

ReneSANCe MC Generator Updates

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Calculating A_{LR} in the $e^+e^- \rightarrow e^+e^-(\gamma)$ process

- ReneSANCe is a “new” MC generator, published June 2020
 - Renat Sadykov, Vitaly Yermolchuk, *Polarized NLO EW e^+e^- cross section calculations with ReneSANCe-v1.0.0* (2020); DOI:10.1016/j.cpc.2020.107445
- Has special ALR modes which calculate ALR numerator and denominator directly
- Much quicker to calculate ALR with this mode than through event generation

Calculating A_{LR} in the $e^+e^- \rightarrow e^+e^-(\gamma)$ process

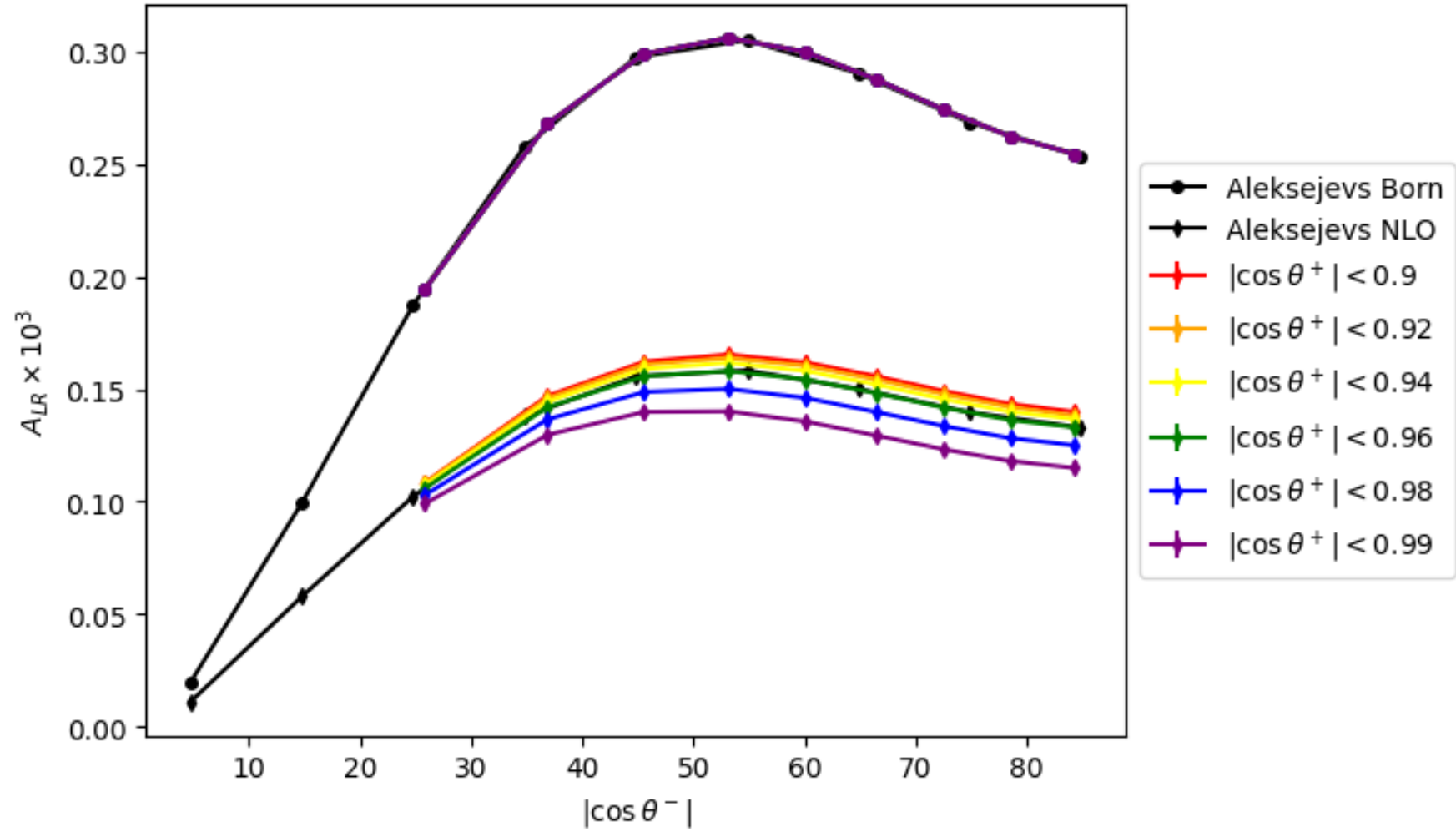
- We compare the generator predictions to recent NLO calculations by Aleksejevs *et al.*
 - A.G. Aleksejevs, S.G. Barkanova, Y.M. Bystritskiy and V.A. Zykunov, “Electroweak Corrections with Allowance for Hard Bremsstrahlung in Polarized Bhabha Scattering”. *Phys. Atom. Nuclei* **83**, 463–479 (2020). <https://doi.org/10.1134/S1063778820030035>
- They integrate ALR as a function of electron direction (cut symmetrically)

$$a < \theta_{e^-} < 180^\circ - a$$



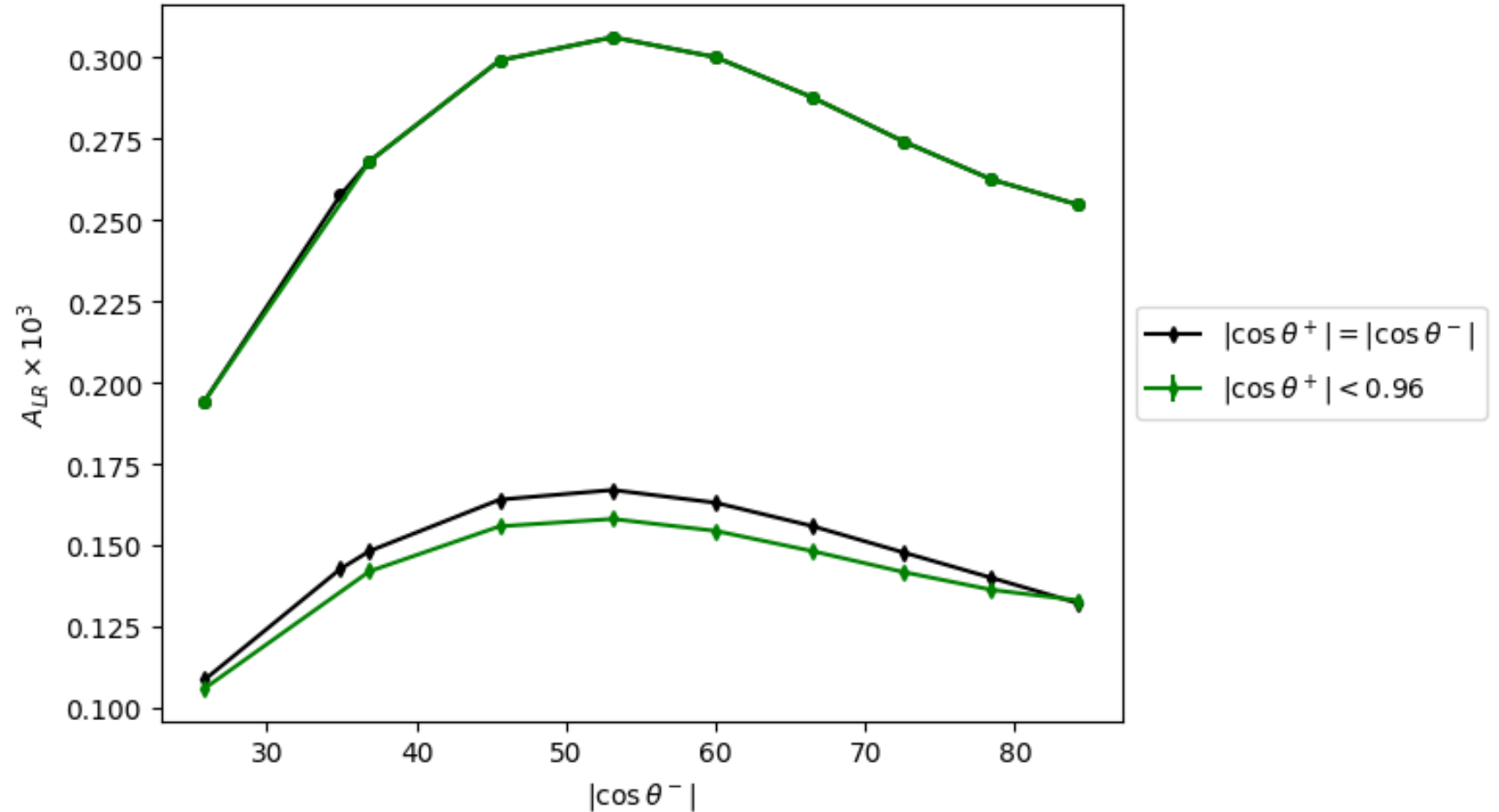
Calculating A_{LR} in the $e^+e^- \rightarrow e^+e^-(\gamma)$ process

- Aleksejevs does not place an explicit constrain on the positron angle
- I find ReneSANCe best reproduces the NLO calculations at $|\cos \theta^+| < 0.96$



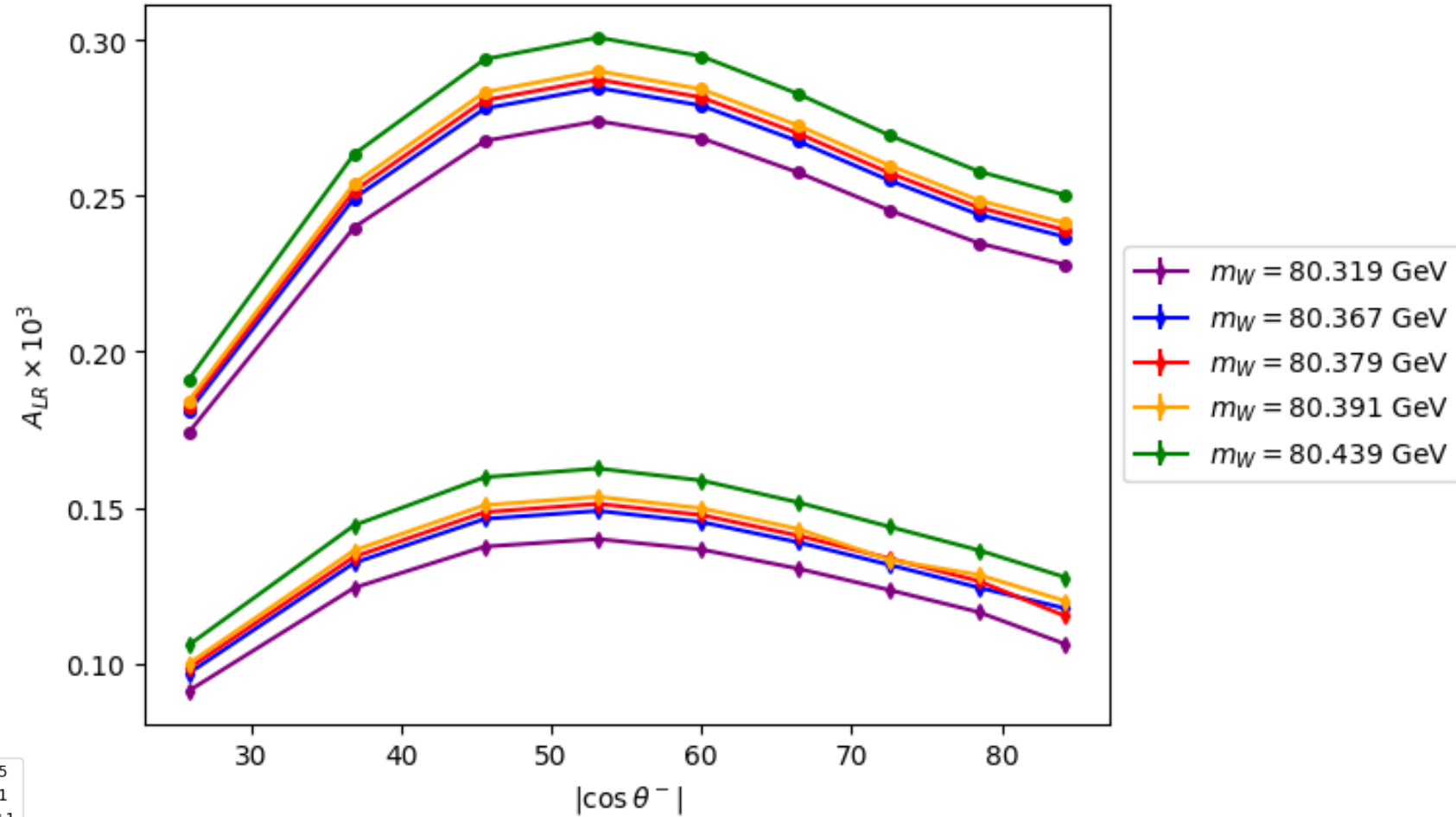
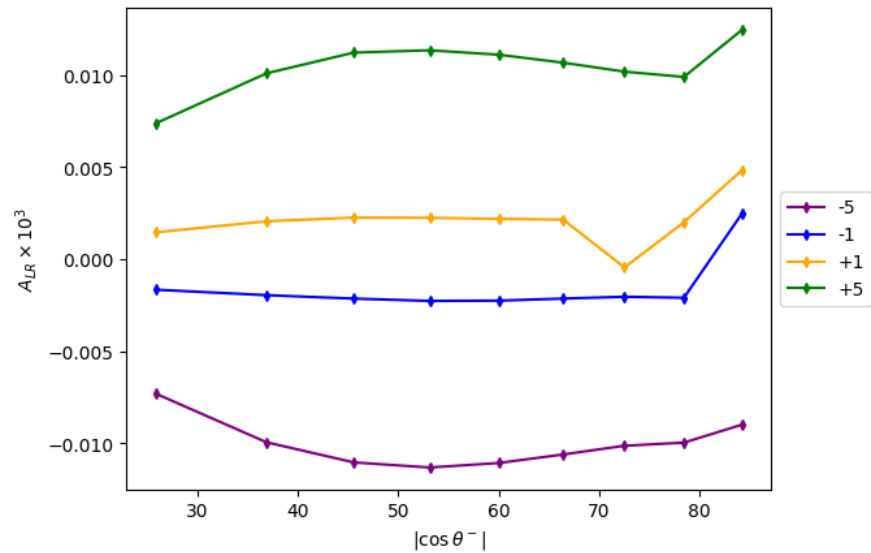
A_{LR} in a Belle II-like selection

- Symmetric acceptance on both e^+ and e^-



A_{LR} to $\sin^2 \theta_W$

- $\sin^2 \theta_W = 1 - \frac{m_W^2}{m_Z^2}$
- Still need to convert
 $\Delta m_W = \Delta \sin^2 \theta_W$



Path to publication

- Planning to redo Aleksejevs comparison with theta cuts rather than $\cos(\theta)$ to match points
- Need to calculate actual difference between Aleksejevs and reneSANCe and understand why $|\cos \theta^+| < 0.96$ works best
- Need to do a run with actual Belle II acceptance from luminosity paper
- Some odd bumps and wiggles in the mW plots to understand/verify
- Calculate $\sin^2\omega$ sensitivity

ReneSANCe at Belle II

- Looked into implementing reneSANCe into basf2 as a standalone generator
- Consensus from the simulation group is that it would make more sense to integrate reneSANCe into the basf2 run control (Start(), Generate(), End(), etc...)
- Will require some rewriting of the reneSANCe source code
- Currently reneSANCe generates events by:
 1. Calculating a sampling phase space based on angular acceptances and events per bin
 2. Randomly sample events by calling the pre-generated phase space files
- For Belle II the files could be generated once and stored on the grid (perhaps multiple sizes to ensure proper statistics of highly transverse electrons)
- Replace event loop with Belle II call and wait for next approach
- I won't have time to work on this going forward so someone else will need to pick it up