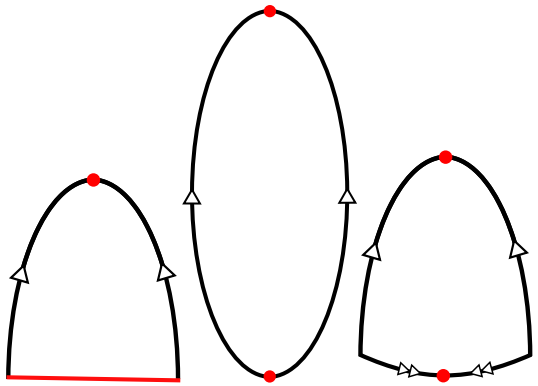

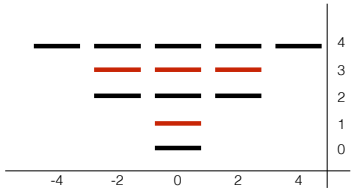

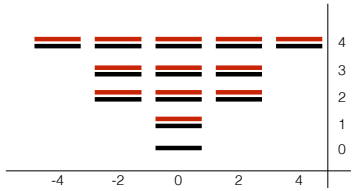

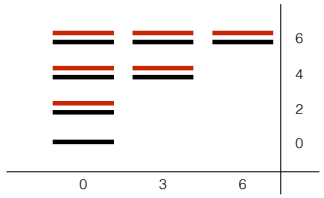

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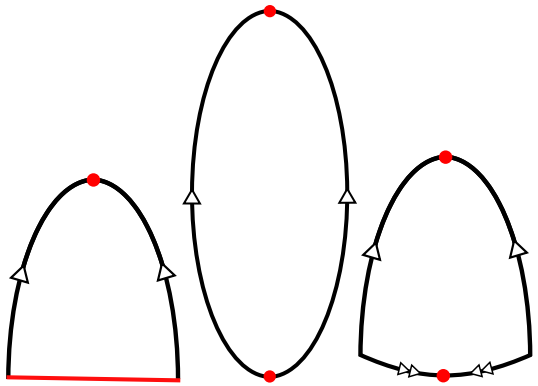
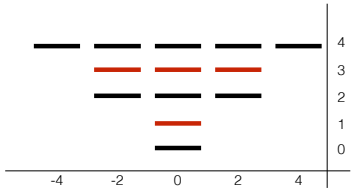
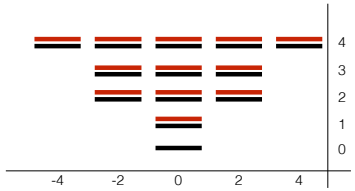
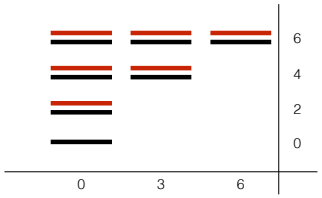
	(l,m)	spin	(l,m)	$m_{DM}/m_{Z'}$	NP	SP	EME	WME
S_4	$(2,\pm2)$	S	$(2,0)$	1	$\sqrt{5}$		-	-
S_6	$(3,\pm3)$	V	$(2,0)$	$\sqrt{2}$	$\sqrt{5}$		-	-
C_2	$(2,\pm2)$	V+S	$(1,0)$	$\sqrt{3}$	$-\sqrt{3}$	$\sqrt{3}$	-	-
C_4	$(4,\pm4)$	V+S	$(1,0)$	$\sqrt{10}$	$-\sqrt{3}$	$\sqrt{3}$	-	-
C_{2h}	$(2,\pm2)$	V	$(2,0)$	1	$\sqrt{5}$		-	-
C_{4h}	$(4,\pm4)$	V	$(2,0)$	$\sqrt{10/3}$	$\sqrt{5}$		-	-
D_3	$(4,3)$	V+S	$(2,0)$	$\sqrt{10/3}$	$\sqrt{5}$		$-\sqrt{5}/2$	$-\sqrt{5}/2$
D_5	$(6,5)$	V+S	$(2,0)$	$\sqrt{7}$	$\sqrt{5}$		$-\sqrt{5}/2$	$-\sqrt{5}/2$

Full strike!









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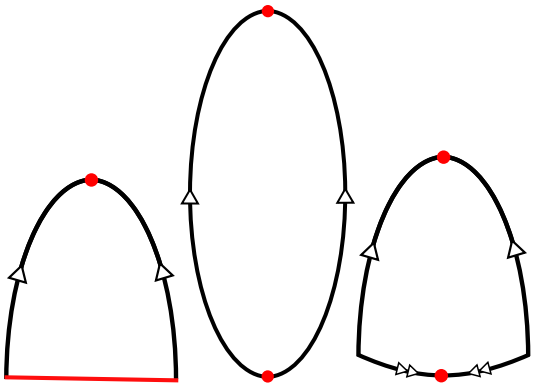

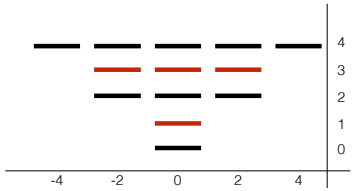

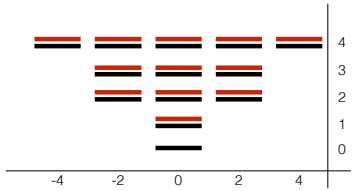

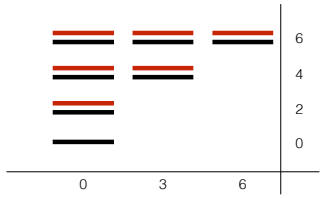

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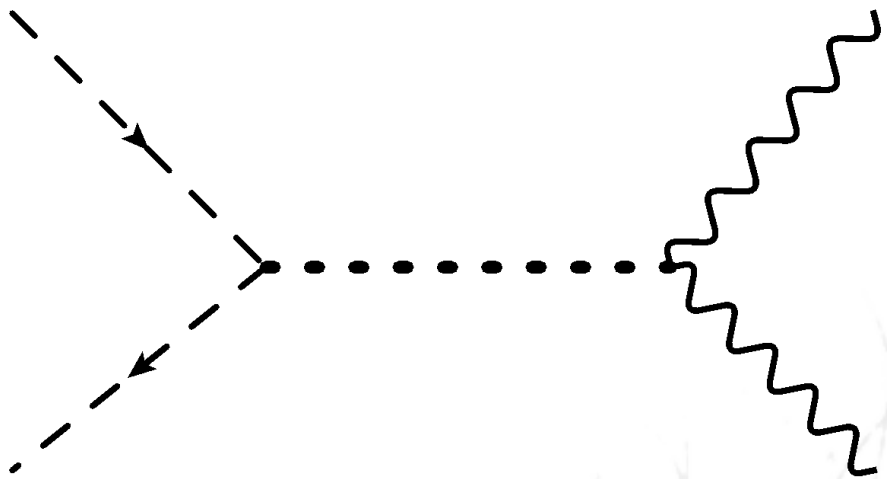
All models in our framework are disfavored

Will Mr. Higgs save the day?

"Tree-level UED" has one parameter: $\frac{1}{R}$

Need localized operators (free parameters) for a fully consistent quantum theory

Many hidden knobs: $H(4,0)$ fine-tuned annihilation resonance



Required increase in $\langle \sigma v \rangle$: $\times 80$

Detailed analysis not yet done but seems possible.

Conclusion

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- Eventually falsifiable too