SANC press release

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In a bunch of four talks, presented at this conference, we describe the SANC version 0.03 which is capable of automatically computing the decay rates and the distributions for the simplest SM decays $Z(H,W) \to f\bar{f}$ in the one-loop approximation. The main aim of this version is to demonstrate the workability of the proposed four-level computer system which is intended to Support Analytic and Numeric calculations for experiments at Colliders.

1. SANC VERSION 0.03

The roots and the main goals of the project SANC were described in two talks [1]–[2]. Within this project a four-level computer system is being created which must automatically calculate, at the one-loop precision level, the pseudo- and realistic observables (decay rates and event distributions) for processes of high energy physics.

It was already used for a revisiting, on the SANC basement, of the EW corrections for Atomic Parity Violation [3] and for the processes $e^+e^- \to f\bar{f}$ (f is any fermion, including t quark) [4–6].

The version of SANC that we describe here realizes, in an Internet-based environment, the full chain of calculations 'from the Lagrangian to realistic distribution' for the case of simplest $1 \to 2$ decays. It returns numbers and distributions for these decays at the one-loop level of precision.

The calculations start from the SM Lagrangian in the R_ξ gauge which depends on 25 input parameters (IPS), fields, and on three gauge parameters: ξ_A, ξ_Z, ξ. The one-loop virtual corrections are computed using the standard reduction to the usual scalar functions: A_0, B_0, C_0 and D_0; and to the auxiliary scalar functions: a_0, b_0, c_0 and d_0, which are due to particular form of photonic propagator in R_ξ gauge (terms $\propto 1/p^4$) [7].

Then SANC computes analytically the one-loop covariant amplitude of a process parametrized in a certain basis by a certain number of scalar form factors (SFF). Next, it computes helicity amplitudes (HA) in terms of these SFF. Presently, we use in here the method of Vega and Wudka [8]. All these calculations (**level 1**) are realized in FORM3 language [9]. An example of calculations of the SFF and HA for the processes $e^+e^- \to f\bar{f}$ is given in the talk [10] which contains also a description of numerous comparisons with other existing codes [11]–[15].

The chain of calculations at level 1 continues with another bunch of FORM3 codes which compute analytically the contributions to the decay rates from the bremsstrahlung processes: $H(Z,W) \to f_1\bar{f}_2\gamma$. It is described in more details in the talk [16].

At **level 2** an s2n.f software generates automatically the fortran codes for decay rates at one loop.

At **level 3** an infrared rearrangement (or exponentiation) procedure should work out (it is still at the stage of development).

Finally, at **level 4** one has a Monte Carlo event generator [17]. It uses the helicity amplitudes for the accompanying bremsstrahlung processes, and for the time being we use the Kleiss–Stirling techniques [18]–[19] to derive them. The Monte-Carlo event generators are being created in collaboration with S. Jadach and Z. Was from

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INF (Krakow, Poland) and B.F.L. Ward from the University of Tennessee (Knoxville, USA). The talk [17] contains a description how this is realized for the case of decays $B \to f\bar{f}$ as well as the results of numerical comparisons with the well-known codes PHOTOS [20] and KORALZ [21]. A more comprehensive description of this work will be given elsewhere [22].

2. CONCLUDING REMARKS

SANC is an **Internet-based** system, it lives in a website *http://brg.jinr.ru/*. It is a **database-based** system, i.e. it is organized as a storage of source codes talking to one another via a homogeneous environment written in JAVA. It uses the **intermediate access principle** which means that: 1) all the relevant one-loop diagrams are precomputed and stored (to save the CPU), 2) there are several intermediate 'entries' to bypass the other CPU consuming computations.

The first phase of SANC is realized in *demonstration version 0.03*. The next phase assumes the creation of a complete software product, accessible via an Internet-based environment, and realizing the full chain of calculations for the *processes* $2 \to 3$ and *decays* $1 \to 4$.

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