Introduction: A new device concept of a multifunctional particle collector was designed to meet the strict regulations of clean rooms and medical-biological environment. The device is meant to assist the existing installations on achieving better performances or to offer an alternative to costly equipments.

Use of COMSOL Multiphysics: After analyzing the clean room parameters, a SolidWorks model (Fig.1.a) has been elaborated and imported in COMSOL Multiphysics. Using COMSOL Fluid Flow Interface the micro-particle collector design (μC3) and the exhaust system impact on the clean room airflow were studied. The flow velocity simulations are solutions of the Navier-Stokes equations derived from the Cauchy momentum equation:

$$\frac{\partial}{\partial t} (\rho u) + \nabla \cdot (\rho u \otimes u + p I) = \nabla \cdot \tau + \rho g$$

To fully describe the fluid flow a statement of the conservation of mass is generally necessary. This is achieved through the mass continuity equation, given in its most general form as:

$$\frac{\partial p}{\partial t} + \nabla \cdot (\rho u) = 0$$

Results: The effective design of the active elements has been readdressed based on COMSOL simulation results (Fig. 2, 3) thus the efficiency of the device parts modeling being correlated (Fig. 4.a,b).

Conclusions: The effects of the model geometry and exhaust system on the clean room air flow were controlled through the redesign of the device parts and through interface process variables monitoring.

References: