The HighTEA collaboration
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What is HighTEA  in a nutshell?

A tool to make state-of-the-art collider phenomenology …

- … available to everyone
  - *No computing resources needed*
  - *No access to complicated codes required*
- … accessible to everyone
  - *No specific programming skills required*
  - *No expertise in theory or HEP tools needed*
- … sustainable
  - *Only a fraction of Computing cost to conventional computations*

Basic idea

- Database of precomputed “Theory Events”
  - **Equivalent to a full fledged computation**
  - Currently this means partonic fixed order events
  - Extensions to included showered/resummed/hadronized events is feasible
- Analysis of the data through an user interface
  - Easy-to-use
  - Fast
  - Flexible:
    - Observables from basic 4-momenta
    - Free specification of bins
    - Renormalization/Factorization Scale variation
    - PDF (member) variation
    - Specify phase space cuts

Not so new idea:
LHE [Alwall et al ‘06],
Ntuple [BlackHat ‘08’13],

(Partially) Unweighting

The hadronic cross section in collinear factorization:

$$\mathrm{d}\sigma(P_1,P_2) = \sum_{ab} \iint_0^1 \mathrm{d}x_1 \mathrm{d}x_2 f_a(x_1,\mu_F^2) f_b(x_2,\mu_F^2) \mathrm{d}\hat{\sigma}_{ab}(x_1P_1, x_2P_2)$$

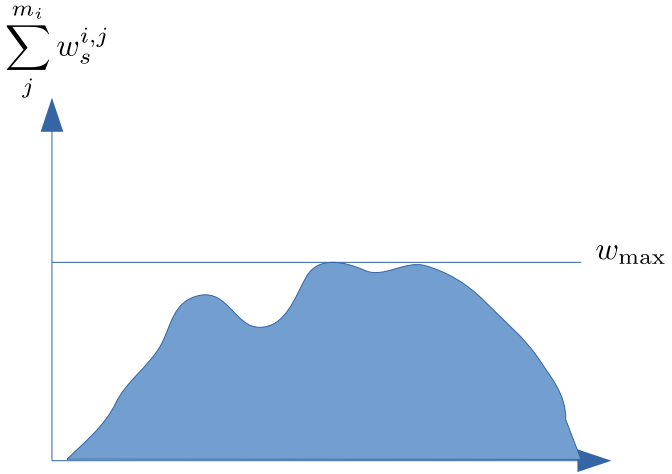
$$\hat{\sigma}_{ab\to X} = \hat{\sigma}^{(0)}_{ab\to X} + \hat{\sigma}^{(1)}_{ab\to X} + \hat{\sigma}^{(2)}_{ab\to X} + \mathcal{O}(\alpha_s^3)$$

Using MC method for integration:

$$\sigma_{\mathrm{tot}} = \frac{1}{n} \sum_i^n \left(\sum_j^{m_i} w_s^{i,j} \right)$$

Beyond LO events might correspond to more than one kinematic:
Subtraction events!

Hit-And-Miss Algorithm:



Accept each event i with probability: $\left(\sum_j^{m_i} w_s^{i,j} \right) / w_{\max}$

Store each sub-event with weight: $w_s^{i,j} \Big/ \left(\sum_j^{m_i} w_s^{i,j} \right)$

Factorizations

Factorizing renormalization and factorization scale dependence:

$$w_s^{i,j} = w_{\mathrm{PDF}}(\mu_F, x_1, x_2) w_{\alpha_s}(\mu_R) \left(\sum_{i,j} c_{i,j} \ln\left(\mu_R^2\right)^i \ln\left(\mu_F^2\right)^j \right)$$

PDF dependence:

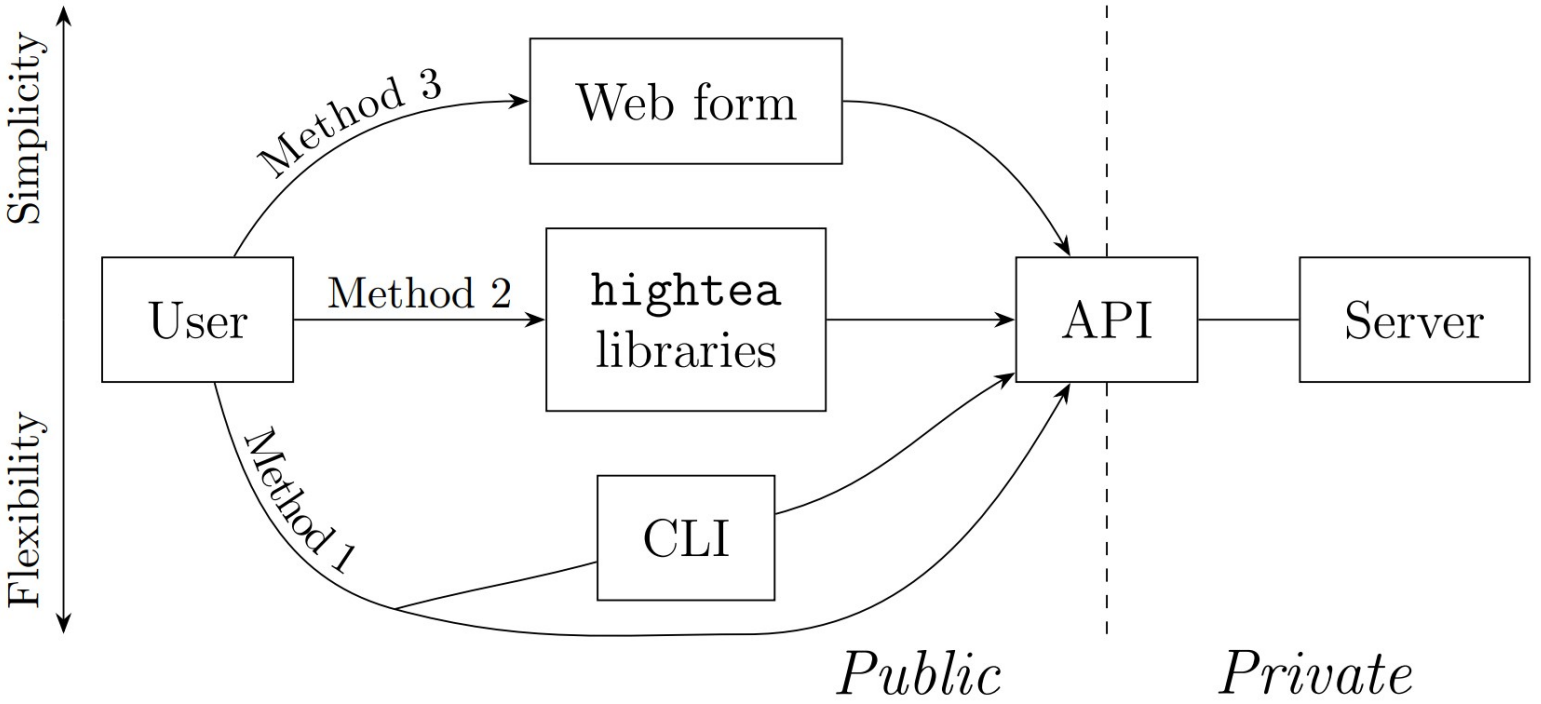
$$w_{\mathrm{PDF}}(\mu, x_1, x_2) = \sum_{ab \in \mathrm{channel}} f_a(x_1, \mu) f_b(x_2, \mu)$$

α_s dependence:

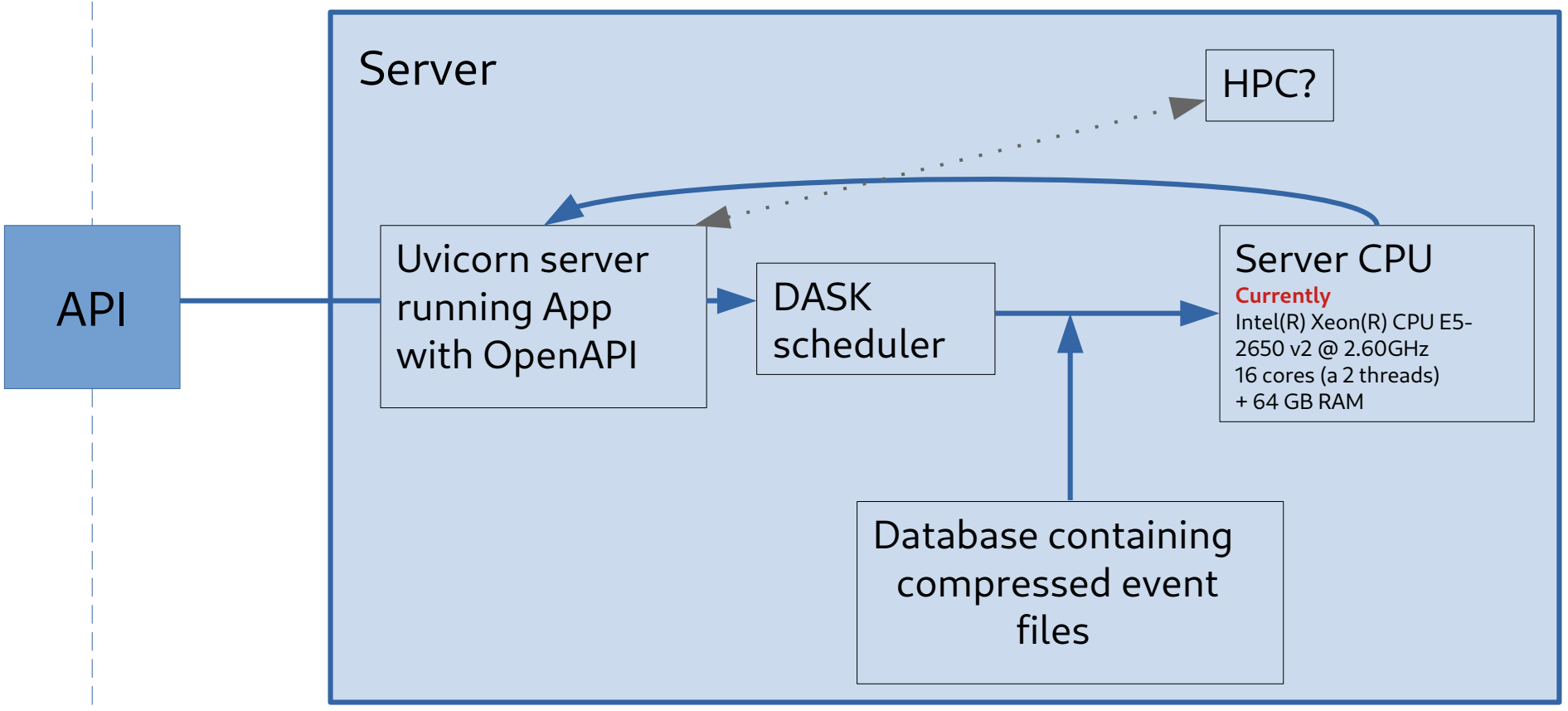
$$w_{\alpha_s}(\mu) = (\alpha_s(\mu))^m$$

Allows **full control over scales and PDF**

HighTEA interface

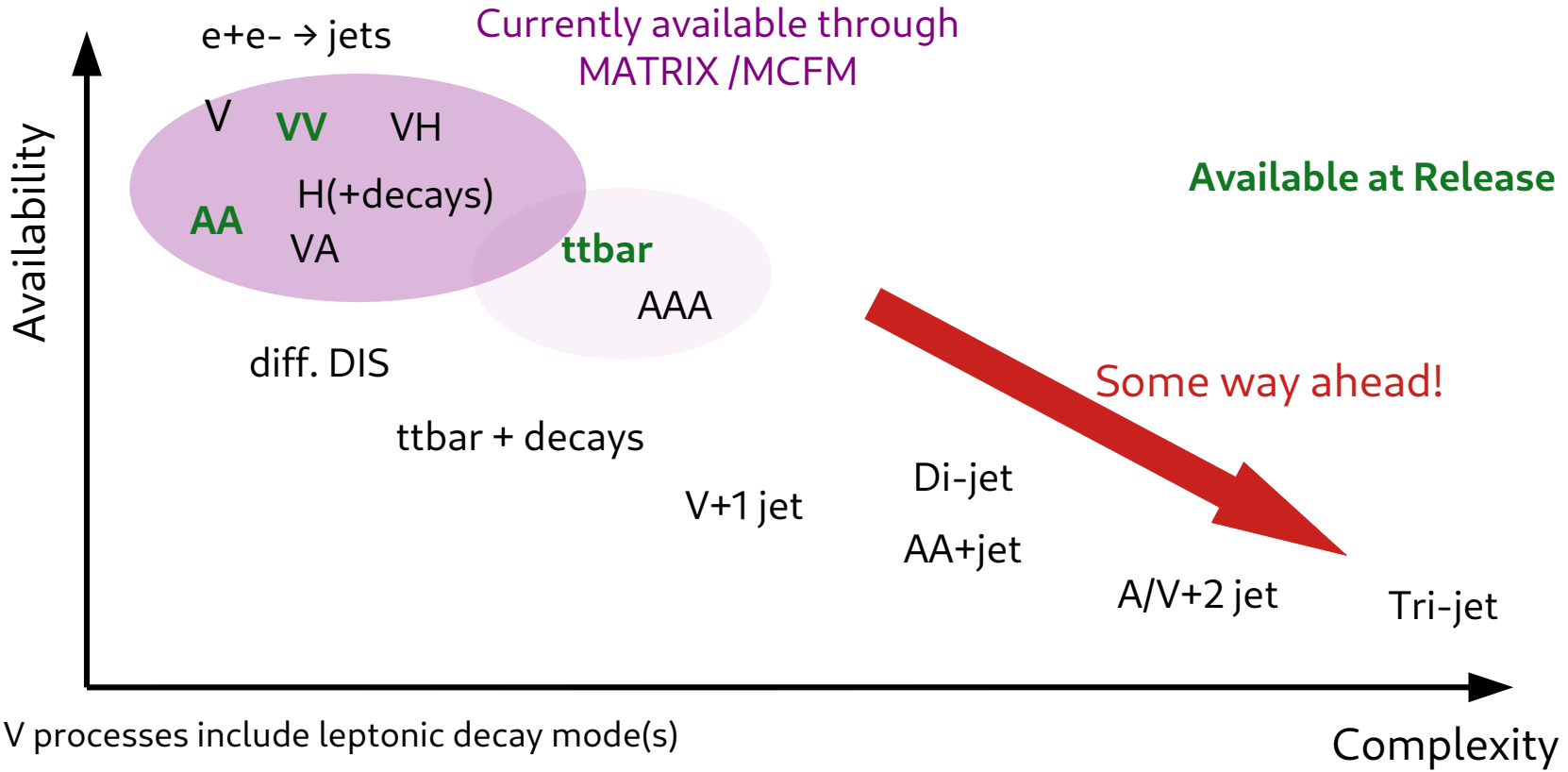


The server


Server
HPC?
API
Uvicorn server running App with OpenAPI
DASK scheduler
Server CPU
Currently
Intel(R) Xeon(R) CPU E5-2650 v2 @ 2.60GHz
16 cores (a 2 threads)
+ 64 GB RAM
Database containing compressed event files

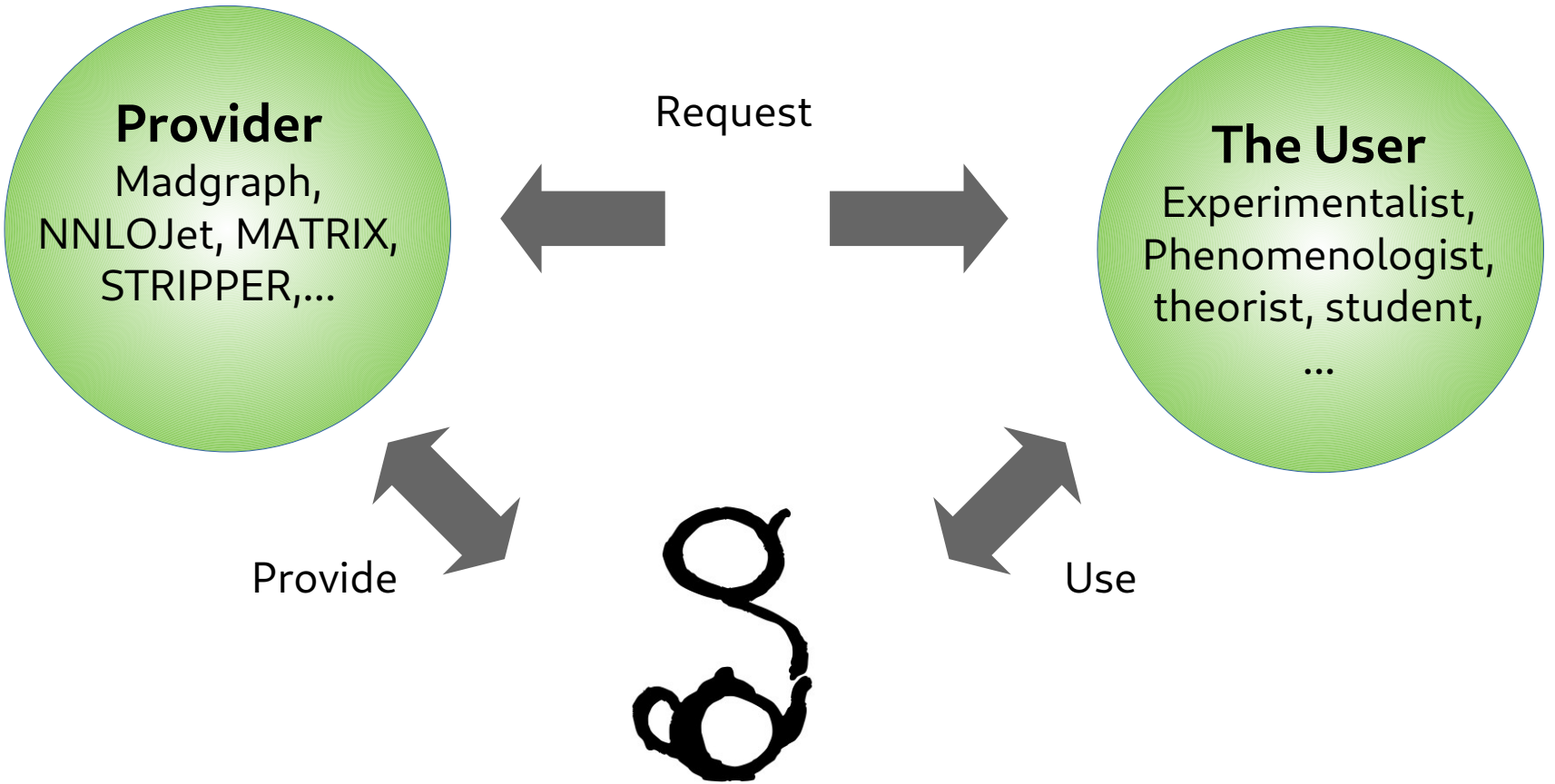
Available Processes

Processes currently implemented in our STRIPPER framework through NNLO QCD



* V processes include leptonic decay mode(s)

The Vision


Provider
Madgraph,
NNLOJet, MATRIX,
STRIPPER,...
Request
The User
Experimentalist,
Phenomenologist,
theorist, student,
...
Provide
Use

More information

Publication

HighTEA: **High energy Theory Event Analyser**

[2304.05993]

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