An Interactive and Comprehensive Working Environment for High-Energy Physics Software with Python and Jupyter Notebooks

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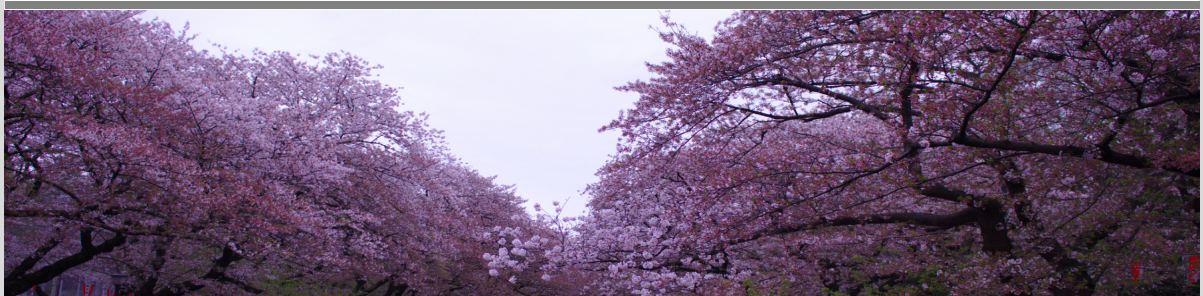


Under the Hood: Integrating basf2

We developed the Python library `hep_ipython_tools` [?] which simplifies the integration of HEP Frameworks with jupyter notebooks.

Core component for seamless Jupyter integration of `basf2`:
Process handler for background framework execution

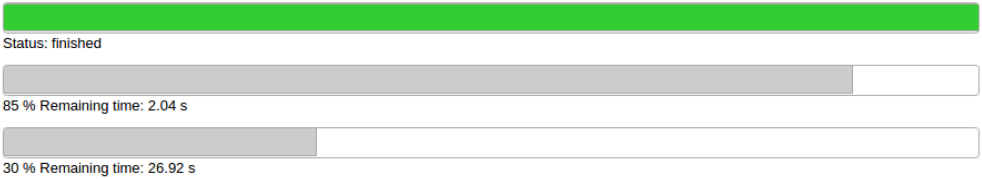
- Creates a separate worker process for `basf2`
- Transfers path configuration and starts processing
- Monitors running framework process
- Installs a message queue between jupyter and basf2 processes to transfer status information (current event number, performance statistics etc.)
- Can support multiple basf2 Instances to concurrently scan a parameter space
- Implementation is generic and can be easily adapted to support other frameworks

Better User Experience: Widgets

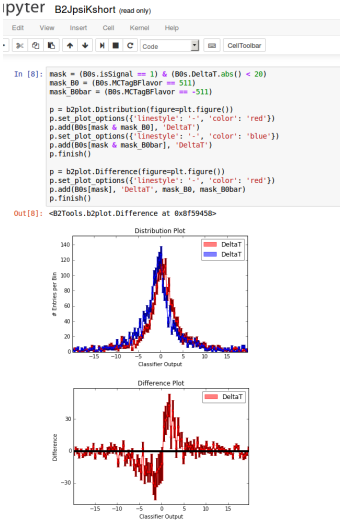
- Jupyter Widgets are graphical exentsions to notebooks to better view use-case specific contents
- Written in Python and JavaScript, running interactively in the user's browser
- Allows to use rich library ecosystem of Python and web-development world (jQuery, HTML5, CSS etc.)

We developed a set of Jupyter widgets to improve the user experience of basf2 in Notebooks

Progress Bar



Full Analysis Example



The shown notebook was already successfully tested with students in a tutorial at KIT.

Conclusion and Outlook

- Perform Python calculations with Jupyter notebooks to have all benefits of Python together with the interactivity.
- The lightweight software layer provided by `hep_ipython_tools` allows a **seamless integration of HEP frameworks** (here basf2) with interactive jupyter notebooks

  Notebooks can be used for:
  - Interactive development of framework module algorithms
  - Working on analyses with fast feedback via inlined plots
  - Self-describing Notebooks for tutorials and outreach
- Using jupyter(hub) with basf2 is a full environment for physics analysis!
- In the future: possibilities for interactive physics analysis via the web browser, centrally hosted at data centers