One loop integrals made easy with Package-*X*

H.H.Patel arXiv:
1503.01469 (2015)
packagex.hepforge.org

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Motivation

Two problems with existing packages:

FeynCalc	FormCalc/LoopTools
R. Mertig, M. Bohm, A. Denner, CPC **64** (1991) 345	T. Hahn, M. Perez-Victoria CPC **118** (1999) 153

1. Too complicated to use

   - Failed compilation
   - Poorly documented

2. Do not always give an answer

   No result for
   - vanishing external invariants
   - at physical threshold

a shame...
these the cases are those for which
compact analytic expressions can be given.

There are 3rd party modules to amend this issue

LOOL	A. Ilakovac, L. Popov arXiv:1407.2727 (2014)
ANT	P. Angel et al. JHEP **1310** (2013) 118

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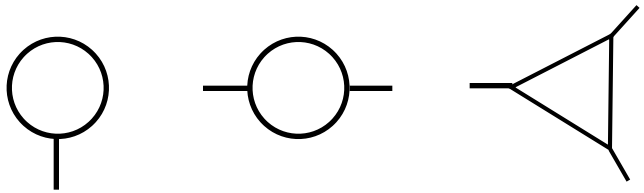
(selected) technical features of Package-X

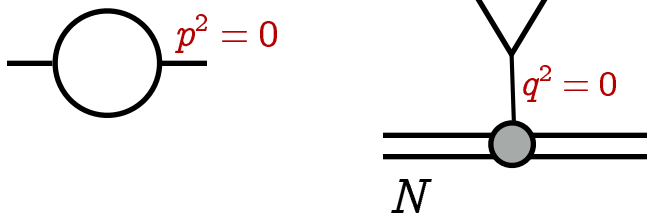
- Analytically integrate up to 3 propagators (limitation)



- for arbitrarily high-rank tensor integrals $\Longrightarrow$ $\mu^{2\epsilon}\int \frac{d^dk}{(2\pi)^d} \frac{k^\mu k^\nu k^\rho k^\sigma k^\alpha k^\beta}{[k^2-m^2][(k-p)^2-m^2]}$

- at any kinematic point

  (e.g. vanishing external momenta, or thresholds)

  $\Longrightarrow$ 

  G. Passarino, M. Veltman, Nucl Phys **B160** (1979) 151
  A. Denner, S. Dittmaier, Nucl Phys **B734** (2006) 62
  H.H.Patel arXiv: 1503.01469 (2015)

- Explicit expressions for $\frac{1}{\epsilon^2}$, $\frac{1}{\epsilon}$ divergent and finite parts $\mathcal{O}(\epsilon^0)$

- All expressions consistent with $+i\varepsilon$ prescription

and more...
(see packagex.hepforge.org)

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Outlook (wishlist)

Short-term:

- Analytic series expansion of a loop integral around any kinematic point, (to any order)

Long-term:

- Support for integrals with 4 propagators

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