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Sources and Monitors

Sources: In general

- A source component generates Monte Carlo neutrons.
  In McStas terms this means:
  - Set the neutron state to something representative of the source we are trying to model.
  - i.e.: insert values in the neutron state vector:
    `{x,y,z, vx,vy,vz, t, sx,sy,sz, p}`
    drawn from appropriate distributions.
  - EXAMPLE:
    Neutrons from a uniform wavelength distribution emerging from a circular aperture.

Access the docs

IMPORTANT:

All (and more) of this information can be found in the online pdf component documentation, e.g.

https://github.com/McStasMcXtrace/McCode/raw/master/docpkg/manuals/mcstas/Component_manual.pdf

or

http://mcstas.org/download/components/doc/manuals/mcstas-components.pdf

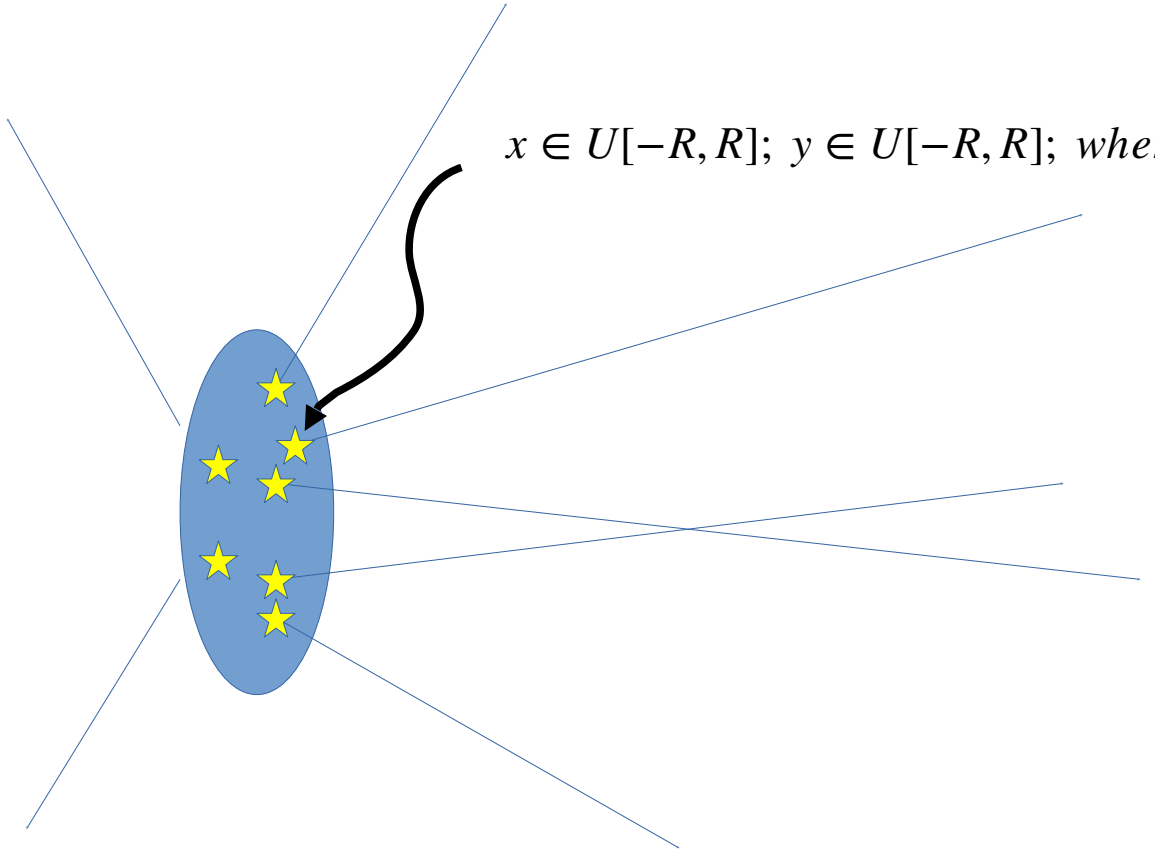
- also distributed with your McStas installation - **`mcdoc -c`**

The component documentation along with the command:

"**`mcdoc <component_you_are_searching_for>`**"

are your best friends when using McStas

Sources: Example 1

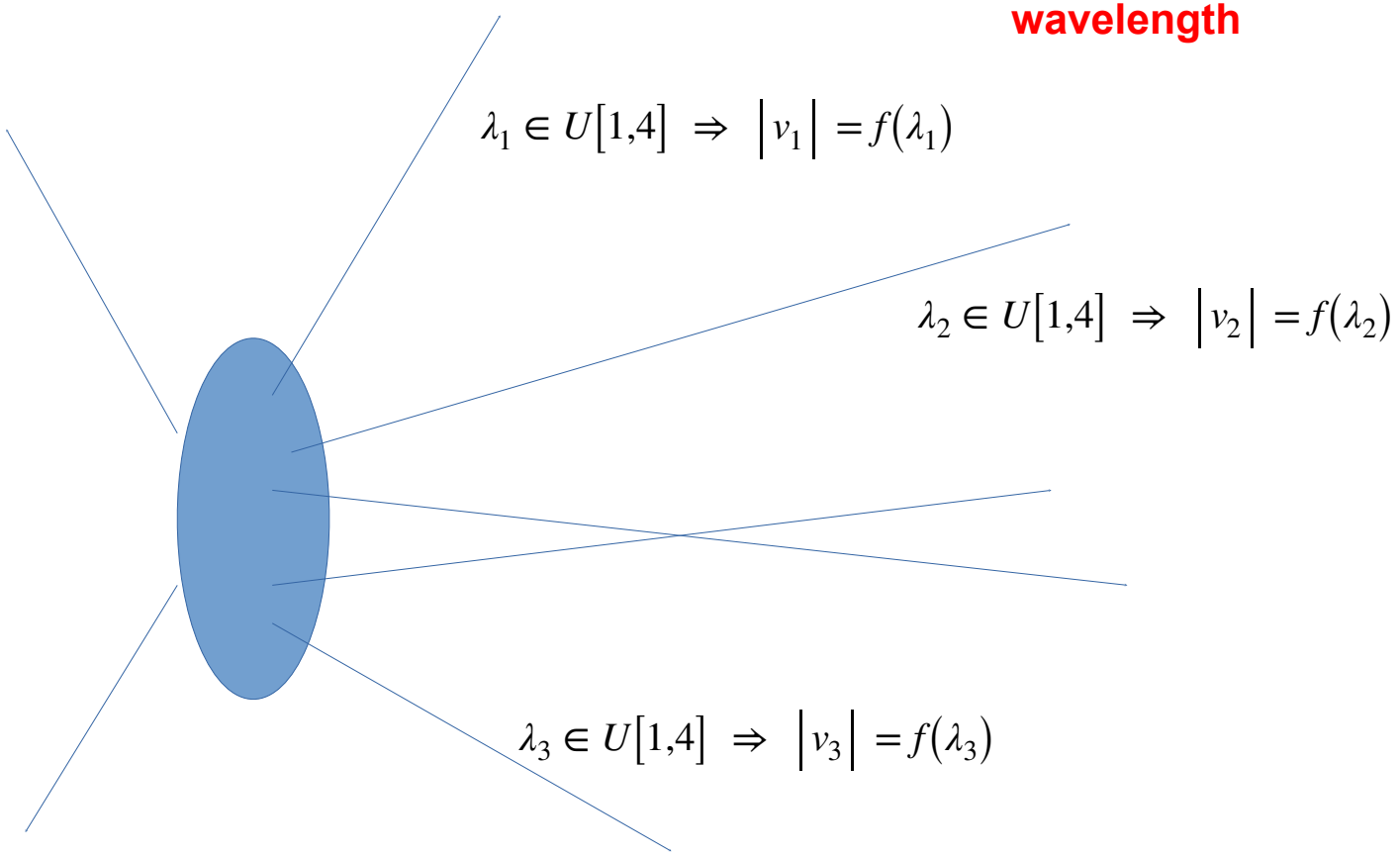


$$x \in U[-R, R];\ y \in U[-R, R];\ wherex^2 + y^2 < R$$

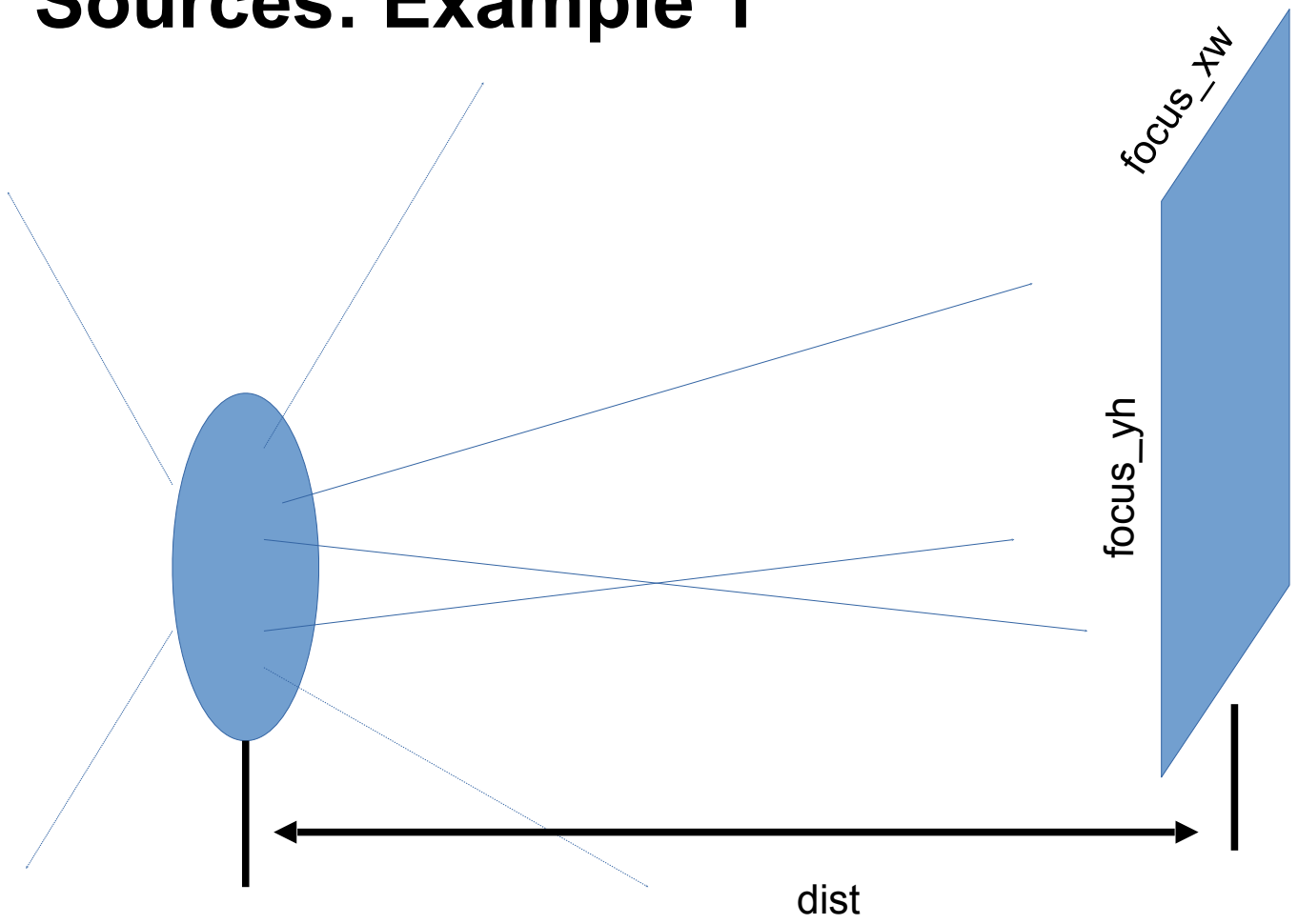
Neutron spatial coordinates are picked from a uniform distribution on a circle with radius R.

Sources: Example 1

Length of the velocity vector encodes the wavelength



Sources: Example 1

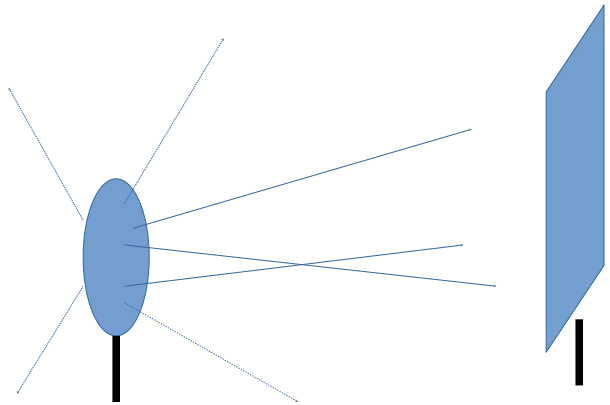


Neutron velocity vector is picked to point at a ROI.

In McStas: this is defined by the parameters: focus_xw, focus_yh, and

dist

Sources: Example 1



```
TRACE

COMPONENT origin = Progress_bar()
AT(0,0,0) ABSOLUTE

COMPONENT src = Source_simple(
        radius=0.05,   lambda0=2.5, dlambda=1.5,
        focus_xw=0.1, focus_yh=0.1, dist=5)
AT(0,0,0) RELATIVE origin
```

Monitors: in general

REALITY:

Monitors:

- Intensity probe of the beam
- Transparent to neutrons → Efficiency <1%

Detectors:

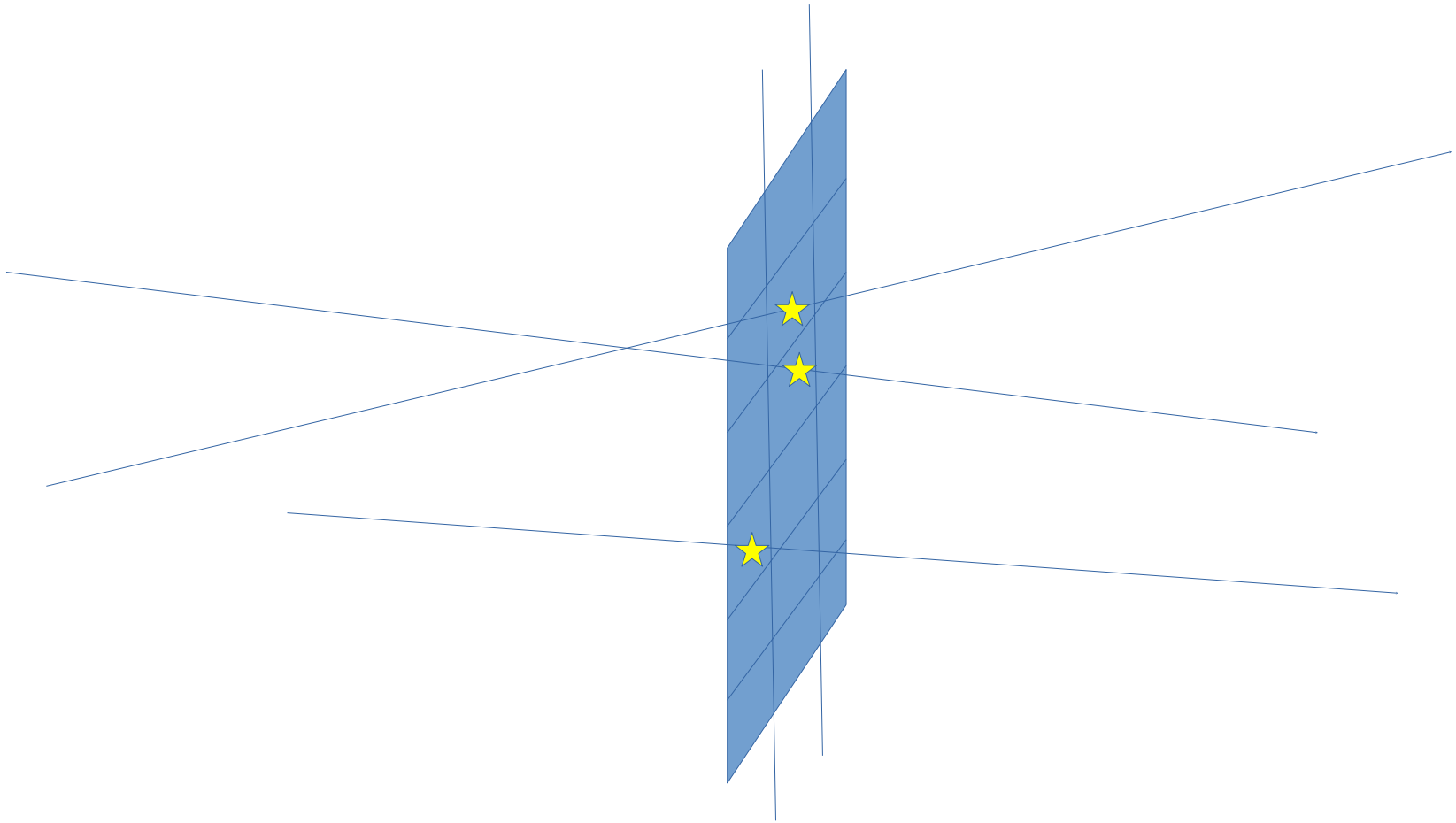
- Should detect *all* neutrons → Efficiency as high as possible

SIMULATIONS (McStas):

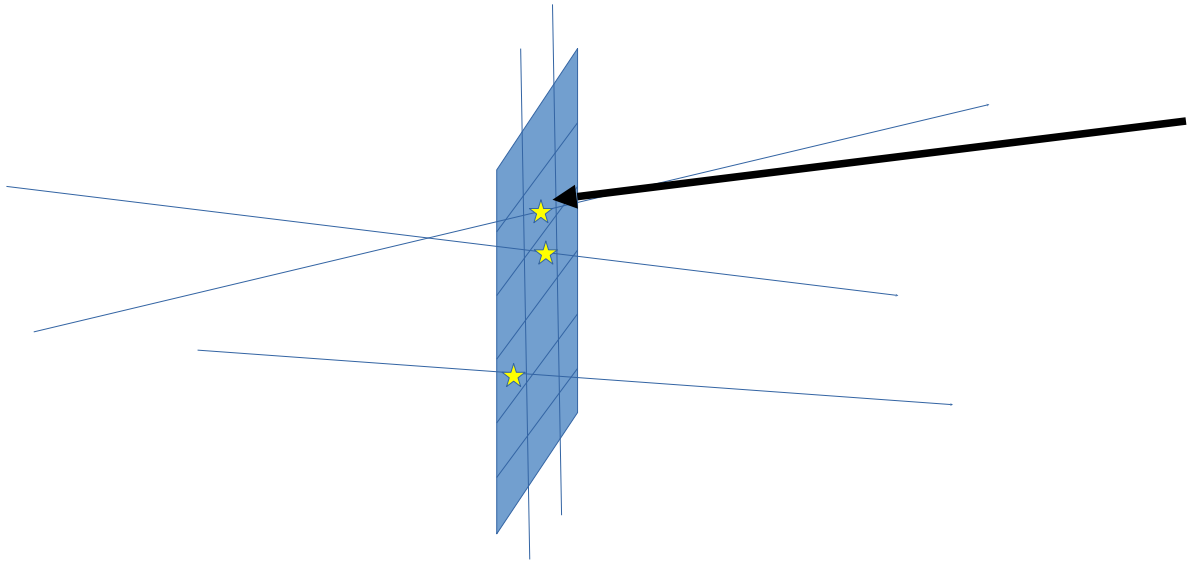
In McStas:

- We can program monitors and detectors to behave any way we like. We refer to both of those indistinguishably as ‘monitors’.
- E.g. monitor with Efficiency =100% and Transparency=100%
- (With exception of PSD_Detector that models a “physical” He^3 detector)

Monitors: Example PSD_monitor



Monitors: Example PSD_monitor

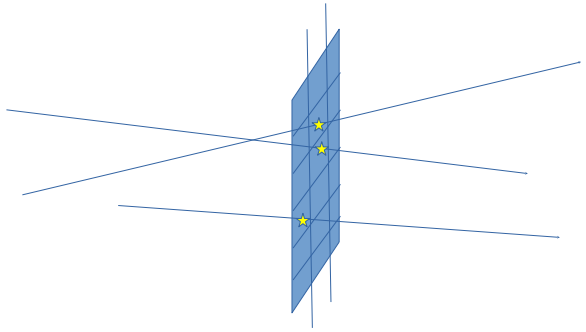


When the simulation has been completed, the detected intensity in pixel (i,j) is:

$$I(i,j) = \sum_{x_k, y_k \in pixel(i,j)} p_k; k = raynumber\,.$$

… during simulation, the pixels are maintained as running sums.

Monitors:
Example PSD_monitor and L_monitor



```
...
TRACE

COMPONENT origin = Progress_bar()
AT(0,0,0) ABSOLUTE

COMPONENT src = Source_simple(
        radius=0.05,     lambda0=2.5, dlambda=1.5,
        focus_xw=0.1, focus_yh=0.1, dist=5)
AT(0,0,0) RELATIVE origin

COMPONENT psd = PSD_monitor(
        xwidth=0.2, yheight=0.2, filename="psd.dat")
AT (0,0,5) RELATIVE src

COMPONENT lm = L_monitor(
        xwidth=0.2, yheight=0.2, filename="lm.dat",
        Lmin=0, Lmax=8)
AT (0,0,5+0.01) RELATIVE src
```

Sources: Mathematical sources

Source_simple:

- Square or circular surface emitting neutrons from either uniform or Gaussian wavelength (or energy) distribution.
- Neutrons are directed towards a square target.

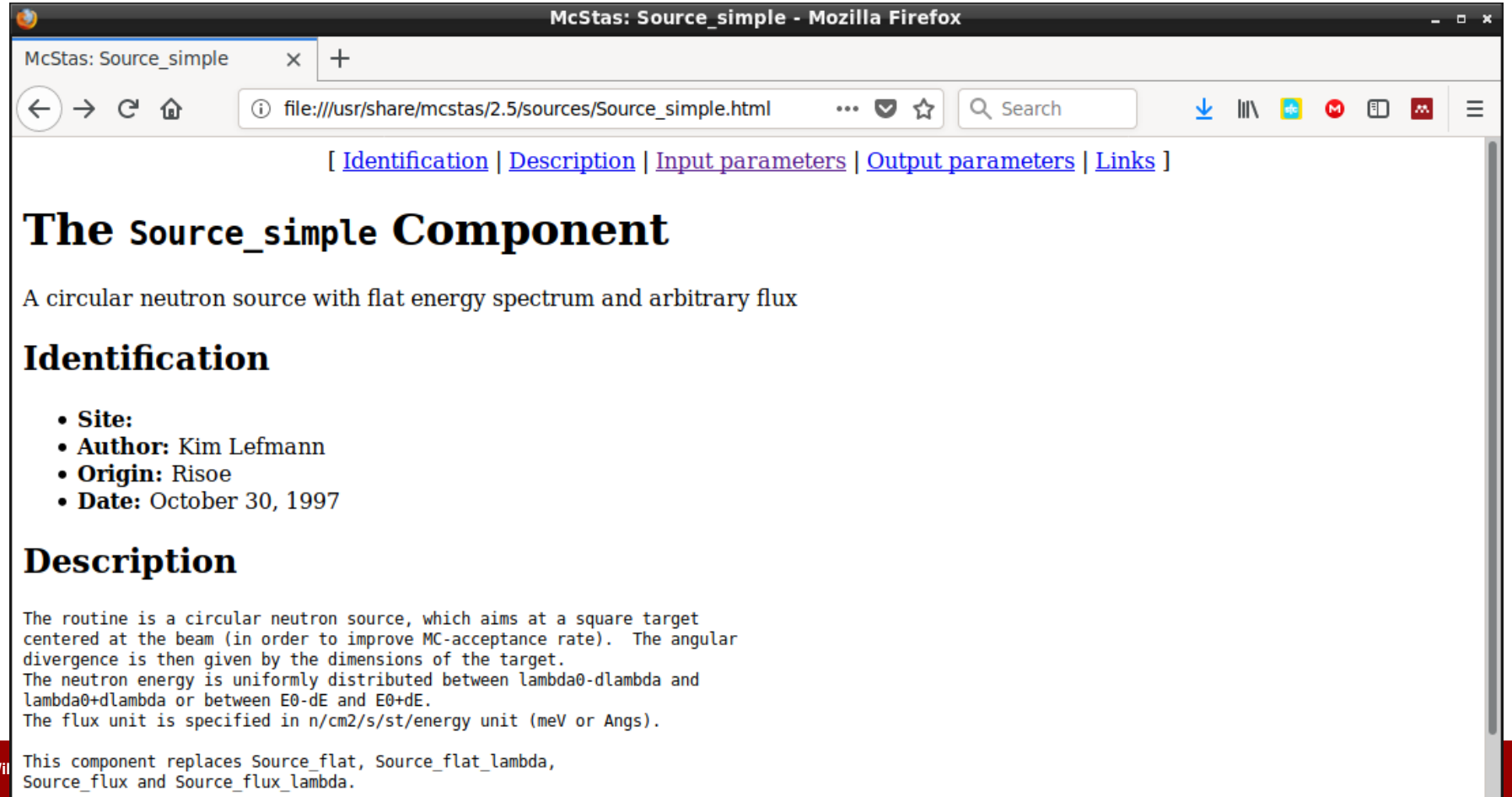
- Source_div:
- Square surface emitting neutrons from either uniform or Gaussian wavelength (or energy) distribution.
- Neutrons have a divergence defined by either uniform or Gaussian distribution.

Source_simple docs

Try “**mcdoc Source_simple**”

or

(in GUI) **Help** → **mcdoc Component Reference** → (In Webpage) **Source_simple**



Source_simple docs

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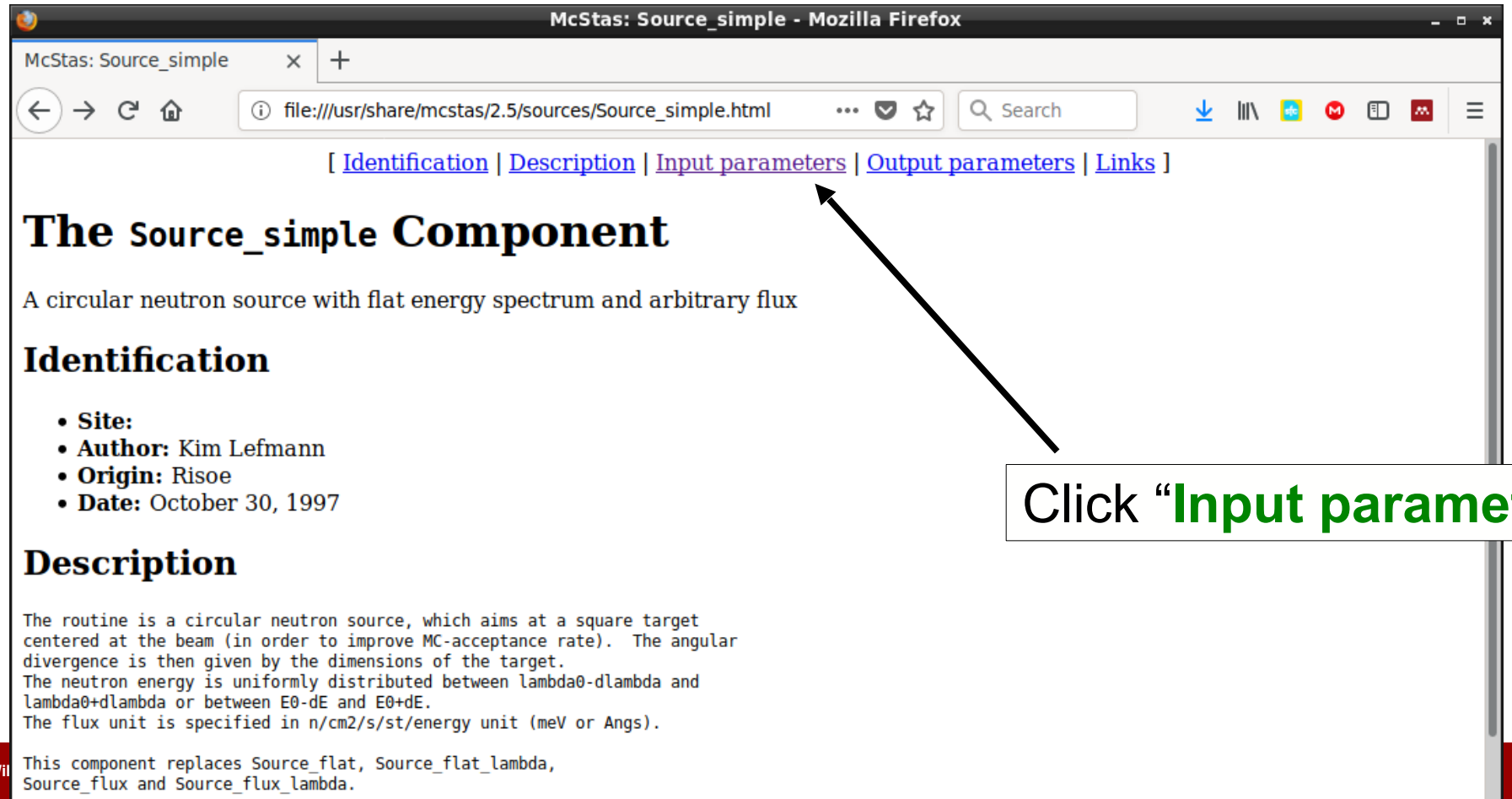
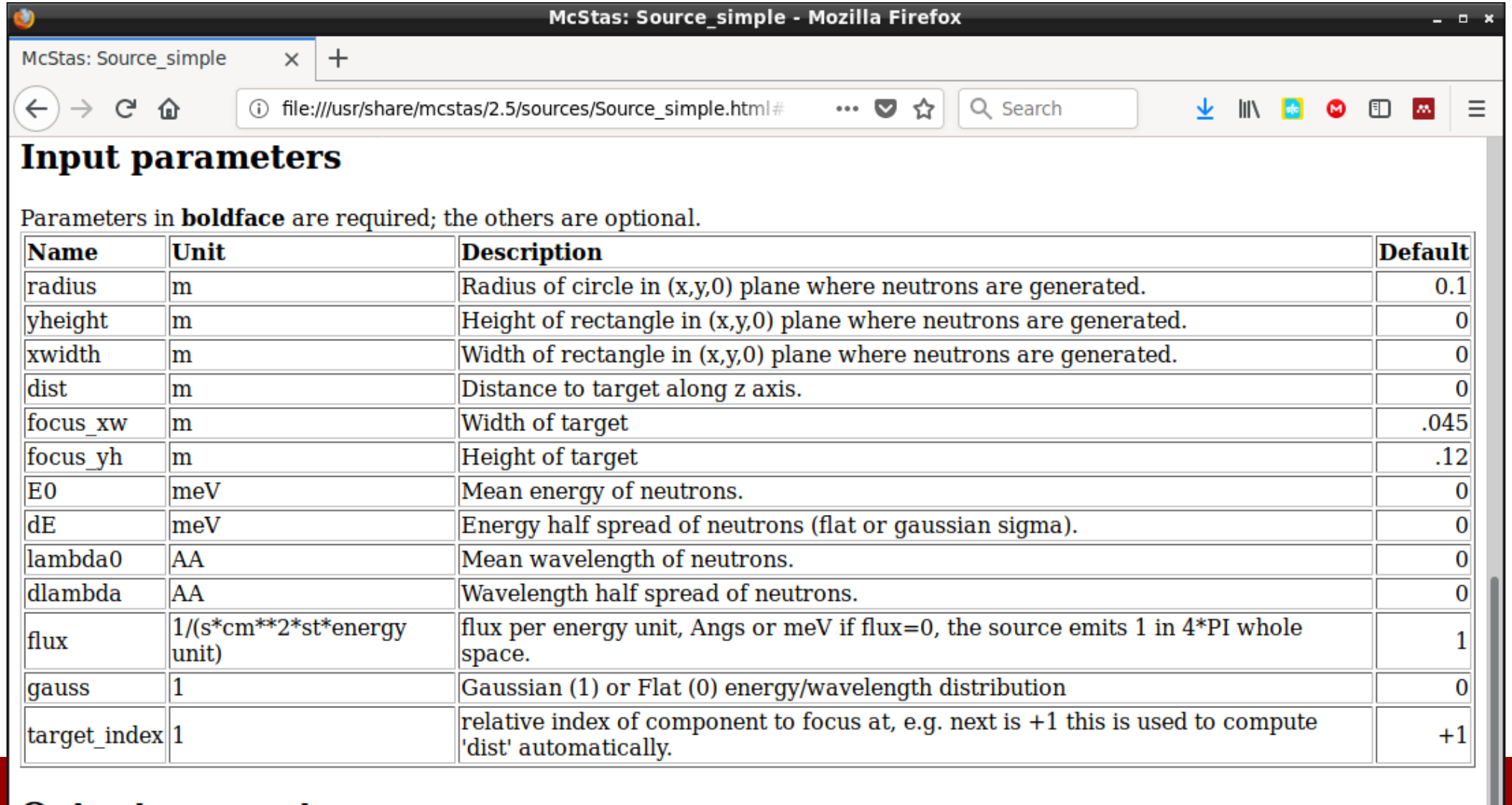


Click “**Input parameters**”

Source_simple docs

Try “**mcdoc Source_simple**” or

(in GUI) **Help** → **mcdoc Component Reference** → (In Webpage) **Source_simple**

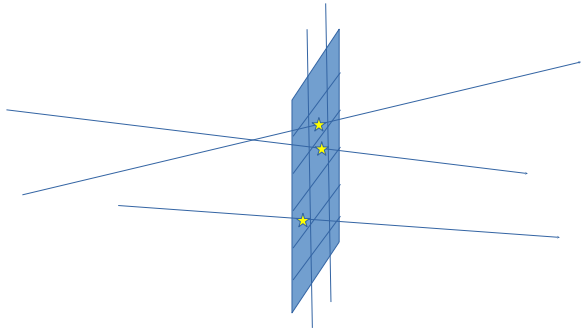


Input parameters

Parameters in **boldface** are required; the others are optional.

Name	Unit	Description	Default
radius	m	Radius of circle in (x,y,0) plane where neutrons are generated.	0.1
yheight	m	Height of rectangle in (x,y,0) plane where neutrons are generated.	0
xwidth	m	Width of rectangle in (x,y,0) plane where neutrons are generated.	0
dist	m	Distance to target along z axis.	0
focus_xw	m	Width of target	.045
focus_yh	m	Height of target	.12
E0	meV	Mean energy of neutrons.	0
dE	meV	Energy half spread of neutrons (flat or gaussian sigma).	0
lambda0	AA	Mean wavelength of neutrons.	0
dlambda	AA	Wavelength half spread of neutrons.	0
flux	1/(s*cm**2*st*energy unit)	flux per energy unit, Angs or meV if flux=0, the source emits 1 in 4*PI whole space.	1
gauss	1	Gaussian (1) or Flat (0) energy/wavelength distribution	0
target_index	1	relative index of component to focus at, e.g. next is +1 this is used to compute 'dist' automatically.	+1

Monitors: Example PSD_monitor and L_monitor



Let’s do a very simple exercise on this:

Head on over to:

Exercise - Sources and Monitors on github

https://github.com/McStasMcXtrace/Schools/blob/master/2024/NECSA_October_2024/01_Monday_October_7th/02_McStas_sources_and_monitors/Exercise/README.md