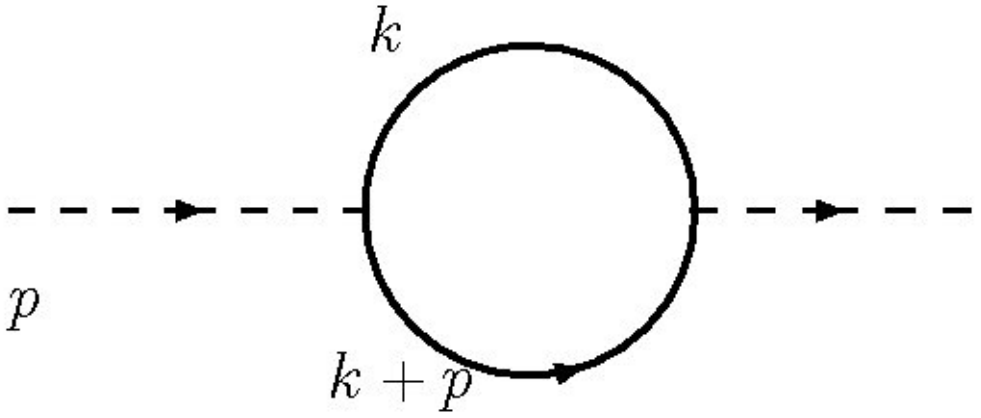
Files to be taken from:
http://www-zeuthen.desy.de/~riemann/Talks/capp07/

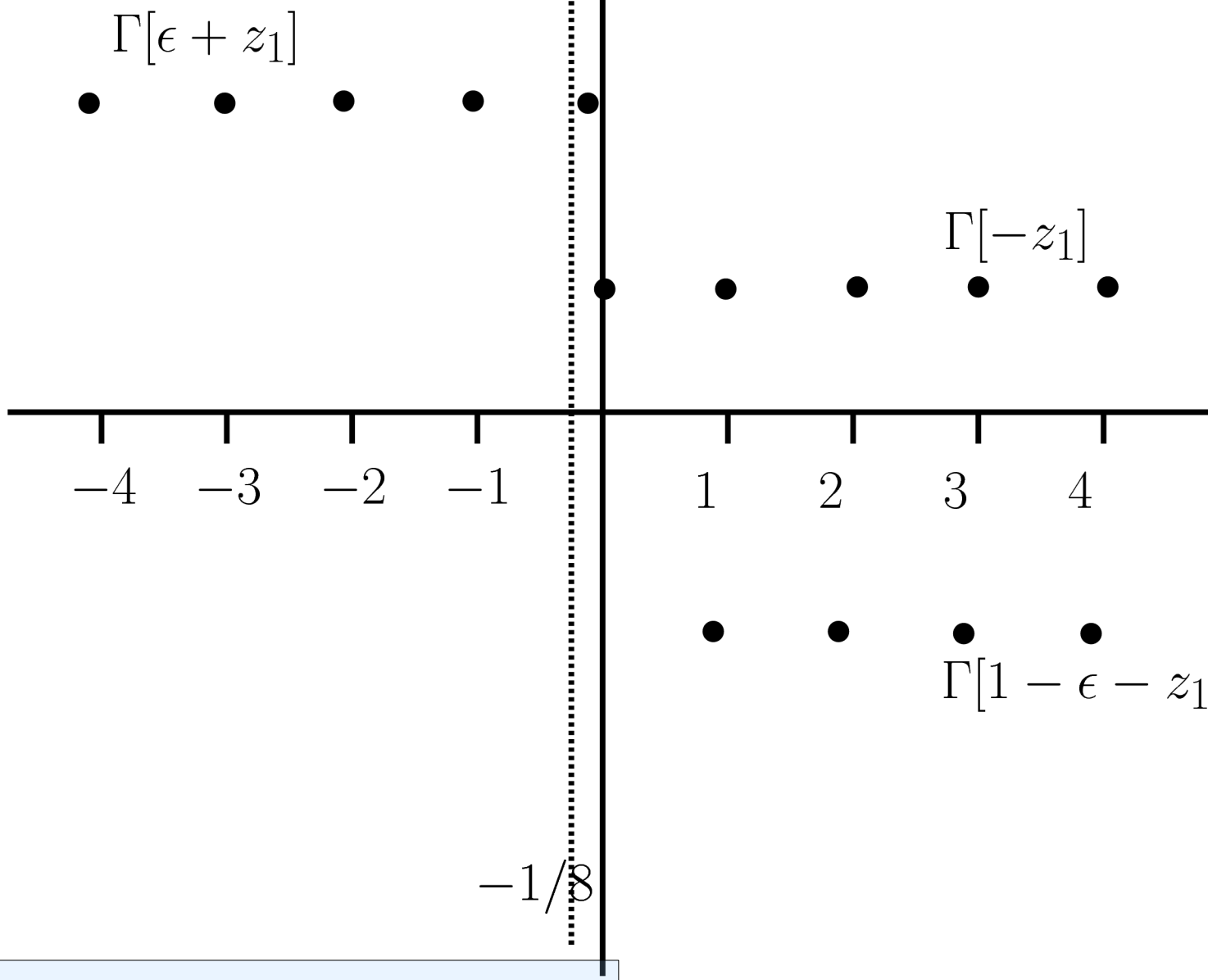
- Main directory: *AMBRE.m* – the main package, AMBREexamples – examples for AMBREdraft.pdf, MB.m – package by M. Czakon
- *KinematicGen.m – generates kinematics for 4,5,6 external legs*
- *Exercises for CAPP07: plan.pdf, SE2l2m.nb, B5l2m2.nb, B5nf_0external.nb*
- *LoopTools_SE: example for SE2l2m.nb*

Self-energy: SE2l2m.nb



Here we learn how:

- construct MB representation using AMBRE.m
- expand in ϵ using MB.m
- get approximate numerical results by summing up finite number of singularities in Gamma's both for large and small four-momenta p



Left-half: gives series sutaible for small s

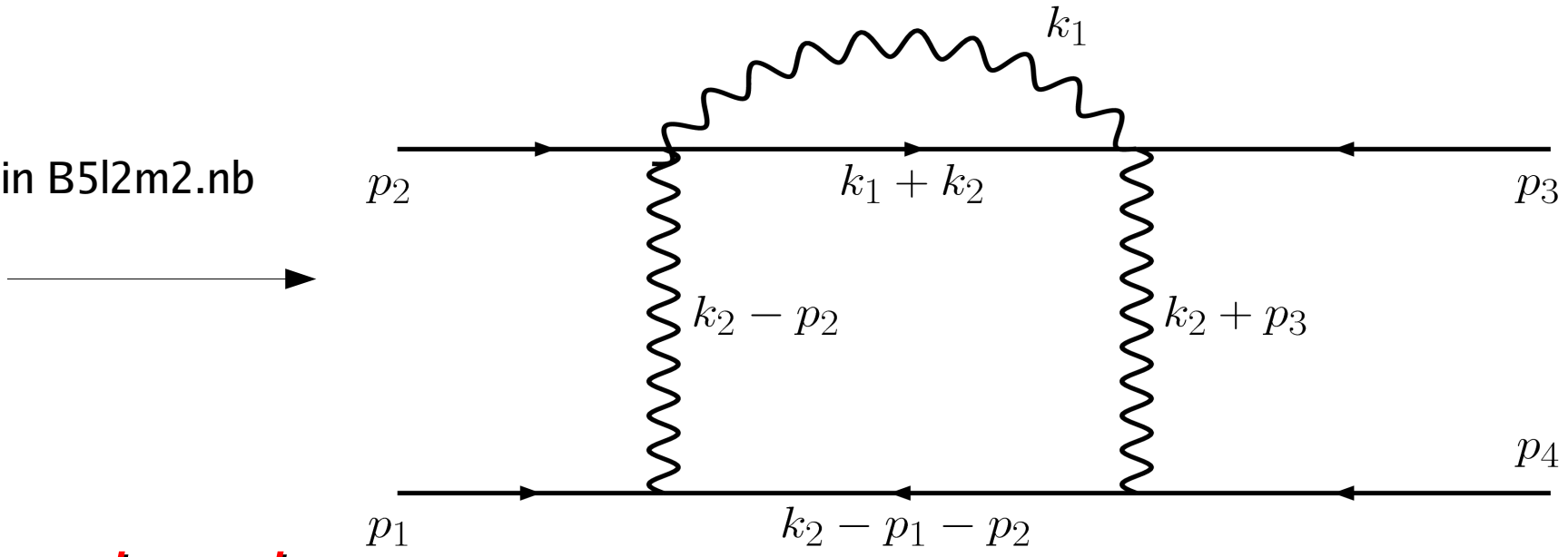
$$\int_{-i\infty}^{+i\infty} dz_1 \, (-s)^{-\epsilon} \left(-\frac{m^2}{s}\right)^{z_1} \frac{\Gamma[1-\epsilon-z_1]^2 \Gamma[-z_1]\Gamma[\epsilon+z_1]}{\Gamma[2-2\epsilon-z_1]},$$

$$Re[z_1] = -1/8$$

Right-half: gives series suitable for large s

Two-loop box: B5l2m.nb

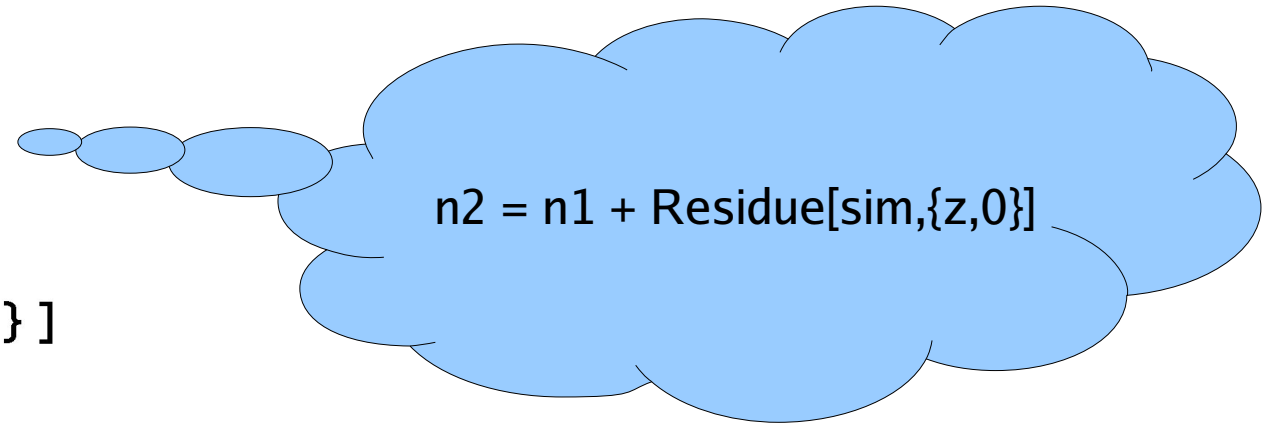
Notation like in B5l2m2.nb

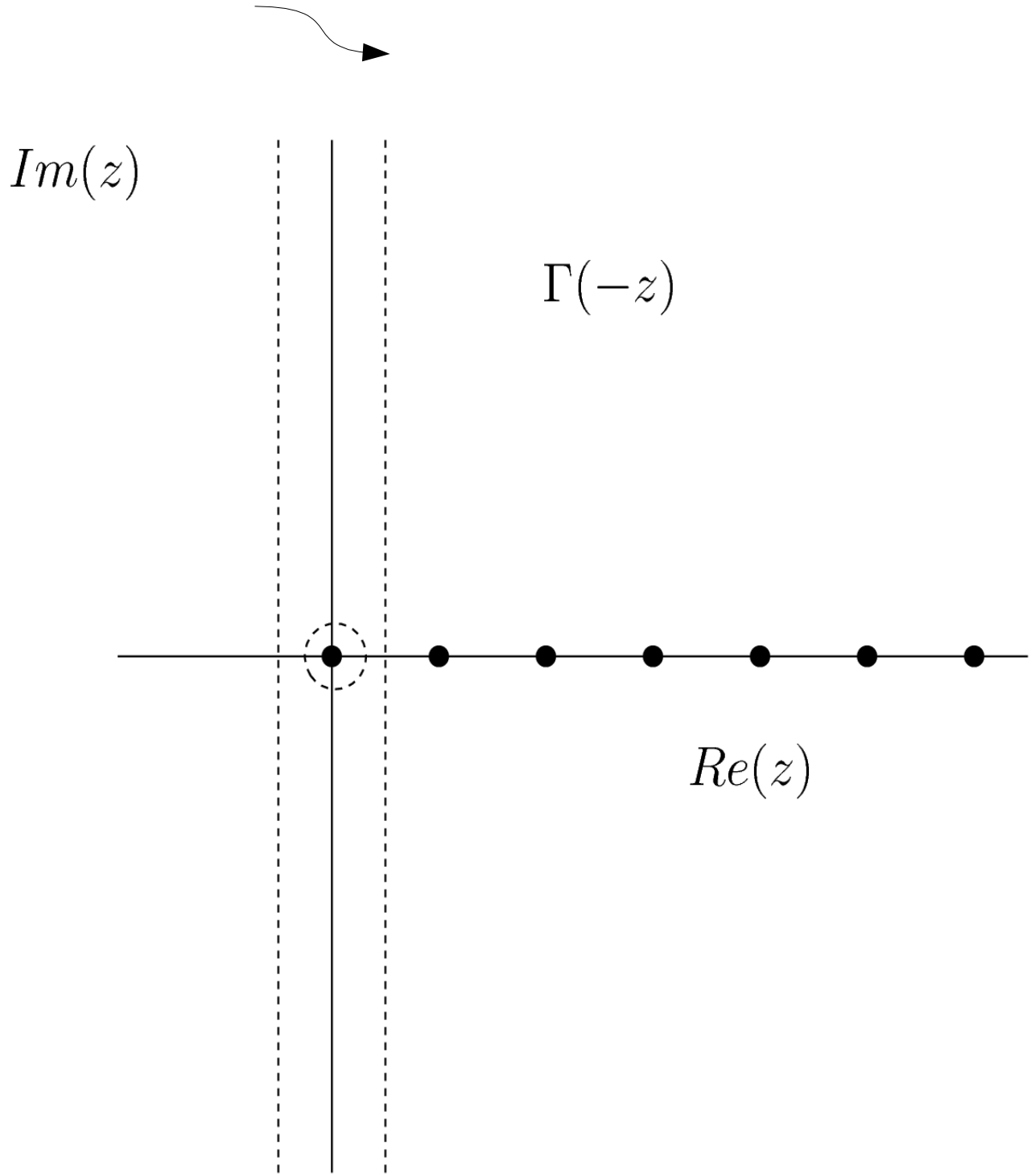


Here we learn how:

- construct MB representation using AMBRE.m beyond one-loop
- solve analytically MB integral by matching expanded MB integral in conformal variable y[t] to the general base which is assumed to be in terms of multiple Riemann's zeta functions, logs and polylogs
- Analytic continuation in practising

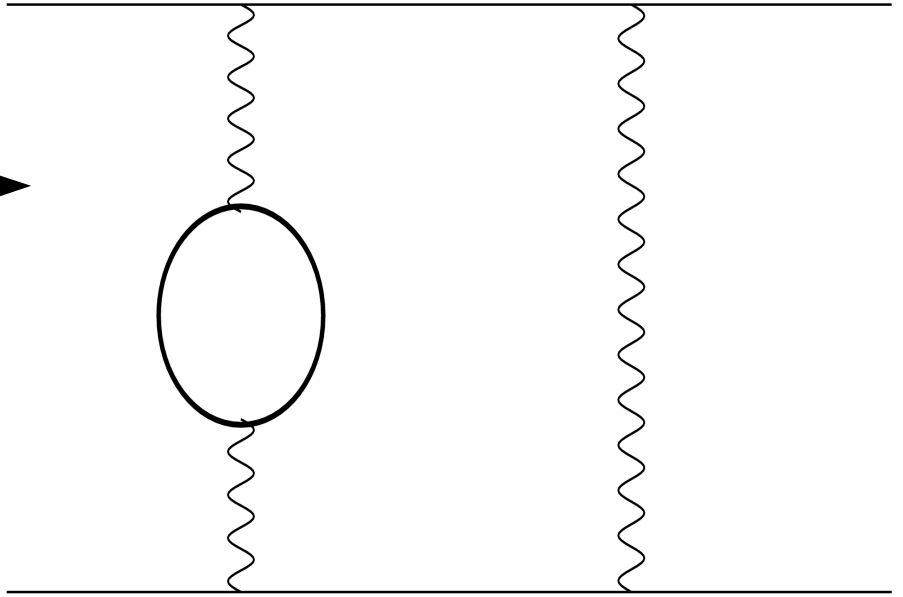
```
(* shifting contours *)

:=
sim = Gamma[-z]

]=
Gamma[-z]

:=
Sum[-Residue[Gamma[-z], {z, n}], {n, 0, 100}] // N

]=
0.367879

:=
n1 = NIntegrate[
   1 / (2 Pi) sim /. z → -1 / 20 + I y, {y, -10, 10}]

]=
0.367879 + 0. ⅈ

:=
n2 = NIntegrate[
   1 / (2 Pi) sim /. z → 1 / 20 + I y, {y, -10, 10}]

]=
-0.632121 + 0. ⅈ

:=
n2 - n1

]=
-1. + 0. ⅈ

:=
Residue[sim, {z, 0}]

]=
-1
```




$Im(z)$
$\Gamma(-z)$
$Re(z)$

Two loop self-energy insertion QED diagram B5nf_0external.nb

All lines massless except 1-loop self-energy insertion



Question: what kind of singularities can be here?
Is 1/eps^3 singularity present?

Here we learn how:

- construct MB representation using AMBRE.m yet with different kinematics
- expand in ϵ using MB.m (analytic continuation in additional parameter is required)

The last example (if we have time)

- AMBREexamples/example1a.nb