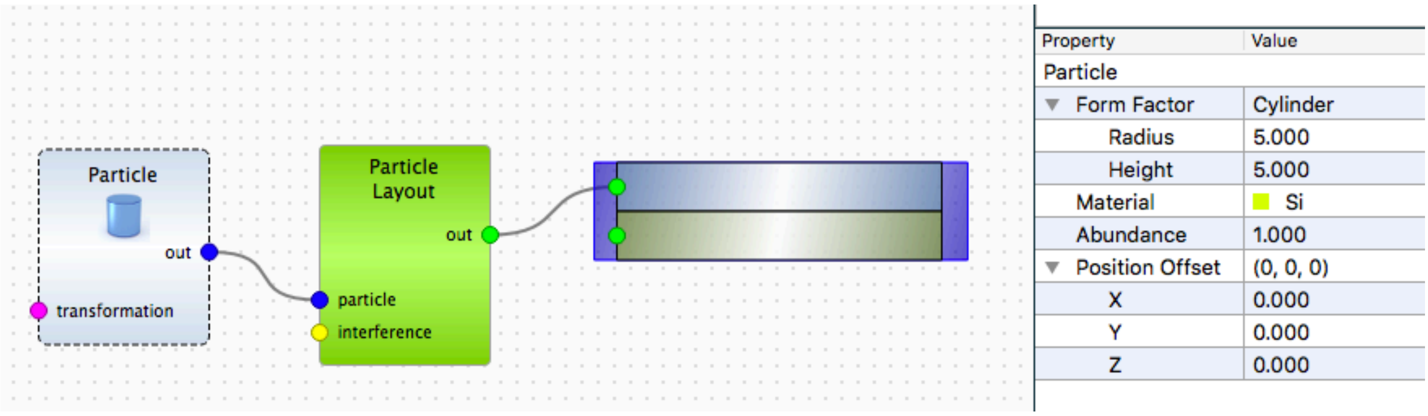
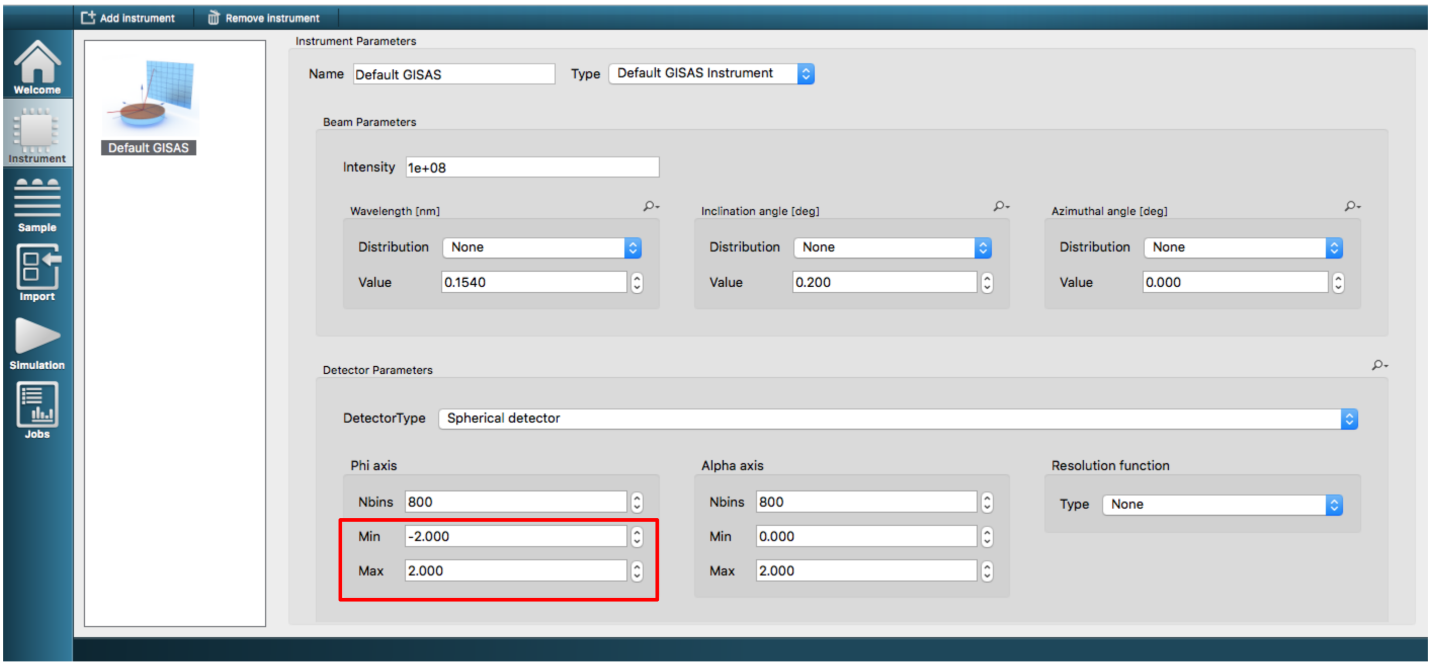
Exercise 4: particles with size distribution

Initial parameters

Take sample from the exercise 1. Change the particle form factor to cylinder of 5 nm raius and 5 nm height.



Extend the detector boundaries for φ_f from -2 to 2 degree.



Tasks

1. Add Gaussian size distribution for cylinder radius. Set as mean value 5 nm and as a standard deviation 1.0. Set number of samples to 10 and a sigma factor to 2.
2. Link height to the size distribution. Compare the simulation results. *For the moment, it is possible only*

in Python.

3. **Advanced:** create cylinders with independent Gaussian size distribution for height and radius. *For the moment, it is possible only in Python.*

Available 1D distributions

Gaussian

The probability density $f(x)$ for Gaussian distribution is defined by the mean value μ and standard deviation σ:

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} \cdot e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

In BornAgain the Gaussian distribution can be set as follows:

```
# Defining particles with parameter following a distribution
distr_1 = ba.DistributionGaussian(mu, sigma)
par_distr_1 = ba.ParameterDistribution("/Particle/Cylinder/Radius", distr_1, 10, 2
.0)
particleDistribution_1 = ba.ParticleDistribution(particle_1, par_distr_1)
```

Gate

Gate as a uniform distribution set by the range boundaries a (minimum) and b (maximum). The probability density:

$$f(x) = \frac{1}{b-a}$$

In BornAgain Python it can be set as:

```
distr_1 = ba.DistributionGate(x_min, x_max)
```

Lorentz

Lorentz (Cauchy) probability distribution function $f(x)$ is defined by the median value μ and half-width at half-maximum γ:

$$f(x) = \frac{\gamma}{\pi \cdot (\gamma^2 + (x-\mu)^2)}$$

In BornAgain Python it can be set as:

```
distr_1 = ba.DistributionLorentz(mu, gamma)
```

Log-normal

The probability density $f(x)$ for the Log-normal distribution is defined by the median value μ and scale parameter σ:

$$f(x) = \frac{1}{x\sigma\sqrt{2\pi}} \cdot e^{-\frac{(\ln x - \ln \mu)^2}{2\sigma^2}}$$

In BornAgain Python it can be set as:

```
distr_1 = ba.DistributionLogNormal(mu, sigma)
```

Cosine

The probability density $f(x)$ for the cosine distribution is defined by the mean value μ and parameter σ.

$$f(x) = \frac{1}{2\pi\sigma} \cdot [1 + \cos(\frac{x - \mu}{\sigma})]$$

In BornAgain Python it can be set as:

```
distr_1 = ba.DistributionCosine(mu, sigma)
```