

# A031 PKG Power RLC extraction for Redhawk

China CPS Team

Xin Wang

# AppBrief Requirements (Title matches the engineering challenge we are trying to solve (not simulation challenge))

## 封装参数提取挑战

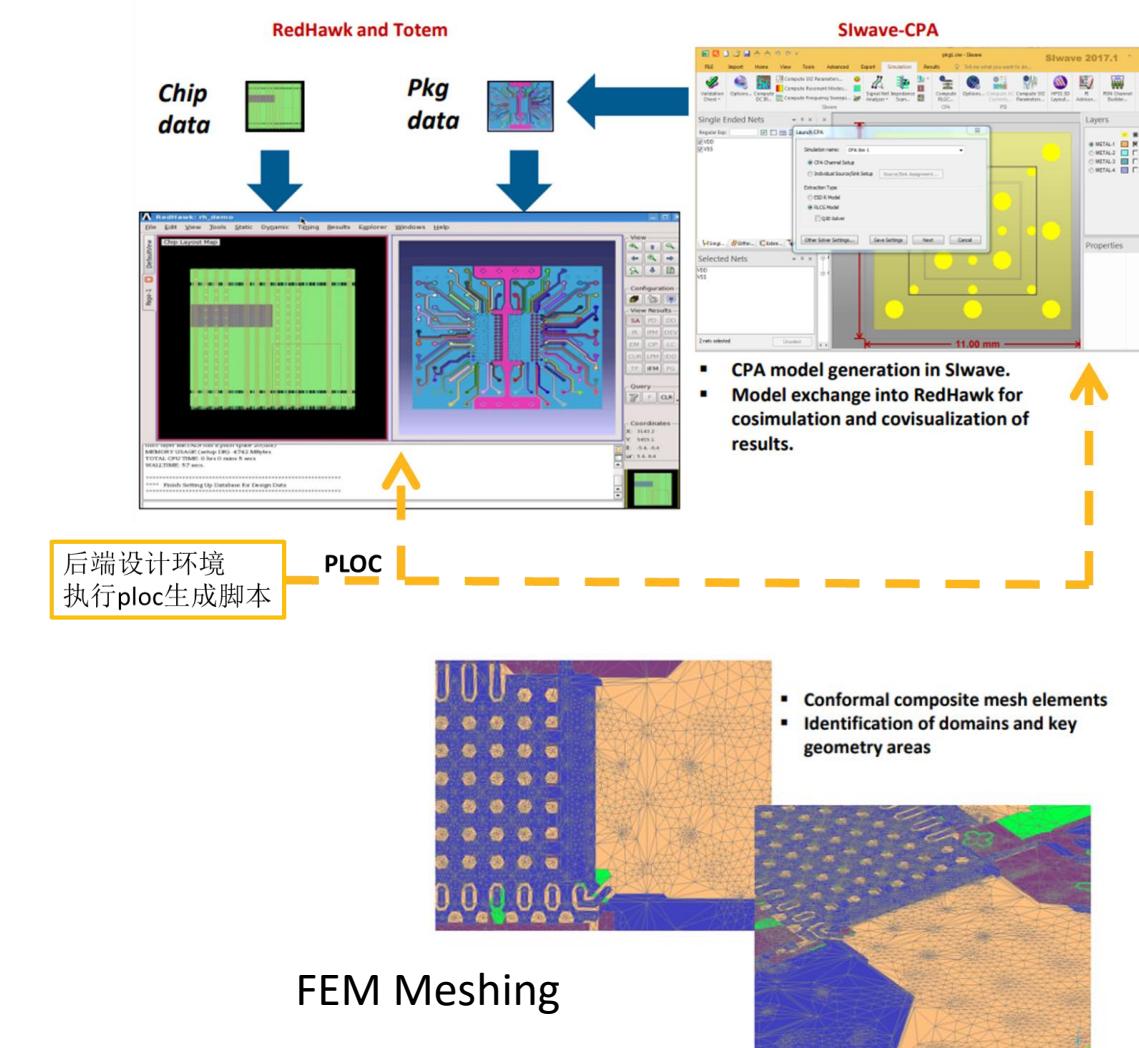
- 封装密度和集成度越来越高，传统的参数提取工具无法满足上百上千乃至上万pin参数提取的需求；
- 传统的参数提取工具输出的PKG模型无法与芯片端工具RedHawk等联合使用；

## ANSYS解决方案

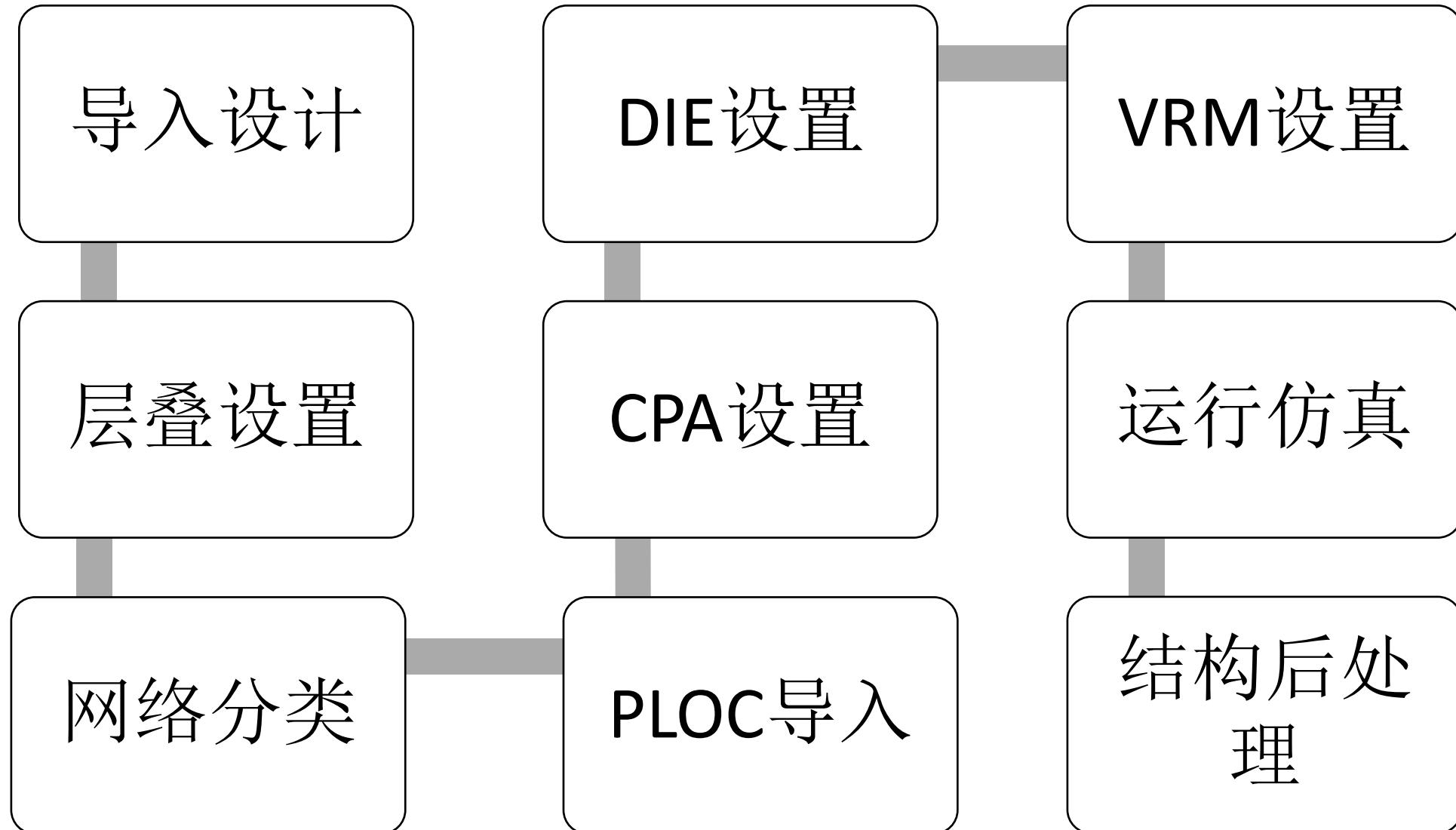
- ANSYS Siwave CPA采用FEM Solver，对信号线以及source和sink的数量没有限制，可以对提取成百上千pin的封装参数，和大规模的PDN结构；
- 包含MoM Q3D Solver，满足高精度参数提取的需求；
- 可以和Chip端RedHawk等工具实现联合仿真，模拟芯片和封装工作时的真是工况；

## Benefits

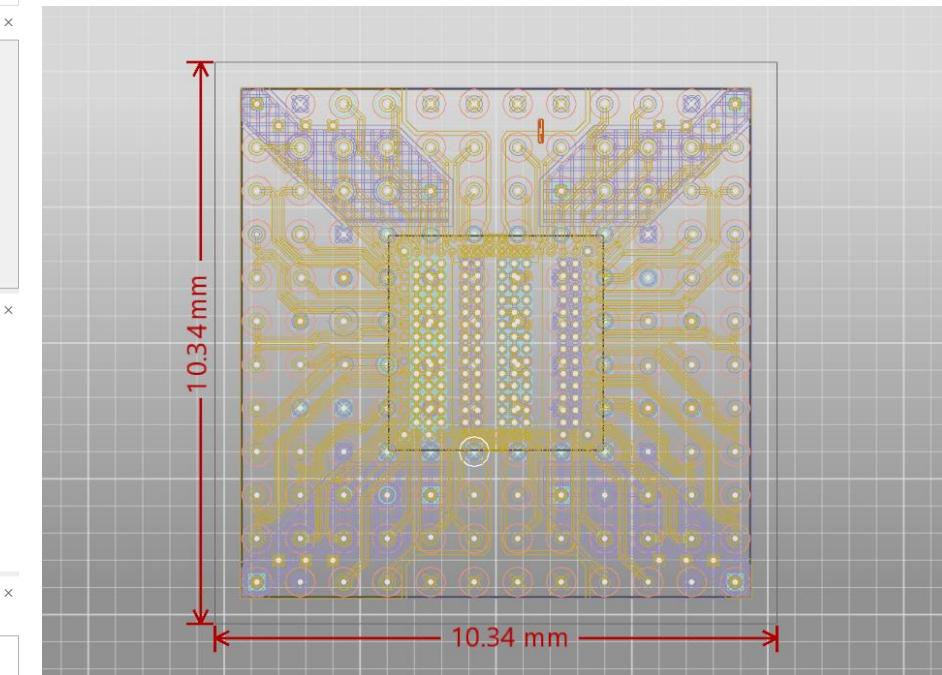
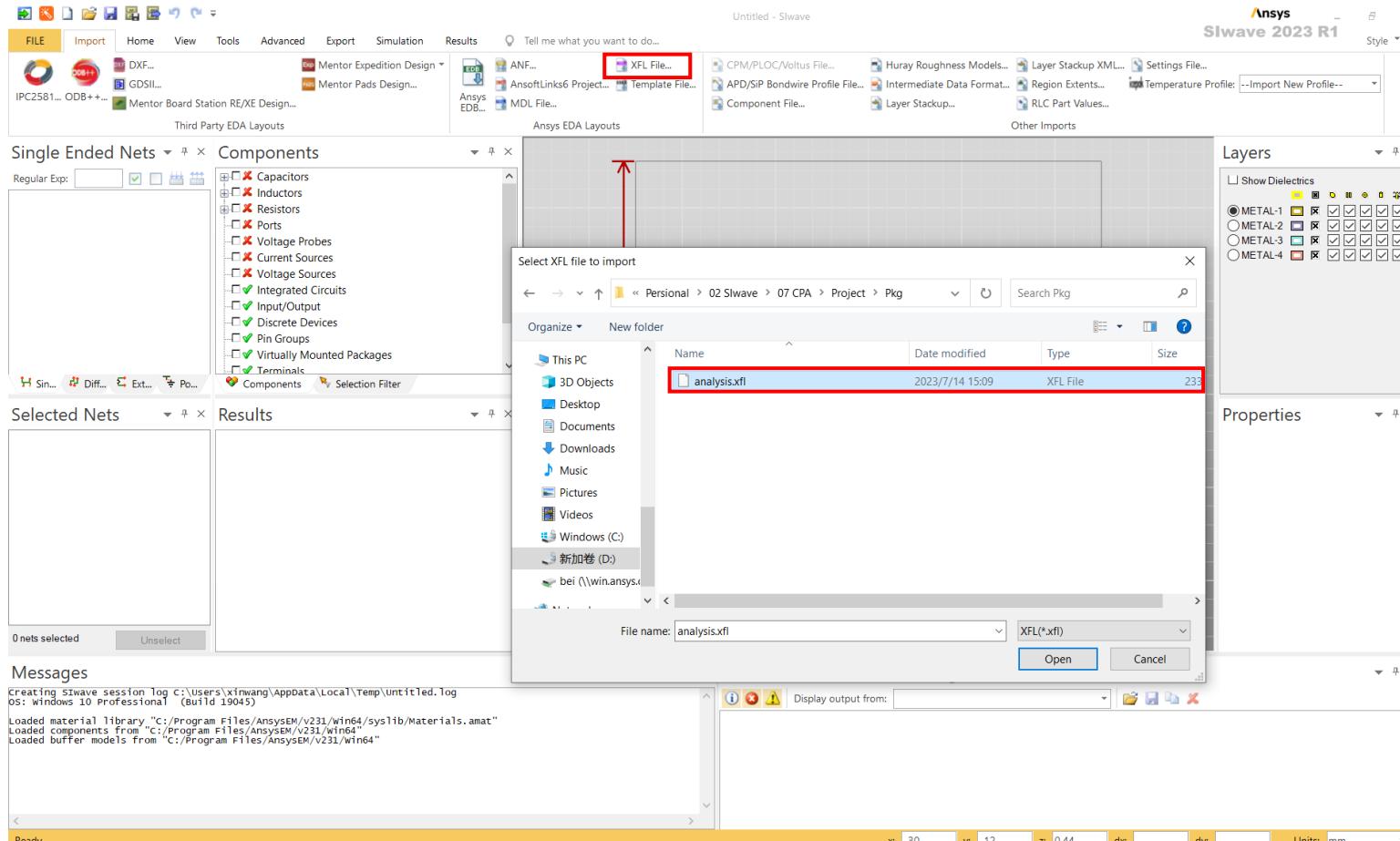
- 非常高容量的FEM求解器-全封装和PCB结构-上万个source/sink；
- 快速提取（几分钟到几小时-即使对与拥有上万个bump的超大封装结构）
- 适用多种结构：RDL、TSV、层压板PKG、PCB以及多Die等结构；



# **CPA输出Redhawk RLC模型 Workflow**



# 导入设计



# 层叠设置

Slwave Workflow Wizard

- Import Component File...
- Import Stackup...
- Verify Stackup...**
- Verify Padstacks...
- Verify Circuit Element Parameters...
- Verify Power/Ground Net Classification...
- Sanitize Layout for Simulation
- Assign S-parameter Capacitor Mode...
- Assign SPICE Netlists...
- Configure DC IR Drop Analysis...
- Configure PI Analysis...
- Configure DDR Analysis...

Always show this dialog after project import

Layer Stackup Editor

C...	Name	Type	Thickness (mm)	Material	Conductivity (S/mm)	Dielectric const.	Dielectric loss tan...	Translucency	Elevation (mm)	Roughness (mm)	Trace Cross-s...
>	TOP	METAL	0.03048	COPPER	5.959E+07	AIR	1	0	65	0.70104	HJ: 0 , HJ: 0 , HJ: 0
	Diel_1	DIELECTRIC	0.2032	FR-4	0		4.5	0.035		0.49784	
	VDD_C1	METAL	0.03048	COPPER	5.959E+07	FR-4	4.5	0.035	65	0.46736	HJ: 0 , HJ: 0 , HJ: 0
	Diel_3	DIELECTRIC	0.2032	FR-4	0		4.5	0.035		0.26416	
	VSS_C1	METAL	0.03048	COPPER	5.959E+07	FR-4	4.5	0.035	65	0.23368	HJ: 0 , HJ: 0 , HJ: 0
	Diel_5	DIELECTRIC	0.2032	FR-4	0		4.5	0.035		0.03048	
	BOTTOM	METAL	0.03048	COPPER	5.959E+07	AIR	1	0	65	0	HJ: 0 , HJ: 0 , HJ: 0

Add / Delete / Move Layer(s)

- Add Above Selected Layer
- Add Below Selected Layer
- Delete Selected Layers
- Move Selected Layers Up
- Move Selected Layers Down

Edit Selected Layer(s)

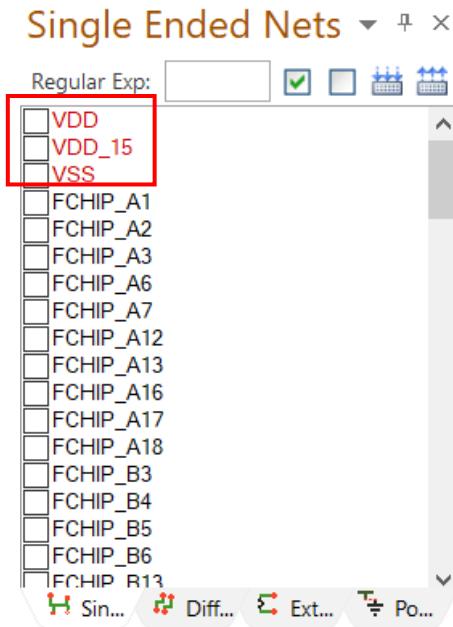
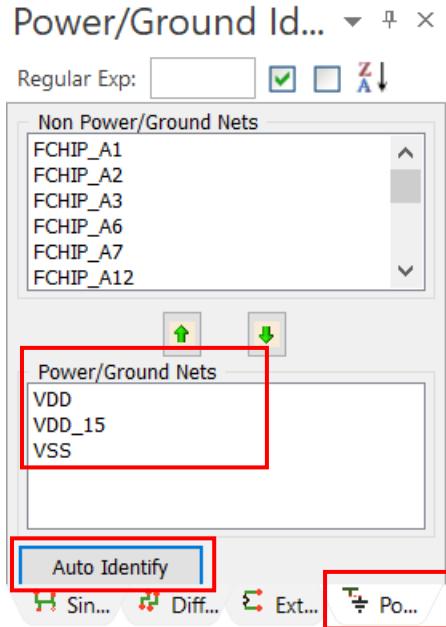
Color: c4ab1e    Update  
Name: TOP    Update  
Type: METAL    Update  
Material: COPPER    Update  
Dielectric Fill: AIR    Update  
Translucency: 65%    Update  
Thickness: 0.03048 mm    Update  
Roughness: HJ: 0 , HJ: 0 , HJ: 0 mm    Update

Select all DIELECTRIC layers Scheme-1 Save Current Color Scheme Color scheme As Is Set as Default Default Scheme for new projects: SIwave

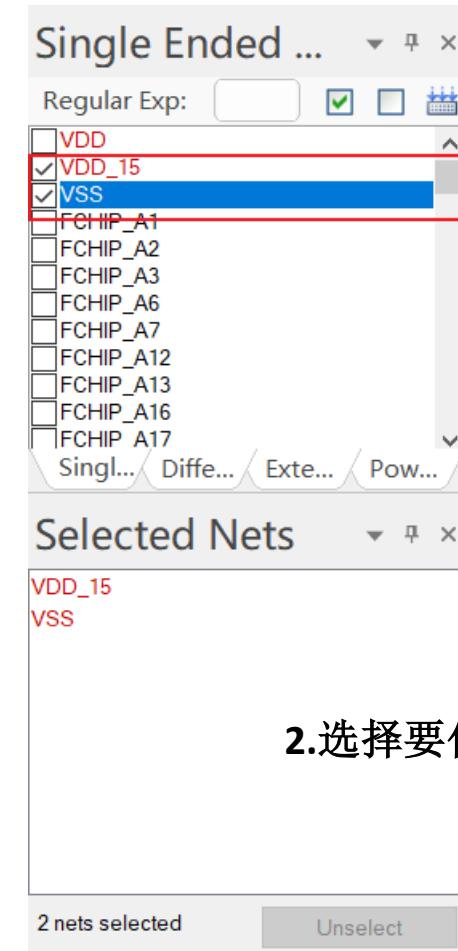
Thickness change affects die elevations    Edit Material Properties    Invert Stackup     Conformal Coat    Units mm     Copper Weight

OK Cancel

# 网络分类



1. 对电源和地网络进行分类



2. 选择要仿真的网络

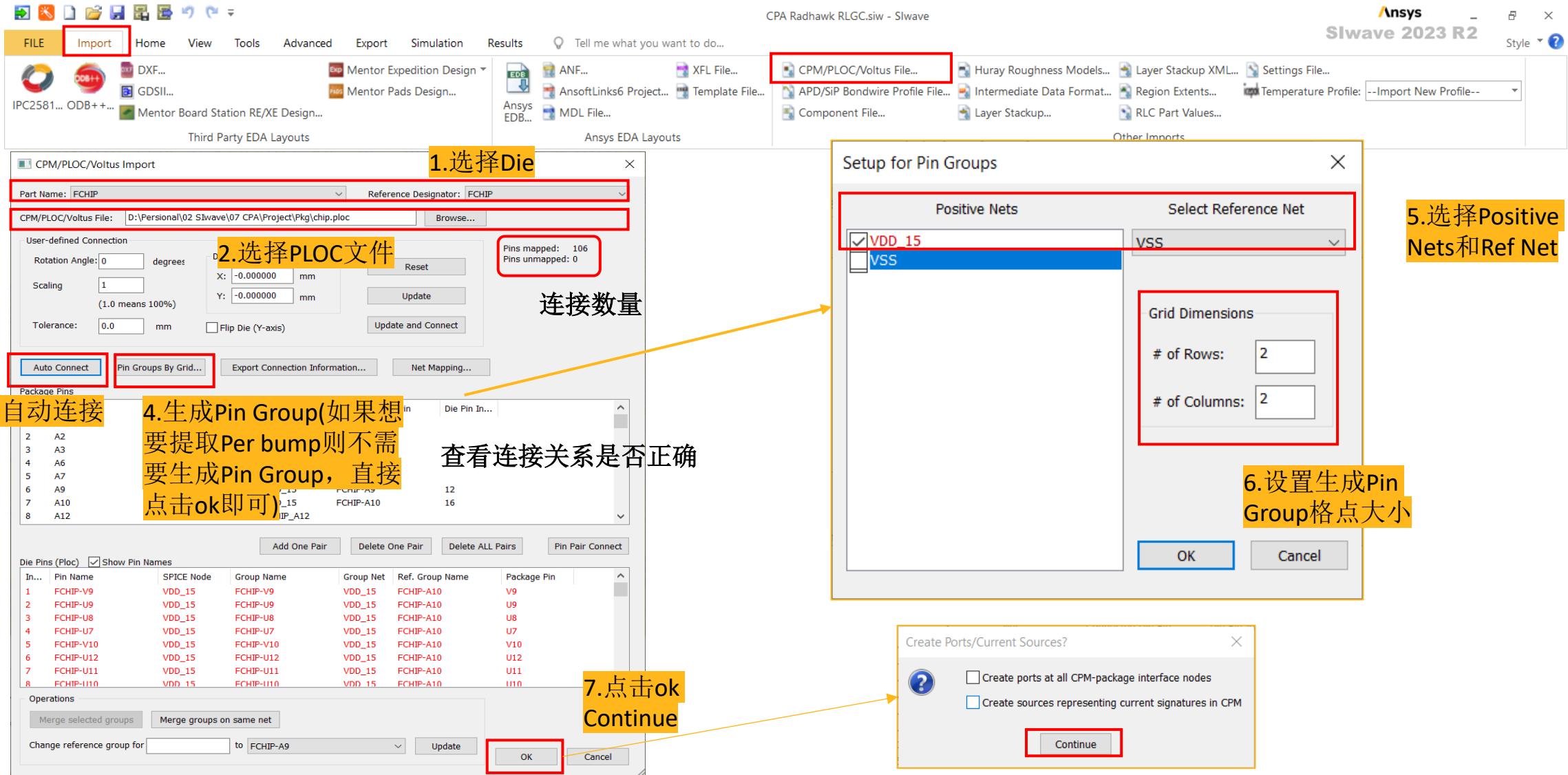
# 什么是PLOC文件

```
1 FCHIP-V9 2387.5 587.5 METAL6 VDD_15
2 FCHIP-U9 2387.5 812.5 METAL6 VDD_15
3 FCHIP-U8 2162.5 812.5 METAL6 VDD_15
4 FCHIP-U7 1937.5 812.5 METAL6 VDD_15
5 FCHIP-V10 2612.5 587.5 METAL6 VDD_15
6 FCHIP-U12 3062.5 812.5 METAL6 VDD_15
7 FCHIP-U11 2837.5 812.5 METAL6 VDD_15
8 FCHIP-U10 2612.5 812.5 METAL6 VDD_15
9 FCHIP-B9 2387.5 4187.5 METAL6 VDD_15
10 FCHIP-B8 2162.5 4187.5 METAL6 VDD_15
11 FCHIP-B7 1937.5 4187.5 METAL6 VDD_15
12 FCHIP-A9 2387.5 4412.5 METAL6 VDD_15
13 FCHIP-B12 3062.5 4187.5 METAL6 VDD_15
14 FCHIP-B11 2837.5 4187.5 METAL6 VDD_15
15 FCHIP-B10 2612.5 4187.5 METAL6 VDD_15
16 FCHIP-A10 2612.5 4412.5 METAL6 VDD_15
17 FCHIP-D4 1262.5 3737.5 METAL6 VSS
18 FCHIP-L4 1262.5 2162.5 METAL6 VSS
19 FCHIP-D11 2837.5 3737.5 METAL6 VSS
20 FCHIP-R11 2837.5 1262.5 METAL6 VSS
21 FCHIP-H4 1262.5 2837.5 METAL6 VSS
22 FCHIP-G11 2837.5 3062.5 METAL6 VSS
23 FCHIP-G4 1262.5 3062.5 METAL6 VSS
```

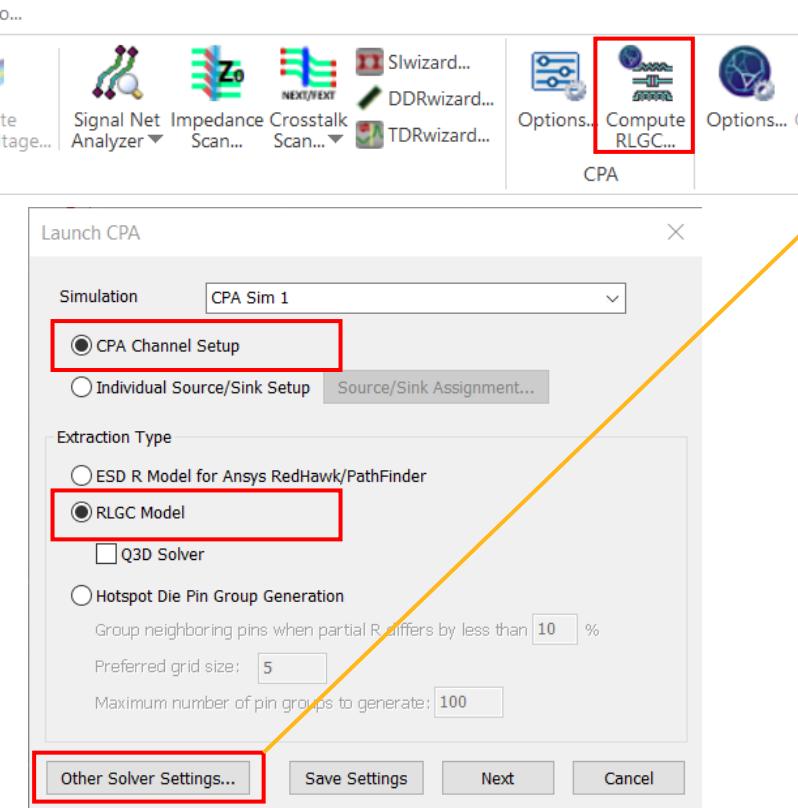
引脚名      坐标信息      所在层      网络名

PLOC中有每个Pin对应的坐标信息，相当于Per Pin。提供要分析的网络信息、后端Die pad名作为CPA模型网表节点。该信息（其他SPICE文件通常不包含）使SIwave能够自动对齐和连接IC管芯引脚和封装引脚。

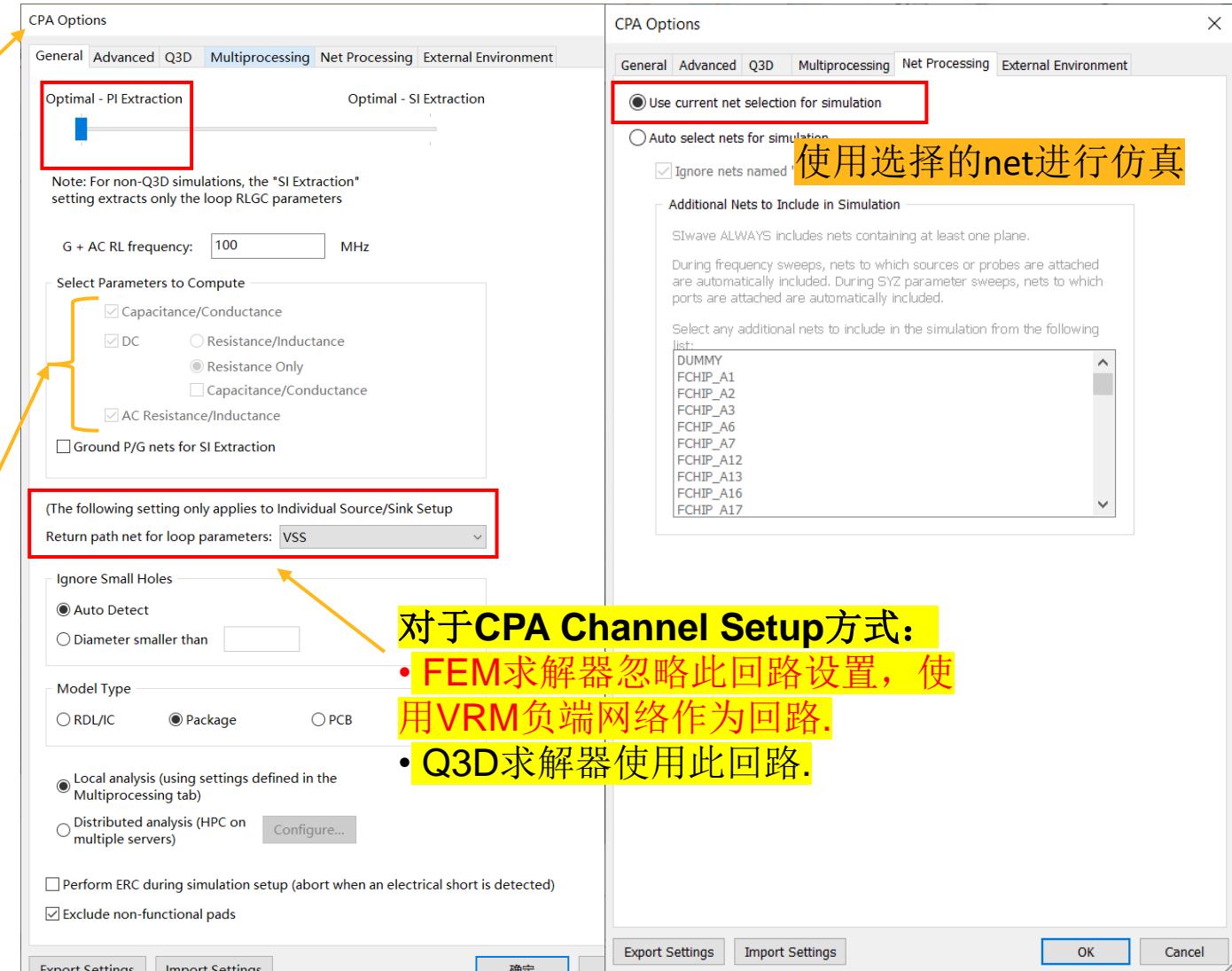
# PLOC导入



# 启动Siwave CPA

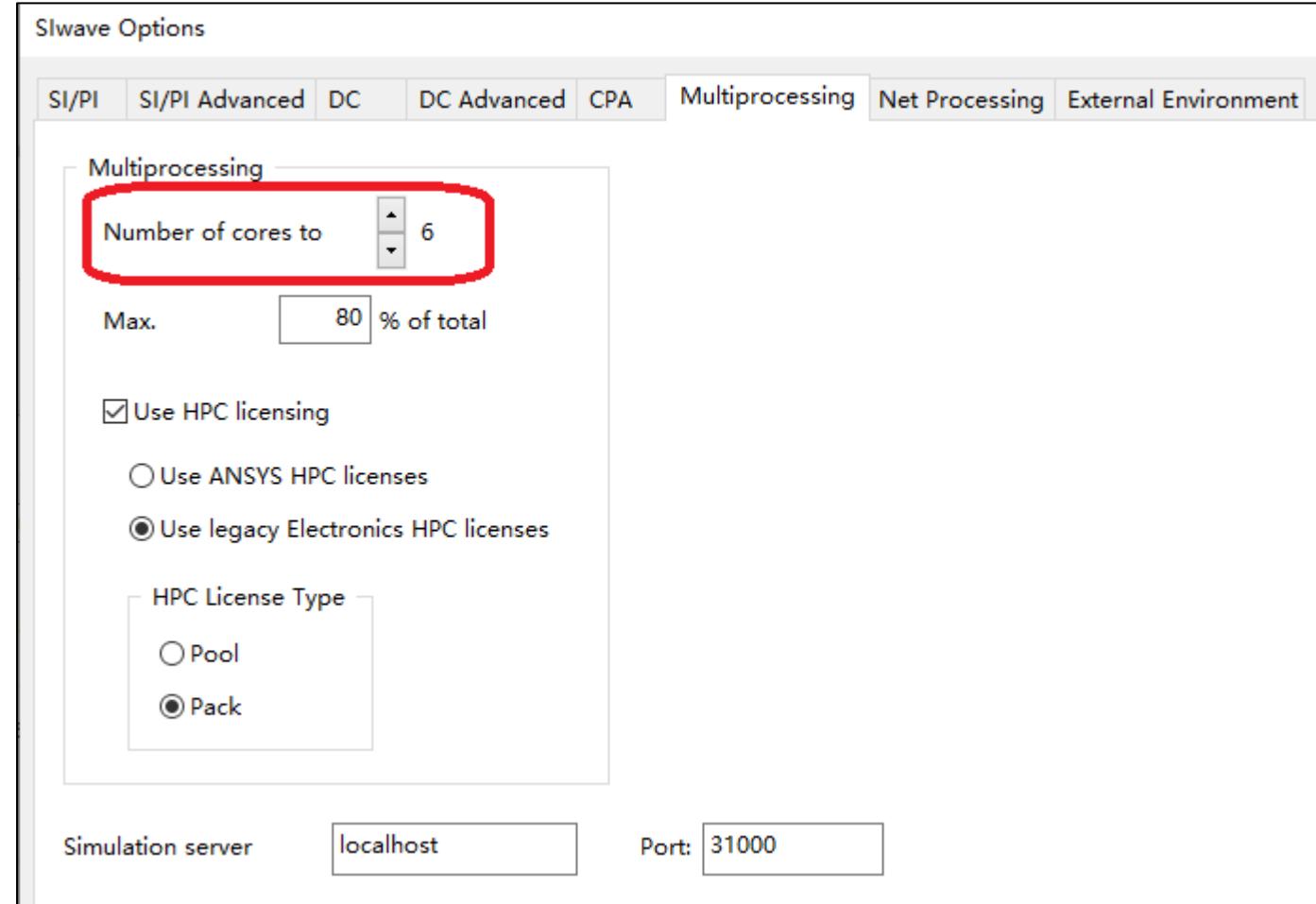


CPA Channel Setup方式后台自动使能 Select Parameters to compute框里的DC R, CG和AC RL选项，无法进行修改。因为必须满足Redhawk兼容

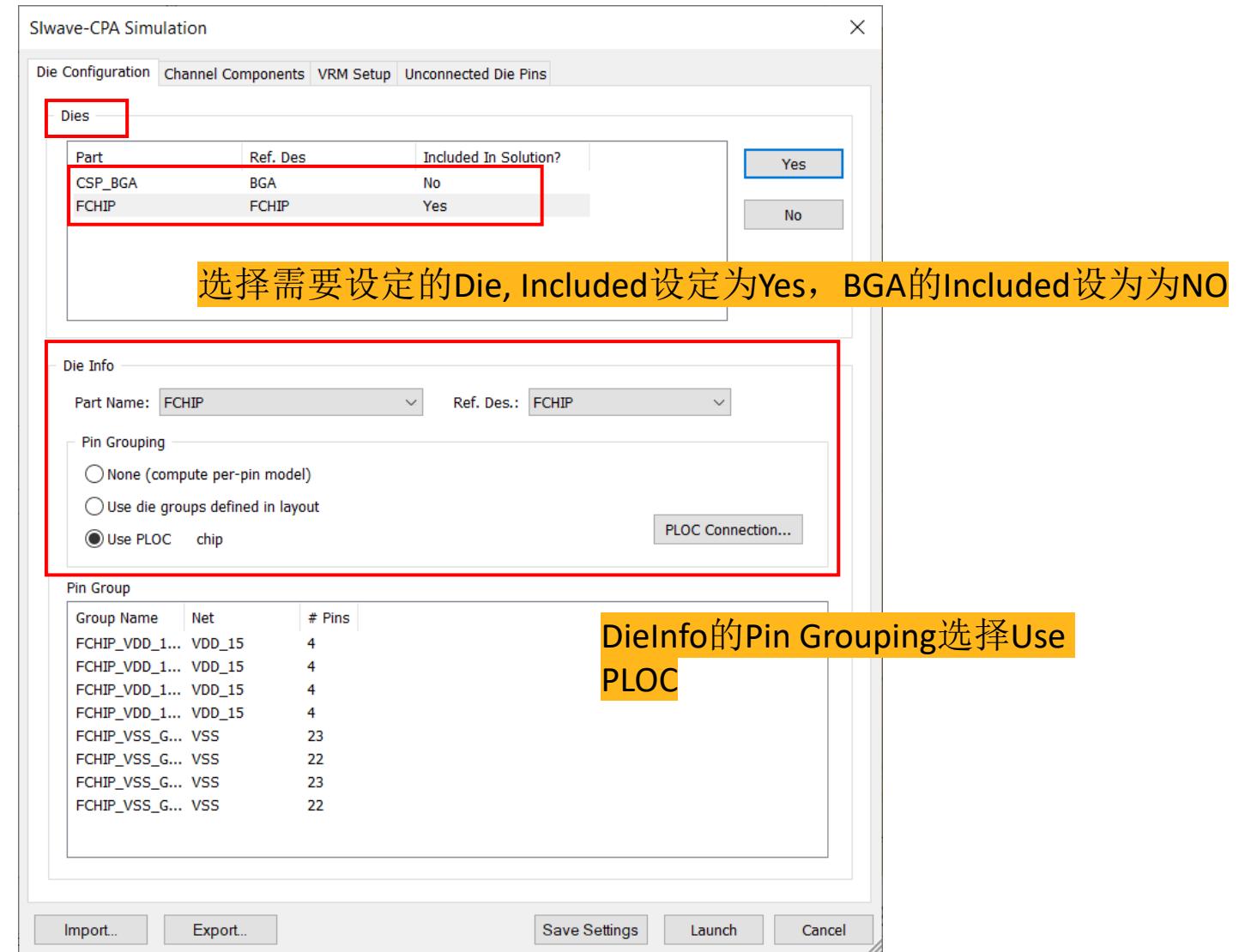
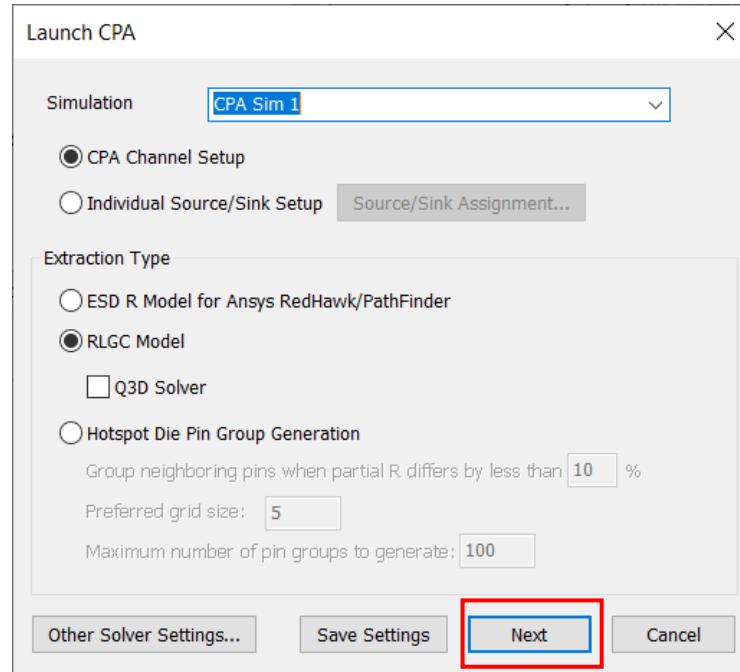


对于CPA Channel Setup方式：  
• FEM求解器忽略此回路设置，使用VRM负端网络作为回路。  
• Q3D求解器使用此回路。

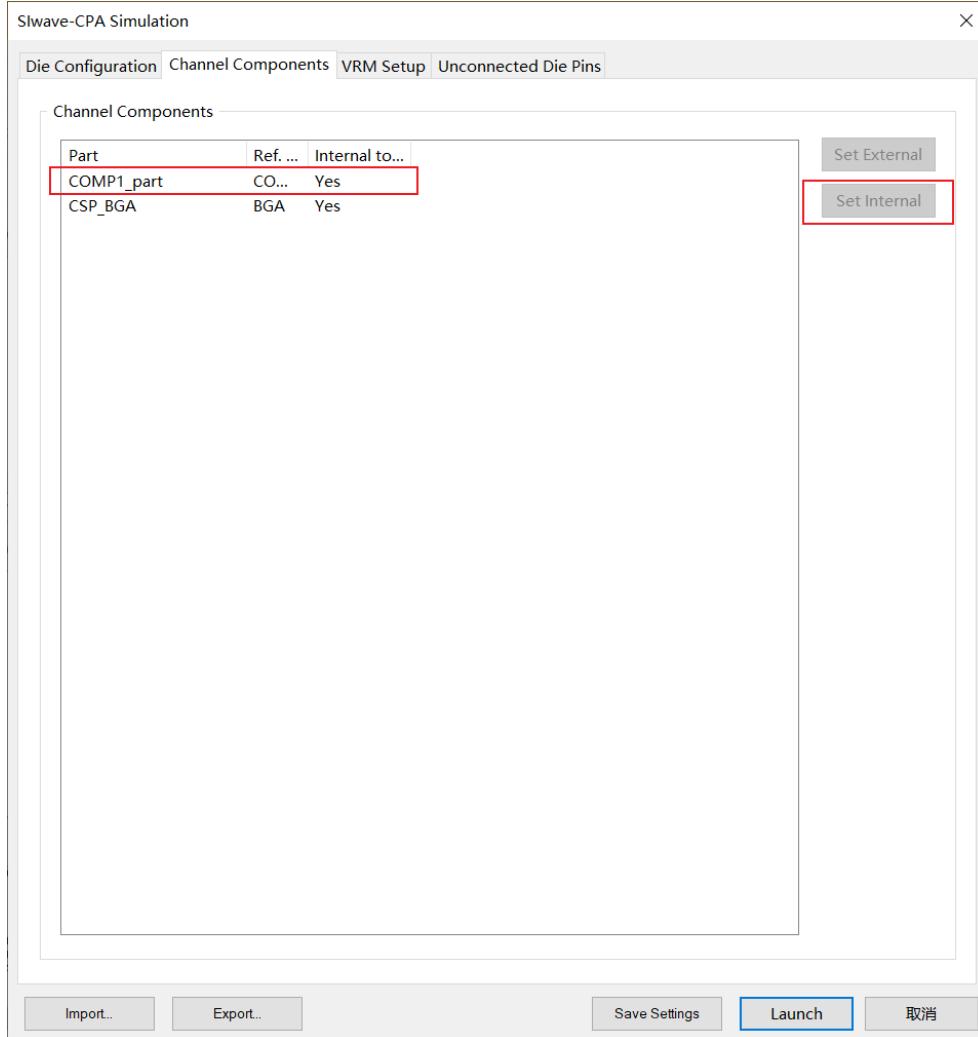
# HPC设置



# DIE设定

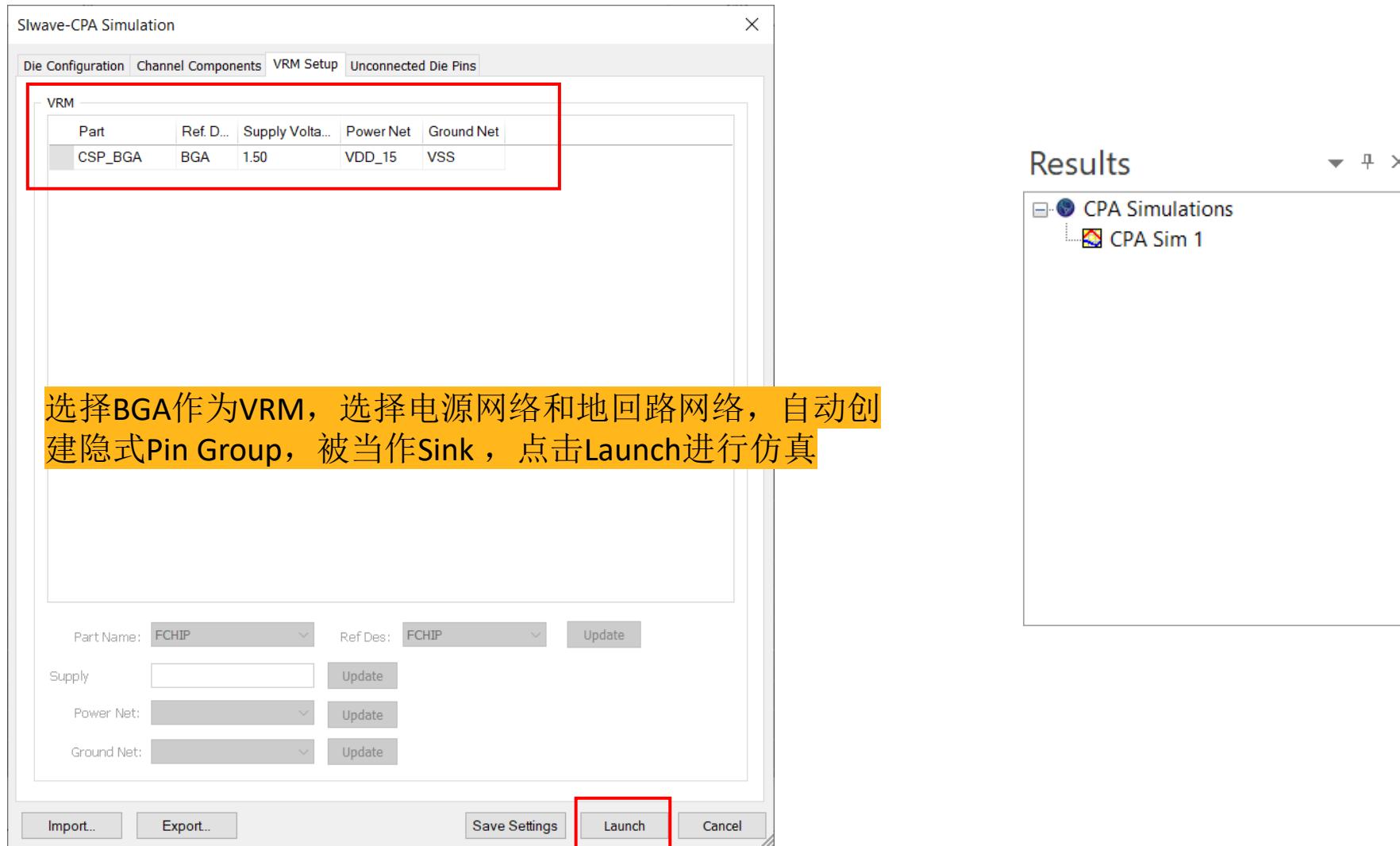


# Channel Component设置

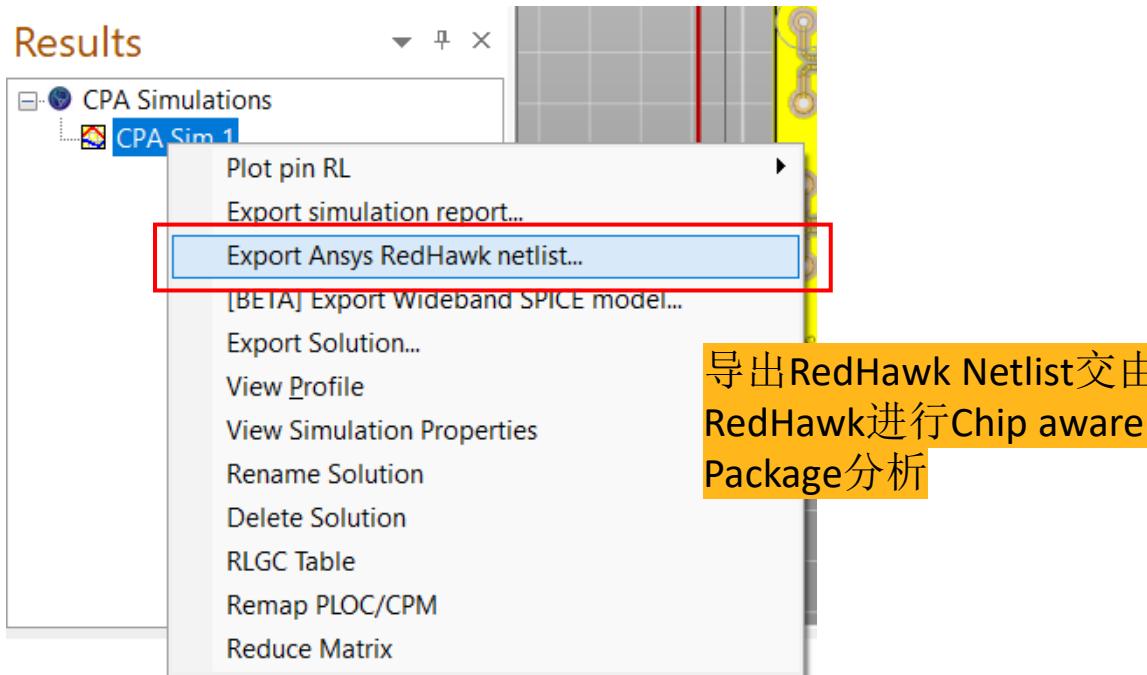


- 其他器件会被归到Channel Components。如果Channel中的器件管脚不需要在生成的CPA模型顶层网表子电路节点定义中显示，设置“internal to netlist”为“Yes”
  - 需赋模型的器件默认将管脚暴露在顶层网表节点中，便于后续更改模型进行What-if分析

# 设定VRM电压



# 结果后处理



D:\Personal\02 Slwave\07 CPA\Workflow\CPA Radhawk RLGC_adsCpa.zip\adsCPA\Extracted				
文件(F) 编辑(E) 查看(V) 书签(A) 工具(T) 帮助(H)				
添加 提取 测试 复制 移动 删除 信息				
名称	大小	压缩后大小	修改时间	创建时间
bin	11 173	2 096		
0000_CPA_Sim_1.pkg	4 576	1 283	2023-07-18...	
0000_CPA_Sim_1.sp	9 129	1 755	2023-07-18...	
0000_CPA_Sim_1_COMP1_part_CO...	1 528	581	2023-07-18...	
0000_CPA_Sim_1_COMP1_part_CO...	278	167	2023-07-18...	
0000_CPA_Sim_1_CSP_BGA_BGA.cpp	6 222	864	2023-07-18...	
0000_CPA_Sim_1_CSP_BGA_BGA.sp	338	190	2023-07-18...	
0000_CPA_Sim_1_FCHIP_FCHIP.cpp	12 478	1 247	2023-07-18...	
0000_CPA_Sim_1_RC.spec	2 880	899	2023-07-18...	
0000_CPA_Sim_1_WB.sp	818	288	2023-07-18...	
Cmatrix.txt	76	40	2023-07-18...	
cpa_annotated.ploc	13 335	1 054	2023-07-18...	
cpa_annotated_ASCII.ploc	6 828	665	2023-07-18...	
cpa_rh_pkg_wrapper.sp	2 752	949	2023-07-18...	
cpa_rh_pkg_wrapper_ASCII.sp	1 669	429	2023-07-18...	
Gmatrix.txt	76	40	2023-07-18...	
Loop_L.txt	8 591	743	2023-07-18...	
Lumped_L.txt	129	90	2023-07-18...	
Lumped_PerNet_R.txt	41	42	2023-07-18...	
mult_whole.lvl	3 450	963	2023-07-18...	
mult_whole_dcres.lvl	1 998	463	2023-07-18...	
mult_whole_dcres_loop.lvl	960	311	2023-07-18...	
mult_whole_loop.lvl	1 482	447	2023-07-18...	
Partial_L.txt	8 737	871	2023-07-18...	
Partial_L_DC.txt	8 737	859	2023-07-18...	

# 总结

- 通过导入PLOC，使SIwave能够自动对齐和连接IC管芯引脚和封装引脚，从而输出PKG Power RLC与Redhawk实现联合仿真；
- CPA FEM Solver可以求解上万bump封装，且求解速率快（几分钟-几小时）；

# **Appendix**

## **ALH注册 CPS中文学习室**



# CPS中文学习室

**适用人群:** 先进封装和系统的SIPI、Thermal、Mechanical工程师。

**设计目标:** 让工程师快速获得最有用、最必要的相关知识（文档、录像、教程）。

## 主要架构

- **入门必读:** 包含软件基本功能。每个工程师全部下载并通学。
- **高级技巧:** 包含最新的高阶流程。需要的工程师专题学习。
- **标准教程:** ALH自带标准软件教程。学习软件操作时使用。

## 进入方式:

- **已有ALH帐号:** 点击以下链接：

[https://jam8.sapjam.com/groups/oOWAdwLABmWAIbpwwDR5uv/overview\\_page/SJgVYUCTz90LbjxUQLHMSh](https://jam8.sapjam.com/groups/oOWAdwLABmWAIbpwwDR5uv/overview_page/SJgVYUCTz90LbjxUQLHMSh)

- **没有ALH帐号:** 参考第二页注册ALH账号后进入。

- **联系人:** [xiaoxia.zhou@ansys.com](mailto:xiaoxia.zhou@ansys.com)

The screenshot shows the homepage of the CPS Chinese Learning Room. At the top, there's a navigation bar with tabs for CPS, SIPI, Thermal, and Mechanical. Below the navigation is a search bar and a user profile section indicating 3,534 members. The main content area features a banner for the 'SIPI Learning Room' with a diagram of a connector board. Below the banner, there are two sections: '① 入门必学' (Essential for Beginners) and '② 高阶技巧' (Advanced Techniques). Each section lists several PDF documents with their download links. To the right of these sections are three columns of text: '精度优先' (Precision Priority), '效率革新' (Efficiency Innovation), and '多物理场' (Multi-physics). At the bottom right, there's a link to the '最新版: 2023R1.1 下载' (Latest Version: Download) and a '新功能Highlight' (New Features Highlight) section.

# ALH注册方法

打开下面网址或扫描右边二维码进行注册：

[https://www.ansys.com/alhactivation\\_cn](https://www.ansys.com/alhactivation_cn)

第13步“是否有激活码”，请选择“否”

第14步“请输入您的激活码”，请填写客户号。

客户号为一串6位或7位数字。

获取方法：

- 询问Ansys客户经理/技术。
- 启动软件，观察Help – About - Client License Settings - Customer Number。



Ansys

