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MCNP6 Source Primer

Release 1.0

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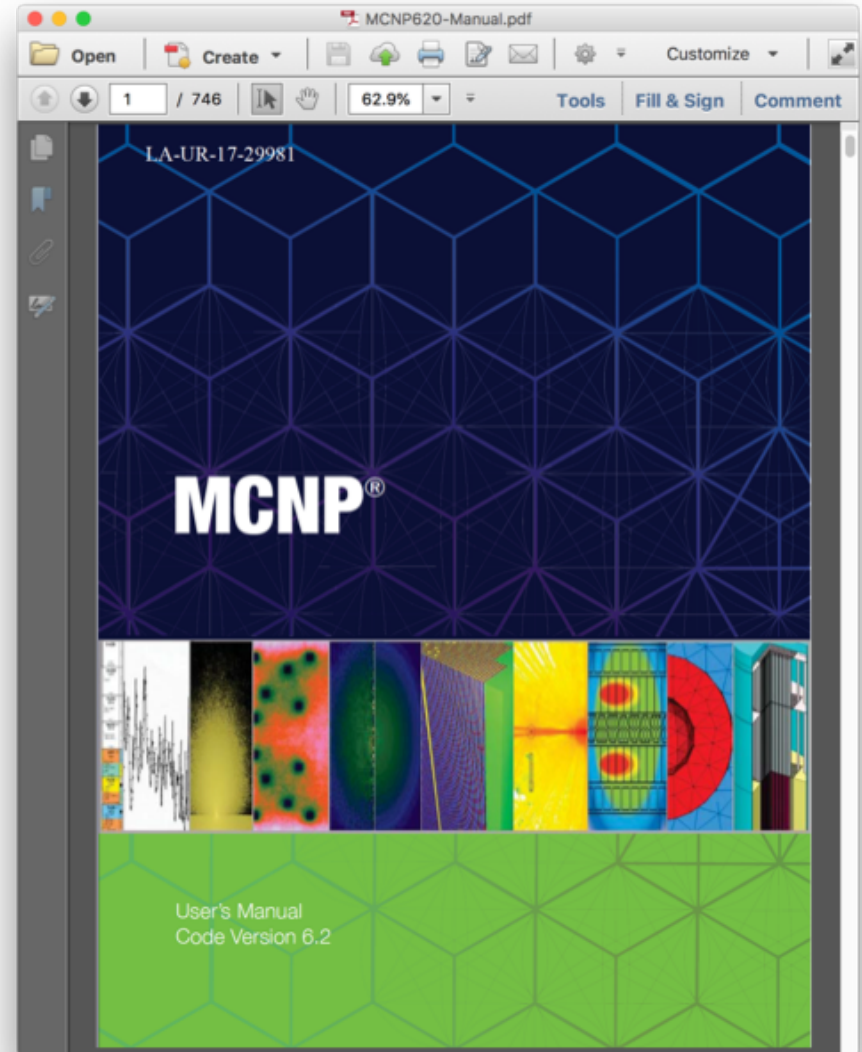
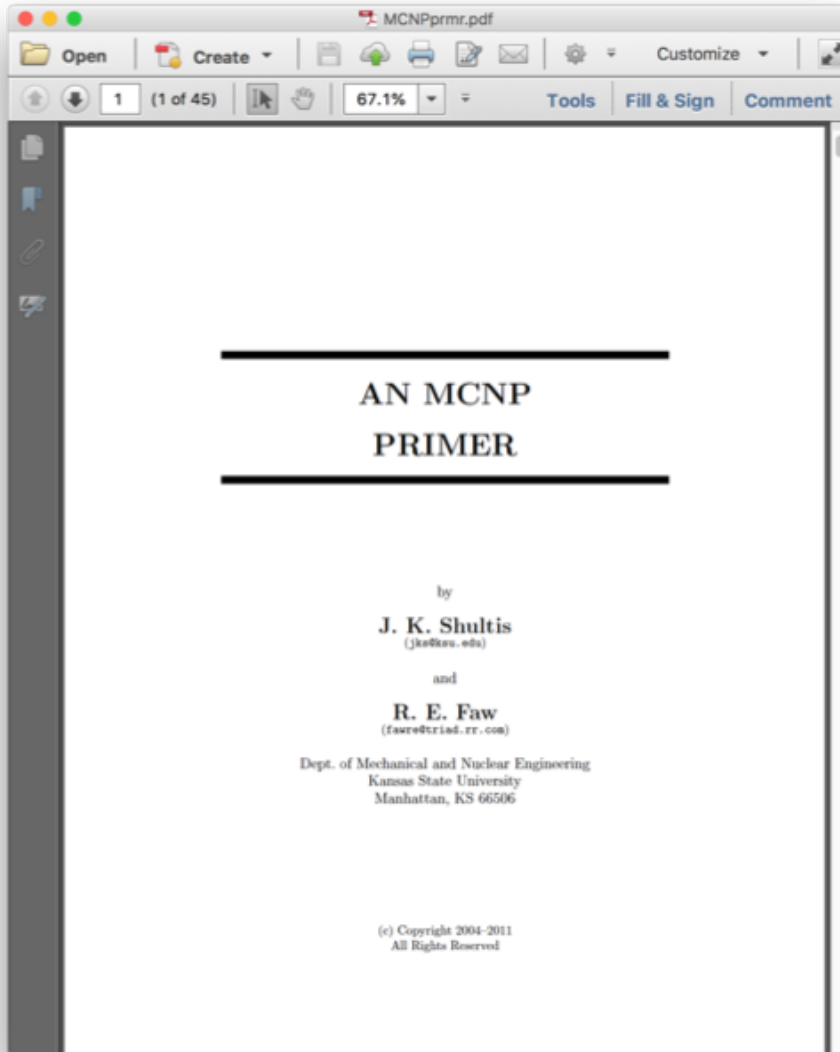
2018 ANS RPSD Topical Meeting
Santa Fe, NM

August 27, 2018



Background

- Where to find general radiation source definition “recipes” for MCNP?



Background

- The MCNP general source definition capabilities (SDEF) are extensive, rich, flexible, complex, etc.

3.3.4 Data Cards Related to Source Specification

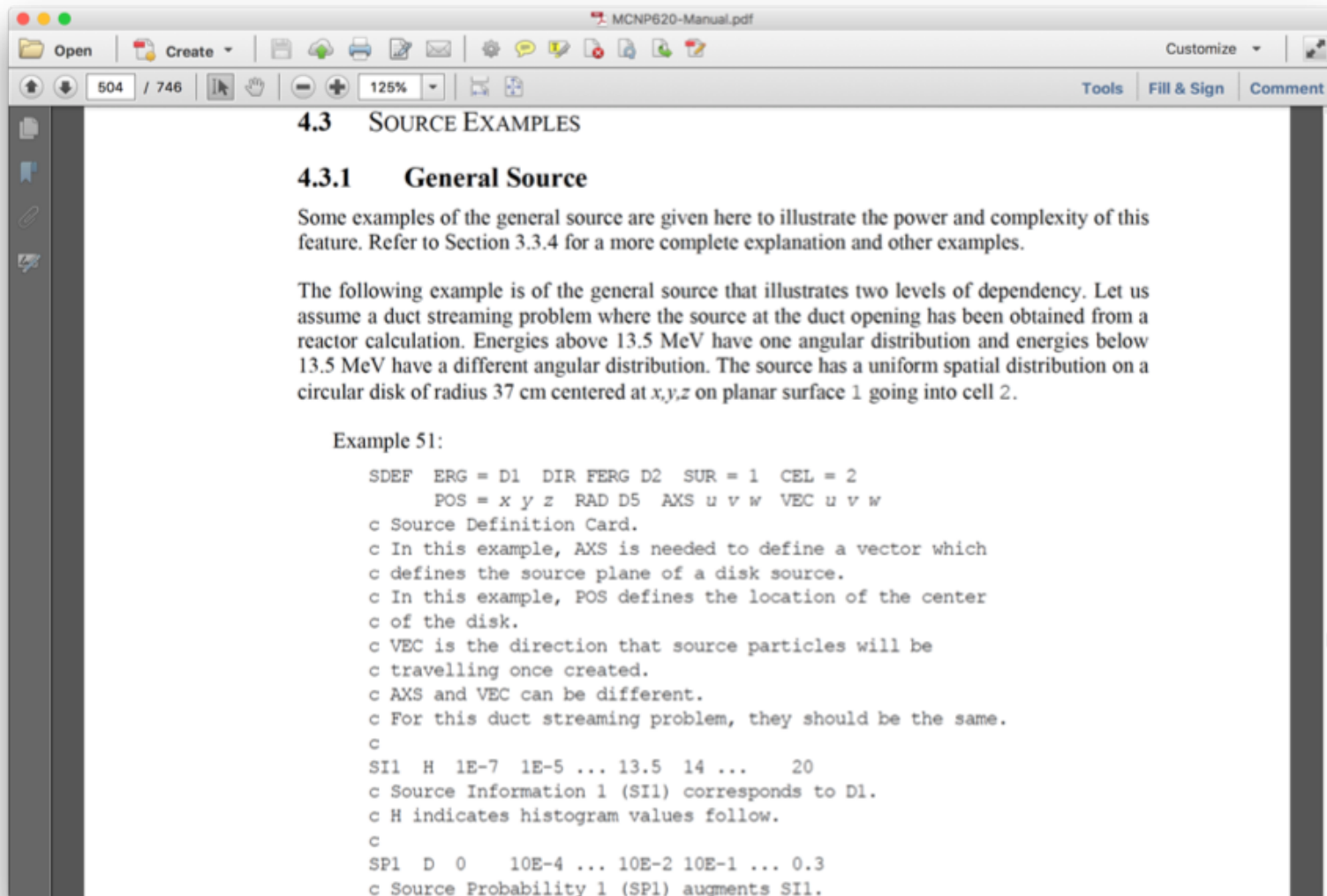
Every MCNP6 problem has one of four sources: general source (SDEF card), surface source (SSR card), criticality source (KCODE card), or user-supplied source. All can use source distribution functions, specified on SI, SP, SB, and DS cards.

INDEX OF SOURCE INPUT INFORMATION		
Mnemonic	Description	Section
SDEF	General Source Definition	3.3.4.1
SI	Source Information	3.3.4.2
SP	Source Probability	3.3.4.3
SB	Source Bias	3.3.4.4
DS	Dependent Source Distribution	3.3.4.5
SC	Source Comment	3.3.4.6
SSW	Surface Source Write	3.3.4.7
SSR	Surface Source Read	3.3.4.8
KCODE	Criticality Source	3.3.4.9
KSRC	Criticality Source Points	3.3.4.10
KOPTS	Criticality Calculations Options	3.3.4.11
HSRC	Shannon Entropy Source Distribution	3.3.4.12
BURN	Depletion/Burnup	3.3.4.13
SOURCE and SRCDX	Subroutines SOURCE and SRCDX	3.3.4.13

3.3.4.1 SDEF GENERAL SOURCE DEFINITION

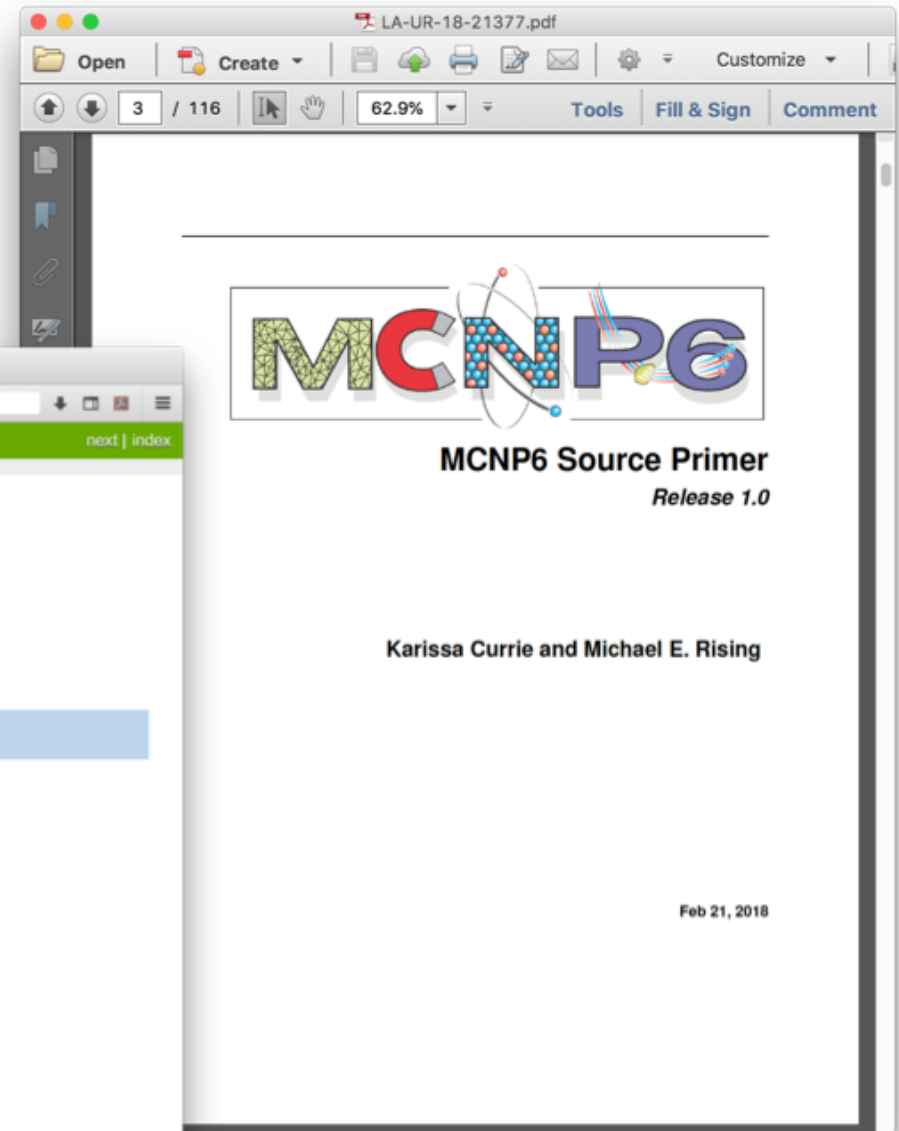
Background

- Many examples exist in many reference locations (Shultis & Faw, MCNP6.2 Manual, etc.)



New Source Primer Collection of Many Source Examples

- PDF and HTML documents available
 - Input files collected together
 - Python sphinx used to create documentation



New Source Primer Collection of Many Source Examples

- Basic, Intermediate and Advanced Source Examples with full MCNP input files

The image displays two screenshots of the MCNP Source Primer 0.1 documentation website. The left screenshot shows the 'Advanced Sources' page, which includes a navigation menu on the left and an MCNP input file for a Cs-137 example. The right screenshot shows the 'Surface Source Write/Read' page, which includes an example of a Cs-137 photon source in a Tungsten shell creating a beam that strikes a Lead target.

MCNP6 Input File (Left Screenshot):

```

MCNP6 Input File
Cs-137 example
c
c Cell Cards
c
10 0 -1 IMP:P=1
20 0 +1 -2 +3 -4 IMP:P=1
30 100 -19.25 +1 -2 -3 -4 IMP:P=1
40 100 -19.25 +1 -2 +4 IMP:P=1
50 200 -7.874 -6 IMP:P=1
60 0 -5 +2 -9 IMP:P=1
70 0 +5 +6 -9 IMP:P=1
99 0 +9 IMP:P=0

c
c Surface Cards
c
1 SO 5
2 SO 10
3 PZ 0
4 CZ 0.5
5 PZ 12.5
6 RPP -10 10 -10 10 15 18
9 SO 50

c
c Data Cards
c
MODE P
NPS 1e6
c
SDEF PAR=P ERG=0.662
c
c Materials
c
M100 74184 1.0
M200 26056 1.0
c
FMESH4:P GEOM=XYZ ORIGIN=-20 -20 -30
IMESH=20 IINTS=100
JMESH=20 JINTS=100
KMESH=30 KINTS=150
OUT=NONE
  
```

MCNP6 Input File (Right Screenshot):

```

MCNP6 Input File
Cs-137 example
c
c Cell Cards
c
10 0 -1 IMP:P=1
20 0 +1 -2 +3 -4 IMP:P=1
30 100 -19.25 +1 -2 -3 -4 IMP:P=1
40 100 -19.25 +1 -2 +4 IMP:P=1
50 200 -7.874 -6 IMP:P=1
60 0 -5 +2 -9 IMP:P=1
70 0 +5 +6 -9 IMP:P=1
99 0 +9 IMP:P=0

c
c Surface Cards
c
1 SO 5
2 SO 10
3 PZ 0
4 CZ 0.5
  
```


New Source Primer Collection of Many Source Examples

- Included are tallies to demonstrate the behavior of the various sources

Advanced Sources -- MCNP So... x

file:///Users/mrising/Work/Projects/Active/Students/KCurrie/Primer/build/html/examples/advanced.html

JMESH=20 JINTS=100
KMESH=30 KINTS=150
OUT=NONE

Below is the plot of the photon flux from the source throughout the geometry including reflecting off the exterior Lead target.

10/18/17 13:05:08
Cs-137 example

```

probid = 10/18/17 13:04:49
basis: XB
( 0.000000, 0.000000, 1.000000)
( 1.000000, 0.000000, 0.000000)
origin:
( 0.00, 0.00, 0.00)
extent = ( 30.00, 30.00)

Mesh Tally 4
Nps 1000000
range = adr=31.Lgrd
dump 2
  
```

MCNP6 Plotting Commands

```

fmesh 4
file
end
end
  
```

Surface Source Write

Example using the surface source write (SSW) option for Cs-137 exiting Tungsten shell

Summary

- **40+ Source Examples**
- **MCNP Input Files**
 - Geometry, sources and tallies defined
 - Plotting (com-file) commands given
- **Basics**
 - Simple, independent PDFs
- **Intermediate**
 - Dependent variables
 - Embedded distributions
 - Cookie cutter cells
- **Advanced**
 - Surface source read/write
 - Repeated structure lattices



MCNP6 General Source Primer

- **What is this document?**
 - *Introduction*
 - *Sources in MCNP*
 - *Tallies in MCNP*
 - *Example Source*
 - **Helpful Links**
- **Basic Sources**
 - *Basic Distributions and Built-in Functions*
 - *Positional Sources*
 - *Directional Sources*
 - *Multiple Independent Distributions*
- **Intermediate Sources**
 - *Dependent Variables*
 - *Embedded Functions*
 - *Cookie Cutter Cell*
- **Advanced Sources**
 - *Surface Source Write/Read*
 - *Repeated Structure Lattices*
- **Known Source Errors**
 - *Fatal Error Given*
 - *No Fatal Error Given*

Questions?