

setup

overhead

tag

```
In[ ]:= home = "topics/aer/truth/";
Get["utility modules.m", Path → dirPack];
stamp1;

... CreateDirectory: /Users/dtopa/Mathematica_files/io/ already exists.
... CreateDirectory: /Users/dtopa/Dropbox/_mm/io/topics/ already exists.
... CreateDirectory: /Users/dtopa/Dropbox/_mm/io/topics/aer/ already exists.
... General: Further output of CreateDirectory::eexist will be suppressed during this calculation. ⓘ

maximum memory: 0.291992 GB
seed file: /Users/dtopa/Mathematica_files/nb/seed 22_01.nb
user: dtopa, CPU: ehcoat1, MM v. 13.0.0 for Mac OS X x86
date: Feb 10, 2022, time: 01:11:32
nb: /Users/dtopa/Mathematica_files/nb/topics/aer/truth/energy-01.nb
```

modules, functions, settings, ...

1 point

strings

```
In[ ]:= dirHeatMaps = "/Volumes/T1a1oc/spackitivity/REPT Data/";
fileNameLeft = "rbspa_rel03_ect-rept-sci-L3_";
fileNameRight = ".cdf";
```

specific days

```
In[ ]:= days = {"20170207_v5.1.0", "20170425_v5.5.0",
               "20170620_v5.3.0", "20170917_v5.3.0", "20171214_v5.3.0"};
```

2 pick one

```
In[*]:= myFile = dirHeatMaps <> fileNameLeft <> days[[1]] <> fileNameRight
Out[*]:=
/Volumes/Tlaloc/spackitivity/REPT
Data/rbspa_rel03_ect-rept-sci-L3_20170207_v5.1.0.cdf
```

3 data sets

```
In[*]:= dataSetNames = Import[dirHeatMaps <> fileNameLeft <> days[[1]] <> fileNameRight]
m = Length[%]
Out[*]:=
{Epoch, Epoch_prot, FEDU_Alpha_DELTA, FEDU_Alpha, FEDU_0to180_Alpha,
 FEDU_180to360_Alpha, FPDU_Alpha, FPDU_0to180_Alpha, FPDU_180to360_Alpha,
 FEDU_Unbinned_Sector_Angle, FEDU_Unbinned_Alpha_DELTA, FEDU_Unbinned_Alpha,
 FEDU_Unbinned_Alpha360, FPDU_Unbinned_Sector_Angle, FPDU_Unbinned_Alpha_DELTA,
 FPDU_Unbinned_Alpha, FPDU_Unbinned_Alpha360, FEDU_Energy, FEDU_Energy_DELTA_minus,
 FEDU_Energy_DELTA_plus, FEDU_PA_LABL, FEDU_PA_0TO180_LABL, FEDU_PA_180TO360_LABL,
 FEDU_ENERGY_LABL, FEDU, FPDU_PA_LABL, FPDU_PA_0TO180_LABL, FPDU_PA_180TO360_LABL,
 FPDU_ENERGY_LABL, FPDU, FPDU_Energy, FEDU_0to180, FEDU_180to360,
 FPDU_0to180, FPDU_180to360, FEDU_Unbinned_0to180, FEDU_Unbinned_0to360,
 FPDU_Unbinned_0to180, FPDU_Unbinned_0to360, FPDU_Unbinned_LightMask_0to360,
 FPDU_Unbinned_Light_Flag, L_star, L, I, B_Calc, B_Eq, MLT, MLAT, Position}
Out[*]:=
49
```

```
In[*]:= TableForm[dataSetNames, TableHeadings → {Automatic, None}]
```

```
Out[*]//TableForm=
```

```

1 | Epoch
2 | Epoch_prot
3 | FEDU_Alpha_DELTA
4 | FEDU_Alpha
5 | FEDU_0to180_Alpha
6 | FEDU_180to360_Alpha
7 | FPDU_Alpha
8 | FPDU_0to180_Alpha
9 | FPDU_180to360_Alpha
10 | FEDU_Unbinned_Sector_Angle
11 | FEDU_Unbinned_Alpha_DELTA
12 | FEDU_Unbinned_Alpha
13 | FEDU_Unbinned_Alpha360
14 | FPDU_Unbinned_Sector_Angle
15 | FPDU_Unbinned_Alpha_DELTA
16 | FPDU_Unbinned_Alpha
17 | FPDU_Unbinned_Alpha360
18 | FEDU_Energy
19 | FEDU_Energy_DELTA_minus
20 | FEDU_Energy_DELTA_plus
21 | FEDU_PA_LABL
22 | FEDU_PA_0TO180_LABL
23 | FEDU_PA_180TO360_LABL
24 | FEDU_ENERGY_LABL
25 | FEDU
26 | FPDU_PA_LABL
27 | FPDU_PA_0TO180_LABL
28 | FPDU_PA_180TO360_LABL
29 | FPDU_ENERGY_LABL
30 | FPDU
31 | FPDU_Energy
32 | FEDU_0to180
33 | FEDU_180to360
34 | FPDU_0to180
35 | FPDU_180to360
36 | FEDU_Unbinned_0to180
37 | FEDU_Unbinned_0to360
38 | FPDU_Unbinned_0to180
39 | FPDU_Unbinned_0to360
40 | FPDU_Unbinned_LightMask_0to360
41 | FPDU_Unbinned_Light_Flag
42 | L_star
43 | L
44 | I
45 | B_Calc
46 | B_Eq
47 | MLT
48 | MLAT
49 | Position

```

2

```
In[ ]:= StringCases[dataSetNames, "FEDU"]
Out[ ]:=
{{}, {}, {FEDU}, {FEDU}, {FEDU}, {FEDU}, {}, {}, {}, {FEDU},
 {FEDU}, {FEDU}, {FEDU}, {}, {}, {}, {}, {FEDU}, {FEDU}, {FEDU}, {FEDU},
 {FEDU}, {FEDU}, {FEDU}, {FEDU}, {}, {}, {}, {}, {}, {}, {FEDU}, {FEDU},
 {}, {}, {FEDU}, {FEDU}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}, {}}
```

3

pure

```
In[ ]:= set = "FEDU";
seq = Import[myFile, {"Datasets", {set}}];
Print["size of ", set, " = ", Dimensions[%]]
size of FEDU = {8034, 17, 12}

In[ ]:= a = seq[[1, All]];
a = Drop[a, 1];
a = Drop[a, -1]
Dimensions[a]
amp = MatrixPlot[a,
  PlotLabel → "Max value = "<>ToString[Max[a]]<>"\n",
  ColorFunction → "TemperatureMap"]
```

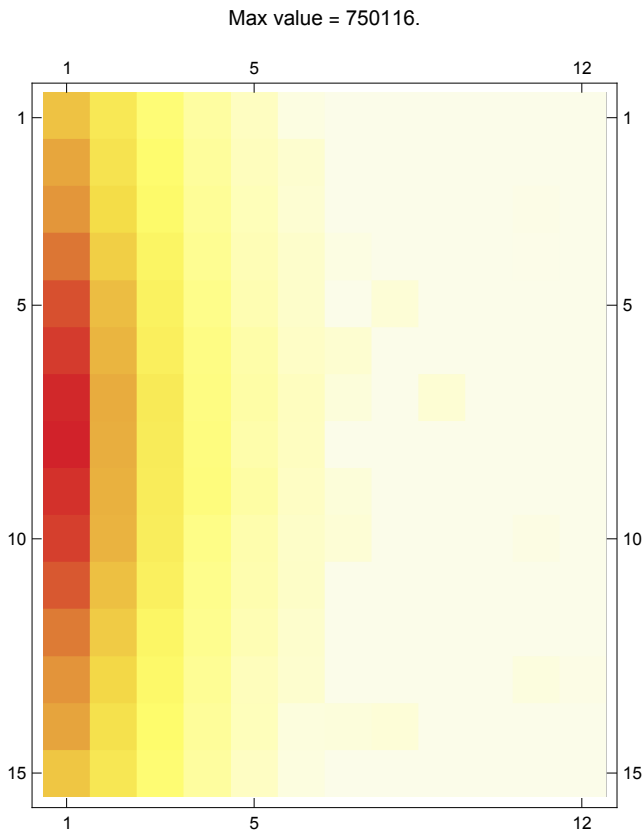
Out[]=

```
{ {270537., 117238., 36285.6, 4841.12, 374.488, 15.6877, 0., 0., 0., 0., 0., 0.},
  {343783., 143321., 46177.9, 6238.25, 548.626, 95.3852, 0., 0., 0., 0., 0., 0.},
  {404559., 179137., 57039.2, 7660.51, 1037.03, 70.9917, 0., 0., 0., 0., 9.08111, 0.},
  {535179., 229363., 76021.5, 11197.4,
    1280.03, 160.779, 13.2985, 0., 0., 0., 4.67873, 0.},
  {644493., 279969., 91865.7, 15780.1, 1718.93, 227.158, 0., 36.3497, 0., 0., 0., 0.},
  {692492., 309380., 101441., 19232.3, 2596.97, 331.778, 81.7235, 0., 0., 0., 0., 0.},
  {739708., 324463., 111393., 20625.1, 2720.67, 410.277, 27.3153, 0., 65.1166, 0., 0.,
    0.}, {750116., 322685., 109478., 21065.9, 2553.99, 386.741, 0., 0., 0., 0., 0., 0.},
  {717666., 313979., 109090., 21230.7, 2885.72, 359.556, 27.3672, 0., 0., 0., 0., 0.},
  {688470., 312321., 104221., 17728.5, 2550.09, 229.645, 54.5838, 0., 0., 0., 9.60948,
    0.}, {626611., 273033., 95894.3, 15321.3, 2203.46, 251.598, 0., 0., 0., 0., 0., 0.},
  {519599., 239542., 75284.1, 12870.2, 1707.45, 148.826, 0., 0., 0., 0., 0., 0.},
  {409645., 192806., 57165.1, 8228.63, 663.434, 145.148, 0.,
    0., 0., 0., 18.1754, 9.08769}, {346410., 154734., 47011.8,
    6465.1, 718.201, 23.8327, 25.4336, 34.3531, 0., 0., 0., 0.},
  {259240., 119525., 38401.1, 4847.43, 360.658, 15.7479, 0., 0., 0., 0., 0., 0.}}
```

Out[]=

{15, 12}

Out[]=



```

In[ ]:= z = seq[[8034, All]];
Dimensions[z];
z = Drop[z, 1];
z = Drop[z, -1]
Dimensions[z]
zmp = MatrixPlot[z,
  PlotLabel → "Max value = " <> ToString[Max[z]] <> lf,
  ColorFunction → "TemperatureMap"]

```

```

Out[ ]:=
{{279 336., 112 943., 35 741.7, 4769.42, 692.678, 35.491, 12.6828, 0., 0., 0., 4.43956,
  0.}, {365 725., 154 046., 47 540.9, 6922.21, 1109.06, 168.756, 0., 0., 0., 0., 0., 0.},
{402 370., 165 329., 52 758.2, 8621.14, 1128.63, 168.057, 25.9337, 0., 0., 0., 0., 0.},
{398 809., 160 703., 49 197.1, 9006.95, 1165.38, 122.132, 0., 0., 0., 0., 0., 0.},
{371 730., 139 495., 39 959.7, 7167.76, 1005.92, 169.26, 0., 0., 0., 0., 0., 0.},
{315 402., 116 026., 35 551.7, 5683., 803.826, 71.7647, 25.4501, 0., 0., 0., 0., 0.},
{263 832., 98 321.4, 26 598.1, 5020.75, 523.471, 70.9628, 0., 0., 0., 0., 0., 0.},
{245 107., 84 807.4, 25 160.5, 3402.88, 489.595, 58.8826, 0., 0., 0., 0., 4.42451, 0.},
{255 882., 96 819.3, 27 640., 4766.55, 482.431, 23.6252, 0., 0., 0., 0., 8.93205, 0.},
{312 523., 119 322., 35 347.2, 5560.64, 635.155, 47.8416, 0., 0., 0., 0., 17.9765, 0.},
{368 216., 142 183., 41 914.1, 7297.41, 963.679, 169.1, 51.6203, 0., 0., 0., 0., 0.},
{418 303., 165 050., 51 135., 10 385.3, 1466.11, 97.4701, 26.0014, 0., 0., 0., 0., 0.},
{416 211., 161 700., 52 657.8, 8691.35, 970.469, 170.56, 0., 0., 0., 0., 0., 0.},
{360 786., 146 518., 47 358.3, 7840.69, 953.05, 24.1068, 25.726, 0., 0., 0., 0., 0.},
{284 510., 111 014., 32 111.3, 4804.36, 450.727,
  94.8456, 12.5307, 0., 30.0362, 0., 4.46239, 0.}}

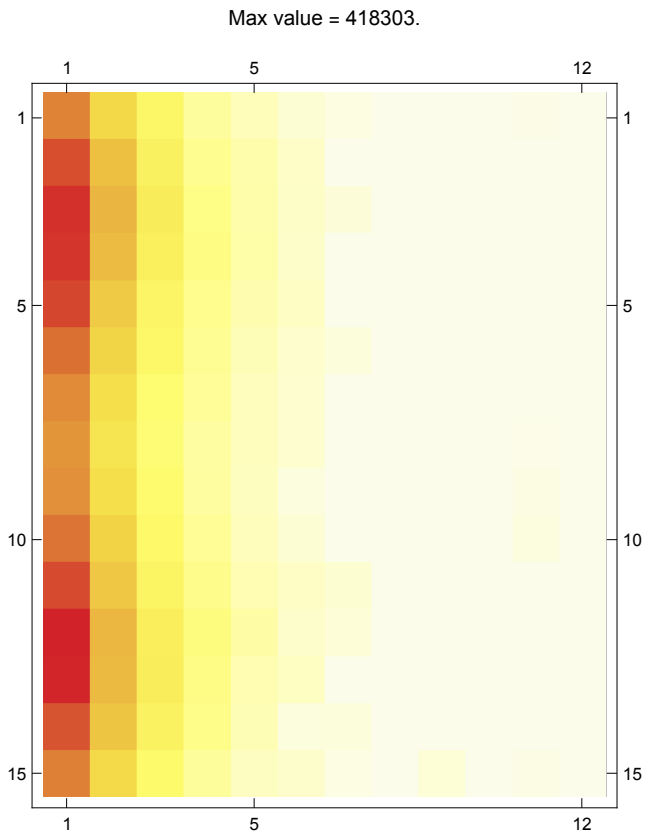
```

```

Out[ ]:=
{15, 12}

```

Out[]:=



In[]:= **Max[a]**
Min[a]

Out[]:=
750 116.

Out[]:=
0.

In[]:= **Max[z]**
Min[z]

Out[]:=
418 303.

Out[]:=
0.

In[]:= **multiExport["energy-matrix-fedu-first", amp]**
multiExport["energy-matrix-fedu-last", zmp]

FPDU

In[]:= **set = "FPDU";**

```
In[ ]:= seq = Import[myFile, {"Datasets", {set}}];  
Print["size of ", set, " = ", Dimensions[%]]  
size of FPDU = {8034, 17, 8}
```



```

In[ ]:= a = seq[1, All];
a = Drop[a, 1];
a = Drop[a, -1]
Dimensions[a]
amp = MatrixPlot[a,
  PlotLabel → "Max value = " <> ToString[Max[a]] <> lf,
  ColorFunction → "TemperatureMap"]

```

```

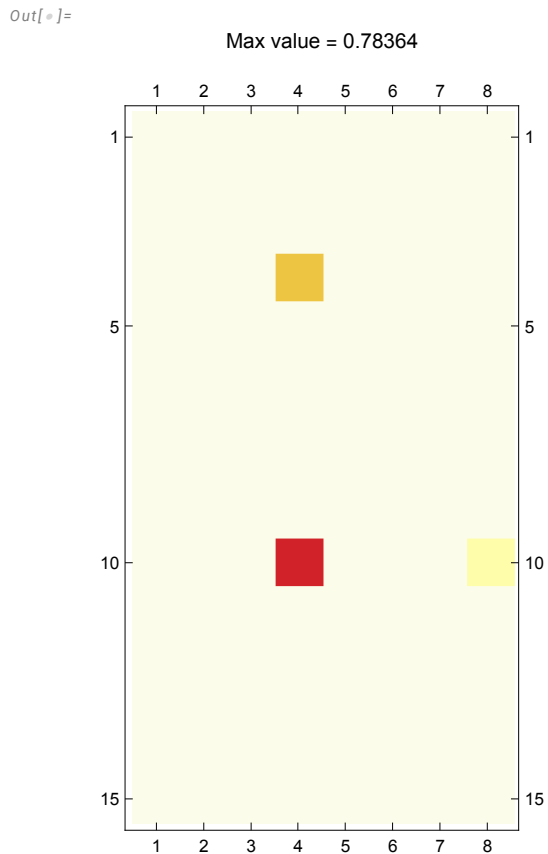
Out[ ]:=
{{0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0.383502, 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0.78364, 0., 0., 0., 0.0522254}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.}}

```

```

Out[ ]:=
{15, 8}

```



```

In[ ]:= z = seq[[8034, All]];
Dimensions[z]
z = Drop[z, 1];
z = Drop[z, -1]
Dimensions[z]
zmp = MatrixPlot[z,
  PlotLabel -> "Max value = " <> ToString[Max[z]] <> lf,
  ColorFunction -> "TemperatureMap"]

```

```

Out[ ]:=
{17, 8}

```

```

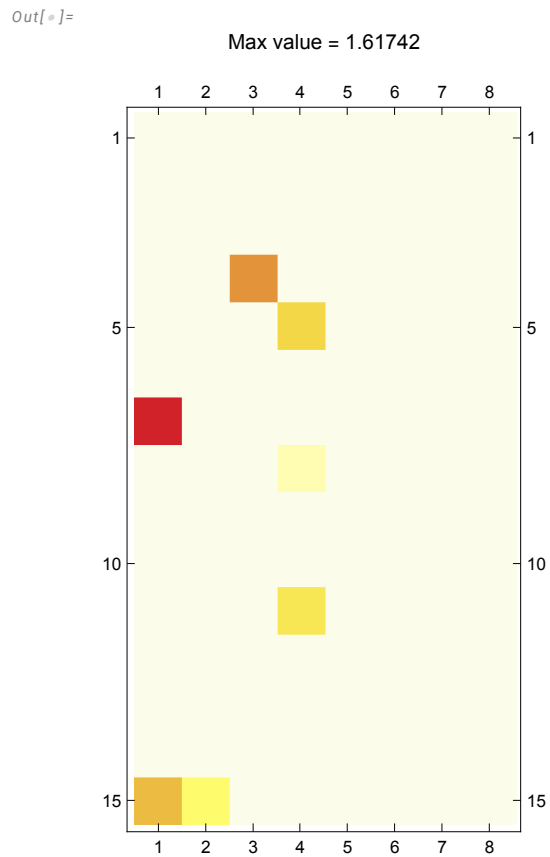
Out[ ]:=
{{0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0.971973, 0., 0., 0., 0., 0.},
 {0., 0., 0., 0.744137, 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {1.61742, 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0.362665, 0., 0., 0., 0.},
 {0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0.742845, 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0., 0., 0., 0., 0., 0., 0., 0.}, {0., 0., 0., 0., 0., 0., 0., 0.},
 {0.802195, 0.612788, 0., 0., 0., 0., 0., 0.}}

```

```

Out[ ]:=
{15, 8}

```




```
In[ ]:= multiExport["energy-matrix-fpdu-first", amp]
multiExport["energy-matrix-fpdu-last", zmp]
```

FEDU_Alpha

```
In[ ]:= seta = "FEDU_Unbinned_0to180";
seqa = Import[myFile, {"Datasets", {set}}];
Print["size of ", set, " = ", Dimensions[%]]
size of FEDU_Unbinned_0to360 = {8034, 36, 12}
```

```
In[ ]:= set = "FEDU_Unbinned_0to360";
seqb = Import[myFile, {"Datasets", {set}}];
Print["size of ", set, " = ", Dimensions[%]]
size of FEDU_Unbinned_0to360 = {8034, 36, 12}
```

```
In[ ]:= Norm[seqa - seqb, 2]
```

 **Norm:** The first Norm argument should be a scalar, vector, or matrix.

Out[]:=

```
Norm[{{ {0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.},
        {0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.},
        ... 32 ..., {0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.},
        {0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.}},
      { ... 1 ... }, ... 8030 ..., { ... 1 ... }, { ... 1 ... }}, 2]
```

large output

[show less](#)

[show more](#)

[show all](#)

[set size limit...](#)

```

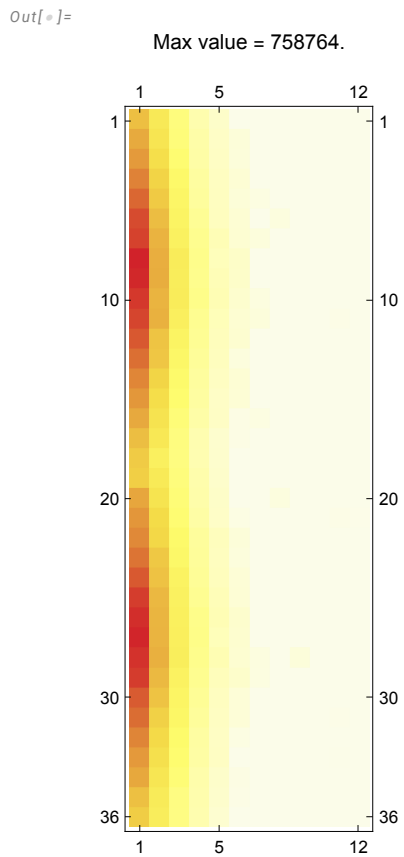
In[ ]:= a = seqa[[1, All]];
Dimensions[a]
amp = MatrixPlot[a,
  PlotLabel -> "Max value = "<> ToString[Max[a]] <> lf,
  ColorFunction -> "TemperatureMap"]

```

```

Out[ ]:=
{36, 12}

```



```

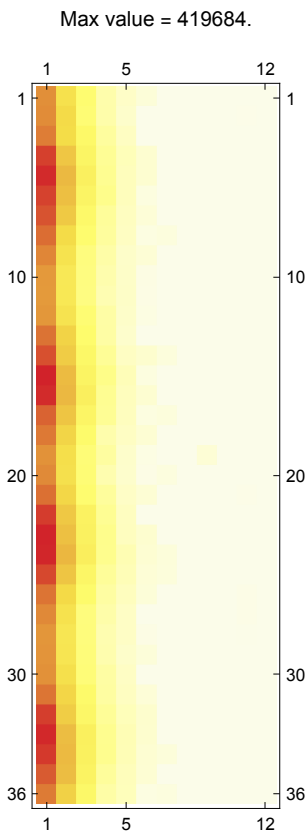
In[ ]:= z = seqa[[8034, All]];
Dimensions[z]
zmp = MatrixPlot[z,
  PlotLabel -> "Max value = "<>ToString[Max[z]]<>"\n",
  ColorFunction -> "TemperatureMap"]

```

Out[]:=

{36, 12}

Out[]:=



```

In[ ]:= multiExport["energy-matrix-fedu-unbinned-first", amp]
multiExport["energy-matrix-fedu-unbinned-last", zmp]

```

FPDU_Alpha

```

In[ ]:= seta = "FPDU_Unbinned_0to180";
seqa = Import[myFile, {"Datasets", {set}}];
Print["size of ", set, " = ", Dimensions[%]]
size of FEDU_Unbinned_0to360 = {8034, 36, 12}

```

```

In[ ]:= set = "FPDU_Unbinned_0to360";
        seqb = Import[myFile, {"Datasets", {set}}];
        Print["size of ", set, " = ", Dimensions[%]]
        size of FPDU_Unbinned_0to360 = {8034, 36, 8}

```

```

In[ ]:= Norm[seqa - seqb, 2]

```

⋯ Thread: Objects of unequal length in

{0., 0., 0., 0., 0., 0., 0., 0.} + {284443., 123991., 40212.5, 4496.95, 460.183, 0., 0., 0., 0., <<2>>} cannot be combined. ⓘ

⋯ Thread: Objects of unequal length in

{0., 0., 0., 0., 0., 0., 0., 0.} + {341488., 144069., 44826.9, 6452.89, 674.942, 143.038, 0., 0., 0., 0., <<2>>} cannot be combined. ⓘ

⋯ Thread: Objects of unequal length in

{0., 0., 0., 0., 0., 0., 0., 0.} + {404093., 184101., 55620.6, 7011.23, 1004.95, 141.983, 0., 0., 0., 0., <<2>>} cannot be combined. ⓘ

⋯ General: Further output of Thread::tdlen will be suppressed during this calculation. ⓘ

```

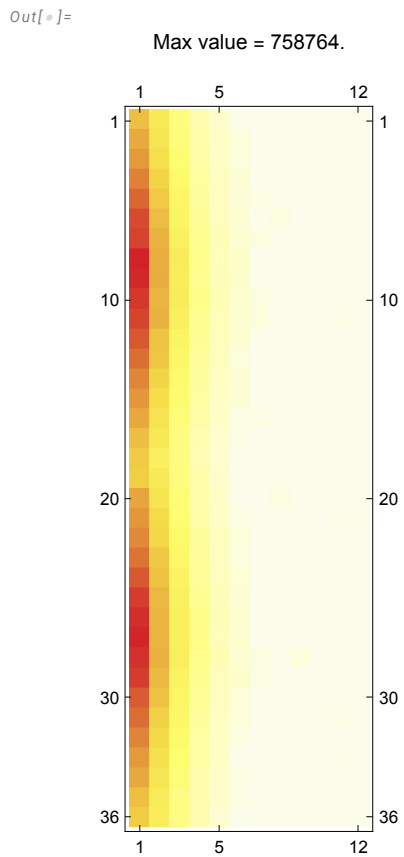
In[ ]:= a = seqa[[1, All]];
Dimensions[a]
amp = MatrixPlot[a,
  PlotLabel -> "Max value = "<> ToString[Max[a]] <> lf,
  ColorFunction -> "TemperatureMap"]

```

```

Out[ ]:=
{36, 12}

```



```

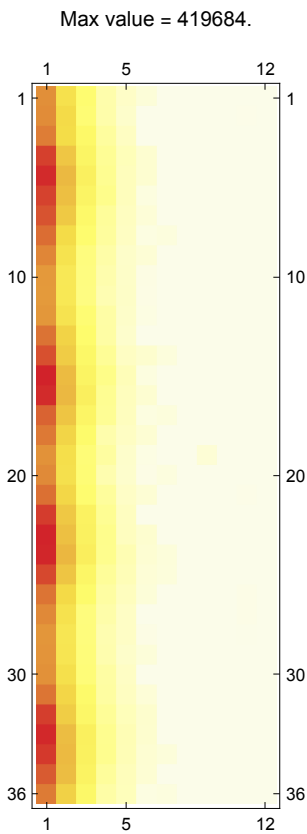
In[ ]:= z = seqa[[8034, All]];
Dimensions[z]
zmp = MatrixPlot[z,
  PlotLabel → "Max value = "<>ToString[Max[z]]<>"\n",
  ColorFunction → "TemperatureMap"]

```

Out[]:=

{36, 12}

Out[]:=



```

In[ ]:= multiExport["energy-matrix-fpdu-unbinned-first", amp]
multiExport["energy-matrix-fpdu-unbinned-last", zmp]

```

alpha

```

In[ ]:= set = "FEDU_Alpha";

In[ ]:= seqe = Import[myFile, {"Datasets", {set}}];
Print["size of ", set, " = ", Dimensions[%]]
size of FEDU_Alpha = {1, 17}

```



```

In[ ]:= seque
Out[ ]:= { {5.29412, 15.8824, 26.4706, 37.0588, 47.6471, 58.2353, 68.8235, 79.4118, 90.,
          100.588, 111.176, 121.765, 132.353, 142.941, 153.529, 164.118, 174.706} }

In[ ]:= set = "FPDU_Alpha";

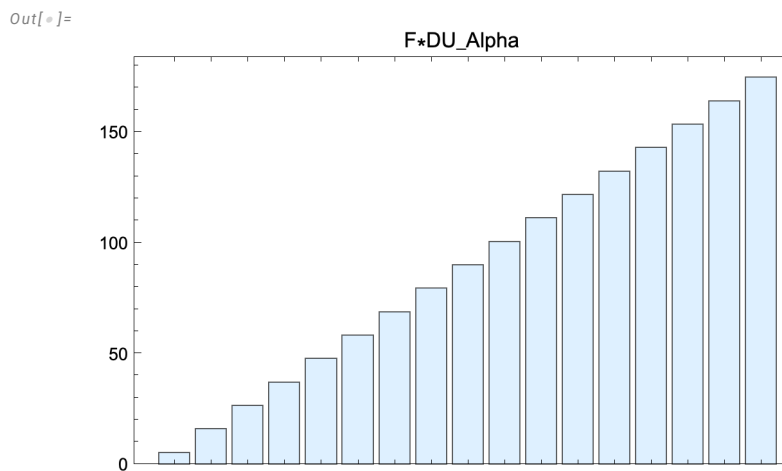
In[ ]:= seqd = Import[myFile, {"Datasets", {set}}];
Print["size of ", set, " = ", Dimensions[%]]
size of FPDU_Alpha = {1, 17}

In[ ]:= seqd
Out[ ]:= { {5.29412, 15.8824, 26.4706, 37.0588, 47.6471, 58.2353, 68.8235, 79.4118, 90.,
          100.588, 111.176, 121.765, 132.353, 142.941, 153.529, 164.118, 174.706} }

In[ ]:= Norm[seque - seqd, 2]
Out[ ]:= 0.

In[ ]:= g001 = BarChart[Flatten[seque],
  PlotLabel -> "F*DU_Alpha",
  Frame -> True,
  ChartStyle -> LightBlue]

```



```

In[ ]:= multiExport["energy-alpha", g001]

```

alpha_delta

```

In[ ]:= set = "FEDU_Alpha_DELTA";
seq = Import[myFile, {"Datasets", {set}}];
Print["size of ", set, " = ", Dimensions[%]]
size of FEDU_Alpha_DELTA = {1, 17}

```

```
In[ ]:= seq
```

```
Out[ ]:=
```

```
{ {10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882,
    10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882} }
```

```
In[ ]:= set = "FPDU_Alpha_DELTA";
```

```
In[ ]:= seq = Import[myFile, {"Datasets", {set}}];
```

```
Print["size of ", set, " = ", Dimensions[%]]
```

```
size of FEDU_Alpha_DELTA = {1, 17}
```

```
In[ ]:= seq
```

```
Out[ ]:=
```

```
{ {10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882,
    10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882, 10.5882} }
```

• •

```
In[ ]:= seqa
```

```
Out[ ]:=
```

```
{ {5.29412, 15.8824, 26.4706, 37.0588, 47.6471, 58.2353, 68.8235, 79.4118, 90.,
    100.588, 111.176, 121.765, 132.353, 142.941, 153.529, 164.118, 174.706} }
```

```
In[ ]:= seqb
```

```
Out[ ]:=
```

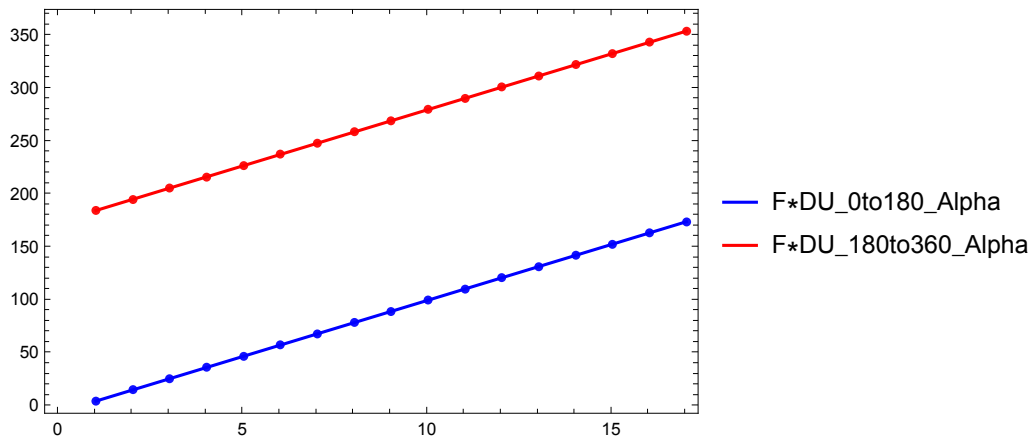
```
{ {185.294, 195.882, 206.471, 217.059, 227.647, 238.235, 248.824, 259.412, 270.,
    280.588, 291.176, 301.765, 312.353, 322.941, 333.529, 344.118, 354.706} }
```

```

In[ ]:= glines = ListPlot[{First[seqa], First[seqb]},
  PlotStyle -> {{Blue, Joined -> True}, {Red, Joined -> True}},
  PlotLegends -> {"F*DU_0to180_Alpha", "F*DU_180to360_Alpha"},
  Joined -> True,
  Mesh -> All,
  Frame -> True]

```

Out[]:=



```

In[ ]:= multiExport["energy-argon", glines];

```

end