

DTU Physics

# Sources and Monitors

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# 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  $\{x, y, z, v_x, v_y, v_z, t, s_x, s_y, s_z, p\}$  drawn from appropriate distributions.

EXAMPLE:

Neutrons from a uniform wavelength distribution emerging from a circular aperture.

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# Access the docs

## IMPORTANT:

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

<http://www.mcstas.org/documentation/manual/mcstas-2.5-components.pdf>

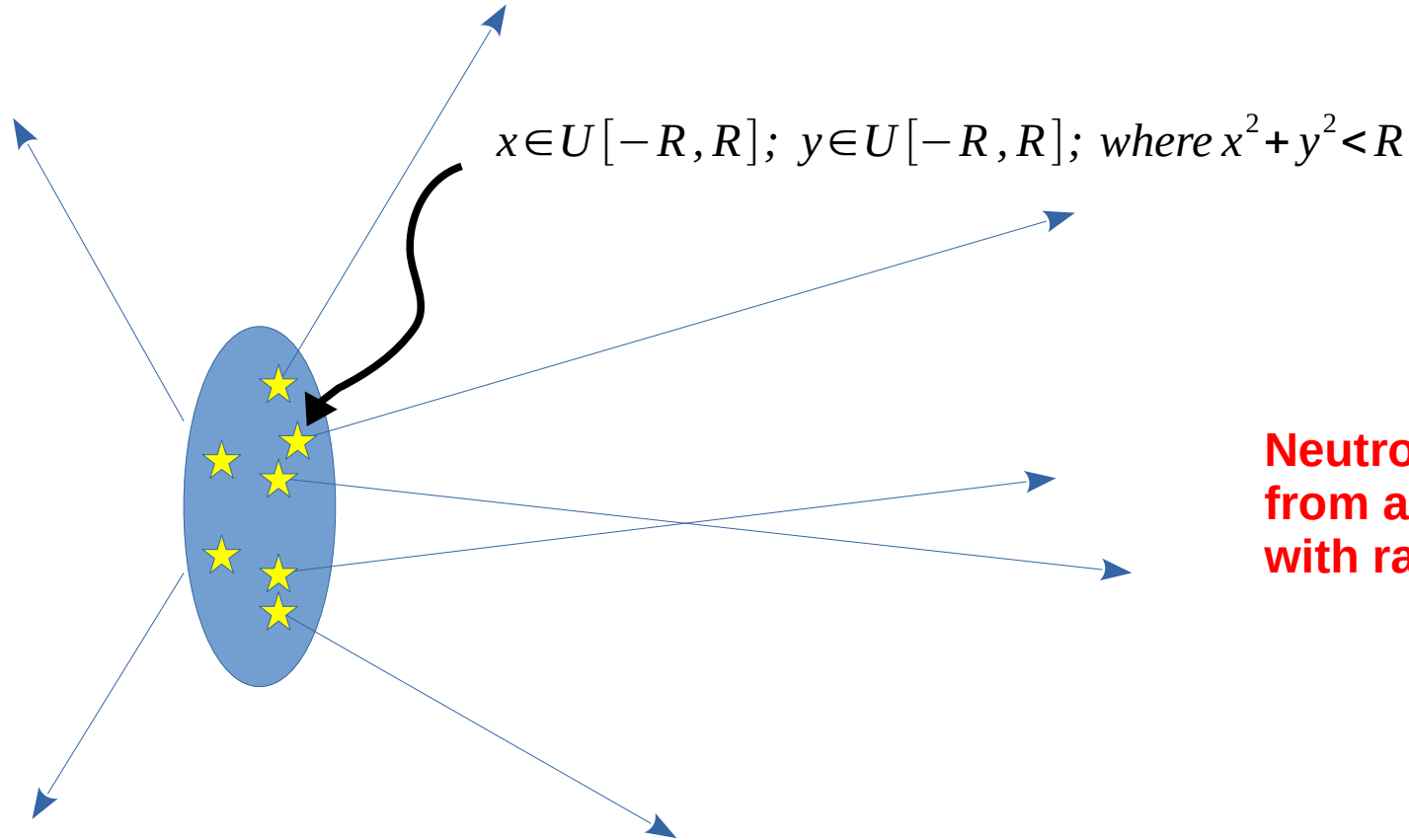
- also distributed with your McStas installation - `mcdoc -c`

The component documentation along with the command:

`“mcdoc <component_you_are_searching_for>”`

are your best friends when using McStas

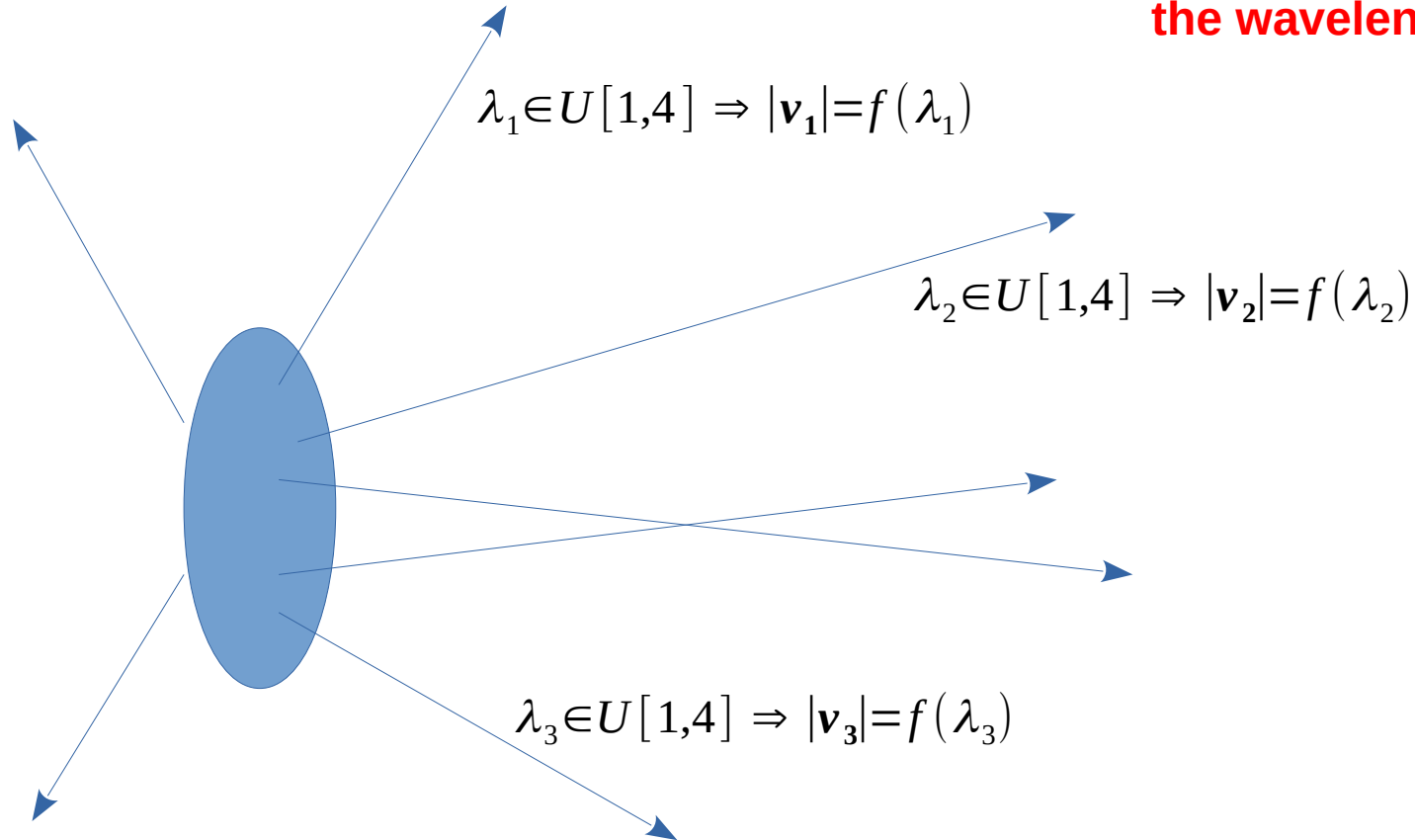
# Sources: Example 1



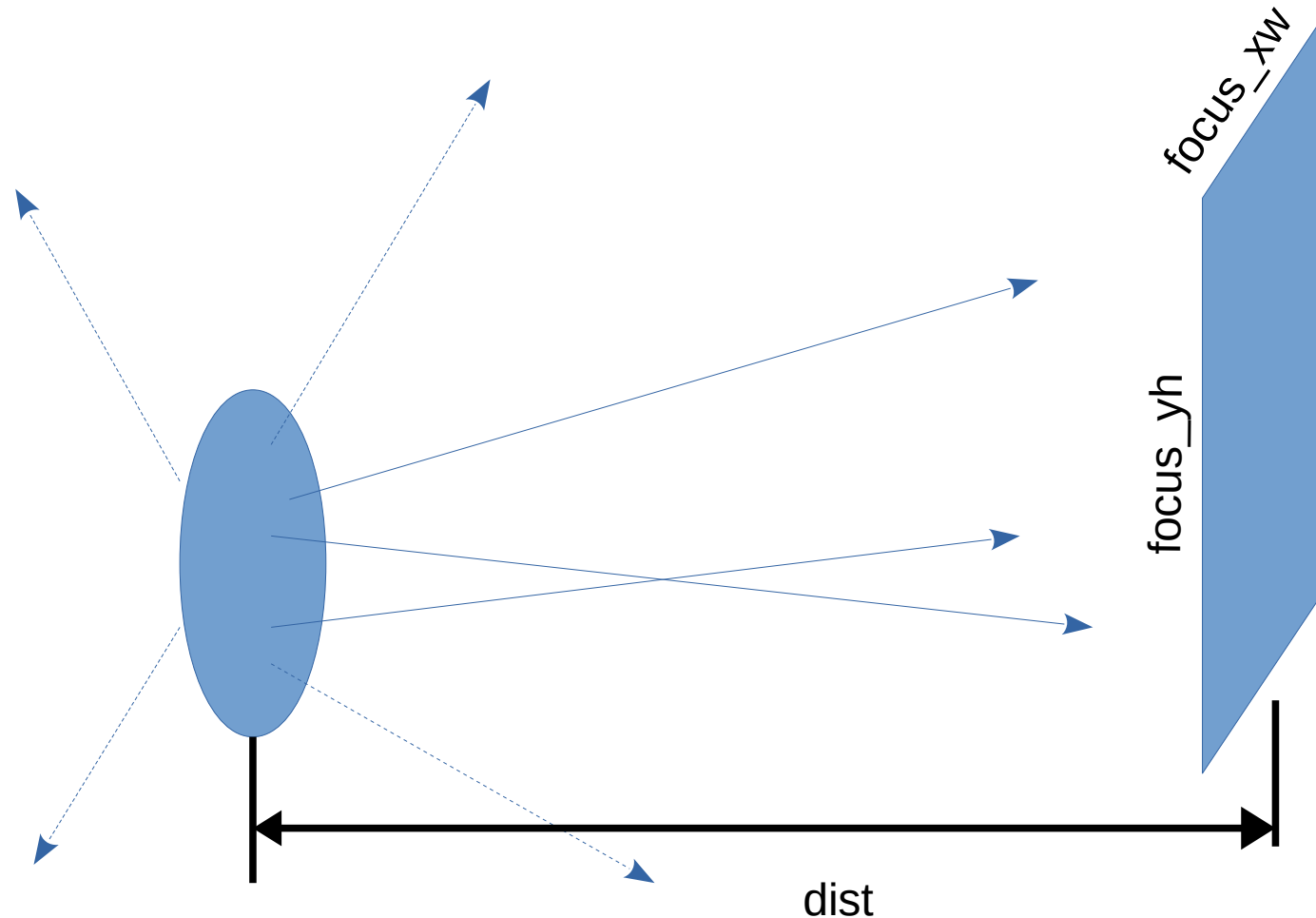
Neutron spatial coordinates are picked from a uniform distribution on a circle with radius  $R$ .

# Sources: Example 1

Length of the velocity vector encodes the wavelength



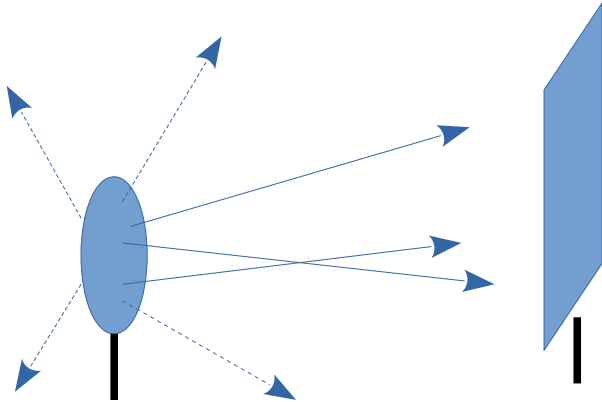
# Sources: Example 1



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

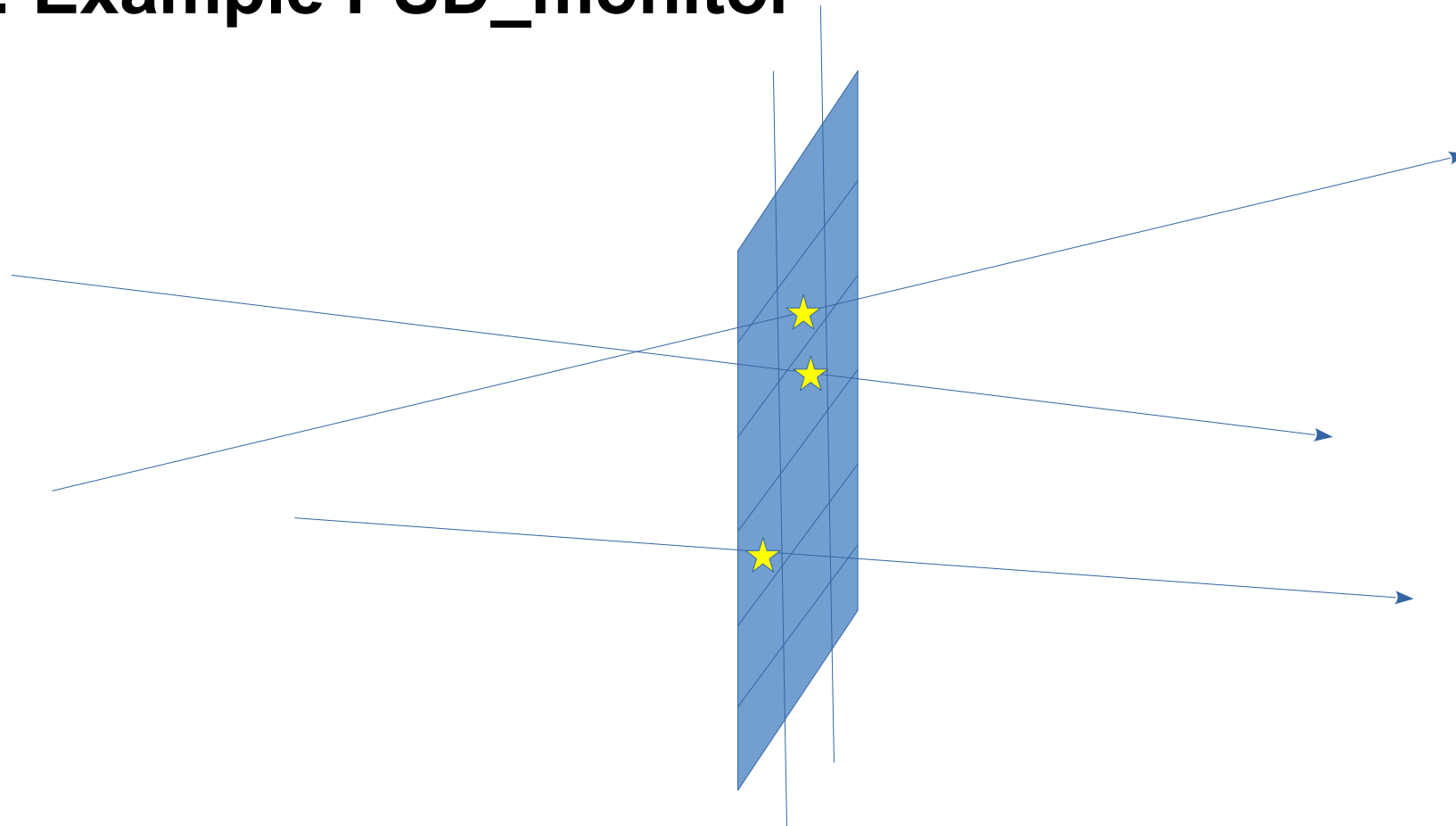
SIMULATIONS (McStas):

In McStas:

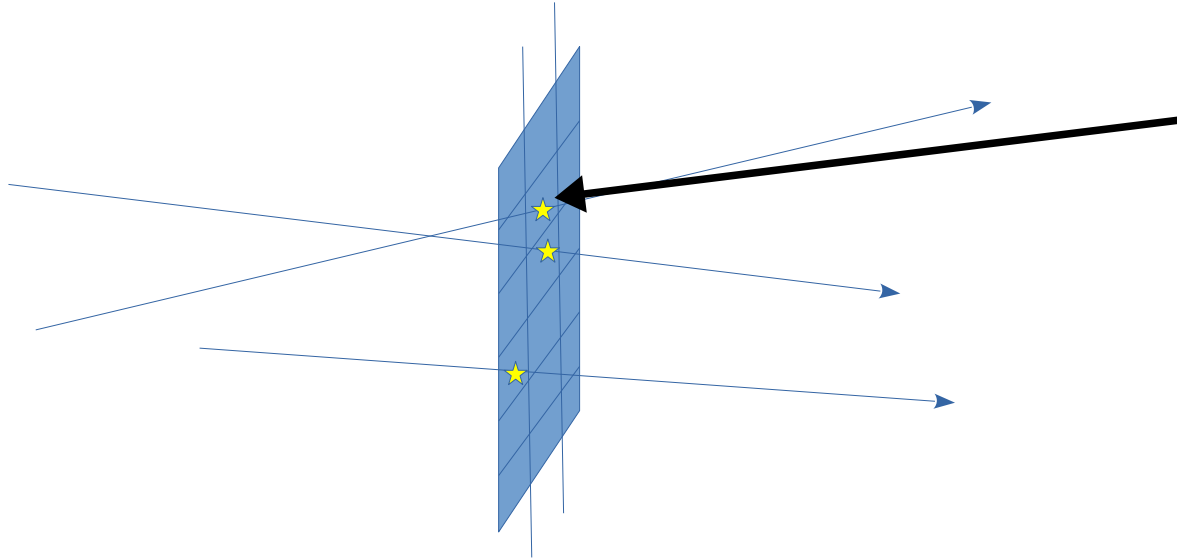
- We can program monitors and detectors to behave any way we like. We refer to both of those indistinguishably as 'monitors'.
- E.g. monitor with Efficiency =100% and Transparency=100%
- (With exception of PSD\_Detector that models a "physical" He<sup>3</sup> detector)



# Monitors: Example PSD\_monitor



# Monitors: Example PSD\_monitor



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

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

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

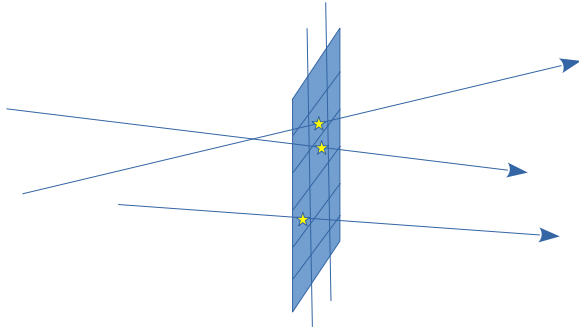
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# Monitors: Example PSD\_monitor and L\_monitor



...

TRACE

COMPONENT origin = Progress\_bar()

AT (0,0,0) ABSOLUTE

COMPONENT src = Source\_simple(  
radius=0.05, lambda0=2.5, dlambd=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



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# 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.

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# Source\_simple docs

Try “**mcdoc Source\_simple**”

or

( in GUI ) **Help** → **mcdoc Component Reference** → (In Webpage ) **Source\_simple**



McStas: Source\_simple - Mozilla Firefox

McStas: Source\_simple x +

file:///usr/share/mcstas/2.5/sources/Source\_simple.html

[ [Identification](#) | [Description](#) | [Input parameters](#) | [Output parameters](#) | [Links](#) ]

## The Source\_simple Component

A circular neutron source with flat energy spectrum and arbitrary flux

### Identification

- **Site:**
- **Author:** Kim Lefmann
- **Origin:** Risoe
- **Date:** October 30, 1997

### Description

The routine is a circular neutron source, which aims at a square target centered at the beam (in order to improve MC-acceptance rate). The angular divergence is then given by the dimensions of the target. The neutron energy is uniformly distributed between  $\lambda_{\text{min}}$  and  $\lambda_{\text{max}}$  or between  $E_{\text{min}}$  and  $E_{\text{max}}$ . The flux unit is specified in n/cm<sup>2</sup>/s/st/energy unit (meV or Angs).

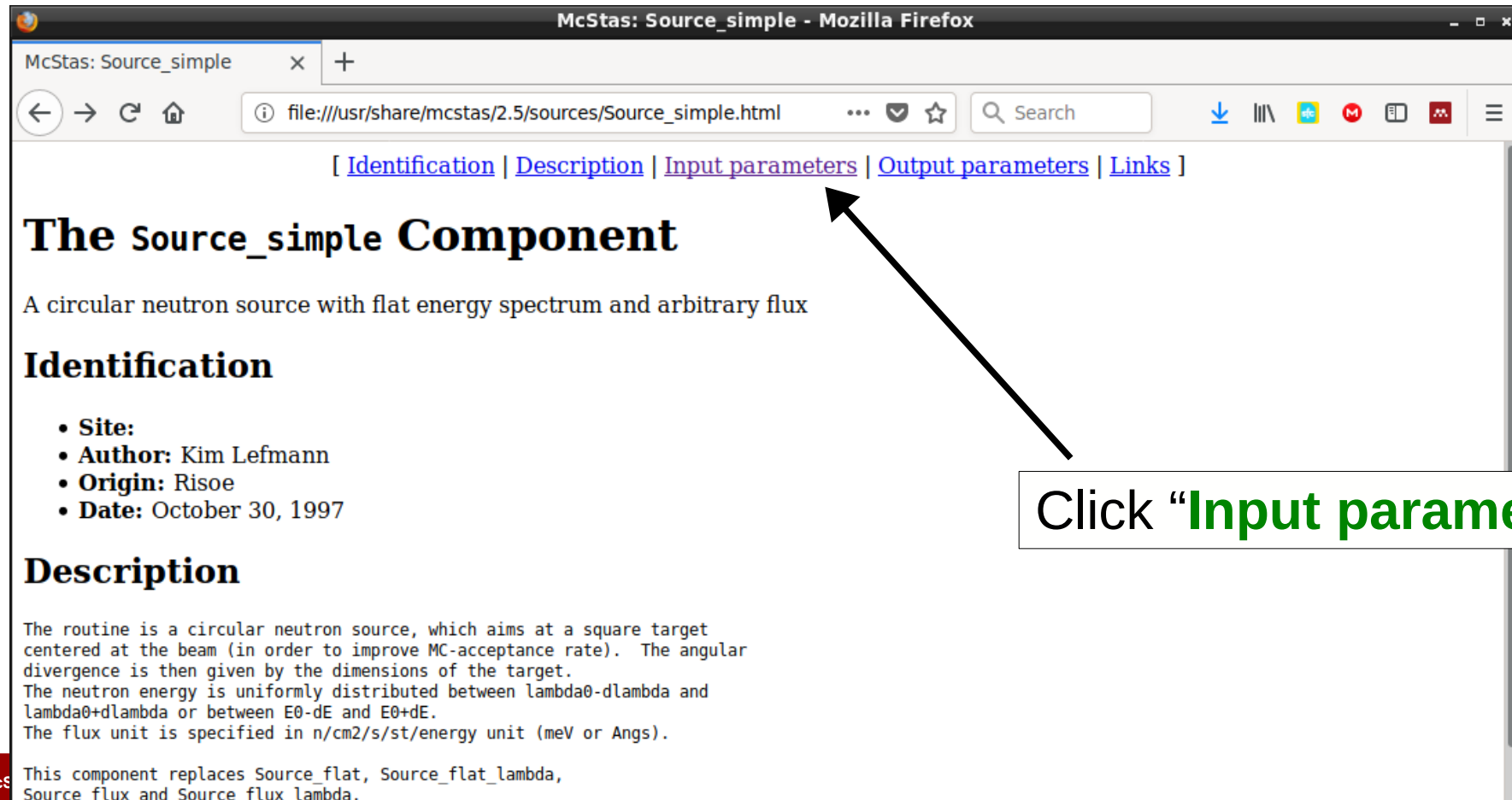
This component replaces Source\_flat, Source\_flat\_lambda, Source\_flux and Source\_flux\_lambda.

# Source\_simple docs

Try “**mcdoc Source\_simple**”

or

( in GUI ) **Help** → **mcdoc Component Reference** → (In Webpage ) **Source\_simple**



McStas: Source\_simple - Mozilla Firefox

file:///usr/share/mcstas/2.5/sources/Source\_simple.html

[ [Identification](#) | [Description](#) | [Input parameters](#) | [Output parameters](#) | [Links](#) ]

## The Source\_simple Component

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This component replaces Source\_flat, Source\_flat\_lambda, Source\_flux and Source\_flux\_lambda.

Click “**Input parameters**”

# Source\_simple docs

McStas: Source\_simple - Mozilla Firefox

McStas: Source\_simple

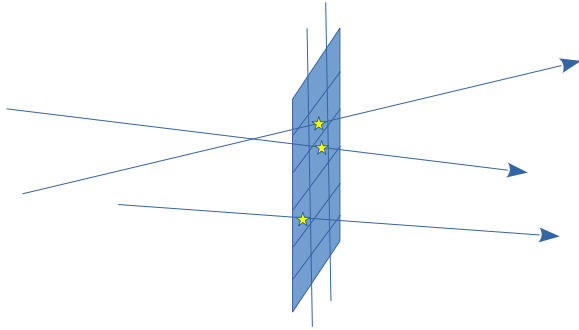
file:///usr/share/mcstas/2.5/sources/Source\_simple.html#

## 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 1 - Sources and Monitors on github

[https://github.com/McStasMcXtrace/Schools/tree/master/CSNS\\_March\\_2019/1\\_Monday\\_March\\_25th/2\\_Sources\\_and\\_Monitors](https://github.com/McStasMcXtrace/Schools/tree/master/CSNS_March_2019/1_Monday_March_25th/2_Sources_and_Monitors)