

# Stem cells and neurodifferentiation

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<http://www.med.muni.cz/histology>

Who we are?

What we do?

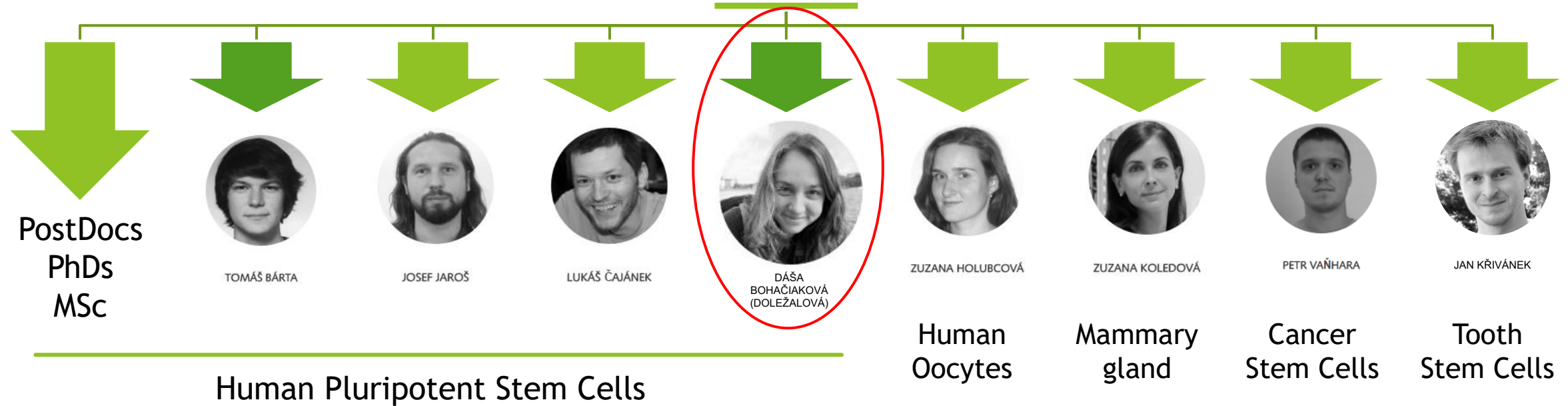
**How can we collaborate/help you?**

Department of Histology and Embryology  
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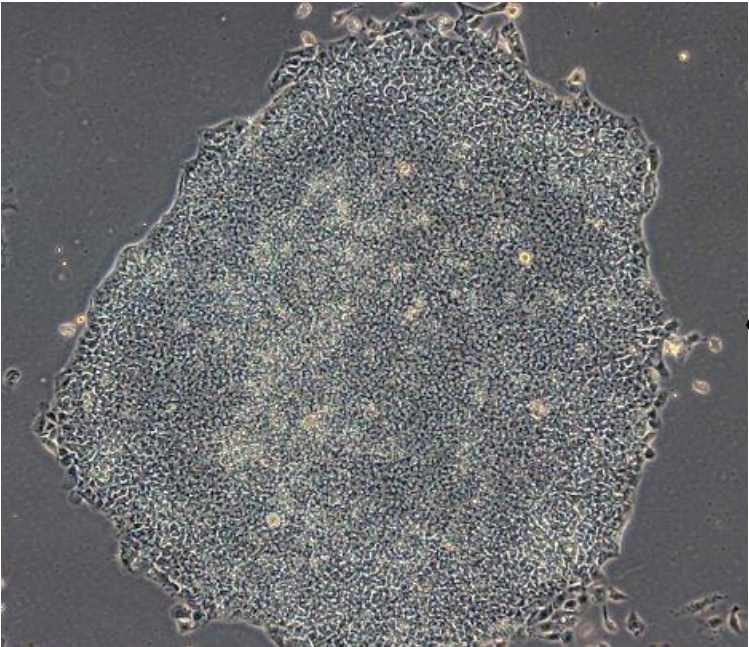
ALEŠ HAMPL  
Head of Department



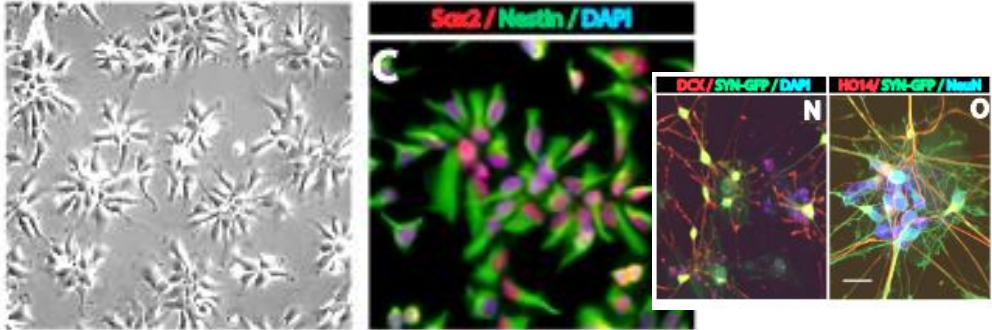
Main objective of our research:

Understand **mechanisms of neural differentiation** and use this knowledge to **model and study CNS-related diseases**

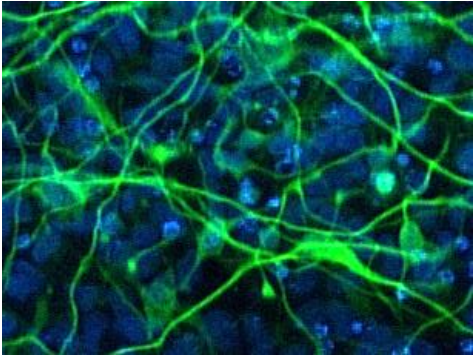
### Human Pluripotent Stem Cells (hESCs + iPSCs)



### Neural stem cells (NSCs)

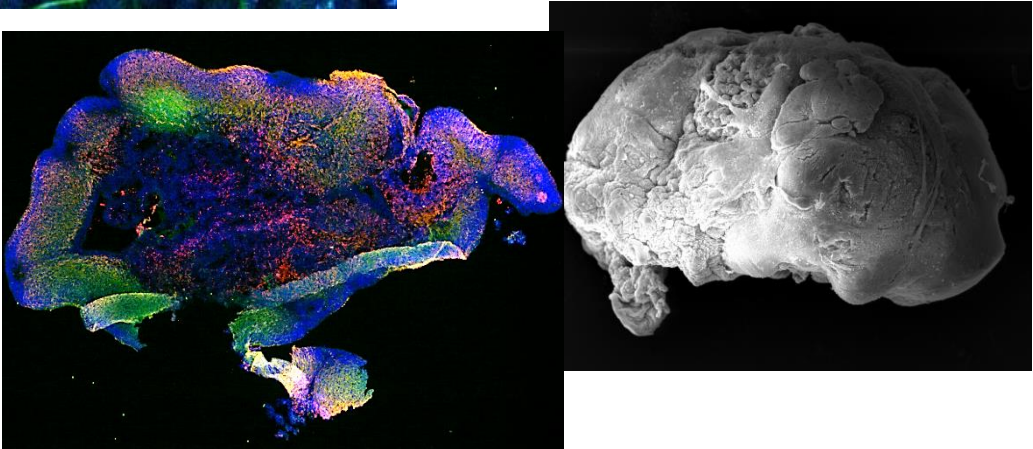


### Neurons



-> **Mixed population** of excitatory and inhibitory neurons + glia  
-> **Pure population** of excitatory neurons (Inducible by NGN2 – VGLUT1 positive)

### 3D Cerebral organoids



- 1) Already existing cell lines which can be **genetically modified**
- 2) Newly derived from whole blood sample (5-10ml) of your **patients**

# 2D vs. 3D

Easy to characterize



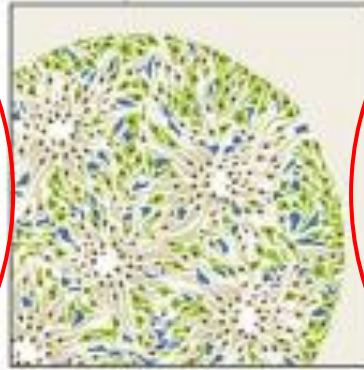
Neurons  
NSCs



Rosettes



Spheroids



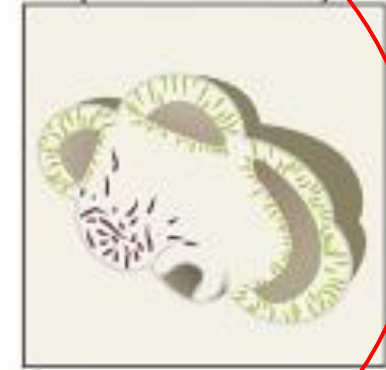
Better functional reproduction of  
*in vivo* properties



Forebrain  
organoids



Cerebral organoids  
(whole-brain)



Homogeneity

Complexity

Three main areas of interest:

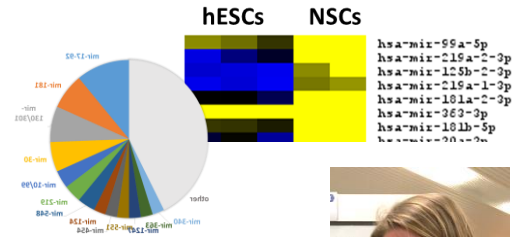
1. Testing the effect of specific genes on neurodevelopment *in vitro*

2. Testing the effect of compounds/toxins on neurodevelopment *in vitro*

3. Disease modeling *in vitro*

# 1. Testing the effect of specific genes on neurodevelopment *in vitro*

## microRNA



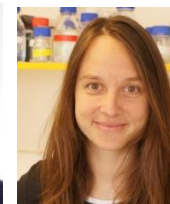
Collaboration with  
 Marek Mráz, CEITEC,  
 Brno



Veronika  
 Fedorová

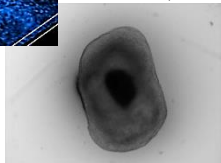
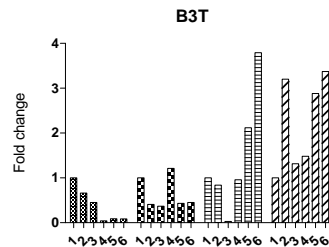
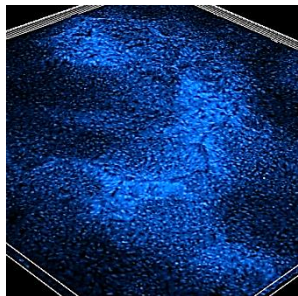


Jan  
 Raška



Dáša  
 Boháčiková

## Tumor suppressor protein p53



Lina  
 Elrefae

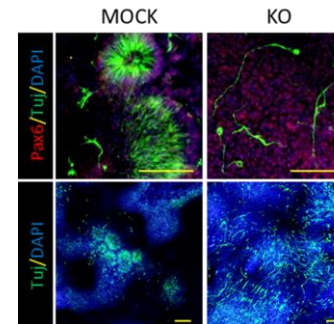
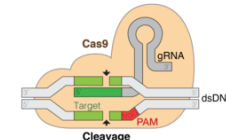


Jan  
 Raška



Tereza  
 Váňová

Collaboration:  
 Štěpánka Vaňáčková,  
 CEITEC, Brno



Veronika  
 Fedorová



Jan  
 Raška

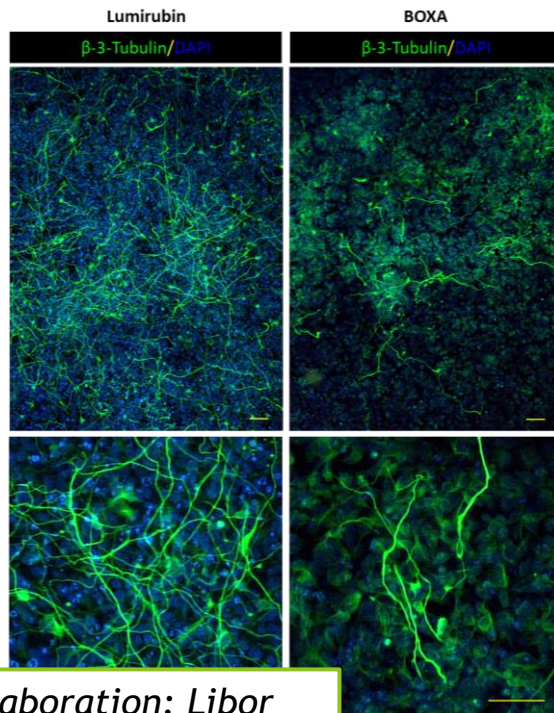


Tereza  
 Váňová

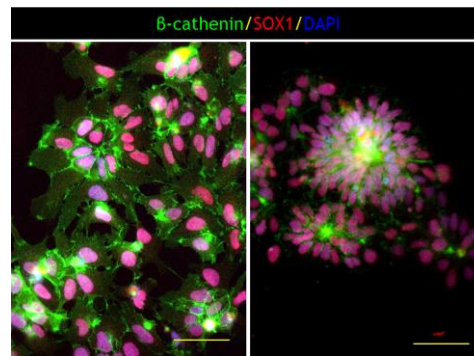
## RNA processing proteins

## 2. Testing the effect of compounds/toxins on neurodevelopment *in vitro*

### Bilirubin photoisomers

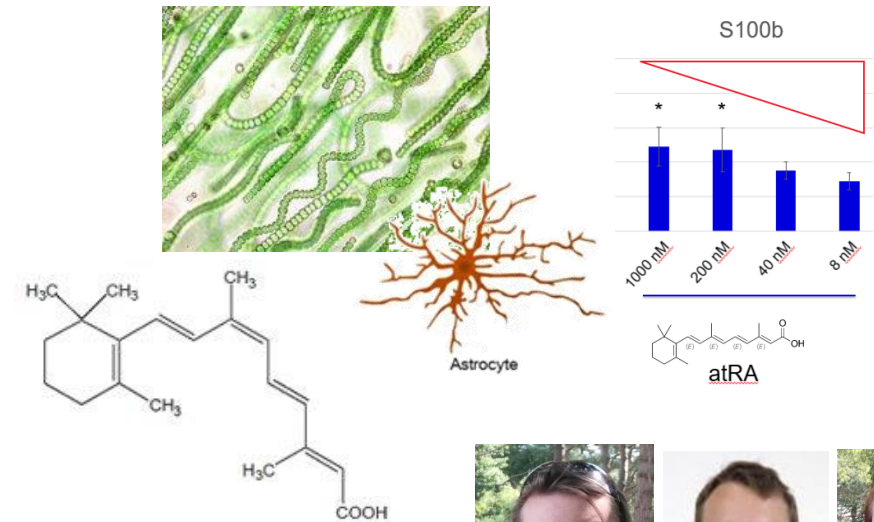


Collaboration: Libor Vitek,  
1.LF UK, Prague



Veronika Pospisilova  
Veronika Fedorová  
Hana Hříbková

### Cyanotoxins and retinoids



Collaboration: Klára Hilscherová, RECETOX, Brno

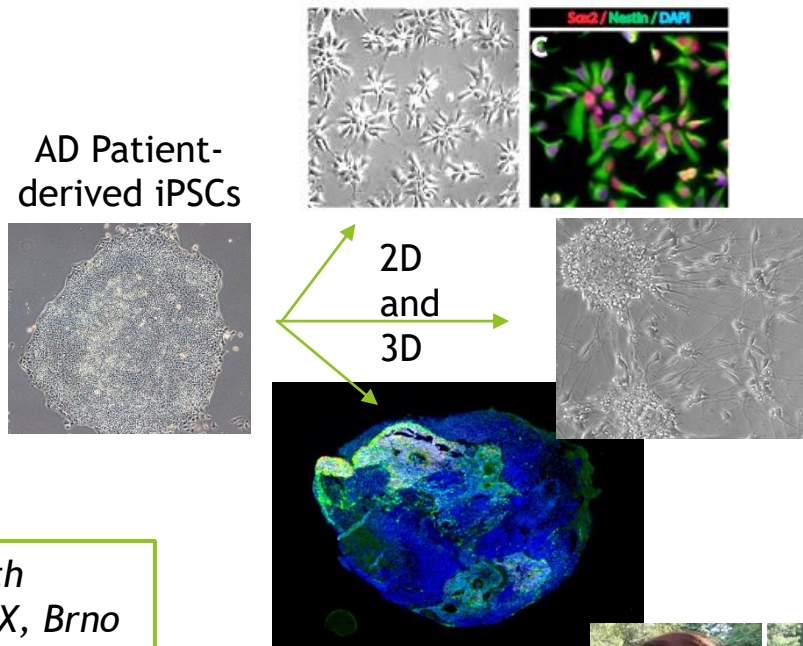


Hana Hříbková  
Jan Raška  
Tereza Váňová



### 3. Disease modeling *in vitro*

#### Modeling Alzheimer's Disease using patient-derived induced pluripotent stem cells



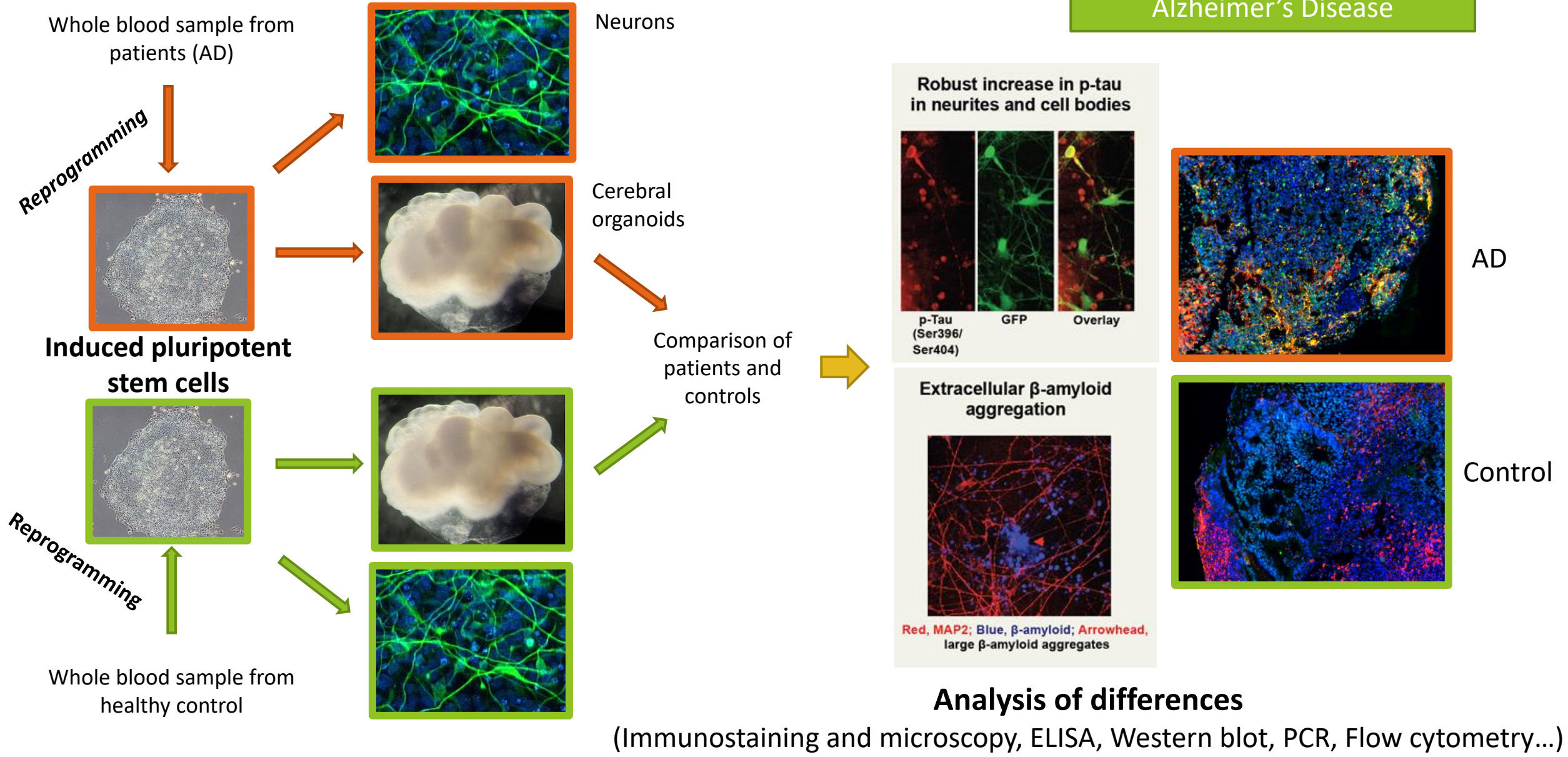
- Is beta-amyloid accumulation related to the **composition of cell membrane lipids**?
- Are **pathogens** involved in the accumulation of beta amyloid?
- Can we design functional tests for patients with AD risk alleles?
- ...

Collaboration with  
Zdeněk Spáčil, RECETOX, Brno  
and  
Kateřina Sheardová, Faculty  
Hospital Brno



### 3. Disease modeling *in vitro*

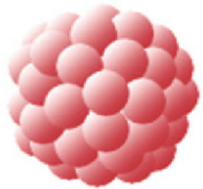
### Alzheimer's Disease



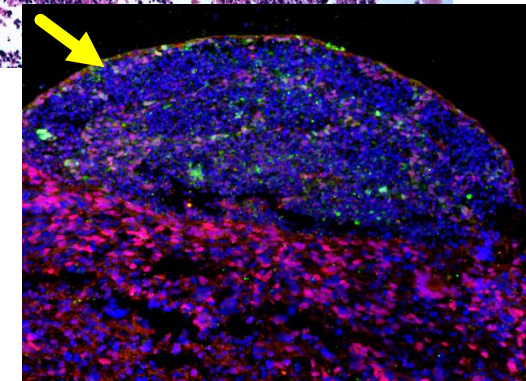
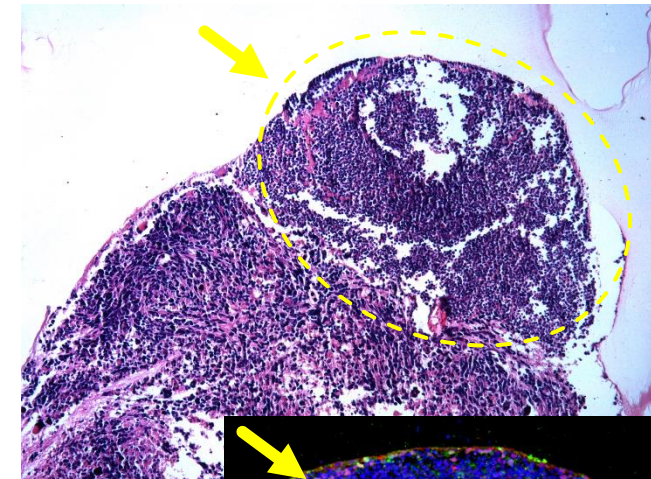
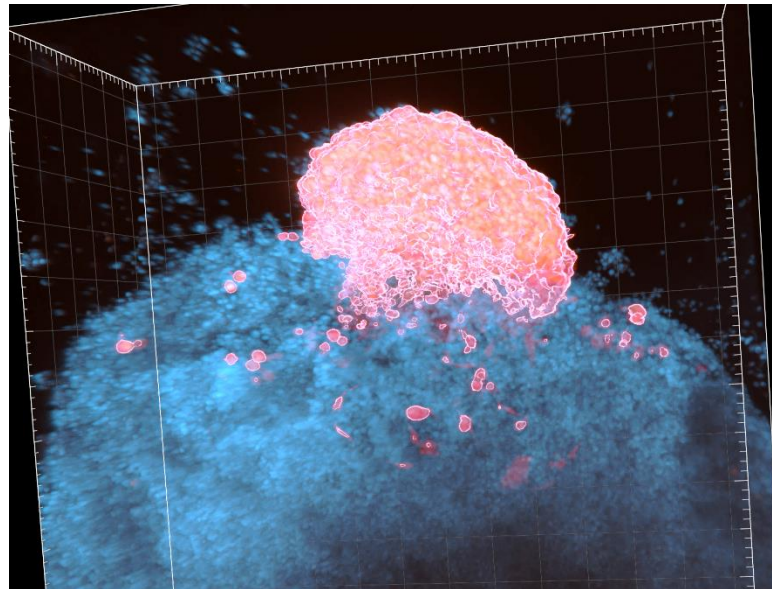
### 3. Disease modeling *in vitro*

Glioblastoma

Glioblastoma cell line/  
tumor biopsy



Cerebral organoid



Veronika  
Fedorová

Tereza  
Váňová

Veronika  
Pospisilova

*Collaboration with Zdeněk  
Hodný, IMG ASCR Prague*

## How can we collaborate/help you?

### Are you interested in:

- the effect of **specific genes** on neurodevelopment *in vitro*?
- the effect of **compounds/toxins** on neurodevelopment *in vitro*?
- iPS-based **disease modeling** in vitro?
- **Glioblastoma**-on-organoid model?

*Feel free to contact us – we're happy to help*

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*bohaciakova@med.muni.cz*