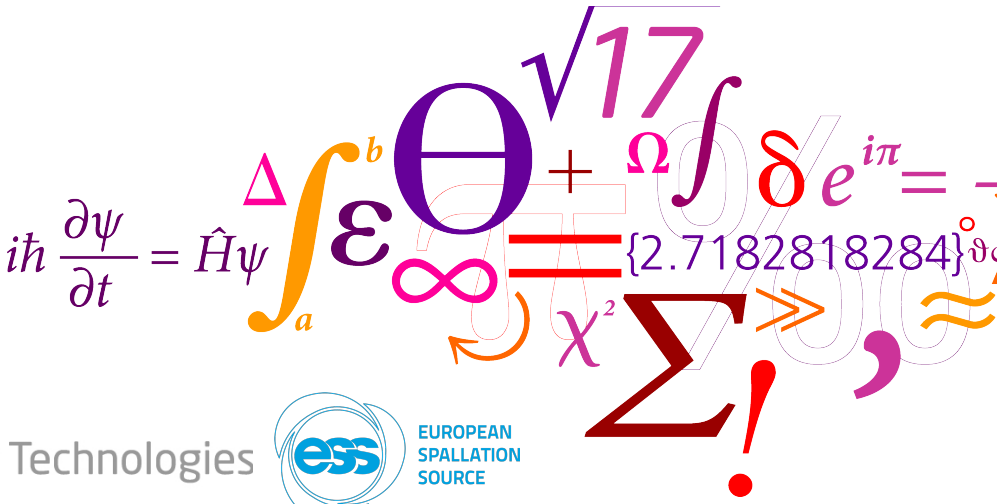
Next generation McStas ESS_butterfly moderator

Peter Willendrup, DTU Physics, ESS DMSC
Esben Klinkby, DTU Nutech, ESS Target Division



DTU Physics
Department of Physics

DTU Nutech
Center for Nuclear Technologies

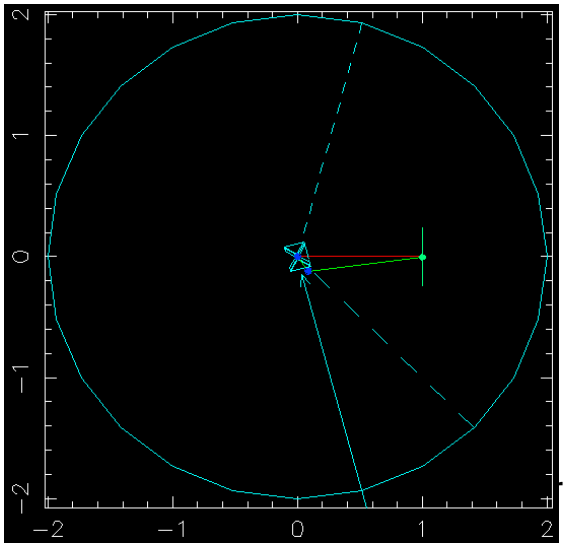
Issues with existing component "ESS_moderator"

» Component origin at centre of moderator assembly

» Backward compatibility options for 2001 "Mezei", TDR, pancake etc.

» "Complicated to use"

» Not fully up to date with
  » engineering reality
  » baseline performance



Input parameters

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

Name	Unit	Description
isleft	1	Fraction of thermal neutrons generated at the "left" moderator slab in case of "2013" or "2014"
Lmin	AA	Lower edge of wavelength distribution
Lmax	AA	Upper edge of wavelength distribution
cold_frac	1	Fraction of neutron statistics from cold source. It is implicitely assumed that supermirror allows each beamline to choose the desired fraction of cold and thermal neutrons (i.e. extreme idealization).
dist	m	Distance from source to focusing rectangle; at (0,0,dist)
focus_xw	m	Width of focusing rectangle
focus_yh	m	Height of focusing rectangle
target_index	1	relative index of component to focus at, e.g. next is +1 this is used to compute 'dist' automatically.
tmax_multiplier	1	Defined maximum emission time at moderator, tmax= tmax_multiplier * ESS_PULSE_DURATION. Only in combination with sourcedef="2013", "2014" or "2015"
yheight_c	m	Height of the cold source
yheight_t	m	Height of the thermal source
n_pulses	1	Number of pulses simulated. 0 and 1 creates one pulse. The integrated intensity is constant
acc_power	MW	Accelerator power in MW
beamport_angle	deg	Direction within the beamport sector (0 < angle < extraction_opening for 2014, -extraction_opening/2 < angle < extraction_opening/2 for 2015) to direct neutrons. For sourcedef="2015", the only allowed values are 5,15,...,55 degrees measured from the central point.
sourcedef	string	ESS source "database", values: "TDR", "2001", "2013", "2014", "2015"
xwidth_c	m	Width / arc-length opening of the cold source.
xwidth_t	m	Edge of thermal source
extraction_opening	deg	Width of extraction-area in degrees (60 or 120 degrees). 120 deg only in combination with sourcedef="2014" and "2015".

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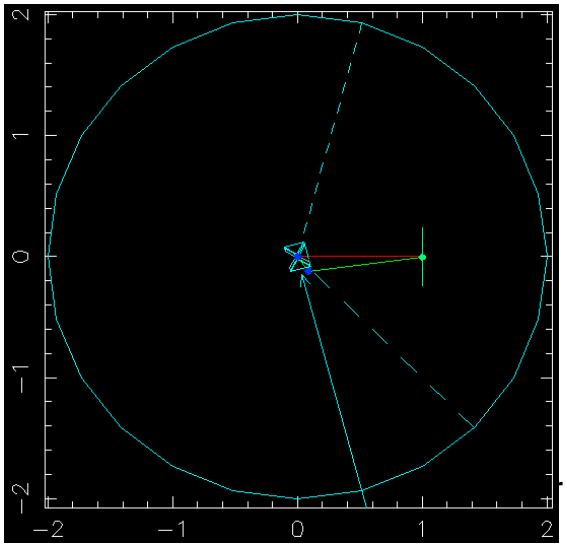


Reproducing "Butterfly" ESS brilliances using McStas
Peter Willendrup and Ken Andersen
(Distributed online at the **McStas share archives**)

ESS DMSC / DTU Physics 2015-12-18

This document is meant to give further clarity on the available ESS source parameterisations for use with McStas. We shall only consider the butterfly type brilliances, as this is the current ESS baseline. (For information on the older TDR and pancake brilliance milestones, please consult the document "**Reproducing ESS TDR and pancake brillances with McStas**").

As of today, a new revision of the ESS_moderator.comp is now officially available at the McStas share in versions for use with McStas 2.x and 1.12c through the archive

http://mcstas.org/download/share/ESS_moderator_December_2015.tgz

The component comes with a library of ESS source brilliances, each labeled:

- **2001**, legacy "Mezei moderators" from the original F. Mezei documents, rescaled to ESS TDR frequency, pulse-length and power.
- **TDR**, Mezei moderators, with a wavelength-dependent correction term to the cold flux, derived from 2012 MCNPX calculations by ESS neutronics group. Corrections calculated by K Lieutenant (Vitess) NOTE: uses the 2001 brilliance for the thermal moderator!
- **2013**, post-TDR update with non-Maxwellian cold spectrum, Troels Schoenfeldt, BEFORE the ESS pancake geometry was introduced.
- **2014** updated brilliance using formulation by Troels Schoenfeldt, including support for the "pancake", i.e. flat geometry and variation of the brilliance over the moderator surface.
- **2015** updated brilliance using formulation by Troels Schoenfeldt, including support for the "butterfly" moderator in 3 and 6cm height versions. This formulation further includes local variation of the brilliance over the moderator surface, and variation with selected beamport angle.

Of these parametrisations, only the **2015** is considered in detail within this document.

As for the earlier released version of ESS_moderator, selecting one of the above parameterisations defines **both** a cold and a thermal brightness, emitted from a dual-moderator surface with a central thermal moderator and cold wings. The fraction of statistics emitted from each of these can be selected through the cold_frac parameter.

3 and 6cm butterfly moderator:

New component “ESS_butterfly” features

» More realistic coordinate system - DONE

» Simpler interface - DONE

» Loss of backward compatibility - DONE

» Updated (performance-wise) wrt. engineering reality - work in progress 

New component “ESS_butterfly” features

» More realistic coordinate system - DONE in N,E sectors 

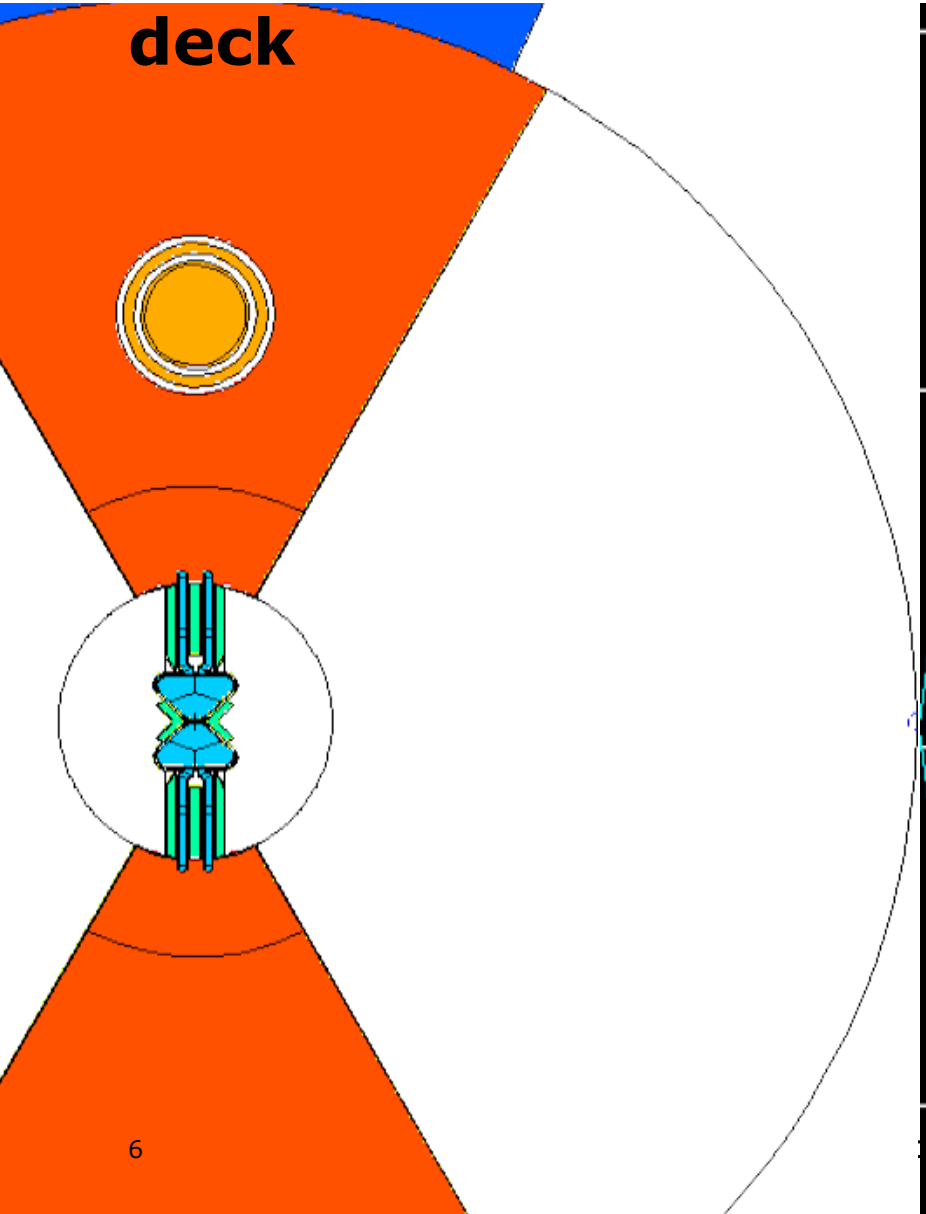
Until yesterday I was unaware of different separation angles across sectors…

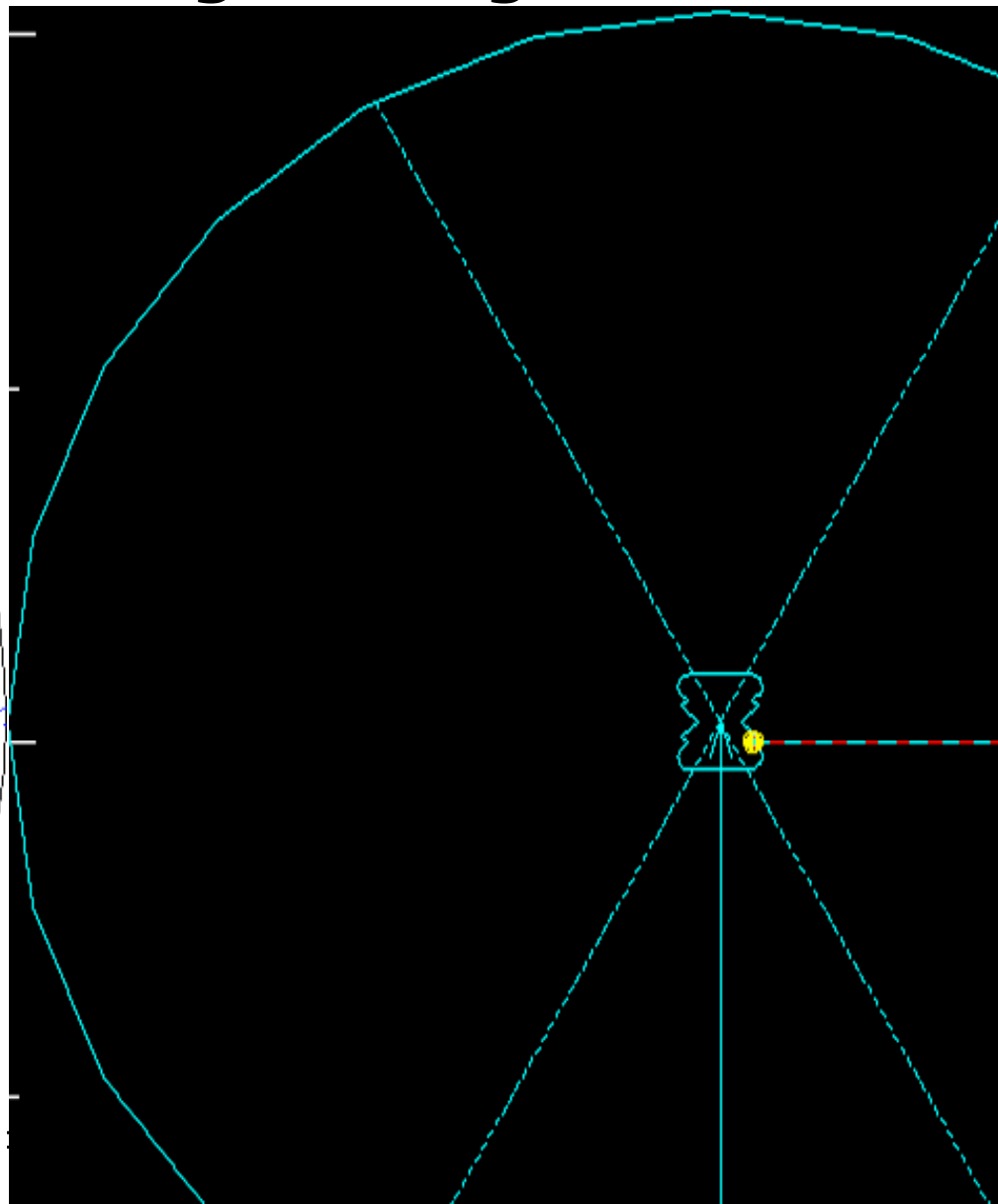
» Simpler interface - DONE 

» Loss of backward compatibility - DONE 

» Updated (performance-wise) wrt. engineering reality - work in progress 

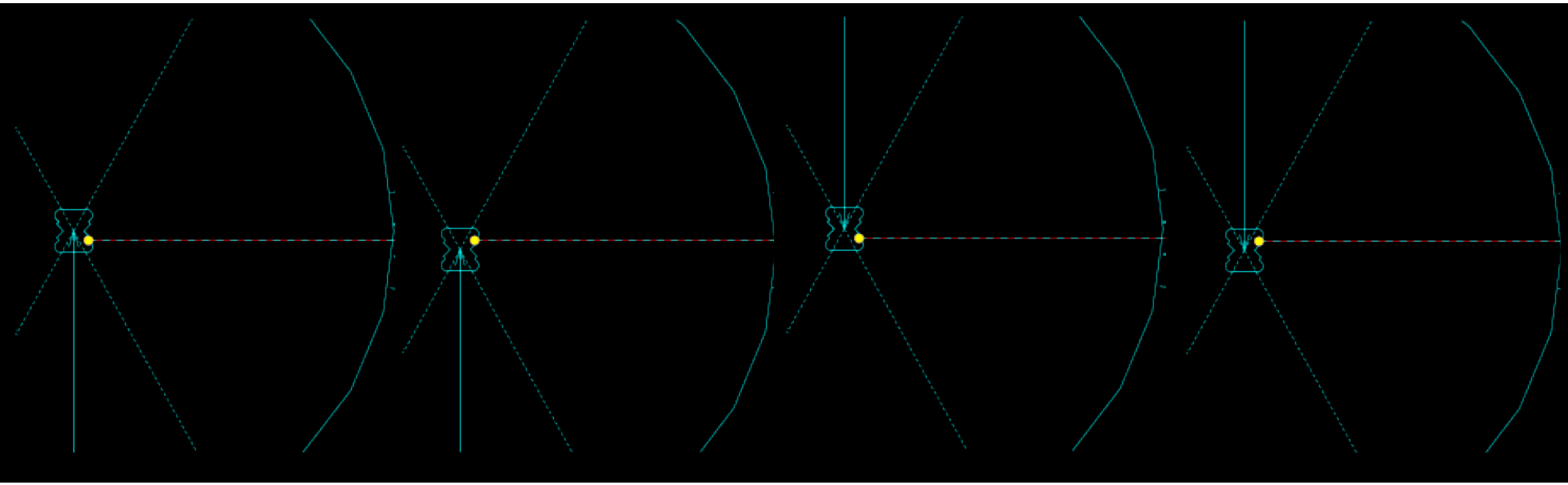
Geometries taken from “engineering” MCNP deck





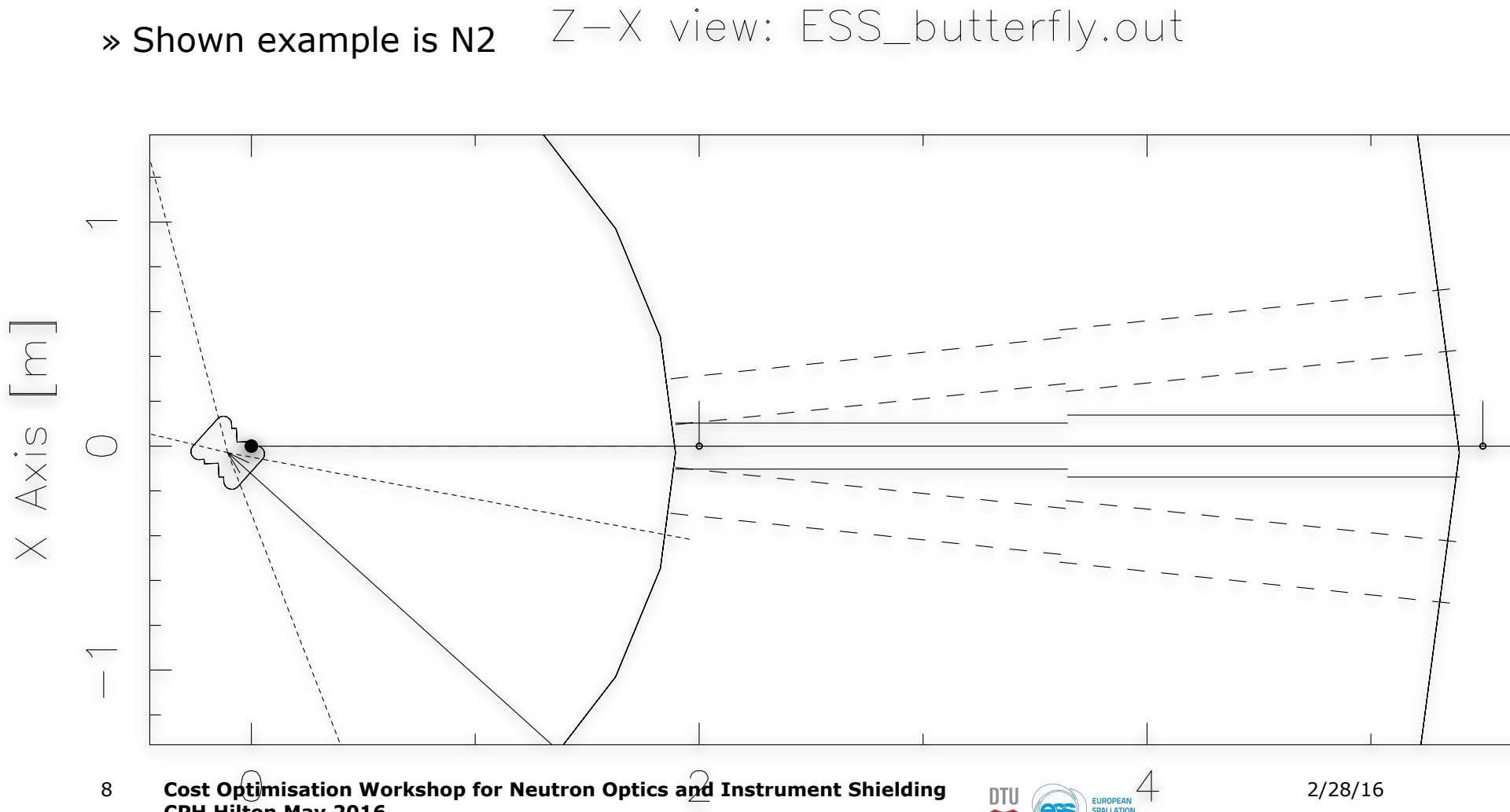
Places origin of component at relevant "Moderator Focus Coordinate System" location

North West South East



Draws various placement assistance objects, e.g. your beam plug and those of the neighbour(s)

» Shown example is N2



Has a simplified input parameter table

Input parameters

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

Name	Unit	Description	Default
sector	str	Defines the 'sector' of your instrument position. Valid values are "N","S","E" and "W"	"N"
beamline	1	Defines the 'beamline number' of your instrument position. Valid values are 1..11	1
yheight	m	Define the moderator height. Valid values are 0.03 m and 0.06 m	0.03
cold_frac	1	Define the statistical fraction of events emitted from the cold part of the moderator	0.5
target_index	1	Relative index of component to focus at, e.g. next is +1 this is used to compute 'dist' automatically.	0
dist	m	Distance from origin to focusing rectangle; at (0,0,dist) - alternatively use target_index\	0
focus_xw	m	Width of focusing rectangle	0
focus_yh	m	Height of focusing rectangle	0

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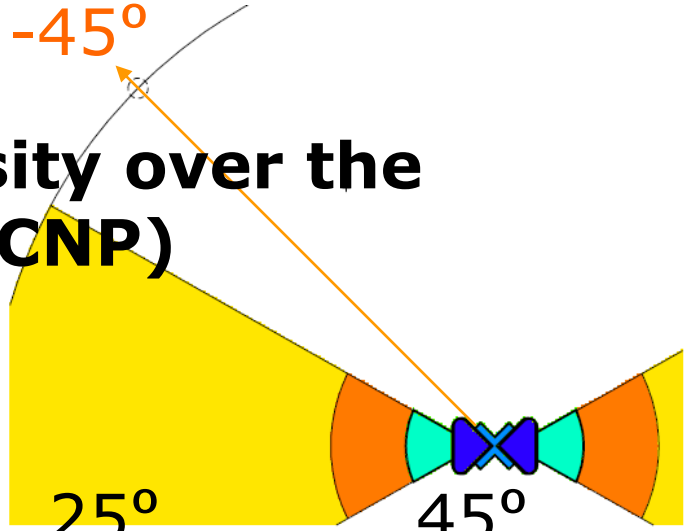
dist	m	Distance from origin to focusing rectangle; at (0,0,dist) - alternatively use target_index\	0
focus_xw	m	Width of focusing rectangle	0
focus_yh	m	Height of focusing rectangle	0

Optionally also:

performance	1	**Scalar "downscaling" of performance, for future inclusion of "engineering reality"**	1

- simple approach to future "performance hits"

Distribution of emission intensity over the butterfly moderator (Esben, MCNP)



-45° -25° -4° 25° 45°

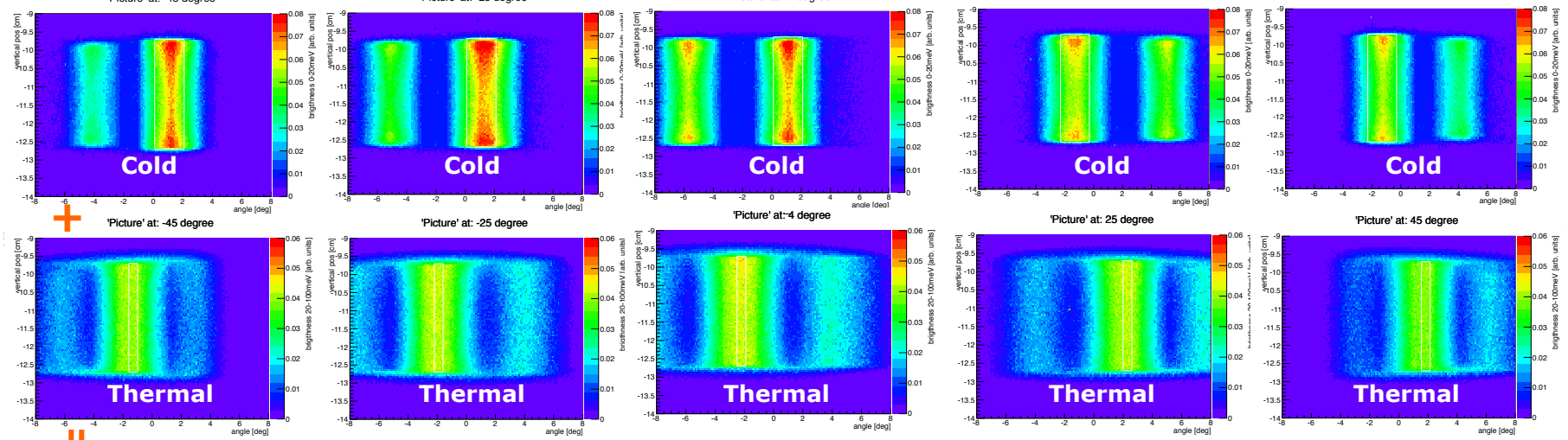


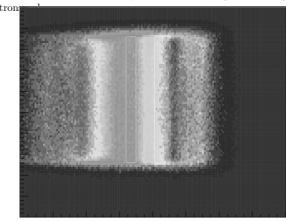
Figure 1.7: Neutron emission map as seen from an angle of −45 degree. Thermal neutrons only.

Figure 1.8: Neutron emission map as seen from an angle of −25 degree. Thermal neutrons only.

Figure 1.9: Neutron emission map as seen from an angle of −4 degree. Thermal neutrons only.

Figure 1.10: Neutron emission map as seen from an angle of 25 degree. Thermal neutrons only.

Figure 1.11: Neutron emission map as seen from an angle of 45 degree. Thermal neutrons only.



Disclaimer: From early 'butterfly' study design, does not take into account what will be engineered in practice!!

Release timescale

» ASAP - e.g. in ~ 1-3 weeks

» Not a full McStas release, but just update a "component" package -> **simple "install on top" approach**

» As usual, **will be announced** to mcstas-users, neutron list, nobugs list and to the science directorate ESS list

» For the spectra:

  » Depending on current MCNP-based performance investigation (**Esben**) we may decide to release the component with a "simple scalar performance loss" wrt. the previous ESS_moderator butterfly spectra.