α_s (s), 2 Loops

Chunks

In[145]:=
```
As50sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 50^2, 2];
As500sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 500^2, 2];
As1000sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1000^2, 2];
```

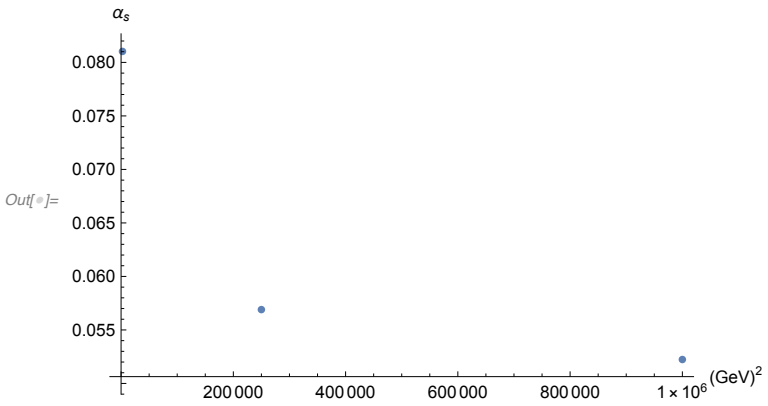
In[148]:=
```
Tablesq = TableForm[{{50^2, As50sq}, {500^2, As500sq}, {1000^2, As1000sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[•]//TableForm=

$(\text{GeV})^2$	α_s
2500	0.081026798733880074128
250 000	0.056900436117960186916
1 000 000	0.052235996714116886498

In[149]:=
```
A = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[•]=



In[150]:=
```
As100sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 100^2, 2];
As150sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 150^2, 2];
As200sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 200^2, 2];
As250sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 250^2, 2];
As300sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 300^2, 2];
As350sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 350^2, 2];
As400sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 400^2, 2];
As450sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 450^2, 2];
```

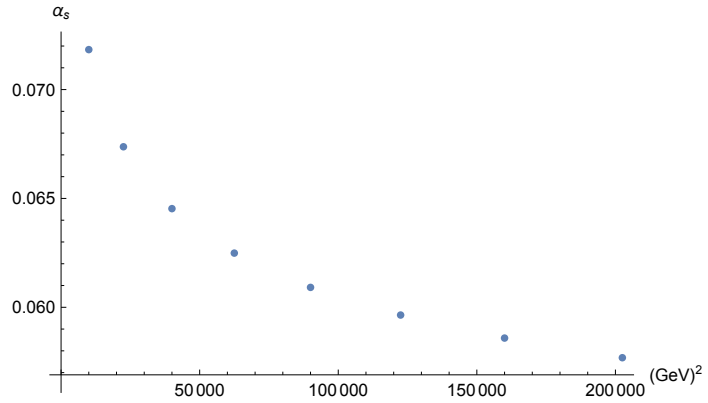
In[158]:=
```
Tablesq =
 TableForm[{{100^2, As100sq}, {150^2, As150sq}, {200^2, As200sq}, {250^2, As250sq},
   {300^2, As300sq}, {350^2, As350sq}, {400^2, As400sq}, {450^2, As450sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[•]//TableForm=

$(\text{GeV})^2$	α_s
10 000	0.071834691868979132829
22 500	0.067372419910228620788
40 000	0.064531263155439720529
62 500	0.062488680782716435070
90 000	0.060914140362668847796
122 500	0.059644011844213721216
160 000	0.058586181511643707104
202 500	0.057684027759108657044

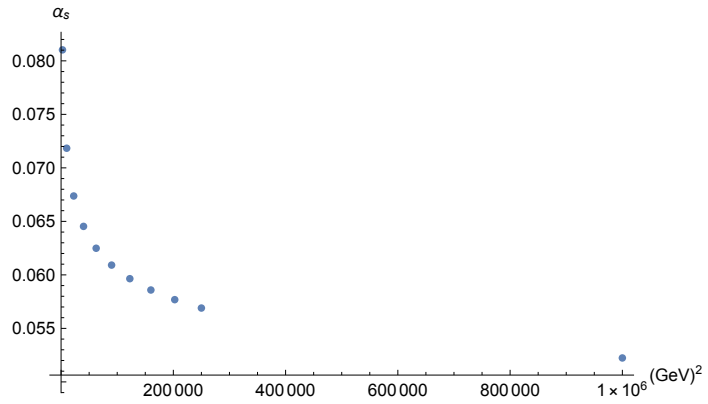
In[159]:=
```
B = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[•]=



In[160]:=
```
Show[A, B]
```

Out[•]=



In[161]:=
```
As550sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 550^2, 2];
As600sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 600^2, 2];
As650sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 650^2, 2];
As700sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 700^2, 2];
As750sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 750^2, 2];
As800sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 800^2, 2];
As850sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 850^2, 2];
As900sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 900^2, 2];
As950sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 950^2, 2];
```

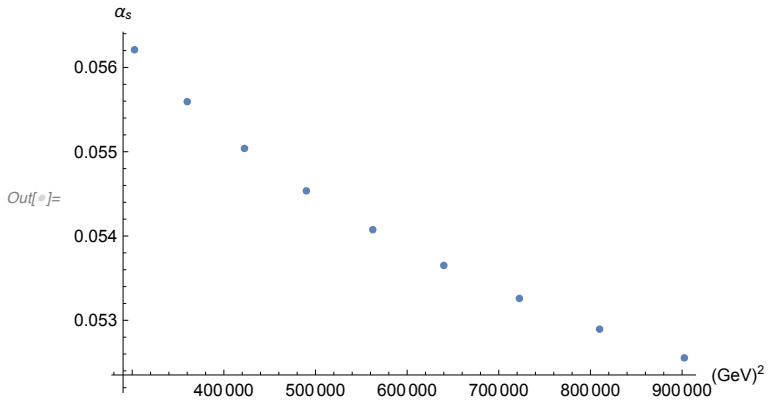
In[170]:=
```
Tablesq = TableForm[{{550^2, As550sq}, {600^2, As600sq}, {650^2, As650sq},
   {700^2, As700sq}, {750^2, As750sq}, {800^2, As800sq}, {850^2, As850sq},
   {900^2, As900sq}, {950^2, As950sq}}, TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[•]//TableForm=

$(\text{GeV})^2$	α_s
302 500	0.056209854400909927812
360 000	0.055593994864007443562
422 500	0.055039350814774126871
490 000	0.054535683721483063875
562 500	0.054075060649620300764
640 000	0.053651219179789732211
722 500	0.053259135257331803311
810 000	0.052894721215044767914
902 500	0.052554609826210405280

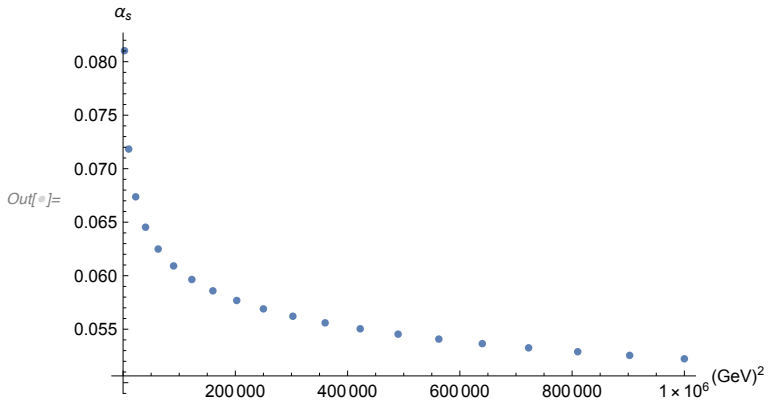
In[171]:=
```
F = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[•]=



In[172]:=
```
Show[A, B, F]
```

Out[•]=



In[173]:=
```
As60sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 60^2, 2];
As70sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 70^2, 2];
As80sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 80^2, 2];
As90sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 90^2, 2];
```

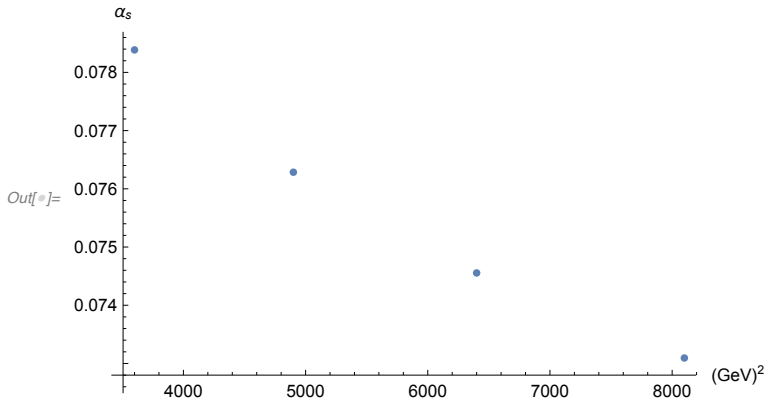
In[177]:=
```
Tablesq = TableForm[{{60^2, As60sq}, {70^2, As70sq}, {80^2, As80sq}, {90^2, As90sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[•]//TableForm=

$(\text{GeV})^2$	α_s
3600	0.078385828636904206947
4900	0.076285028462074945735
6400	0.074555122316157581099
8100	0.073093744118024322037

In[178]:=
```
G = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

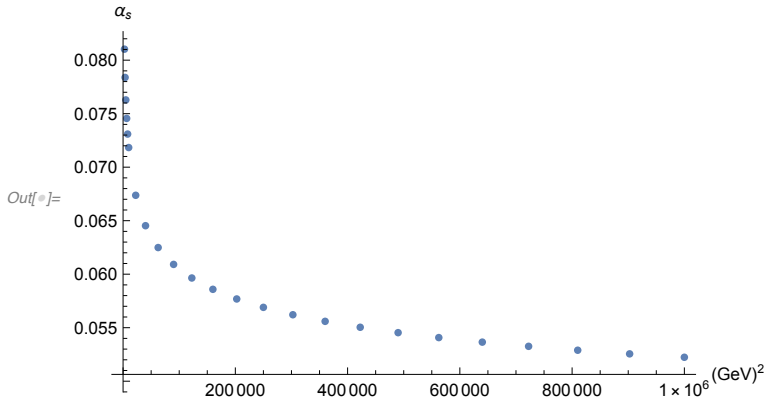
Out[•]=



Partial Plot

In[179]:=
```
Show[A, B, F, G]
```

Out[•]=



Chunk 100

In[180]:=
```
As110sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 110^2, 2];
As120sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 120^2, 2];
As130sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 130^2, 2];
As140sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 140^2, 2];
As160sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 160^2, 2];
As170sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 170^2, 2];
As180sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 180^2, 2];
As190sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 190^2, 2];
```

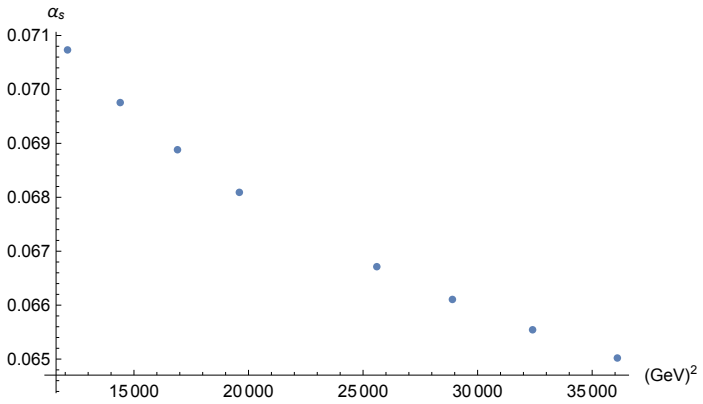
In[188]:=
```
Tablesq =
 TableForm[{{110^2, As110sq}, {120^2, As120sq}, {130^2, As130sq}, {140^2, As140sq},
   {160^2, As160sq}, {170^2, As170sq}, {180^2, As180sq}, {190^2, As190sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[•]//TableForm=

$(\text{GeV})^2$	α_s
12 100	0.070732903557301793167
14 400	0.069756443621002344898
16 900	0.068881927901714457921
19 600	0.068091765480858975689
25 600	0.066713271389132171123
28 900	0.066105848224977992552
32 400	0.065543293391183417771
36 100	0.065019985394224645729

In[189]:=
```
A1 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[•]=



Chunk 200

In[190]:=
```
As210sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 210^2, 2];
As220sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 220^2, 2];
As230sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 230^2, 2];
As240sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 240^2, 2];
As260sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 260^2, 2];
As270sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 270^2, 2];
As280sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 280^2, 2];
As290sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 290^2, 2];
```

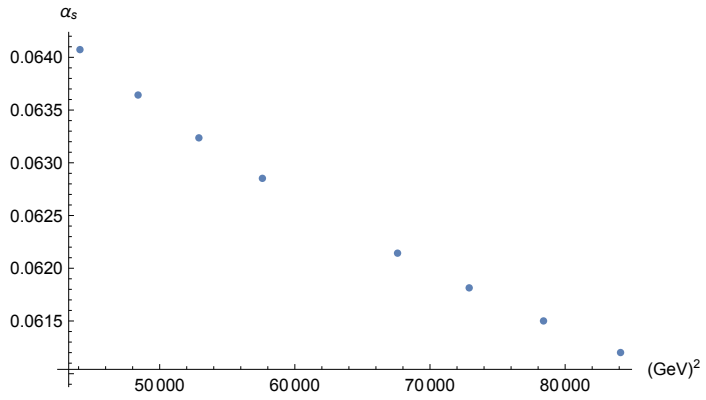
In[198]:=
```
Tablesq =
 TableForm[{{210^2, As210sq}, {220^2, As220sq}, {230^2, As230sq}, {240^2, As240sq},
   {260^2, As260sq}, {270^2, As270sq}, {280^2, As280sq}, {290^2, As290sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[•]//TableForm=

$(\text{GeV})^2$	α_s
44 100	0.064073222667363487532
48 400	0.063642564217221804865
52 900	0.063236475903702910540
57 600	0.062852543640402881756
67 600	0.062143072493766162156
72 900	0.061814131319880143329
78 400	0.061500461389438904308
84 100	0.061200829315751713216

In[199]:=
```
A2 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[199]=



Chunk 300

In[200]:=
```
As310sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 310^2, 2];
As320sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 320^2, 2];
As330sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 330^2, 2];
As340sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 340^2, 2];
As360sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 360^2, 2];
As370sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 370^2, 2];
As380sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 380^2, 2];
As390sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 390^2, 2];
```

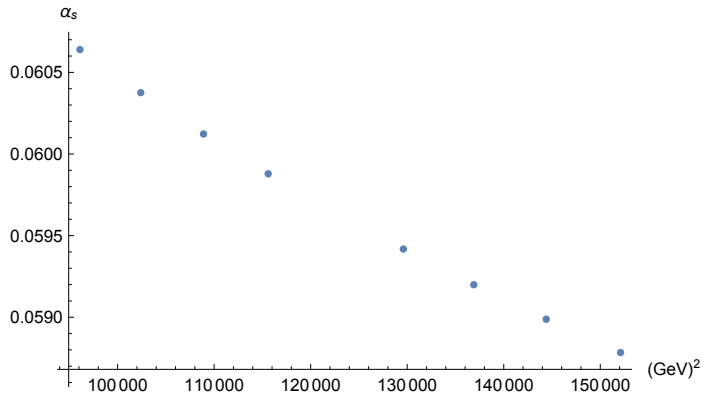
In[208]:=
```
Tablesq =
 TableForm[{{310^2, As310sq}, {320^2, As320sq}, {330^2, As330sq}, {340^2, As340sq},
   {360^2, As360sq}, {370^2, As370sq}, {380^2, As380sq}, {390^2, As390sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[208]//TableForm=

$(\text{GeV})^2$	α_s
96 100	0.060639418778793760168
102 400	0.060375791461295351967
108 900	0.060122474299915095958
115 600	0.059878760694113901576
129 600	0.059417648499930726976
136 900	0.059199143913365829373
144 400	0.058988017793021500048
152 100	0.058783831094190074689

In[209]:=
```
A3 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[209]=



Chunk 400

In[210]:=
```
As410sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 410^2, 2];
As420sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 420^2, 2];
As430sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 430^2, 2];
As440sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 440^2, 2];
As460sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 460^2, 2];
As470sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 470^2, 2];
As480sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 480^2, 2];
As490sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 490^2, 2];
```

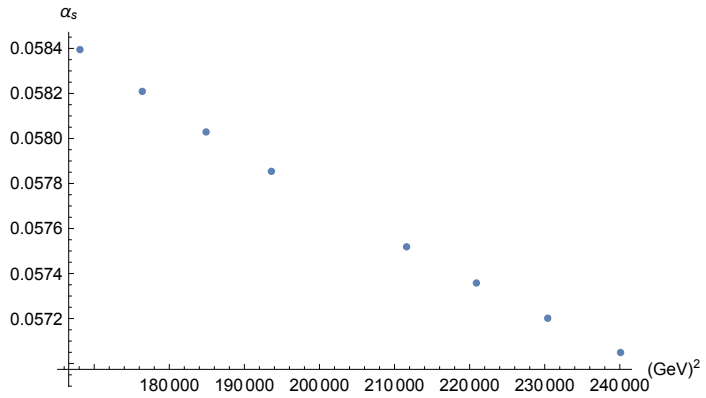
In[218]:=
```
Tablesq =
 TableForm[{{410^2, As410sq}, {420^2, As420sq}, {430^2, As430sq}, {440^2, As440sq},
   {460^2, As460sq}, {470^2, As470sq}, {480^2, As480sq}, {490^2, As490sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[218]//TableForm=

(GeV)^2	α_s
168 100	0.058394699564843088076
176 400	0.058209045185288869337
184 900	0.058028904731235234910
193 600	0.057853988367594914191
211 600	0.057518774033221032277
220 900	0.057357995975972193954
230 400	0.057201478429876813869
240 100	0.057049020867452931521

In[219]:=
```
A4 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[219]=



Chunk 500

In[220]:=
```
As510sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 510^2, 2];
As520sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 520^2, 2];
As530sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 530^2, 2];
As540sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 540^2, 2];
As560sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 560^2, 2];
As570sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 570^2, 2];
As580sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 580^2, 2];
As590sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 590^2, 2];
```

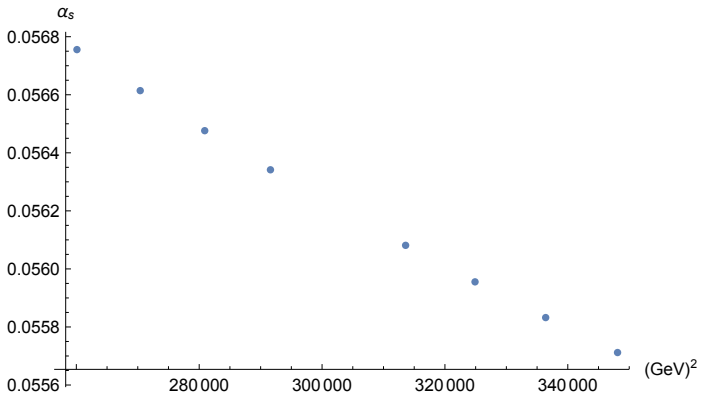
In[228]:=
```
Tablesq =
 TableForm[{{510^2, As510sq}, {520^2, As520sq}, {530^2, As530sq}, {540^2, As540sq},
   {560^2, As560sq}, {570^2, As570sq}, {580^2, As580sq}, {590^2, As590sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[228]//TableForm=

$(\text{GeV})^2$	α_s
260 100	0.056755549228167120068
270 400	0.056614196440692464298
280 900	0.056476224275765538732
291 600	0.056341488704186236350
313 600	0.056081194070076701069
324 900	0.055955387833495190333
336 400	0.055832322675609424948
348 100	0.055711891938847787816

In[229]:=
```
A5 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[•]=



Chunk 600

In[230]:=
```
As610sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 610^2, 2];
As620sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 620^2, 2];
As630sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 630^2, 2];
As640sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 640^2, 2];
As660sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 660^2, 2];
As670sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 670^2, 2];
As680sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 680^2, 2];
As690sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 690^2, 2];
```

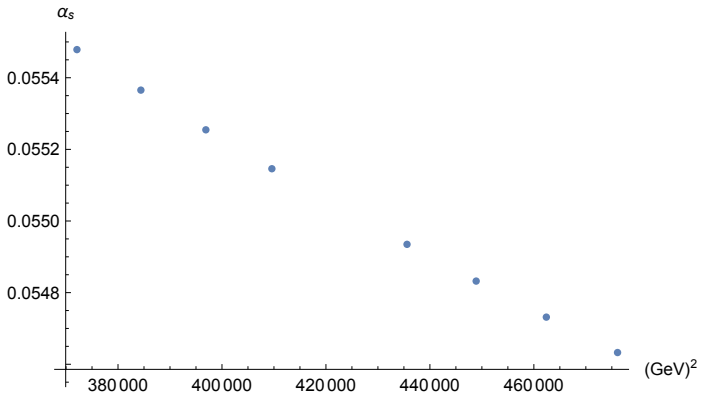
In[238]:=
```
Tablesq =
 TableForm[{{610^2, As610sq}, {620^2, As620sq}, {630^2, As630sq}, {640^2, As640sq},
   {660^2, As660sq}, {670^2, As670sq}, {680^2, As680sq}, {690^2, As690sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[•]//TableForm=

$(\text{GeV})^2$	α_s
372 100	0.055478536170970628523
384 400	0.055365425675612588036
396 900	0.055254577939243998572
409 600	0.055145911947352094458
435 600	0.054934821514753897776
448 900	0.054832254629615114264
462 400	0.054731584121030411316
476 100	0.054632747118079648059

In[239]:=
```
A6 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[239]=



Chunk 700

In[240]:=
```
As710sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 710^2, 2];
As720sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 720^2, 2];
As730sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 730^2, 2];
As740sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 740^2, 2];
As760sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 760^2, 2];
As770sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 770^2, 2];
As780sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 780^2, 2];
As790sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 790^2, 2];
```

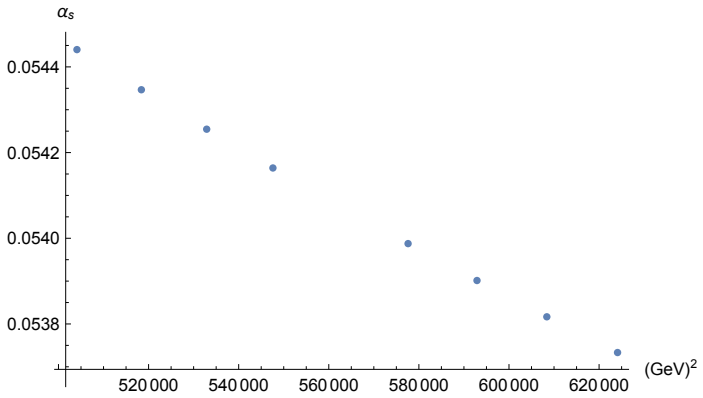
In[248]:=
```
Tablesq =
 TableForm[{{710^2, As710sq}, {720^2, As720sq}, {730^2, As730sq}, {740^2, As740sq},
   {760^2, As760sq}, {770^2, As770sq}, {780^2, As780sq}, {790^2, As790sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[248]//TableForm=

$(\text{GeV})^2$	α_s
504 100	0.054440336822561110117
518 400	0.054346651935621074868
532 900	0.054254577042602629750
547 600	0.054164062448929858478
577 600	0.053987526204795069752
592 900	0.053901415623814230513
608 400	0.053816687257335576031
624 100	0.053733301196660642306

In[249]:=
```
A7 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[249]=



Chunk 800

In[250]:=
```
As810sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 810^2, 2];
As820sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 820^2, 2];
As830sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 830^2, 2];
As840sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 840^2, 2];
As860sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 860^2, 2];
As870sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 870^2, 2];
As880sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 880^2, 2];
As890sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 890^2, 2];
```

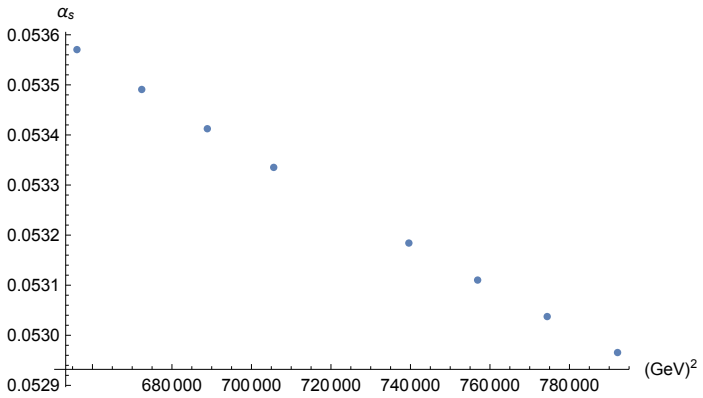
In[258]:=
```
Tablesq =
 TableForm[{{810^2, As810sq}, {820^2, As820sq}, {830^2, As830sq}, {840^2, As840sq},
   {860^2, As860sq}, {870^2, As870sq}, {880^2, As880sq}, {890^2, As890sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[258]//TableForm=

(GeV)^2	α_s
656 100	0.053570404503660162642
672 400	0.053490821942090019965
688 900	0.053412437668990850157
705 600	0.053335219186451855374
739 600	0.053184155842026858712
756 900	0.053110252039109721710
774 400	0.053037396029561159963
792 100	0.052965561024338273917

In[259]:=
```
A8 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

Out[•]=



Chunk 900

In[260]:=
```
As910sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 910^2, 2];
As920sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 920^2, 2];
As930sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 930^2, 2];
As940sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 940^2, 2];
As960sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 960^2, 2];
As970sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 970^2, 2];
As980sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 980^2, 2];
As990sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 990^2, 2];
```

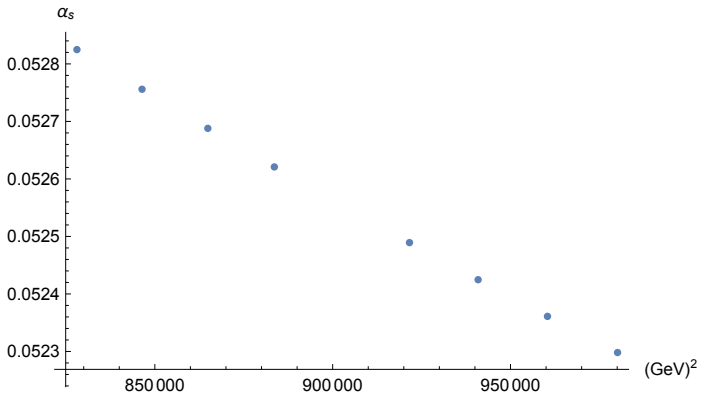
In[268]:=
```
Tablesq =
 TableForm[{{910^2, As910sq}, {920^2, As920sq}, {930^2, As930sq}, {940^2, As940sq},
   {960^2, As960sq}, {970^2, As970sq}, {980^2, As980sq}, {990^2, As990sq}},
  TableHeadings → {None, {"(GeV)^2", "α_s"}}]
```

Out[•]//TableForm=

(GeV)^2	α_s
828 100	0.052824851727486863250
846 400	0.052755928577916296839
864 900	0.052687928631777378794
883 600	0.052620829564789759773
921 600	0.052489248604131726862
940 900	0.052424725792682674381
960 400	0.052361021961010131205
980 100	0.052298118323926280843

In[269]:=
```
A9 = ListPlot[%, AxesLabel → {"(GeV)^2", "α_s"}]
```

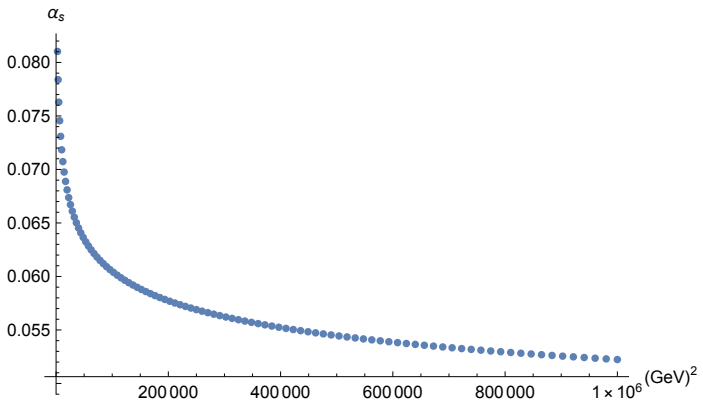
Out[269]=



Total Plot

In[270]:=
```
Show[A, B, F, G, A1, A2, A3, A4, A5, A6, A7, A8, A9]
```

Out[270]=



Load RunDec

In[ ]:=
```
<< ~/Desktop/Software/CRunDec3/RunDec.m
```

```
RunDec: a Mathematica package for running and decoupling of the
        strong coupling and quark masses
by K.G. Chetyrkin, J.H. K\"uhn and M. Steinhauser (January 2000)
by F. Herren and M. Steinhauser (February 2017, v3.0)
```