

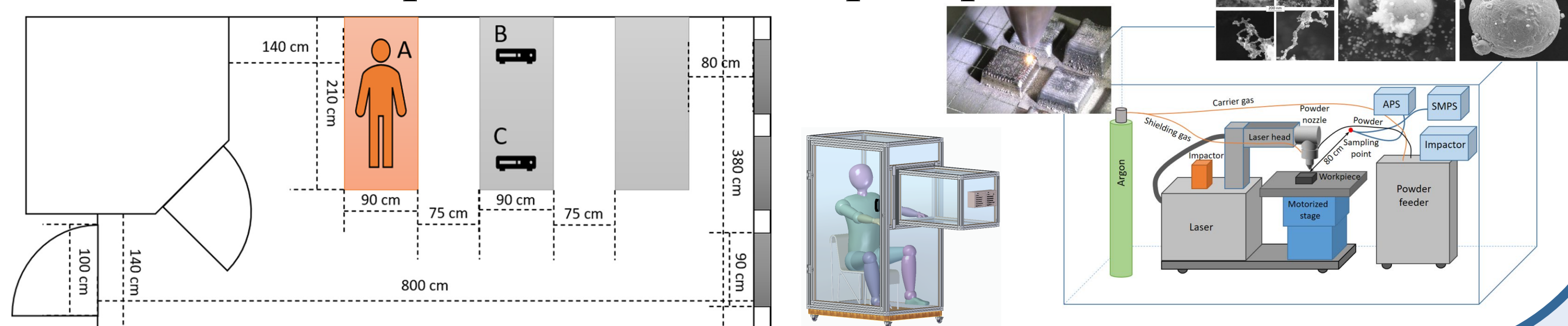
Introduction

The main profile of the research group is the research, development and application of laser optical measurement techniques in various fields. One of these is the study of the impact of aerosols on climate, our immediate environment and humans. Within this, the areas currently actively pursued are studies on the aerosol transport of pathogens that play a significant role in the development of epidemics; studies on aerosol deposition in the airways (health effects, pharmacology); characterisation and impact of aerosols (nanoparticles) formed and released during intense laser-light-matter interactions. Another line of research related to optical metrology is the development of 3D metal printing technologies and the related metrology and air quality effects.

Methods

Optical particle counters were utilized - to perform real-life measurements of size-fractionated aerosol concentration in a plethysmography box, - to examine the particles generated by various activities performed by health care professionals caring for patients in a real-world hospital setting, and the associated viral load was estimated using mathematical methods.

Scanning mobility particle sizer, optical particle sizer, and aerodynamic particle sizer were utilized to assess the concentration and the size distribution of particles in the ambient air during 3D metal printing. Scanning electron microscopy and X-ray spectroscopic methods were used to reveal the composition of the sampled particles.



Publications of the group

- [1] A. Nagy, A. Horváth, Á. Farkas, P. Fűri, T. Erdélyi, B. G. Madas, A. Czitrovsky, B. Merkely, A. Szabó, Z. Ungvári, and V. Müller, *Modeling of nursing care-associated airborne transmission of SARS-CoV-2 in a real-world hospital setting*, *Geroscience*, vol. 44, no. 2, pp. 585–595, 2022.
- [2] Groma, V. ; Kugler, Sz. ; Farkas, Á. ; Fűri, P. ; Madas, B. ; Nagy, A. ; Erdélyi, T. ; Horváth, A. ; Müller, V. ; Szántó-Egész, R. et al., *Size distribution and relationship of airborne SARS-CoV-2 RNA to indoor aerosol in hospital ward environments*, *Scientific reports* 13:1 Paper: 3566 , 11 p. (2023)
- [2] L. Péter, J. Osán, S. Kugler, V. Groma, S. Pollastri, and A. Nagy, *Comprehensive Analysis of Two H13-Type Starting Materials Used for Laser Cladding and Aerosol Particles Formed in This Process*, *Materials*, vol. 15, no. 20, 2022.
- [3] Farkas, Á.; Tamási, L. ; Nagy, A. ; Tomisa, G. ; Kis, E., Horváth, A., *Real-life measurement of size-fractionated aerosol concentration in a plethysmography box during the COVID-19 pandemic and estimation of the associated viral load*, *Journal of hospital infection* 118 pp. 7-14., 8 p. (2021)

Results

Airborne transmission of pathogens by aerosol particles

- During bronchoscopy and lung function tests, patients emit the same amount of particles as they do during normal speech, so the risk of hospital staff becoming infected during the test is not significantly higher than when talking to the same patient.
- In the nursing home bedroom, staff and patient activities significantly increased the concentration of submicron particles in the air. In contrast, the concentration of supermicron particles increased mainly during nursing activities.
- While submicron particles mainly deposit in the acinar regions, the supermicron particles deposit in the larger airways. The above information became crucial when it was shown that, in addition to particles 1–5 microns in size, viral RNA was detected on particles in the submicron range and even below 300 nm.

Intense laser-light-matter interactions

- A significant aerosol formation was observed in the ultrafine size range during the intense laser-metal interaction by vapour phase nucleation, where the elemental composition of the particles changed compared to the feedstock powder used for construction.
- Satellite particles were also observed in the submicron size range formed during the laser interaction, and a fraction in the micron size range that was already present in the feedstock powder.
- The consequences of the above to the health and the 3D printing process have also been explored.

