ERC Advanced Grant
Research Proposal (Part B1)

Beyond Double Precision (BeDoP)

Principal Investigator (PI):	**Dr Paul Zimmermann**
PI's host institution:	**Inria, France**
Proposal full title:	**Beyond Double Precision**
Proposal short name:	**BeDoP**
Project duration:	**60 months**
Targeted Review Panel:	**PE6 (Computer Science and Informatics)**

Proposal Abstract

On May 25, 2008, IBM's Roadrunner supercomputer reached the petaflop milestone, i.e., 10^{15} floating-point operations per second (flops). We anticipate that the **exaflop milestone** of 10^{18} flops will be reached around 2020. Given that current hardware uses a double precision floating-point format of 53 bits corresponding to about 16 decimal digits, and that **rounding errors** usually increase linearly with the number of operations, we need to reconsider the **final accuracy** of results obtained on future exascale computers.

We strongly believe that (i) the scientific community has a **blind confidence** in double precision arithmetic, (ii) even today some scientific computations are **fast but wrong**, with some potential **disastrous consequences**, and (iii) in the near future the world will realize that **double precision is not enough**.

It is therefore **our responsibility** as computer scientists to (i) **warn the scientific community** about the limits of double precision for large computations, (ii) design and improve software tools that will enable scientists to go **beyond double precision** in the parts of their programs that require it, and (iii) make those software tools **efficient and robust**.

The BeDoP project will address these **crucial issues** by: (i) demonstrating the **limits of double precision** on large-scale applications, (ii) making multiple-precision tools **easier to use** in modern computer languages, and (iii) improving the efficiency and robustness of those tools, in particular by using **formal proof** techniques.

Our dream with the BeDoP project is that scientific computations on exascale computers will no longer give **very fast and very wrong results**, but instead give **very fast and very accurate results.**