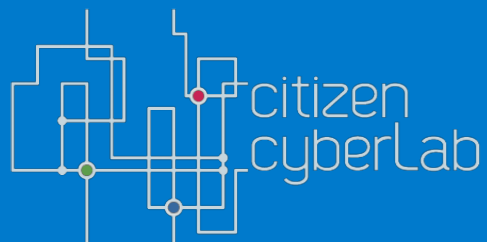


Virtual Atom Smasher

One example of an educational game in
particle physics

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- B. The “Virtual Atom Smasher” Prototype
- C. Computing resources

A

Background

- The *Virtual Atom Smasher* is a pilot project of the *Citizen Cyberlab* EU ICT project
- Research *Creativity* and *learning* in on-line citizen science
- In **addition** to helping scientists perform laborious tasks, it enable citizens to *learn* about science and actively *take part*

* You can learn more in <http://citizencyberlab.eu/about/>



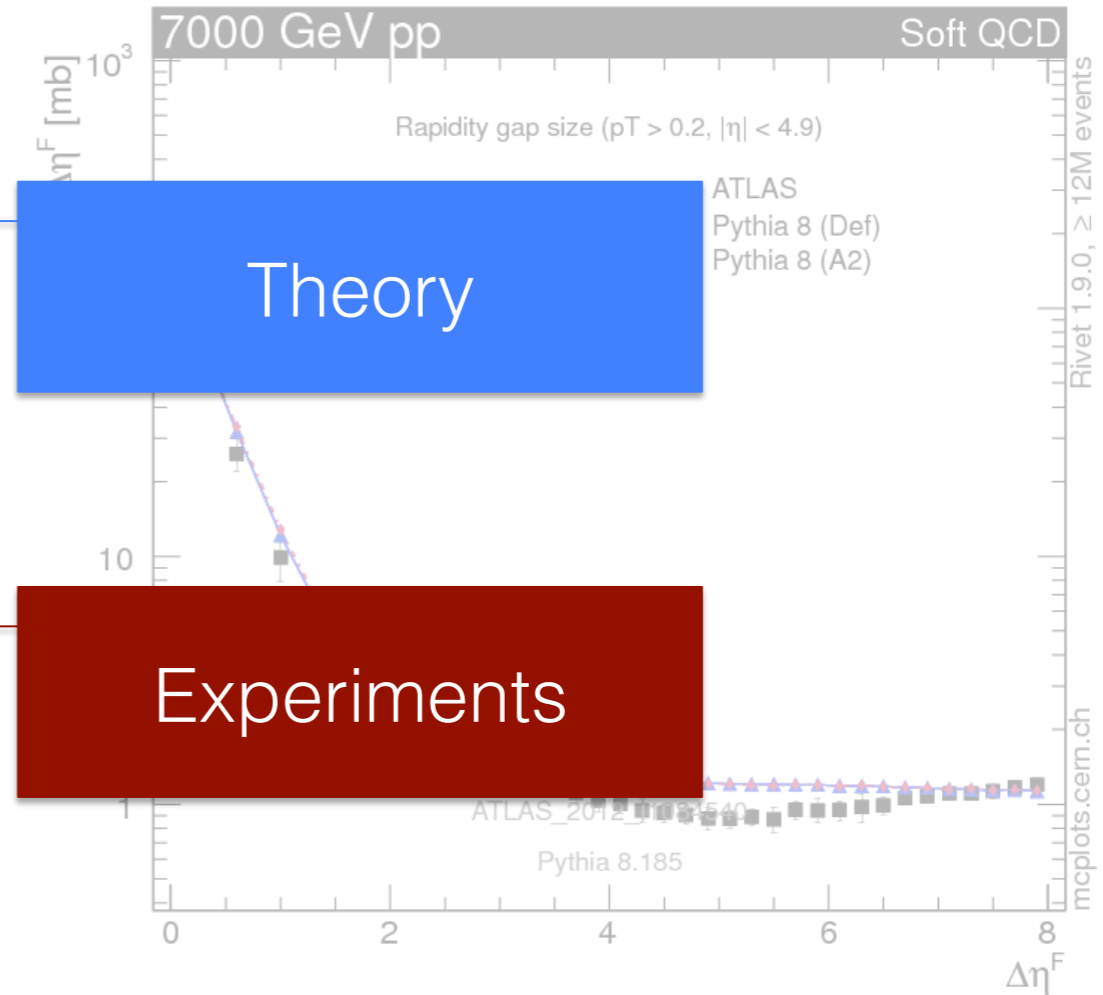
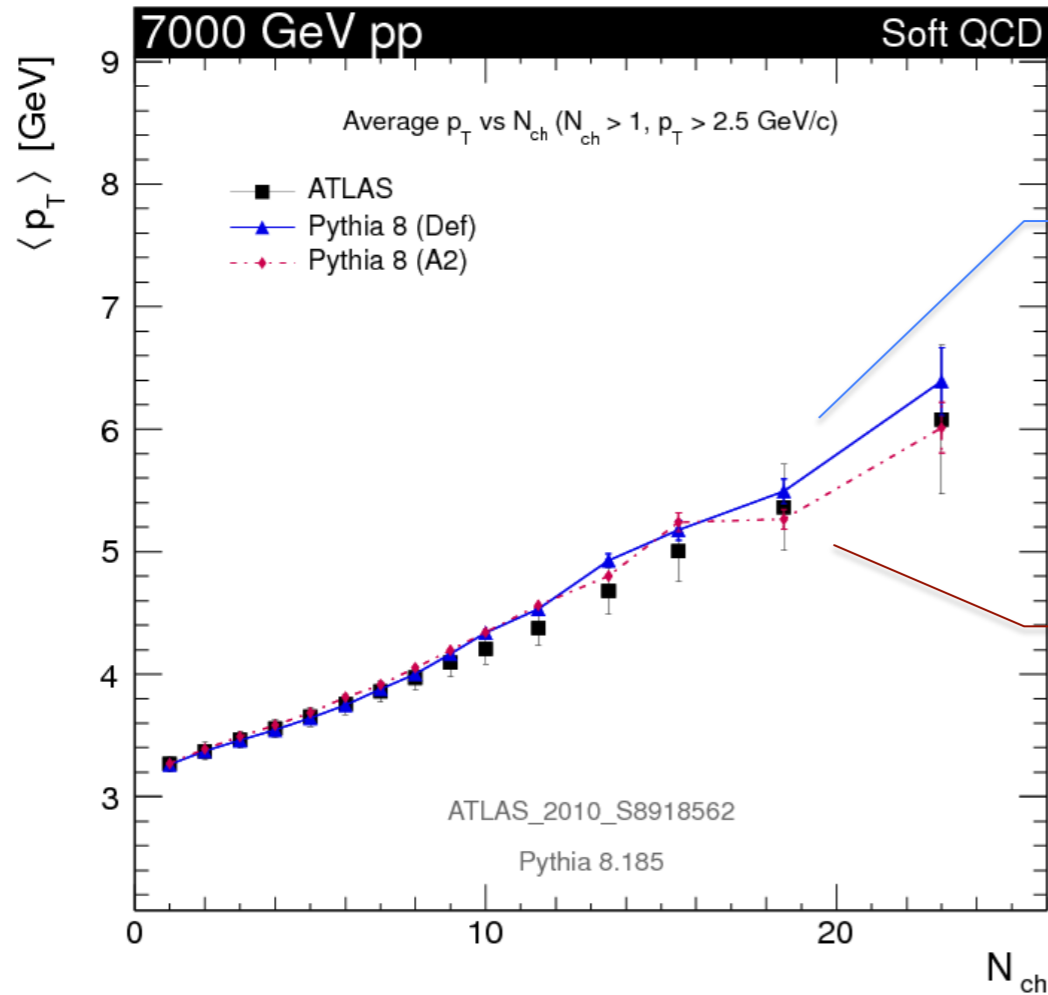
A

Theoretical Physics

- In High-Energy Particle Physics the **scientific discovery** follows a particular pattern:
 1. Create a theoretical **model**, applying the current knowledge and observation
 2. Create a computer **simulation** that creates virtual collisions, just like the ones that happen in the big particle colliders (LHC, LEP..), using that model
 3. **Adjust** the model until it matches the results from the experiments

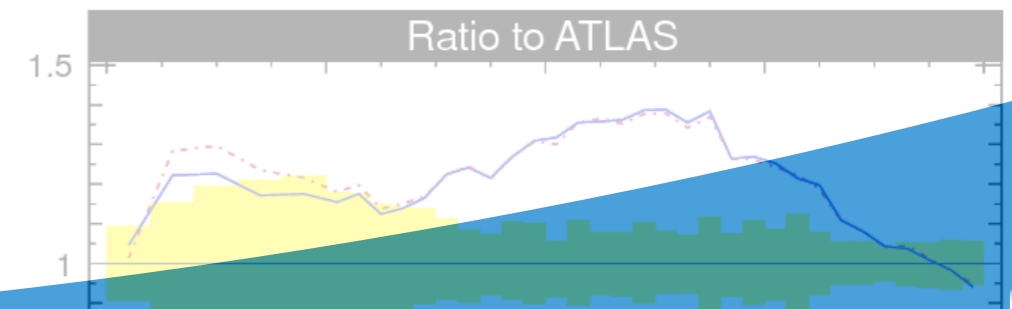
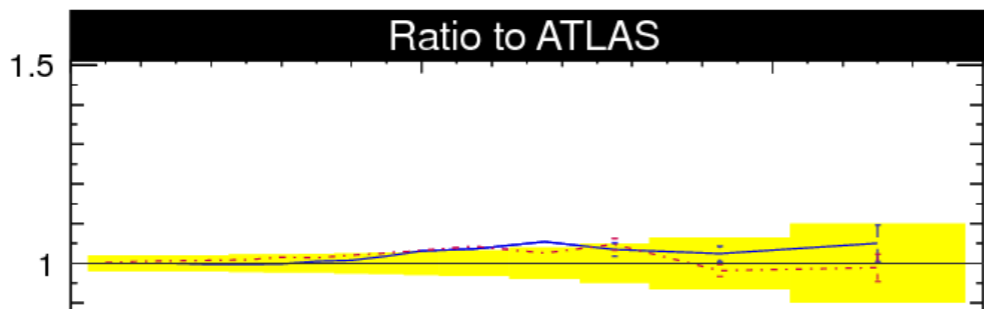


Theoretical Physics



Theory

Experiments



A

In Practice

- In practice we are using a couple of software for this purposes:
- We are generating collisions with **event generators** (such as *pythia*, *sherpa*, *vincia*, *phojet*, *epos*)

Reminder: “event” = The products of a collision in a particle collider

- We are validating it's results by comparing them to theory using **generator validators**

A

In Practice

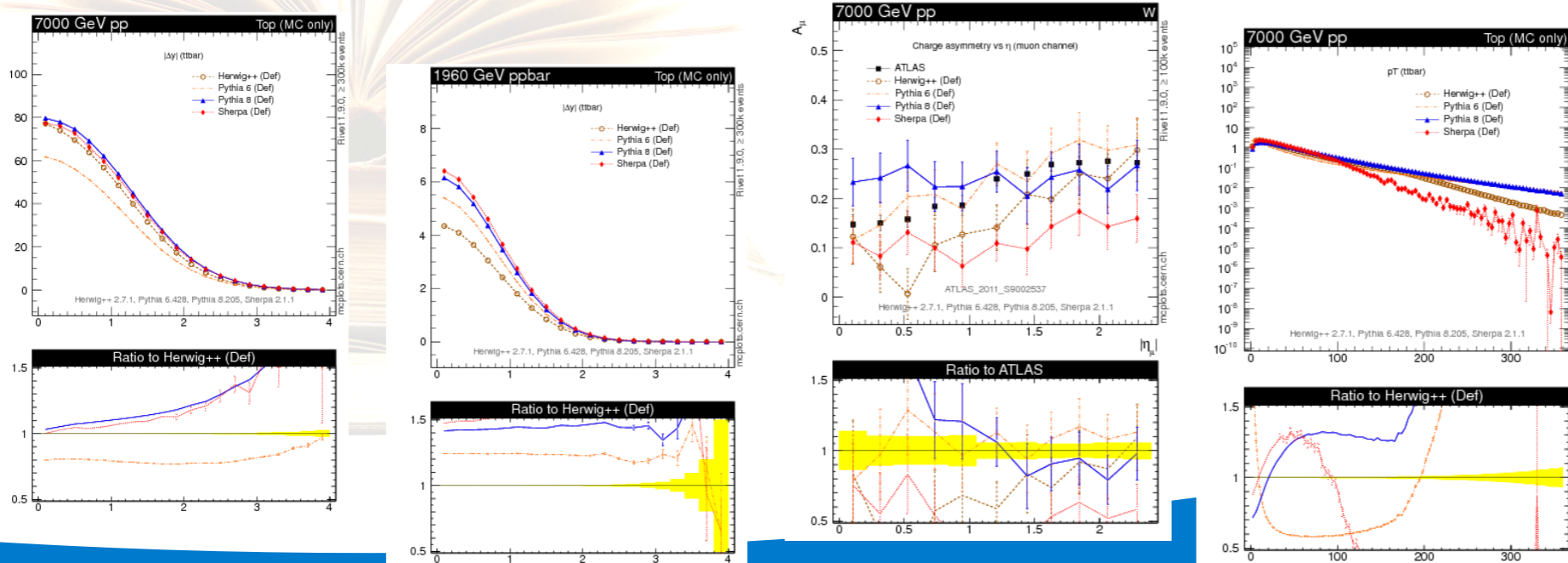
- One of the most widely used event generator in HEP is **Pythia**
- Use **Monte-Carlo** method for statistically solving the complex theoretical models
- **As a result:** It needs to simulate **thousands** of events until the results are statistically correct (takes a lot of time)





In Practice

- One of the most widely used generator validator in HEP is **Rivet**
- Compares the results from an event generator to the ones observed in experiments



A

So it's simple!

- We have all the software in place, so the 'tuning' process is quite simple, right?
- Just **change** the following parameters:

```
! * Strong-force Coupling  
Vincia:alphaSValue      = 0.138
```

```
! * Hadronic Energy Scale  
Vincia:cutoffScale      = 0.45
```

```
! * String parameters  
StringZ:aLund            = 0.38  
StringZ:bLund           = 0.62  
StringPT:sigma          = 0.26
```

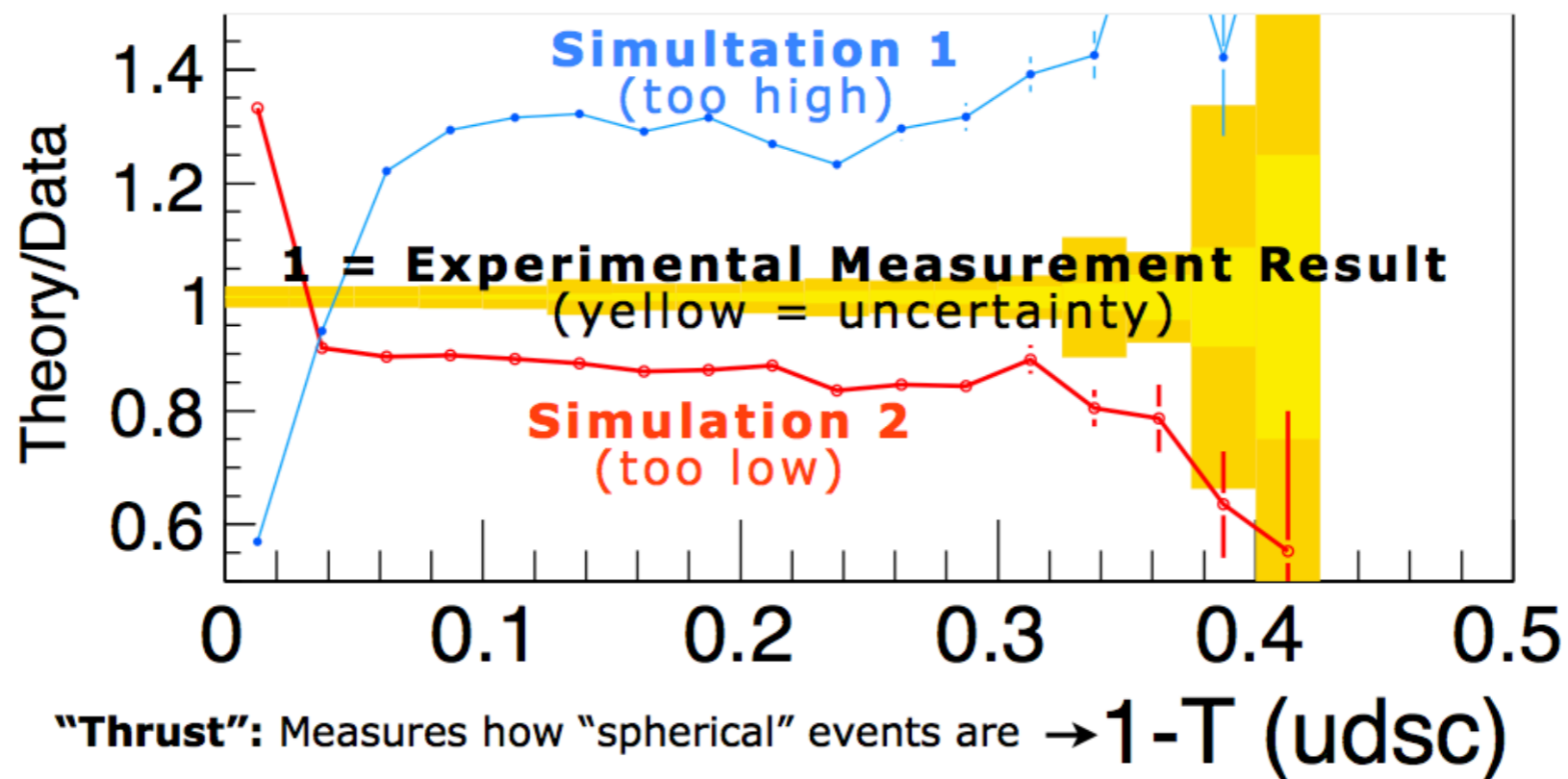
```
! * Quark flavor parameters  
StringFlav:probStoUD    = 0.21  
StringFlav:mesonUDvector = 0.35  
StringFlav:mesonSvector = 0.55  
StringFlav:probQQtoQ    = 0.08  
StringFlav:probSQtoQQ   = 1.00  
StringFlav:probQQ1toQQ0 = 0.03  
StringFlav:decupletSup  = 1.00  
StringFlav:etaSup       = 0.60  
StringFlav:etaPrimeSup  = 0.10
```

A

So it's simple!

- And make sure that results are getting better:

Example: the effect of changing
Vincia:alphaSvalue





So it's simple!



- Actually, a 15-y/o student did this in 2010
- Mikkel Jeppsson (Right) was an intern at CERN
- Peter Skands (Left) wrote a simple interface to these software
- We found the best results in use now!

A

So it's simple!

So, why not **everyone**?



Virtual Atom Smasher



The image shows the homepage of the Virtual Atom Smasher website. The background is a colorful, abstract watercolor-style pattern in shades of purple, blue, and orange. In the top left, there is a circular logo featuring a stylized atom with a central nucleus and orbiting electrons. To the right of the logo, the text reads "Virtual Atom Smasher" in a bold, sans-serif font, with "Virtual" in orange and "Atom Smasher" in dark grey. Below this, a subtitle says "Learn particle physics & help scientists at CERN".

The main content area is divided into two columns. The left column is titled "Welcome visitor!" and contains two paragraphs of text. The right column is titled "Welcome fellow scientist!" and features a registration form with fields for "E-Mail:" and "Password:", a yellow "Create an account" button, and a dark grey "Login" button.

Virtual Atom Smasher
Learn particle physics & help scientists at CERN

Welcome visitor!

Virtual Atom Smasher is a revolutionary educational game that brings you along with the theoretical physicists inside CERN!

Playing this game you are not only learning about particle physics, but you are actively helping scientists with their research!

Welcome fellow scientist!

E-Mail:

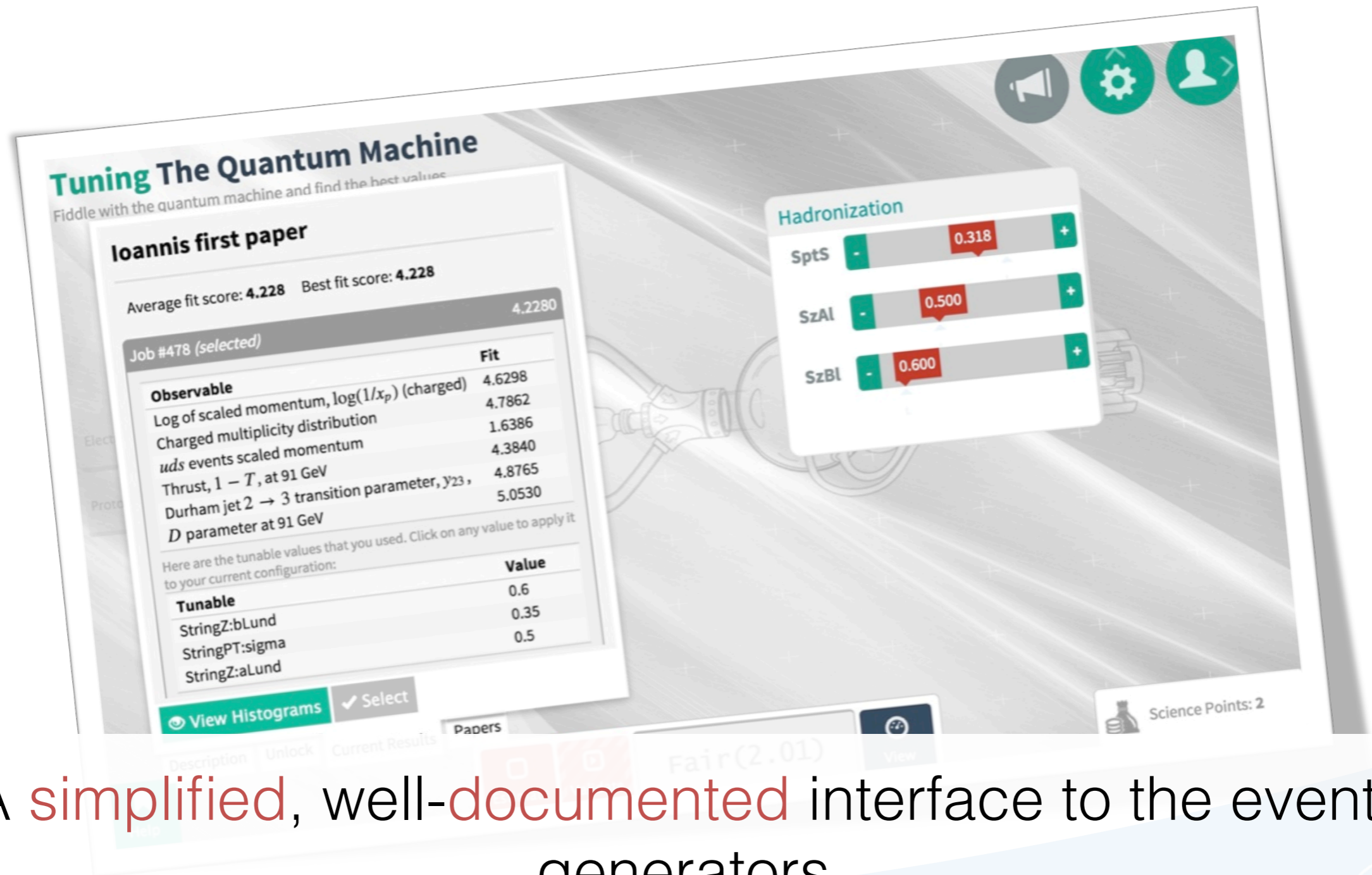
Password:

[Create an account](#) [Login](#)



B

Virtual Atom Smasher



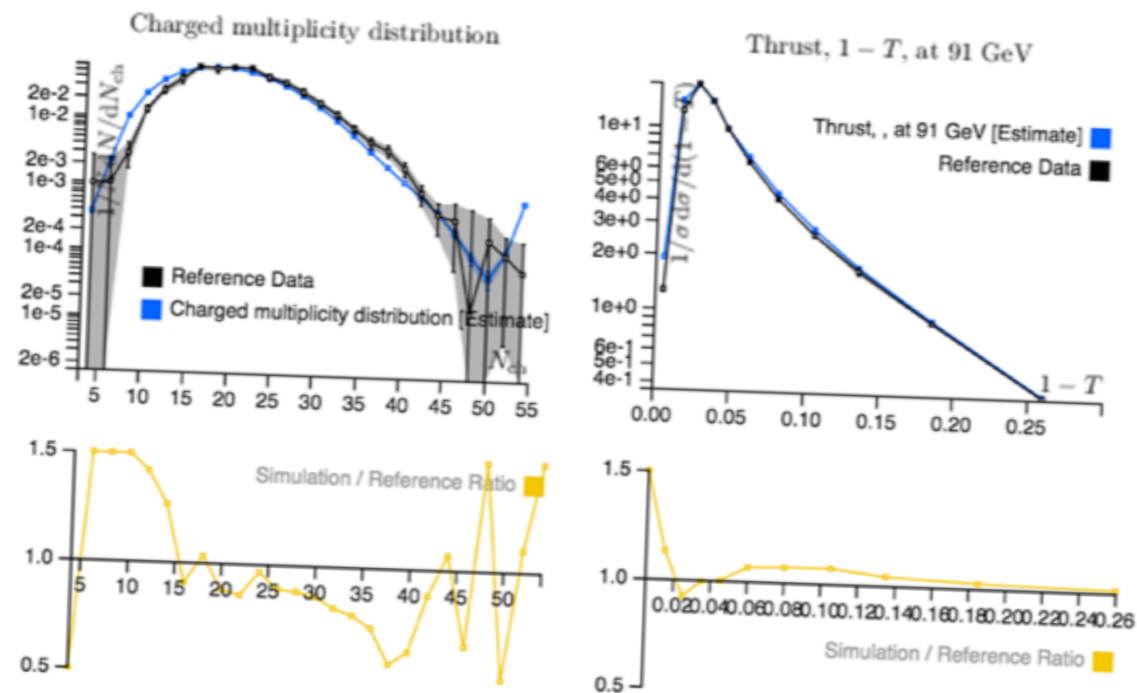
A **simplified**, well-**documented** interface to the event generators

B

Virtual Atom Smasher

! Fair Matches

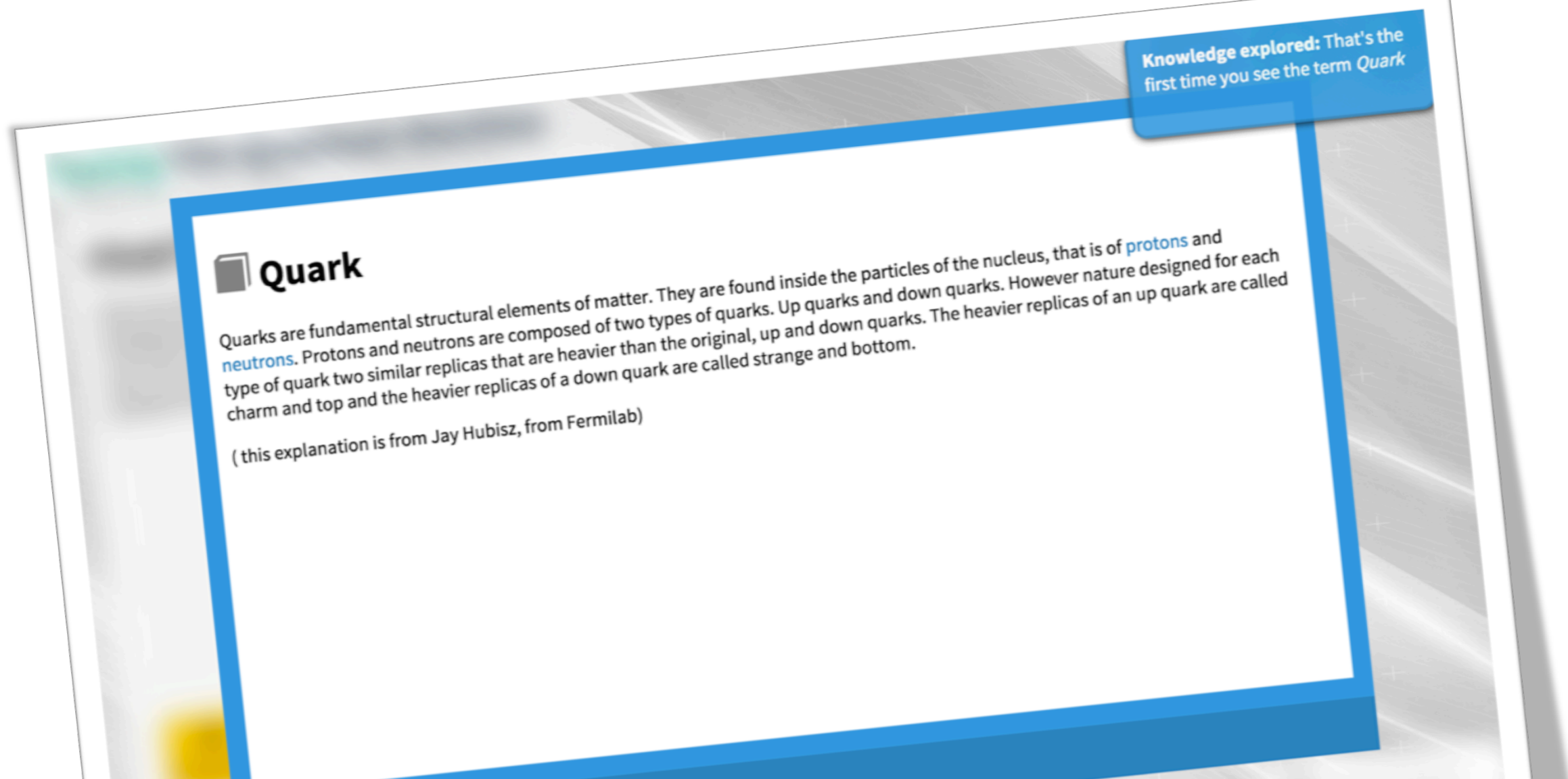
Histograms that are fairly good, but still have some minor issues to fix (error bigger than 3 sigma).



Integrated real-time **plots** from the generator validation

B

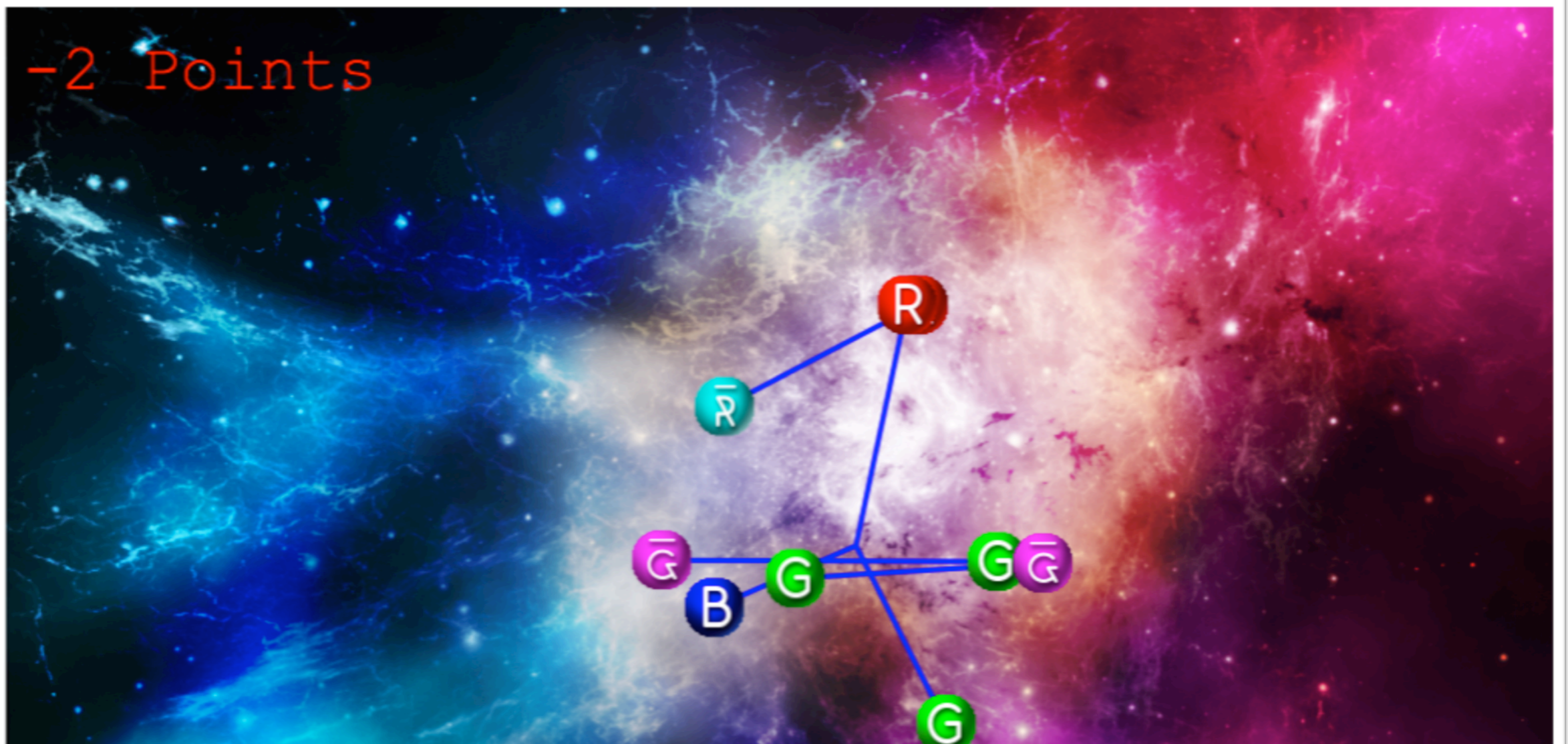
Virtual Atom Smasher



Integrated **explanations** for all the scientific terms found in the game

B

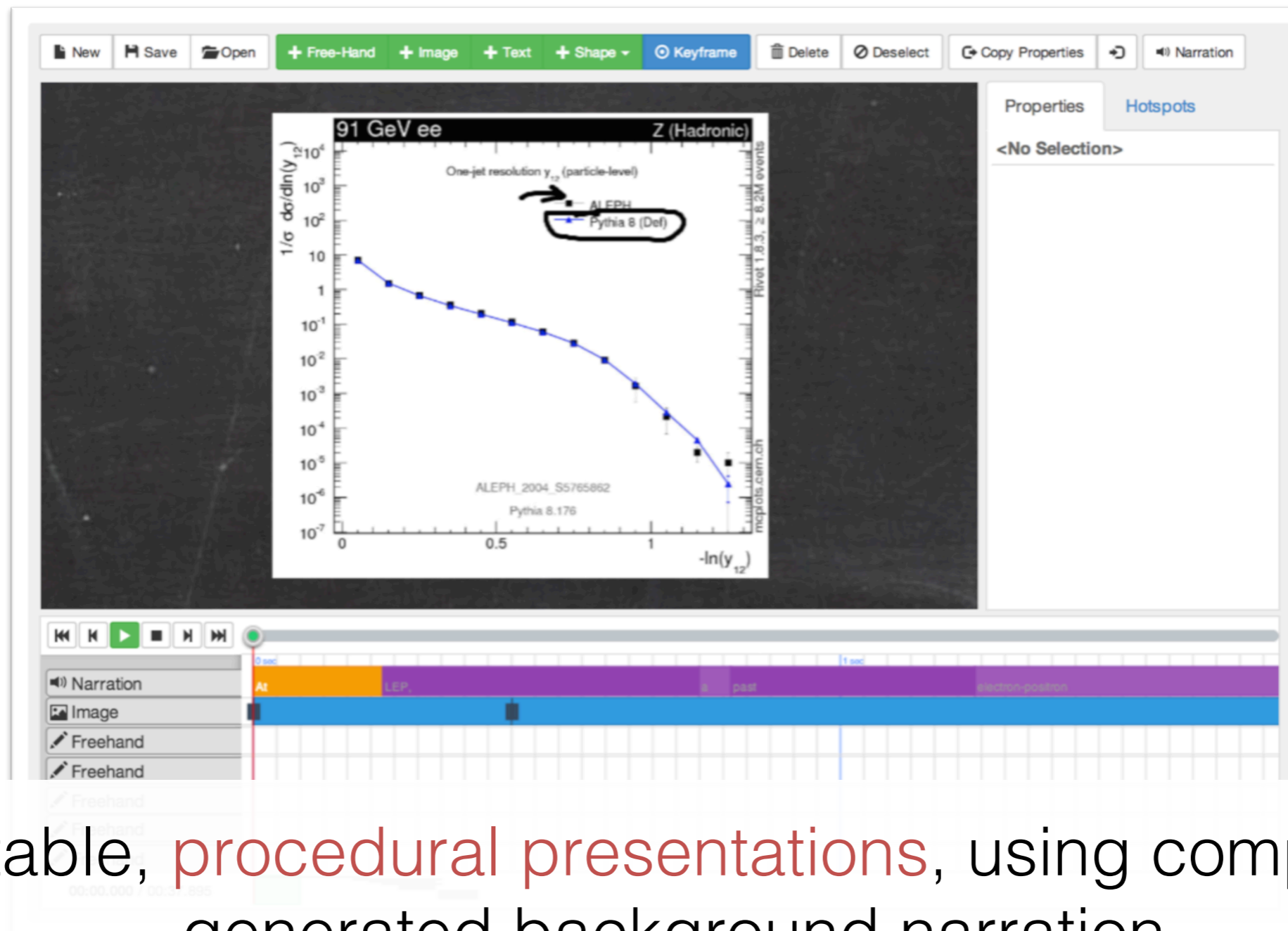
Virtual Atom Smasher



Physics *mini-games* for understanding the more complex scientific topics

B

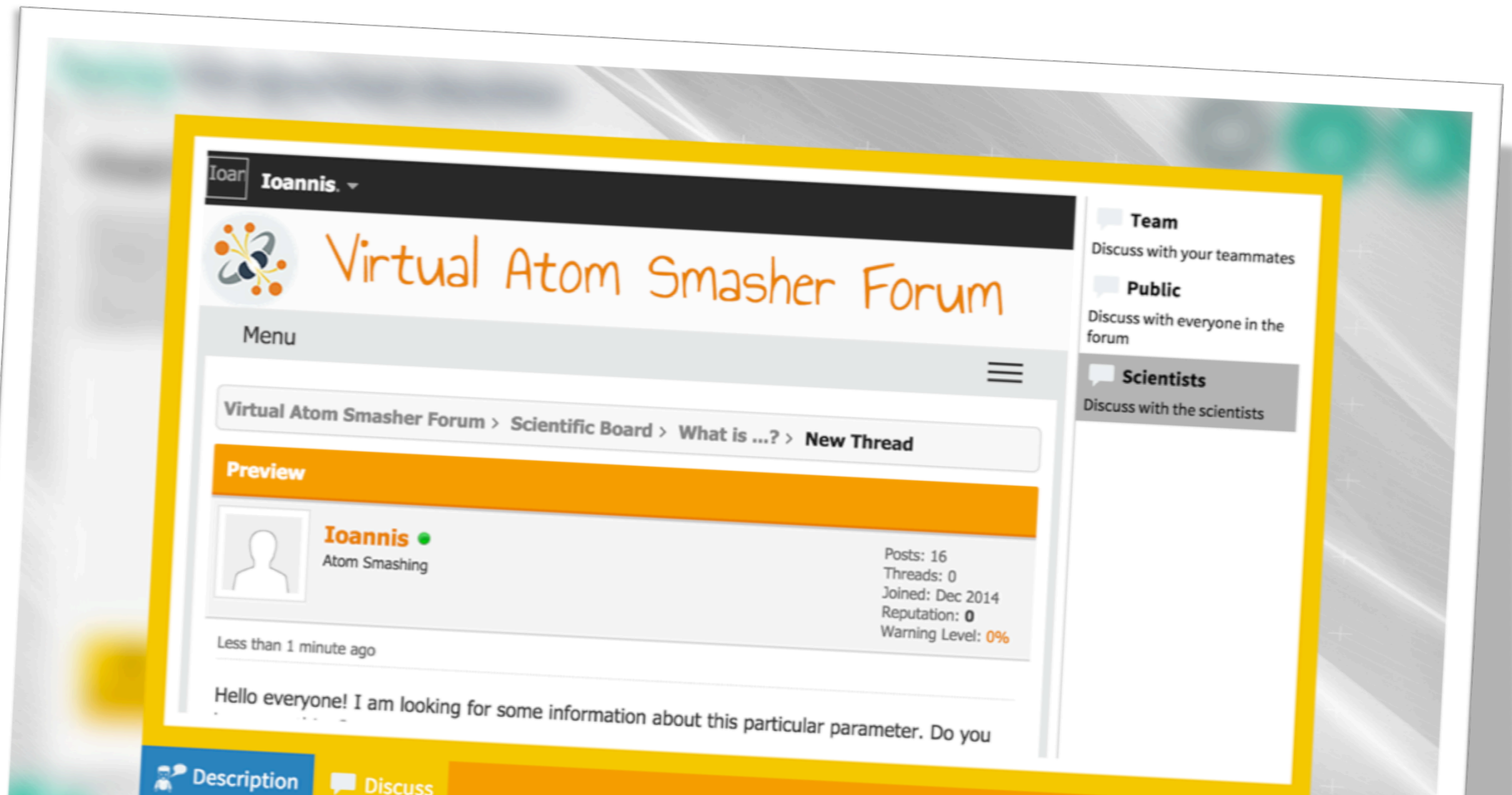
Virtual Atom Smasher



Editable, procedural presentations, using computer-generated background narration

B

Virtual Atom Smasher



Of course, integrated forums between the teams and the scientists

B

Virtual Atom Smasher

On-line demo!

<http://test4theory.cern.ch/vas>

C Computing Resources

- There are **distributed** worker nodes, each one of them contributing to the simulation
- The resources are grouped in teams (currently everyone joins the “**newbies**” team, with resources provided by CERN)
- But you can create **your own** teams and use your own computing resources