Today, environmental pollution is one of the biggest problems not only related to climate change and biodiversity, but also has a negative impact on public health, leading to increased morbidity and mortality. Among other factors, the so-called particulate matter (PM) is a commonly used indicator of air pollution. PM consists of a heterogeneous mixture of solid and liquid particles floating in the air, including combustion products of coal, coarse dust, mineral dust, fibres, microplastics, metals and biological compounds. Particles smaller than 10 µm pose the greatest threat to human health due to their high ability to penetrate the respiratory tract. Recent studies have shown a significant relationship between particulate matter levels and SARS-CoV-2 infection and mortality, suggesting that air pollutants may play an important role in disease spread. In addition to airborne and direct contact, infectious diseases can also be transmitted indirectly through contaminated objects. Viruses deposited on surfaces can retain their infectivity for a long time, therefore this type of transmission is an important epidemiological factor. The survival rate of viruses depends on their type, type of surface, soiling level and the surrounding environmental conditions. The genetic material of many species of bacteria, viruses and fungi is detectable in solid contaminant particles, suggesting that they may act as a potential mechanical vector of disease as “aerosolized fomite” that drives the spread of infections. Recent animal studies have shown that this mode of transmission is possible. Airborne viruses spread mainly through microscopic droplets excreted from the respiratory tract, which, due to their high protein content, protect the virus, extending its viability. These virus-contaminated droplets can deposit both on coarse particles accumulated on the surrounding surfaces as well as on airborne solids, which can then be involved in the indirect transmission of infectious diseases

The project aims to show that airborne particles such as PM 2.5, PM10, dust, pollen or soot can cause adhesion, increase survival and allow the spread of viruses, thus potentially leading to more efficient disease transmission in environment. Our aim is to show that viruses are able to persist on the surface of selected airborne particles and to assess whether this association affects virus stability. The study will include four airborne, morphologically distinct viruses representing different families, namely: severe acute respiratory syndrome virus 2 (SARS-CoV-2), influenza A virus (IAV), human rhinovirus A (HRV) and monkeypox virus (MPXV). The obtained results will confirm the ability of viruses to adhere to selected solid particles. Based on conventional virological methods, we will evaluate the stability of the viruses contained in the various matrices under realistic environmental conditions that mimic the seasonality of the selected viruses. Then, a highly innovative bioaerosol generation system, adapted to the requirements of a class 3+ biosafety level laboratory (BSL-3 +), will be used to study the droplet size distribution during aerosol aging and the viability of the viruses contained in these droplets under real-life conditions. The main innovation in the work is the generation of dry bioaerosol from virus-contaminated particles, which will be performed after appropriate adjustment of the aerosol generation and collection system. This modification will make it possible for the first time to evaluate the stability of airborne contaminated particulate viruses under controlled experimental conditions. The obtained results will be compared with the survival of the virus in the respiratory droplets in order to evaluate the beneficial or unfavourable influence of the presence of particulate matter on the environmental stability of the virus. With the help of the developed aerolization system, we will try to find out whether airborne particles can become contaminated with infectious aerosol droplets when mixed in air, as is likely the case in reality. The obtained results are of key importance for elucidating the role of dust and other airborne particles in the indirect transmission of infectious diseases. The obtained results concerning the size of generated particles in the context of virus survival will provide data for the further development of mathematical models concerning the probability of disease spreading depending on the level and type of air pollution. Among the advantages of the project, the development of appropriate experimental conditions is of particular importance, as so far no systems for testing aerosols in the form of infectious solid particles suspended in air have been described in the literature.