

$\alpha_s(s)$, 3 Loops

Chunks

```
In[339]:= g = 3;
```

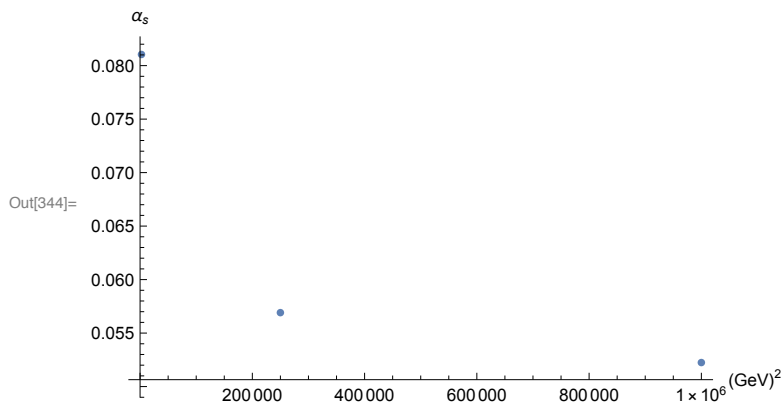
```
In[340]:= As50sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 502, g];  
As500sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5002, g];  
As1000sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 10002, g];
```

```
In[343]:= Tablesq = TableForm[{{502, As50sq}, {5002, As500sq}, {10002, As1000sq}},  
TableHeadings → {None, {"(GeV)2", " $\alpha_s$ "}}]
```

Out[343]//TableForm=

(GeV) ²	α_s
2500	0.081042844922550225111
250 000	0.056910538072901930957
1 000 000	0.052244866919978510302

```
In[344]:= A = ListPlot[%, AxesLabel → {"(GeV)2", " $\alpha_s$ "}]
```



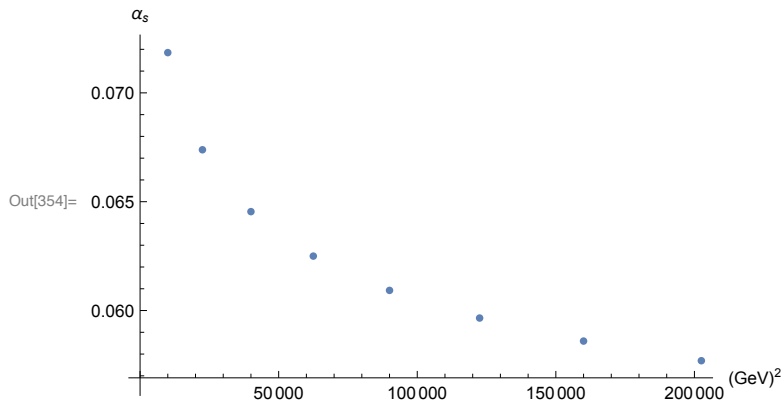
```
In[345]:= As100sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1002, g];  
As150sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1502, g];  
As200sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2002, g];  
As250sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2502, g];  
As300sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3002, g];  
As350sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3502, g];  
As400sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4002, g];  
As450sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4502, g];
```

```
In[353]:= Tablesq =
  TableForm[{{1002, As100sq}, {1502, As150sq}, {2002, As200sq}, {2502, As250sq},
    {3002, As300sq}, {3502, As350sq}, {4002, As400sq}, {4502, As450sq}},
    TableHeadings → {None, {"(GeV)2", "αs"}}]
```

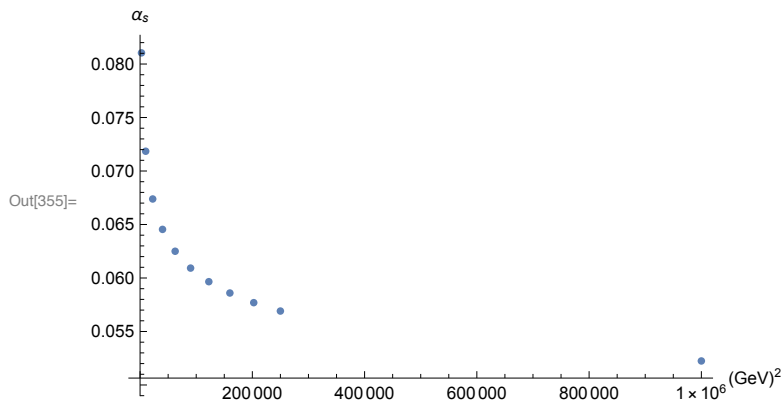
```
Out[353]//TableForm=
```

$(\text{GeV})^2$	α_s
10 000	0.071848633099032443675
22 500	0.067385250490322488243
40 000	0.064543365929010817636
62 500	0.062500253003981134601
90 000	0.060925300459474673563
122 500	0.059654837994564151291
160 000	0.058596728781027591492
202 500	0.057694336808985267342

```
In[354]:= B = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



```
In[355]:= Show[A, B]
```



```

In[356]:= As550sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5502, g];
As600sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6002, g];
As650sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6502, g];
As700sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7002, g];
As750sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7502, g];
As800sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8002, g];
As850sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8502, g];
As900sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9002, g];
As950sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9502, g];

```

```

In[365]:= Tablesq = TableForm[{{5502, As550sq}, {6002, As600sq}, {6502, As650sq},
{7002, As700sq}, {7502, As750sq}, {8002, As800sq}, {8502, As850sq},
{9002, As900sq}, {9502, As950sq}}, TableHeadings → {None, {"(GeV)2", "αs"}}]

```

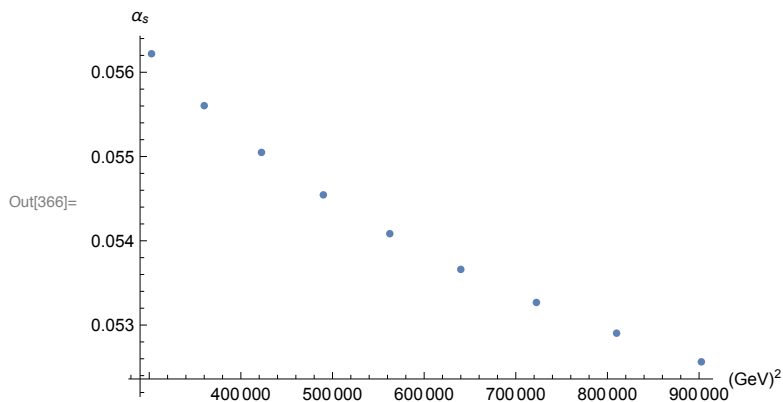
Out[365]/TableForm=

(GeV) ²	α _s
302 500	0.056219773769605650316
360 000	0.055603751392187307511
422 500	0.055048960713990709298
490 000	0.054545160514222640944
562 500	0.054084415768506235190
640 000	0.053660462403547644756
722 500	0.053268275035106197993
810 000	0.052903764912357701868
902 500	0.052563563914676016800

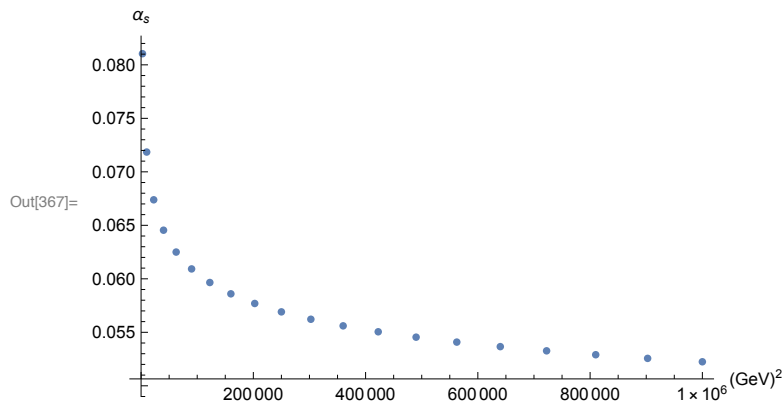
```

In[366]:= F = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]

```



In[367]:= Show[A, B, F]



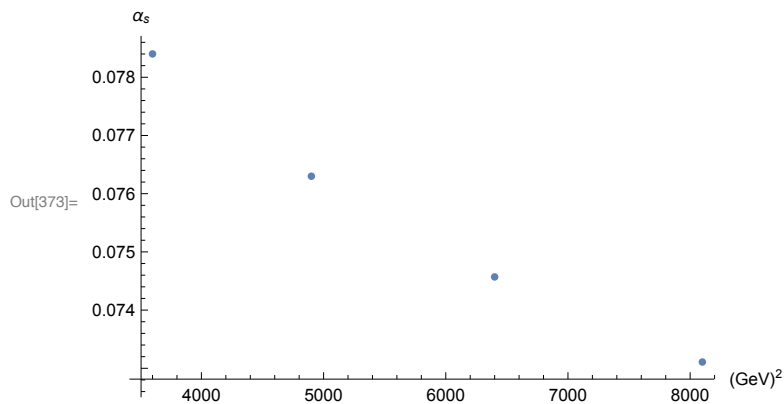
```
In[368]:= As60sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 60^2, g];
As70sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 70^2, g];
As80sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 80^2, g];
As90sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 90^2, g];
```

```
In[372]:= Tablesq = TableForm[{{60^2, As60sq}, {70^2, As70sq}, {80^2, As80sq}, {90^2, As90sq}},
TableHeadings -> {None, {"(GeV)^2", "\alpha_s"}}]
```

Out[372]/TableForm=

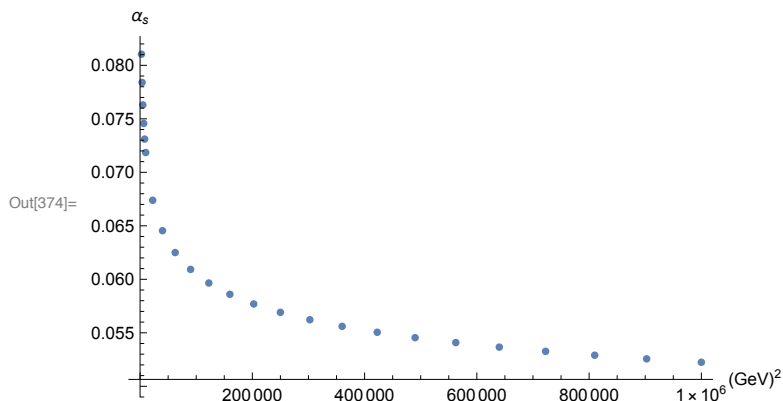
$(\text{GeV})^2$	α_s
3600	0.078401300611566445981
4900	0.076300024832276413737
6400	0.074569715720336059232
8100	0.073107989826216327024

```
In[373]:= G = ListPlot[%, AxesLabel -> {"(GeV)^2", "\alpha_s"}]
```



Partial Plot

In[374]:= Show[A, B, F, G]



Chunk 100

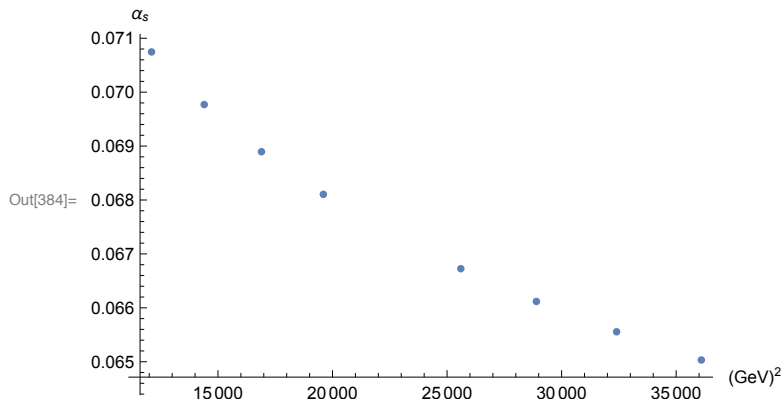
```
In[375]:= As110sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1102, g];
As120sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1202, g];
As130sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1302, g];
As140sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1402, g];
As160sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1602, g];
As170sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1702, g];
As180sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1802, g];
As190sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 1902, g];
```

```
In[383]:= Tablesq =
  TableForm[{{1102, As110sq}, {1202, As120sq}, {1302, As130sq}, {1402, As140sq},
    {1602, As160sq}, {1702, As170sq}, {1802, As180sq}, {1902, As190sq}},
    TableHeadings -> {None, {"(GeV)2", " $\alpha_s$ "}}]
```

Out[383]//TableForm=

(GeV) ²	α_s
12 100	0.070746574882723131781
14 400	0.069769873235607262170
16 900	0.068895139174159992248
19 600	0.068104778052557773477
25 600	0.066725934342810438839
28 900	0.066118356017301743845
32 400	0.065555656927641297039
36 100	0.065032214286029275758

```
In[384]:= A1 = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



Chunk 200

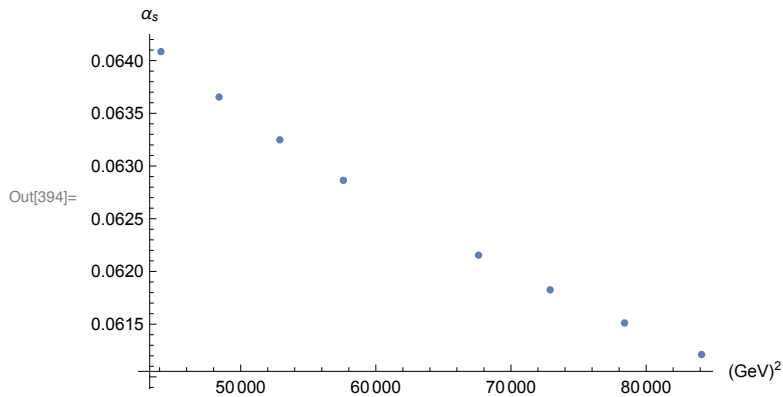
```
In[385]:= As210sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2102, g];
As220sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2202, g];
As230sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2302, g];
As240sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2402, g];
As260sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2602, g];
As270sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2702, g];
As280sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2802, g];
As290sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 2902, g];
```

```
In[393]:= Tablesq =
TableForm[{{2102, As210sq}, {2202, As220sq}, {2302, As230sq}, {2402, As240sq},
{2602, As260sq}, {2702, As270sq}, {2802, As280sq}, {2902, As290sq}},
TableHeadings → {None, {"(GeV)2", "αs"}}]
```

Out[393]//TableForm=

(GeV) ²	α _s
44 100	0.064085206931764338589
48 400	0.063654436799468042831
52 900	0.063248242959205148706
57 600	0.062864210743936956857
67 600	0.062154554460621531072
72 900	0.061825527271649442967
78 400	0.061511775222129218582
84 100	0.061212064620650914075

```
In[394]:= A2 = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



Chunk 300

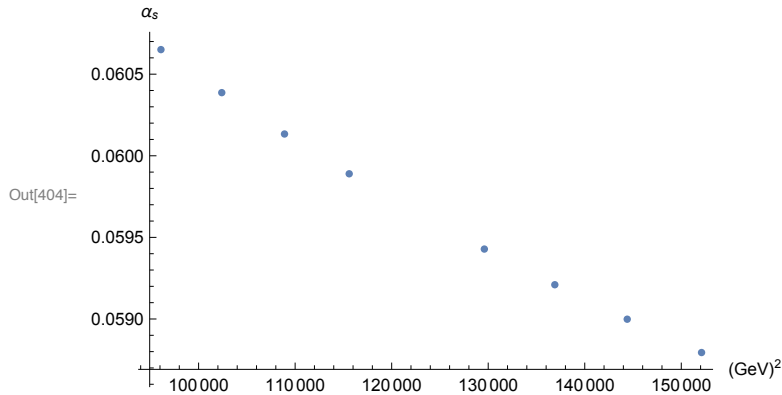
```
In[395]:= As310sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3102, 3];
As320sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3202, 3];
As330sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3302, 3];
As340sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3402, 3];
As360sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3602, 3];
As370sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3702, 3];
As380sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3802, 3];
As390sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 3902, 3];
```

```
In[403]:= Tablesq =
TableForm[{{3102, As310sq}, {3202, As320sq}, {3302, As330sq}, {3402, As340sq},
{3602, As360sq}, {3702, As370sq}, {3802, As380sq}, {3902, As390sq}},
TableHeadings → {None, {"(GeV)2", "αs"}}]
```

Out[403]/TableForm=

(GeV) ²	α _s
96 100	0.060650506744198841131
102 400	0.060386810153772347319
108 900	0.060133426381305669189
115 600	0.059889648648514620174
129 600	0.059428415022638775431
136 900	0.059209852851248896162
144 400	0.058998671066796250653
152 100	0.058794430512706345814

```
In[404]:= A3 = ListPlot[%, AxesLabel -> {"(GeV)2", "αs"}]
```



Chunk 400

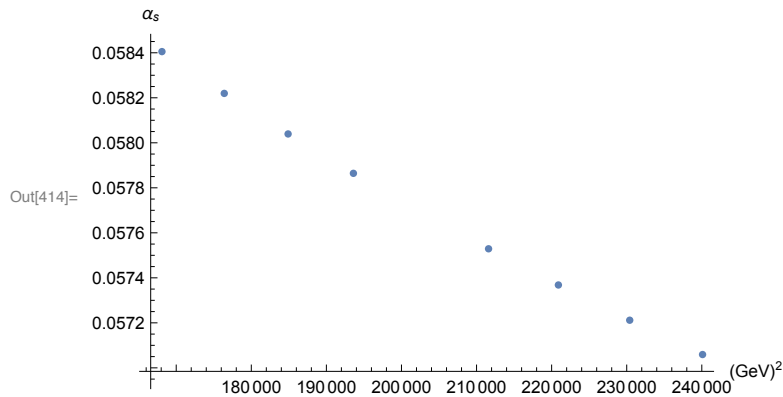
```
In[405]:= As410sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4102, g];
As420sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4202, g];
As430sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4302, g];
As440sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4402, g];
As460sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4602, g];
As470sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4702, g];
As480sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4802, g];
As490sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 4902, g];
```

```
In[413]:= Tablesq =
TableForm[{{4102, As410sq}, {4202, As420sq}, {4302, As430sq}, {4402, As440sq},
{4602, As460sq}, {4702, As470sq}, {4802, As480sq}, {4902, As490sq}},
TableHeadings -> {None, {"(GeV)2", "αs"}}]
```

Out[413]/TableForm=

(GeV) ²	α _s
168 100	0.058405196296689024078
176 400	0.058219492904019812363
184 900	0.058039304880732650530
193 600	0.057864342317185884849
211 600	0.057529039419356967831
220 900	0.057368218874592857611
230 400	0.057211659961531915934
240 100	0.057059162100734262158


```
In[414]:= A4 = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



Chunk 500

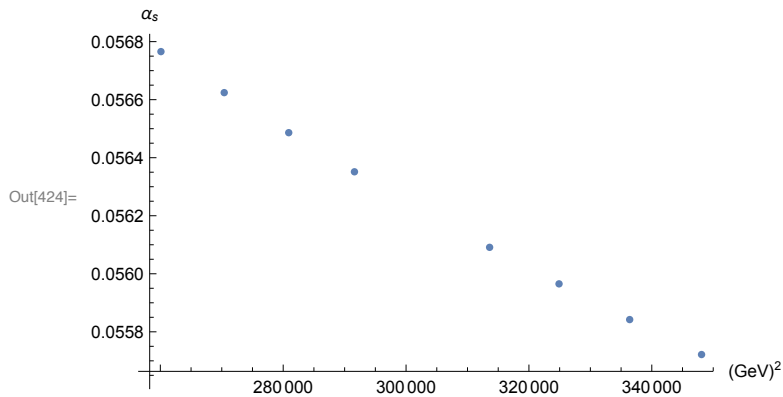
```
In[415]:= As510sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5102, g];
As520sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5202, g];
As530sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5302, g];
As540sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5402, g];
As560sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5602, g];
As570sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5702, g];
As580sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5802, g];
As590sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 5902, g];
```

```
In[423]:= Tablesq =
TableForm[{ {5102, As510sq}, {5202, As520sq}, {5302, As530sq}, {5402, As540sq},
{5602, As560sq}, {5702, As570sq}, {5802, As580sq}, {5902, As590sq} },
TableHeadings → {None, {"(GeV)2", "αs"}}]
```

Out[423]/TableForm=

(GeV) ²	α _s
260 100	0.056765612879361490962
270 400	0.056624222720149485391
280 900	0.056486214075542398989
291 600	0.056351442878808685409
313 600	0.056091079418838325840
324 900	0.055965239916988711143
336 400	0.055842142218942054755
348 100	0.055721679639207811923

```
In[424]:= A5 = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



Chunk 600

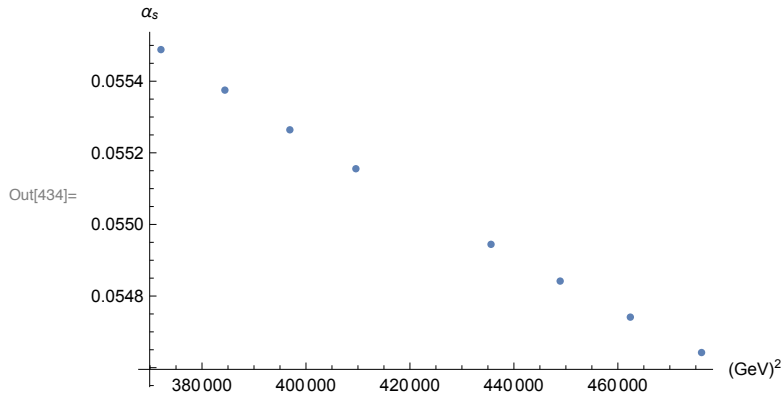
```
In[425]:= As610sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6102, g];
As620sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6202, g];
As630sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6302, g];
As640sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6402, g];
As660sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6602, g];
As670sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6702, g];
As680sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6802, g];
As690sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 6902, g];
```

```
In[433]:= Tablesq =
TableForm[{{6102, As610sq}, {6202, As620sq}, {6302, As630sq}, {6402, As640sq},
{6602, As660sq}, {6702, As670sq}, {6802, As680sq}, {6902, As690sq}},
TableHeadings → {None, {"(GeV)2", "αs"}}]
```

Out[433]/TableForm=

(GeV) ²	α _s
372 100	0.055488262172783352246
384 400	0.055375121773210570612
396 900	0.055264244732348380499
409 600	0.055155550014400039573
435 600	0.054944403785154538152
448 900	0.054841809791944135674
462 400	0.054741112678640579564
476 100	0.054642249557757258915

```
In[434]:= A6 = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



Chunk 700

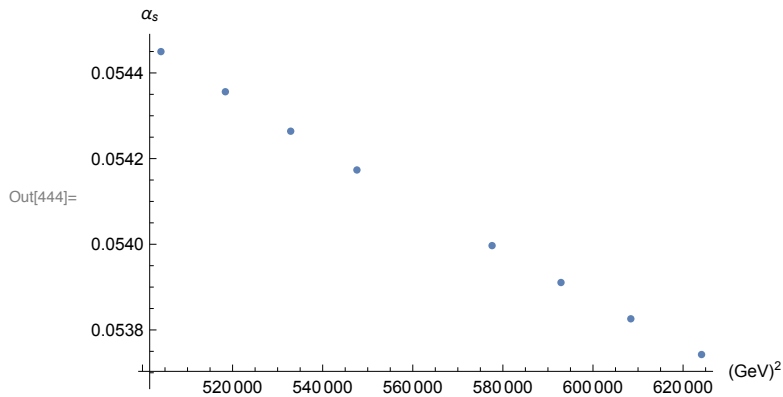
```
In[435]:= As710sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7102, g];
As720sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7202, g];
As730sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7302, g];
As740sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7402, g];
As760sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7602, g];
As770sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7702, g];
As780sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7802, g];
As790sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 7902, g];
```

```
In[443]:= Tablesq =
TableForm[{{7102, As710sq}, {7202, As720sq}, {7302, As730sq}, {7402, As740sq},
{7602, As760sq}, {7702, As770sq}, {7802, As780sq}, {7902, As790sq}},
TableHeadings → {None, {"(GeV)2", "αs"}}]
```

Out[443]/TableForm=

(GeV) ²	α _s
504 100	0.054449788424293487458
518 400	0.054356078787898254524
532 900	0.054263979573242542616
547 600	0.054173441072623900628
577 600	0.053996858208997718039
592 900	0.053910724891956150159
608 400	0.053825974157019755063
624 100	0.053742566084927082720

```
In[444]:= A7 = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



Chunk 800

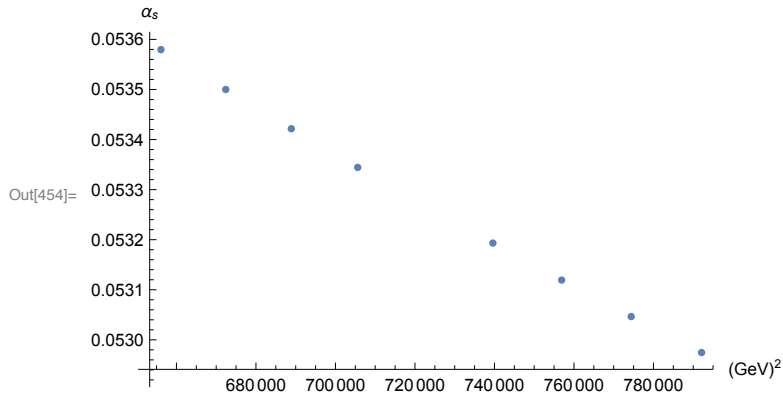
```
In[445]:= As810sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8102, g];
As820sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8202, g];
As830sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8302, g];
As840sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8402, g];
As860sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8602, g];
As870sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8702, g];
As880sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8802, g];
As890sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 8902, g];
```

```
In[453]:= Tablesq =
TableForm[{{8102, As810sq}, {8202, As820sq}, {8302, As830sq}, {8402, As840sq},
{8602, As860sq}, {8702, As870sq}, {8802, As880sq}, {8902, As890sq}},
TableHeadings → {None, {"(GeV)2", "αs"}}]
```

Out[453]/TableForm=

(GeV) ²	α _s
656 100	0.053579626400097329727
672 400	0.053500022839060862283
688 900	0.053421617885384477938
705 600	0.053344379032541402345
739 600	0.053193275845506101223
756 900	0.053119352554644676855
774 400	0.053046477336118776396
792 100	0.052974623393773130825

```
In[454]:= A8 = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



Chunk 900

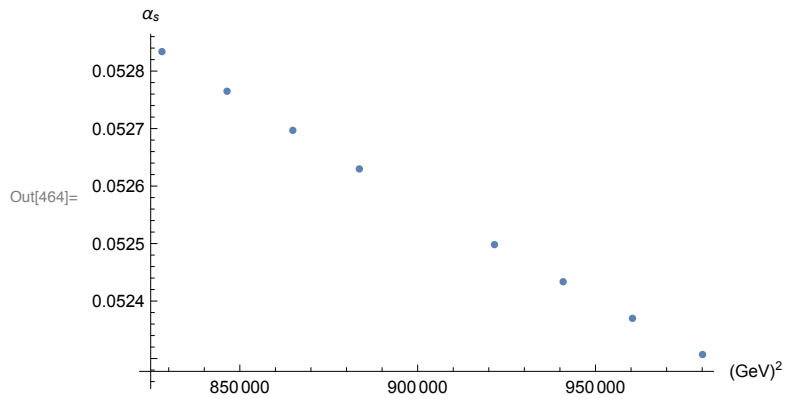
```
In[455]:= As910sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9102, g];
As920sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9202, g];
As930sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9302, g];
As940sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9402, g];
As960sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9602, g];
As970sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9702, g];
As980sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9802, g];
As990sq = AsRunDec[asMz /. NumDef, Mz /. NumDef, 9902, g];
```

```
In[463]:= Tablesq =
TableForm[{{9102, As910sq}, {9202, As920sq}, {9302, As930sq}, {9402, As940sq},
{9602, As960sq}, {9702, As970sq}, {9802, As980sq}, {9902, As990sq}},
TableHeadings → {None, {"(GeV)2", "αs"}}]
```

Out[463]/TableForm=

(GeV) ²	α _s
828 100	0.052833877011071452699
846 400	0.052764935699793911746
864 900	0.052696917837821395736
883 600	0.052629801094939621204
921 600	0.052498185479588767202
940 900	0.052433645678459299185
960 400	0.052369925075265531923
980 100	0.052307004879821535740

```
In[464]:= A9 = ListPlot[%, AxesLabel → {"(GeV)2", "αs"}]
```



Total Plot

```
In[465]:= Show[A, B, F, G, A1, A2, A3, A4, A5, A6, A7, A8, A9]
```

