Strong2020 and Radio MonteCarLow activities

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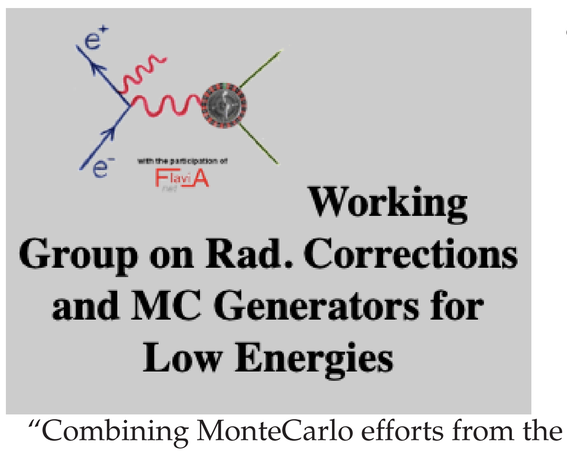
Abstract

For over 15 years the **Radio MonteCarLow WG** ("Radiative Corrections and Monte Carlo Generators for Low Energies Working Group") [1], has provided valuable support to the development of radiative corrections and Monte Carlo generators for low energy e^+e^- data and τ-lepton decays. The working group, composed of theoretical and experimental experts from the e^+e^- physics and τ communities, have published the highly cited report *"Quest for precision in hadronic cross sections at low energy: Monte Carlo tools vs. experimental data"* S. Actis et al. Eur. Phys. J. C 66, 585-686 (2010) [2]. Parts of the Radio MonteCarLow WG program have recently been included as a Joint Research Initiative in the group application of the European hadron physics community, **STRONG2020** [3], with a more specific goal of creating an annotated database for low-energy hadronic cross sections in e^+e^- collisions. The database will contain information about the reliability of the data sets, their systematic errors, and the treatment of radiative corrections.

The Radio MonteCarLow Activities



- **20 meetings between theorists and experimentalists** to discuss the status of radiative corrections and Monte Carlo generators at low energies

RADIO MONTECARLOW

"Combining MonteCarlo efforts from the wild east to the wild west since 2006!"

- Working **list of Monte Carlo Generators**:

– for luminosity
– for $e^+e^- \to leptons + hadrons$
– for $e^+e^- \to hadrons + energetic\,\gamma$ from initial state radiation (ISR)
– for τ production and decays

- **Final Working Group Report** [2]:

– 5 sections with overview of experimental results and status of Monte Carlo generators:

1. luminosity measurements at low energies (up to B factories energy)
2. R measurement by energy scan
3. R measurement by radiative return
4. τ-lepton physics
5. calculation of vacuum polarization with emphasis on the hadronic contributions

– achievements on hadronic cross section measurements and τ physics
– outline of the prospects for future years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THE EUROPEAN PHYSICAL JOURNAL C

Review

Quest for precision in hadronic cross sections at low energy: Monte Carlo tools vs. experimental data

Working Group on Radiative Corrections and Monte Carlo Generators for Low Energies

S. Actis[38], A. Arbuzov[9,e], G. Balossini[32,33], P. Beltrame[13], C. Bignamini[32,33], R. Bonciani[15], C.M. Carloni Calame[35], V. Cherepanov[25,26], M. Czakon[1], H. Czyż[19,s,f,i], A. Denig[22], S. Eidelman[25,26,g], G.V. Fedotovich[25,26,e], A. Ferroglia[23], J. Gluza[19], A. Grzelińska[8], M. Gunia[19], A. Hafner[22], F. Ignatov[25], S. Jadach[8], F. Jegerlehner[3,19,41], A. Kalinowski[29], W. Kluge[17], A. Korchin[20], J.H. Kühn[18], E.A. Kuraev[9], P. Lukin[25], P. Mastrolia[14], G. Montagna[32,33,b,d], S.E. Müller[22,f], F. Nguyen[34,d], O. Nicrosini[33], D. Nomura[36,h], G. Pakhlova[24], G. Pancheri[11], M. Passera[28], A. Penin[10], F. Piccinini[33], W. Płaczek[7], T. Przedzinski[6], E. Remiddi[4,5], T. Riemann[41], G. Rodrigo[37], P. Roig[27], O. Shekhovtsova[11], C.P. Shen[16], A.L. Sibidanov[25], T. Teubner[21,h], L. Trentadue[30,31], G. Venanzoni[11,c,i], J.J. van der Bij[13], P. Wang[2], B.F.L. Ward[39], Z. Was[8,g], M. Worek[40,19], C.Z. Yuan[2]

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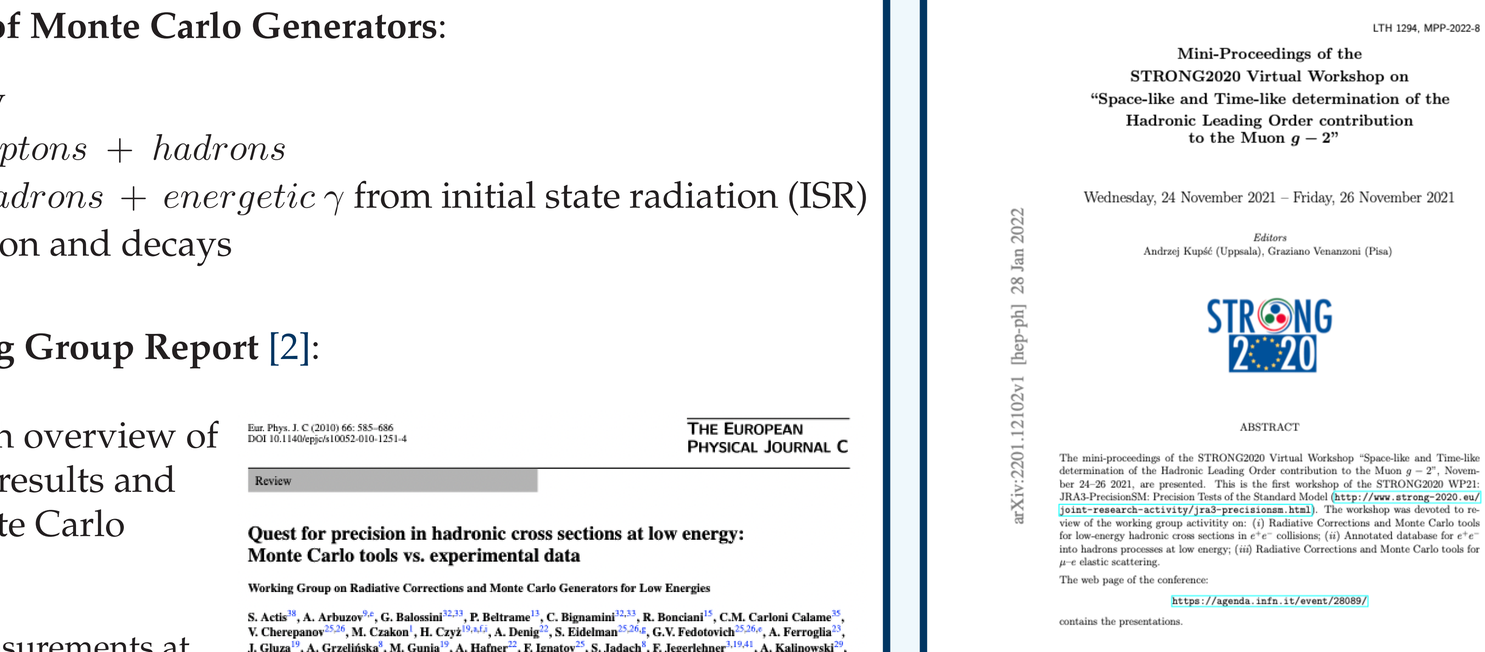
Springer

The Strong2020 Project and the Precision SM DB

- EU project that aims to **study strong interactions** combining knowledge from many frontiers:

LOW ENERGY · HIGH ENERGY · INSTRUMENTATION · INFRASTRUCTURES

- Task within the project: **PrecisionSM "Hadron Physics for Precision Tests of the Standard Model"** with the goal of:
– combining theory and experiment for Standard Model and Beyond precision tests, **Recent Working Group Report** [4]:


LTH 1294, MPP-2022-8

Mini-Proceedings of the STRONG2020 Virtual Workshop on "Space-like and Time-like determination of the Hadronic Leading Order contribution to the Muon $g-2$"

Wednesday, 24 November 2021 – Friday, 26 November 2021

Editors
Andrzej Kupść (Uppsala), Graziano Venanzoni (Pisa)

STRONG 2020

arXiv:2201.12102v1 [hep-ph] 28 Jan 2022

ABSTRACT

The mini-proceedings of the STRONG2020 Virtual Workshop "Space-like and Time-like determination of the Hadronic Leading Order contribution to the Muon $g-2$", November 24–26 2021, are presented. This is the first workshop of the STRONG2020 WP21: JRA3-PrecisionSM: Precision Tests of the Standard Model (http://www.strong-2020.eu/joint-research-activity/jra3-precisionsm.html). The workshop was devoted to review of the working group activitity on: (*i*) Radiative Corrections and Monte Carlo tools for low-energy hadronic cross sections in e^+e^- collisions; (*ii*) Annotated database for e^+e^- into hadrons processes at low energy; (*iii*) Radiative Corrections and Monte Carlo tools for μ-e elastic scattering.

The web page of the conference:

https://agenda.infn.it/event/28089/

contains the presentations.

→ Topics:

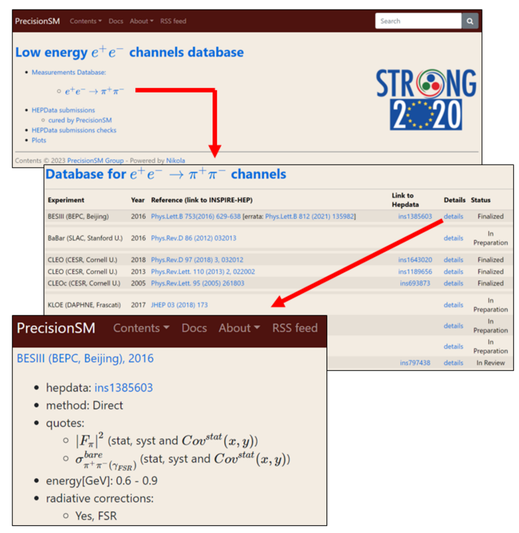
1. R measurement
2. Radiative Corrections and Monte Carlo generators for time-like processes
3. Radiative Corrections and Monte Carlo generators for space-like processes

- Latest WorkStop 07-09 June 2023: "Radiative corrections and Monte Carlo tools for low-energy hadronic cross sections in e^+e^- collision", Zurich University

– constructing the annotated **Strong2020 Precision SM DataBase** for low-energy cross sections in $e^+e^- \to hadrons$, which includes:

1. uploading in the public repository HEPData [5] all measurements from all experiments
2. cataloguing the measurements in the **PrecisionDB Website** [https://precision-sm.github.io]

– At present the database contains $e^+e^- \to \pi^+\pi^-$ measurements, important for the calculation of the Muon $g-2$ theoretical value. We are in the process of reviewing the other channels.



Conclusions

The Radio MonteCarLow and the Strong2020 Working Groups are facilitating the collaboration between the experimental and theoretical groups with the goal of understanding the status of the Monte Carlo generators and the measurements in hadronic physics. All these efforts have been recently revived by the first measurement of the anomalous magnetic moment of the muon at Fermilab [6], and by the recent measurement of the $e^+e^- \to \pi^+\pi^-$ cross section measurement with the CMD-3 detector [7]. The Fermilab measurement combined with the final result from the Brookhaven experiment shows a 4.2σ discrepancy with respect to the Standard Model theoretical prediction that includes an evaluation of the leading-order hadronic-vacuum-polarization contribution from $e^+e^- \to hadrons$ cross-section data, and a 1.5σ discrepancy from the Lattice based calculation. The CMD-3 result evaluated a significantly larger hadronic contribution to the muon anomalous magnetic moment than the previous measurements.

References

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[2] https://arxiv.org/abs/0912.0749
[3] http://www.strong-2020.eu
[4] https://arxiv.org/pdf/2201.12102.pdf
[5] https://www.hepdata.net
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[7] https://arxiv.org/abs/2302.08834

Acknowledgements

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