Virofight
Novel nano-technology
to contain viruses

VIROFIGHT Project

VIROFIGHT project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 899619.

VIROFIGHT:

General purpose virus-neutralizing engulfing shells with modular target specificity

Project Partners and teams

Virofight

Technische Universität München

- **Prof. Dr. Hendrik Dietz, Professor for Biophysics, Physics Department (Coordinator)**
- Prof. Dr. Ulrike Protzer, Institute Director, Institute of Virology, School of Medicine

AARHUS UNIVERSITY

- Prof. Dr. Jorgen Kjems, Director, Interdisciplinary Nanoscience Center (iNANO)

UR Universität Regensburg

- Prof. Dr. Ralf Wagner, Head of Molecular Microbiology (Virology)

NATIONAL INSTITUTE OF CHEMISTRY

- Dr. Roman Jerala, Head of department, Synthetic biology and immunology

ARTTIC a PNO international management services company

- Adeline Paul, Project Manager, ARTTIC

ARTTIC a PNO innovation services company

- Dr. Michael Hagn, Senior Consultant, ARTTIC Innovation GmbH

Project facts

Virofight

- Project Duration: 01.06.2020-31.05.2024
- Coordinator: Prof. Dr. Hendrik Dietz,
  Professor for Biophysics,
  Physics Department
  Technical University Munich
- Project funding: 3.88mio €

VIROFIGHT MISSION

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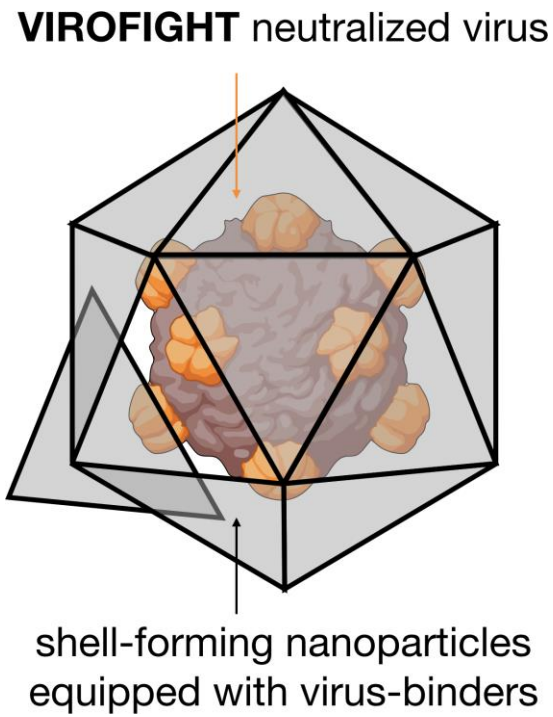
The mission of this project is to develop and test a prototypical drug platform with the principal capacity to neutralize *any given virus*

VIROFIGHT CONCEPT

- Current antivirals target virus-specific proteins or enzymes by small molecules.
- We plan to *engulf whole viruses* with synthetic nano-shells to neutralize the pathogen.
- Enables avidity effects, occlude large portions of the viral surface, modularity, …



VIROFIGHT OPPORTUNITY

- Test targets:
  - Virus-like particles with various env proteins
  - lentiviral pseudo-type, hepatitis B, adeno virus

- In principle, no need for detailed molecular knowledge about the target viral pathogen.

- Hence, our concept offers a route to fight newly emerging viral diseases or disease variants.

- In our grant we proposed a “blind” experiment to test this idea.

  → **Adapt for SARS-CoV2**

VIROFIGHT KEY TECHNOLOGIES

- **DNA / protein nanotech:** Fabrication of fully addressable synthetic virus-sized nano-shells and attaching the virus-binders to them

- **Aptamers, peptides:** Identification of molecular binders against user-defined targets through *in vitro* selection processes to obtain specificity to any given target virus

- **Real viruses and virus-like particles** as test targets

VIROFIGHT OBJECTIVES

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1. **Create** discrete, size-adaptable nano-shells that can *fully engulf and neutralize entire virus particles*, with variants for spherical and filamentous viruses (WP1)
2. **Create** a set of molecular building blocks that can *polymerize into virus-neutralizing shells on the surface of viruses* (WP2)
3. **Establish** a generic molecular selection pipeline against purified virus-like particles, purified viruses and viruses in serum yielding chemically modified DNA and RNA aptamers (WP3)
4. **Test** the neutralizing effectiveness against virus-like particles & lentivirus pseudo-type particles as models for a variety of aggressive viral pathogens, and HIV, hepatitis B and adeno viruses as models for real enveloped and non-enveloped viruses (WP4)

VIROFIGHT MILESTONES

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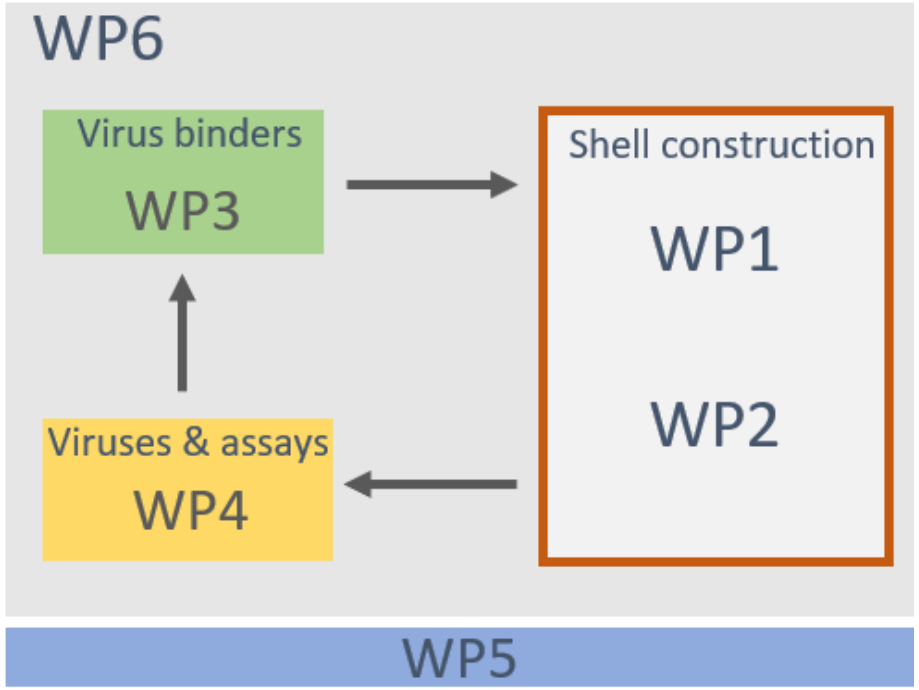
1. **Selection pipeline against viral proteins is established**
   - **AU, M18**; biophysical methods proving successful selection of molecular binders against given molecular targets.
2. **Delivery of virus-binding shells in physiological buffer for performing virus neutralization assays**
   - **TUM, M24**; Biophysical methods proving successful construction of shells and survival in physiological buffer (e.g. cryo EM images acquired after 24h incubation in suitable buffer).
3. **Self-assembling coiled-coil modules**
   - **NIC, M24**; Biophysical methods proving successful self-assembly of these molecular constructs (SAXS, cryo EM, EMSA etc).
4. **Viral neutralization capacity is shown**
   - **UREG, M48**; Cell-based neutralization assays showing significant inhibition versus control (e.g. measuring the number of infected cells via reporter fluorescence gene intensity using flow cytometry). Goal is at least 80% suppression over control.

VIROFIGHT implementation

- **Four interlinked scientific work-packages for iterative progress.**
- **WP5: dissemination, exploitation, communication**
- **WP6: project management**



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Contact information

- Hendrik Dietz (dietz@tum.de)