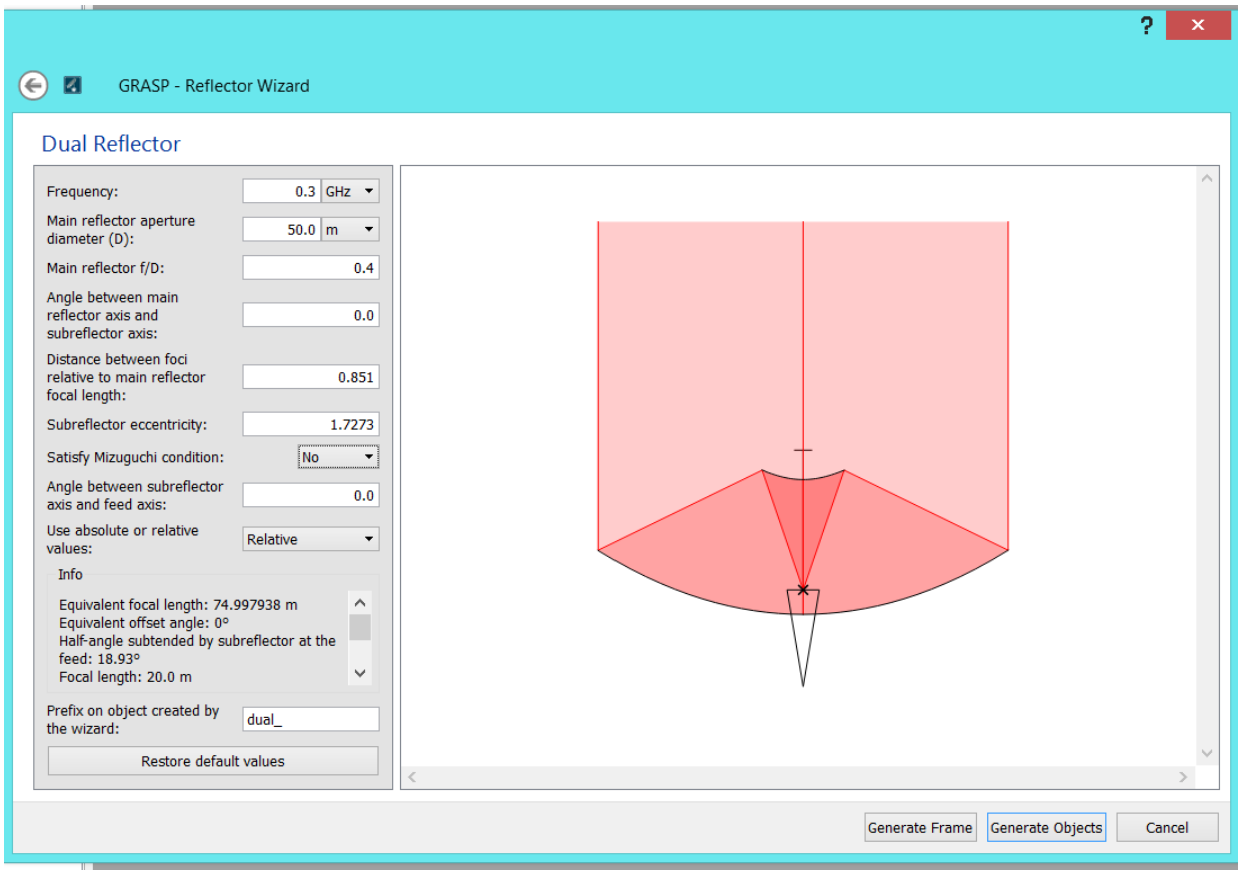
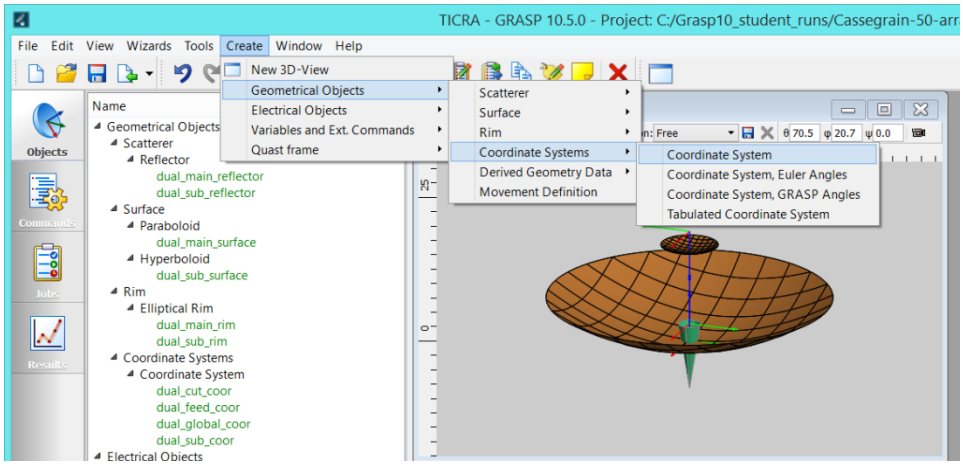
Array Feeding Cassegrain with GRASP

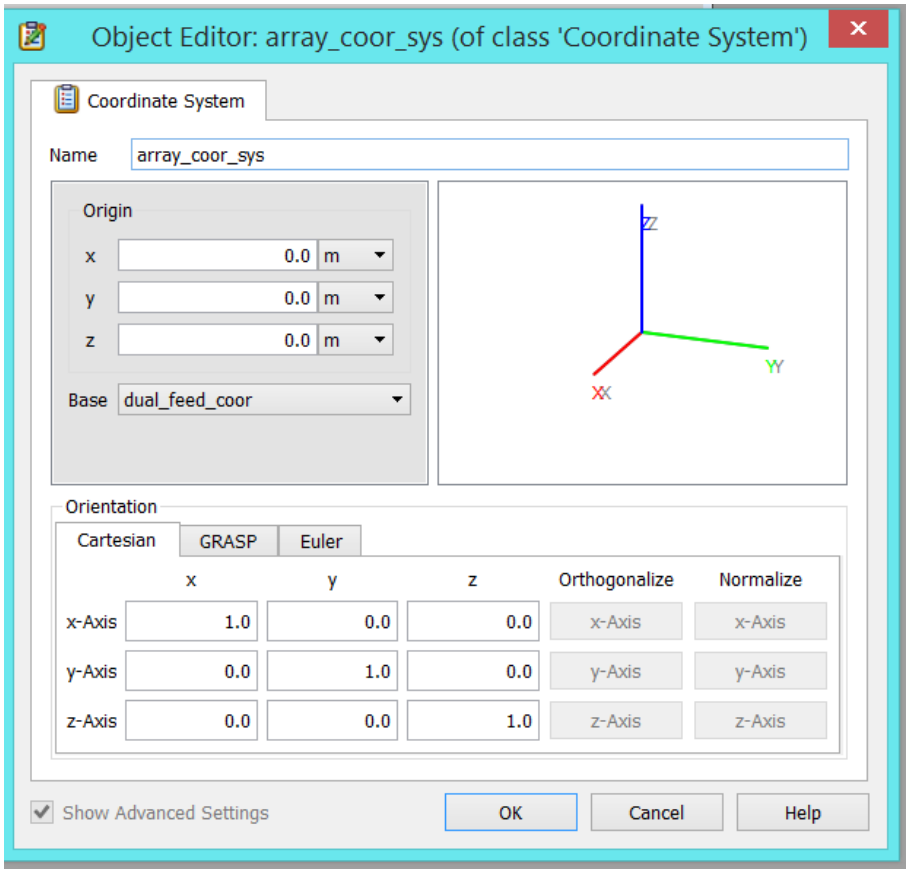
Start with dual reflector wizard and enter a 50λ diameter main reflector and a 10λ diameter subreflector. The main reflector *f/D* = 0.4 and effective *f/D* = 1.5 of the equivalent parabola.



Add coordinate system for array feed.

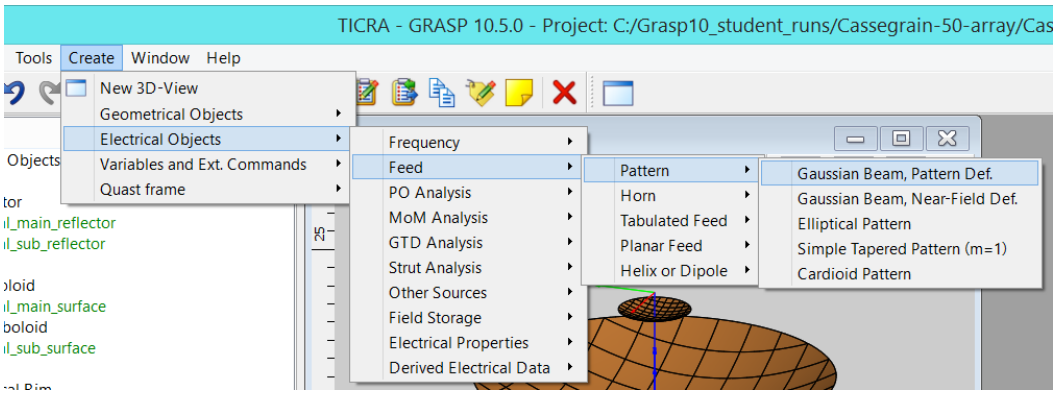


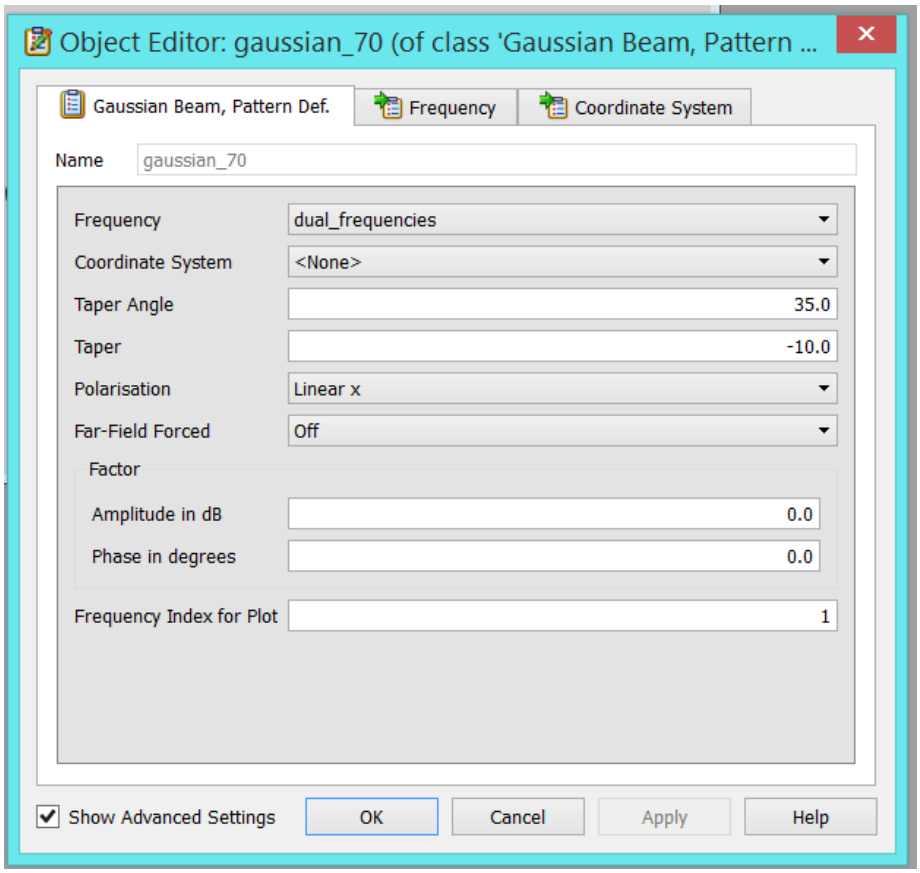
An array coordinate system is created with its coordinate system base: dual_feed_coor which the wizard created to locate the Gaussian Beam Feed.



The array consists of four elements spaced at 1.42λ with 14 dB gain so that combination has 20 dB gain (38.8° beamwidth). The element as 70° 10 dB beamwidth to produce 14 dB gain. The spacing was chosen to allow insert of square horn elements.

Add a 14 dB gain Gaussian beam feed.





Generate the *.isp file of the array element position and orientation using gaussian_70 array elements.

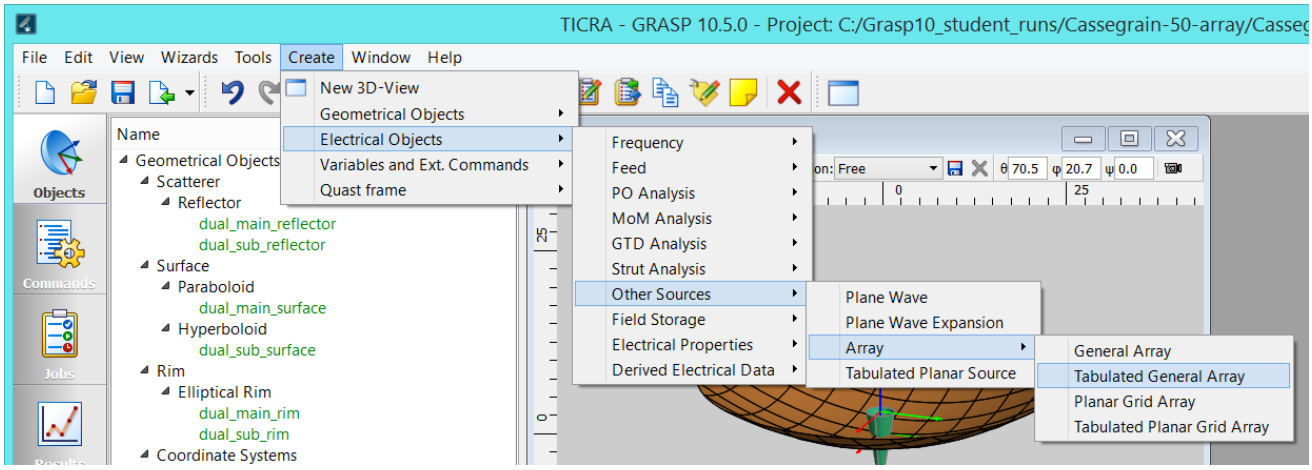
Sqfeed.isp

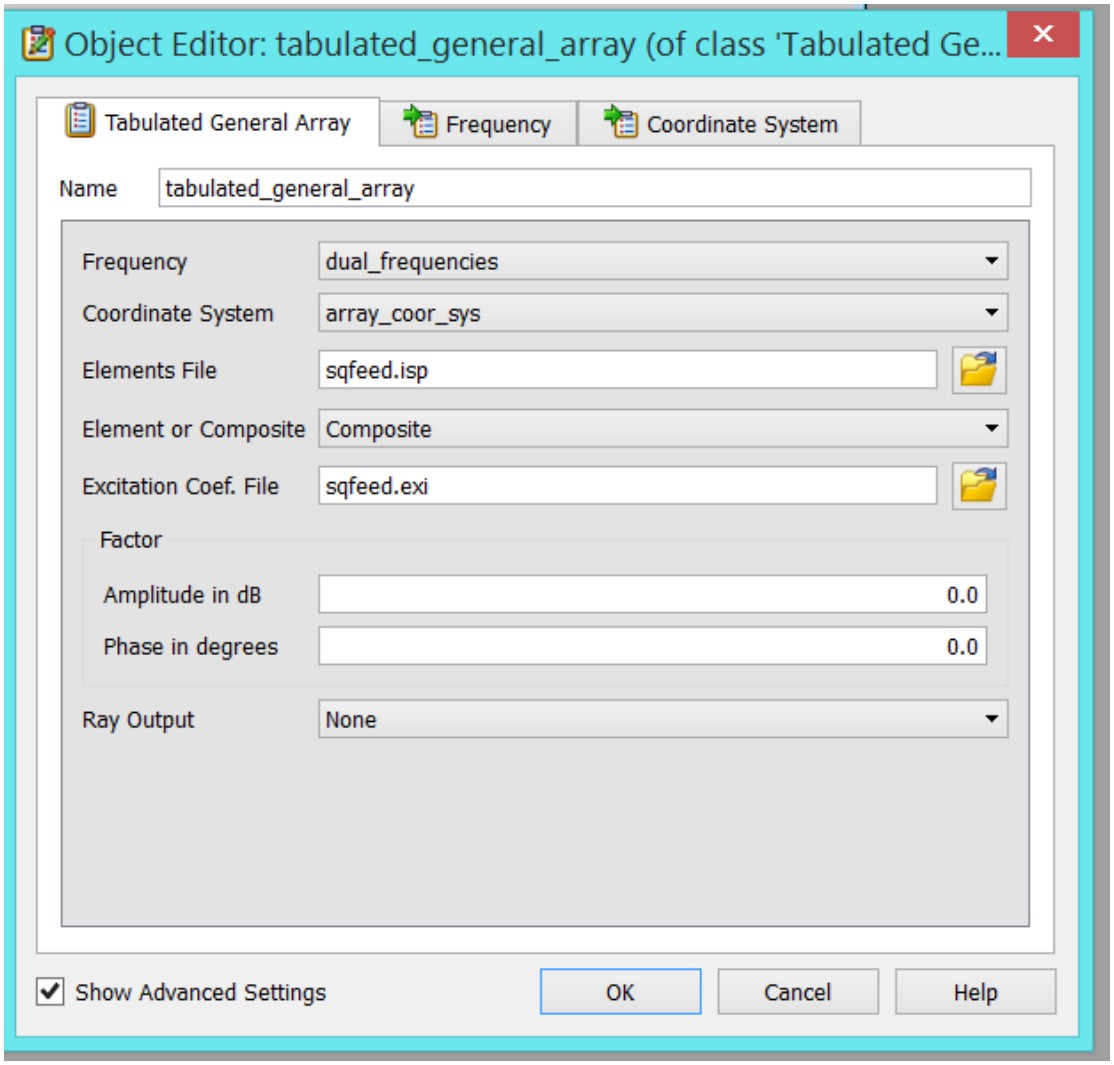
Square array 1.42 m spacing using 70 deg 10 dB beamwidth gau
++++
m
1 -7.100000E-01 -7.100000E-01 0.000000E+00 0.000 0.000 0.000 gaussian_70
2 7.100000E-01 -7.100000E-01 0.000000E+00 0.000 0.000 0.000 gaussian_70
3 -7.100000E-01 7.100000E-01 0.000000E+00 0.000 0.000 0.000 gaussian_70
4 7.100000E-01 7.100000E-01 0.000000E+00 0.000 0.000 0.000 gaussian_70

Associated with the array element position and orientation angles is the array excitation file: sqfeed.exi

Square array 1.42 m spacing using 70 deg 10 dB beamwidth gau
++++
1 -6.021 0.000
2 -6.021 0.000
3 -6.021 0.000
4 -6.021 0.000

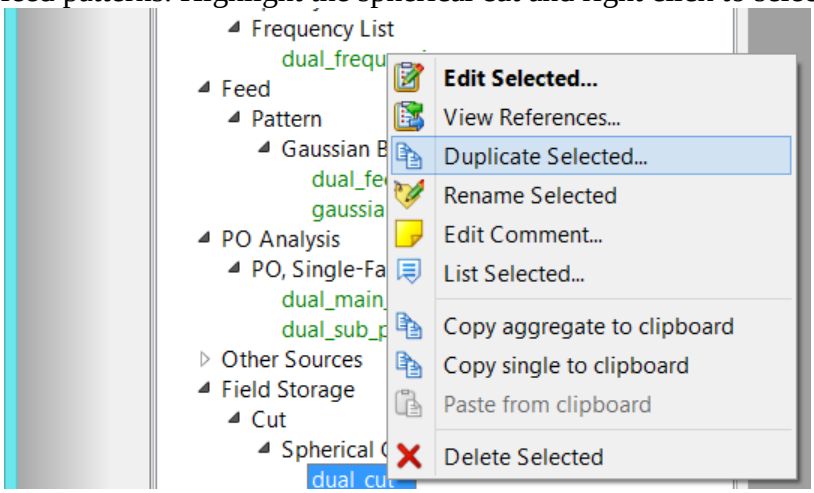
Store the *.isp array geometry file and *.exi array excitation in the “working” directory of the GRASP project.





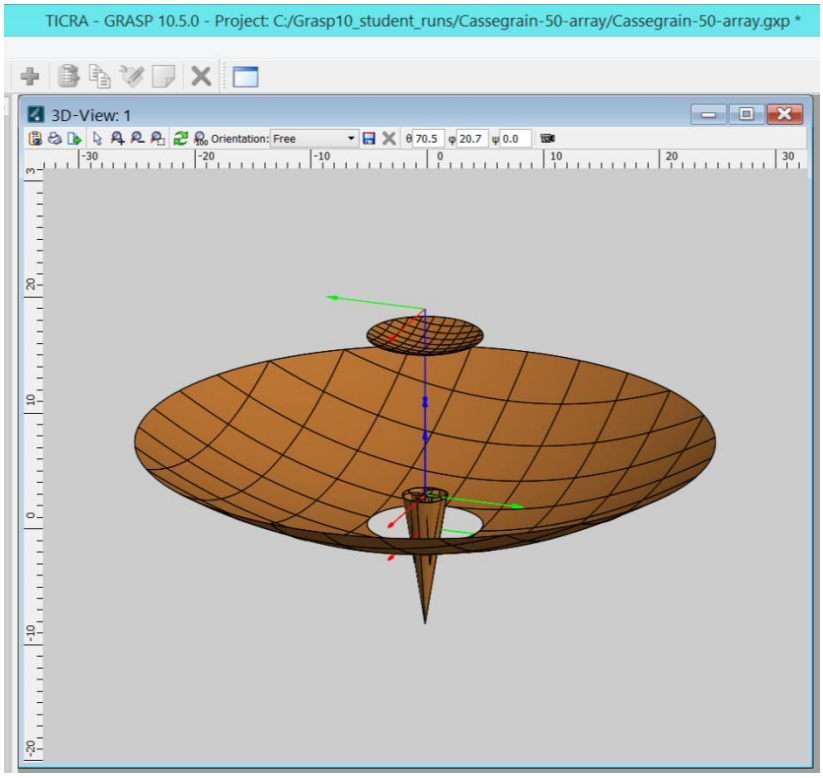
The object uses the dual_frequencies list. The array elements are located in the array_coor_sys whose coordinate base: dual_feed_coor was written by the wizard. The location and orientation of the elements are contained in "sqfeed.isp", pattern calculations use the sum of the array elements: "Composite."

Duplicate the output pattern specification to allow storage of single element and composite array feed patterns. Highlight the spherical cut and right click to select duplicate.

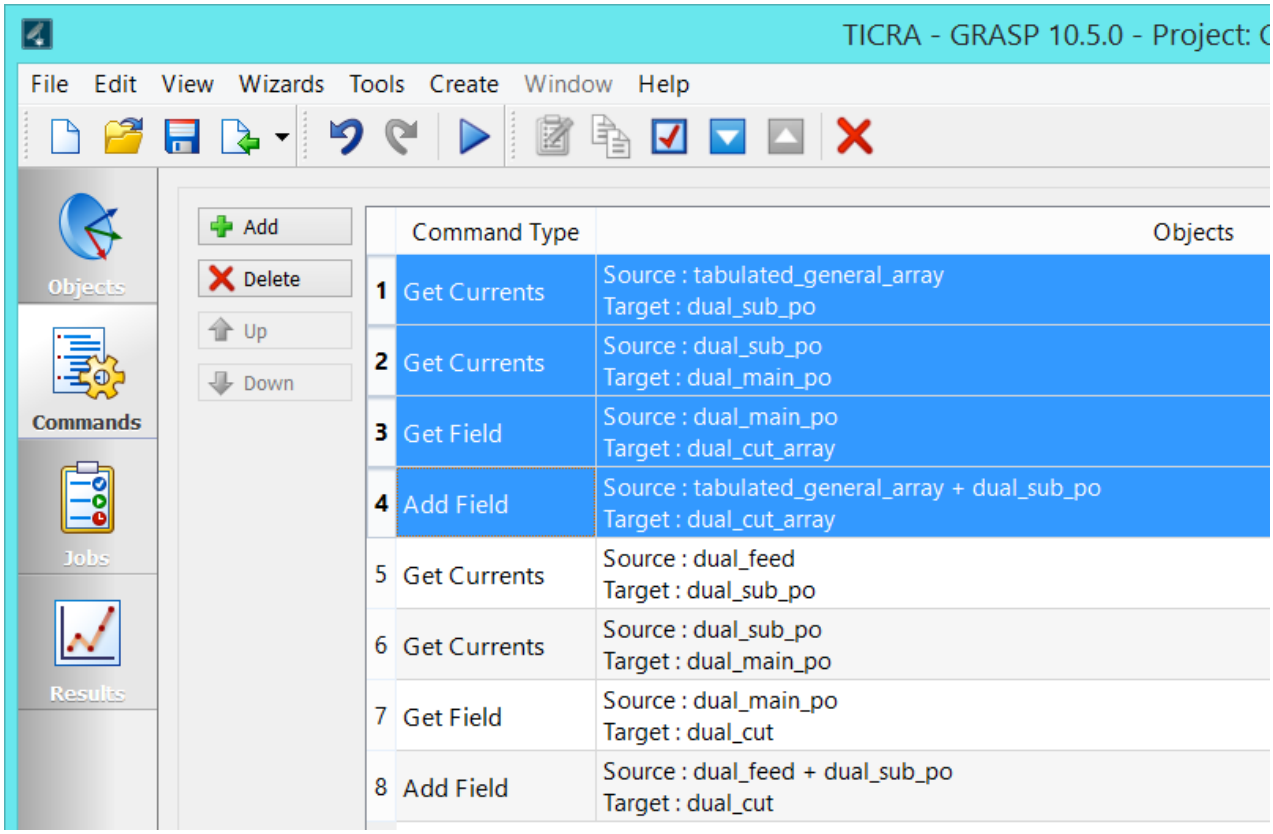


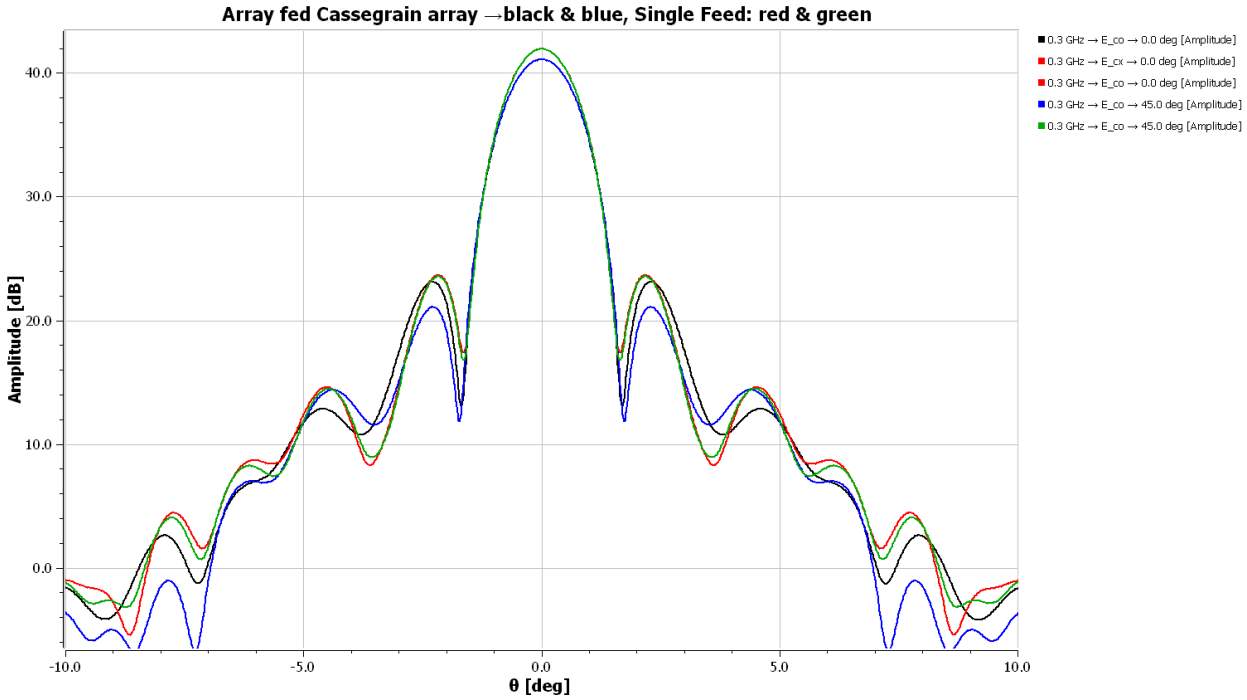
Add "dual_cut_array" spherical cut output object by duplicating and renaming.

Add main reflector center hole as an approximation to the subreflector blockage.

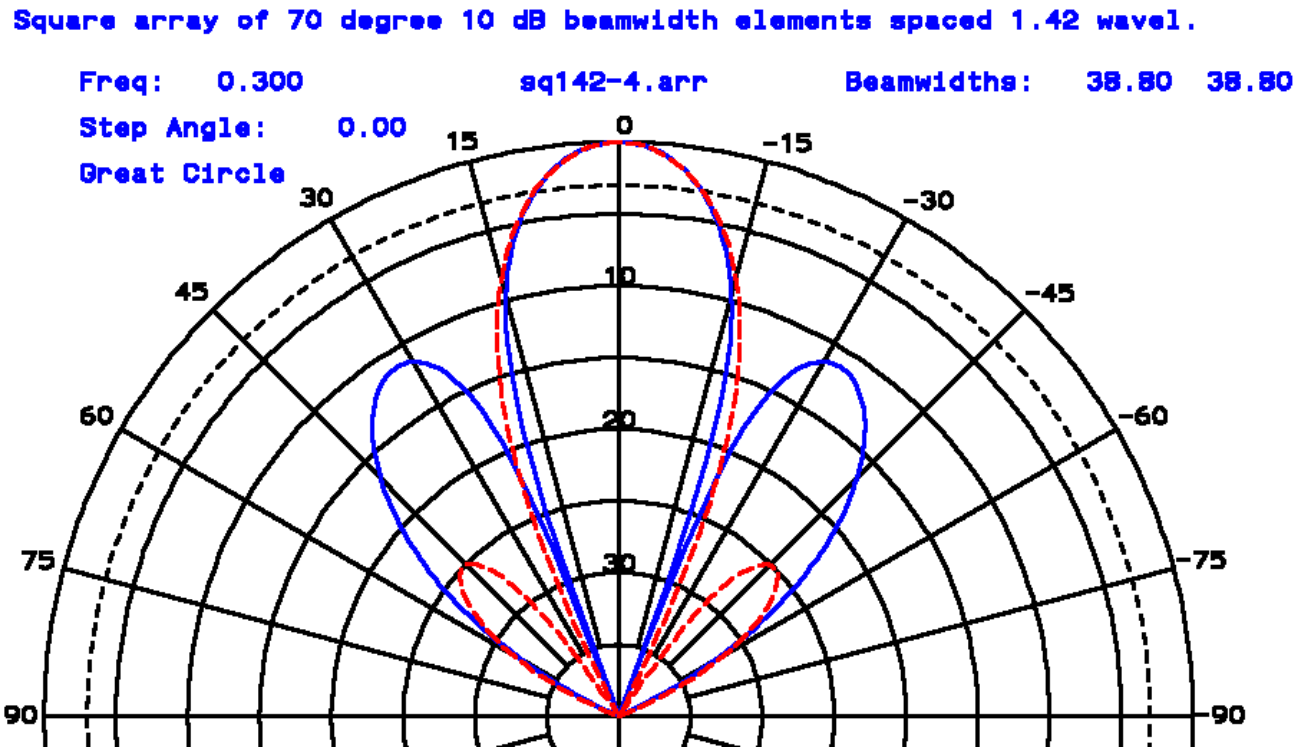


Array (composite) computations are added to the command list so that both patterns with an array feed and the single feed element are stored.





The array fed subreflector Cassegrain has lower gain than a single Gaussian beam fed antenna. The composite array feed pattern is computed:



The array pattern has same beamwidth as the single element. The large sidelobes are caused by grating lobes that have been reduced by the element pattern. GRASP computes excessive gain for the array because the 14 dB gain Gaussian beam elements have overlapping equivalent areas at 1.42λ element spacing. This produces 0.3 dB excessive gain in the array-fed Cassegrain.

The gain of the four element array is reduced by 0.3 dB due to sidelobes computed by the normalized mutual resistance method using the array element beamwidths and spacing. GRASP computes the difference between a single feed and the array feed as 0.84 dB. The GRASP job computes spillover losses for both the sub- and main-reflectors but they are not used in the PO/PTD calculation.

```
----- TASK No. 1 -----     Started at 21:00:25 on November 10, 2016

dual_sub_po get_currents ( source : sequence(ref(tabulated_general_array)),
auto_convergence_of_po : on, convergence_on_scatterer :
sequence(ref(dual_main_reflector)), convergence_on_output_grid :
sequence(ref(dual_cut_array)))

 PO1 =   18  PO2 =   42  Face =    1, Final PO-values from auto-convergence
 PTD =  123              Edge =    1, Final PTD-value from auto-convergence.

 Calculating currents.
 No. of PO-points (target):               549
 No. of PTD points (target):              123

 Relative power hitting scatterer:    0.816312
 Spill-over:     0.8814 dB
Total task time:  0.23 sec
```

Spillover loss on subreflector using array feed

```
----- TASK No. 2 -----     Started at 21:00:25 on November 10, 2016

dual_main_po get_currents ( source : sequence(ref(dual_sub_po)),
auto_convergence_of_po : on, convergence_on_output_grid :
sequence(ref(dual_cut_array)))

 PO1 =   16  PO2 =   37  Face =    1, Final PO-values from auto-convergence
 PTD =   33              Edge =    1, Final PTD-value from auto-convergence.
 PTD =   11              Edge =    2, Final PTD-value from auto-convergence.

 Calculating currents.
 No. of PO-points (target):               486
 No. of PO points (source):               549
 No. of PTD points (source):              123
 No. of edges with PTD (target):            2
   PTD points at edge 1:                   33
 No. of PO points (source):               549
 No. of PTD points (source):              123
   PTD points at edge 2:                   11
 No. of PO points (source):               549
 No. of PTD points (source):              123

 Relative power hitting scatterer:    0.704481
 Spill-over:     1.5213 dB
Total task time:  0.50 sec
```

Spillover loss on main reflector using array feed

```
----- TASK No. 5 -----     Started at 21:00:26 on November 10, 2016

dual_sub_po get_currents ( source : sequence(ref(dual_feed)),
auto_convergence_of_po : on, convergence_on_scatterer :
sequence(ref(dual_main_reflector)), convergence_on_output_grid :
sequence(ref(dual_cut)))

 PO1 =   18  PO2 =   40  Face =    1, Final PO-values from auto-convergence
 PTD =  130              Edge =    1, Final PTD-value from auto-convergence.

 Calculating currents.
 No. of PO-points (target):                524
 No. of PTD points (target):               130

 Relative power hitting scatterer:    0.924964
 Spill-over:     0.3388 dB
Total task time:  0.19 sec
```

Spillover loss on subreflector using single feed

```
----- TASK No. 6 -----     Started at 21:00:26 on November 10, 2016

dual_main_po get_currents ( source : sequence(ref(dual_sub_po)),
auto_convergence_of_po : on, convergence_on_output_grid :
sequence(ref(dual_cut)))

 PO1 =   21  PO2 =   36  Face =    1, Final PO-values from auto-convergence
 PTD =   33              Edge =    1, Final PTD-value from auto-convergence.
 PTD =   10              Edge =    2, Final PTD-value from auto-convergence.

 Calculating currents.
 No. of PO-points (target):                621
 No. of PO points (source):                524
 No. of PTD points (source):               130
 No. of edges with PTD (target):             2
   PTD points at edge 1:                    33
 No. of PO points (source):                524
 No. of PTD points (source):               130
   PTD points at edge 2:                    10
 No. of PO points (source):                524
 No. of PTD points (source):               130

 Relative power hitting scatterer:    0.804615
 Spill-over:     0.9441 dB
Total task time:  0.56 sec
```

Spillover loss on main reflector using single feed

The difference between the sum of spillover losses with an array feed and a single feed of approximately the same pattern (same gain) is 1.12 dB. The difference between the spillover losses of 1.12 for the two cases and that computed by GRASP 0.84 dB has a difference of 0.28 dB. This is very close to the difference predicted by the normalized mutual resistance method of 0.30 dB. Of course, if we were using GRASP with an array, we would not have these spillover terms for comparison.