latticeadaptor Documentation

Release 0.3.9

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CONTENTS:

CHAPTER

ONE

LATTICEADAPTOR

This package is used to convert a table of accelerator lattice elements and their arguments to various accelerator lattice formats. Currently covered are:

- MadX (Sequence and Line format)
- Elegant
- Tracy
- Free software: MIT license
- Documentation: https://latticeadaptor.readthedocs.io.

1.1 Features

- Fast lattice comparison by plotting element locations against eachother.
- Fast settings compare by comparing magnet settings.
- Quick twiss plotting.
- Quick lattice element plotting.
- Conversion from table to standard formats.

1.2 Tutorial on Binder

https://mybinder.org/v2/gh/tomerten/latticeadaptor/main?filepath=docs%2Fnotebook%2FTutorial.ipynb

CHAPTER

TWO

INSTALLATION

2.1 Stable release

To install latticeadaptor, run this command in your terminal:

```
$ pip install latticeadaptor
```

This is the preferred method to install latticeadaptor, as it will always install the most recent stable release.

If you don't have pip installed, this Python installation guide can guide you through the process.

2.2 From sources

The sources for latticeadaptor can be downloaded from the Github repo.

You can either clone the public repository:

```
$ git clone git://github.com/tomerten/latticeadaptor
```

Or download the tarball:

```
$ curl  -OL https://github.com/tomerten/latticeadaptor/tarball/master
```

Once you have a copy of the source, you can install it with:

```
$ python setup.py install
```

CHAPTER

THREE

API

3.1 Package latticeadaptor

Top-level package for latticeadaptor.

latticeadaptor.**hello**(*who='world'*)
'Hello world' method.

Parameters **who** (*str*) – whom to say hello to

Returns a string

3.2 Module latticeadaptor.lark

A module containing the madx lark file.

3.3 Module latticeadaptor.mappings

A module containing mappings between elements and attributes for the different lattice formats used: * MadX * Elegant * Tracy

CHAPTER

FOUR

DEVELOPMENT

- Tom Mertens

CHAPTER

FIVE

HISTORY

5.1 v0.0.0 (2021-05-05)

5.2 v0.3.7 (2021-07-06) : correction to calculate lattice lengths when using madx sequence files.

5.3 v0.3.8 (2021-07-07) : update dependency version numbers

5.4 v0.3.9 (2021-07-07) : update dependency version numbers lattice-json and latticeconstructor (updated elegant mapping)

This package was created with package et-micc,

CHAPTER

SIX

TUTORIAL

[1]:
```
from latticeadaptor.core import LatticeAdaptor
```

6.1 Properties

[2]:
```
la = LatticeAdaptor()
la.__dict__
```

[2]:
```
{'history': <queue.LifoQueue at 0x7f8317468b50>,
 'name': None,
 'len': 0.0,
 '_table': None,
 'filename': None,
 'inputstr': None,
 'builder': <latticeconstructor.core.LatticeBuilderLine at 0x7f8317468940>}
```

6.2 Methods

[3]:
```
from types import FunctionType
[x for x, y in LatticeAdaptor.__dict__.items() if (type(y) == FunctionType) and not x.
↪startswith('_')]
```

[3]:
```
['load_from_file',
 'load_from_string',
 'parse_table_to_madx_sequence_string',
 'parse_table_to_madx_sequence_file',
 'parse_table_to_elegant_string',
 'parse_table_to_elegant_file',
 'parse_table_to_tracy_string',
 'parse_table_to_tracy_file',
 'madx_sequence_add_start_end_marker_string',
 'parse_table_to_madx_install_str',
 'parse_table_to_madx_remove_str',
 'madx_sequence_save_string',
 'add_drifts',
 'parse_table_to_madx_line_string',
 'parse_table_to_madx_line_file',
```

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```
 'get_quad_strengths',
 'get_sext_strengths',
 'load_strengths_to_table',
 'compare_seq_center_positions',
 'update_table',
 'undo']
```

6.3 Load lattice from string

Lattices can be loaded from string or from file. Currently two lattice formats are implemented: - lte - madx (both sequence and line def)

[4]:
```
latticestring = """
QF : QUADRUPOLE, L := 0.50 , K1 :=  1.00;
QD : QUADRUPOLE, L := 1.00 , K1 := -1.00;
D1 : DRIFT, L := 1.00;
D2 : DRIFT, L := 1.00;

FODO: SEQUENCE, L=4.00;
QF, at = 0.25;
D1, at = 1.00;
QD, at = 2.00;
D2, at = 3.00;
QF, at = 3.75;
ENDSEQUENCE;
"""
la1 = LatticeAdaptor()
la1.load_from_string(latticestring, ftype='madx')
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[5]:
```
la1.name, la1.len
```

[5]:
```
('FODO', 4.0)
```

[6]:
```
la1.table
```

[6]:

	family	L	K1	name	at
0	QUADRUPOLE	0.5	1.0	QF	0.25
1	DRIFT	1.0	NaN	D1	1.00
2	QUADRUPOLE	1.0	-1.0	QD	2.00
3	DRIFT	1.0	NaN	D2	3.00
4	QUADRUPOLE	0.5	1.0	QF	3.75

6.4 Load lattice from file

[7]:
```
# first write it to file
la1.parse_table_to_madx_sequence_file('lattice.seq')

# check if written ok
with open('lattice.seq','r') as f:
    dat = f.read()

print(dat)
```

```
QF              : QUADRUPOLE  , L:=0.5, K1:=1.0;
D1              : DRIFT       , L:=1.0;
QD              : QUADRUPOLE  , L:=1.0, K1:=-1.0;
D2              : DRIFT       , L:=1.0;
FODO: SEQUENCE, L=4.0;
QF         , at =     0.250000;
D1         , at =     1.000000;
QD         , at =     2.000000;
D2         , at =     3.000000;
QF         , at =     3.750000;
ENDSEQUENCE;
```

[8]:
```
la3 = LatticeAdaptor()
la3.load_from_file('lattice.seq',ftype='madx')
la3.table
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[8]:

	family	L	K1	name	at
0	QUADRUPOLE	0.5	1.0	QF	0.25
1	DRIFT	1.0	NaN	D1	1.00
2	QUADRUPOLE	1.0	-1.0	QD	2.00
3	DRIFT	1.0	NaN	D2	3.00
4	QUADRUPOLE	0.5	1.0	QF	3.75

6.5 Create lattice manually

Lattice can also be created manually by defining: - lattice name - lattice length - lattice table as data frame

[9]:
```
import pandas as pd

# create manually
latticename = 'FODO'
latticelen  = 4.00
latticetable = pd.DataFrame([
    {'name': 'QF','pos': 0.25,'family': 'QUADRUPOLE','L': 0.5,'K1': 1.0,'ANGLE': 0.0,'at
↪': 0.25},
    {'name': 'D1','pos': 1.0,'family': 'DRIFT','L': 1.0,'at': 1.0},
    {'name': 'QD','pos': 2.0,'family': 'QUADRUPOLE','L': 1.0,'K1': -1.0,'at': 2.0},
    {'name': 'D2','pos': 3.0,'family': 'DRIFT','L': 1.0,'at': 3.0},
    {'name': 'QF','pos': 3.75,'family': 'QUADRUPOLE','L': 0.5,'K1': 1.0,'ANGLE': 0.0,'at
↪': 3.75}
```

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```
    ])

# uplaod it to the latticeadaptor object
la2 = LatticeAdaptor()
la2.name  = latticename
la2.len   = latticelen
la2.table = latticetable

la2.table
```

[9]:

	name	pos	family	L	K1	ANGLE	at
0	QF	0.25	QUADRUPOLE	0.5	1.0	0.0	0.25
1	D1	1.00	DRIFT	1.0	NaN	NaN	1.00
2	QD	2.00	QUADRUPOLE	1.0	-1.0	NaN	2.00
3	D2	3.00	DRIFT	1.0	NaN	NaN	3.00
4	QF	3.75	QUADRUPOLE	0.5	1.0	0.0	3.75

6.6 Convert table to lattice format

6.6.1 MADX Sequence

[10]:
```
print(la1.parse_table_to_madx_sequence_string())
```

```
QF              : QUADRUPOLE  , L:=0.5, K1:=1.0;
D1              : DRIFT       , L:=1.0;
QD              : QUADRUPOLE  , L:=1.0, K1:=-1.0;
D2              : DRIFT       , L:=1.0;
FODO: SEQUENCE, L=4.0;
QF         , at =     0.250000;
D1         , at =     1.000000;
QD         , at =     2.000000;
D2         , at =     3.000000;
QF         , at =     3.750000;
ENDSEQUENCE;
```

[11]:
```
print(la2.parse_table_to_madx_sequence_string())
```

```
QF              : QUADRUPOLE  , L:=0.5, K1:=1.0, ;
D1              : DRIFT       , L:=1.0;
QD              : QUADRUPOLE  , L:=1.0, K1:=-1.0;
D2              : DRIFT       , L:=1.0;
FODO: SEQUENCE, L=4.0;
QF         , at =     0.250000;
D1         , at =     1.000000;
QD         , at =     2.000000;
D2         , at =     3.000000;
QF         , at =     3.750000;
ENDSEQUENCE;
```

[12]:
```
#save to file
la1.parse_table_to_madx_sequence_file('lattice.seq')
```

6.6.2 MADX Line

[13]:
```
print(la1.parse_table_to_madx_sequence_string())
```

```
QF               : QUADRUPOLE  , L:=0.5, K1:=1.0;
D1               : DRIFT       , L:=1.0;
QD               : QUADRUPOLE  , L:=1.0, K1:=-1.0;
D2               : DRIFT       , L:=1.0;
FODO: SEQUENCE, L=4.0;
QF          , at =     0.250000;
D1          , at =     1.000000;
QD          , at =     2.000000;
D2          , at =     3.000000;
QF          , at =     3.750000;
ENDSEQUENCE;
```

[14]:
```
la1.parse_table_to_madx_line_file('lattice.madx')
with open('lattice.madx','r') as f:
    dat = f.read()
print(dat)
```

```
QF               : QUADRUPOLE  , L:=0.5, K1:=1.0;
D1               : DRIFT       , L:=1.0;
QD               : QUADRUPOLE  , L:=1.0, K1:=-1.0;
D2               : DRIFT       , L:=1.0;


FODO: LINE=(QF,D1,QD,D2,QF);
```

[15]:
```
 latticestring = """
QF : QUADRUPOLE, L := 0.50 , K1 :=  1.00;
QD : QUADRUPOLE, L := 1.00 , K1 := -1.00;
D1 : DRIFT, L := 1.00;
D2 : DRIFT, L := 1.00;

FODO: SEQUENCE, L=4.00;
QF, at = 0.25;
QD, at = 2.00;
QF, at = 3.75;
ENDSEQUENCE;
"""
la4 = LatticeAdaptor()
la4.load_from_string(latticestring, ftype='madx')
la4.table
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[15]:

	family	L	K1	name	at
0	QUADRUPOLE	0.5	1.0	QF	0.25
1	QUADRUPOLE	1.0	-1.0	QD	2.00
2	QUADRUPOLE	0.5	1.0	QF	3.75

[16]:
```
la4.parse_table_to_madx_line_file('lattice.madx')
with open('lattice.madx','r') as f:
```

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```
    dat = f.read()
print(dat)
```

```
QF               : QUADRUPOLE  , L:=0.5, K1:=1.0;
D1               : DRIFT       , L:=1.0;
QD               : QUADRUPOLE  , L:=1.0, K1:=-1.0;
D2               : DRIFT       , L:=1.0;


FODO: LINE=(QF,D1,QD,D2,QF);
```

[17]:
```
# generate madx inputstring to save sequence file
la1.madx_sequence_save_string('test.seq')
```

[17]:
```
"SAVE, SEQUENCE=FODO, file='test.seq';"
```

6.6.3 Elegant

[18]:
```
latticestring = """
QF : QUADRUPOLE, L := 0.50 , K1 :=  1.00;
QD : QUADRUPOLE, L := 1.00 , K1 := -1.00;


FODO: SEQUENCE, L=4.00;
QF, at = 0.25;
QD, at = 2.00;
QF, at = 3.75;
ENDSEQUENCE;
"""
la = LatticeAdaptor()
la.load_from_string(latticestring,ftype='madx')
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[19]:
```
la.table
```

[19]:

	family	L	K1	name	at
0	QUADRUPOLE	0.5	1.0	QF	0.25
1	QUADRUPOLE	1.0	-1.0	QD	2.00
2	QUADRUPOLE	0.5	1.0	QF	3.75

[20]:
```
print(la.parse_table_to_elegant_string())
```

```
QF               : KQUAD       , L=  0.500000000000, K1=  1.000000000000
D1               : DRIF        , L=  1.000000000000
QD               : KQUAD       , L=  1.000000000000, K1= -1.000000000000
D2               : DRIF        , L=  1.000000000000


FODO: LINE=(QF, D1, QD, D2, QF)
```

[21]:
```
la.parse_table_to_elegant_file('lattice.lte')
with open('lattice.lte','r') as f:
    dat = f.read()
print(dat)
```

```
QF              : KQUAD       , L=  0.500000000000, K1=  1.000000000000
D1              : DRIF        , L=  1.000000000000
QD              : KQUAD       , L=  1.000000000000, K1= -1.000000000000
D2              : DRIF        , L=  1.000000000000


FODO: LINE=(QF, D1, QD, D2, QF)
```

6.6.4 Tracy

[22]:
```
print(la1.parse_table_to_tracy_string())
```

```
QF: Quadrupole, L = 0.500000, K = 1.000000, N = Nquad, Method = 4;
D1: Drift, L = 1.0;
QD: Quadrupole, L = 1.000000, K = -1.000000, N = Nquad, Method = 4;
D2: Drift, L = 1.0;


FODO: QF, D1, QD, D2, QF;

ring: FODO;

cell: ring, symmetry = 1;

end;
```

[23]:
```
la1.parse_table_to_tracy_file('lattice.lat')
with open('lattice.lat','r') as f:
    dat = f.read()

print(dat)
```

```
QF: Quadrupole, L = 0.500000, K = 1.000000, N = Nquad, Method = 4;
D1: Drift, L = 1.0;
QD: Quadrupole, L = 1.000000, K = -1.000000, N = Nquad, Method = 4;
D2: Drift, L = 1.0;


FODO: QF, D1, QD, D2, QF;

ring: FODO;

cell: ring, symmetry = 1;

end;
```

6.7 Lattice operations

6.7.1 Install string for markers at start and end of lattice

[24]:
```
la1.table
```

[24]:
```
       family    L   K1 name    at   pos
0  QUADRUPOLE  0.5  1.0   QF  0.25  0.25
1       DRIFT  1.0  NaN   D1   1.0   1.0
2  QUADRUPOLE  1.0 -1.0   QD   2.0   2.0
3       DRIFT  1.0  NaN   D2   3.0   3.0
4  QUADRUPOLE  0.5  1.0   QF  3.75  3.75
```

[25]:
```
print(la1.madx_sequence_add_start_end_marker_string())
```

```
MSTART      : MARKER      ;
MEND        : MARKER      ;

USE, SEQUENCE=FODO;
SEQEDIT, SEQUENCE = FODO;
FLATTEN;
INSTALL, ELEMENT = MSTART          , AT =     0.000000;
INSTALL, ELEMENT = MEND            , AT =     4.000000;
FLATTEN;
ENDEDIT;
```

6.7.2 Add drifts back to sequence

[26]:
```
 latticestring = """
QF : QUADRUPOLE, L := 0.50 , K1 :=  1.00;
QD : QUADRUPOLE, L := 1.00 , K1 := -1.00;
D1 : DRIFT, L := 1.00;
D2 : DRIFT, L := 1.00;

FODO: SEQUENCE, L=4.00;
QF, at = 0.25;
QD, at = 2.00;
QF, at = 3.75;
ENDSEQUENCE;
"""
la4 = LatticeAdaptor()
la4.load_from_string(latticestring, ftype='madx')
la4.table
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[26]:
```
       family    L   K1 name    at
0  QUADRUPOLE  0.5  1.0   QF  0.25
1  QUADRUPOLE  1.0 -1.0   QD  2.00
2  QUADRUPOLE  0.5  1.0   QF  3.75
```

[27]:
```
la4.add_drifts()
la4.table
```

[27]:
```
       family    L   K1 name    at   pos
0  QUADRUPOLE  0.5  1.0   QF  0.25  0.25
1       DRIFT  1.0  NaN   D1   NaN   1.0
2  QUADRUPOLE  1.0 -1.0   QD   2.0   2.0
3       DRIFT  1.0  NaN   D2   NaN   3.0
4  QUADRUPOLE  0.5  1.0   QF  3.75  3.75
```

6.7.3 Extract settings

[28]:
```
la1.get_quad_strengths()
```

[28]:
```
{'QF': 1.0, 'QD': -1.0}
```

[29]:
```
la1.get_sext_strengths()
```

[29]:
```
{}
```

6.7.4 Load settings

[30]:
```
from latticeadaptor.utils import highlight_cells
```

[31]:
```
settings_dict = {'QF' : 1.53}
la1.load_strengths_to_table(settings_dict,'K1')
la1.table.style.apply(
    highlight_cells,_list=list(settings_dict.values()),color="lightgreen",axis=1
)
```

[31]:
```
<pandas.io.formats.style.Styler at 0x7f83506b4ca0>
```

6.7.5 Update table from builder

[32]:
```
la1.name, la1.len, la1.builder.lattice
```

[32]:
```
('FODO', 4.0, ['QF', 'D1', 'QD', 'D2', 'QF'])
```

[33]:
```
la1.builder.lattice.append("D1")
la1.builder.lattice
```

[33]:
```
['QF', 'D1', 'QD', 'D2', 'QF', 'D1']
```

[34]:
```
la1.table
```

[34]:
```
       family    L    K1 name    at   pos
0  QUADRUPOLE  0.5  1.53   QF  0.25  0.25
1       DRIFT  1.0   NaN   D1   1.0   1.0
2  QUADRUPOLE  1.0  -1.0   QD   2.0   2.0
3       DRIFT  1.0   NaN   D2   3.0   3.0
4  QUADRUPOLE  0.5  1.53   QF  3.75  3.75
```

[35]:
```
la1.builder.positions
```

[35]:
```
  name    at
0   QF  0.25
1   D1  1.00
2   QD  2.00
3   D2  3.00
4   QF  3.75
```

[36]:
```
la1.update_table()
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[37]:
```
la1.builder.definitions
```

[37]:
```
{'QF': {'family': 'QUADRUPOLE', 'L': 0.5, 'K1': 1.0},
 'QD': {'family': 'QUADRUPOLE', 'L': 1.0, 'K1': -1.0},
 'D1': {'family': 'DRIFT', 'L': 1.0},
 'D2': {'family': 'DRIFT', 'L': 1.0}}
```

[38]:
```
la1.name, la1.len, la1.builder.lattice
```

[38]:
```
('FODO', 5.0, ['QF', 'D1', 'QD', 'D2', 'QF', 'D1'])
```

[39]:
```
la1.builder.positions
```

[40]:
```
la1.builder.table
```

[40]:
```
       family    L   K1 name    at
0  QUADRUPOLE  0.5  1.0   QF  0.25
1       DRIFT  1.0  NaN   D1  1.00
2  QUADRUPOLE  1.0 -1.0   QD  2.00
3       DRIFT  1.0  NaN   D2  3.00
4  QUADRUPOLE  0.5  1.0   QF  3.75
5       DRIFT  1.0  NaN   D1  4.50
```

6.7.6 Compare settings

[41]:
```
from latticeadaptor.utils import compare_settings_dicts
from latticeadaptor.utils import Beamlinegraph_compare_from_seq_files
```

[42]:
```
la2.compare_seq_center_positions('lattice.seq')
```

[42]:
```
(  name_x   pos name_y
 0     QF  0.25     QF
 1     D1  1.00     D1
 2     QD  2.00     QD
 3     D2  3.00     D2
 4     QF  3.75     QF,
 Empty DataFrame
 Columns: [name, pos]
 Index: [])
```

[43]:
```
quad_set1 = la1.get_quad_strengths()
quad_set2 = la2.get_quad_strengths()
compare_settings_dicts(quad_set1, quad_set2, threshold=1)
```

```
QF           1.000000000000   1.000000000000
QD          -1.000000000000  -1.000000000000
```

[44]:
```
quad_set1 = la1.get_quad_strengths()
quad_set2 = la2.get_quad_strengths()
compare_settings_dicts(quad_set1, quad_set2, threshold=.1)
```

```
QF           1.000000000000   1.000000000000
QD          -1.000000000000  -1.000000000000
```

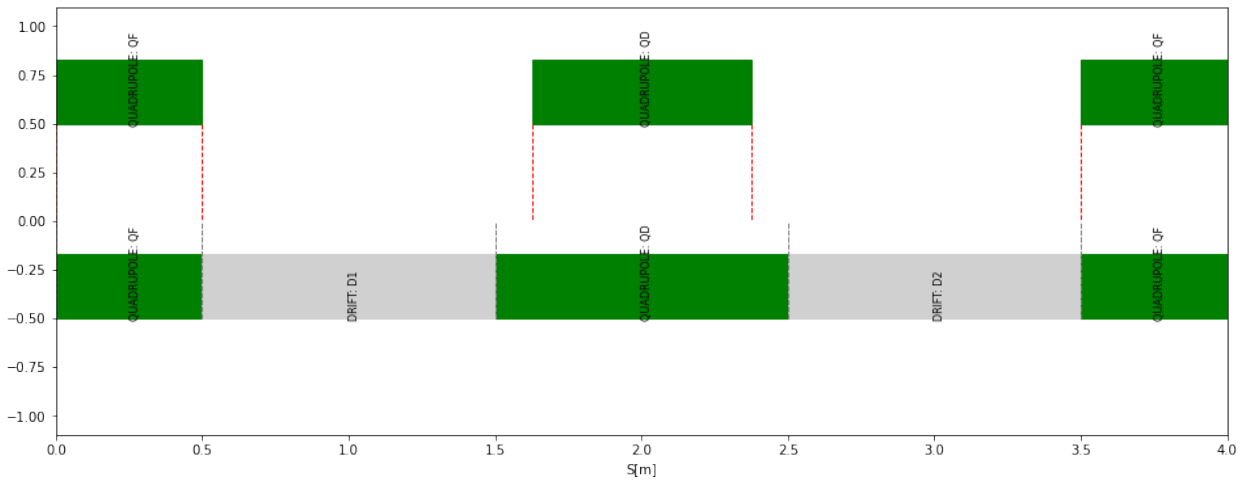
[45]:
```
latticestring = """
QF : QUADRUPOLE, L := 0.50 , K1 :=  1.00;
QD : QUADRUPOLE, L := 0.75 , K1 := -1.00;

FODO: SEQUENCE, L=4.00;
QF, at = 0.25;
QD, at = 2.00;
QF, at = 3.75;
ENDSEQUENCE;
"""
la4 = LatticeAdaptor()
la4.load_from_string(latticestring, ftype='madx')
la4.parse_table_to_madx_sequence_file('lattice2.seq')
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[46]:
```
Beamlinegraph_compare_from_seq_files('lattice.seq','lattice2.seq')
```

[46]:
```
(<module 'matplotlib.pyplot' from '/home/mti/anaconda3/envs/lae/lib/python3.9/site-
↪packages/matplotlib/pyplot.py'>,
 <AxesSubplot:xlabel='S[m]'>)
```



6.8 Plotting

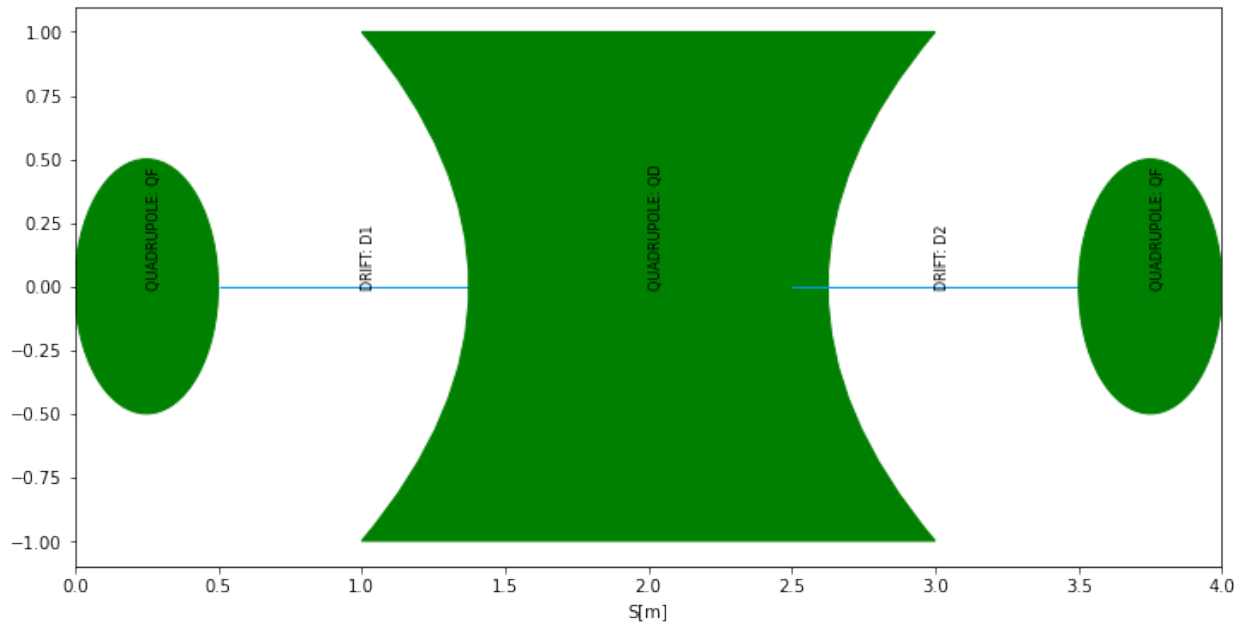
[47]:
```
from latticeadaptor.utils import Beamlinegraph_from_seq_file
```

[48]:
```
madxseqsymm = """
QF : QUADRUPOLE, L := 0.50 , K1 :=  1.00;
QD : QUADRUPOLE, L := 1.00 , K1 := -1.00;
D1 : DRIFT, L := 1.00;
D2 : DRIFT, L := 1.00;

FODO: SEQUENCE, L=4.00;
QF, at = 0.25;
D1, at = 1.00;
QD, at = 2.00;
D2, at = 3.00;
QF, at = 3.75;
ENDSEQUENCE;
"""
la = LatticeAdaptor()
la.load_from_string(madxseqsymm,ftype='madx')
la.parse_table_to_madx_sequence_file('fodo.seq')
Beamlinegraph_from_seq_file('fodo.seq')
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[48]:
```
(<module 'matplotlib.pyplot' from '/home/mti/anaconda3/envs/lae/lib/python3.9/site-
↪packages/matplotlib/pyplot.py'>,
 <AxesSubplot:xlabel='S[m]'>)
```



[49]:
```
madxseqsymm = """
QF: QUADRUPOLE, L=0.5,K1=0.2;
QD: QUADRUPOLE, L=1.0,K1=-0.2;
```

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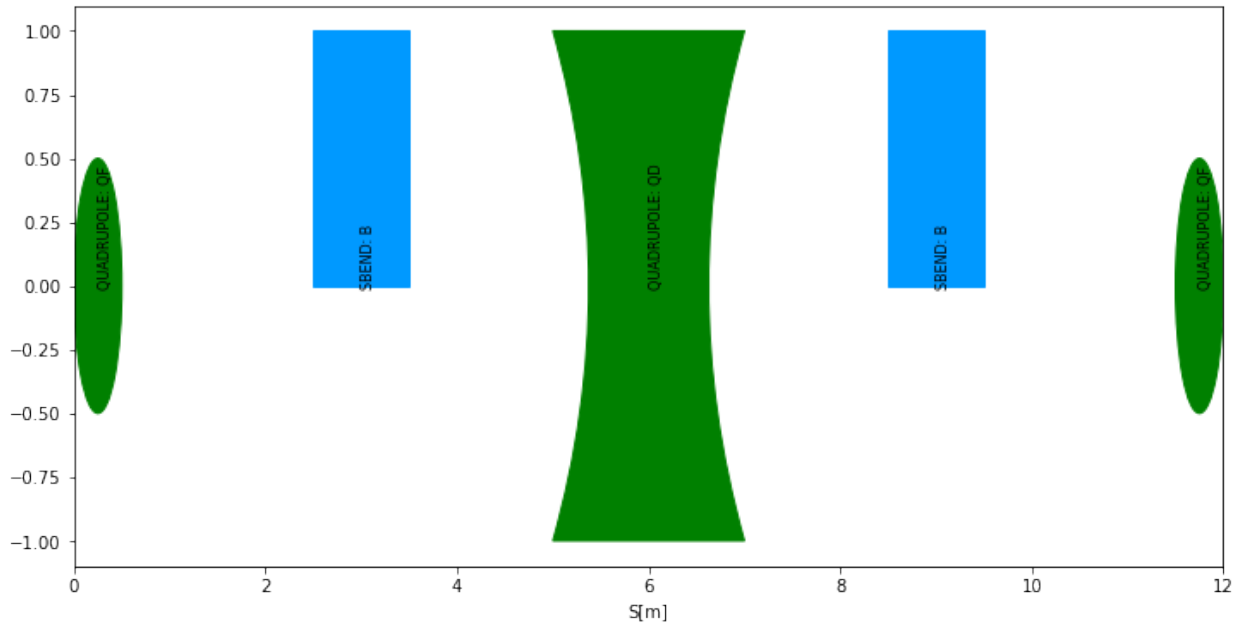
```
B: SBEND, L=1.0, ANGLE=15.0, E1 =7.5, E2=7.5;
FODO: SEQUENCE, L=12.0;
QF, at = 0.25;
B,  at = 3.00;
QD, at = 6.00;
B,  at = 9.00;
QF, at = 11.75;
ENDSEQUENCE;
"""
la = LatticeAdaptor()
la.load_from_string(madxseqsymm,ftype='madx')
la.parse_table_to_madx_sequence_file('fodob.seq')
Beamlinegraph_from_seq_file('fodob.seq')
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[49]:
```
(<module 'matplotlib.pyplot' from '/home/mti/anaconda3/envs/lae/lib/python3.9/site-
↪packages/matplotlib/pyplot.py'>,
 <AxesSubplot:xlabel='S[m]'>)
```



[50]:
```
from latticeadaptor.utils import twissplot
import numpy as np

from cpymad.madx import Madx
madx = Madx(stdout=False)
madx.command.beam(particle='electron',energy=1.7)
madx.call(file='fodo.seq')
madx.use(sequence='FODO')
twiss = madx.twiss()
twissplot(
    twiss, cols=["betx", "bety", "dx"],
    beamlinegraph=True,
```

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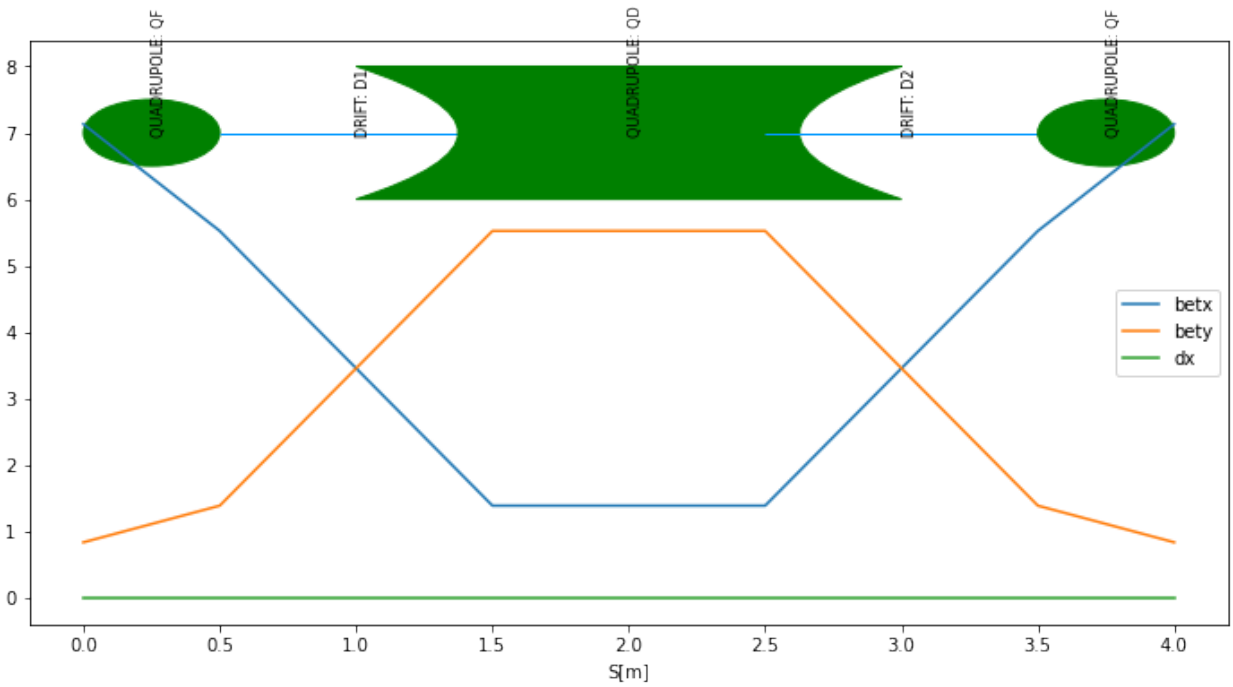
```
    sequence='fodo.seq',
    offset_array = np.array([0.0,7.0]),
    anno=True
)
```

[50]:
```
(<module 'matplotlib.pyplot' from '/home/mti/anaconda3/envs/lae/lib/python3.9/site-
↪packages/matplotlib/pyplot.py'>,
 <AxesSubplot:xlabel='S[m]'>)
```



6.9 Advanced editing

[51]:
```
from latticeadaptor.utils import dipole_split_angles_to_dict

dipolename = 'B'
dipolelen  = 6.00
dipoleanglerad = 0.098
anglelistdeg = [1.4,2.5,6.4]
split_dict = dipole_split_angles_to_dict(dipolename,dipolelen,dipoleanglerad,
↪anglelistdeg,verbose=True)
```

```
Dipole length [m]       :     6.000000
Dipole Bend Angle [rad] :     0.098000
Dipole Bend Angle [deg] :     5.614986
Dipole Bend Radius [m]  :    61.224490


BM splitting angles              [deg] :     1.400000    2.500000    2.807493    5.
↪614986    6.400000
```

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```
BM splitting angles  - cumulative [rad] :     0.024435    0.043633    0.049000    0.
↪098000    0.111701
BM splitting angles  - individual [rad] :     0.024435    0.019199    0.005367    0.
↪049000    0.013701
BM splitting lengths - cumulative [m]   :     1.495997    2.671422    3.000000    6.
↪000000    6.838841
BM splitting lengths - individual [m]   :     1.495997    1.175426    0.328578    3.
↪000000    0.838841
```

[52]:
```
split_dict
```

[52]:
```
{'B': {'lengths': array([1.4959965 , 1.17542582, 0.32857768, 3.        , 0.83884115]),
  'angles': array([0.02443461, 0.01919862, 0.00536677, 0.049     , 0.01370107])}}
```

[53]:
```
from latticeadaptor.utils import split_dipoles, filter_family

dfdip  = filter_family(la.table, 'SBEND')
newdip = split_dipoles(dfdip, split_dict ,dipoleanglerad/2)
newdip
```

[53]:

	L	at	family	name	pos	ANGLE	E1	E2	\
0	0.000000	3.995997	MARKER	MBEAMPORT_2A1	3.995997	NaN	NaN	NaN	
1	1.495997	3.247998	SBEND	B1_1p40_deg	NaN	0.024435	7.5	0.0	
2	0.000000	5.171422	MARKER	MBEAMPORT_2A2	5.171422	NaN	NaN	NaN	
3	1.175426	4.583709	SBEND	B1_2p50_deg	NaN	0.019199	0.0	0.0	
4	0.000000	5.500000	MARKER	MB_MIDDLE	5.500000	NaN	NaN	NaN	
5	0.328578	5.335711	SBEND	B1_2p81_deg	NaN	0.005367	0.0	0.0	
6	3.000000	7.000000	SBEND	B2_5p61_deg	NaN	0.049000	0.0	0.0	
7	0.000000	9.338841	MARKER	MBEAMPORT_2B2	9.338841	NaN	NaN	NaN	
8	0.838841	8.919421	SBEND	B2_6p40_deg	NaN	0.013701	0.0	7.5	
9	0.000000	9.995997	MARKER	MBEAMPORT_2A1	9.995997	NaN	NaN	NaN	
10	1.495997	9.247998	SBEND	B1_1p40_deg	NaN	0.024435	7.5	0.0	
11	0.000000	11.171422	MARKER	MBEAMPORT_2A2	11.171422	NaN	NaN	NaN	
12	1.175426	10.583709	SBEND	B1_2p50_deg	NaN	0.019199	0.0	0.0	
13	0.000000	11.500000	MARKER	MB_MIDDLE	11.500000	NaN	NaN	NaN	
14	0.328578	11.335711	SBEND	B1_2p81_deg	NaN	0.005367	0.0	0.0	
15	3.000000	13.000000	SBEND	B2_5p61_deg	NaN	0.049000	0.0	0.0	
16	0.000000	15.338841	MARKER	MBEAMPORT_2B2	15.338841	NaN	NaN	NaN	
17	0.838841	14.919421	SBEND	B2_6p40_deg	NaN	0.013701	0.0	7.5	

	K1
0	NaN
1	NaN
2	NaN
3	NaN
4	NaN
5	NaN
6	NaN
7	NaN
8	NaN
9	NaN

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```
10 NaN
11 NaN
12 NaN
13 NaN
14 NaN
15 NaN
16 NaN
17 NaN
```

[54]:
```
latticestring = """
QF : QUADRUPOLE, L := 0.50 , K1 :=  1.00;
QD : QUADRUPOLE, L := 0.75 , K1 := -1.00;

FODO: SEQUENCE, L=4.00;
QF, at = 0.25;
QD, at = 2.00;
QF, at = 3.75;
ENDSEQUENCE;
"""
la = LatticeAdaptor()
la.load_from_string(latticestring, ftype='madx')
la.add_drifts()
la.table
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[54]:

	family	L	K1	name	at	pos
0	QUADRUPOLE	0.5	1.0	QF	0.25	0.25
1	DRIFT	1.125	NaN	D1	NaN	1.0625
2	QUADRUPOLE	0.75	-1.0	QD	2.0	2.0
3	DRIFT	1.125	NaN	D2	NaN	2.9375
4	QUADRUPOLE	0.5	1.0	QF	3.75	3.75

[55]:
```
la.undo()
la.table
```

[55]:

	family	L	K1	name	at
0	QUADRUPOLE	0.50	1.0	QF	0.25
1	QUADRUPOLE	0.75	-1.0	QD	2.00
2	QUADRUPOLE	0.50	1.0	QF	3.75

[56]:
```
print(la.parse_table_to_madx_install_str())
```

```
USE, SEQUENCE=FODO;
SEQEDIT, SEQUENCE = FODO;
FLATTEN;
INSTALL, ELEMENT = QF              , AT =     0.250000;
INSTALL, ELEMENT = QD              , AT =     2.000000;
INSTALL, ELEMENT = QF              , AT =     3.750000;
FLATTEN;
ENDEDIT;
```

[57]:
```
print(la.parse_table_to_madx_remove_str())
```

```
USE, SEQUENCE=FODO;
SEQEDIT, SEQUENCE = FODO;
FLATTEN;
REMOVE, ELEMENT = QF              ;
REMOVE, ELEMENT = QD              ;
REMOVE, ELEMENT = QF              ;
FLATTEN;
ENDEDIT;
```

6.10 Advanced diplole splitting example

[58]:
```
# load more complicated lattice
lad = LatticeAdaptor()
lad.load_from_file("bessy_base.seq",ftype='madx')

# filter the dipoles out
dfdip = filter_family(lad.table,"SBEND")
dfdip.head()
```

```
Length has been autoset - check if value is ok - otherwise update it.
```

[58]:

	family	name	L	K2	K1	ANGLE	E1	E2	at
0	SBEND	BM2D1R	0.855	NaN	NaN	0.19635	0.098175	0.098175	5.1825
1	SBEND	BM1T1R	0.855	NaN	NaN	0.19635	0.098175	0.098175	9.8175
2	SBEND	BM2T1R	0.855	NaN	NaN	0.19635	0.098175	0.098175	20.1825
3	SBEND	BM1D2R	0.855	NaN	NaN	0.19635	0.098175	0.098175	24.8175
4	SBEND	BM2D2R	0.855	NaN	NaN	0.19635	0.098175	0.098175	35.1825

[59]:
```
# dipole values
dipole_length         = 0.855
dipole_bend_angle_rad = np.pi / 16
dipole_bend_angle_deg = np.rad2deg(dipole_bend_angle_rad)
dipole_bend_radius    = dipole_length / dipole_bend_angle_rad

# general splitting
split_angles_BM2_deg  = [4.0, 6.7, dipole_bend_angle_deg -2.0]
split_angles_BM1_deg  = [2.0, dipole_bend_angle_deg - 6.7, dipole_bend_angle_deg - 4.0]

# special splitting - minus signs due to BM2 magnets
split_angles_special = {
    "BM2D2R" : sorted(
    [
        3.7,
        4.0,
        4.1,
        4.3,
        6.7,
        dipole_bend_angle_deg - 2.0,
    ]
```

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```
),
    "BM2D5R" : sorted(
    [
        3.6580,
        4.0,
        4.129,
        4.299,
        6.7,
        dipole_bend_angle_deg - 2.0,
    ]
)
}

# add all the splitings to a single dict
splitting_dict  = {}

for i, row in dfdip.iterrows():
    if row["name"] not in list(split_angles_special.keys()):
        if "BM1" in row["name"]:
            angle_list = split_angles_BM1_deg

        elif "BM2" in row["name"]:
            angle_list = split_angles_BM2_deg

        else:
            print("NOK")
            break

    else:
        angle_list = split_angles_special[row["name"]]


    splitting_dict = {**splitting_dict,**dipole_split_angles_to_dict(row["name"], row.L,␣
↪row.ANGLE, angle_list, verbose=True)}
```

```
Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     4.000000    5.625000    6.700000    9.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.069813    0.098175    0.116937    0.
↪161443    0.196350
BM splitting angles  - individual [rad] :     0.069813    0.028362    0.018762    0.
↪044506    0.034907
BM splitting lengths - cumulative [m]   :     0.304000    0.427500    0.509200    0.
↪703000    0.855000
BM splitting lengths - individual [m]   :     0.304000    0.123500    0.081700    0.
↪193800    0.152000
```

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```
Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     2.000000    4.550000    5.625000    7.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.034907    0.079412    0.098175    0.
↪126536    0.196350
BM splitting angles  - individual [rad] :     0.034907    0.044506    0.018762    0.
↪028362    0.069813
BM splitting lengths - cumulative [m]   :     0.152000    0.345800    0.427500    0.
↪551000    0.855000
BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     4.000000    5.625000    6.700000    9.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.069813    0.098175    0.116937    0.
↪161443    0.196350
BM splitting angles  - individual [rad] :     0.069813    0.028362    0.018762    0.
↪044506    0.034907
BM splitting lengths - cumulative [m]   :     0.304000    0.427500    0.509200    0.
↪703000    0.855000
BM splitting lengths - individual [m]   :     0.304000    0.123500    0.081700    0.
↪193800    0.152000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     2.000000    4.550000    5.625000    7.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.034907    0.079412    0.098175    0.
↪126536    0.196350
BM splitting angles  - individual [rad] :     0.034907    0.044506    0.018762    0.
↪028362    0.069813
BM splitting lengths - cumulative [m]   :     0.152000    0.345800    0.427500    0.
↪551000    0.855000
BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000

Dipole length [m]       :     0.855000
```

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```
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles              [deg] :     3.700000    4.000000    4.100000    4.
↪300000    5.625000    6.700000    9.250000   11.250000
BM splitting angles  - cumulative [rad] :     0.064577    0.069813    0.071558    0.
↪075049    0.098175    0.116937    0.161443    0.196350
BM splitting angles  - individual [rad] :     0.064577    0.005236    0.001745    0.
↪003491    0.023126    0.018762    0.044506    0.034907
BM splitting lengths - cumulative [m]   :     0.281200    0.304000    0.311600    0.
↪326800    0.427500    0.509200    0.703000    0.855000
BM splitting lengths - individual [m]   :     0.281200    0.022800    0.007600    0.
↪015200    0.100700    0.081700    0.193800    0.152000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles              [deg] :     2.000000    4.550000    5.625000    7.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.034907    0.079412    0.098175    0.
↪126536    0.196350
BM splitting angles  - individual [rad] :     0.034907    0.044506    0.018762    0.
↪028362    0.069813
BM splitting lengths - cumulative [m]   :     0.152000    0.345800    0.427500    0.
↪551000    0.855000
BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles              [deg] :     4.000000    5.625000    6.700000    9.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.069813    0.098175    0.116937    0.
↪161443    0.196350
BM splitting angles  - individual [rad] :     0.069813    0.028362    0.018762    0.
↪044506    0.034907
BM splitting lengths - cumulative [m]   :     0.304000    0.427500    0.509200    0.
↪703000    0.855000
BM splitting lengths - individual [m]   :     0.304000    0.123500    0.081700    0.
↪193800    0.152000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
```

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```
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     2.000000    4.550000    5.625000    7.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.034907    0.079412    0.098175    0.
↪126536    0.196350
BM splitting angles  - individual [rad] :     0.034907    0.044506    0.018762    0.
↪028362    0.069813
BM splitting lengths - cumulative [m]   :     0.152000    0.345800    0.427500    0.
↪551000    0.855000
BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     4.000000    5.625000    6.700000    9.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.069813    0.098175    0.116937    0.
↪161443    0.196350
BM splitting angles  - individual [rad] :     0.069813    0.028362    0.018762    0.
↪044506    0.034907
BM splitting lengths - cumulative [m]   :     0.304000    0.427500    0.509200    0.
↪703000    0.855000
BM splitting lengths - individual [m]   :     0.304000    0.123500    0.081700    0.
↪193800    0.152000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     2.000000    4.550000    5.625000    7.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.034907    0.079412    0.098175    0.
↪126536    0.196350
BM splitting angles  - individual [rad] :     0.034907    0.044506    0.018762    0.
↪028362    0.069813
BM splitting lengths - cumulative [m]   :     0.152000    0.345800    0.427500    0.
↪551000    0.855000
BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
```

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```
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     4.000000    5.625000    6.700000    9.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.069813    0.098175    0.116937    0.
↪161443    0.196350
BM splitting angles  - individual [rad] :     0.069813    0.028362    0.018762    0.
↪044506    0.034907
BM splitting lengths - cumulative [m]   :     0.304000    0.427500    0.509200    0.
↪703000    0.855000
BM splitting lengths - individual [m]   :     0.304000    0.123500    0.081700    0.
↪193800    0.152000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     2.000000    4.550000    5.625000    7.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.034907    0.079412    0.098175    0.
↪126536    0.196350
BM splitting angles  - individual [rad] :     0.034907    0.044506    0.018762    0.
↪028362    0.069813
BM splitting lengths - cumulative [m]   :     0.152000    0.345800    0.427500    0.
↪551000    0.855000
BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     4.000000    5.625000    6.700000    9.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.069813    0.098175    0.116937    0.
↪161443    0.196350
BM splitting angles  - individual [rad] :     0.069813    0.028362    0.018762    0.
↪044506    0.034907
BM splitting lengths - cumulative [m]   :     0.304000    0.427500    0.509200    0.
↪703000    0.855000
BM splitting lengths - individual [m]   :     0.304000    0.123500    0.081700    0.
↪193800    0.152000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479
```

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```
BM splitting angles               [deg] :     2.000000    4.550000    5.625000    7.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.034907    0.079412    0.098175    0.
↪126536    0.196350
BM splitting angles  - individual [rad] :     0.034907    0.044506    0.018762    0.
↪028362    0.069813
BM splitting lengths - cumulative [m]   :     0.152000    0.345800    0.427500    0.
↪551000    0.855000
BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     4.000000    5.625000    6.700000    9.
↪250000   11.250000
BM splitting angles  - cumulative [rad] :     0.069813    0.098175    0.116937    0.
↪161443    0.196350
BM splitting angles  - individual [rad] :     0.069813    0.028362    0.018762    0.
↪044506    0.034907
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↪193800    0.152000

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BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000

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Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479
```

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```
BM splitting angles               [deg] :     3.658000    4.000000    4.129000    4.
↪299000    5.625000    6.700000    9.250000   11.250000
BM splitting angles  - cumulative [rad] :     0.063844    0.069813    0.072065    0.
↪075032    0.098175    0.116937    0.161443    0.196350
BM splitting angles  - individual [rad] :     0.063844    0.005969    0.002251    0.
↪002967    0.023143    0.018762    0.044506    0.034907
BM splitting lengths - cumulative [m]   :     0.278008    0.304000    0.313804    0.
↪326724    0.427500    0.509200    0.703000    0.855000
BM splitting lengths - individual [m]   :     0.278008    0.025992    0.009804    0.
↪012920    0.100776    0.081700    0.193800    0.152000

Dipole length [m]       :     0.855000
Dipole Bend Angle [rad] :     0.196350
Dipole Bend Angle [deg] :    11.250000
Dipole Bend Radius [m]  :     4.354479


BM splitting angles               [deg] :     2.000000    4.550000    5.625000    7.
↪250000   11.250000
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↪123500    0.304000

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↪044506    0.034907
```

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```
BM splitting lengths - cumulative [m]   :     0.304000    0.427500    0.509200    0.
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BM splitting lengths - cumulative [m]   :     0.152000    0.345800    0.427500    0.
↪551000    0.855000
```

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```
BM splitting lengths - individual [m]   :     0.152000    0.193800    0.081700    0.
↪123500    0.304000
```

[60]:
```
# check one of the entries
splitting_dict['BM2D1R']
```

[60]:
```
{'lengths': array([0.304 , 0.1235, 0.0817, 0.1938, 0.152 ]),
 'angles': array([0.06981317, 0.0283616 , 0.01876229, 0.0445059 , 0.03490658])}
```

[61]:
```
# create a table containing the beamport markers

# split the dipoles and add the markers (auto-named)
dfbeamports = split_dipoles(dfdip, splitting_dict, dipole_bend_angle_rad/2.0)

# update the pos
dfbeamports['pos'] = dfbeamports['at']
dfbeamports = dfbeamports.sort_values(by="pos").reset_index(drop=True)
```

[62]:
```
dfbeamports.head(10)
```

[62]:

	L	at	family	name	pos	ANGLE	E1	E2	K1	K2
0	0.3040	4.90700	SBEND	BM2D1R1_4p00_deg	4.90700	0.069813	0.098175	0.000000	NaN	NaN
1	0.0000	5.05900	MARKER	MBEAMPORT_2A1	5.05900	NaN	NaN	NaN	NaN	NaN
2	0.1235	5.12075	SBEND	BM2D1R1_5p62_deg	5.12075	0.028362	0.000000	0.000000	NaN	NaN
3	0.0000	5.18250	MARKER	MBM2D1R_MIDDLE	5.18250	NaN	NaN	NaN	NaN	NaN
4	0.0817	5.22335	SBEND	BM2D1R2_6p70_deg	5.22335	0.018762	0.000000	0.000000	NaN	NaN
5	0.0000	5.26420	MARKER	MBEAMPORT_2B1	5.26420	NaN	NaN	NaN	NaN	NaN
6	0.1938	5.36110	SBEND	BM2D1R2_9p25_deg	5.36110	0.044506	0.000000	0.000000	NaN	NaN
7	0.0000	5.45800	MARKER	MBEAMPORT_2B2	5.45800	NaN	NaN	NaN	NaN	NaN
8	0.1520	5.53400	SBEND	BM2D1R2_11p25_deg	5.53400	0.034907	0.000000	0.098175	NaN	NaN
9	0.1520	9.46600	SBEND	BM1T1R1_2p00_deg	9.46600	0.034907	0.098175	0.000000	NaN	NaN

[63]:
```
# sort, add sectors
dfbeamportssec = dfbeamports.copy().sort_values(by="pos").reset_index(drop=True)
dfbeamportssec['sector'] = dfbeamportssec["name"].apply(lambda x: x[3:5] if (not "PORT"␣
↪in x) and not "MIDDLE" in x else np.nan)
dfbeamportssec["sector"] = dfbeamportssec["sector"].fillna(method="ffill")

# check out the D2 sector
```

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```
dfbeamportssec.loc[dfbeamportssec.sector=="D2"].sort_values(by="pos").head()
```

[63]:

```
         L        at  family              name       pos     ANGLE        E1  \
27  0.1520  24.46600   SBEND  BM1D2R1_2p00_deg  24.46600  0.034907  0.098175
28  0.0000  24.54200  MARKER     MBEAMPORT_1A1  24.54200       NaN       NaN
29  0.1938  24.63890   SBEND  BM1D2R1_4p55_deg  24.63890  0.044506  0.000000
30  0.0000  24.73580  MARKER     MBEAMPORT_1A2  24.73580       NaN       NaN
31  0.0817  24.77665   SBEND  BM1D2R1_5p62_deg  24.77665  0.018762  0.000000

     E2  K1  K2 sector
27  0.0 NaN NaN     D2
28  NaN NaN NaN     D2
29  0.0 NaN NaN     D2
30  NaN NaN NaN     D2
31  0.0 NaN NaN     D2
```

[64]:

```
# highlighting some beamports - visual checking
from latticeadaptor.utils import highlight_cells, highlight_row

dfbeamportssec.loc[dfbeamportssec.sector=="D2"][-15:].style.apply(
    highlight_row,_list=["MBEAMPORT_2A1","MBEAMPORT_2A3","MBEAMPORT_2A4"], column=["name
↪"],axis=1
).apply(highlight_row,_list=["BM2D2R1_3p70_deg","BM2D2R1_4p10_deg","BM2D2R1_4p30_deg"],␣
↪column=["name"],color="orange",axis=1)
```

[64]:

```
<pandas.io.formats.style.Styler at 0x7f83148fd790>
```

[65]:

```
# rename some of the auto-named markers
dfbeamports.loc[37, "name"] = "M_PINHOLE3"
dfbeamports.loc[41, "name"] = "M_OLD_STREAK_CAMERA"
dfbeamports.loc[43, "name"] = "M_ADP_FILL_PATTERN"

# check if updated in original seq table
dfbeamports[36:50].style.apply(
    highlight_cells,
    _list=["M_PINHOLE3","M_OLD_STREAK_CAMERA","M_ADP_FILL_PATTERN"],
    color="lightgreen")
```

[65]:

```
<pandas.io.formats.style.Styler at 0x7f8314be1160>
```

CHAPTER

SEVEN

INDICES AND TABLES

- genindex
- modindex
- search

PYTHON MODULE INDEX

INDEX

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M