SYMBOLIC REGRESSION FOR PRECISION LHC PHYSICS (# 117)

Josh Bendavid, Daniel Conde, Manuel Morales-Alvarado, Maria Ubiali, Veronica Sanz

UNIVERSITY OF CAMBRIDGE
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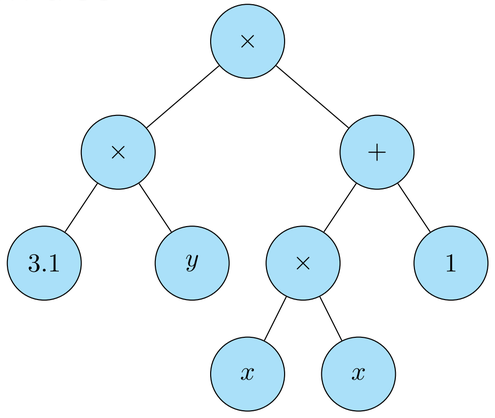
Our goal: find robust, simple, analytical expressions to describe collider observables

- We simulate particle collisions and use event-level kinematics as input data
- We use symbolic regression (SR) to find accurate, simple equations that describe the data

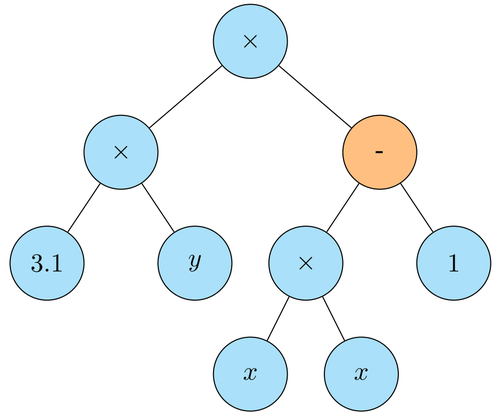
In SR, equations are represented by expression trees. During optimisation, they mutate and mix to provide better candidates

Expression tree

$$3.1y\ (x^2+1) \quad \leftrightarrow$$



Mutation



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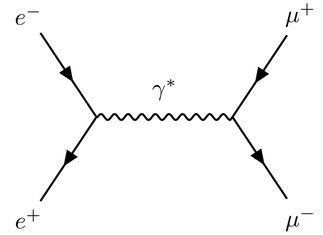
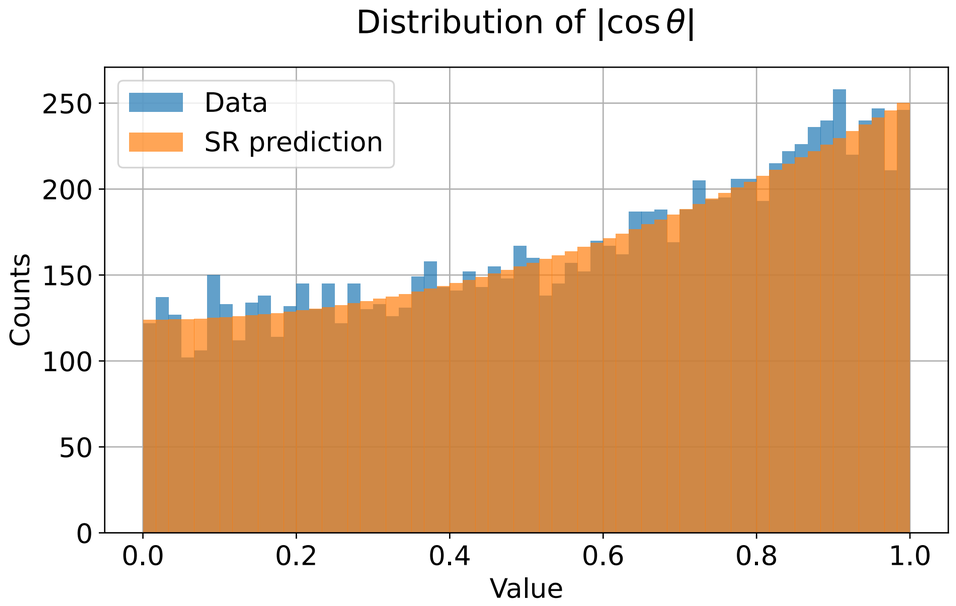
We assess the quality and the robustness of the SR results by equation recovery. Consider an angular distribution:

$e^- e^+ \to \mu^- \mu^+$





SR formulas $(x_0 = \cos\theta)$

Bins	Accuracy	Score	**Best**
10	$x_0^2 \cdot (296.52358194355 \cdot x_0^4 + 7046.0674) + 7613.42$	$7250.1396 \cdot x_0^2 + 7589.319$	$7250.1396 \cdot x_0^2 + 7589.319$
30	$x_0^2(123.43398x_0^4 + 2326.98053420264) + 2538.3494$	$2415.3643x_0 + 2125.6453$	$2417.7627x_0^2 + 2527.635$
100	$x_0(207.340216x_0 + 428.81232) + 109.830989048 + 750.30175$	$725.2477x_0 + 637.3749$	$726.08685x_0^2 + 757.9762$

$$\frac{d\sigma}{d\Omega} = \frac{\alpha^2}{4s}\left(1 + \cos^2\theta\right)$$

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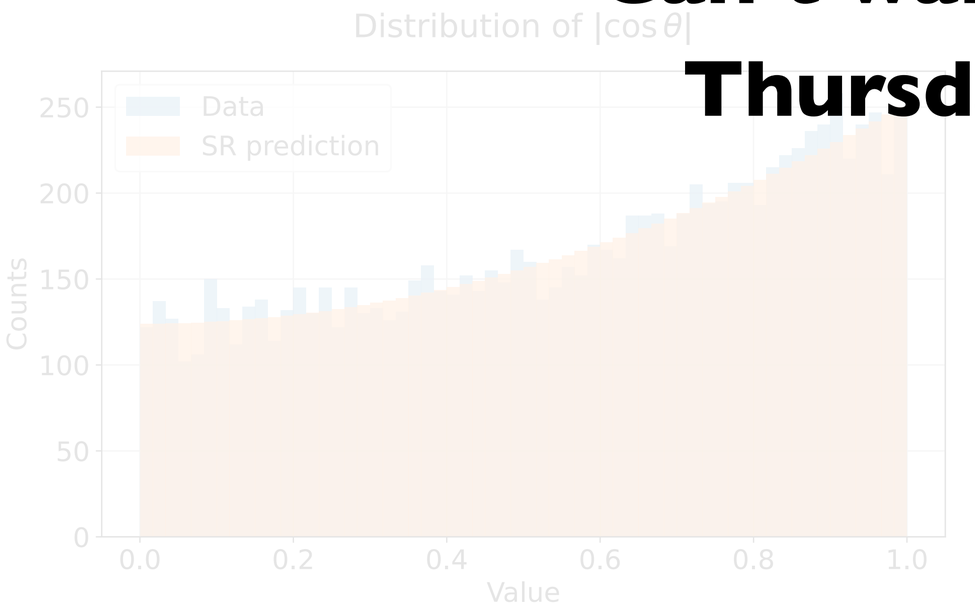
We assess the quality and the robustness of the SR results by equation recovery. Try, for example, an angular distribution:

Can't wait to know more?
Thursday, poster 117!



SR formulas $(x_0 = \cos\theta)$

Bins	Accuracy	Score	Best
10	$x_0^2 \cdot (896.5235819435 x_0 + 7040.0674) + 7613.42$	$7250.1396 \cdot x_0^2 + 7589.319$	$7250.1396 \cdot x_0^2 + 7589.319$
50	$x_0(2326.98053420264) + 2538.3494$	$2415.3643 x_0 + 2125.6453$	$2417.7627 x_0^2 + 2527.635$
100	$x_0(207.340216 x_0 + 428.81232) + 109.830989048 + 750.30175$	$725.2477 x_0 + 637.3749$	$726.08685 x_0^2 + 757.9762$

$$\frac{d\sigma}{d\Omega} = \frac{\alpha^2}{4s}\left(1 + \cos^2\theta\right)$$