Towards Decoding the Shield of Human Immunodeficiency Viruses (HIV)

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Human Immunodeficiency Viruses (HIV)

- **Statistics**

  - US: 1.1 mio

  - **People living with HIV by WHO region, 2018 (in millions)**
    - Africa: 25.7
    - South-East Asia: 3.5
    - Europe: 1.9
    - Eastern Mediterranean: 2.5
    - Americas: 3.8

- **Antiretroviral Therapy** prevents the growth of the virus, but do not kill or cure the virus.

- **U.S. Federal Funding for HIV/AIDS, 2019 (in US$ billions)**
  - Total: $34.8 Billion
  - Domestic Care & Treatment: $21.5 billion (62%)
  - Global: $6.8 billion (19%)
  - Domestic Cash & Housing Assistance: $3.1 billion (9%)
  - Domestic Research: $2.6 billion (7%)
  - Domestic Prevention: $0.9 billion (3%)

World Health Organization; KFF data analysis
How does immune system work?

1. Antigen binds to the virus.
2. Antibody (immune system) binds to the virus.
3. Antibody (immune system) deactivates the virus.
How does immune system work?

Antibody has to recognize the 3D structure of virus antigen.
Why is it very challenging for immune system to combat HIV viruses?

HIV virus: antigen = **Env protein**

HIV viruses can vary the glycan shield easily ("mutation")

with “glycan shield” (blue, violet dots)

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HIV viruses can vary the glycan shield easily (“mutation”)

After mutation: Antibody fails to recognize the 3D structure of Env.
How to develop an antibody-based vaccine against HIV?

Characterize the exact 3D structure of Env protein: requires a novel analytical method.

Env protein

with “glycan shield”
(blue, violet dots)
Tandem-Trapped Ion Mobility Spectrometry (Tandem-TIMS)

How does Tandem-TIMS work?

(Video courtesy of Bruker Daltonics)

Research strategy

- Egg white protein Avidin
- Hemoglobin A, Hemoglobin S, involved in Sickle-cell disease (with Dr. Marshall/MagLab)
- Env protein of HIV
- Complexity

(ongoing) + glycoproteins implicated in other major diseases
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Thank you for your attention