



# 《电磁工业软件理论与仿真》

## HFSS-RCS仿真方法

电子科技大学（深圳）高等研究院  
电子产品工业软件研究中心

2023-04



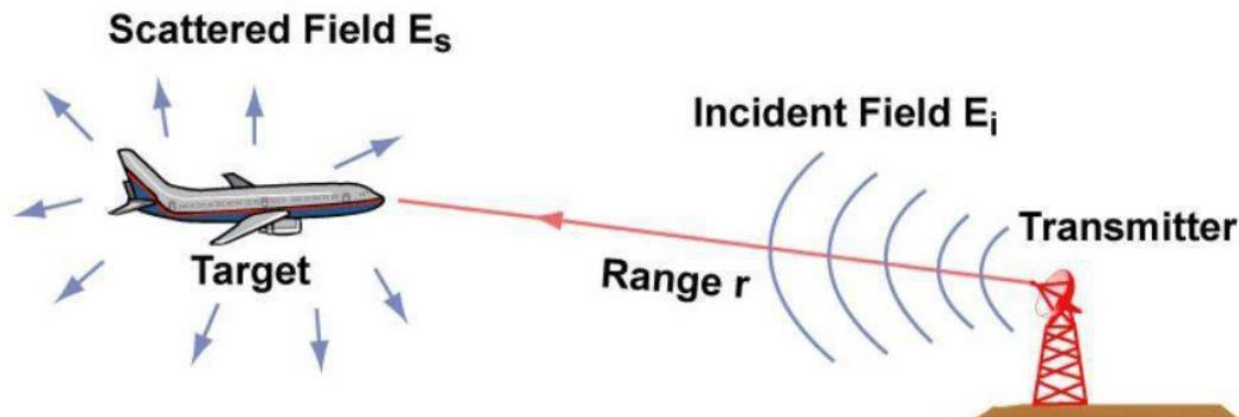
# RCS (Radar Cross Section)

简介



# RCS简介

RCS是目标在雷达接收方向上反射雷达信号能力的度量，一个目标的RCS等于单位立体角目标在雷达接收天线方向上反射的功率(每单位立体角)与入射到目标处的功率密度(每平方米)之比。



$$\sigma = \lim_{R \rightarrow \infty} 4\pi R^2 \frac{|E_s|^2}{|E_0|^2}$$

RCS单站：辐射源与接收机位于同一点

RCS双站：散射方向不指向辐射源



## 学习目的:

(1)边界、激励、求解设置

(2)查看后处理结果



# HFSS RCS单站仿真方法

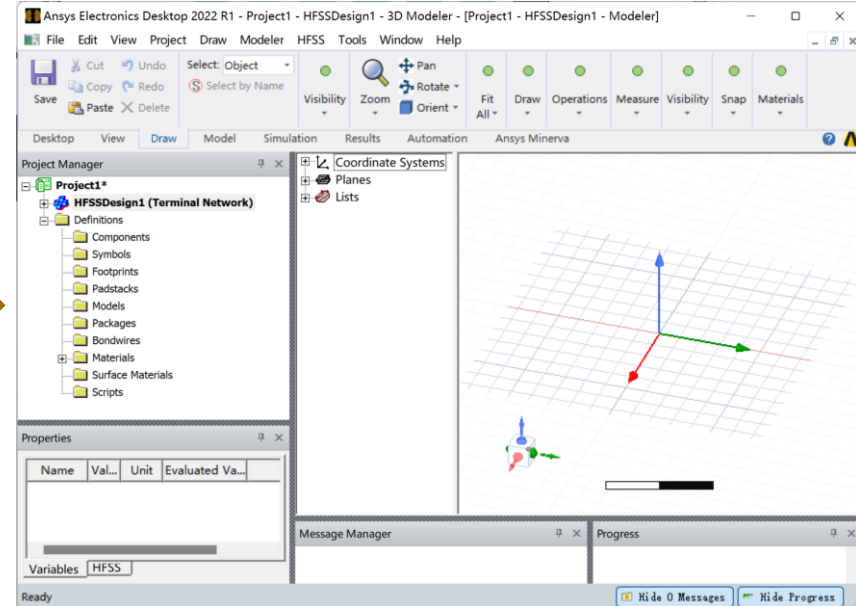
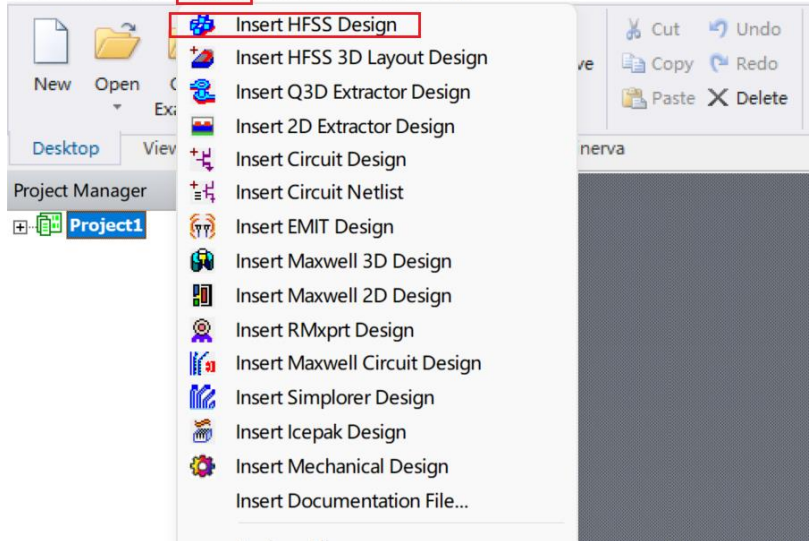


# HFSS RCS单站仿真方法

## ——创建工程

Ansys Electronics Desktop 2022 R1 - Project1

File Edit View **Project** Tools Window Help

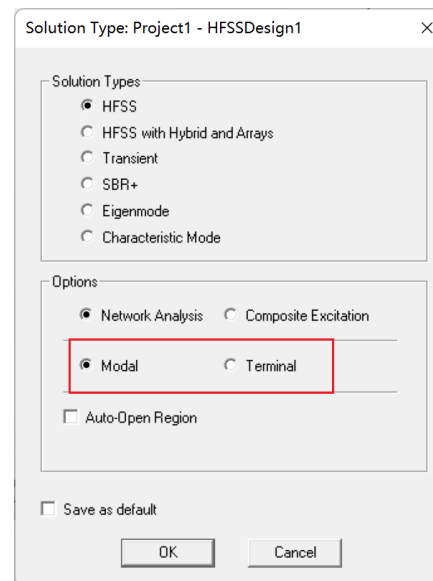
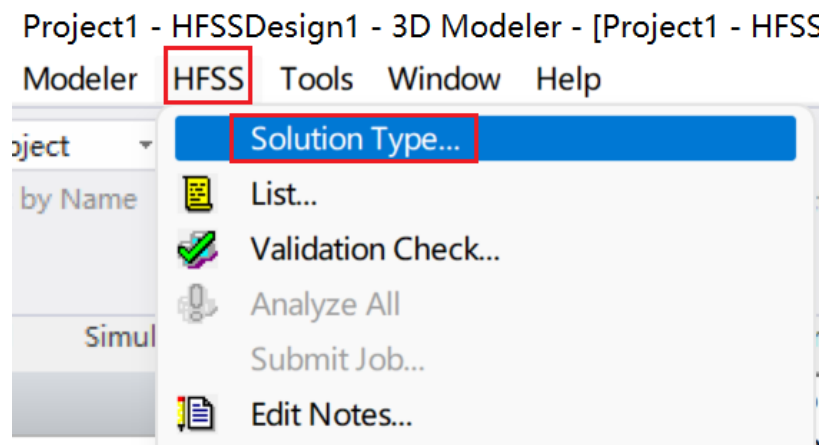




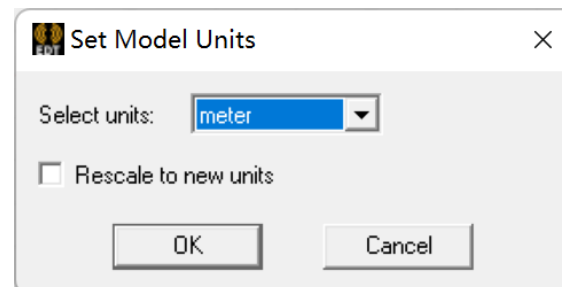
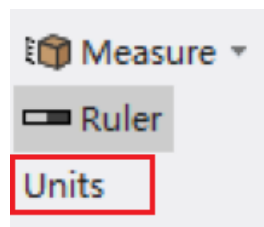
# HFSS RCS单站仿真方法

## ——创建工程

### 修改求解类型



### 在工具栏点击Units并根据实际情况修改单位



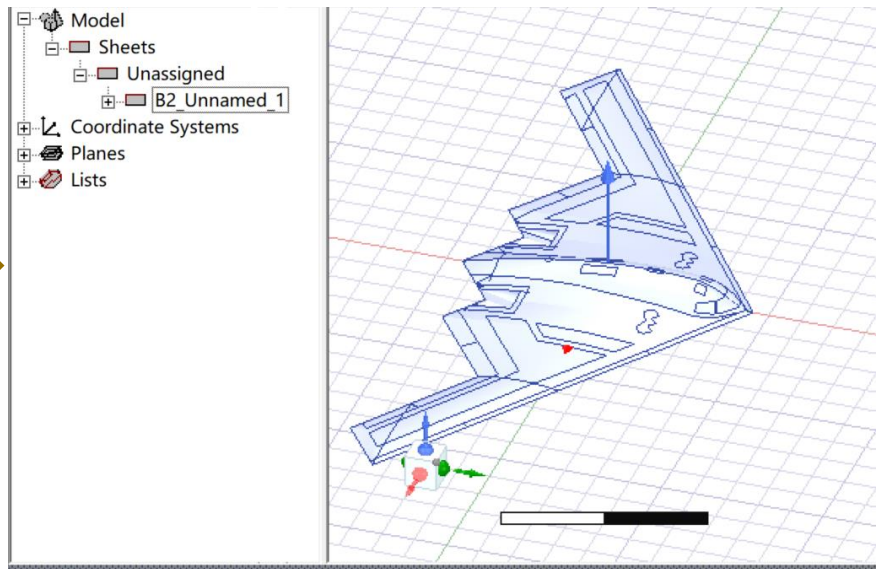
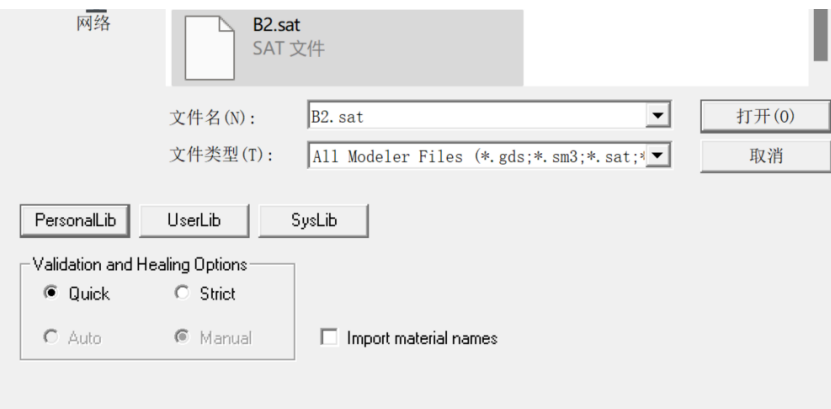
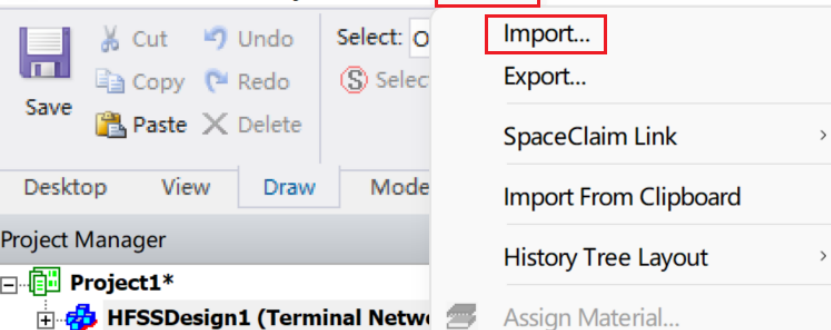


# HFSS RCS单站仿真方法

## ——导入模型

ANSYS Electronics Desktop 2022 R1 - Project1 - HFSSDesign1 - 3D Mod

File Edit View Project Draw **Modeler** HFSS Tools Window



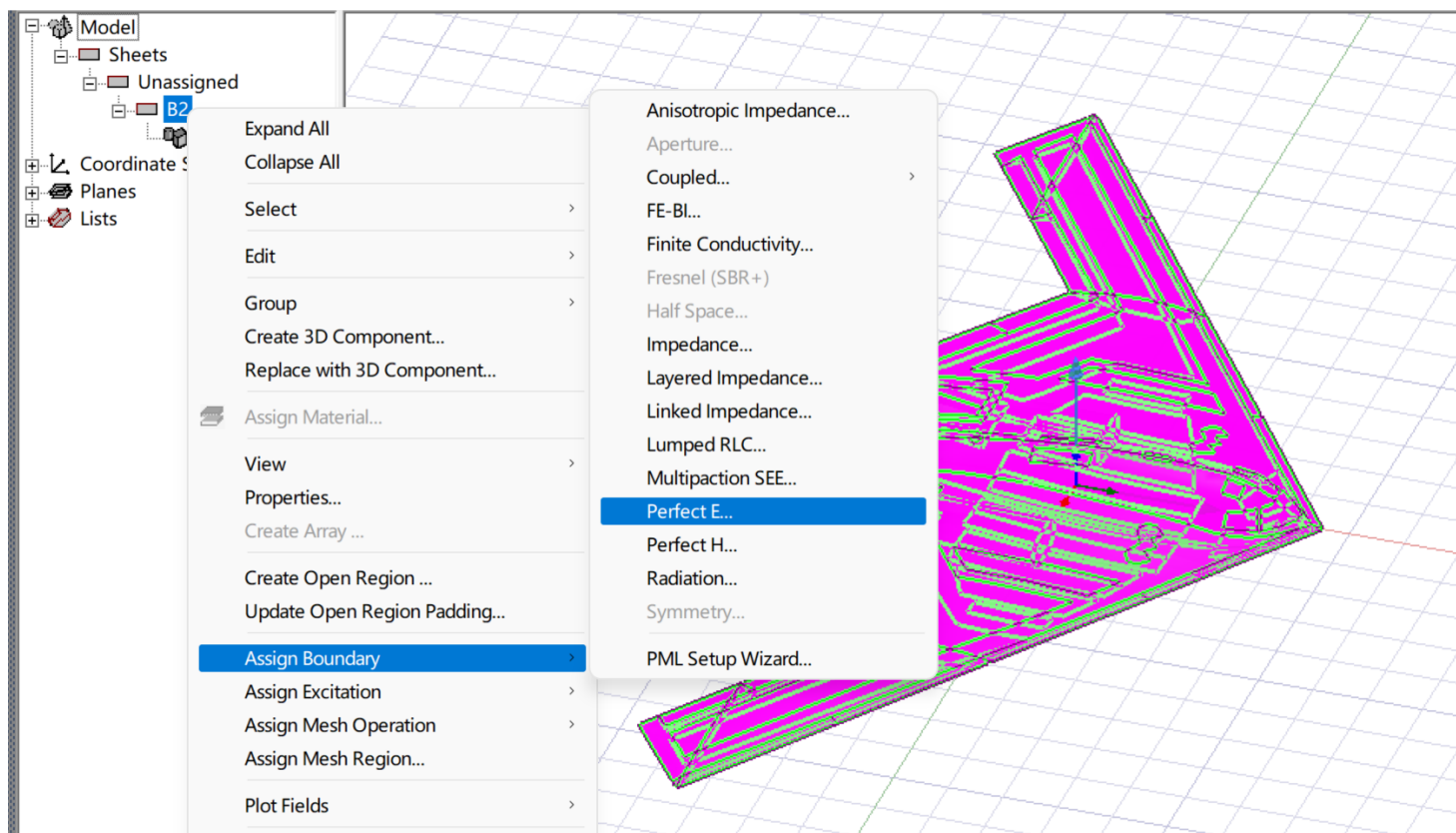




# HFSS RCS单站仿真方法

## ——设置边界

将Sheets下的B2设置为理想电边界  
若Model下有Solids，需将对应部分进行材料设置

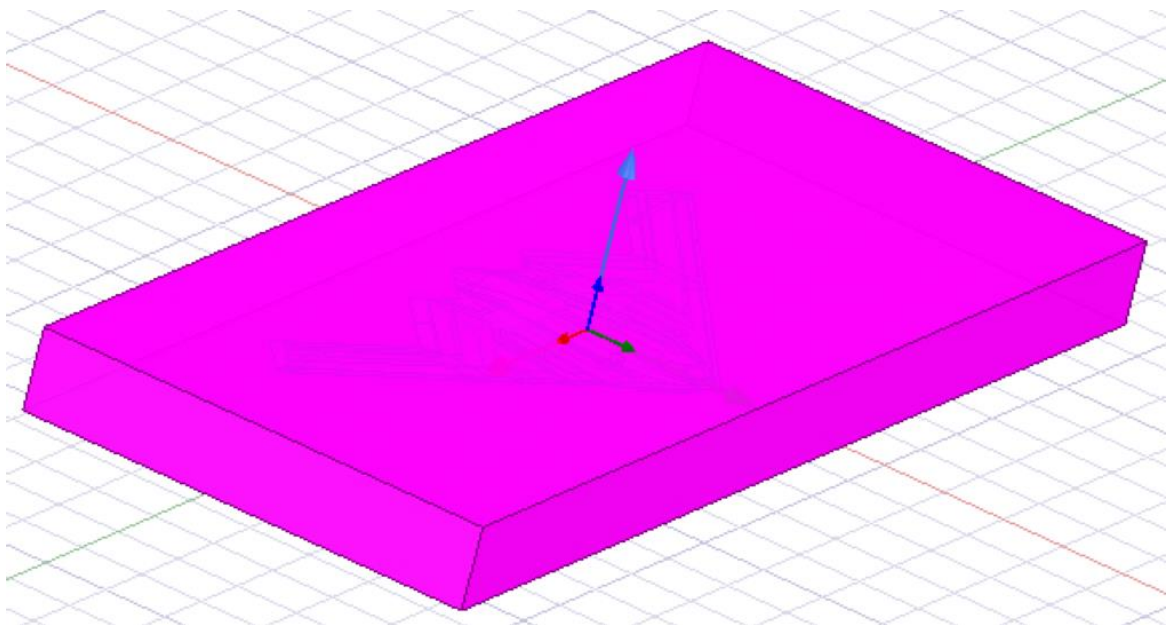
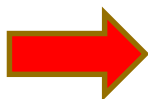
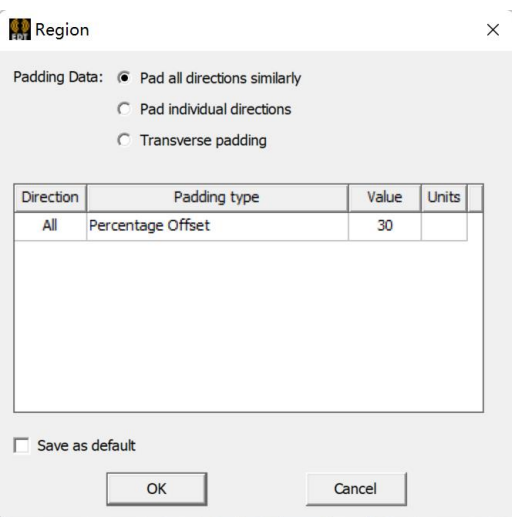




# HFSS RCS单站仿真方法

## ——设置边界

点击工具栏中的create region，也可在Draw选项卡中找到

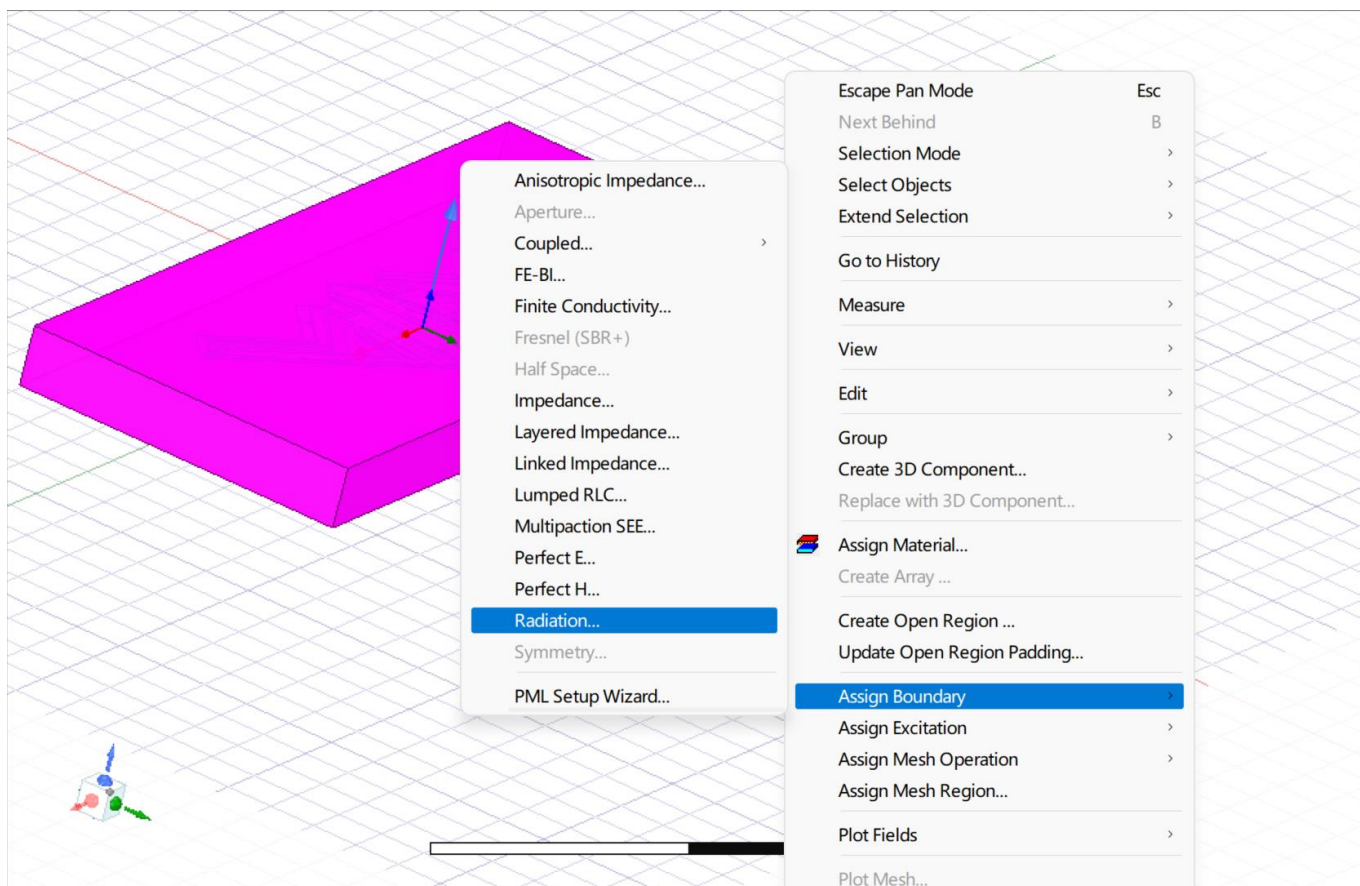




# HFSS RCS单站仿真方法

## ——设置边界

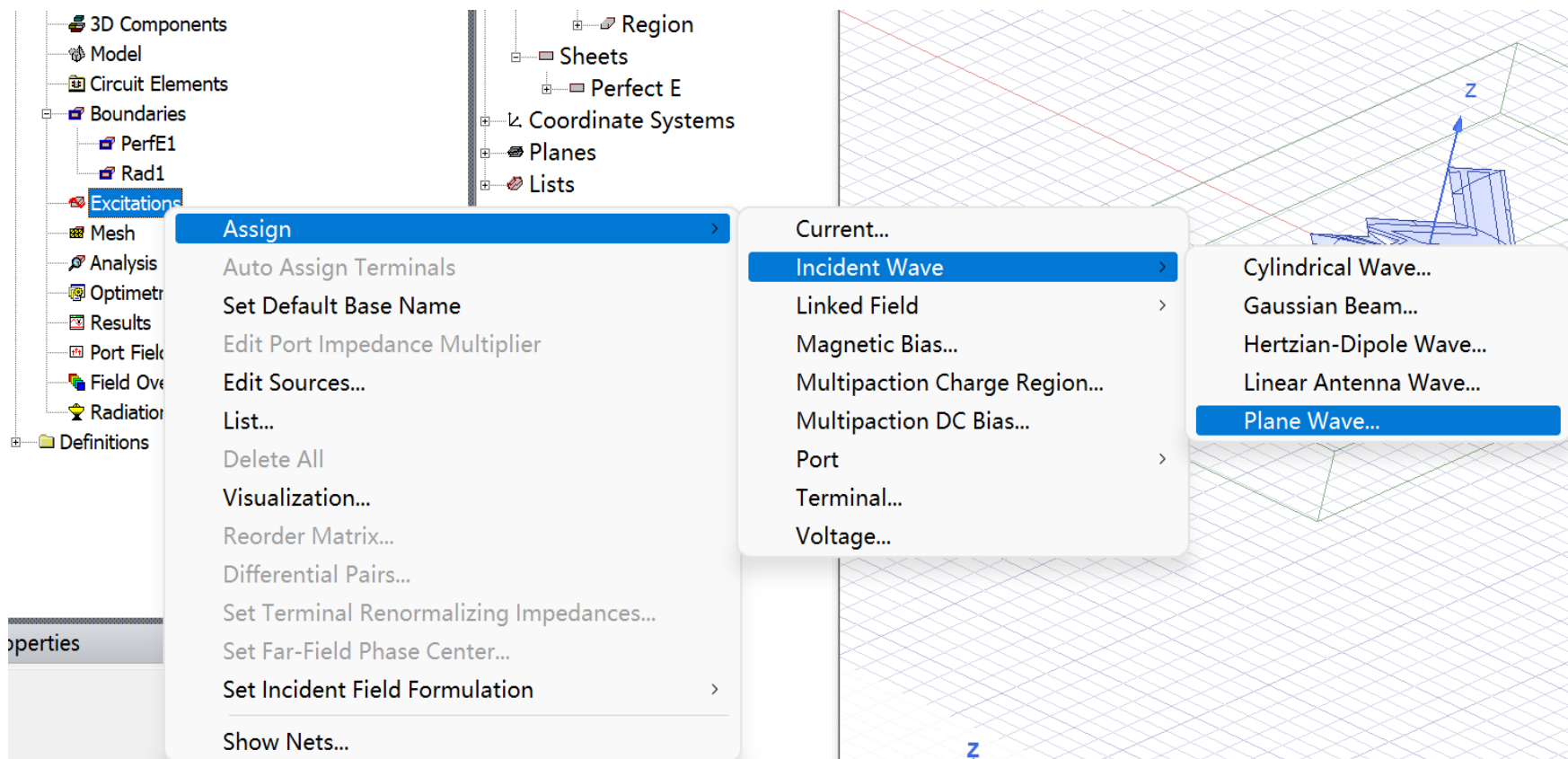
将生成的盒子设置为辐射边界





# HFSS RCS单站仿真方法

## ——设置激励





# HFSS RCS单站仿真方法

## ——设置激励

选择球坐标系

Incident Wave Source : General Data

Name: IncPWave1

Vector Input Format

☐ Cartesian ☒ Spherical

Excitation Location and/or Zero Phase Position

X Coord: 0 mm

Y Coord: 0 mm

Z Coord: 0 mm

Use Defaults

< 上一步(B) 下一页(N) > 取消



# HFSS RCS单站仿真方法

## ——设置激励

### 设置入射波源属性

Incident Wave Source : Spherical Vector Setup

IWavePhi

Start  deg Step  deg

Stop  deg View Point List...

IWaveTheta

Start  deg Step  deg

Stop  deg View Point List...

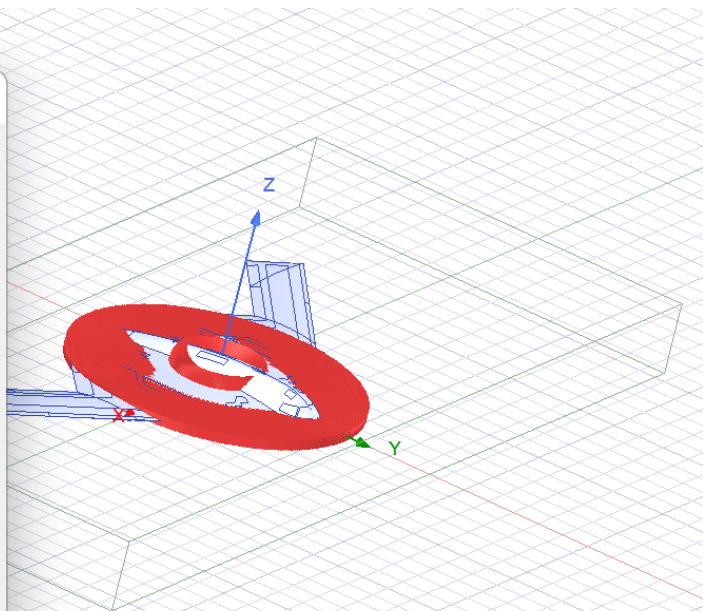
Eo Vector

Phi  V / m

Theta  V / m

Note that the Eo vector will be normalized to a unit vector. Use the Edit Sources dialog to scale that vector as needed.

< 上一步(B) 下一页(N) > 取消

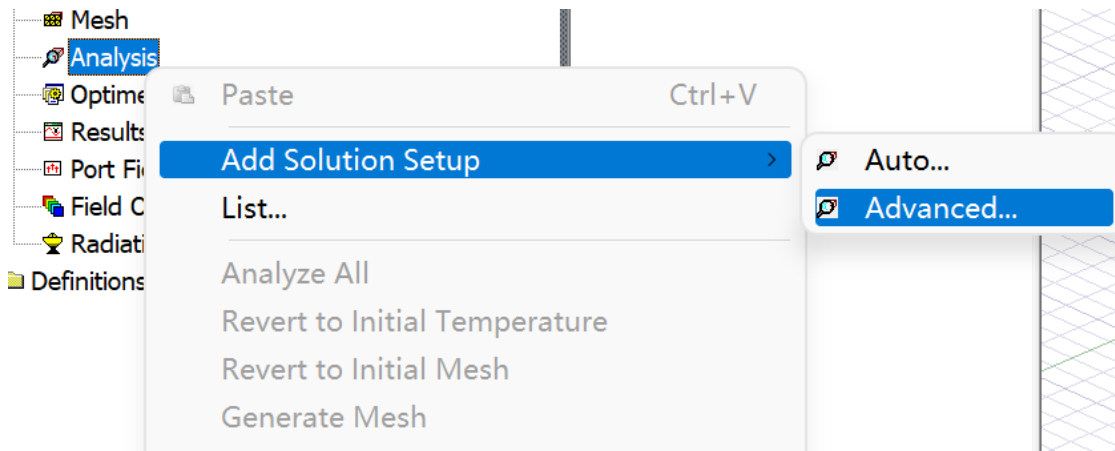






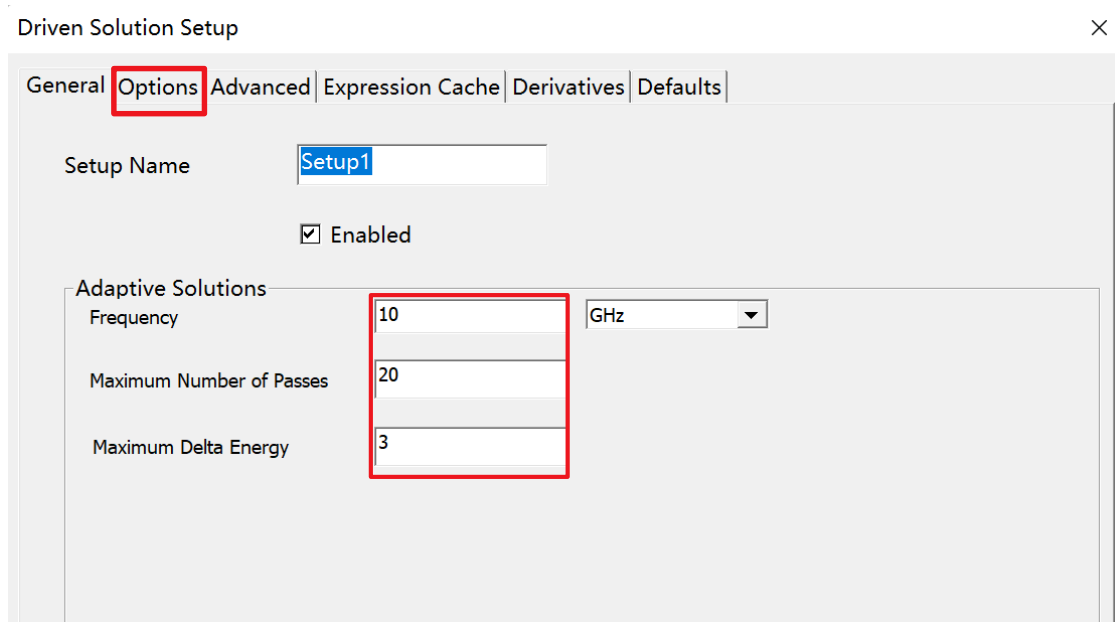
# HFSS RCS单站仿真方法

## ——求解设置



根据电脑性能调整设置，此处仅作演示。

Passes越大，delta energy越小，计算结果越精确，计算时间和消耗内存越大。

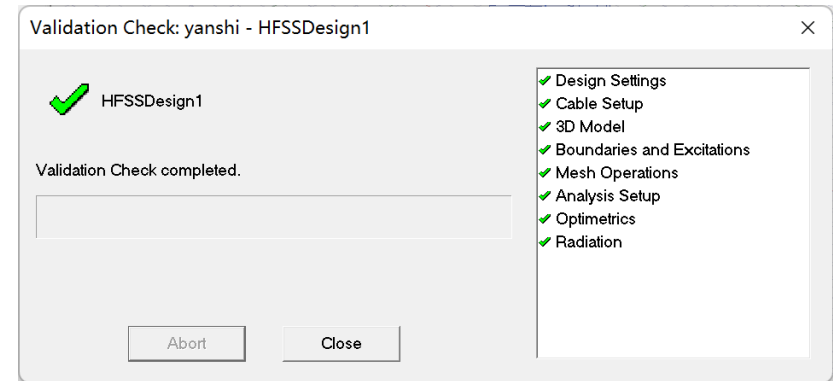
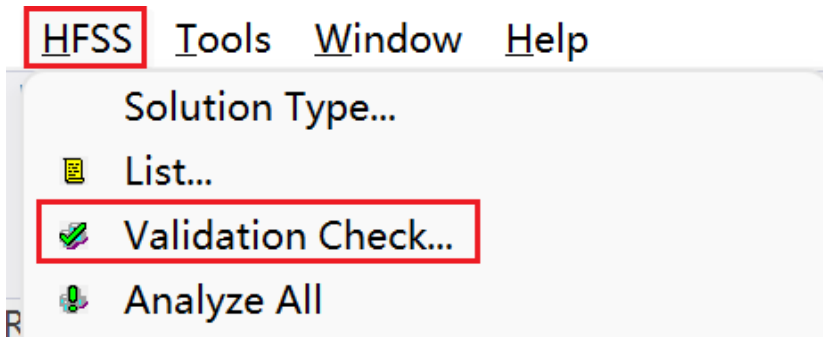


在options-initial mesh options可修改网格尺寸。

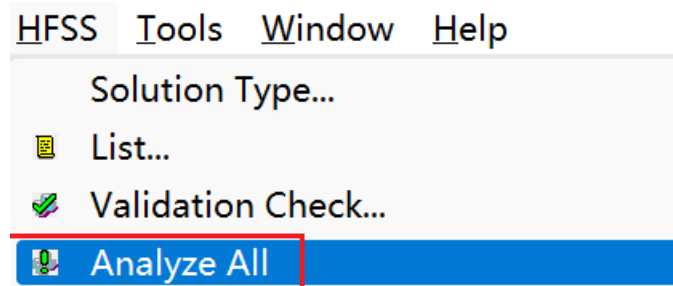


# HFSS RCSS单站仿真方法

## ——验证检查



验证检查



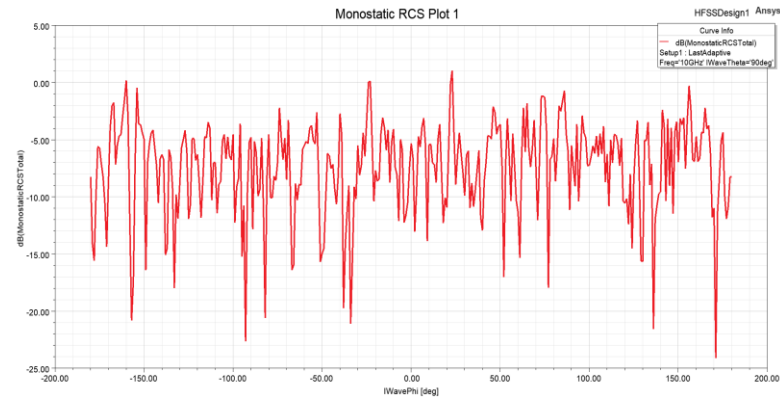
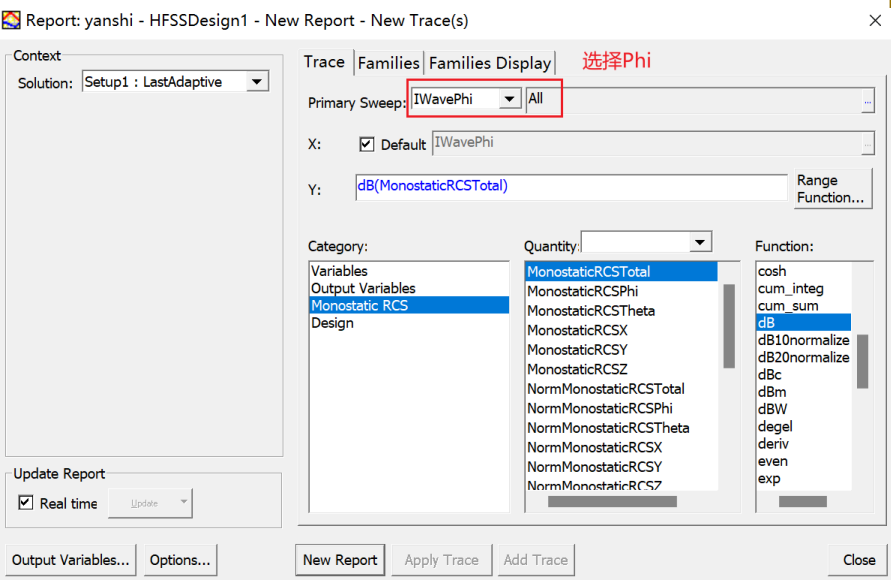
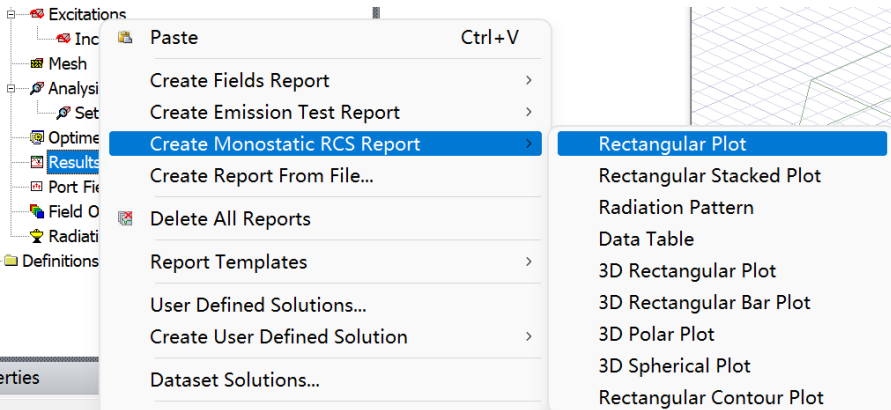
检查通过开始仿真计算





# HFSS RCS单站仿真方法

## ——后处理查看

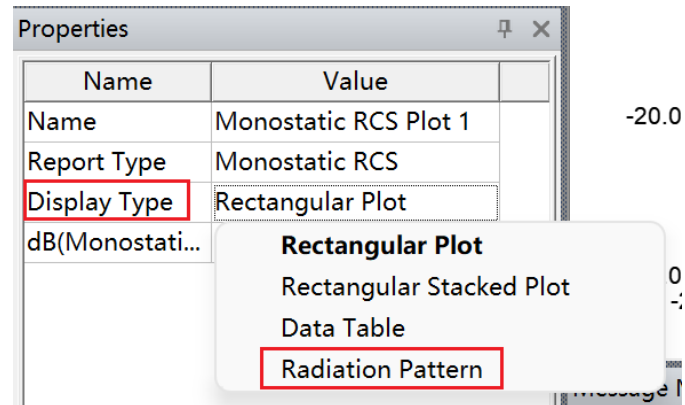




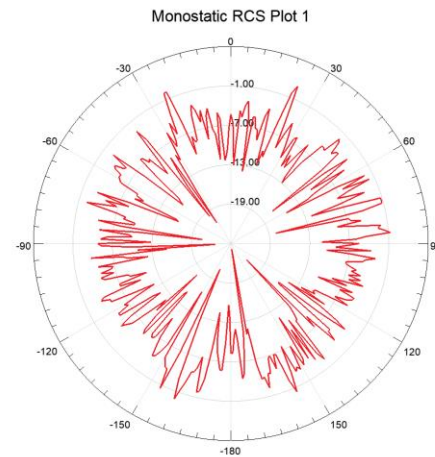
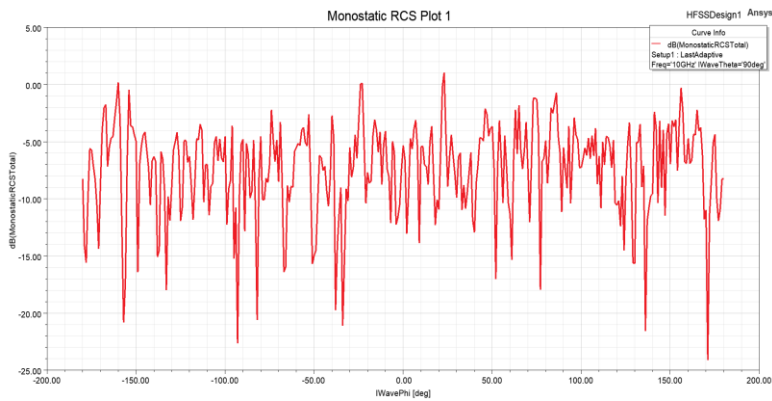
# HFSS RCS单站仿真方法

## ——后处理查看

### 调整查看类型



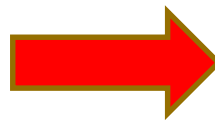
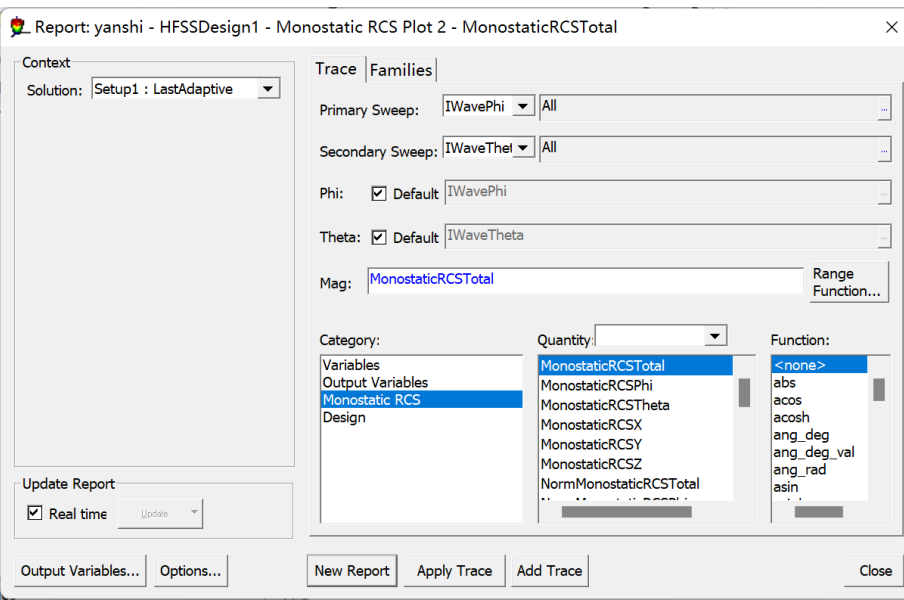
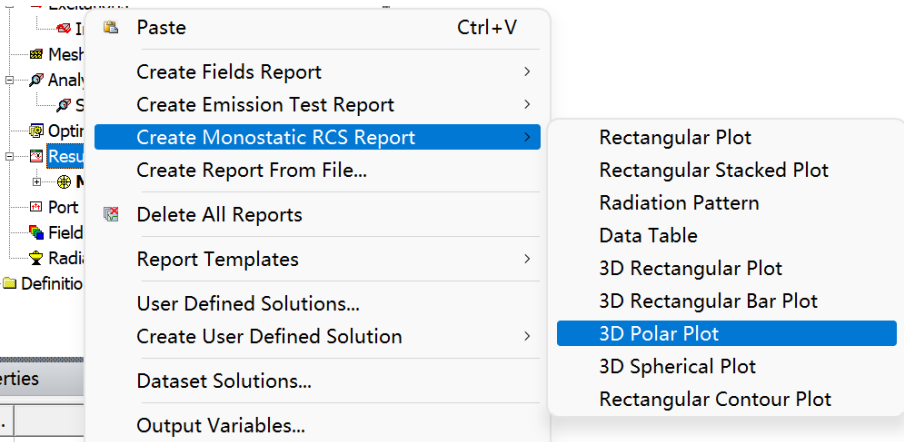
### 显示区别



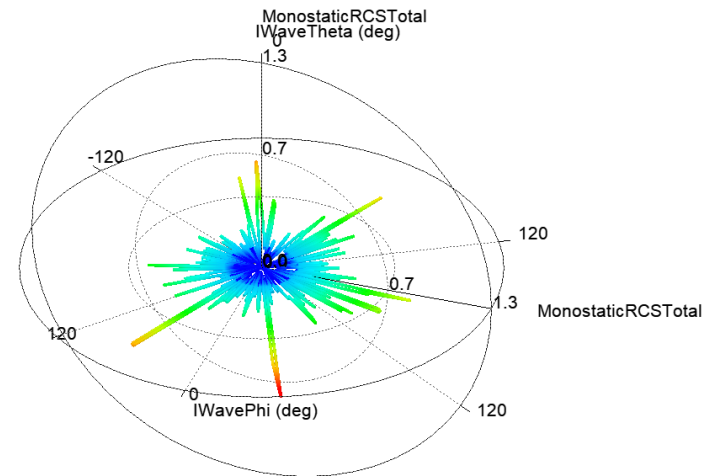


# HFSS RCS单站仿真方法

## ——后处理查看



Monostatic RCS Plot 2

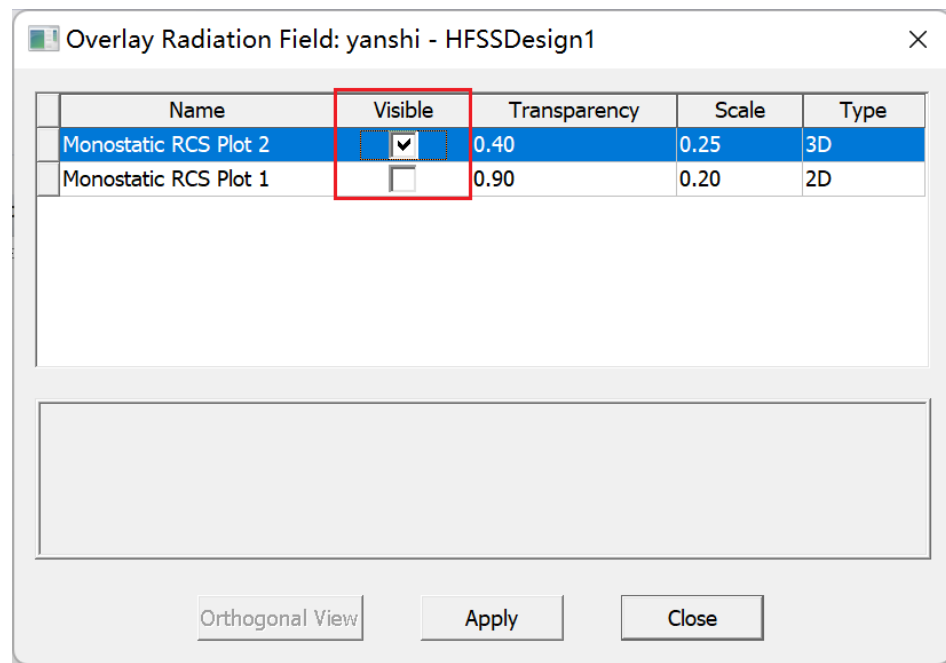
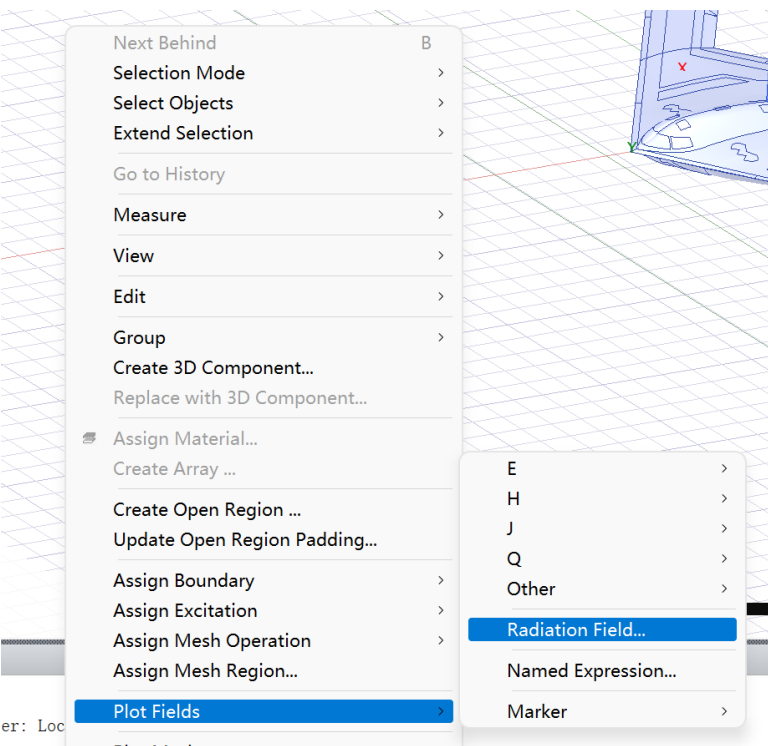




# HFSS RCS单站仿真方法

## ——后处理查看

在模型中显示结果



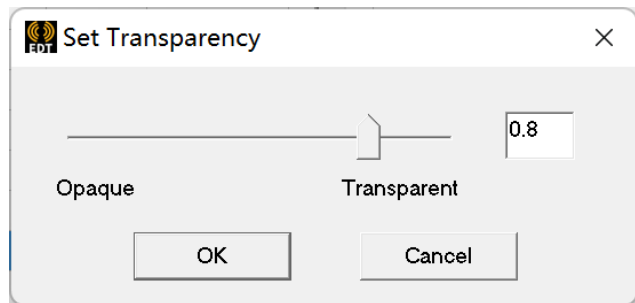
模型空白处右键点击



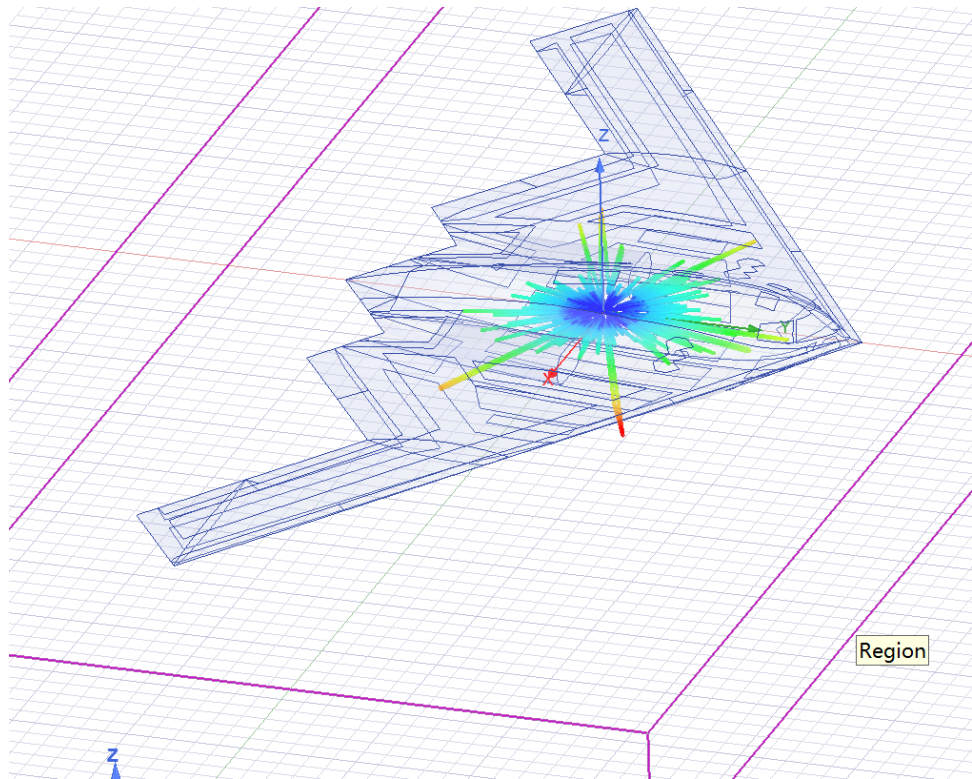
# HFSS RCS单站仿真方法

## ——后处理查看

调整模型透明度



双击Region/B2, 修改透明度





# HFSS RCS双站仿真方法

创建工程、模型导入、边界设置与单站RCS相同

激励设置做如下改变



# HFSS RCS双站仿真方法

## ——激励设置

复制单站RCS工程  
双击Excitations-IncPwave1

Incident Wave Source

General Data | Spherical Vector Setup | Plane Wave Options | Defaults

**IWavePhi** 修改为固定方向

Start: 90 deg Step: 1 deg

Stop: 90 deg

View Point List...

**IWaveTheta**

Start: 90 deg Step: 0 deg

Stop: 90 deg

View Point List...

**Eo Vector**

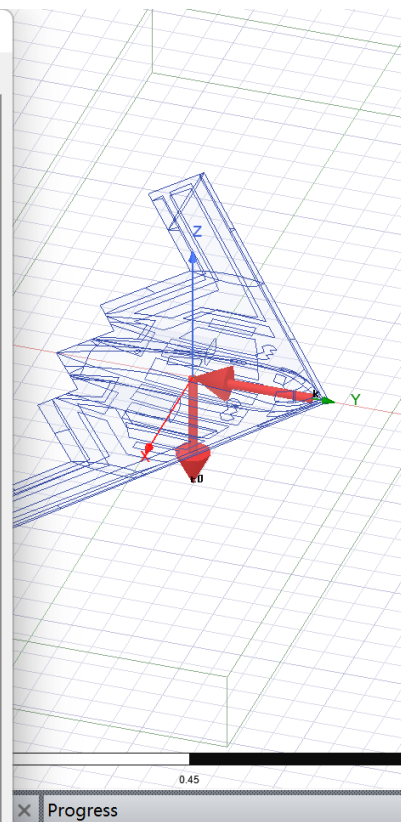
Phi: 0 V / m

Theta: 1 V / m

Note that the Eo vector will be normalized to a unit vector. Use the Edit Sources dialog to scale that vector as needed.

Use Defaults

确定 取消

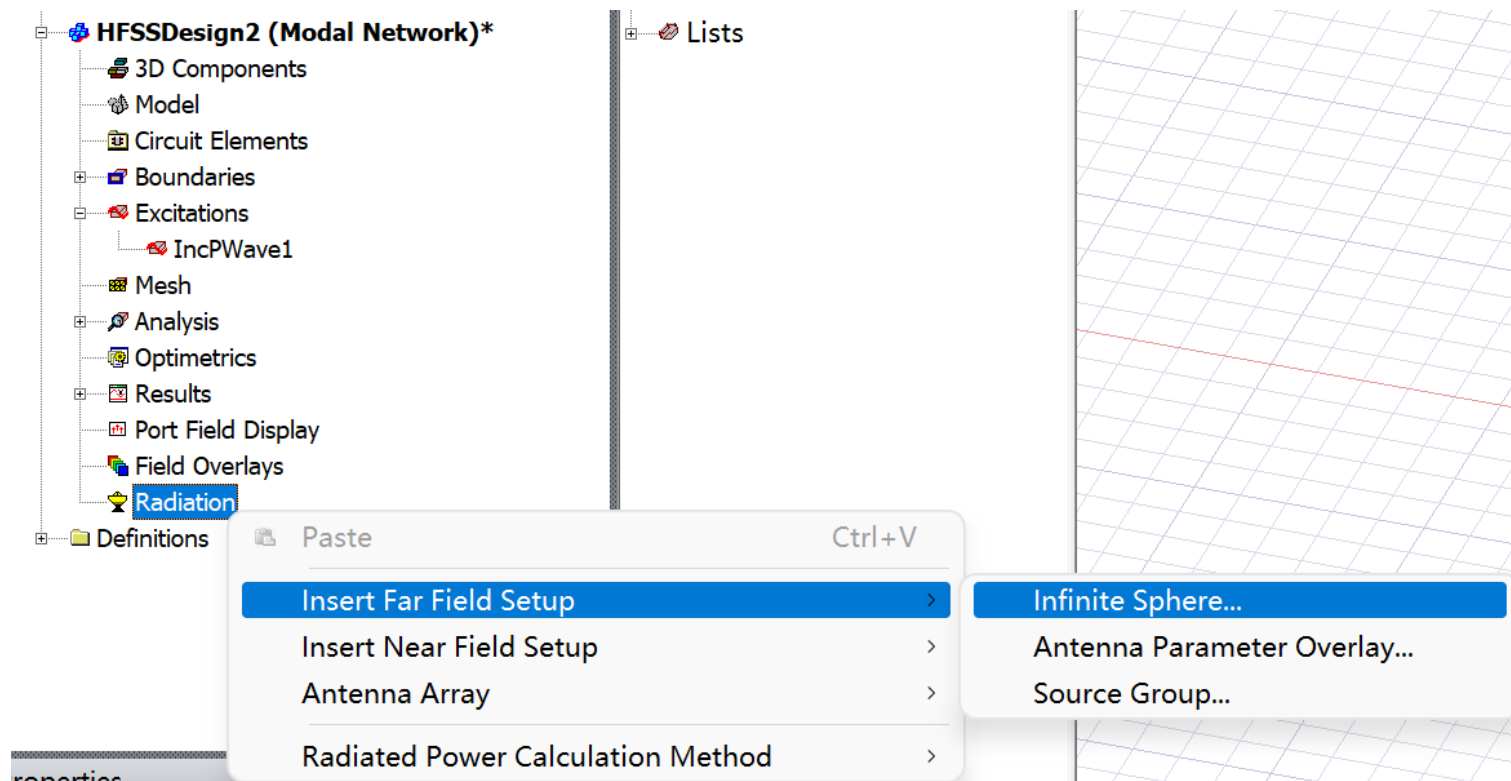




# HFSS RCS双站仿真方法

## ——远场设置

方法一：全部扫描，查看结果时单独选择方位角







# HFSS RCSS双站仿真方法

## ——远场设置

Far Field Radiation Sphere Setup

Infinite Sphere | Coordinate System | Radiation Surface

Name: Infinite Sphere1

Phi

Start: -180 deg

Stop: 180 deg

Step Size: 1 deg

Theta

Start: 0 deg

Stop: 90 deg

Step Size: 1 deg

Save As Defaults View Sweep Points...

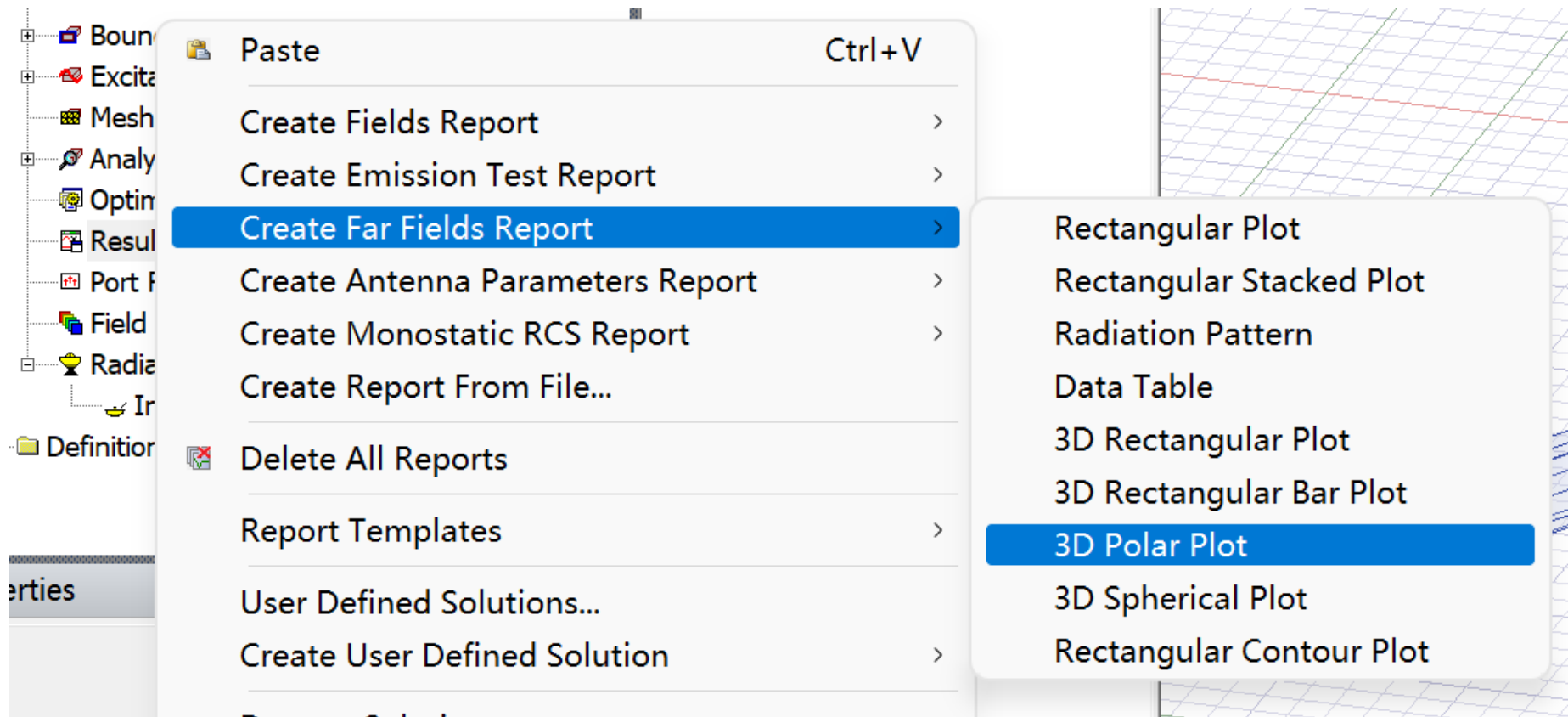
确定 取消 帮助



# HFSS RCS双站仿真方法

## ——后处理查看

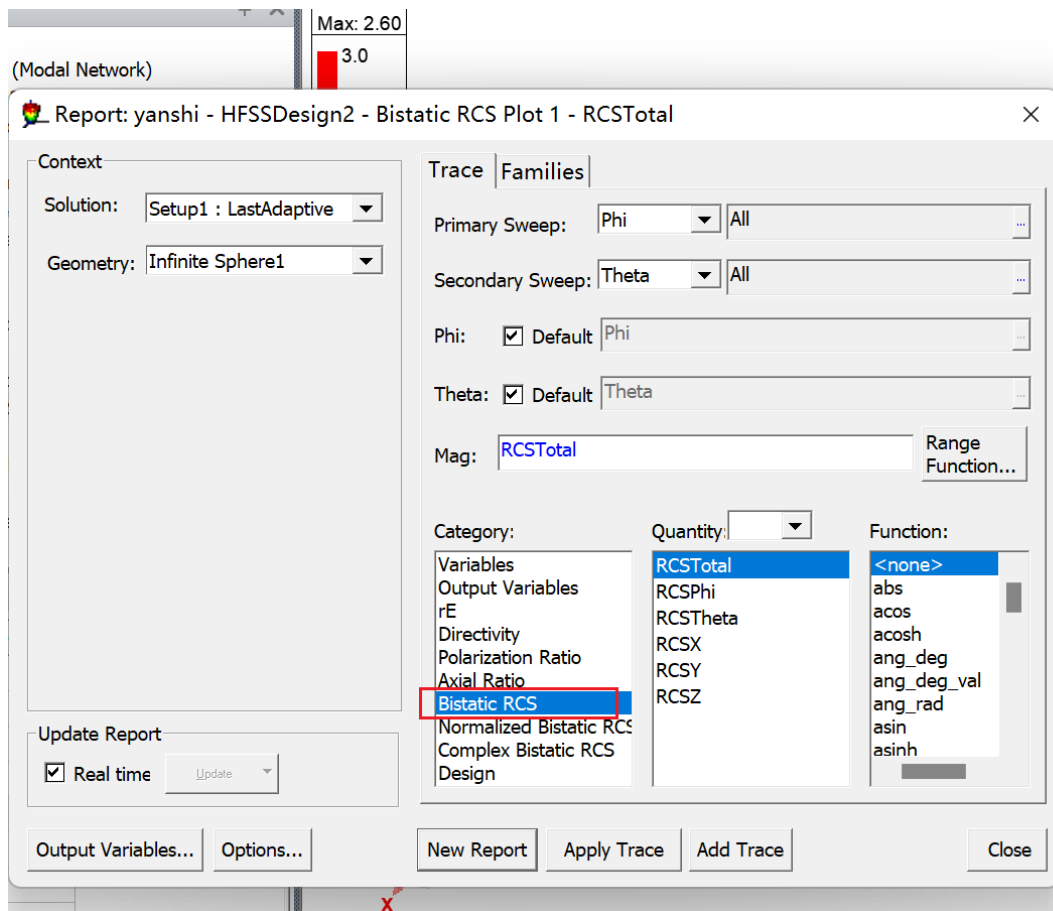
仿真计算完成后右键Result



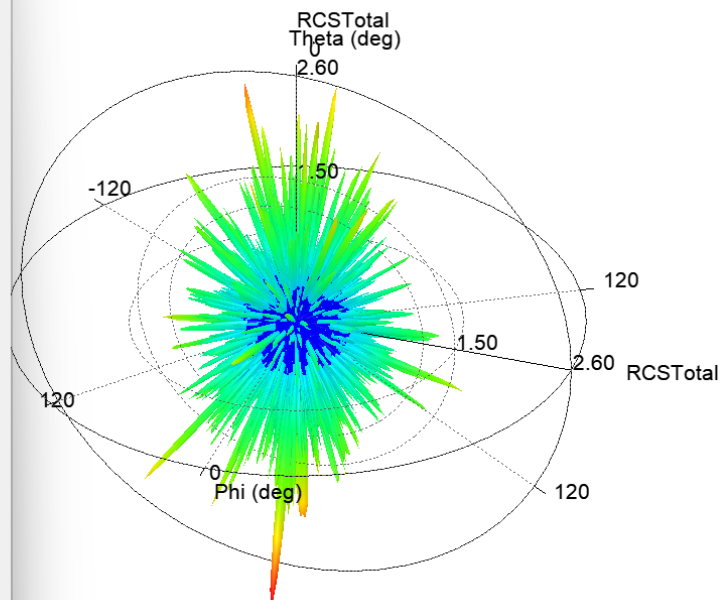


# HFSS RCS双站仿真方法

## ——后处理查看



Bistatic RCS Plot 1

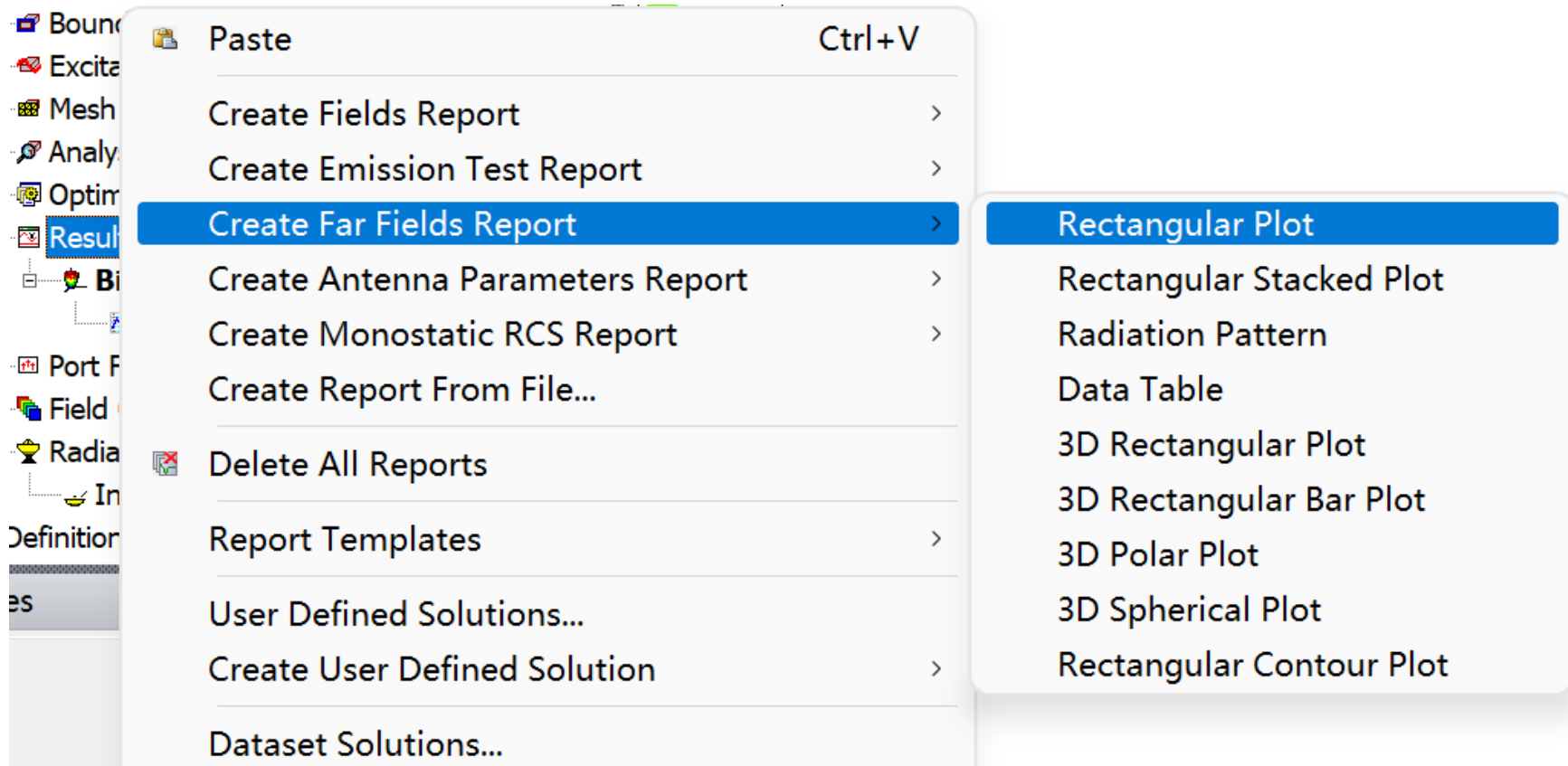




# HFSS RCS双站仿真方法

## ——后处理查看

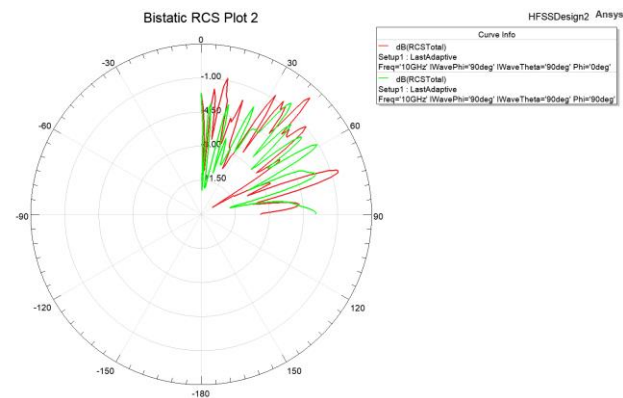
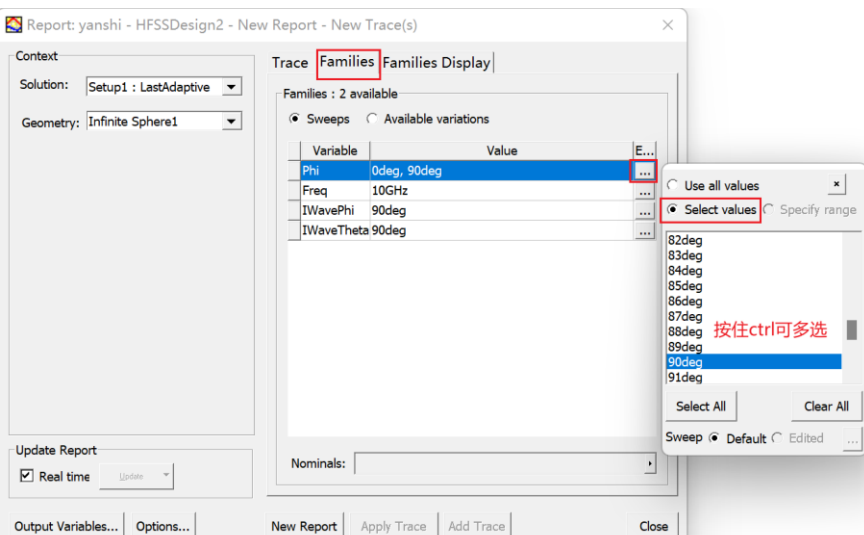
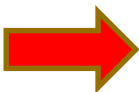
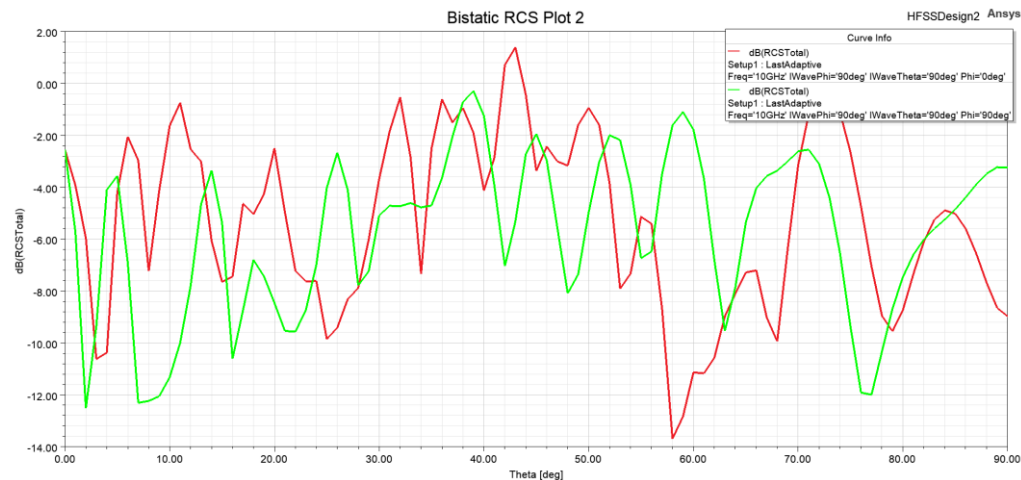
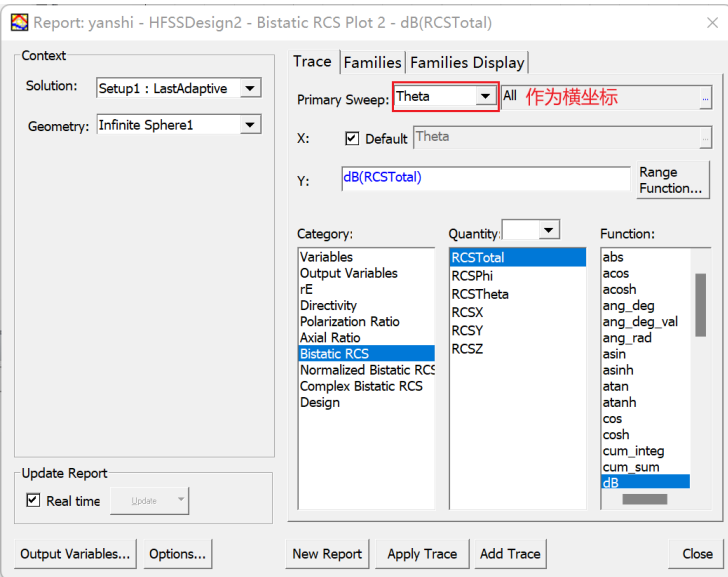
### 右键Result





# HFSS RCS双站仿真方法

## ——后处理查看



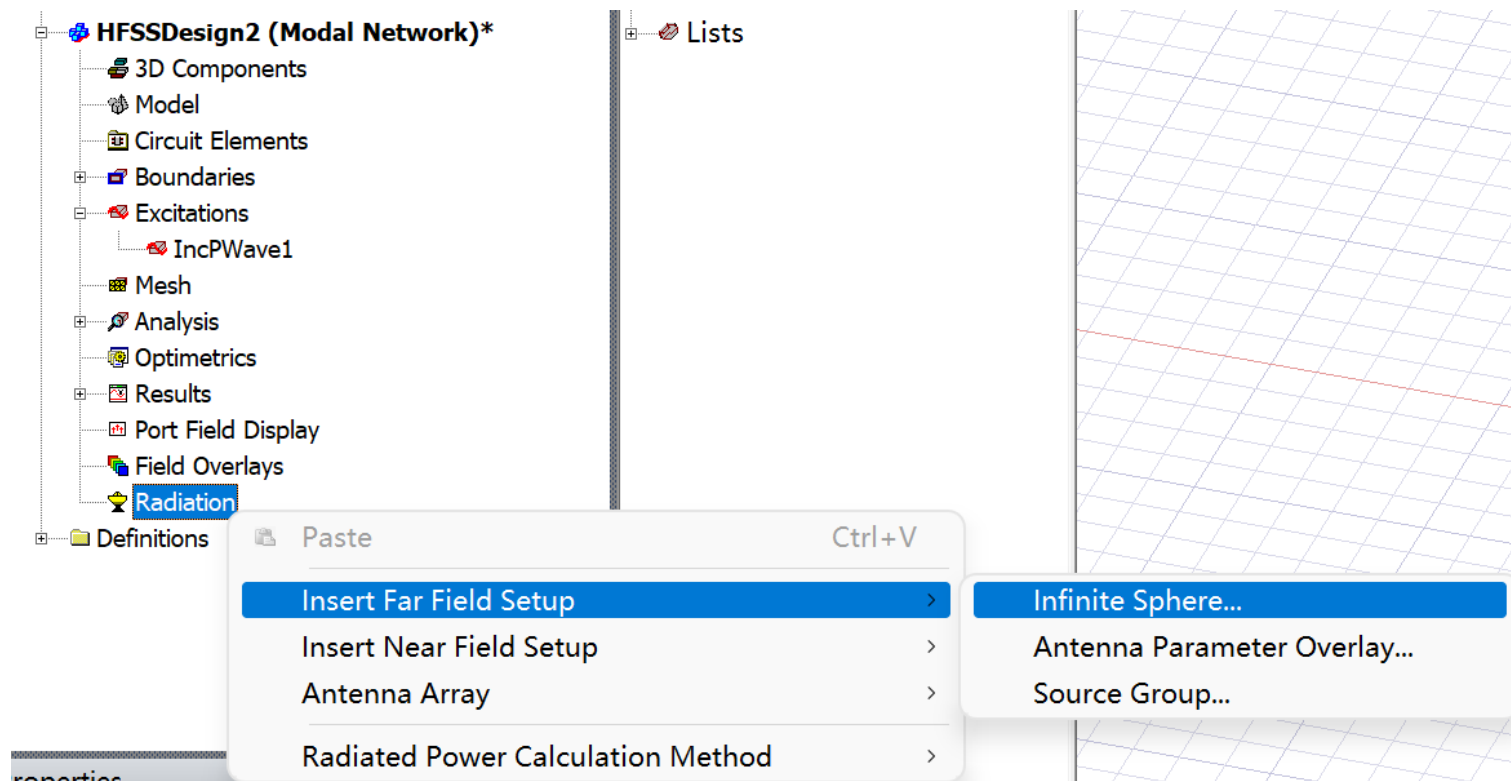
更改查看类型



# HFSS RCS双站仿真方法

## ——远场设置

方法二：远场设定指定考察位置





# HFSS RCS双站仿真方法

## ——远场设置

Far Field Radiation Sphere Setup

Infinite Sphere | Coordinate System | Radiation Surface

Name:

Phi

Start:  deg

Stop:  deg

Step Size:  deg

Theta

Start:  deg

Stop:  deg

Step Size:  deg

Save As Defaults View Sweep Points...

确定 取消 帮助

Far Field Radiation Sphere Setup

Infinite Sphere | Coordinate System | Radiation Surface

Name:

Phi

Start:  deg

Stop:  deg

Step Size:  deg

Theta

Start:  deg

Stop:  deg

Step Size:  deg

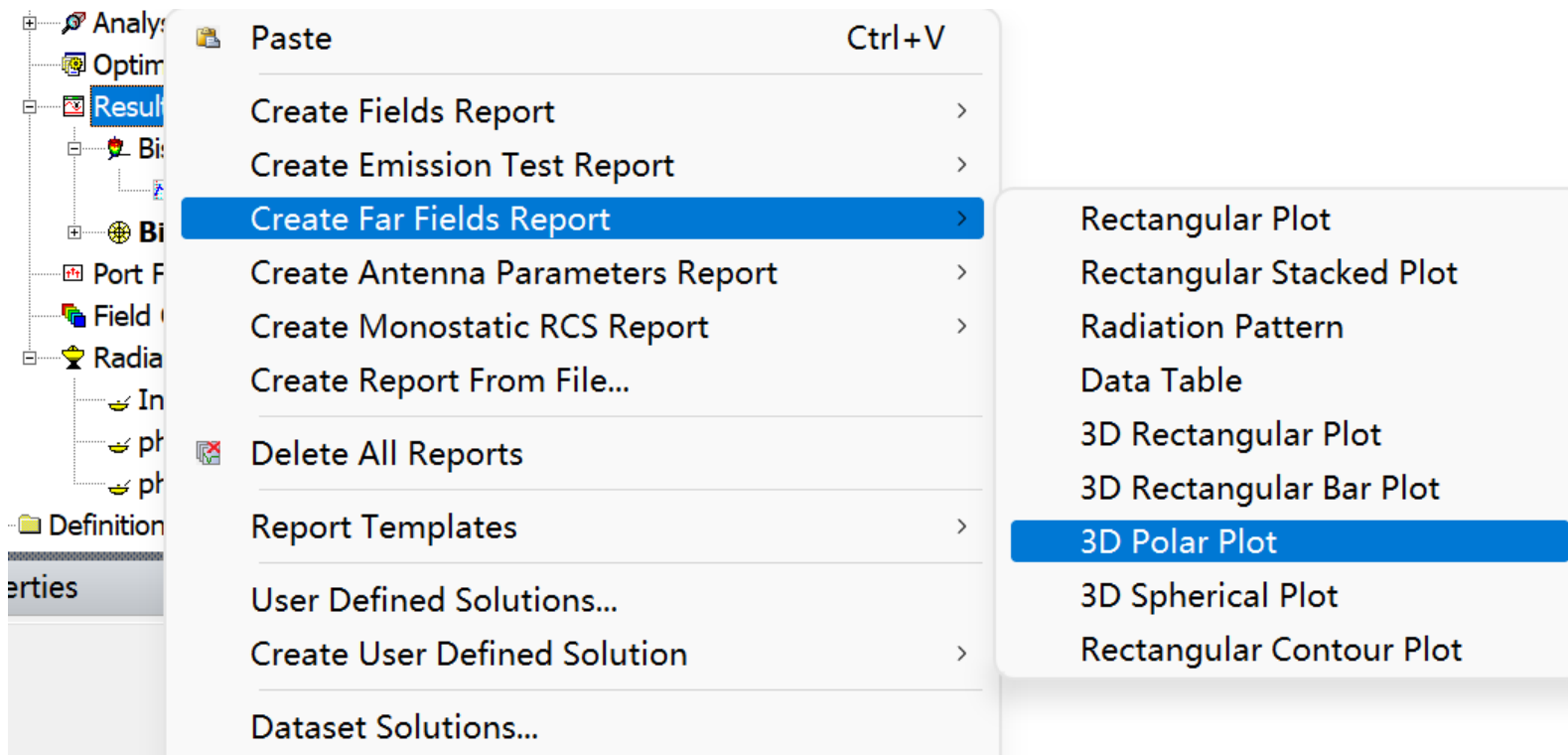
Save As Defaults View Sweep Points...

确定 取消 帮助



# HFSS RCS双站仿真方法

## ——后处理查看

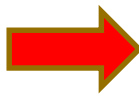
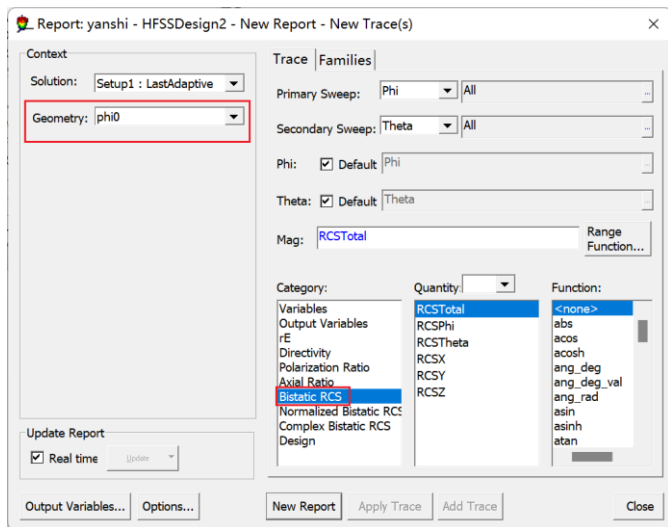




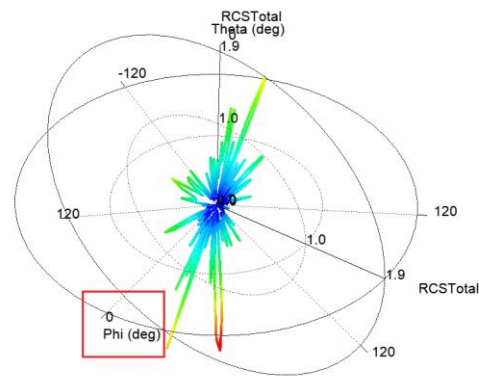


# HFSS RCS双站仿真方法

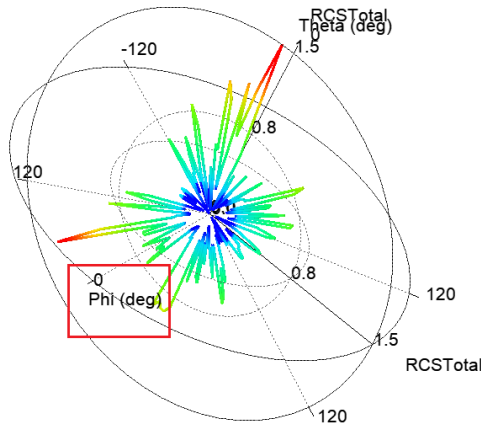
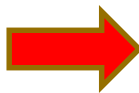
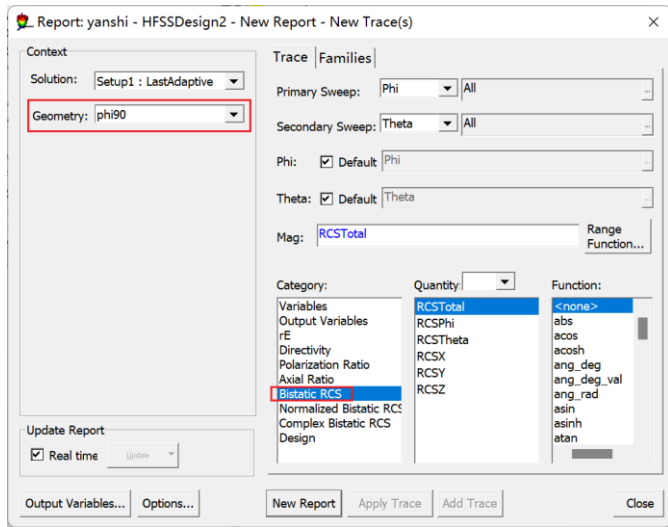
## ——后处理查看



Bistatic RCS Plot 3



Bistatic RCS Plot 4





# HFSS RCS双站仿真方法

## ——后处理查看

The screenshot displays the HFSS software interface. On the left is a vertical toolbar with icons for 'Anal', 'Opti', 'Resu', and 'Port'. The 'Results' menu is open, showing a list of options. The 'Create Far Fields Report' option is highlighted in blue. To the right of this menu, a secondary sub-menu is visible, also with 'Rectangular Plot' highlighted in blue. The sub-menu lists various plot types: 'Rectangular Stacked Plot', 'Radiation Pattern', 'Data Table', '3D Rectangular Plot', '3D Rectangular Bar Plot', '3D Polar Plot', '3D Spherical Plot', and 'Rectangular Contour Plot'.

**Results Menu:**

- Paste (Ctrl+V)
- Create Fields Report >
- Create Emission Test Report >
- Create Far Fields Report >**
- Create Antenna Parameters Report >
- Create Monostatic RCS Report >
- Create Report From File...
- Delete All Reports
- Report Templates >
- User Defined Solutions...
- Create User Defined Solution >

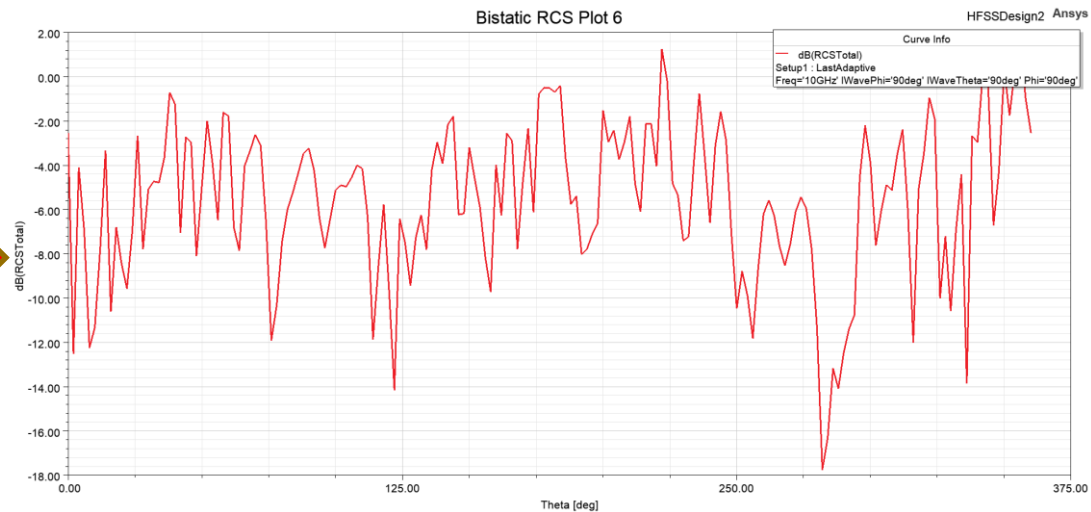
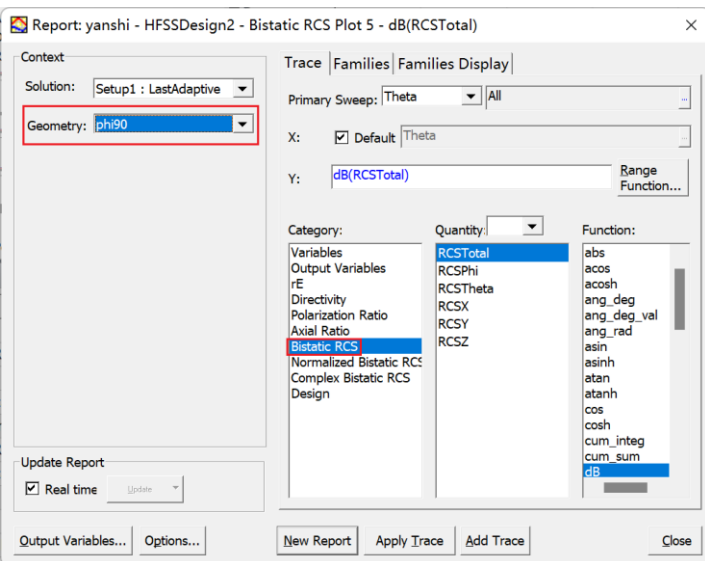
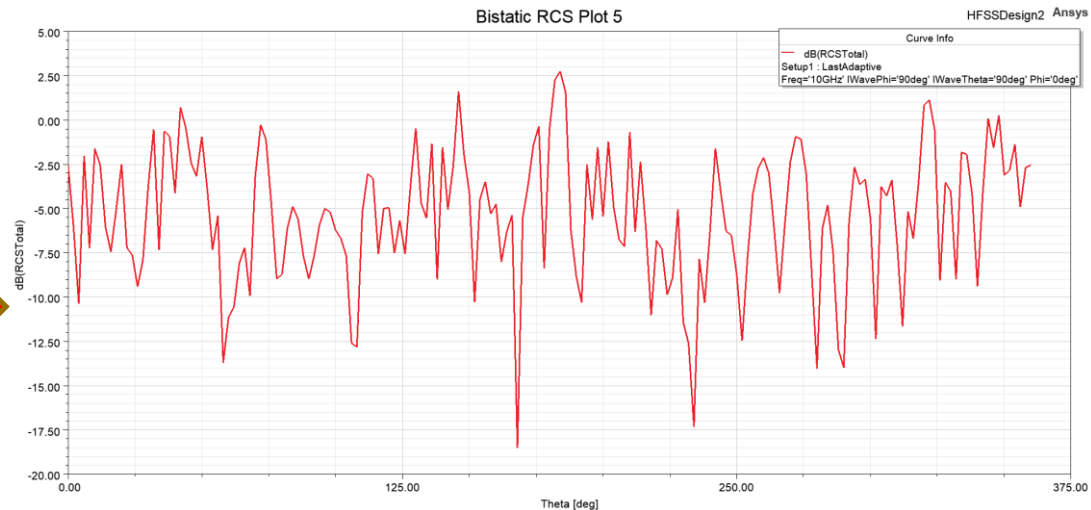
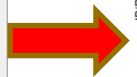
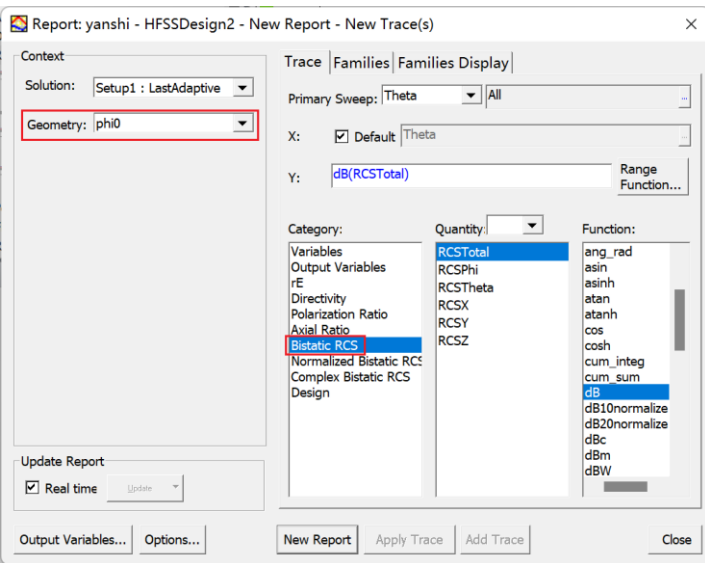
**Rectangular Plot Sub-menu:**

- Rectangular Plot**
- Rectangular Stacked Plot
- Radiation Pattern
- Data Table
- 3D Rectangular Plot
- 3D Rectangular Bar Plot
- 3D Polar Plot
- 3D Spherical Plot
- Rectangular Contour Plot



# HFSS RCS双站仿真方法

## ——后处理查看





感谢倾听