

Standard SANC Modules

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on behalf of **SANC** group

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SANC: Support of Analytic and Numerical Calculations for Colliders

Computer system for semi-automatic calculations of realistic and pseudo-observables for various processes of elementary particle interactions from the SM Lagrangian to event distributions at the one-loop precision level for the present and future colliders.

SANC v1.10:

Dubna <http://sanc.jinr.ru/>

CERN <http://pcphsanc.cern.ch/>

Ref.1: *SANCscope* — v.1.00 *Comput. Phys. Comm.* **174** (2006) 481
A. Andonov, A. Arbuzov, D. Bardin, S. Bondarenko, P. Christova, L. Kalinovskaya, G. Nanava and W. von Schlippe

Ref.2: *SANCnews: Sector fbb* *Comput. Phys. Comm.* **177** (2007) 738
D. Bardin, S. Bondarenko, L. Kalinovskaya, G. Nanava, L. Romyantsev, and W. von Schlippe

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- **Standard SANC Form and Fortran Modules (SSFM)**
for use in MC generators by ourselves or by the others;

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 - a) generator for $H \rightarrow 4\mu$ decay in the single Z pole approximation;
 - b) generators for NC and CC Drell–Yan processes;
 - c) generator for $t \rightarrow b\nu$ decay;

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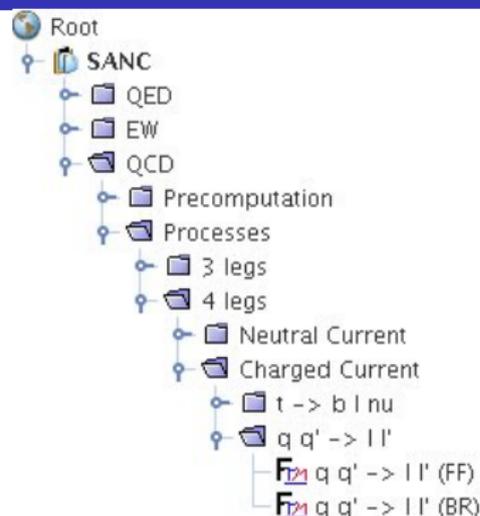
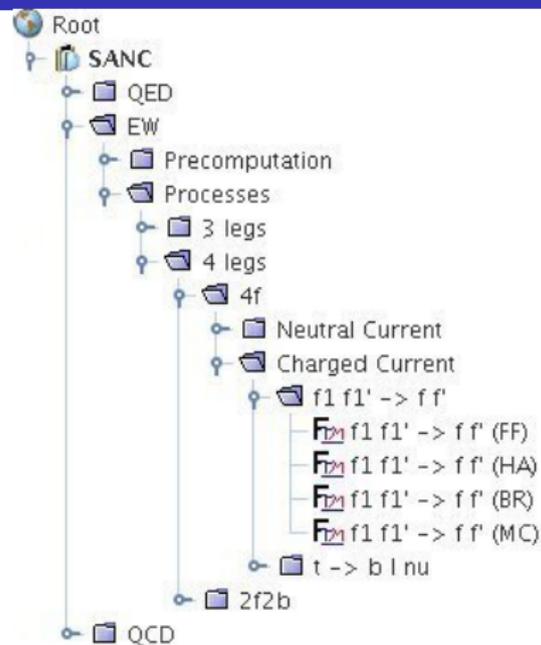
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Les Houches Workshop Proceedings, 2006, 2008
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For more information about SSFM and MC generators see ATL-COM-PHYS-2008-176.

FORM modules: EW and QCD interplay



Scalar Form Factors (FF), Helicity Amplitudes(HA), integrated bremsstrahlung (BR), fully differential bremsstrahlung (MC).

SANC client download

SANC Project Official Home Page

Joint Institute for Nuclear Research



SUPPORT OF ANALYTIC AND NUMERIC CALCULATIONS FOR EXPERIMENTS AT COLLIDERS

SANC Project

New Client v.1.10 available!

New SANC Modules [a](#)

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SANC Project Download.

- SANC Client -- Special interface for networking at SANC Server.
- SANC Modules -- Stand alone SANC products for precision calculations.
- SANC Generators -- Stand alone SANC packages for events generation.

SANC Client.

Combined SANC Client Version 1.10.00 for Linux and Windows:

- [SANC Client v.1.10 \(1.41 Mb zip-file\)](#)

Requirements:

- 5 MB free disk space on hard drive
- The Java Runtime Environment (JRE) version 5 or later
- Linux users require bash 3.0 or later

Instructions:

- All needed instructions are included in download zip-file -- see README.txt
- For more information see [Users Support](#).



SANC Fortran packages

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- **SANC NC v1.10: SSFM for the DY NC processes:**
 $(uu, dd) \rightarrow (\mu\mu, ee)$ and **SSFM for the processes:**
 $ee(uu, dd) \rightarrow HZ$;
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Example of the implementation of the SSFM to WINHAC (<http://cern.ch/placzek/winhac>) will be presented by Andrey Arbuzov.

SANC Fortran package structure

The adopted form of presentation of the differential cross section at the one-loop level in obvious notation is:

$$d\hat{\sigma}^{1\text{-loop}} = d\hat{\sigma}^{\text{Born}} + d\hat{\sigma}^{\text{Subt}} + d\hat{\sigma}^{\text{Virt+Soft}}(\bar{\omega}) + d\hat{\sigma}^{\text{Hard}}(\bar{\omega}). \quad (1)$$

Each fortran package contains

- documentation,
- declaration, initialization and various input files,
- libraries,
- main file,
- **SSFM:**
files containing subroutines corresponding to terms in (1)

SANC Fortran packages download

SANC Modules.

SANC NC package (Neutral Current processes modules).

- [13/02/2008 SANC NC v1.10 package](#) (300 Kb tgz-file) [[last stable version](#)]

In v1.10 package the f1f1HZ processes are added. For description of the f1f1HZ processes please refer to the paper D. Bardin et al., Comput. Phys. Comm. 177 (2007) 738-756. Details are in the file CHANGES.

- [31/01/2008 SANC NC v1.01 package](#) (155 Kb tgz-file) [[stable version](#)]

In v1.01 package two bugs are fixed and some procedures are optimized. Details are in the file CHANGES.

- [05/11/2007 SANC DY NC v1.00 package](#) (154 Kb tgz-file)

This package is intended for calculation of the 1-loop radiative correction to Drell-Yan Neutral Current processes at partonic level. For a Technical Description of this module please refer to the paper Eur. Phys. J. C54 (2008) 451.

SANC CC package (Charge Current processes modules).

- [28/10/2008 SANC CC v1.11 package](#) (131 Kb tgz-file) [[last stable version](#)]

In v1.11 package some bugs in the QCD soft-virtual part are fixed. Details are in the file CHANGES.

- [30/07/2008 SANC CC v1.10 package](#) (131 Kb tgz-file)

In v1.10 package the modules for the 1-loop QCD radiative corrections to Drell-Yan Charge Current processes at partonic level are added. Details are in the file CHANGES.

- [11/07/2008 SANC CC v1.03 package](#) (127.5 Kb tgz-file) [[stable version](#)]

In v1.03 package some bugs are fixed. Details are in the file CHANGES.

- [14/04/2008 SANC CC v1.02 package](#) (129 Kb tgz-file)

In v1.02 package two bugs are fixed and some optimization are done. Details are in the file CHANGES.

- [04/02/2008 SANC CC v1.01 package](#) (131 Kb tgz-file)

In v1.01 package some procedures are optimized. Details are in the file CHANGES.

- [21/12/2007 SANC DY CC v1.00 package](#) (130 Kb tgz-file)

This sanc_cc_v1.00 package is intended for calculation of the 1-loop radiative correction to Drell-Yan Charge Current processes at partonic level, see A. Arbuzov et al., Eur. Phys. J. C46 (2006) 407.

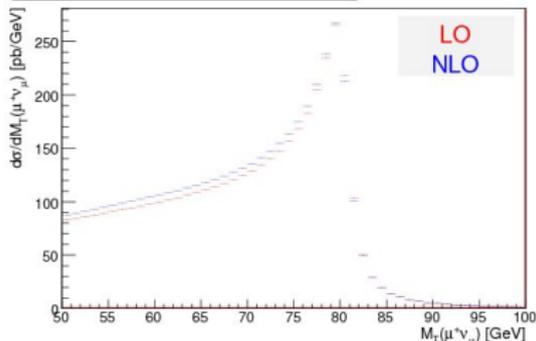
SANC MC generators

The `sanc_**_foam_v1.**` packages are intended for generation of unweighted events of the DY processes in NC and CC sector.

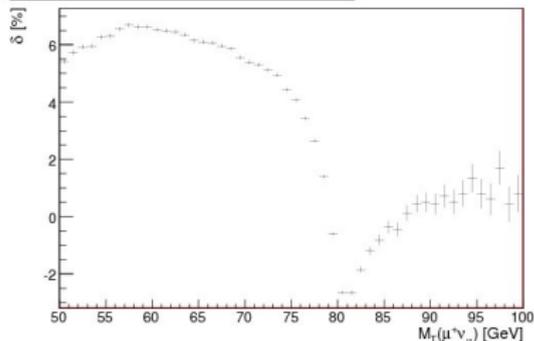
- use **SSF**M,
- one-loop EW radiative corrections,
- hadronic level,
- based on **FOAM** algorithm,
- **Les Houches Accord** format of the output data – gives the possibility to link output to general purpose programs such as **PYTHIA** and **HERWIG**.

SANC MC generators, examples of distributions for single-W production

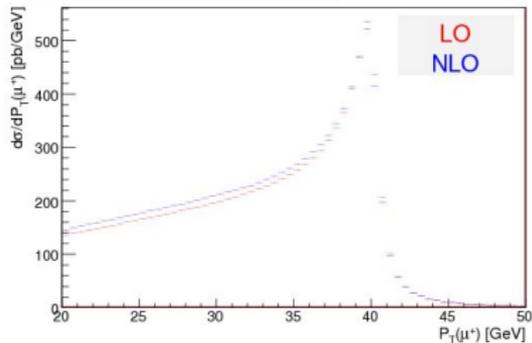
Distribution of transverse mass of $\mu^+\nu_\mu$ pair



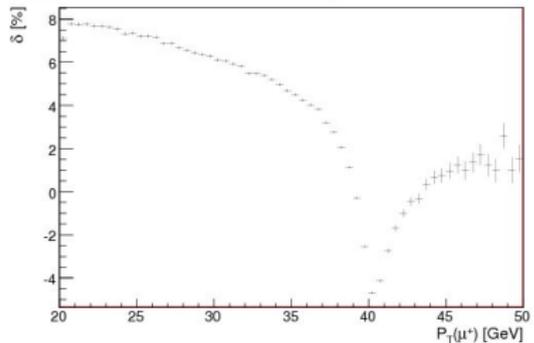
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Distribution of μ^+ transverse momentum



Distribution of μ^+ transverse momentum



SANC MC generators download

SANC Generators.

Drell-Yan Neutral Current processes generator.

➔ [23/05/2008 SANC NC DY FOAM v1.10 package](#) (345 Kb tgz-file) [\[last stable version\]](#)

In v1.10 package the Les Houches format event files is introduced. Details are in the file CHANGES.

➔ [22/02/2008 SANC NC DY FOAM v1.01 package](#) (584 Kb tgz-file) [\[stable version\]](#)

In v1.01 package the modules are taken from the sanc_nc_v1.01 package. Details are in the file CHANGES.

➔ [25/12/2007 SANC NC DY FOAM v1.00 package](#) (583 Kb tgz-file)

This SANC generator is intended for generation of unweighted events of the Drell-Yan Neutral Current processes at hadronic level taking into account the 1-loop EW radiative correction using the FOAM algorithm. Please read the instructions (in tgz file) for using this package.

Drell-Yan Charge Current processes generator.

➔ [15/04/2008 SANC CC DY FOAM v1.00 package](#) (235 Kb tgz-file) [\[last stable version\]](#)

This SANC generator is intended for generation of unweighted events of the Drell-Yan Charge Current processes at hadronic level taking into account the 1-loop EW radiative correction using the FOAM algorithm. Please read the instructions (in tgz file) for using this package. In v1.00 package the modules are taken from the sanc_cc_v1.02 package.

Conclusions

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Conclusions

- The Standard SANC Form and Fortran Modules were introduced.
- They were used in the Fortran packages at the parton level for quick studies of different features of the given sub-processes: estimates of effects due to variations of input parameters, interplay of different RC contributions (QED-EW-QCD, initial and final state radiation) *etc.*;
- Also they were used in the SANC Monte Carlo event generators that provide distributions of the final state particles with full kinematics, which was interfaced with parton showering codes (PYTHIA and HERWIG) and the events can be further processed through the whole experiment simulation environment.

SANC processes at the hadron level: list for export

IN PREPARATION, SANC CC/NC v1.20

type of the process	parton showers from PHYTHIA and HERWIG
DY CC	*
DY NC	*
$t \rightarrow bud$	
$t \rightarrow bl\nu$	
$ud \rightarrow tb$	*
$f\bar{f} \rightarrow HZ$ within cascade approach: $f\bar{f} \rightarrow HZ^* \rightarrow H\mu^+\mu^-$	*