

MadAgents

Daniel Schiller

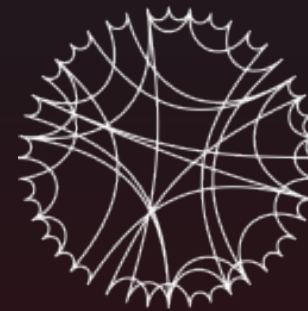
16.09.2026, ML4Jets, Vienna

Based on [arXiv:2601.21015](#) and [arXiv:2607.22813](#)

With Sascha Diefenbacher, Tilman Plehn and Nikita Schmal



AITP
AI and Theoretical Physics



STRUCTURES
CLUSTER OF
EXCELLENCE

MadGraph



Software:

Usage:

MadGraph



Software:

- Advanced capabilities
- Limited documentation and user interface

Usage:

MadGraph



Software:

- Advanced capabilities
- Limited documentation and user interface

Usage:

- Tool for research
- Many unknown settings, even user mistakes

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Documentation

Collaborators

Community support

Usage:

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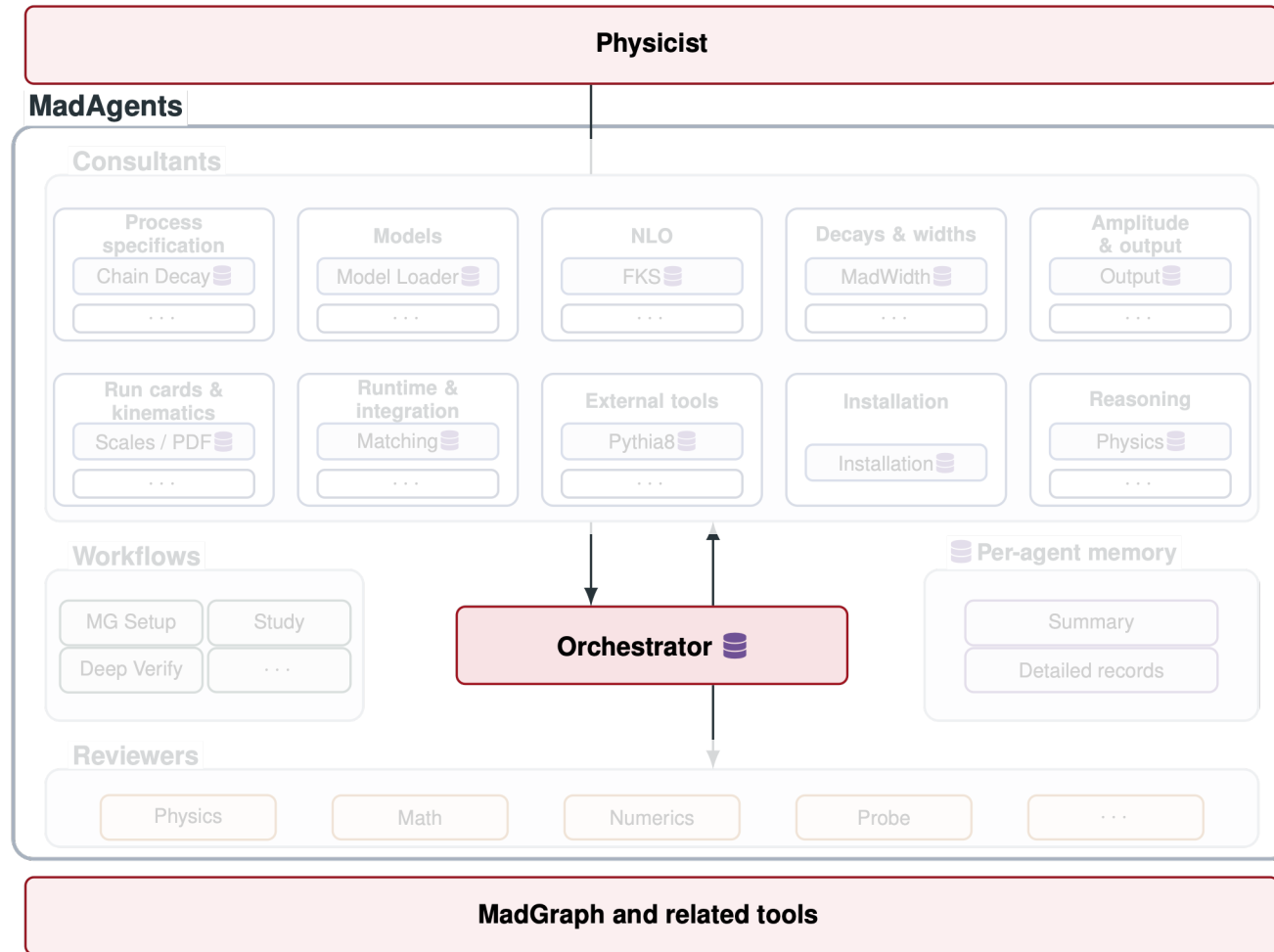
MadAgents:

Multi-Agent system as the smart interface for MadGraph

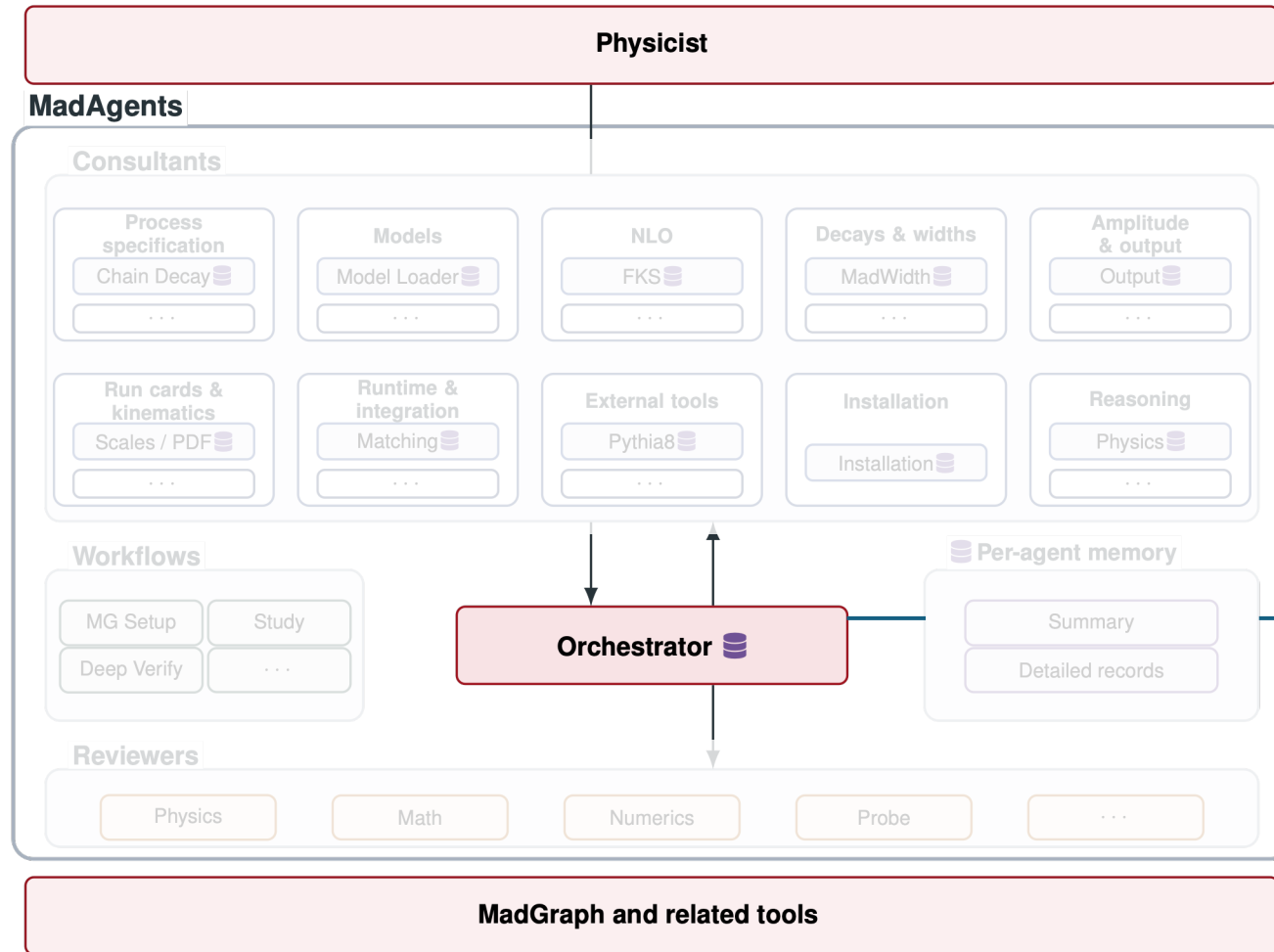
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MadAgents



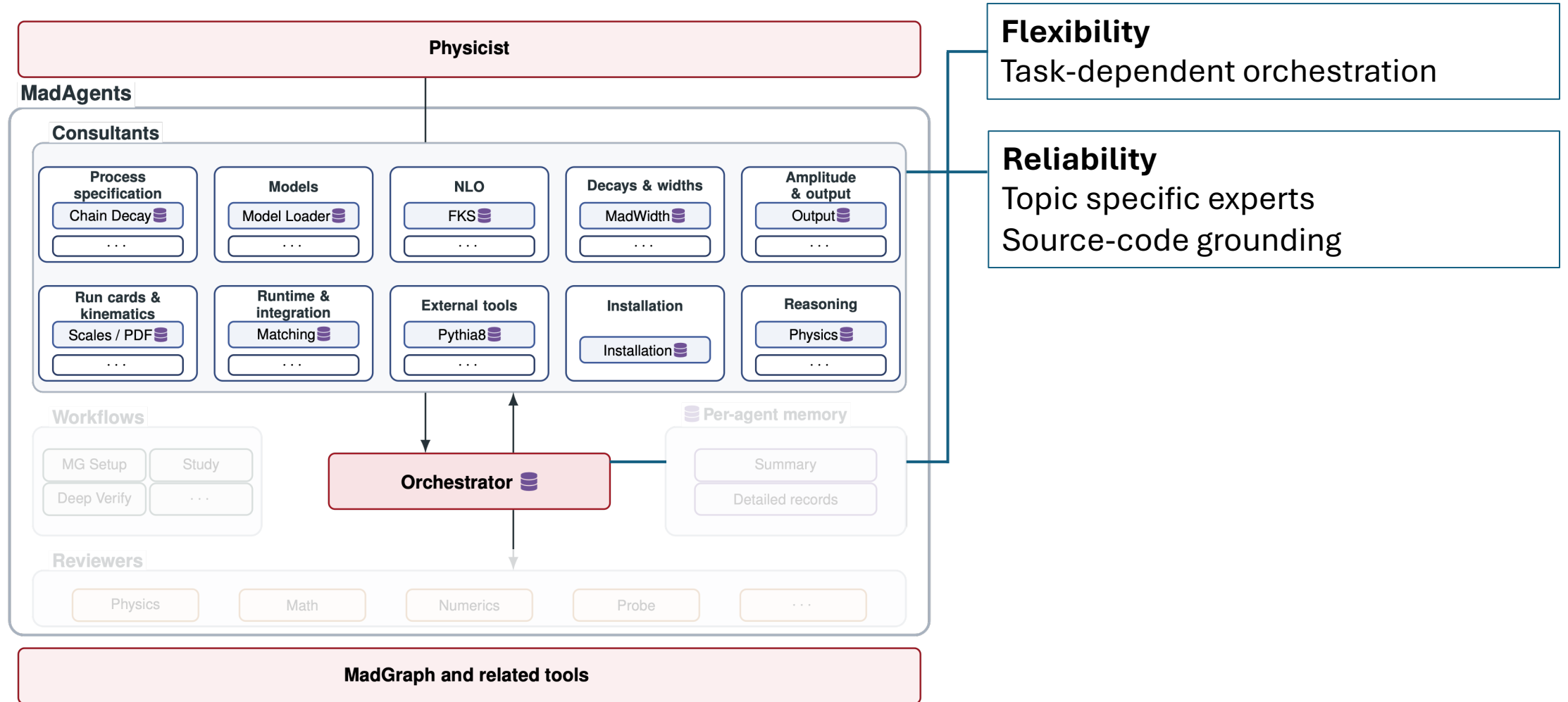
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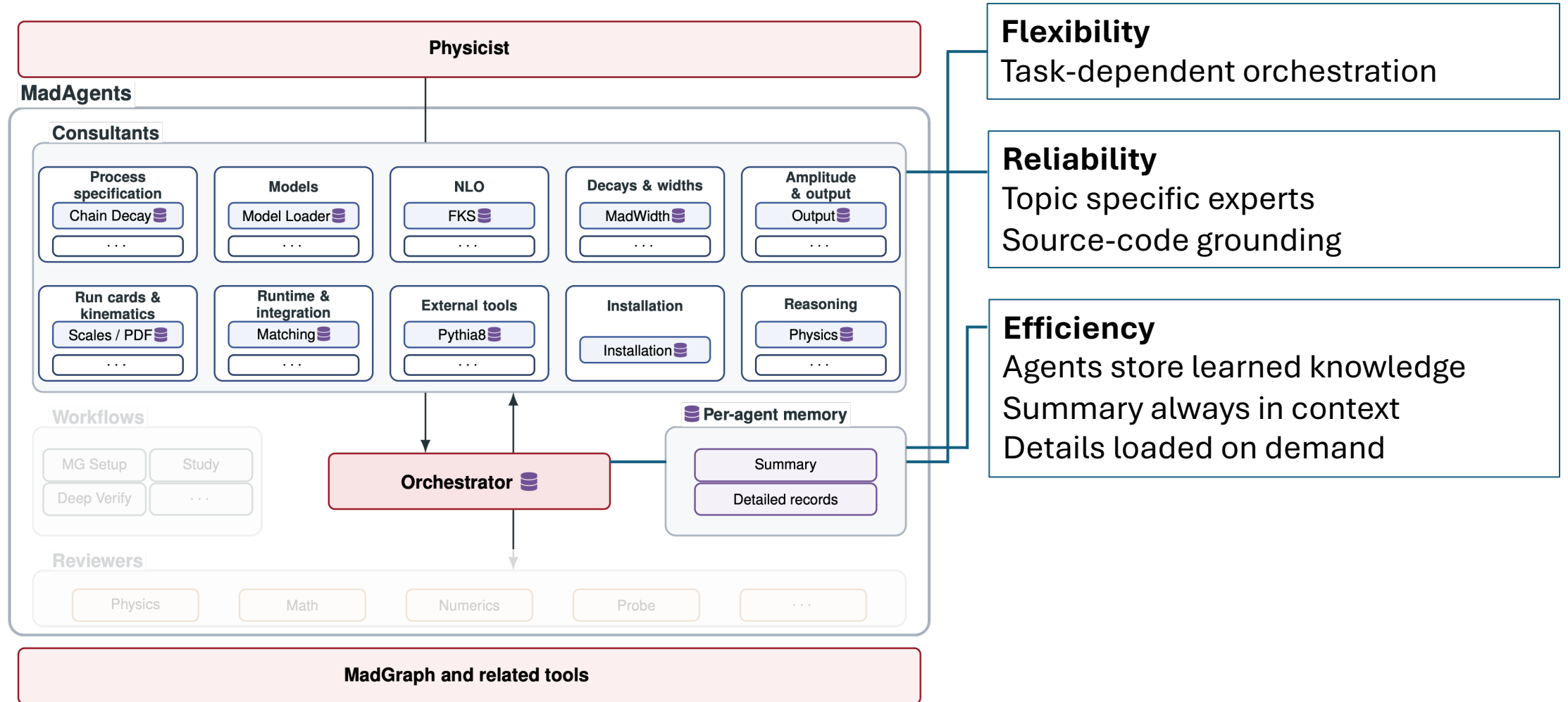
Flexibility

Task-dependent orchestration

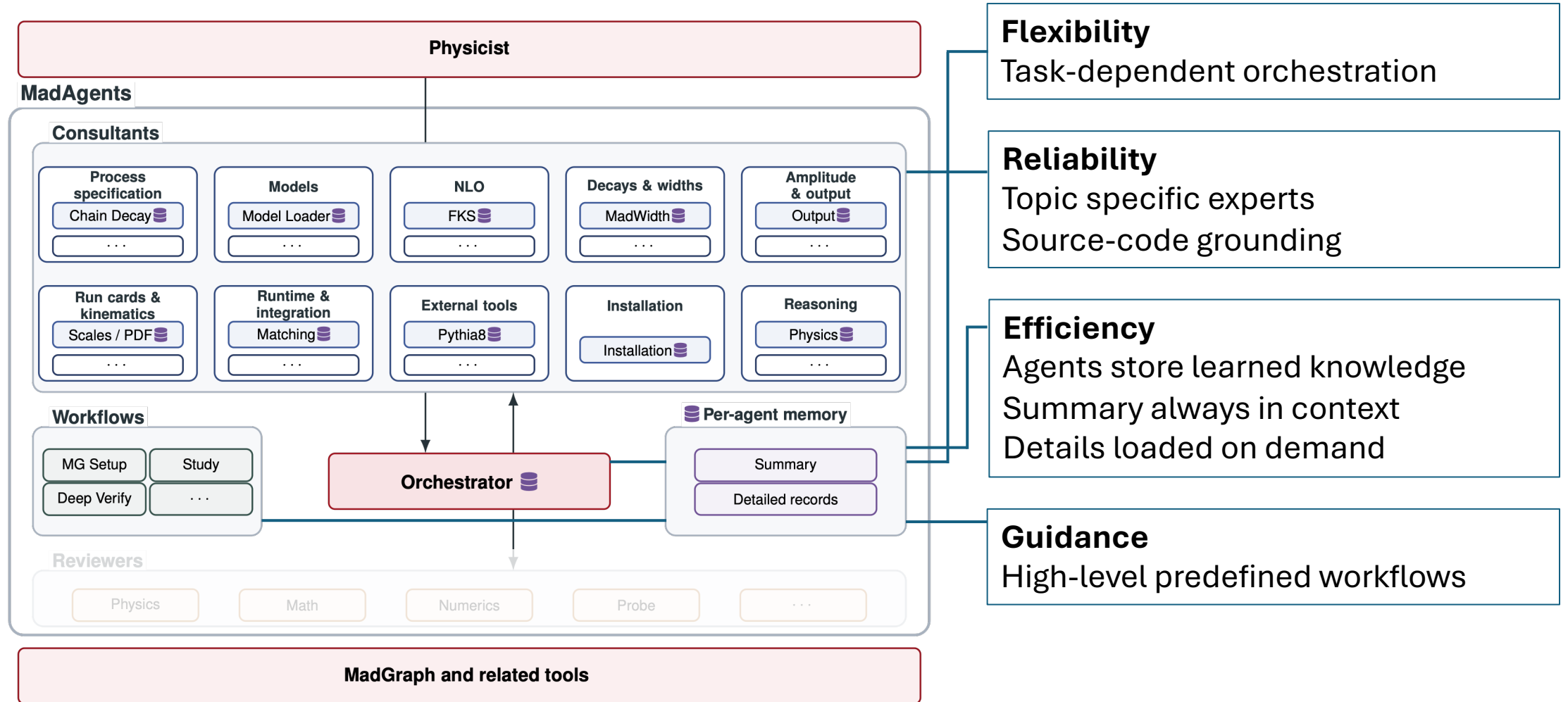
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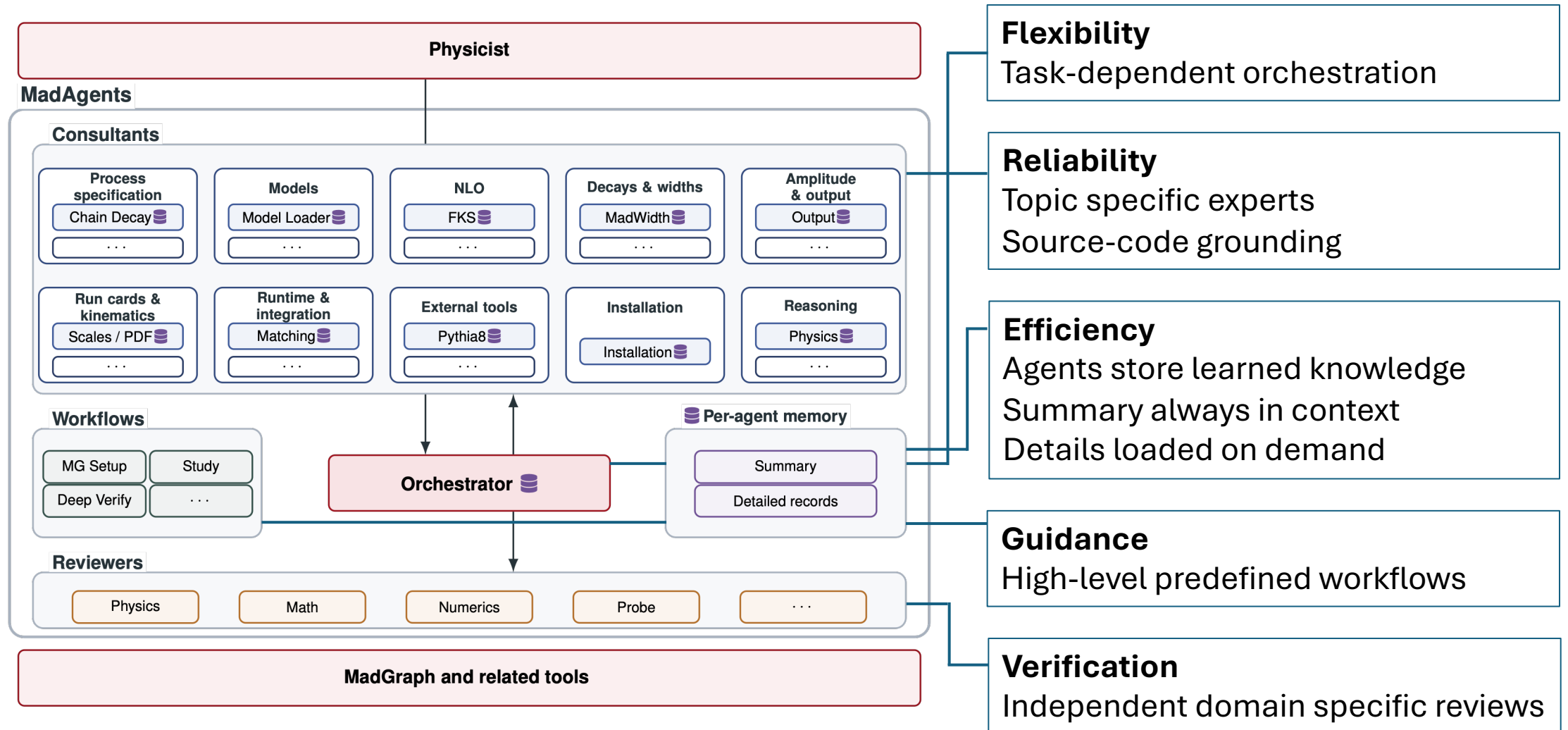
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MadAgents

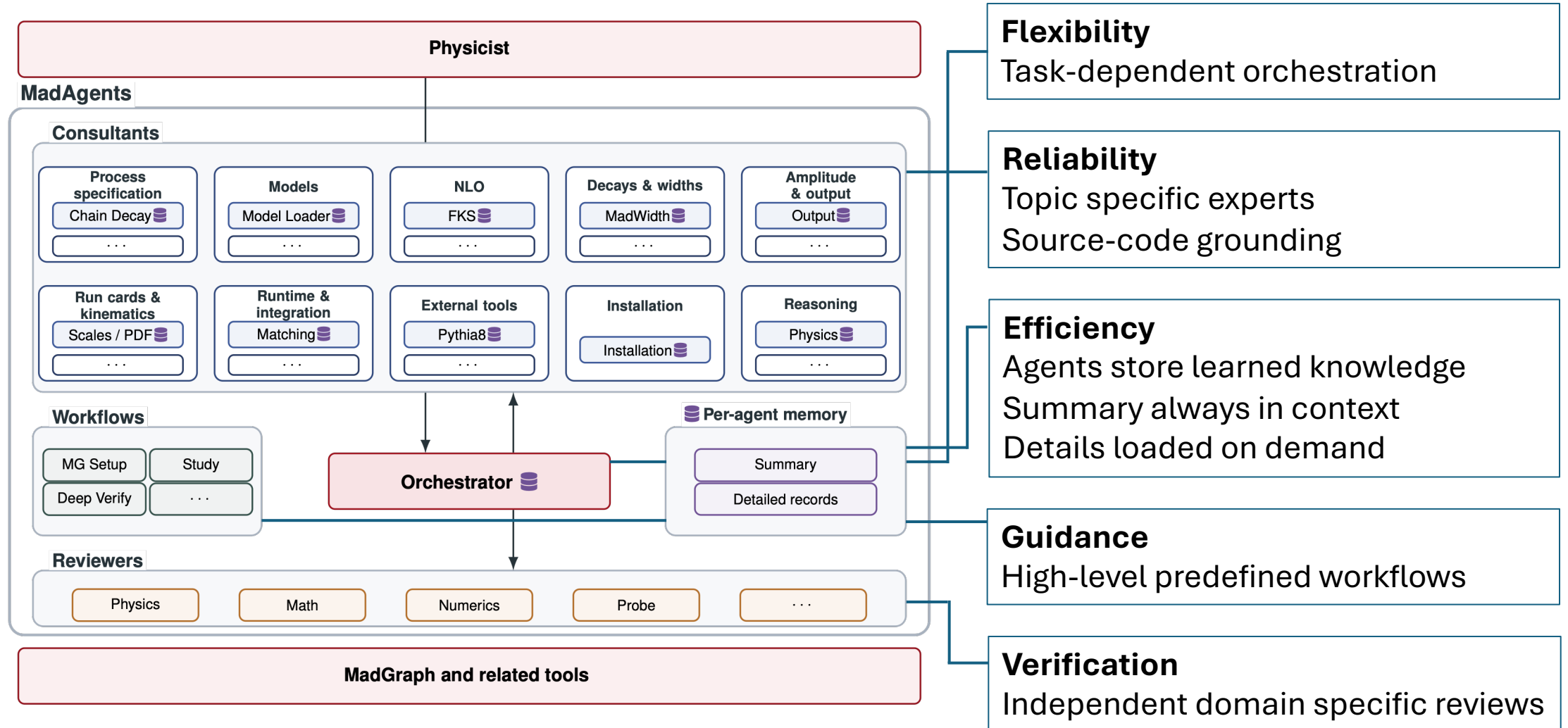


MadAgents



MadAgents

Claude Code, Codex and OpenCode implementation!



From intent to a simulation setup

/mg-setup skill for creating a MadGraph setup

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1 Frame

What is the physics request?

From intent to a simulation setup

/mg-setup skill for creating a MadGraph setup

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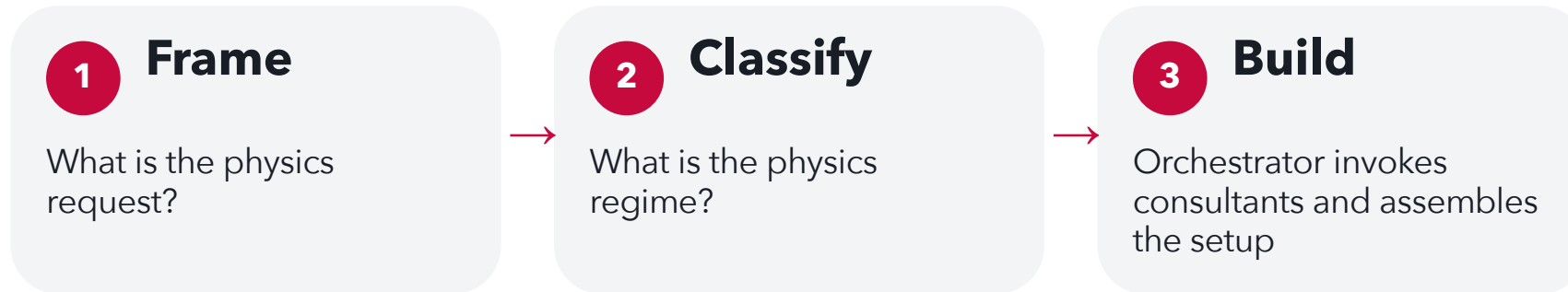


2 Classify

What is the physics regime?

From intent to a simulation setup

/mg-setup skill for creating a MadGraph setup



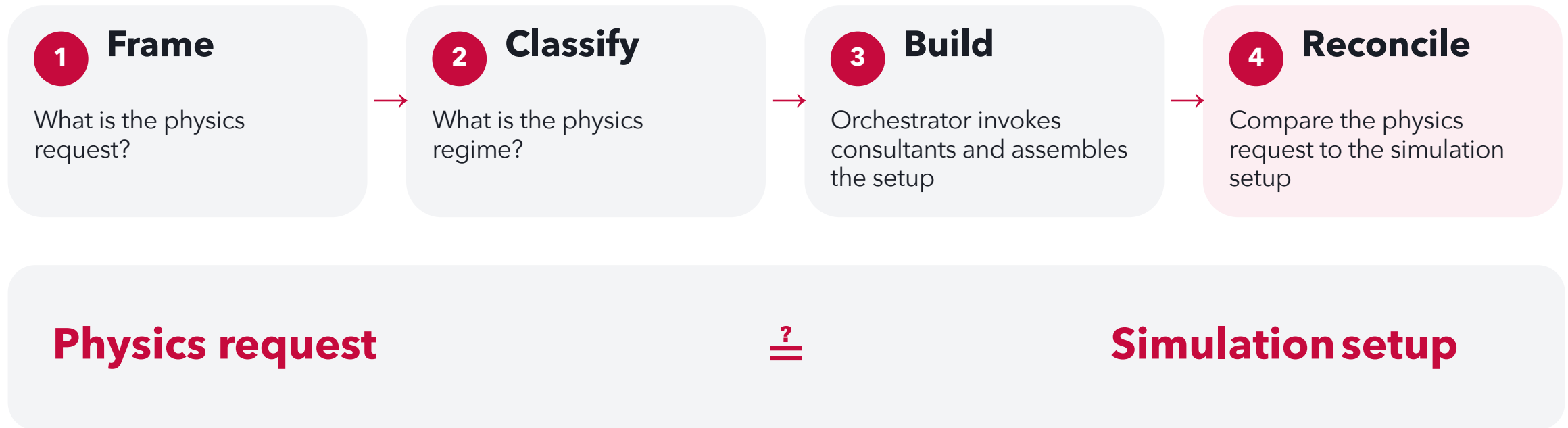
From intent to a simulation setup

/mg-setup skill for creating a MadGraph setup



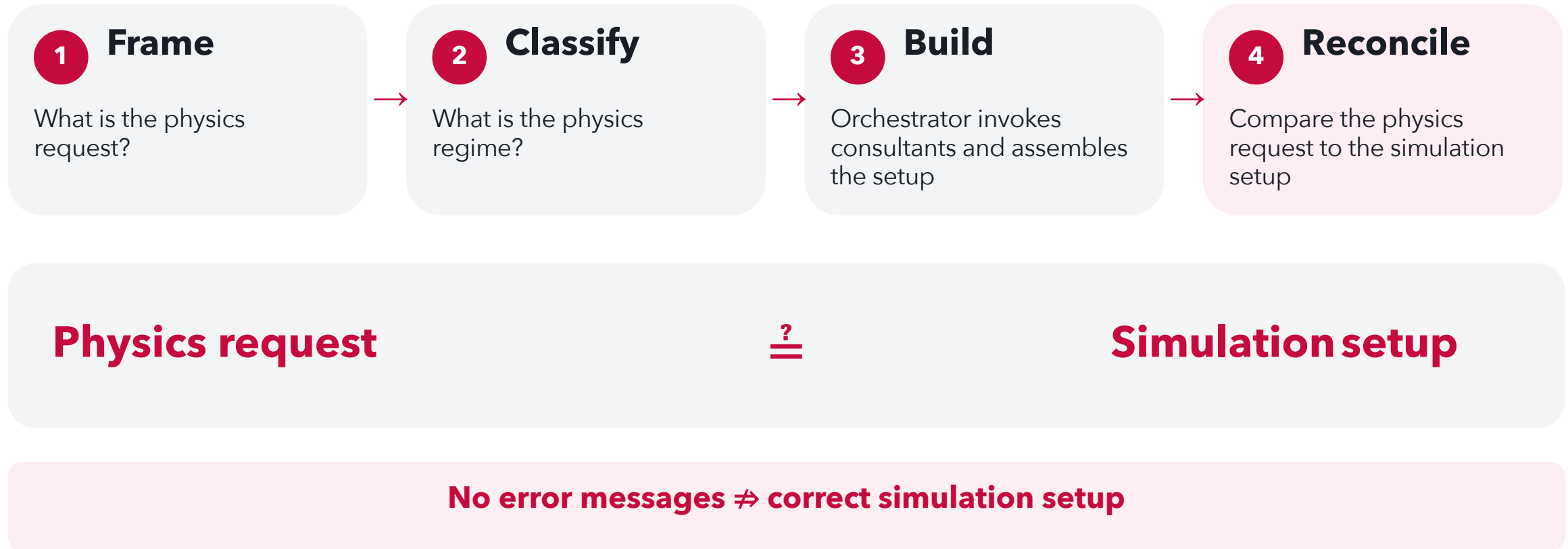
From intent to a simulation setup

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From intent to a simulation setup

/mg-setup skill for creating a MadGraph setup





Efficiency and reliability

Efficiency and reliability

1 MEMORY

Always loaded

- Single file
- Summaries of detailed memories

Efficiency and reliability

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- Summaries of detailed memories

pointers



2 WIKI

Opened on demand

- Files with detailed records
- Avoid past mistakes and retain knowledge

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EXAMPLE · A SUB-THRESHOLD DECAY CHAIN

USER TASK

**Set up $H \rightarrow W W^*$
with a chained
decay**

Efficiency and reliability

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2 WIKI

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EXAMPLE · A SUB-THRESHOLD DECAY CHAIN

USER TASK

**Set up $H \rightarrow W W^*$
with a chained
decay**



MEMORY ENTRY

bw-cutoff-sizing-derivation
Derive and adjust *bw cutoff*



WIKI FILE

$bw_{cutoff} \geq (m_{pole} - m_{floor}) / \Gamma_{eff}$
Re-read myamp.f and the generated card

Silent Failure Tests

Agents excel at fixing error messages

Incorrect simulation settings may produce no error message

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Incorrect simulation settings may produce no error message

I'm running generate $p p \rightarrow t \bar{t}, t \rightarrow b w^+$. What are the matrix-element-level final-state particles of each event?

$b w^+ t \bar{t}$

Silent Failure Tests

Agents excel at fixing error messages

Incorrect simulation settings may produce no error message

I'm running generate $p p > t t^-, t > b w^+$. What are the matrix-element-level final-state particles of each event?

$b w^+ t^-$

Qwen3.5 27B

w/ MadAgents

w/ trained
memory

Silent Failure Tests

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I'm running generate $p p > t t^-, t > b w^+$. What are the matrix-element-level final-state particles of each event?

$b w^+ t^-$

Qwen3.5 27B	w/ MadAgents	w/ trained memory
6/10	9/10	9/10

Silent Failure Tests

Agents excel at fixing error messages

Incorrect simulation settings may produce no error message

I'm running generate p p > t t~, t > b w+. What are the matrix-element-level final-state particles of each event?

b w+ t~

I'm setting up the LO signal calculation
 $b\bar{b} \rightarrow A, \quad A \rightarrow Z h, \quad Z \rightarrow \ell^+ \ell^-, \quad h \rightarrow b\bar{b}$
in 2HDM type-II with $m_A = 170\text{GeV}$ and the SM-like Higgs is at $m_h = 125\text{ GeV}$. How do I simulate this?

Decay chain + widen bw cutoff

Qwen3.5 27B	w/ MadAgents	w/ trained memory
6/10	9/10	9/10

Silent Failure Tests

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	Qwen3.5 27B	w/ MadAgents	w/ trained memory
I'm running generate $p p \rightarrow t \bar{t}, t \rightarrow b w^+$. What are the matrix-element-level final-state particles of each event? $b w^+ t \sim$	6/10	9/10	9/10
I'm setting up the LO signal calculation $b \bar{b} \rightarrow A, A \rightarrow Z h, Z \rightarrow \ell^+ \ell^-, h \rightarrow b \bar{b}$ in 2HDM type-II with $m_A = 170\text{GeV}$ and the SM-like Higgs is at $m_h = 125\text{ GeV}$. How do I simulate this? Decay chain + widen bw cutoff	0/10	2/10	5/10

Use cases



Installation



**Teaching
inexperienced
users**



**Advanced
user-support**



**Autonomous
execution**

Provide Expert Physics Insight



Advanced user-
support

**Experienced user has a
dataset**

Task: precision improvements

Provide Expert Physics Insight



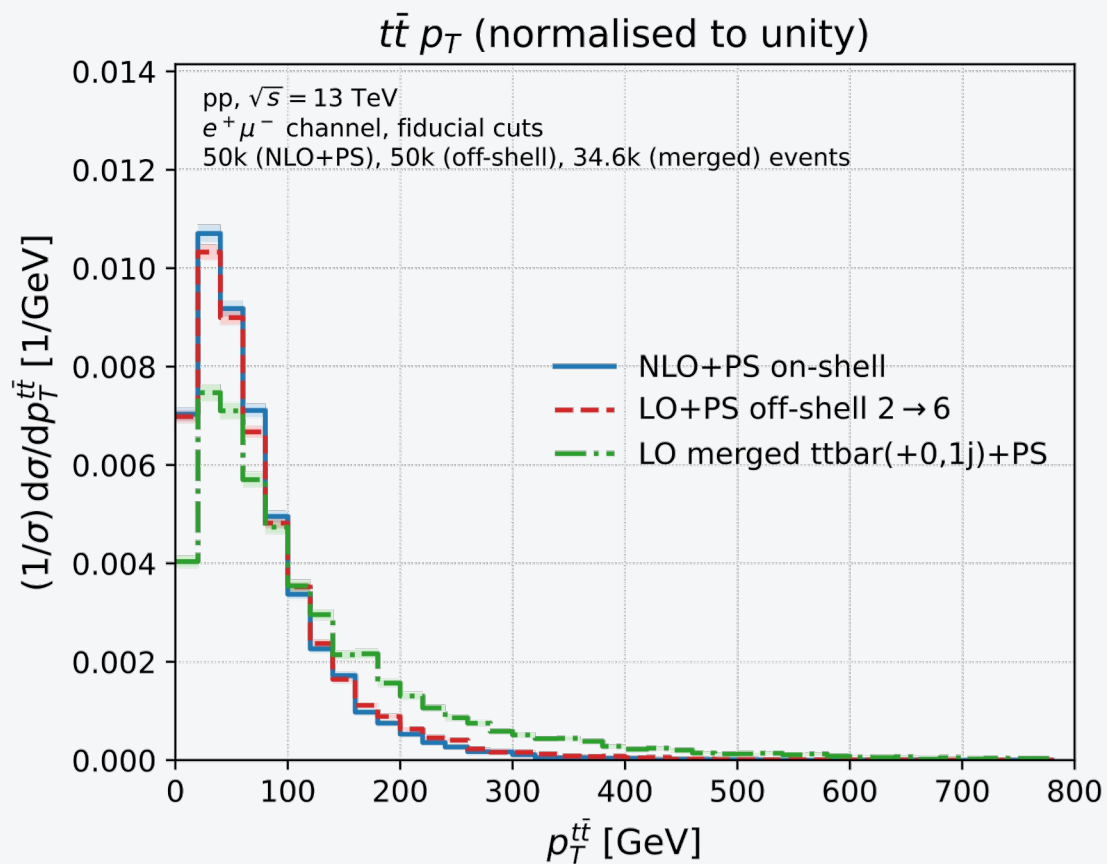
Advanced user-
support

Experienced user has a dataset

Task: precision improvements

Outcome: MadAgents discusses three improvements

Create a plot to visualize the effects



MadAgents in SFitterAgents



Autonomous execution

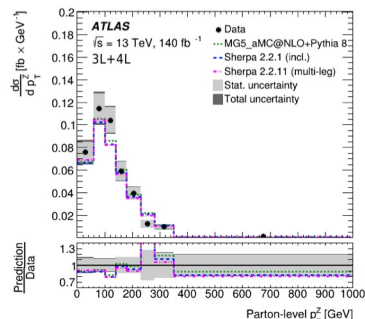
SFitterAgents

Theory

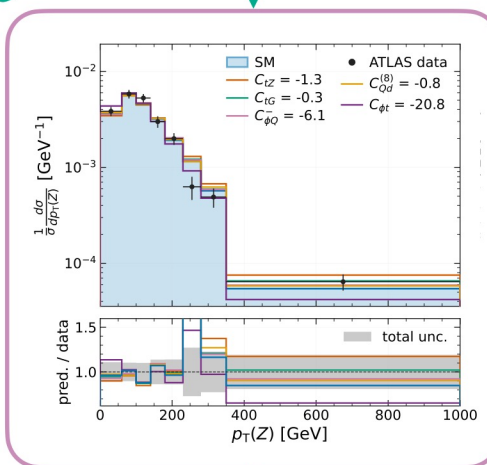
$$\mathcal{L}_{SMEFT} = \mathcal{L}_{SM} + \sum_i \frac{C_i}{\Lambda^2} \mathcal{O}_i^{(6)}$$

MadAgents

Experiment



JHEP 07 (2024) 163, arXiv:2312.04450



[Credit: Nikita Schmal]

MadAgents in SFitterAgents



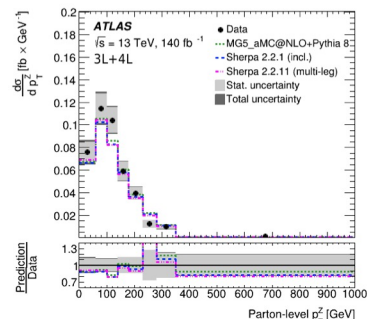
Autonomous
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SFitterAgents

Theory

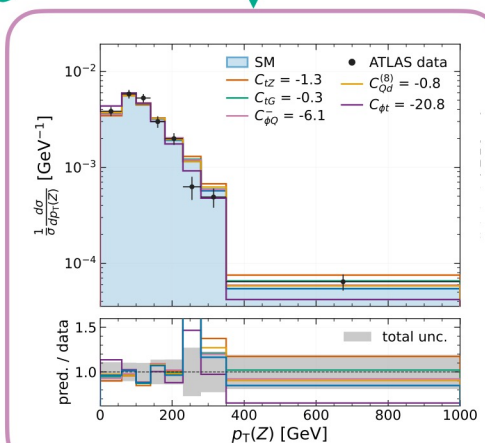
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Experiment

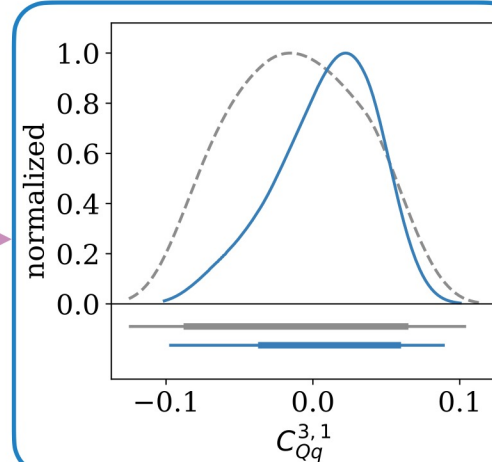


JHEP 07 (2024) 163, arXiv:2312.04450

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SFitter



[Credit: Nikita Schmal]

SM regeneration

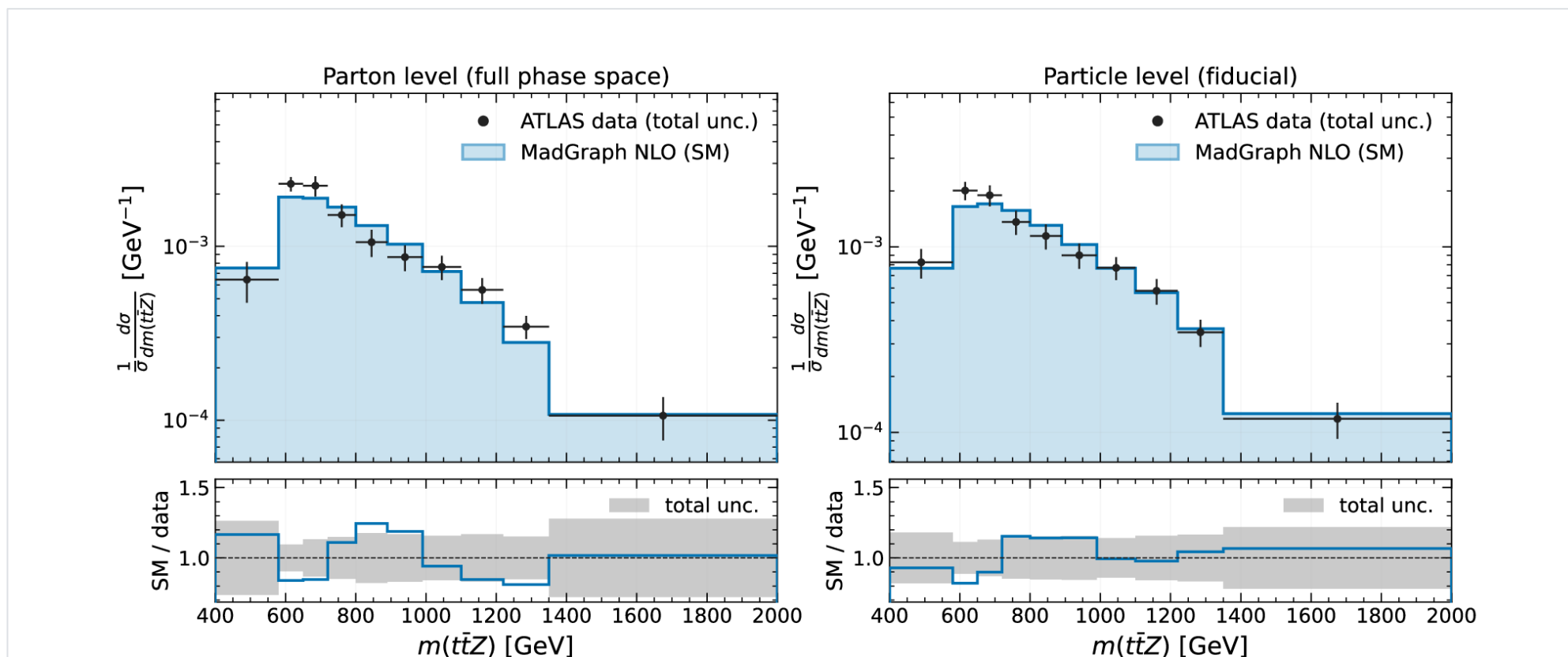
Published measurements



MadGraph



SM baseline



SM regeneration

Physicist in the loop!

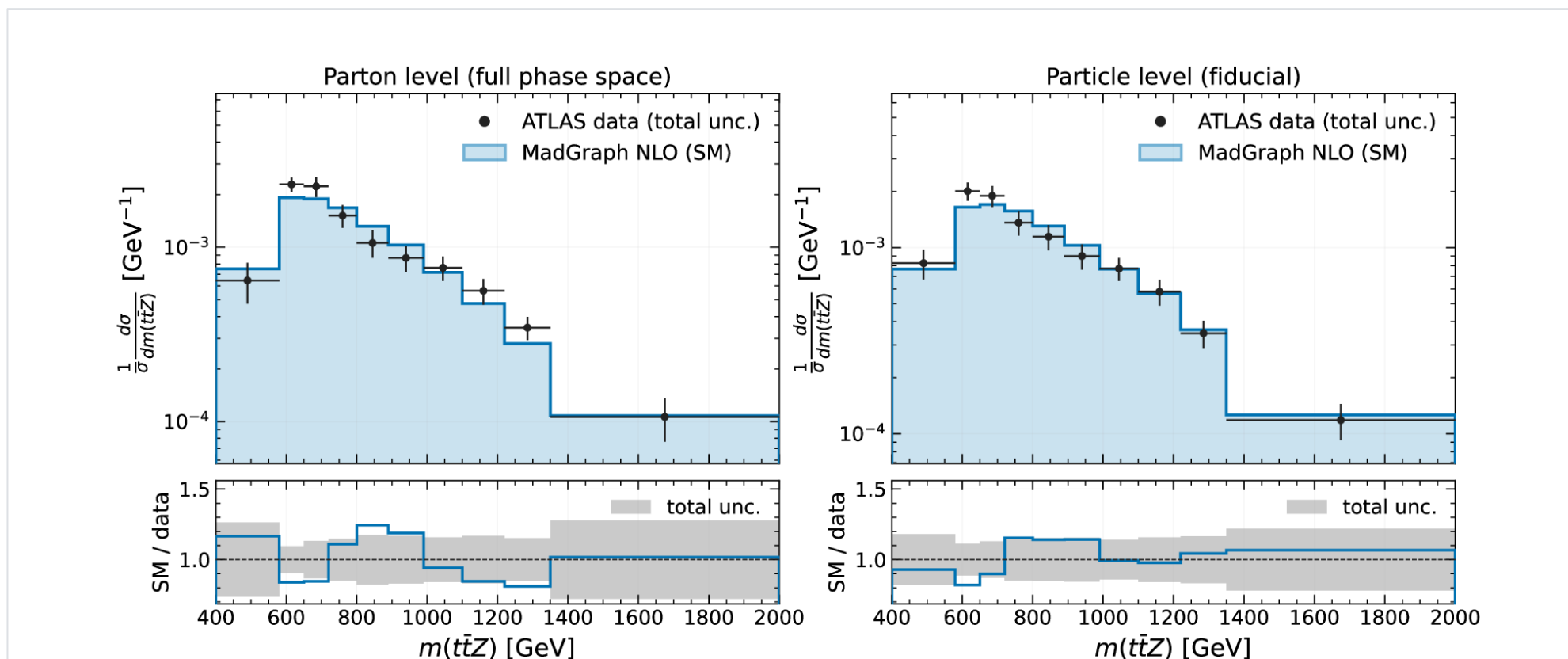
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MadGraph



SM baseline



SFitter inference

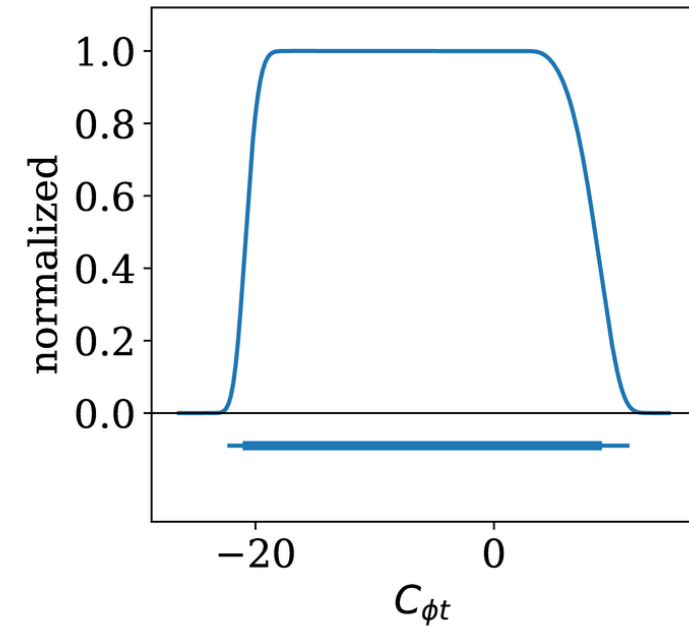
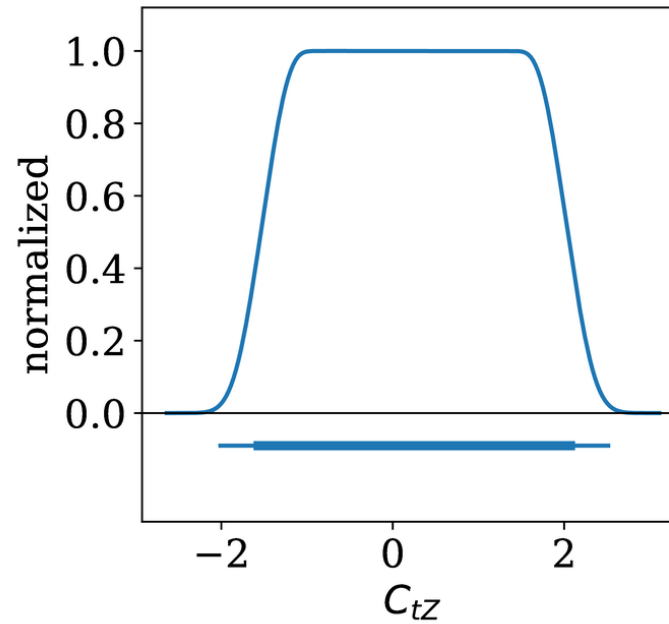
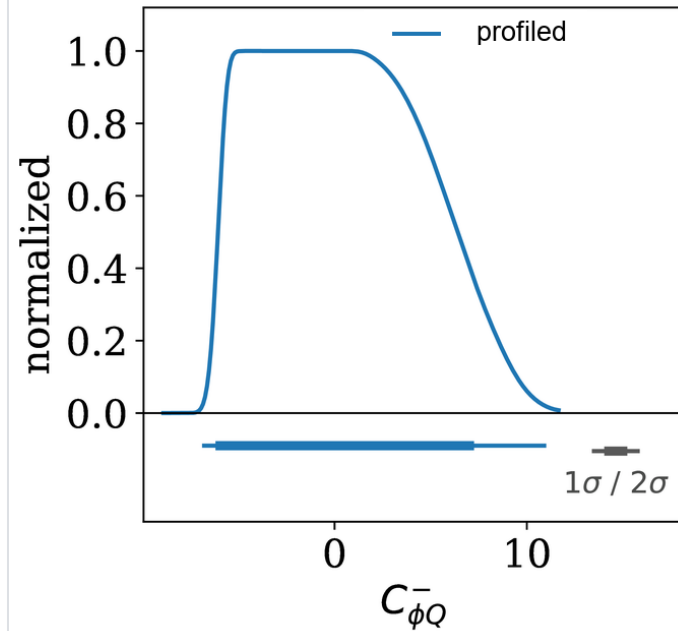
SMEFT simulation



SFitter



Wilson coeff. constraints



SFitter inference

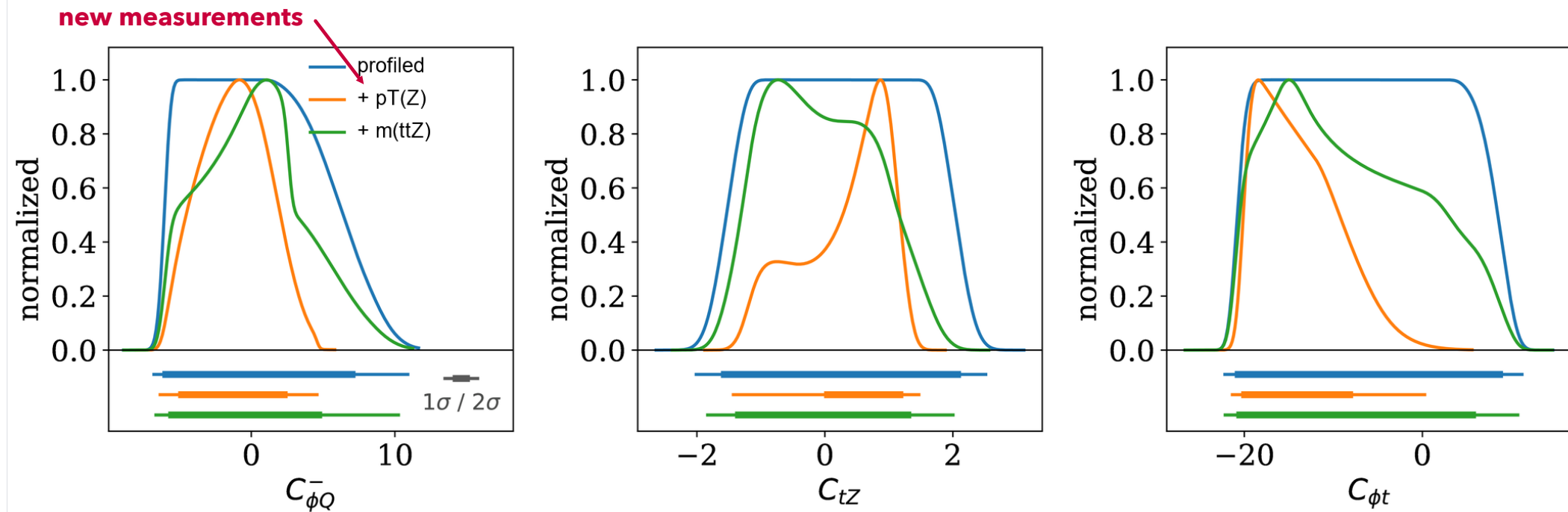
SMEFT simulation



SFitter



Wilson coeff. constraints



Combining all measurements

From many measurements to global fits

Experiment	$\sqrt{s}$ [TeV]	$\mathcal{L}$ [fb ⁻¹]	Channel	Observable	# Bins	Ref.
CMS	8	19.7	$e\mu$	$\sigma_{t\bar{t}}$		[64]
ATLAS	8	20.2	lj	$\sigma_{t\bar{t}}$		[65]
CMS	13	137	lj	$\sigma_{t\bar{t}}$		[66]
CMS	13	35.9	ll	$\sigma_{t\bar{t}}$		[67]
ATLAS	13	36.1	ll	$\sigma_{t\bar{t}}$		[68]
ATLAS	13	36.1	aj	$\sigma_{t\bar{t}}$		[69]
ATLAS	13	139	lj	$\sigma_{t\bar{t}}$		[70]
CMS	13.6	1.21	ll, lj	$\sigma_{t\bar{t}}$		[71]
CMS	8	19.7	lj	$\frac{1}{\sigma} \frac{d\sigma}{dp_T}$	7	[72]
CMS	8	19.7	ll	$\frac{1}{\sigma} \frac{d\sigma}{dp_T}$	5	[72]
ATLAS	8	20.3	lj	$\frac{1}{\sigma} \frac{d\sigma}{dm_{t\bar{t}}}$	7	[73]
CMS	13	137	lj	$\frac{1}{\sigma} \frac{d\sigma}{dm_{t\bar{t}}}$	15	[66]
CMS	13	35.9	ll	$\frac{1}{\sigma} \frac{d\sigma}{d\Delta y_{t\bar{t}}}$	8	[74]
ATLAS	13	36	lj	$\frac{1}{\sigma} \frac{d\sigma}{dm_{t\bar{t}}}$	9	[75]
ATLAS	13	139	$aj, \text{high-}p_T$	$\frac{1}{\sigma} \frac{d\sigma}{dm_{t\bar{t}}}$	13	[76]
CMS	8	19.7	lj	A_C		[77]
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ATLAS	8	20.3	lj	A_C		[79]
ATLAS	8	20.3	ll	A_C		[80]
CMS	13	138	lj	A_C		[81]
ATLAS	13	139	lj	A_C		[82]
ATLAS	13	139		$\sigma_{t\bar{t}Z}$		[83]
CMS	13	77.5		$\sigma_{t\bar{t}Z}$		[84]
ATLAS	13	140	$3\ell + 4\ell$	$\frac{1}{\sigma} \frac{d\sigma}{dp_T(Z)}$	8	[63]
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Combining all measurements

From many measurements to global fits

Agents can easily handle published measurements and likelihoods

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Conclusion



MadAgents: smart interface for MadGraph

- Teaching
- Workflow acceleration
- Expert-level support
- Extends to global analyses



MadAgents



SFitterAgents

Conclusion



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MadAgents



SFitterAgents

Increase the speed of scientific progress

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SFitterAgents

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Papers: [arXiv:2601.21015](https://arxiv.org/abs/2601.21015), [arXiv:2607.22813](https://arxiv.org/abs/2607.22813)

Code Repo: github.com/MadGraphTeam/MadAgents

Claude Code, Codex and **OpenCode** implementations exist!