

```
In[1]:= SetDirectory@NotebookDirectory[];
          |设置目录           |当前笔记本的目录
Import["QLanczos_package.m"];
          |导入
```

---

## Parameters

```
In[2]:= d = 5;
          κ = 0.1;
n = 1; (*η=n*ηprac*)
Id = IdentityMatrix[d];
          |单位矩阵
η = 1.5 * 10.^-15; (*machine precision*)

In[3]:= ηList = Table[10.^j, {j, -15, 5, 0.1}];
          |表格
MList = Table[10.^j, {j, 2, 20, 1}];
          |表格
(*the measurement number for a real matrix element is M*)
rep = 100; (*replications*)
```

---

## Model

```
In[4]:= Ham = HeisenbergHam;
```

---

## Spectrum

```
In[5]:= {Δ, U} = funSpectrum[Ham];
HamNorm = Max[Abs[Δ]]
          |...|绝对值
Δ = Δ / HamNorm;
Eg = Δ[[1]]
```

```
Out[5]= 17.0321
```

```
Out[6]= -1.
```

```
In[7]:= htot = 27. / HamNorm
Out[7]= 1.58524
```

---

## Reference state

```
In[8]:= φ = φHeisenberg;
φ = Flatten[Conjugate[U].φ];
          |压平           |共轭
probφ = Abs[φ]^2;
          |绝对值
```

```
In[1]:= pg = probφ[[1]] (*pg>10^-3*)
ER = Total[probφ * Λ];

```

\总计

```
εR = ER - Eg
```

```
Out[1]= 0.682614
```

```
Out[2]= 0.119312
```

## Power

```
In[1]:= Eθ = Eg + 1.;
```

```
{Hmat, Smat} = funMatP[Λ, Eθ, d, probφ];
```

```
In[2]:= EB = Hmat[[d, d]] / Smat[[d, d]];

```

```
εB = EB - Eg (*used to identify τ for GP, ITE and F*)
```

```
Out[2]= 0.0072981
```

```
In[3]:= {EK, cn} = funSubDiag[Hmat + η * Id, Smat + η * Id];

```

```
εK = EK - Eg (*10^-9<εK<10^-2*)

```

```
Out[3]= 0.000390209
```

```
In[4]:= costH = 1.;
```

```
costS = 1.;
```

```
{εPList, γPList} = funEpsilonGamma[Hmat, Smat, costH, costS, Id, ηList, Eg, pg];

```

```
In[5]:= {εPList1, γPList1} =

```

```
funEtaPracGP[MList, rep, n, Hmat, Smat, d, κ, costH, costS, Id, Eg, pg];

```

```
In[6]:= {MListP, εListP} = funEpsilonM[Hmat, Smat, costH, costS, Id, ηList, Eg, d, κ];

```

## Chebyshev Polynomial

```
In[1]:= Eθ = 0.;
```

```
{Hmat, Smat} = funMatCP[Λ, Eθ, d, probφ, htot];

```

```
In[2]:= costH = 1.;
```

```
costS = 1.;
```

```
{εCPList, γCPList} = funEpsilonGamma[Hmat, Smat, costH, costS, Id, ηList, Eg, pg];

```

```
In[3]:= {εCPList1, γCPList1} =

```

```
funEtaPracF[MList, rep, n, Hmat, Smat, d, κ, costH, costS, Id, Eg, pg];

```

```
In[4]:= {MListCP, εListCP} = funEpsilonM[Hmat, Smat, costH, costS, Id, ηList, Eg, d, κ];

```

## Gaussian-Power

```

In[1]:= τMIN = 0;
τMAX = 64;
While[True,
  (*Whil…*)
  τ = (τMIN + τMAX) / 2.;
  {Hmat, Smat} = funMatGP[Λ, Eg, τ, 1, probφ, htot];
  EK = Hmat[[1, 1]] / Smat[[1, 1]];
  err = EK - Eg;
  If[err > εB, τMIN = τ];
  (*If[err < εB, τMAX = τ];*)
  (*Print[{err, τMIN, τMAX}];*)
  (*Print[err]*)
  If[Abs[err - εB] < 10-10, Break[]];
  (*Break*)
];
τ
Out[1]= 6.34638

In[2]:= Eθ = Eg;
{Hmat, Smat} = funMatGP[Λ, Eθ, τ, d, probφ, htot];

In[3]:= costH = htot;
costS = 1.;
{εGPList, γGPList} = funEpsilonGamma[Hmat, Smat, costH, costS, Id, ηList, Eg, pg];

In[4]:= {εGPList1, γGPList1} =
  funEtaPracF[MList, rep, n, Hmat, Smat, d, κ, costH, costS, Id, Eg, pg];

In[5]:= {MListGP, εListGP} = funEpsilonM[Hmat, Smat, costH, costS, Id, ηList, Eg, d, κ];

```

## Inverse Power

```

In[1]:= Eθ = Eg - 1.;
{Hmat, Smat} = funMatIP[Λ, Eθ, d, probφ];

In[2]:= costH = 1.;
costS = 1.;
{εIPLlist, γIPLlist} = funEpsilonGamma[Hmat, Smat, costH, costS, Id, ηList, Eg, pg];

In[3]:= {εIPLlist1, γIPLlist1} =
  funEtaPracGP[MList, rep, n, Hmat, Smat, d, κ, costH, costS, Id, Eg, pg];

In[4]:= {MListIP, εListIP} = funEpsilonM[Hmat, Smat, costH, costS, Id, ηList, Eg, d, κ];

```

## Imaginary-time evolution

```

In[1]:= τMIN = 0;
τMAX = 64;
While[True,
  (*While*)
  τ = (τMIN + τMAX) / 2.;
  {Hmat, Smat} = funMatITE[Λ, Eg, τ, d, probφ];
  EK = Hmat[[d, d]] / Smat[[d, d]];
  err = EK - Eg;
  If[err > εB, τMIN = τ];
  (*If*)
  If[err < εB, τMAX = τ];
  (*If*)
  (*Print[{err, τMIN, τMAX}];*)
  (*Print*)
  If[Abs[err - εB] < 10-10, Break[]];
  (*Break*)
];
τ
Out[1]= 1.1768

In[2]:= Eθ = Eg;
{Hmat, Smat} = funMatITE[Λ, Eθ, τ, d, probφ];

In[3]:= costH = 1.;
costS = 1.;
{εITEList, γITEList} = funEpsilonGamma[Hmat, Smat, costH, costS, Id, ηList, Eg, pg];

In[4]:= {εITEList1, γITEList1} =
  funEtaPracGP[MList, rep, n, Hmat, Smat, d, κ, costH, costS, Id, Eg, pg];

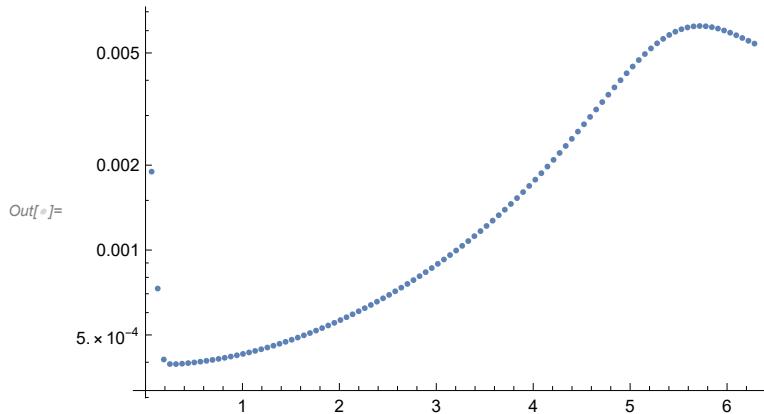
In[5]:= {MListITE, εListITE} = funEpsilonM[Hmat, Smat, costH, costS, Id, ηList, Eg, d, κ];

```

## Real-time evolution

```
In[1]:= ΔtList = Table[ $\frac{2. * \pi}{100}$  j, {j, 1, 100}];  
[表格]  
  
εKList = ConstantArray[0, Length[ΔtList]];  
[常量数组] [长度]  
  
Do [  
[Do循环]  
  Δt = ΔtList[[j]];  
  {Hmat, Smat} = funMatRTE[Λ, Eg, Δt, d, probφ];  
  {EK, cn} = funSubDiag[Hmat + η * Id, Smat + η * Id];  
  err = EK - Eg;  
  εKList[[j]] = err;  
 , {j, 1, Length[ΔtList]}]  
[长度]  
Δt = ΔtList[[Position[εKList, Min[εKList]] [[1, 1]]]]  
[位置] [最小值]  
ListLogPlot[Transpose[{ΔtList, εKList}], PlotRange → Full]  
[点集的对数图] [转置] [绘制范围] [全范围]
```

Out[1]= 0.314159



```
In[2]:= Eθ = Eg;  
{Hmat, Smat} = funMatRTE[Λ, Eθ, Δt, d, probφ];  
  
In[3]:= costH = 1.;  
costS = 1.;  
{eRTELList, γRTELList} = funEpsilonGamma[Hmat, Smat, costH, costS, Id, ηList, Eg, pg];  
  
In[4]:= {eRTELList1, γRTELList1} =  
funEtaPracRTE[MList, rep, n, Hmat, Smat, d, κ, costH, costS, Id, Eg, pg];  
  
In[5]:= {MListRTE, eListRTE} = funEpsilonMRTE[Hmat, Smat, costH, costS, Id, ηList, Eg, d, κ];
```

---

## Filter

```
In[6]:= τMIN = 0;
τMAX = 64;
While[True,
  (*Whil...*)
  τ = (τMIN + τMAX) / 2.;
  {Hmat, Smat} = funMatF[Λ, Eg, 0, τ, 1, probφ];
  EK = Hmat[[1, 1]] / Smat[[1, 1]];
  err = EK - Eg;
  If[err > εB, τMIN = τ];
  (*If*)
  If[err < εB, τMAX = τ];
  (*If*)
  (*Print[{err, τMIN, τMAX}];*)
  (*Print*)
  If[Abs[err - εB] < 10-10, Break[]];
  (*...*)
  (*Break*)
];
τ
Out[6]:= 11.2447
```

```

In[1]:= ΔEList = Table[ $\frac{2.}{d * 100} * j$ , {j, 1, 100}];

εKList = ConstantArray[0, Length[ΔEList]];
 $\downarrow$ 常量数组  $\downarrow$ 长度

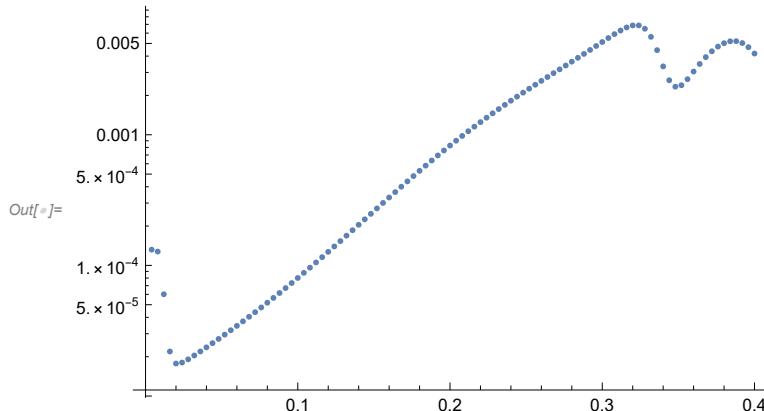
Do[( $\downarrow$ Do循环
    ΔE = ΔEList[[j]];
    {Hmat, Smat} = funMatF[Λ, Eg, ΔE, τ, d, probφ];
    {EK, cn} = funSubDiag[Hmat + η * Id, Smat + η * Id];
    err = EK - Eg;
    εKList[[j]] = err;
  ), {j, 1, Length[ΔEList]}]
 $\downarrow$ 长度

ΔE = ΔEList[[Position[εKList, Min[εKList]][[1, 1]]]]
 $\downarrow$ 位置  $\downarrow$ 最小值

ListLogPlot[Transpose[{ΔEList, εKList}], PlotRange → Full]
 $\downarrow$ 点集的对数图  $\downarrow$ 转置  $\downarrow$ 绘制范围  $\downarrow$ 全范围

```

Out[1]= 0.02



```

In[2]:= E0 = Eg;
{Hmat, Smat} = funMatF[Λ, E0, ΔE, τ, d, probφ];

In[3]:= costH = 1.;
costS = 1.;
{εFList, γFList} = funEpsilonGamma[Hmat, Smat, costH, costS, Id, ηList, Eg, pg];

In[4]:= {εFList1, γFList1} =
  funEtaPracF[MList, rep, n, Hmat, Smat, d, κ, costH, costS, Id, Eg, pg];

In[5]:= {MListF, εListF} = funEpsilonM[Hmat, Smat, costH, costS, Id, ηList, Eg, d, κ];

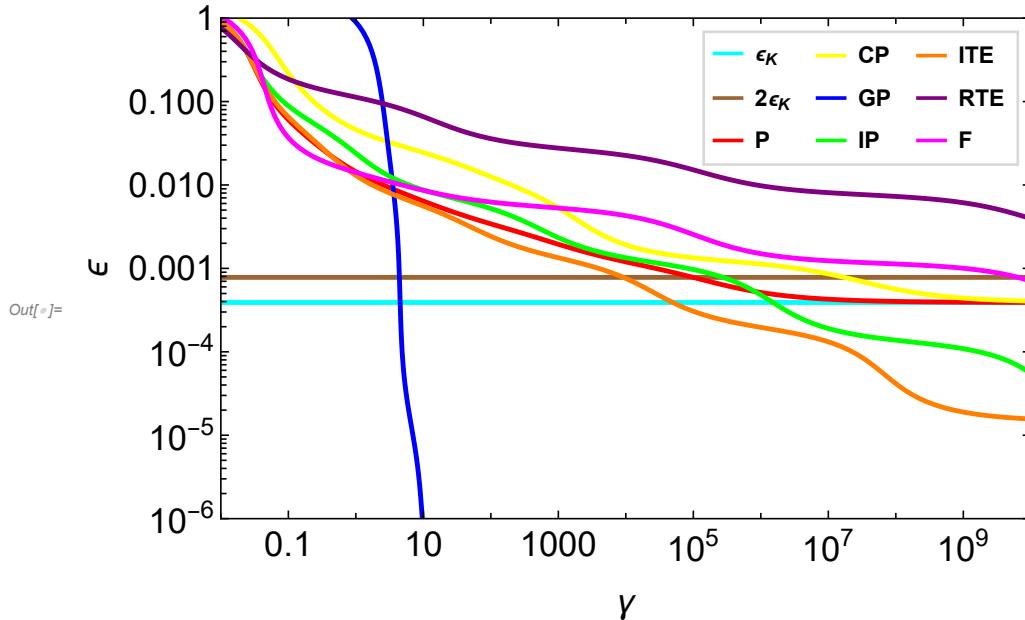
```

## Plot

```

In[=]: PR = {{1.*^-2, 1.*^10}, {1.*^-6, 1.*^0}}; (*plot range*)
Fig = ListLogLogPlot[{Transpose[{γPList, 0.*εPList + εK}], 
    |点集的双对数图| 转置
    Transpose[{γPList, 0.*εPList + 2.*εK}], Transpose[{γPList, εPList}],
    |转置| 转置
    Transpose[{γCPList, εCPList}], Transpose[{γGPList, εGPList}],
    |转置| 转置
    Transpose[{γIPList, εIPList}], Transpose[{γITEList, εITEList}],
    |转置| 转置
    Transpose[{γRTELList, εRTELList}], Transpose[{γFList, εFList}]},
    |转置| 转置
PlotRange → PR, Joined → True, PlotStyle → {Thickness[0.006], Cyan},
    |绘制范围| 连接点| 真| 绘图样式| 粗细| 蓝绿色
    {Thickness[0.006], Brown}, {Thickness[0.006], Red}, {Thickness[0.006], Yellow},
    |粗细| 棕色| 粗细| 红色| 粗细| 黄色
    {Thickness[0.006], Blue}, {Thickness[0.006], Green}, {Thickness[0.006], Orange},
    |粗细| 蓝色| 粗细| 绿色| 粗细| 橙色
    {Thickness[0.006], Purple}, {Thickness[0.006], Magenta}},
    |粗细| 紫色| 粗细| 品红色
Frame → True, FrameStyle → Directive[Black, Thickness[0.002]],
    |边框| 真| 边框样式| 指令| 黑色| 粗细
FrameTicksStyle → Directive[Black, Thickness[0.002]], FrameLabel → {"γ", "ε"},
    |边框刻度样式| 指令| 黑色| 粗细| 边框标签
LabelStyle → {FontSize → 18, FontFamily → "Arial"}, ImageSize → 500,
    |标签样式| 字体大小| 字体系列| 图像尺寸
PlotLegends → Placed[LineLegend[{"εK", "2εK", "P", "CP", "GP", "IP", "ITE", "RTE", "F"}, 
    |绘图的图例| 放置| 线的图例
    LegendFunction → (Framed[#, FrameStyle → LightGray] &), LegendMarkerSize → {16, 8},
    |图例函数| 加边框| 边框样式| 浅灰色| 图例标记尺寸
    LabelStyle → {Black, Bold, FontSize → 12, FontFamily → "Arial"}, 
    |标签样式| 黑色| 粗体| 字体大小| 字体系列
    LegendMargins → 0, LegendLayout → {"Column", 3}], {0.79, 0.84}]]
    |图例边幅| 图例布局| 列

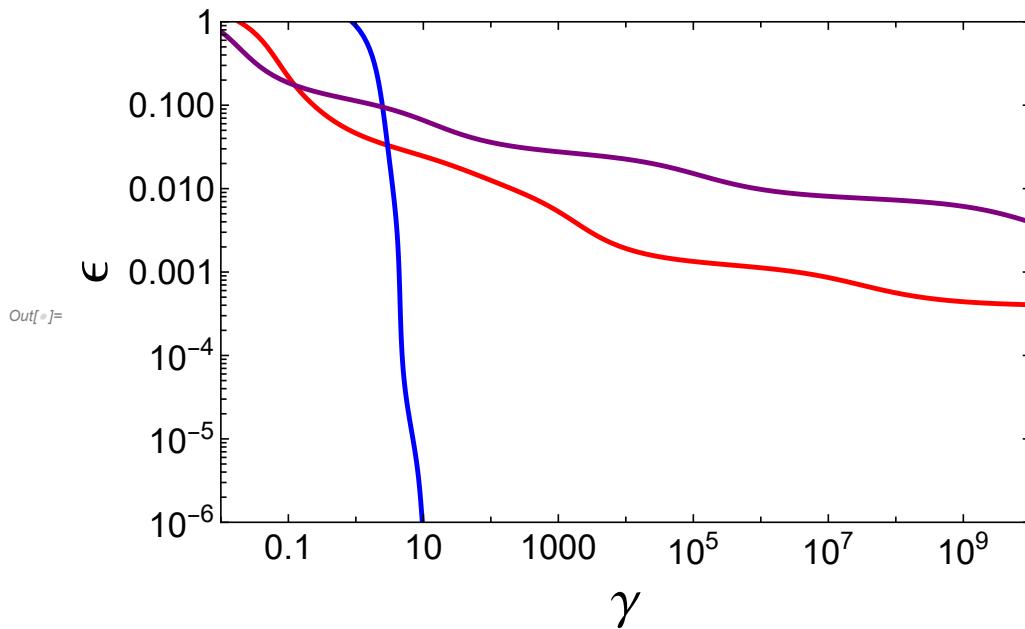
```



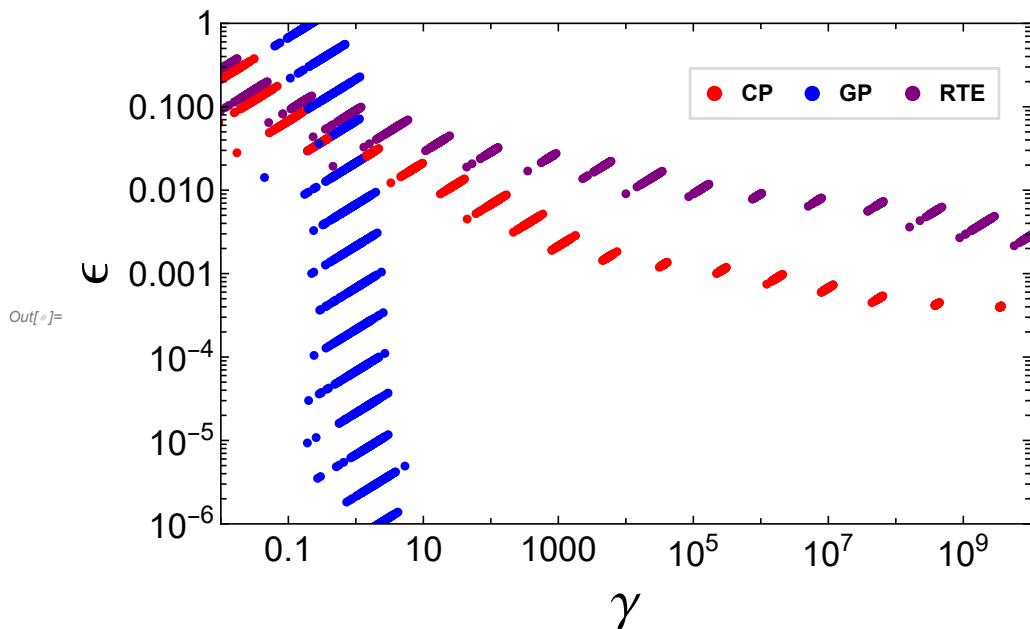
```

In[ $\circ$ ] = Fig1 = ListLogLogPlot[Transpose[{γCPList, εCPList}], Transpose[{γGPList, εGPList}],
    Transpose[{γRTEList, εRTEList}]], PlotRange → PR, Joined → True, PlotStyle →
    {Thickness[0.006], Red}, {Thickness[0.006], Blue}, {Thickness[0.006], Purple},
    Frame → True, FrameStyle → Directive[Black, Thickness[0.002]],
    FrameTicksStyle → Directive[Black, Thickness[0.002]], FrameLabel → {"γ", "ε"},
    LabelStyle → {FontSize → 18, FontFamily → "Arial"}, ImageSize → 500]

```



```
In[6]:= Fig2 = Legended[Show[Table[ListLogLogPlot[
  |图例|显示|表格|点集的双对数图
  {Transpose[{γCPList1[[i]], εCPList1[[i]]}], Transpose[{γGPList1[[i]], εGPList1[[i]]}],
  |转置|转置
  Transpose[{γRTEList1[[i]], εRTEList1[[i]]}]}, PlotRange -> PR, Joined -> False,
  |绘制范围|连接点|假
  Frame -> True, FrameStyle -> Directive[Black, Thickness[0.002]],
  |边框|真|边框样式|指令|黑色|粗细
  FrameTicksStyle -> Directive[Black, Thickness[0.002]],
  |边框刻度样式|指令|黑色|粗细
  FrameLabel -> {"γ", "ε"}, LabelStyle -> {FontSize -> 18, FontFamily -> "Arial"},
  |边框标签|标签样式|字体大小|字体系列
  ImageSize -> 500, PlotStyle -> {Red, Blue, Purple}], {i, 1, rep}]],
  |图像尺寸|绘图样式|红色|蓝色|紫色
  Placed[PointLegend[{Red, Blue, Purple}, {"CP", "GP", "RTE"}],
  |放置|点的图例|红色|蓝色|紫色
  LegendFunction -> (Framed[#, FrameStyle -> LightGray] &), LegendMarkerSize -> {16, 8},
  |图例函数|加边框|边框样式|浅灰色|图例标记尺寸
  LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"},
  |标签样式|黑色|粗体|字体大小|字体系列
  LegendMargins -> 0, LegendLayout -> {"Column", 3}], {0.77, 0.86}]]
  |图例边幅|图例布局|列]
```



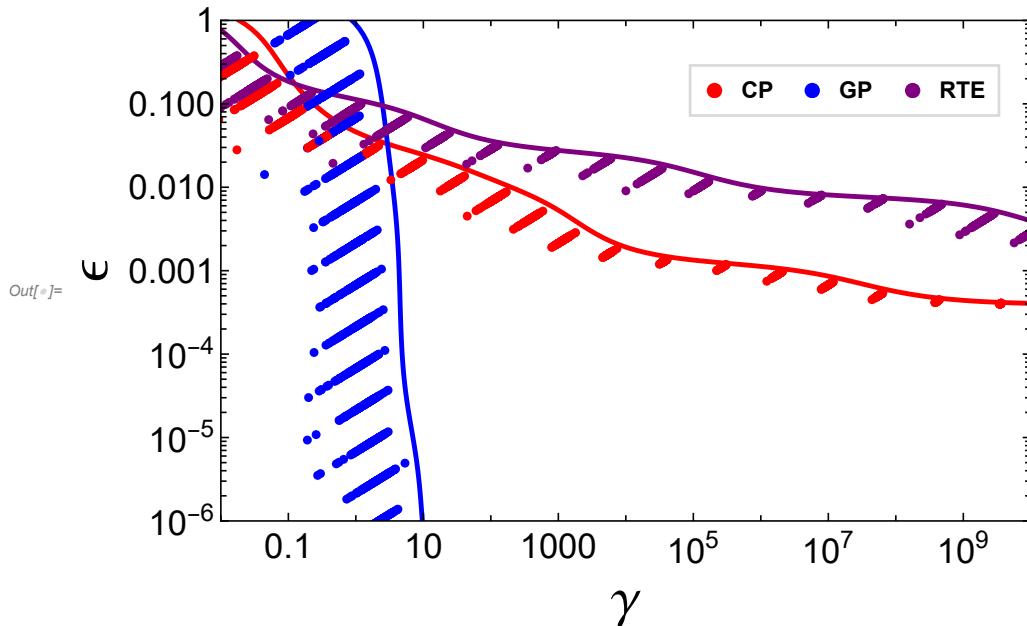
In[3]:= `Fig3 = Show[Fig1, Fig2, PlotLabel -> "Scaling=" <> ToString[n]]`

显示

绘图标签

转换为字符串

Scaling=1



In[4]:= (\*path="C:\\\\Users\\\\John\\\\Desktop\\\\Revise\\\\practical\_eta-n=" <> ToString[n] <> ".pdf";  
常量  
Out[4]=

转换为字符串

`Export[path, Fig3]; */`

导出

## M vs epsilon with 1-kappa probability using eta\_pract

```
In[5]:= lleg1 = LineLegend[{Cyan}, {"εκ"}, LegendMarkerSize -> {14, 7},  
线的图例 蓝绿色 图例标记尺寸  
LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];  
标签样式 黑色 粗体 字体大小 字体系列 图例边幅  
lleg2 = LineLegend[{Brown}, {"2εκ"}, LegendMarkerSize -> {14, 7},  
线的图例 棕色 图例标记尺寸  
LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];  
标签样式 黑色 粗体 字体大小 字体系列 图例边幅  
pleg1 = PointLegend[{Red}, {"P"}, LegendMarkerSize -> {14, 7},  
点的图例 红色 图例标记尺寸  
LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];  
标签样式 黑色 粗体 字体大小 字体系列 图例边幅  
pleg2 = PointLegend[{Yellow}, {"CP"}, LegendMarkerSize -> {14, 7},  
点的图例 黄色 图例标记尺寸  
LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];  
标签样式 黑色 粗体 字体大小 字体系列 图例边幅  
pleg3 = PointLegend[{Blue}, {"GP"}, LegendMarkerSize -> {14, 7},  
点的图例 蓝色 图例标记尺寸  
LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];  
标签样式 黑色 粗体 字体大小 字体系列 图例边幅  
pleg4 = PointLegend[{Green}, {"IP"}, LegendMarkerSize -> {14, 7},  
占的图例 绿色 图例标记尺寸
```

```

LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];
|标签样式      |黑色 |粗体 |字体大小      |字体系列          |图例边幅

pleg5 = PointLegend[{Orange}, {"ITE"}, LegendMarkerSize -> {14, 7},
|点的图例     |橙色 |图例标记尺寸

LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];
|标签样式      |黑色 |粗体 |字体大小      |字体系列          |图例边幅

pleg6 = PointLegend[{Purple}, {"RTE"}, LegendMarkerSize -> {14, 7},
|点的图例     |紫色 |图例标记尺寸

LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];
|标签样式      |黑色 |粗体 |字体大小      |字体系列          |图例边幅

pleg7 = PointLegend[{Magenta}, {"F"}, LegendMarkerSize -> {14, 7},
|点的图例     |品红色 |图例标记尺寸

LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"}, LegendMargins -> 0];
|标签样式      |黑色 |粗体 |字体大小      |字体系列          |图例边幅

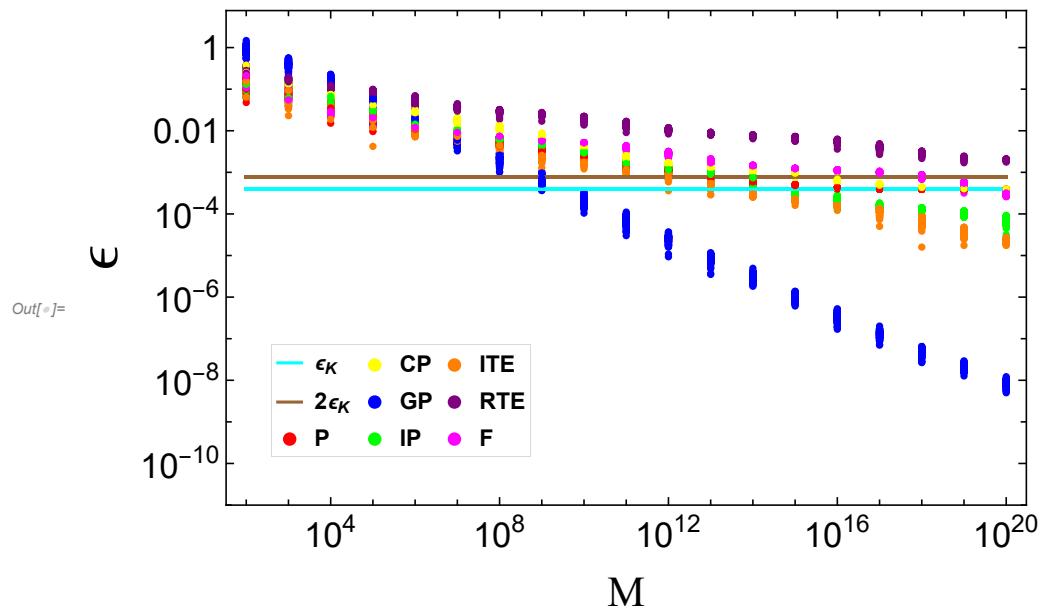
Fig =
Legended[Show[Table[ListLogLogPlot[{Transpose[{MList, 0.*MList + 1.*eK}],
|图例       |显示 |表格 |点集的双对数图 |转置
Transpose[{MList, 0.*MList + 2.*eK}], Transpose[{MList, ePList1[[i]]}],
|转置           |转置
Transpose[{MList, eCPList1[[i]]}], Transpose[{MList, eGPList1[[i]]}],
|转置           |转置
Transpose[{MList, eIPList1[[i]]}], Transpose[{MList, eITEList1[[i]]}],
|转置           |转置
Transpose[{MList, eRTEList1[[i]]}], Transpose[{MList, eFList1[[i]]}],
|转置           |转置
PlotRange -> {{Min[MList] / 3, Max[MList] * 3}, {Min[eGPList] / 3, Max[eGPList] * 3}},
|绘制范围      |最小值 |最大值 |最小值 |最大值
Joined -> {True, True, False, False, False, False, False, False, False, False},
|连接点      |真   |真   |假   |假   |假   |假   |假   |假   |假
Frame -> True, FrameStyle -> Directive[Black, Thickness[0.002]], FrameTicksStyle ->
|边框        |真   |边框样式 |指令 |黑色 |粗细 |边框刻度样式
Directive[Black, Thickness[0.002], 18], FrameLabel -> {"M", "E"},
|指令        |黑色 |粗细 |边框标签

LabelStyle -> {FontSize -> 22, FontFamily -> "Arial"}, ImageSize -> 500, PlotStyle ->
|标签样式      |字体大小      |字体系列          |图像尺寸          |绘图样式
{Cyan, Brown, Red, Yellow, Blue, Green, Orange, Purple, Magenta}], {i, 1, rep}]],
|蓝绿色 |棕色 |红色 |黄色 |蓝色 |绿色 |橙色 |紫色 |品红色

Placed[Grid[{{lleg1, pleg2, pleg5}, {lleg2, pleg3, pleg6}, {pleg1, pleg4, pleg7}}},
|放置       |格子

Alignment -> Left, Frame -> True, FrameStyle -> LightGray], {{0.22, 0.45}, {0.5, 1.5}}]
|对齐       |左   |边框 |真   |边框样式 |浅灰色

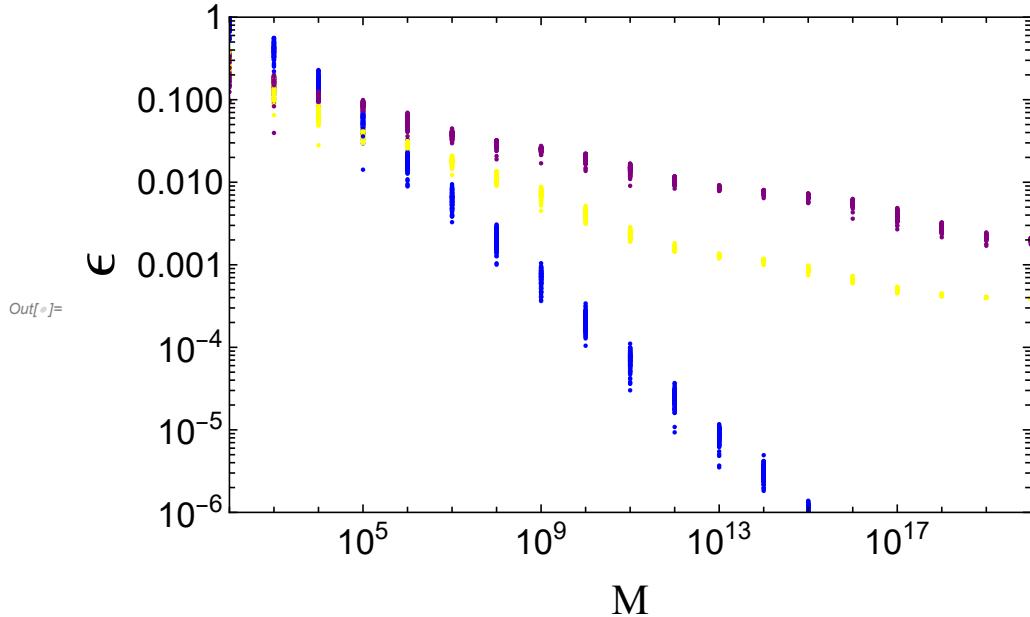
```



In[6]:= PR = {{10<sup>2</sup>, 10<sup>20</sup>}, {10<sup>-6</sup>, 10<sup>0</sup>} }; (\*plot range\*)

Fig4 =

```
Show[Table[ListLogLogPlot[{Transpose[{MList, eCPList1[[i]]}],  
|显示|表格|点集的双对数图|转置  
Transpose[{MList, eGPList1[[i]]}], Transpose[{MList, eRTEList1[[i]]}],  
|转置|转置  
PlotRange -> PR, Joined -> {False, False}, PlotStyle -> {{PointSize[0.0055], Yellow},  
|绘制范围|连接点|假|假|绘图样式|点的大小|黄色  
{PointSize[0.0055], Blue}, {PointSize[0.0055], Purple}}, Frame -> True,  
|点的大小|蓝色|点的大小|紫色|边框|真  
FrameStyle -> Directive[Black, Thickness[0.002]], FrameTicksStyle ->  
|边框样式|指令|黑色|粗细|边框刻度样式  
Directive[Black, Thickness[0.002], 18], FrameLabel -> {"M", "\u039b"},  
|指令|黑色|粗细|边框标签  
LabelStyle -> {FontSize -> 22, FontFamily -> "Arial"}, ImageSize -> 500], {i, 1, rep}]]]  
|标签样式|字体大小|字体系列|图像尺寸
```



In[7]:= ePListx = funExtract[ePList1, MList, rep, x];  
eCPListx = funExtract[eCPList1, MList, rep, x];  
eGPListx = funExtract[eGPList1, MList, rep, x];  
eIPListx = funExtract[eIPList1, MList, rep, x];  
eITEListx = funExtract[eITEList1, MList, rep, x];  
eRTEListx = funExtract[eRTEList1, MList, rep, x];  
eFListx = funExtract[eFList1, MList, rep, x];

```
In[5]:= Fig5 = ListLogLogPlot[{Transpose[{MList, ePListx}],  

    |点集的双对数图| 转置  

    Transpose[{MList, eCPListx}], Transpose[{MList, eGPListx}],  

    |转置| 转置  

    Transpose[{MList, eIPListx}], Transpose[{MList, eITEListx}],  

    |转置| 转置  

    Transpose[{MList, eRTEListx}], Transpose[{MList, eFListx}]],  

    |转置| 转置  

    PlotRange -> PR, Joined -> True, PlotStyle -> {{Thickness[0.004], Red, Dashed},  

    |绘制范围| 连接点 |真| 绘图样式 |粗细 |红色 |虚线  

    {Thickness[0.004], Yellow, Dashed}, {Thickness[0.004], Blue, Dashed},  

    |粗细| 黄色 |虚线 |粗细 |蓝色 |虚线  

    {Thickness[0.004], Green, Dashed}, {Thickness[0.004], Orange, Dashed},  

    |粗细| 绿色 |虚线 |粗细 |橙色 |虚线  

    {Thickness[0.004], Purple, Dashed}, {Thickness[0.004], Magenta, Dashed}},  

    |粗细| 紫色 |虚线 |粗细 |品红色 |虚线  

    Frame -> True, FrameStyle -> Directive[Black, Thickness[0.002]],  

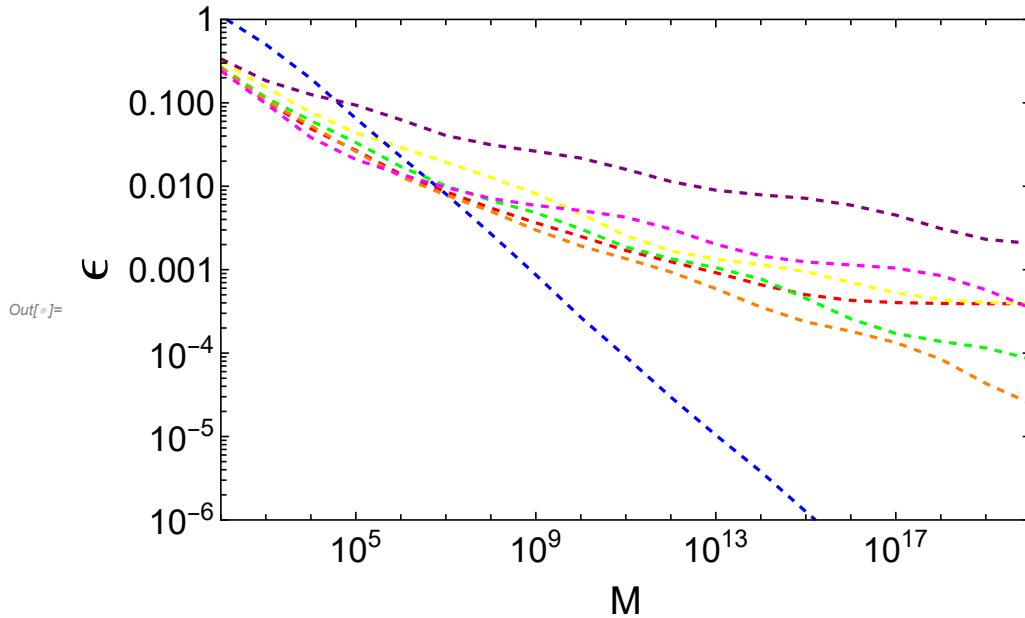
    |边框| 真 |边框样式 |指令 |黑色 |粗细  

    FrameTicksStyle -> Directive[Black, Thickness[0.002]], FrameLabel -> {"M", "E"},  

    |边框刻度样式| 指令 |黑色 |粗细 |边框标签  

    LabelStyle -> {FontSize -> 18, FontFamily -> "Arial"}, ImageSize -> 500]  

    |标签样式| 字体大小 |字体系列 |图像尺寸
```



```

In[6]:= Fig6 = ListLogLogPlot[Transpose[{MList, 0.*MList + 1.*εK}],  

    |点集的双对数图| 转置  

    Transpose[{MList, 0.*MList + 2.*εK}], Transpose[{MListP, εListP}],  

    |转置| 转置  

    Transpose[{MListCP, εListCP}], Transpose[{MListGP, εListGP}],  

    |转置| 转置  

    Transpose[{MListIP, εListIP}], Transpose[{MListITE, εListITE}],  

    |转置| 转置  

    Transpose[{MListRTE, εListRTE}], Transpose[{MListF, εListF}]],  

    |转置| 转置  

    PlotRange → PR, Joined → True, PlotStyle → {{Thickness[0.004], Cyan},  

    |绘制范围| 连接点 |真| 绘图样式 |粗细 |蓝绿色  

    {Thickness[0.004], Brown}, {Thickness[0.004], Red}, {Thickness[0.004], Yellow},  

    |粗细| 棕色 |粗细 |红色 |粗细 |黄色  

    {Thickness[0.004], Blue}, {Thickness[0.004], Green}, {Thickness[0.004], Orange},  

    |粗细| 蓝色 |粗细 |绿色 |粗细 |橙色  

    {Thickness[0.004], Purple}, {Thickness[0.004], Magenta}},  

    |粗细| 紫色 |粗细 |品红色  

    Frame → True, FrameStyle → Directive[Black, Thickness[0.002]],  

    |边框| 真 |边框样式 |指令 |黑色 |粗细  

    FrameTicksStyle → Directive[Black, Thickness[0.002]], FrameLabel → {"M", "E"},  

    |边框刻度样式| 指令 |黑色 |粗细 |边框标签  

    LabelStyle → {FontSize → 18, FontFamily → "Arial"}, ImageSize → 500,  

    |标签样式| 字体大小 |字体系列 |图像尺寸  

    PlotLegends → Placed[LineLegend[{"εk", "2εk", "P", "CP", "GP", "IP", "ITE", "RTE", "F"}],  

    |绘图的图例| 放置 |线的图例  

    LegendFunction → (Framed[#, FrameStyle → LightGray] &), LegendMarkerSize → {16, 8},  

    |图例函数| 加边框 |边框样式 |浅灰色 |图例标记尺寸  

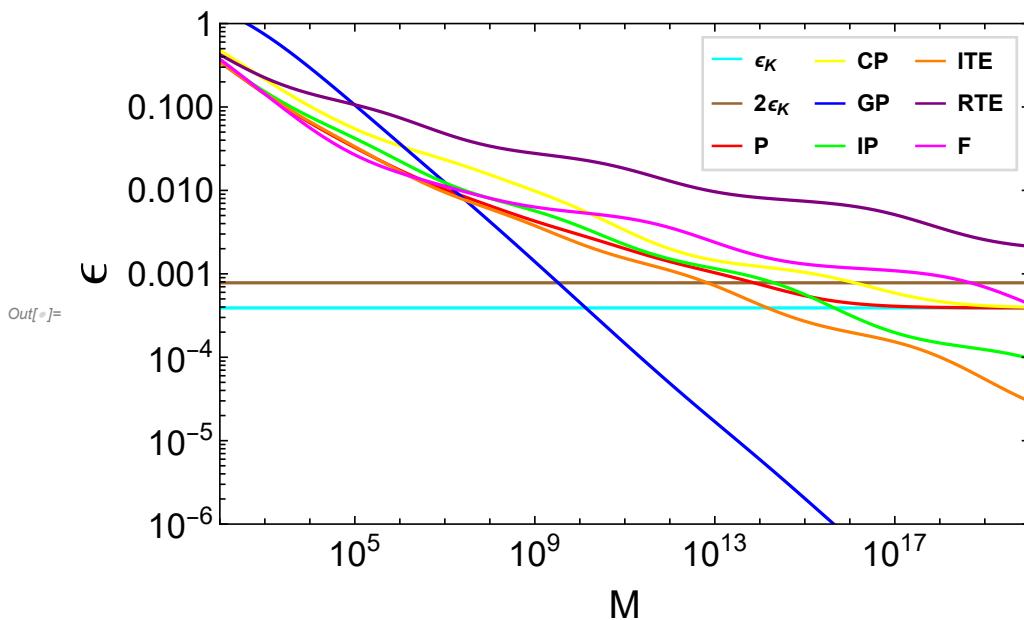
    LabelStyle → {Black, Bold, FontSize → 12, FontFamily → "Arial"},  

    |标签样式| 黑色 |粗体 |字体大小 |字体系列  

    LegendMargins → 0, LegendLayout → {"Column", 3}], {0.79, 0.84}]  

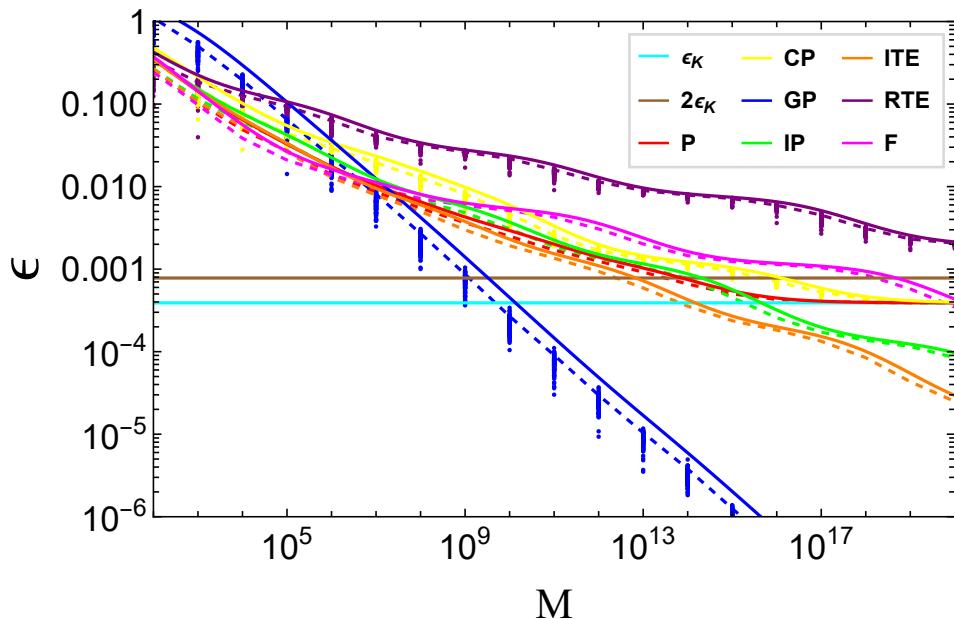
    |图例边幅| 图例布局 |列

```



In[6]:= **Fig7 = Show[Fig4, Fig5, Fig6]**

[显示](#)



Out[6]=

In[7]:= **path = "C:\\\\Users\\\\John\\\\Desktop\\\\Revise\\\\M-epsilon-Scaling=" <> ToString[n] <> ".pdf";**  
[常量](#) [转换为字符串](#)  
**Export[path, Fig7];**  
[导出](#)

```

In[=]: PR = {{10^2, 10^20}, {10^-6, 10^0}}; (*plot range*)

Fig8 = ListLogLogPlot[
  点集的双对数图

  {Transpose[{MList, 0.*MList + 1.*eK}], Transpose[{MList, 0.*MList + 2.*eK}],
   转置 转置
  Transpose[{2*(2d - 1)*MListP, eListP}], Transpose[{d*(d + 1)*MListCP, eListCP}],
   转置 转置
  Transpose[{2*(2d - 1)*MListGP, eListGP}],
   转置
  Transpose[{2*(2d - 1)*MListIP, eListIP}], Transpose[
   转置
  {2*(2d - 1)*MListITE, eListITE}], Transpose[{2*(2d - 1)*MListRTE, eListRTE}],
   转置
  Transpose[{d*(d + 1)*MListF, eListF}], PlotRange -> PR, Joined -> True,
   绘制范围 连接点 真
  PlotStyle -> {{Thickness[0.004], Cyan}, {Thickness[0.004], Brown},
   绘图样式 粗细 蓝绿色 粗细 棕色
  {Thickness[0.004], Red}, {Thickness[0.004], Yellow}, {Thickness[0.004], Blue},
   粗细 红色 粗细 黄色 粗细 蓝色
  {Thickness[0.004], Green}, {Thickness[0.004], Orange},
   粗细 绿色 粗细 橙色
  {Thickness[0.004], Purple}, {Thickness[0.004], Magenta}},
   粗细 紫色 粗细 品红色
  Frame -> True, FrameStyle -> Directive[Black, Thickness[0.002]],
  边框 真 边框样式 指令 黑色 粗细
  FrameTicksStyle -> Directive[Black, Thickness[0.002]], FrameLabel -> {"M_tot", "E"},
  边框刻度样式 指令 黑色 粗细 边框标签
  LabelStyle -> {FontSize -> 18, FontFamily -> "Arial"}, ImageSize -> 500,
  标签样式 字体大小 字体系列 图像尺寸
  PlotLegends -> Placed[LineLegend[{"e_k", "2e_k", "P", "CP", "GP", "IP", "ITE", "RTE", "F"}],
  绘图的图例 放置 线的图例
  LegendFunction -> (Framed[#, FrameStyle -> LightGray] &), LegendMarkerSize -> {16, 8},
  图例函数 加边框 边框样式 浅灰色 图例标记尺寸
  LabelStyle -> {Black, Bold, FontSize -> 12, FontFamily -> "Arial"},
  标签样式 黑色 粗体 字体大小 字体系列
  LegendMargins -> 0, LegendLayout -> {"Column", 3}], {0.79, 0.84}]
  图例边幅 图例布局 列
]

```

