

atlast-camera-concepts

May 28, 2026

Import maria (of course) and numpy (for some frequency definitions).

```
[1]: import maria
from maria.instrument import Band
import numpy as np

nu = np.array([42, 91.5, 151, 217.5, 288.5, 350, 403, 654, 845.5])*1e9 # in GHz
```

The below defines a bunch of bands, but this can be found in maria/band/configs/atlast.yml

```
[2]: f042 = Band(
    center=nu[0],
    width=24.e+9,
    shape="top_hat",
    time_constant=0,
    efficiency=0.5,
    gain_error=5.e-2,
    NEP=3.e-17,
    knee=1.0)

f093 = Band(
    center=nu[1], # in Hz
    width=51e9, # in Hz
    NET_RJ=40e-6, # in K sqrt(s)
    knee=1e0, # in Hz
    shape="top_hat",
    efficiency=0.5,
    gain_error=5e-2)

f150 = Band(
    center=nu[2],
    width=62e9,
    NET_RJ=60e-6,
    knee=1e0,
    shape="top_hat",
    efficiency=0.5,
    gain_error=5e-2)
```

```

f220 = Band(
    center=nu[3],
    width=69e9,
    NET_RJ=100e-6,
    knee=1e0,
    shape="top_hat",
    efficiency=0.5,
    gain_error=5e-2)

f280 = Band(
    center=nu[4],
    width=73e9,
    NET_RJ=100e-6,
    knee=1e0,
    shape="top_hat",
    efficiency=0.5,
    gain_error=5e-2)

f350 = Band(
    center=nu[5],
    width=50e9,
    NET_RJ=300e-6,
    knee=1e0,
    shape="top_hat",
    efficiency=0.5,
    gain_error=5e-2)

f400 = Band(
    center=nu[6],
    width=38e9,
    NET_RJ=400e-6,
    knee=1e0,
    shape="top_hat",
    efficiency=0.5,
    gain_error=5e-2)

f650 = Band(
    center=nu[7],
    width=118e9,
    NET_RJ=400e-6,
    knee=1e0,
    shape="top_hat",
    efficiency=0.5,
    gain_error=5e-2)

f850 = Band(
    center=nu[8],

```

```

width=119e9,
NET_RJ=400e-6,
knee=1e0,
shape="top_hat",
efficiency=0.5,
gain_error=5e-2)

```

```

[3]: array_ultralow = {"field_of_view": 2.0,
    "shape": "circle",
    "beam_spacing": 2.0,
    "primary_size": 50,
    "polarized": True,
    "bands": [f042][:]}

array_low = {"field_of_view": 2.0,
    "shape": "circle",
    "beam_spacing": 2.0,
    "primary_size": 50,
    "polarized": True,
    "bands": [f093, f150][:]}

array_med = {"field_of_view": 1.0,
    "shape": "circle",
    "beam_spacing": 2.0,
    "primary_size": 50,
    "polarized": True,
    "bands": [f220, f280][:]}

array_high = {"field_of_view": 1.0,
    "shape": "circle",
    "beam_spacing": 2.0,
    "primary_size": 50,
    "polarized": True,
    "bands": [f350, f400][:]}

array_ultrahigh = {"field_of_view": 0.3,
    "shape": "circle",
    "beam_spacing": 2.0,
    "primary_size": 50,
    "polarized": True,
    "bands": [f650, f850][:]}

```

Let's look at the arrays individually first:

```

[4]: instruments = maria.get_instrument(arrays=[array_ultralow])
    print(instruments)
    instruments.plot()

```

```

instruments = maria.get_instrument(arrays=[array_low])
print(instruments)
instruments.plot()

instruments = maria.get_instrument(arrays=[array_med])
print(instruments)
instruments.plot()

instruments = maria.get_instrument(arrays=[array_high])
print(instruments)
instruments.plot()

instruments = maria.get_instrument(arrays=[array_ultrahigh])
print(instruments)
instruments.plot()

```

Instrument(1 array)

arrays:

| | n | FOV | baseline | bands | polarized |
|--------|-------|--------|----------|--------|-----------|
| array1 | 16642 | 2.002° | 0 m | [f042] | True |

bands:

| | name | center | width | NEP | NET_RJ | NET_CMB | FWHM |
|---|------|--------|--------|-------------|---------------|----------------|--------|
| 0 | f042 | 42 GHz | 24 GHz | 0.5 30 aW/s | 183.7 uK_RJ/s | 192.4 uK_CMB/s | 37.49" |

Instrument(1 array)

arrays:

| | n | FOV | baseline | bands | polarized |
|--------|--------|--------|----------|-------------|-----------|
| array1 | 157204 | 1.999° | 0 m | [f092,f151] | True |

bands:

| | name | center | width | NEP | NET_RJ | NET_CMB | FWHM |
|---|------|----------|--------|----------------|------------|----------------|--------|
| 0 | f092 | 91.5 GHz | 51 GHz | 0.5 13.88 aW/s | 40 uK_RJ/s | 49.58 uK_CMB/s | 17.21" |
| 1 | f151 | 151 GHz | 62 GHz | 0.5 25.32 aW/s | 60 uK_RJ/s | 104.6 uK_CMB/s | 10.43" |

Instrument(1 array)

arrays:

| | n | FOV | baseline | bands | polarized |
|--------|--------|--------|----------|-------------|-----------|
| array1 | 222068 | 59.99' | 0 m | [f217,f288] | True |

bands:

| | name | center | width | NEP | NET_RJ | NET_CMB | FWHM |
|---|------|-----------|--------|----------------|-------------|----------------|--------|
| 0 | f217 | 217.5 GHz | 69 GHz | 0.5 46.96 aW/s | 100 uK_RJ/s | 297.1 uK_CMB/s | 7.24" |
| 1 | f288 | 288.5 GHz | 73 GHz | 0.5 49.68 aW/s | 100 uK_RJ/s | 601.7 uK_CMB/s | 5.458" |


```
Instrument(1 array)
```

```
arrays:
```

| | n | FOV | baseline | bands | polarized |
|--------|--------|--------|----------|-------------|-----------|
| array1 | 575048 | 59.99' | 0 m | [f350,f403] | True |

```
bands:
```

| | name | center | width | NEP | NET_RJ | NET_CMB |
|--------|------|---------|--------|-----|------------|----------------|
| FWHM | | | | | | |
| 0 | f350 | 350 GHz | 50 GHz | 0.5 | 102.1 aW/s | 300 uK_RJ/s |
| | | | | | | 3.684 mK_CMB/s |
| 4.499" | | | | | | |
| 1 | f403 | 403 GHz | 38 GHz | 0.5 | 103.4 aW/s | 400 uK_RJ/s |
| | | | | | | 9.488 mK_CMB/s |
| 3.907" | | | | | | |

```
Instrument(1 array)
```

```
arrays:
```

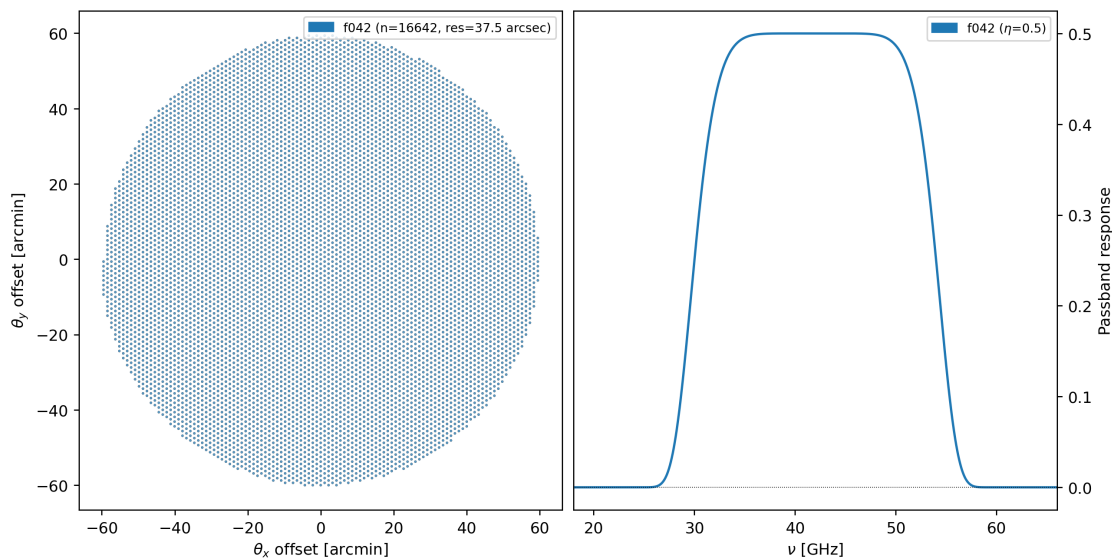
| | n | FOV | baseline | bands | polarized |
|--------|--------|--------|----------|-------------|-----------|
| array1 | 180700 | 17.99' | 0 m | [f654,f846] | True |

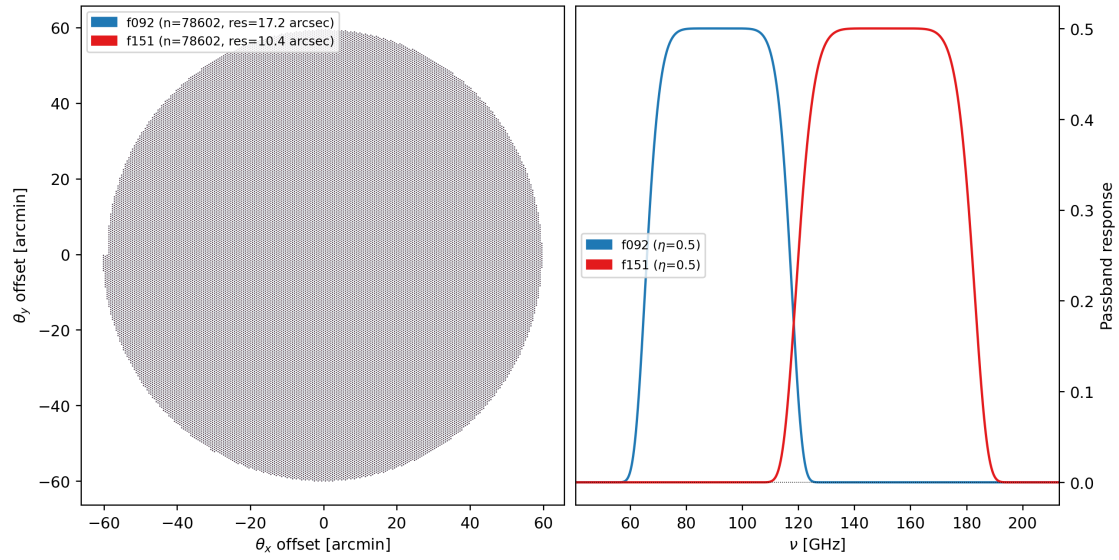
```
bands:
```

| | name | center | width | NEP | NET_RJ | NET_CMB |
|--------|------|-----------|---------|-----|------------|----------------|
| FWHM | | | | | | |
| 0 | f654 | 654 GHz | 118 GHz | 0.5 | 321.2 aW/s | 400 uK_RJ/s |
| | | | | | | 268.1 mK_CMB/s |
| 2.408" | | | | | | |
| 1 | f846 | 845.5 GHz | 119 GHz | 0.5 | 324 aW/s | 400 uK_RJ/s |
| | | | | | | 4.603 K_CMB/s |
| 1.862" | | | | | | |

```
/Users/amroczko/opt/miniconda3/lib/python3.12/site-  
packages/IPython/core/events.py:96: UserWarning: Creating legend with loc="best"  
can be slow with large amounts of data.
```

```
func(*args, **kwargs)
```

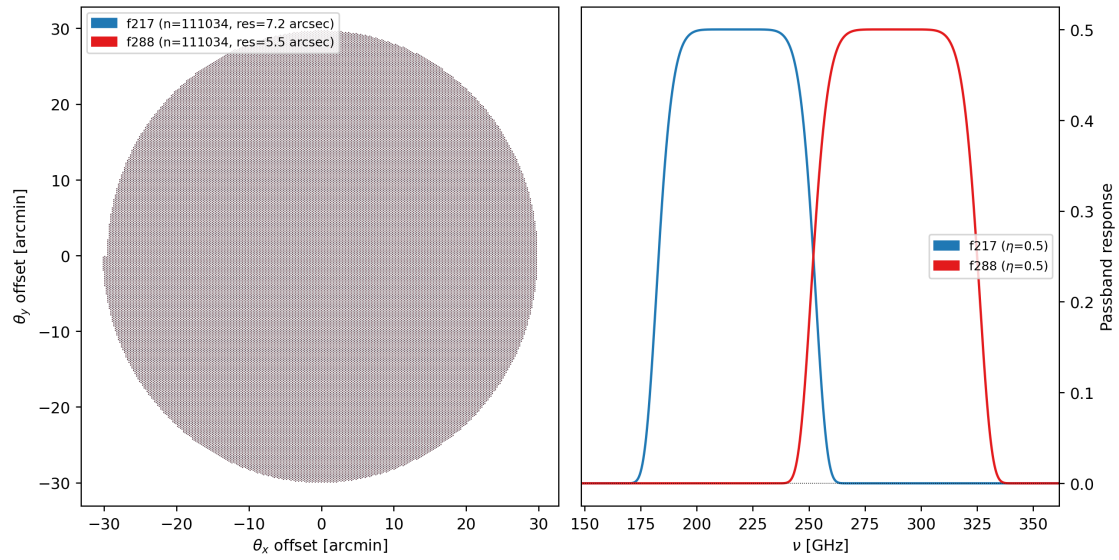


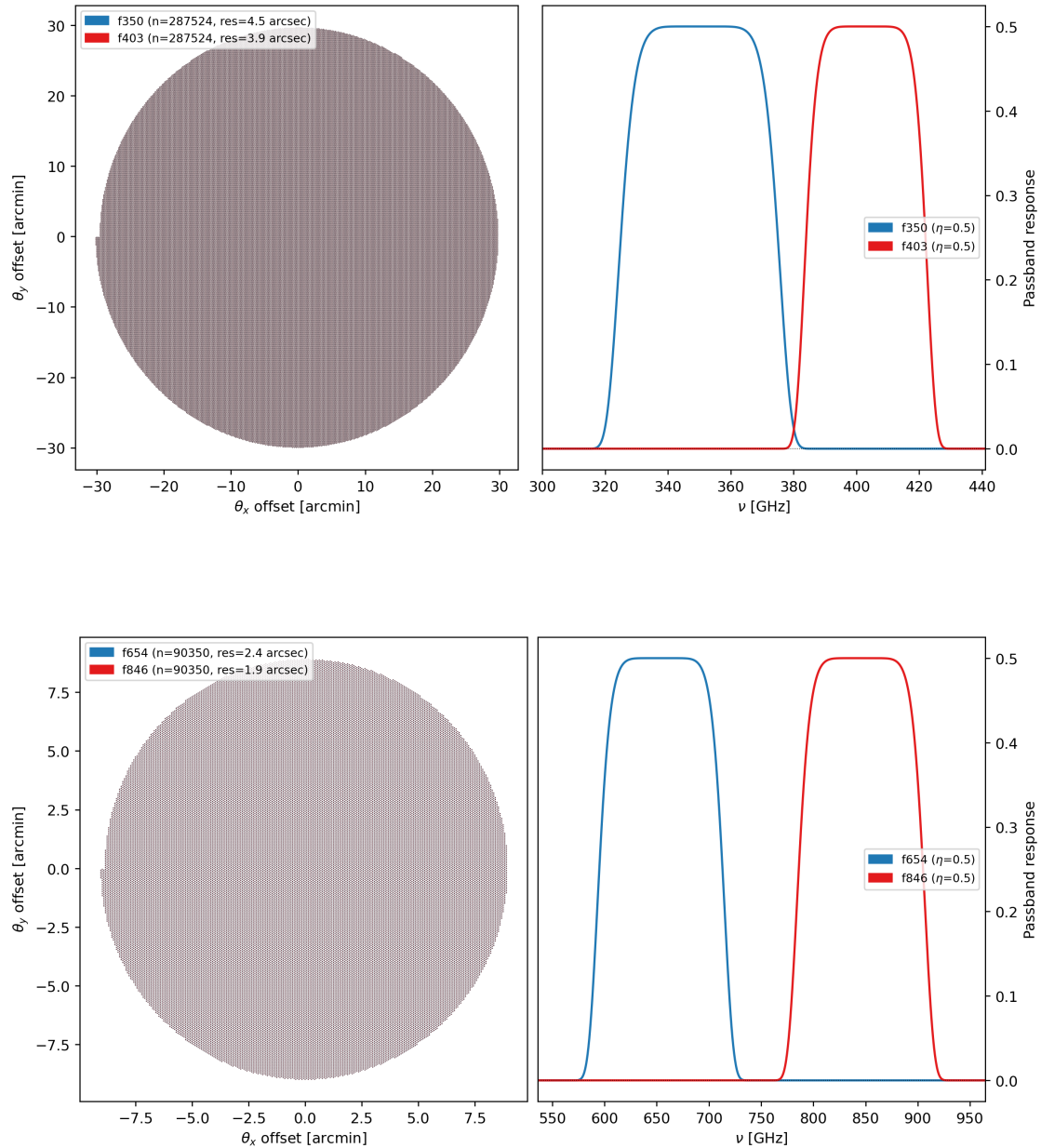


```

/Users/amroczko/opt/miniconda3/lib/python3.12/site-
packages/IPython/core/pylabtools.py:170: UserWarning: Creating legend with
loc="best" can be slow with large amounts of data.
fig.canvas.print_figure(bytes_io, **kw)

```





Here's a concept for a set of 4 dichroic arrays with f/2.0 in the lower band of each. The upper portions will be spaced more widely.

```
[5]: instruments = maria.get_instrument(arrays=[array_low, array_med, array_high,
      ↪ array_ultrahigh])
print(instruments)
instruments.plot()
print('this results in a total of '+str(instruments.dets.n)+' detectors')
```

Instrument(4 arrays)

```
arrays:
      n      FOV baseline      bands polarized
array1 157204 1.999°      0 m [f092,f151]      True
array1 222068 59.99'      0 m [f217,f288]      True
array1 575048 59.99'      0 m [f350,f403]      True
array1 180700 17.99'      0 m [f654,f846]      True
```

```
bands:
      name      center      width      NEP      NET_RJ      NET_CMB
FWHM
  0 f092      91.5 GHz      51 GHz      0.5      13.88 aW/s      40 uK_RJ/s      49.58 uK_CMB/s
17.21"
  1 f151      151 GHz      62 GHz      0.5      25.32 aW/s      60 uK_RJ/s      104.6 uK_CMB/s
10.43"
  2 f217      217.5 GHz      69 GHz      0.5      46.96 aW/s      100 uK_RJ/s      297.1 uK_CMB/s
7.24"
  3 f288      288.5 GHz      73 GHz      0.5      49.68 aW/s      100 uK_RJ/s      601.7 uK_CMB/s
5.458"
  4 f350      350 GHz      50 GHz      0.5      102.1 aW/s      300 uK_RJ/s      3.684 mK_CMB/s
4.499"
  5 f403      403 GHz      38 GHz      0.5      103.4 aW/s      400 uK_RJ/s      9.488 mK_CMB/s
3.907"
  6 f654      654 GHz      118 GHz      0.5      321.2 aW/s      400 uK_RJ/s      268.1 mK_CMB/s
2.408"
  7 f846      845.5 GHz      119 GHz      0.5      324 aW/s      400 uK_RJ/s      4.603 K_CMB/s
1.862"
```

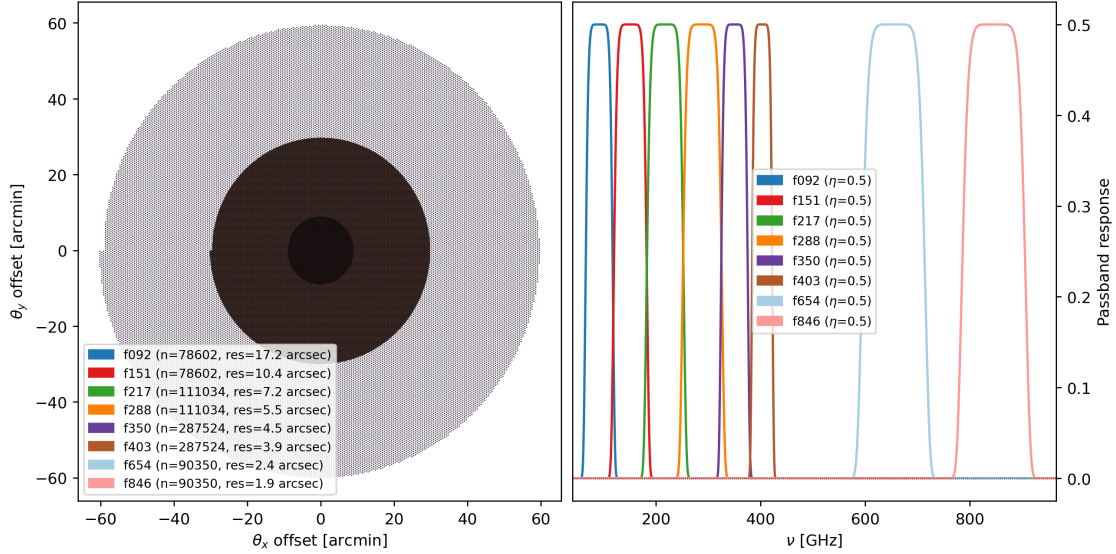
this results in a total of 1135020 detectors

```
/Users/amroczko/opt/miniconda3/lib/python3.12/site-
packages/IPython/core/events.py:96: UserWarning: Creating legend with loc="best"
can be slow with large amounts of data.
```

```
func(*args, **kwargs)
```

```
/Users/amroczko/opt/miniconda3/lib/python3.12/site-
packages/IPython/core/pylabtools.py:170: UserWarning: Creating legend with
loc="best" can be slow with large amounts of data.
```

```
fig.canvas.print_figure(bytes_io, **kw)
```



This is for a FoV about 1/10 the total area possible, using f/0.5 detector spacing. To get the full counts, we scale by 100x for area and another factor of 2x for the dual-frequencies. This only shows the lower band of each dichroic detector.

```
[7]: array_ultralow_small = {"field_of_view": 0.2,
    "shape": "circle",
    "beam_spacing": 0.5,
    "primary_size": 50,
    "polarized": True,
    "bands": [f042][:1]}

array_low_small = {"field_of_view": 0.2,
    "shape": "circle",
    "beam_spacing": 0.5,
    "primary_size": 50,
    "polarized": True,
    "bands": [f093, f150][:1]}

array_med_small = {"field_of_view": 0.1,
    "shape": "circle",
    "beam_spacing": 0.5,
    "primary_size": 50,
    "polarized": True,
    "bands": [f220, f280][:1]}

array_high_small = {"field_of_view": 0.1,
    "shape": "circle",
    "beam_spacing": 0.5,
```

```

        "primary_size": 50,
        "polarized": True,
        "bands": [f350, f400][:1]}

array_ultrahigh_small = {"field_of_view": 0.03,
        "shape": "circle",
        "beam_spacing": 0.5,
        "primary_size": 50,
        "polarized": True,
        "bands": [f650, f850][:1]}

instruments = maria.get_instrument(arrays=[array_ultralow_small,
↪array_low_small, array_med_small, array_high_small,array_ultrahigh_small])
print(instruments)
instruments.plot()
print('The full instrument would have '+str(2*100*instruments.dets.n)+'↪
↪detectors')

```

Instrument(5 arrays)

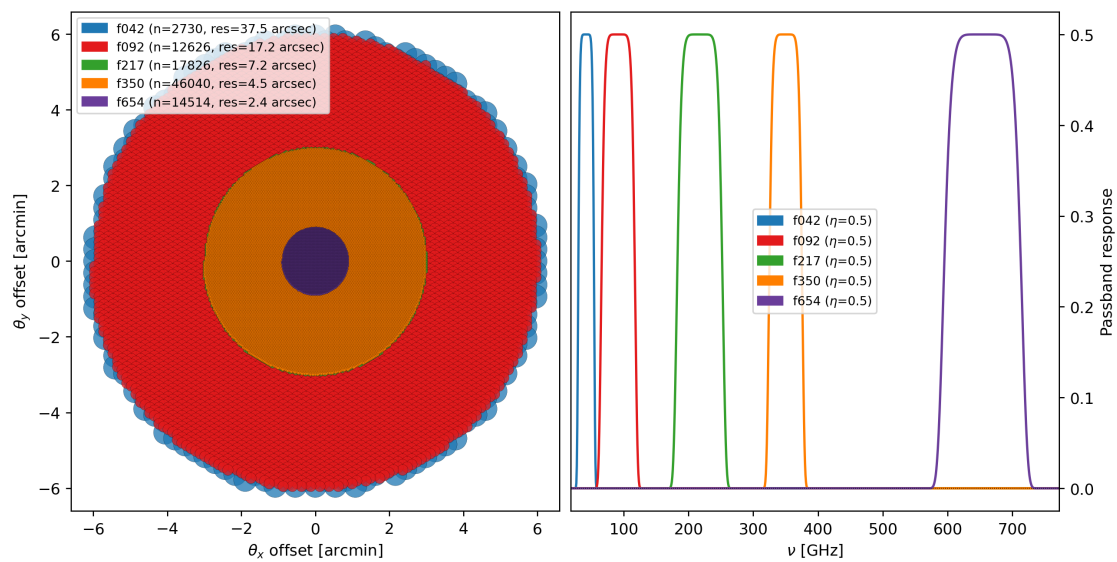
arrays:

| | n | FOV | baseline | bands | polarized |
|--------|-------|--------|----------|--------|-----------|
| array1 | 2730 | 12.1' | 0 m | [f042] | True |
| array2 | 12626 | 11.99' | 0 m | [f092] | True |
| array3 | 17826 | 6.001' | 0 m | [f217] | True |
| array4 | 46040 | 5.996' | 0 m | [f350] | True |
| array5 | 14514 | 1.8' | 0 m | [f654] | True |

bands:

| | name | center | width | NEP | NET_RJ | NET_CMB |
|--------|------|-----------|---------|-----|------------|---------------|
| FWHM | | | | | | |
| 0 | f042 | 42 GHz | 24 GHz | 0.5 | 30 aW/s | 183.7 uK_RJ/s |
| 37.49" | | | | | | |
| 1 | f092 | 91.5 GHz | 51 GHz | 0.5 | 13.88 aW/s | 40 uK_RJ/s |
| 17.21" | | | | | | |
| 2 | f217 | 217.5 GHz | 69 GHz | 0.5 | 46.96 aW/s | 100 uK_RJ/s |
| 7.24" | | | | | | |
| 3 | f350 | 350 GHz | 50 GHz | 0.5 | 102.1 aW/s | 300 uK_RJ/s |
| 4.499" | | | | | | |
| 4 | f654 | 654 GHz | 118 GHz | 0.5 | 321.2 aW/s | 400 uK_RJ/s |
| 2.408" | | | | | | |

The full instrument would have 18747200 detectors



[]: