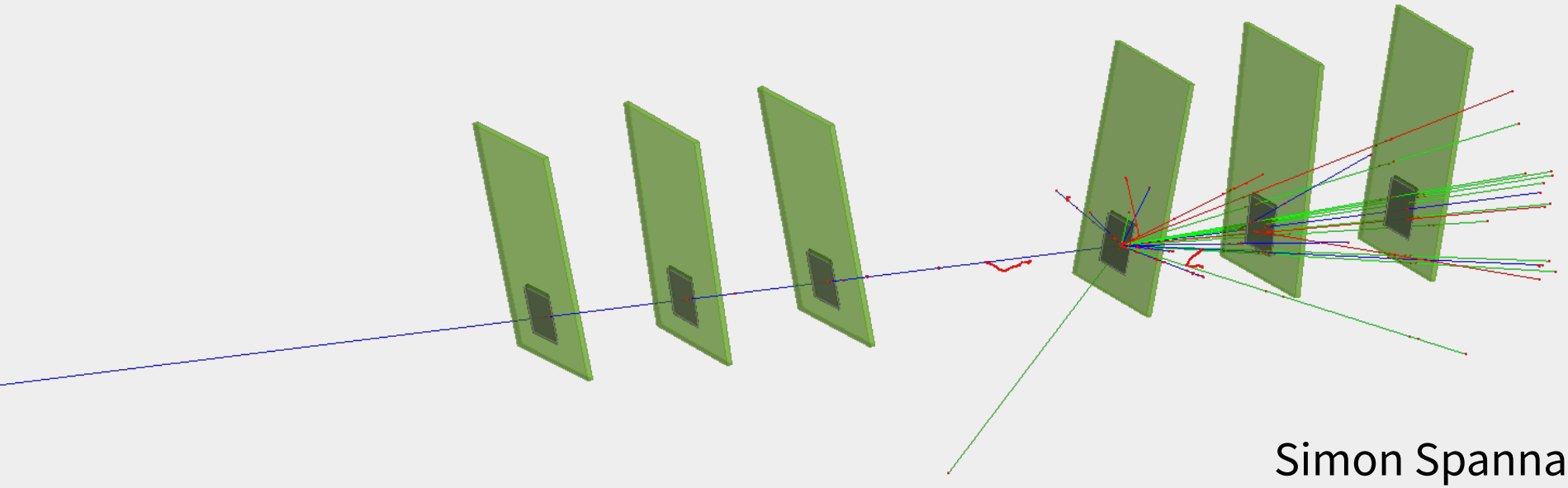

cern.ch/allpix-squared



# Allpix Squared

https://gitlab.cern.ch/allpix-squared/allpix-squared

## Hands-On Exercises

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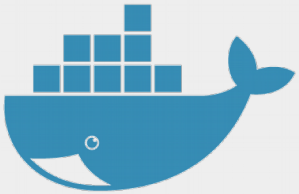
# Resources

- Website
  https://cern.ch/allpix-squared
  - Release Notes, Information, User Manual, Code Reference
- Repository
  https://gitlab.cern.ch/simonspa/allpix-squared
  - Source Code, Issue Tracker
- Mailing Lists:
  - allpix-squared-users https://e-groups.cern.ch/e-groups/Egroup.do?egroupId=10262858
  - allpix-squared-developers https://e-groups.cern.ch/e-groups/Egroup.do?egroupId=10273730
- User Manual:
  https://cern.ch/allpix-squared/usermanual/allpix-manual.pdf

# Contributing

- Open for everyone: extend, improve, add modules
- Discuss with us (mailing list, issue tracker) before starting work
  - Maybe someone is working on your feature already
- We are very strict wrt. code quality → comments on MR
  - Don’t be discouraged by suggestions for change
  - Don’t be dispirited by new software tools
  - See as opportunity to learn something about sw dev.





# Best Practices: Software

- Software repository = software repository
  - Do not commit your own configuration files
  - Keep them in a separate repository
- Check your code before committing
  - Use **`make format`** and **`make lint`**
  - Use the git hook provided in the repository
- Update **documentation** whenever you change sth.
- Make atomic commits – small, self-contained, descriptive

# Examples

- Check the repository
- All examples documented with short description
  - Available as Markdown in repo
  - Included in the manual

- More examples very welcome
  - If you have a nicely working setup to demonstrate certain functionality – have it included in the repo!

# Task: Play with Logging

- Change the logging verbosity and style
- Log to a file

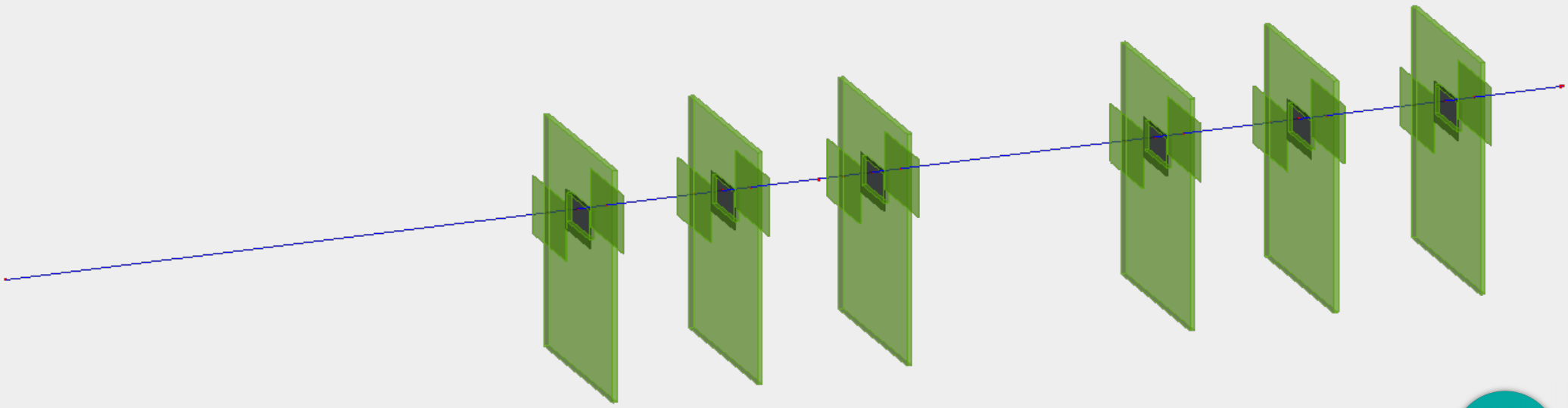
```
1  [AllPix]
2  log_level = "WARNING"
3  log_format = "DEFAULT"
```

# Task: A EUDET Beam Telescope

- Set up a telescope configuration similar to the EUDET telescopes
  - 6 Mimosa26 sensors, perpendicular to beam
  - Distance arbitrary – but beware of the support material!
- Decide for a set of modules and discuss the choice
- (try to) visualize your setup

# Task: A EUDET Beam Telescope

- Six sensors (black-ish)
- Large PCB with cutout, two thin Kapton foils
- 100 GeV Pion track passing



# Task: Using the CLI Interface

- Alter the number of events to be simulated without changing your configuration file
- Change the beam energy from the CLI

# Task: Using the CLI Interface

- Number of events:

```
$ allpix -c /my/conf -o number_of_events=1
```

- Beam energy:

```
allpix -c /my/conf -o DepositionGeant4.beam_energy=10MeV
```

# Task: Automatic Detector Misalignment

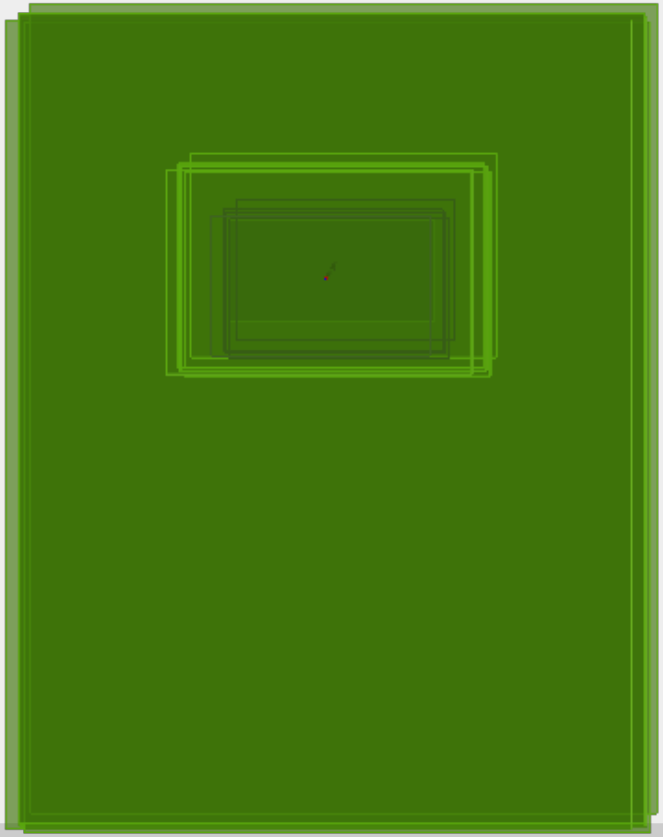
- Artifacts in reconstructed simulation residuals
  - From pixel-perfect alignment, cured by misaligning detectors
- Set new parameters for detector(s):

```
25
26  alignment_precision_position = 0.1mm 0.1mm 1mm
27  alignment_precision_orientation = 0.1deg 1.3deg 2deg
28
```

  - Parameters define Gaussian width to draw shifts from
- Observe new position and orientation
- Make them reproducible for multiple runs:
  - Set **`random_seed_core`** to known value

# Task: Misalignment

- Applied to all EUDET planes: 0.5mm 0.5mm 1mm
- Projection of telescope: misalignment visible



```
(DEBUG) Loading all detectors:
(DEBUG) Detector telescope0...
(DEBUG) Position:    (0,0,0)
(DEBUG)  misaligned: (-756.34um,479.298um,-213.954um)
(DEBUG) Orientation: (0,0,0)
(DEBUG)  misaligned: (0,0,0)
(DEBUG) Interpreting Euler angles as XYZ rotation
(DEBUG) Detector telescope1...
(DEBUG) Position:    (0,0,50mm)
(DEBUG)  misaligned: (-223.759um,-458.657um,50.5156mm)
(DEBUG) Orientation: (0,0,0)
(DEBUG)  misaligned: (0,0,0)
(DEBUG) Interpreting Euler angles as XYZ rotation
(DEBUG) Detector telescope2...
(DEBUG) Position:    (0,0,100mm)
(DEBUG)  misaligned: (699.039um,-928.538um,99.8759mm)
(DEBUG) Orientation: (0,0,0)
(DEBUG)  misaligned: (0,0,0)
(DEBUG) Interpreting Euler angles as XYZ rotation
(DEBUG) Detector telescope3...
(DEBUG) Position:    (0,0,200mm)
(DEBUG)  misaligned: (478.862um,-549.374um,200.11mm)
(DEBUG) Orientation: (0,0,0)
(DEBUG)  misaligned: (0,0,0)
(DEBUG) Interpreting Euler angles as XYZ rotation
(DEBUG) Detector telescope4...
(DEBUG) Position:    (0,0,250mm)
(DEBUG)  misaligned: (50.886um,-424.941um,249.156mm)
(DEBUG) Orientation: (0,0,0)
(DEBUG)  misaligned: (0,0,0)
(DEBUG) Interpreting Euler angles as XYZ rotation
(DEBUG) Detector telescope5...
(DEBUG) Position:    (0,0,300mm)
(DEBUG)  misaligned: (-83.645um,-411.32um,299.585mm)
(DEBUG) Orientation: (0,0,0)
(DEBUG)  misaligned: (0,0,0)
(DEBUG) Interpreting Euler angles as XYZ rotation
```

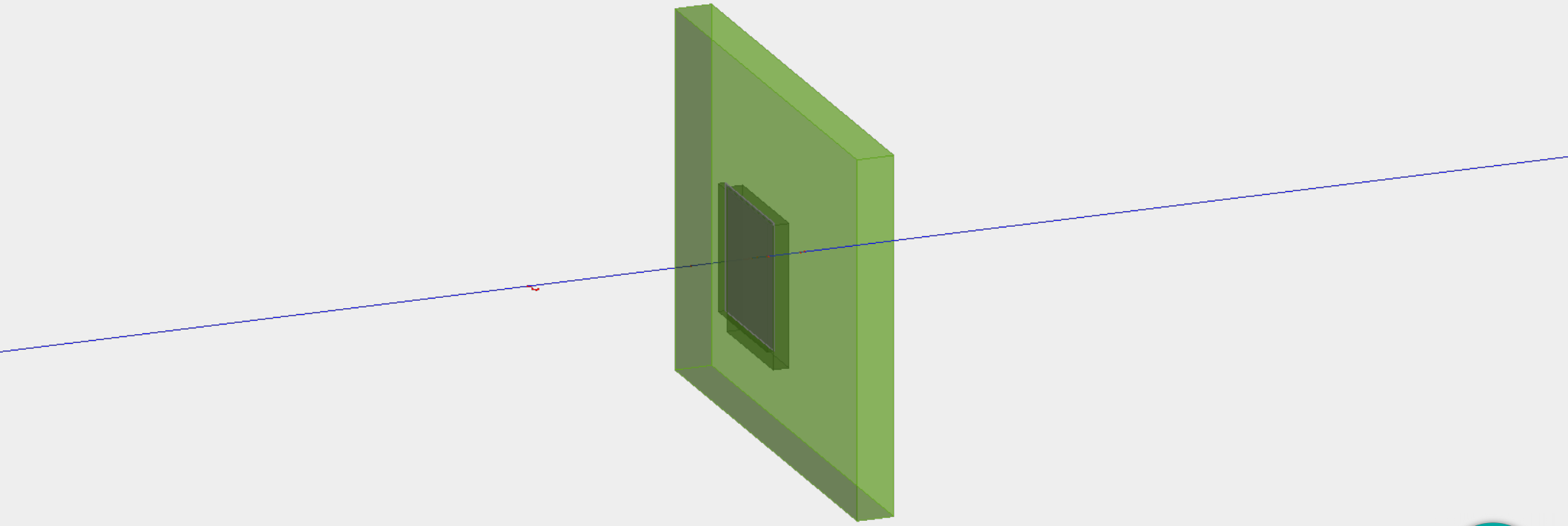
# Task: New Detector Model

- Prepare a **new model file** for a detector with the following properties:
  - Hybrid detector
  - 200x50 pixels
  - Pitch: 25x100um
  - Readout chip:
    - Thickness: 700um
    - Periphery: 1.1mm bottom, 100um other sides
  - Sensor
    - Thickness: 285um
    - Guard rings: 250um each side
  - Bumps:
    - Height 30um
    - Radius sphere 15um
    - Radius cylinder 12um
- Place it on a PCB
  - 20.5x15.5x1.6mm
- Simulate it! Visualize it!

# Task: New Detector Model

- Remember: point Allpix Squared to model path:

```
7  detectors_file = "detectors.conf"
8  model_paths = "./"
```



# Task: Add Second Digitizer

- Add a new digitizer with different settings
  - Threshold?
  - Noise?
- Produce histograms for both (cluster hitmap...)

# Task: Add Second Digitizer

```
[DefaultDigitizer]
output = "dig1"
threshold = 1000e

[DefaultDigitizer]
output = "dig2"
threshold = 600e
```

```
[DetectorHistogrammer]
input = "dig1"

[DetectorHistogrammer]
input = "dig2"
```

# Task: Use Different Propagators

- Take two detectors of the same type
- Assign different propagators:
  - ProjectionPropagation
  - GenericPropagation
- Relay the output accordingly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