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Two-loop QED corrections to the bound-electron g factor involving the magnetic loop

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Provides a measure of the Zeeman splitting of energy levels

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Precision: 10^{-11} for medium-light H-like ions

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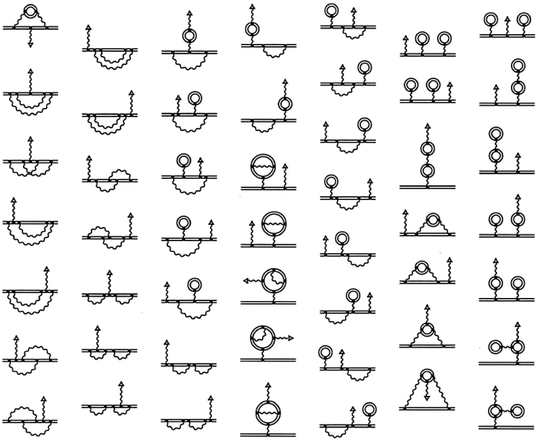
QED calculations

- Perturbative approach: free e^-+perturbative binding to nucleus (series in $(Z\alpha)$)
- Non-perturbative approach: bound state QED

Loops from QED are to be treated perturbatively in all approaches (series in α)
Current knowledge of two-loop corrections:

- Perturbative approach: $(Z\alpha)^4$ [K. Pachucki, A. Czarnecki, U. D. Jentschura, V. A. Yerokhin, Phys. Rev. A **72**, 022108 (2005)]
  $(Z\alpha)^5$ [A. Czarnecki, M. Dowling, J. Piclum, R. Szafron, Phys. Rev. Lett. **120**, 043203 (2018)]
- Non-perturbative approach: partial knowledge

Two-loop QED corrections



50 total diagrams

(29 inequivalent diagrams)

(from T. Beier *et al.*, Phys. Rev. A **62**, 032510 (2000))

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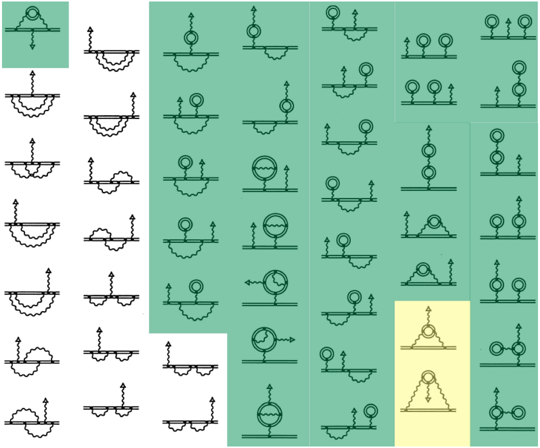

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Diagrams with 0&1 self-energy loops
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[V.A. Yerokhin, Z. Harman, Phys. Rev. A 88, 042502 (2013)]
(with free VP ($e^- e^+$) loops)
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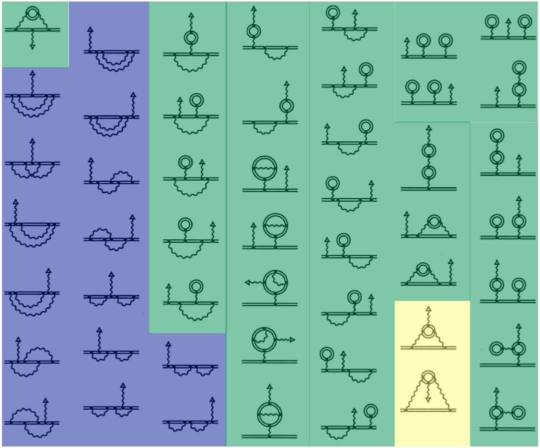

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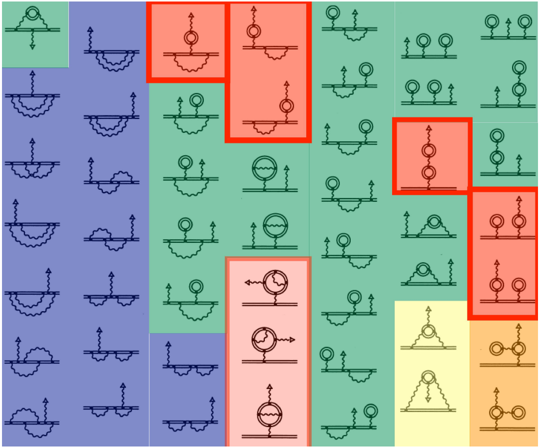
Diagrams with 2 self-energy loops
$\rightarrow$ Calculation in progress
[B. Sikora, Ph.D. thesis, Ruprecht-Karls-Universität Heidelberg (2018)]

Two-loop QED corrections



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This work: revisit diagrams that vanished in the free VP loop approach & calculate lowest nonvanishing contribution