

# Introducing Acts White Papers

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# Introduction

- A white paper<sup>1</sup> ...
  - ... informs concisely about a complex issue
  - ... helps readers understand a topic, solve a problem, or make a decision
- In Acts, white papers come as LaTeX documents
  - Easy & powerful plotting, e.g., using TikZ
  - Easy cross-referencing
  - Easy citations
  - Write (very) fancy equations
- Each white paper has a GitHub repository that is indexed in the documentation
- Today: Tutorial on how to add your own LaTeX document to the Acts documentation<sup>2</sup>

<sup>1</sup> See [here](#), accessed on November 7, 2023

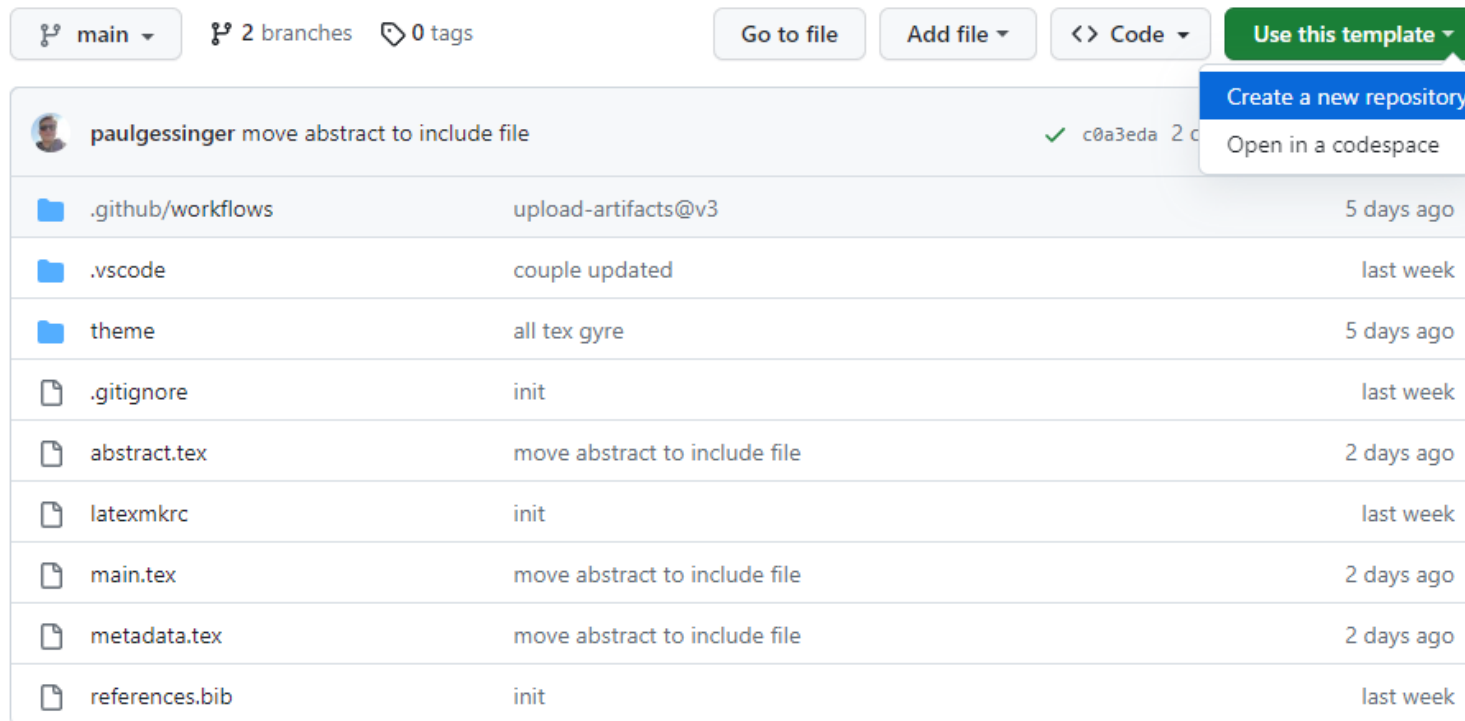
<sup>2</sup> You can find the Acts documentation on how to add white papers [here](#)

# Example

- During vertex seed finding, tracks are modelled as 2D probability distributions
  - Vertex seed = Maximum of the distribution
  - Seed width: Calculated from the FWHM of the distribution
- For a single track, one can compute the maximum and the width analytically
  - Unit test: Compare numerical and analytical calculations
- Without derivation it is hard to see where the analytical expressions come from
  - Make a white paper

# Copy Template Repository

- Go to <https://github.com/acts-project/whitepaper-template>
- Click on “Create a new repository”



The screenshot shows the GitHub interface for a repository. At the top, there are navigation buttons: 'main', '2 branches', '0 tags', 'Go to file', 'Add file', '<> Code', and 'Use this template'. Below these is a commit by paulgessinger with the message 'move abstract to include file' and a green checkmark. A dropdown menu is open under the 'Use this template' button, showing 'Create a new repository' (highlighted) and 'Open in a codespace'. Below the commit is a table of files and folders.

File/Folder	Commit Message	Time
.github/workflows	upload-artifacts@v3	5 days ago
.vscode	couple updated	last week
theme	all tex gyre	5 days ago
.gitignore	init	last week
abstract.tex	move abstract to include file	2 days ago
latexmkrc	init	last week
main.tex	move abstract to include file	2 days ago
metadata.tex	move abstract to include file	2 days ago
references.bib	init	last week

- Provide a name and a description
- Click on “Create repository”

## Create a new repository

A repository contains all project files, including the revision history. Already have a project repository elsewhere? [Import a repository.](#)

*Required fields are marked with an asterisk (\*).*

### Repository template

 acts-project/whitepaper-template ▾

Start your repository with a template repository's contents.

Include all branches

Copy all branches from acts-project/whitepaper-template and not just the default branch.

Owner \*

 felix-russo ▾

Repository name \*

gaussian-track-densities

✔ gaussian-track-densities is available.

Great repository names are short and memorable. Need inspiration? How about [stunning-octo-broccoli](#) ?

Description (optional)

Documentation for the unit test of the Acts module AdaptiveGridTrackDensity.

 Public

Anyone on the internet can see this repository. You choose who can commit.

 Private

You choose who can see and commit to this repository.

 You are creating a public repository in your personal account.

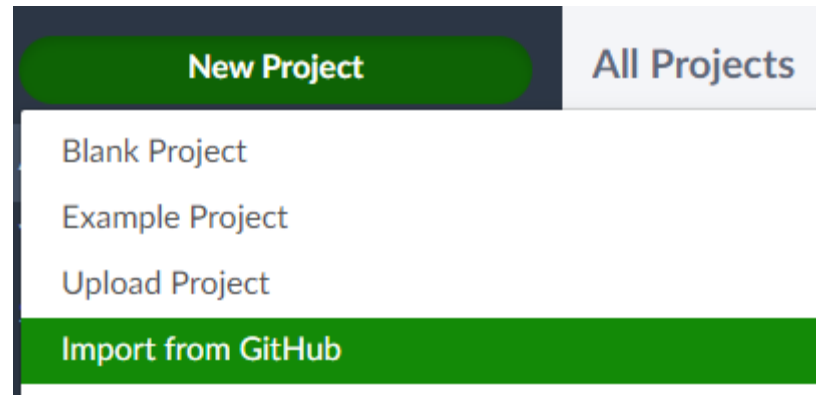
Create repository

# Local Compilation and Usage of Overleaf

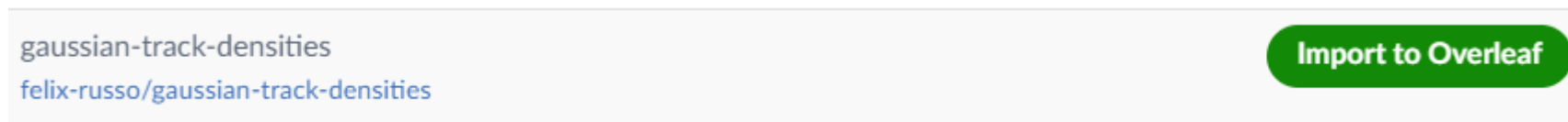
- You can modify the repository either locally or on Overleaf
- Overleaf = Web-Based LaTeX tool with GitHub integration
- In this tutorial, we will focus on Overleaf

# Connect GitHub to Overleaf

- Go to Overleaf
- Click on “New project” and “Import from GitHub”

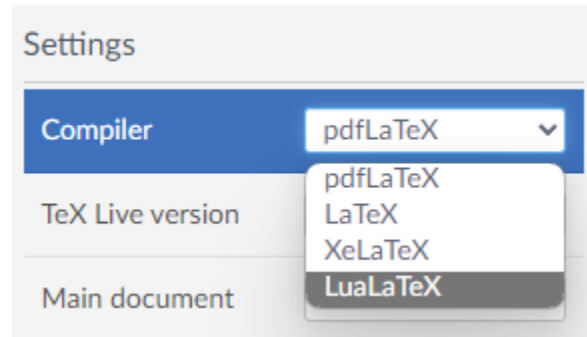


- Import the repository you created in the previous step



# Set LaTeX Compiler

- Click on “Menu” and choose LuaLaTeX as your compiler



- Template should compile now



# Write a White Paper

- Go to metadata.tex to specify the author(s) and the title

```
\title{Gaussian Track Densities}  
\author{Felix Russo}
```

- Write an abstract into abstract.tex
  - You can only use basic LaTeX markup here
  - Gets rendered using MathJax and will be displayed on the website

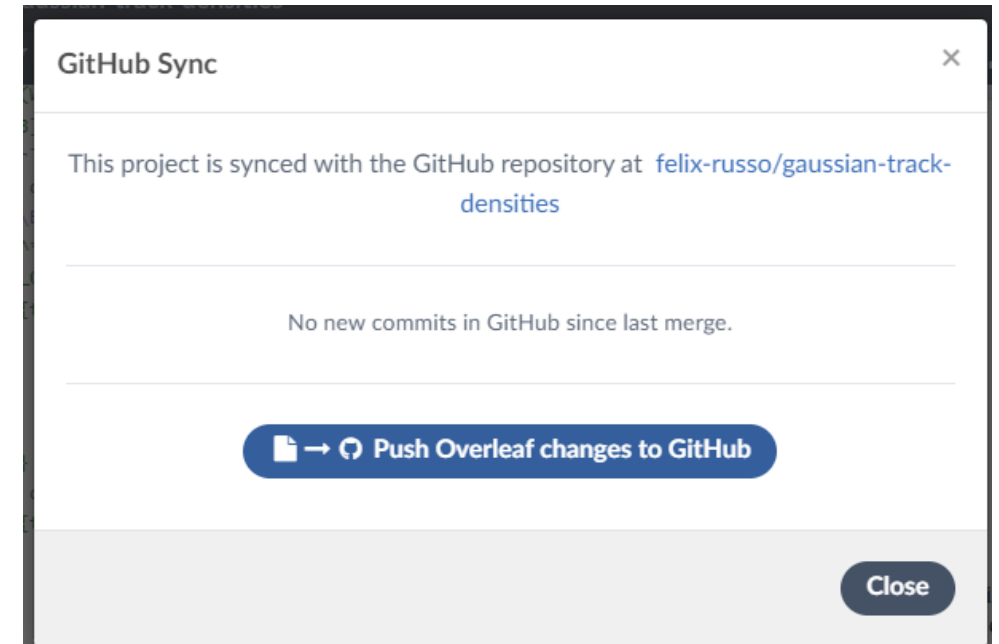
```
%% Only use basic LaTeX markup here, it gets rendered by MathJax.
```

```
Given the impact parameters  $(d_0, z_0, t_0)$  of a track in Perigee parametrization, one can model the probability of the particle passing exactly through a point  $(d, z, t)$  using a multivariate Gaussian distribution. In this white paper, we derive the maximum and the width of such a distribution for  $d = 0$ . This is useful in vertex seed finding, where we only consider the track density along the beam axis. We use the analytical results from this white paper in the unit test of the Acts module AdaptiveGridTrackDensity.
```

- Put your references into references.bib
- Recommended: Put your macros into macros.sty

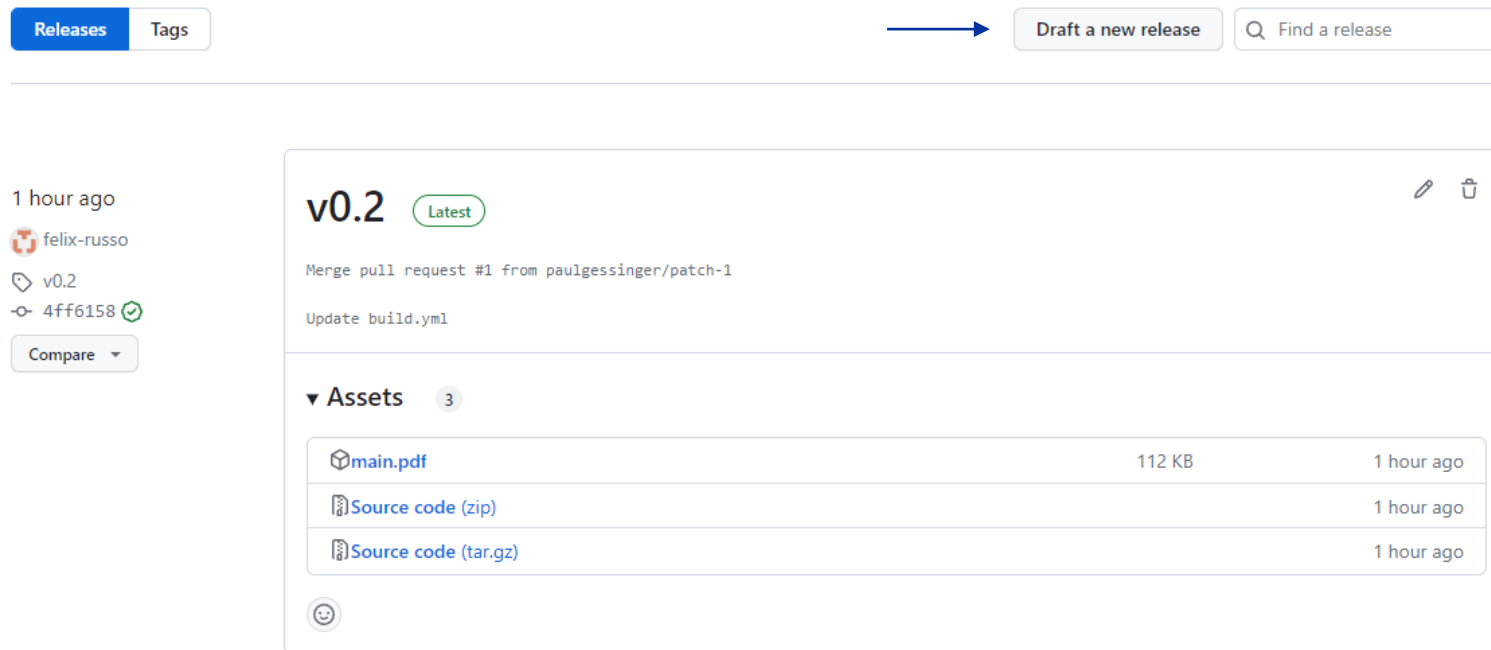
# Synchronizing with Github

- To push your changes from Overleaf to GitHub
  - Click on the menu
  - Click on GitHub
  - Click on “Push Overleaf Changes to GitHub”
- Tip: Only do changes on Overleaf and push them to GitHub – conflict resolution is tedious in Overleaf



# Creating a Tag

- Highly recommended: Version your GitHub repository
  - Latest version is automatically included in the Acts documentation
  - In your GitHub repository, click on “Releases” and then select “Draft a new release”



# Installing Requirements

- Create a virtual environment

```
python -m venv venv_white_paper
```

- Activate it

```
source venv_white_paper/bin/activate
```

- Install requirements

```
pip install -r docs/requirements.txt
```

- Install ImageMagick

```
sudo apt install imagemagick
```

- You might need to modify its security policy according to the second answer [here](#)

# Add Documentation Entry

- Add the following to the bottom of docs/white\_papers.toml

```
[[white_papers]]  
repository = "https://github.com/felix-russo/gaussian-track-densities"  
slug = "gaussian-track-densities"
```

- To get corresponding metadata and save it to docs/white\_papers.toml:

```
docs/white_papers.py pull --github-token $GITHUB_TOKEN
```

- Reference your white paper in the code
- Make a PR & transfer the ownership of your repository to acts
  - PR from today's tutorial is [here](#)
  - For ownership transfer, please contact Paul Gessinger-Befurt

# Result

- A piece of code with a link ...

```
// The analytical calculations of the following can be found here:  
// https://acts.readthedocs.io/en/latest/white\_papers/gaussian-track-densities.html  
// Analytical maximum of the Gaussian  
ActsSquareMatrix<3> ipWeights = ipCov.inverse();  
ActsScalar denom =  
    | ipWeights(1, 1) * ipWeights(2, 2) - ipWeights(1, 2) * ipWeights(1, 2);  
  
ActsScalar zNom =  
    | ipWeights(0, 1) * ipWeights(2, 2) - ipWeights(0, 2) * ipWeights(1, 2);  
ActsScalar correctMaxZ = zNom / denom * d0 + z0;  
  
ActsScalar tNom =  
    | ipWeights(0, 2) * ipWeights(1, 1) - ipWeights(0, 1) * ipWeights(1, 2);  
ActsScalar correctMaxT = tNom / denom * d0 + t0;  
  
// Analytical FWHM of the Gaussian  
ActsScalar correctFWHM = 2. * std::sqrt(2 * std::log(2.) / ipWeights(1, 1));
```

# Result

- ... to a white paper!

## Gaussian Track Densities

GitHub 

### Authors

- Felix Russo

### Description

Given the impact parameters  $(d_0, z_0, t_0)$  of a track in Perigee parametrization, one can model the probability of the particle passing exactly through a point  $(d, z, t)$  using a multivariate Gaussian distribution. In this white paper, we derive the maximum and the width of such a distribution for  $d = 0$ . This is useful in vertex seed finding, where we only consider the track density along the beam axis. We use the analytical results from this white paper in the unit test of the Acts module AdaptiveGridTrackDensity.

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# Questions and Feedback...

- ... are more than welcome!