



# Targeting the cause of neurodegenerative and autoimmune diseases

June 2019

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## To develop therapies that improve the life of patients with neurodegenerative and autoimmune diseases

- Leveraging the biology of human endogenous retroviruses (HERVs) to stop causal factors associated with these disorders
- The HERV field is a new frontier pioneered by GeNeuro since 2006, based on 15 years of R&D at Institut Mérieux and INSERM
- **Approach validated through results on Multiple Sclerosis disease progression markers in a Phase IIb clinical trial**









# Recent data validates GeNeuro's platform approach against pathogenic HERV proteins

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- Positive results of temelimab 1 year 270-patient RRMS Phase IIb and its 1 year extension
  - Consistent benefit with temelimab at highest dose on the key markers of neurodegeneration linked to disease progression
  - At two years, first encouraging signs of dose-dependent effects on clinical measures of disease progression
  - Observed effects independent of inflammatory activity of the patients, confirming direct neuroprotective mode of action
  - Results strongly supported by preclinical evidence and mode of action rationale
- Clear positioning against **non-active progression**, key unmet medical need in MS
  - Successful Phase IIa of temelimab in T1D
  - Preclinical development of new anti-pHERV-K monoclonal antibody as treatment option for ALS, in partnership with the NIH
  - Wide application potential in other autoimmune and degenerative diseases

# First mover in HERV-mediated diseases

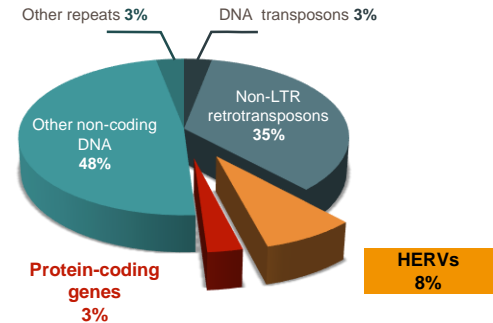
Program	Pre-clinical	Phase I	Phase IIa	Phase IIb	Phase III
<b>1. Temelimab</b> Multiple Sclerosis  CHANGE-MS  ANGEL-MS	<u>Planning next stage developments based on positive neurodegeneration 96-week results</u>  <b>270 patients / 50 centers</b> in the RRMS indication / Completed March 2018  <b>219 patients extension of CHANGE-MS</b> / Completed March 2019 				
<b>3. Temelimab</b> Type 1 Diabetes	Safety & signal finding Phase IIa  Launched April 2017 / 6-month data Sept. 2018, full 12-month data 2Q2019				
<b>4. Temelimab</b> CIDP	ODD granted by the US FDA  Planning discussions with FDA to design a proof-of-concept study				
<b>5. Anti-HERV-K</b> ALS	<b>R&amp;D Agreement with NIH, IND submission planned by mid-2020</b> 				
<b>6. New anti HERV-W Ab</b> Inflammatory Psychosis	Research collaborations with Academic labs 				

# Human Endogenous Retroviruses (HERVs)

## Ancestral retroviral genomic (DNA) insertions

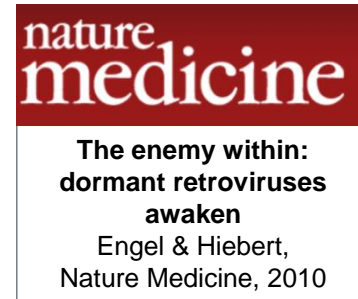
### HERV elements are latent in human genome

- Represent approximately 8% of total human genome
- Genetic transposition leads to variable copy number, with non-ubiquitous copies in individuals
- HERVs are normally latent but may be de-repressed and transcribed to produce viral proteins



### Missing link between viral infections and poorly understood autoimmune / neurodegenerative diseases

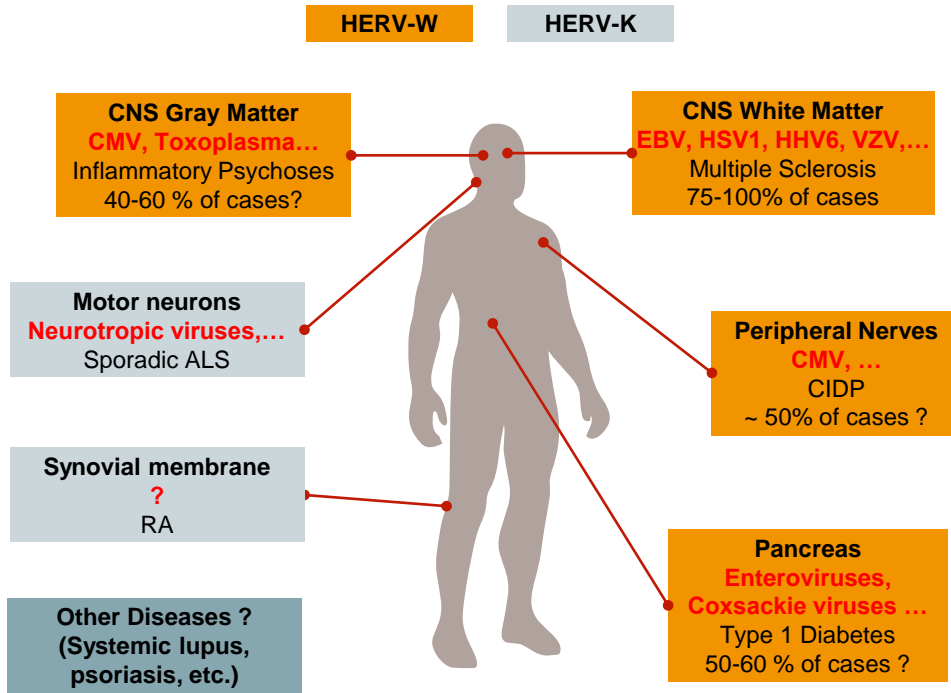
- Strong epidemiology data associates environmental viruses with diseases such as MS and T1D
- Environmental viruses do not appear to play a direct role in disease development
- They can activate HERV genes upon infection of permissive cells
- Pathogenic HERV proteins have been suggested as potential causal factors in autoimmune / neurodegenerative diseases



# Viruses triggering HERV Proteins and link to disease

## Examples of pHERV Env mediated diseases

### Transactivating viruses in affected organs



- Pathogenic HERV proteins found at high levels in affected organs
- Pathogenicity is generally mediated by (abnormally expressed) viral envelope proteins – pHERV Env W, K...
- pHERV Env directed toxicities found in:
  - Microglia
  - OPCs
  - Pancreatic beta islet cells
  - Motor Neurons
  - Schwann cells
  - Others...

# Broad and strong IP supporting first mover advantage

- Mérieux Group & GeNeuro worked for more than 25 years in the HERV field
- 16 families of patents in HERV-W\*, including the following 3 broad categories:
- **Key granted patents on temelimab filed from 2008 to 2014**  
Strong IP development strategy to continue protecting temelimab beyond 2034 (2039 w. SPC)

## SEP 16 family

Background including sequences

## TLR4 family

Antibody strategy against target

## MSRV\* ligand family

Product patents & disease areas

Existing IP portfolio & constant efforts to protect new discoveries place GeNeuro in a strong competitive position

- **New anti pHERV-K patent, co-owned with and in-licensed from NIH**

\* previous name of pHERV-W Env



A vertical image on the left side of the slide shows a close-up of a microscope's objective lens and stage. The image is overlaid with several semi-transparent white circles of varying sizes, some of which are connected by thin white lines, suggesting a network or flow. The background of the slide is white.

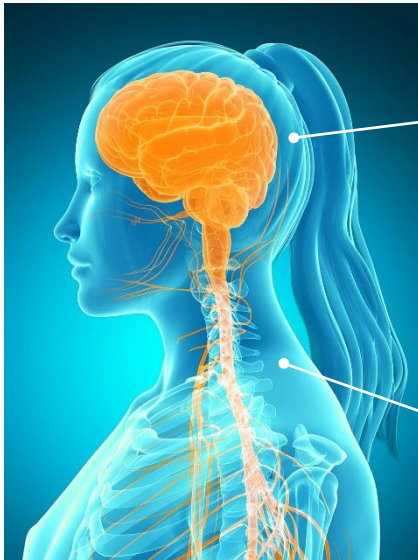
# Temelimab mode of action in MS

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# 2.5 million MS patients worldwide

## \$21.8 bn market in 2018

MS is a life-long inflammatory and degenerative disorder of the central nervous system

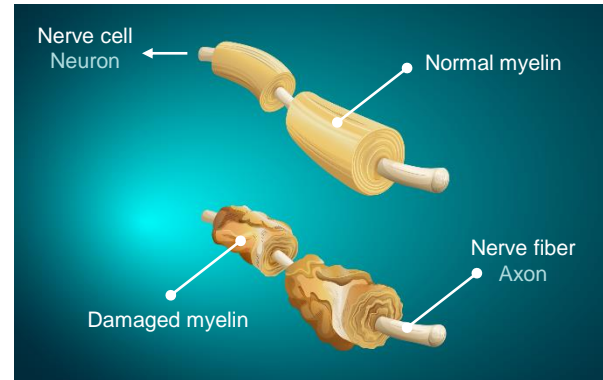


### Brain impairment

Vision, cognition  
motor coordination,  
equilibrium

### Spinal cord impairment

Walking, strength,  
sensation, sexuality,  
bowel / bladder control



- Disease onset mainly occurs in young adults
- Female to male ratio is 2:1
- Mean prevalence about 1/1000

Source: Inserm/Disc : F. Koulikoff.

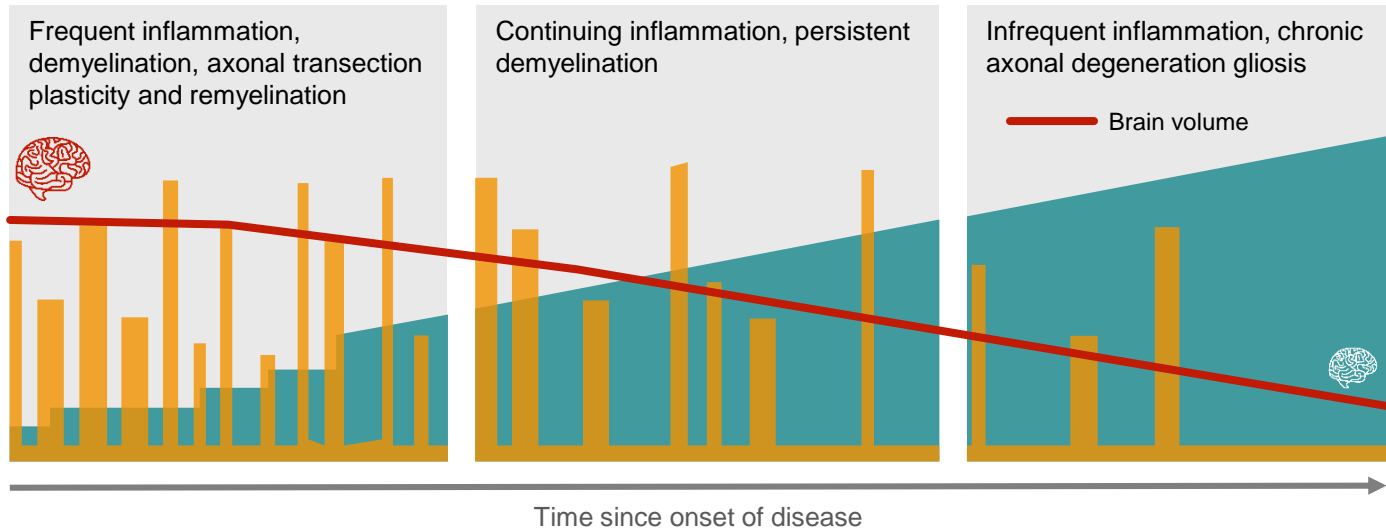
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# From the outset of disease, Multiple Sclerosis is marked by neuroinflammation and axonal loss/brain atrophy

RRMS

SPMS



Inflammation

Inflammation mediated by adaptive immunity (B and T lymphocytes)

Axonal loss

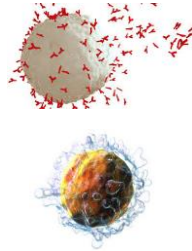
Neuronal damage mediated by innate immunity (activated microglia) and accelerated by hampered remyelination (oligodendrocyte precursor cells)

Adapted from Compston et al., The Lancet 2002 - RRMS: Relapsing-Remitting MS; SPMS: Secondary Progressive MS

# Known drivers of multiple sclerosis and existing therapeutic agents

## Adaptive Immunity

T- and B-cells are selectively recruited to the CNS



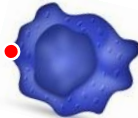
### Target of most DMTs

- $\alpha$ -CD20s mAbs
- $S_1P_{1/n}$  agonists
- $\alpha$ -integrin mAb
- etc.



## Innate Immunity

CNS resident Microglia

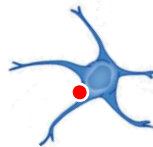


No approved drugs



## Repair

Dysfunctional  
Oligodendrocyte Precursor Cells (OPCs)



No approved drugs

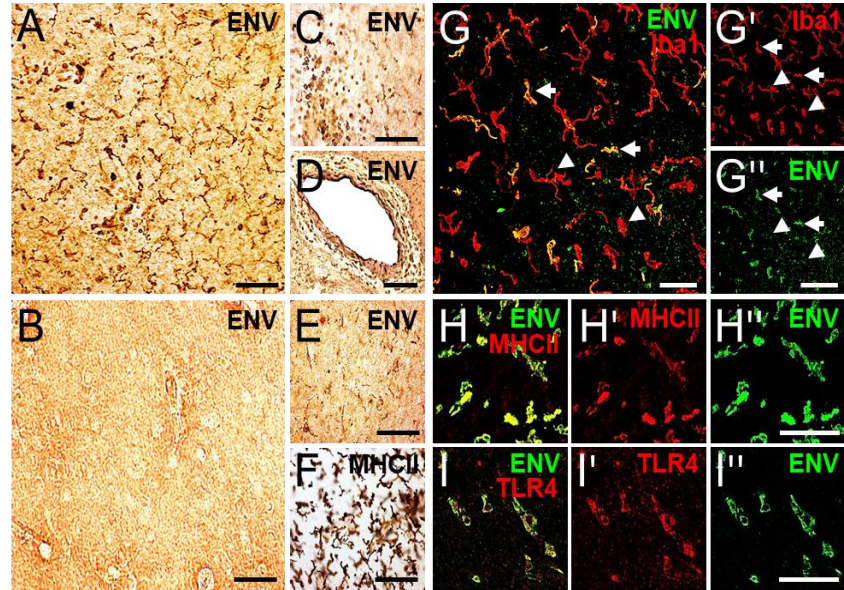




# Consistent presence of pathogenic HERV-W Envelope protein (pHERV-W Env) in the brains of MS patients

Highly expressed in active MS lesions

- Consistently found in MS brains
- Expression levels correlate with lesion activity
- Present from earliest to latest stages of disease
- Env is predominantly present in microglial/monocytic cells in the MS brain belonging to the innate immune system



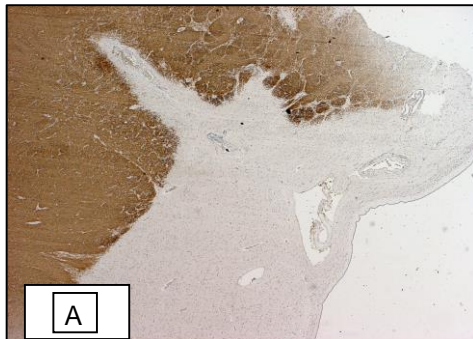
pHERV-W Env positive microglial/monocytic cells in MS lesions  
Kremer et al., under revision

Sources: Perron et al., MS Journal, 2012; Van Horssen et al., MS & Related Disorders 2016; Rolland et al., J Immunol, 2006; Antony et al., Nat NeuroSci, 2004; Kremer et al., Ann. Neurol, 2013; Perron et al., PLOS One, 2013; Madeira et al., J Neuroimmunol 2016

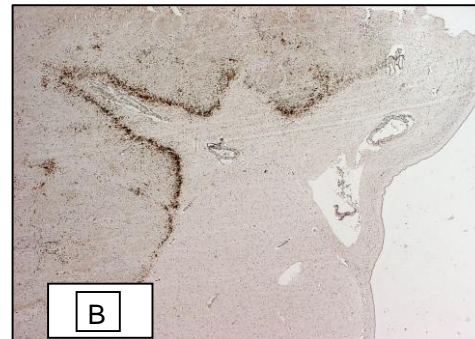
# pHERV-W Env protein is expressed in progressive MS lesions

- In progressive plaques, pHERV-W Env is expressed in the demyelinating border composed of activated microglia

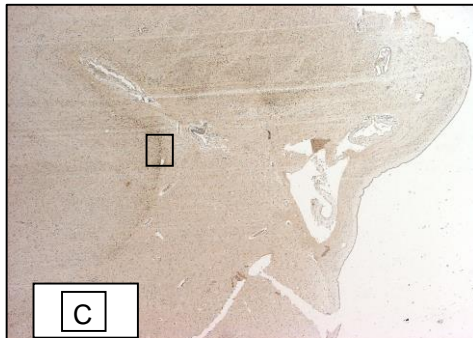
A - Chronic plaque with microglial line (myelin in brown)



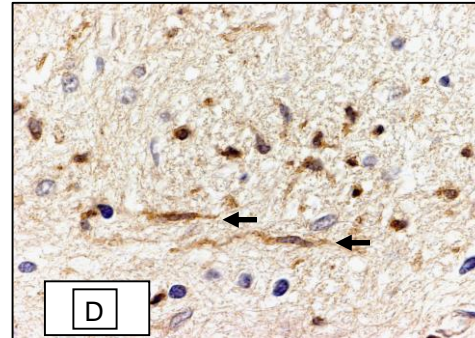
B - The line of microglia is highly activated (HLA-DR+++).



C - pHERV-W Env is expressed in the microglial line only



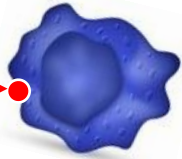
D - Activated and migrating microglial cells are strongly positive for pHERV-W Env







# pHERV-W Env acts on key cells associated with MS disease progression: Microglia and OPCs



TLR4+ (●)  
Microglia

## pHERV-W Env

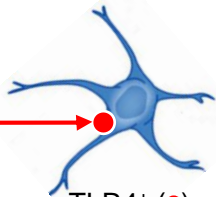
- induces an aggressive phenotype (M1) in TLR4<sup>+</sup> microglial cells
- activates microglia to associate themselves with myelinated axons
- decreases microglial expression of regenerative factors



**fuels microglial-dependent neurodegeneration in MS**



pHERV-W Env



TLR4+ (●)

## pHERV-W Env

- induces release of cytokines & activates NO synthase
- reduces myelin protein expression
- significantly reduces OPC differentiation capacity



**drives OPC mediated remyelination failure**

Oligodendrocyte Precursor Cell (OPCs)

# pHERV-W Env fuels microglial cell mediated neurodegeneration in MS

## Microglia activation yields aggressive phenotype

pHERV-W Env activates microglia in neuron / oligodendrocyte co-cultures, leading to axonal injury due to increased TNF $\alpha$ .

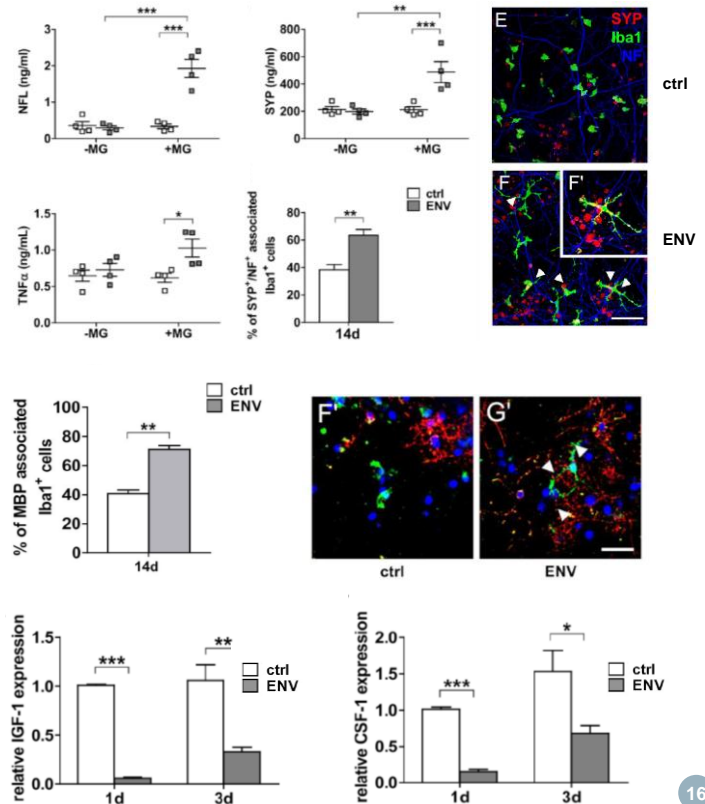
- Release of axonal neurofilament light chain (NFL)
- Release of synaptophysin (SYP)

## Microglia are directed towards myelinated axons

In neuron / oligodendrocyte / microglia co-cultures pHERV-W Env induces microglia to associate themselves with axonal structures.

## Regenerative factors in microglia decreased

Stimulation of microglia with pHERV-W ENV leads to significant decrease of regenerative genes transcription (IGF-1, CSF-1, FGF-2) in microglia.



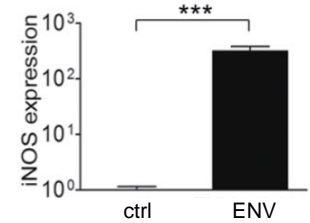
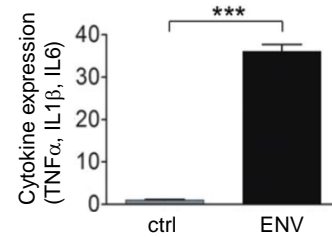




# pHERV-W Env drives OPC mediated remyelination failure

## OPCs express increased levels of cytokines & iNOS

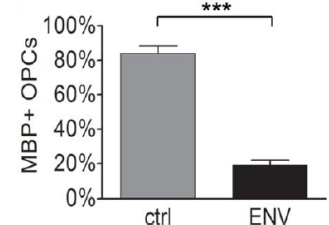
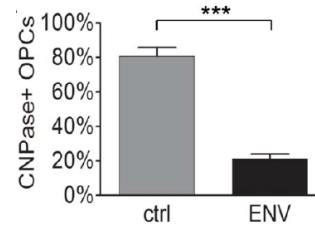
pHERV-W Env stimulation of rOPCs *in vitro* leads to a strong induction of iNOS expression. Proinflammatory cytokines such as  $TNF\alpha$ , interleukin (IL)-1 $\beta$ , and IL-6 are highly upregulated upon stimulation with pHERV-W Env.



## OPC differentiation capacity is significantly reduced

pHERV-W Env markedly decreases number of OPCs expressing early (E) and late (L) markers of myelin:

- 2',3'-cyclic nucleotide 3'-phosphodiesterase, CNPase, (E)
- Myelin basic protein, MBP, (L)



Source: Kremer et al., Ann Neurol 2013

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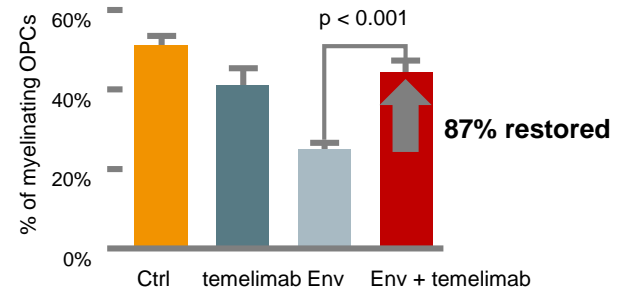


# Temelimab (GNbAC1) rescues myelin expression by blocking Env-induced nitrosative stress in OPCs

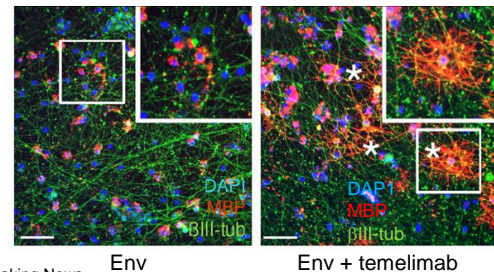
- Recombinant, humanized IgG4- $\kappa$  mAb
- PK approx. dose linear, Half-life  $\approx$  1 month
- Binds with high affinity to pHERV-W Env ( $K_d = 2.2$  nM)
- Blocks pHERV-W Env activation of TLR4
- Rescues MBP\* expression in OPCs

\*MBP: Myelin Basic Protein; marker of OPC maturation

Source: Kremer et al. Mult Scler. 2015, Göttele et al. Glia 2018, Data presented at MSParis2017 - Late Breaking News



*In vitro* myelinating co-cultures displaying the **temelimab** mediated rescue of myelinated segments (**MBP in red**)



A close-up, vertical photograph of a microscope's objective lens and stage. The lens is in sharp focus, showing its metallic texture and the light reflecting off its surface. The background is blurred, showing other parts of the microscope and a blue-tinted light source.

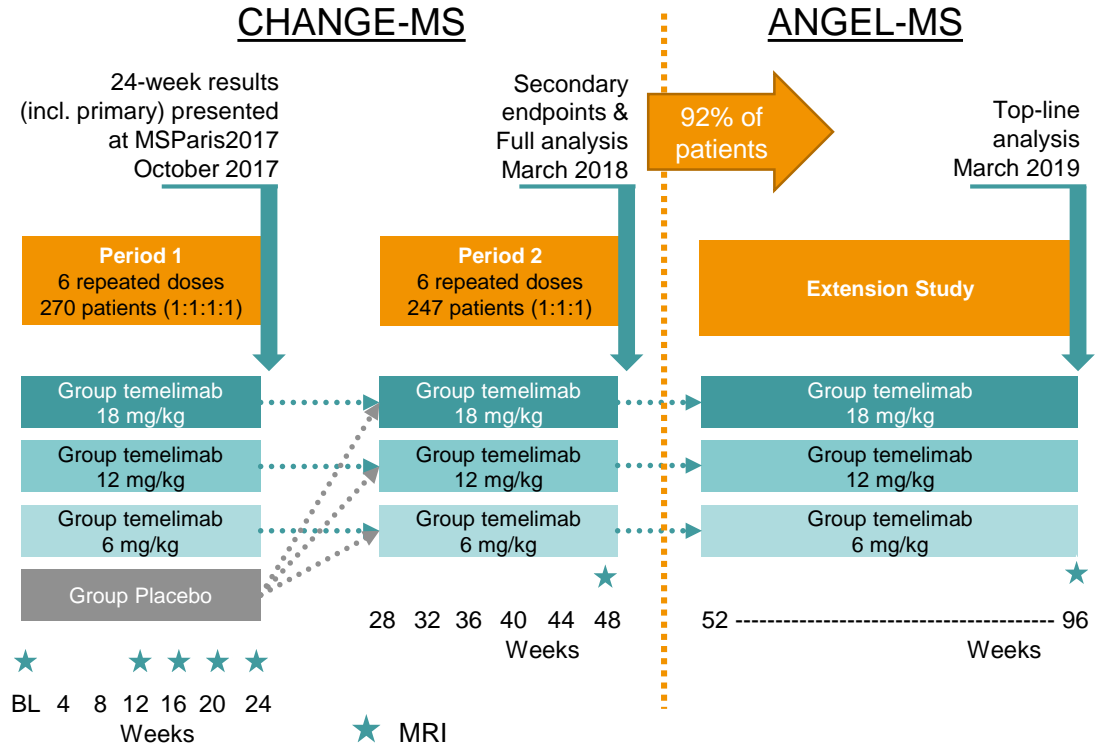
# Temelimab clinical results in MS

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# Phase IIb trial (CHANGE-MS followed by ANGEL-MS)

## Efficacy in RRMS patients at 6 months, 1 year and 2 years

- International, randomized, double-blind, placebo-controlled Phase 2b study in RRMS patients + extension
- Primary Endpoint: Cumulative # Gd+ lesions on brain MRI scans at weeks 12-24
- After 24 weeks, the control group is composed of patients originally randomized to placebo.
- Remyelination and neuroprotection endpoints at 48 weeks and at week 96 in extension study



Administration: IMP IV every 4 weeks



# ANGEL-MS: extension study to CHANGE-MS assessing safety & efficacy of temelimab in RRMS patients

- 219 patients from CHANGE-MS entered ANGEL-MS (92% of completers)
  - Early termination was a result of Servier's decision to opt-out
  - 154 patients (70%) completed 96 weeks or more across the combined studies
  - Approximately 90% of patients completed at least 86 weeks
- All patients remained on active therapy; patients, investigators and MRI reading center remained blinded to dose/original randomization group
- Delays in study start-up led to dose interruptions between the trials
  - > 80% missed  $\geq 1$  dose;  $\approx 50\%$  missed  $\geq 2$  doses and  $\approx 20\%$  missed  $\geq 3$  doses
- Analysis strategy:
  - As per SAP, original randomization groups: 18, 12 and 6mg/kg & Control Group (defined as patients originally randomized to placebo in CHANGE-MS, and re-randomized to active treatment after 6 months)
  - Several sensitivity analyses performed:
    - (1) by dose groups (placebo patients placed into the active dose group they were re-randomized to)
    - (2) by exposure (separating quartiles by total exposure to temelimab, irrespective of body weight);
    - (3) separating 18mg/kg against all other treatments
  - No adjustments were performed for multiple testing

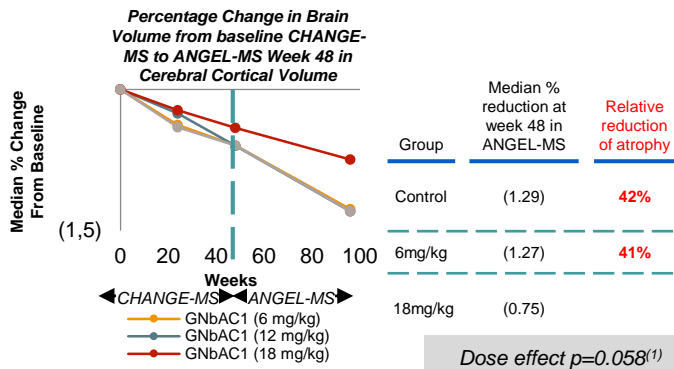
# CHANGE-MS and ANGEL-MS 48-week results position temelimab's against disease progression in MS

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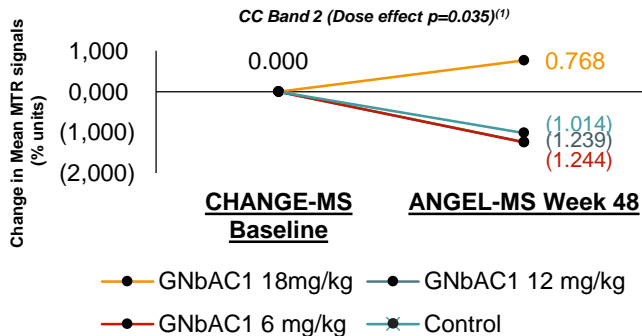
- **No clinically relevant benefit on MRI markers of neuroinflammation**
  - Primary endpoint on the reduction of number of Gd+ lesions at Week 24 not met
  - All groups substantially improved from Week 24 to Week 48
  - No significant differences across groups
- **Consistent benefit with temelimab at highest dose on key markers of neurodegeneration, linked to disease progression**
  - Reduction of Brain Atrophy (thalamus, cerebral cortex, deep gray matter and whole brain)
  - Reduction in T1 Black Holes (marker of permanent tissue damage)
  - Benefit seen on Magnetization Transfer Ratio (MTR - measure of remyelination)
- **Temelimab's effect is independent from the inflammatory activity experienced by the patients during the study**
- **First encouraging signals of neuroprotection translating into clinical benefits at 96 weeks**
- **Continued excellent safety and tolerability**
  - Opens the door for possible increase in dose, and/or
  - Combination with powerful anti-inflammatory agents

# Clinical data show positive effects of temelimab

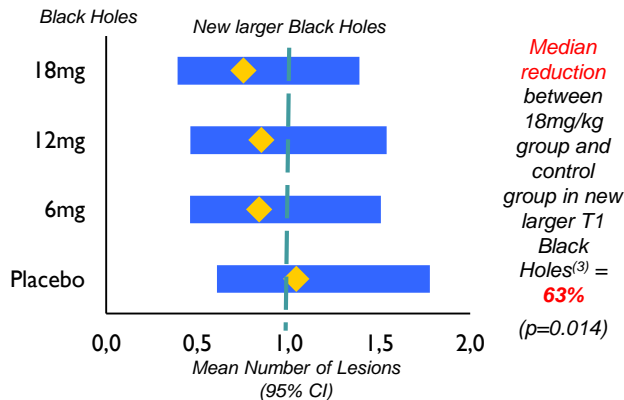
## 1 Evolution of Cortical Atrophy over 96 weeks



## 2 Evolution of Cortical MTR<sup>(2)</sup> signal over 96 weeks



## 3 Reduction of Black Holes at week 48 (not computed at week 96 for technical reasons)



## 4 Very well tolerated drug

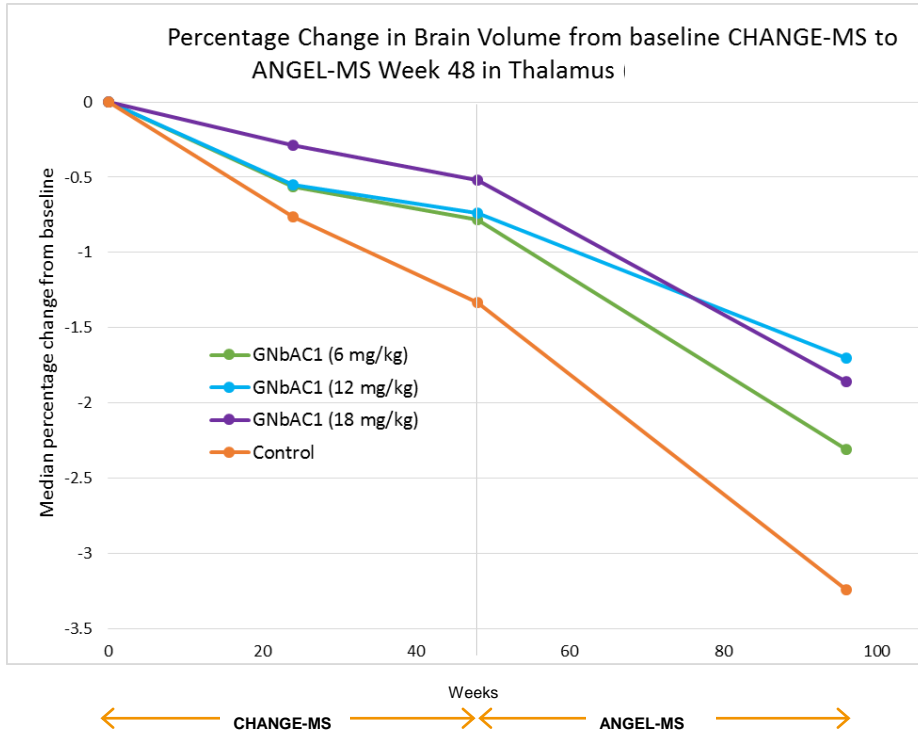
# of Patients (%)	18 mg/kg (N=77)	12 mg/kg (N=68)	6 mg/kg (N=74)
Adverse Events (AEs)	34 (44.2%)	32 (47.1%)	33 (44.6%)
Serious Adverse Events (SAEs)	5 (6.5%)	1 (1.5%)	6 (8.1%)
Serious Related AEs	3 (3.9%)	0	0
AEs Leading to Study Discontinuation	2 (2.6%)	1 (1.5%)	1 (1.4%)
Fatality <sup>(4)</sup>	1 (1.3%)	0	0

(1) Dose effect analyzed by linear regression, SAS analysis proc GLM; (2) MTR = Magnetization transfer ratio; (3) T1 hypointense lesion  $\geq 14\text{mm}^3$  volume; (4) Patient had previously voluntarily exited the study; the investigator considered the event as unrelated.



# Continued reduction Thalamic atrophy

## Original CHANGE-MS Groups



### CHANGE-MS

Group	Median % reduction at week 48	Relative reduction of atrophy
Control	-1.27	
18mg/kg	-0.36	<b>72%</b>

Dose effect\* p=0.014

### ANGEL-MS

Group	Median % reduction at week 48	Relative reduction of atrophy
Control	-3.24	<b>43%</b>
6mg/kg	-2.31	<b>19%</b>
12mg/kg	-1.70	<b>-9%</b>
18mg/kg	-1.86	

Dose effect\* p=0.038

\* Dose-effect analyzed by linear regression model

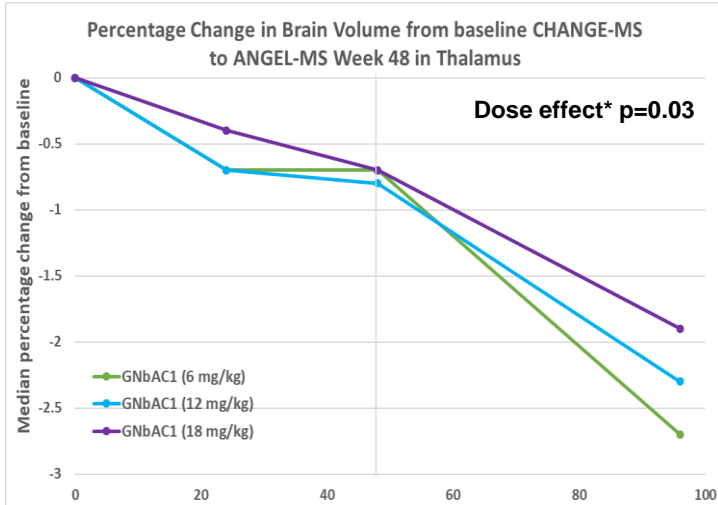




# Continued reduction Thalamic atrophy

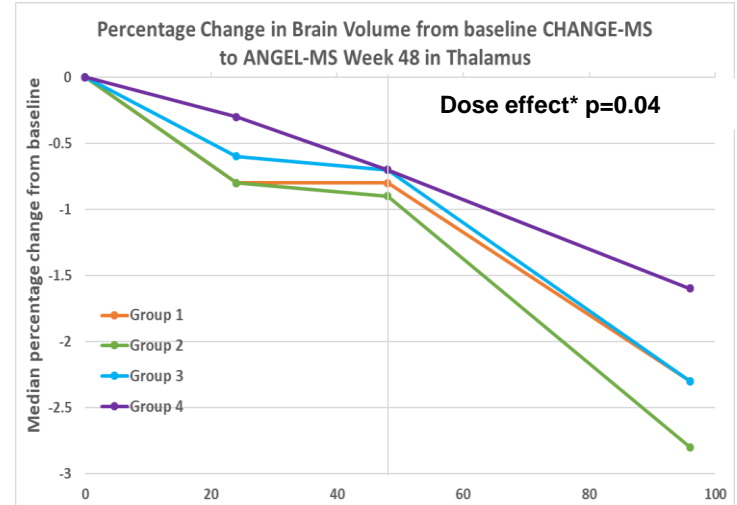
## Sensitivity analysis by Dose and by Exposure

### BY DOSE



Group	Median % reduction at week 48 in ANGEL-MS	Relative reduction of atrophy
6mg/kg	-2.7	
12mg/kg	-2.3	17%
18mg/kg	-1.9	30%

### BY EXPOSURE



Group	Median % reduction at week 48 in ANGEL-MS	Relative reduction of atrophy
G1 MIN	-2.3	
G4 MAX	-1.6	30%

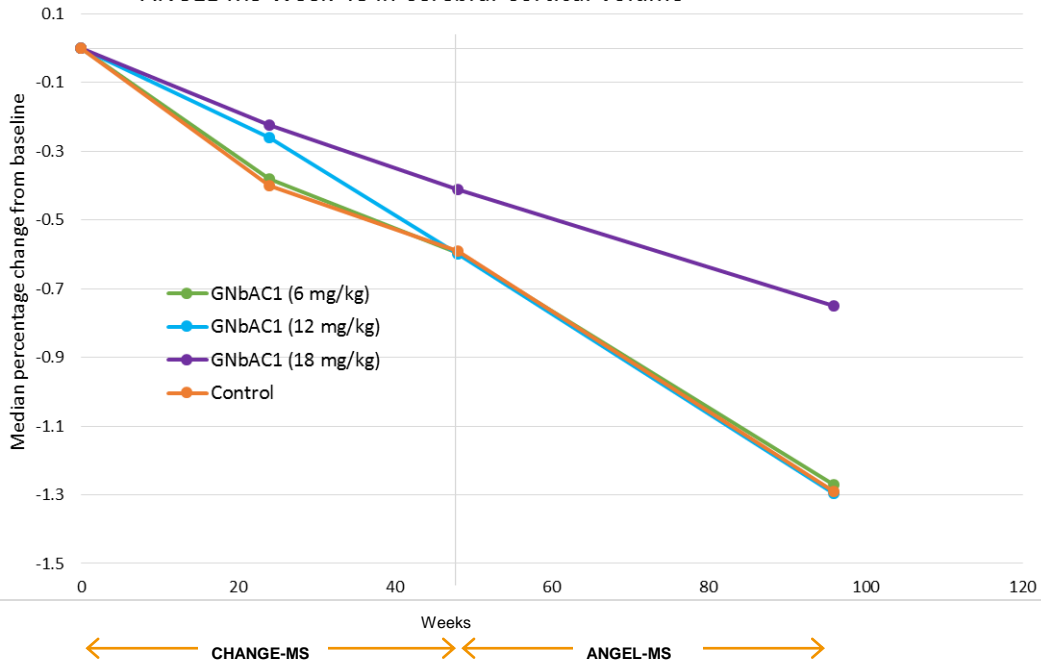
\* Dose-effect analyzed by linear regression model



# Continued reduction of Cortex atrophy

## Original CHANGE-MS Groups

Percentage Change in Brain Volume from baseline CHANGE-MS to ANGEL-MS Week 48 in Cerebral Cortical Volume



### CHANGE-MS

Group	Median % reduction at week 48	Relative reduction of atrophy
Control	-0.59	
18mg/kg	-0.41	<b>31%</b>

Dose effect\* p=0.045

### ANGEL-MS

Group	Median % reduction at week 48	Relative reduction of atrophy
Control	-1.29	<b>42%</b>
6mg/kg	-1.27	<b>41%</b>
12mg/kg	-1.29	<b>42%</b>
18mg/kg	-0.75	

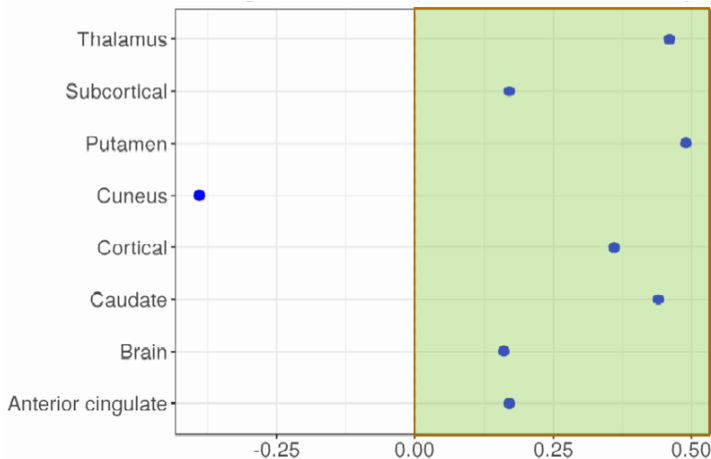
Dose effect\* p=0.058

\* Dose-effect analyzed by linear regression model



# Consistent benefit with temelimab seen in non-active population is a key asset

## Median change in volume in non-active population\* in CHANGE-MS 18mg/kg versus Control Group



- Effects of temelimab on OPCs and microglia are not due to immune modulation
- Suggests temelimab monotherapy could effectively target neurodegeneration and promote regeneration in non-active populations
- Suggests temelimab as adjunct to highly-effective DMTs for all forms of active MS

\* defined as patients without Gd+ activity at baseline

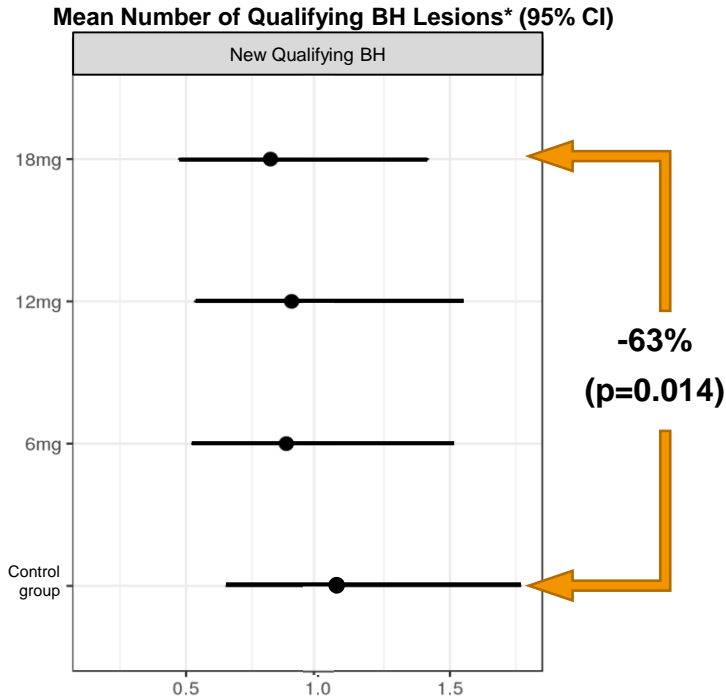
Source: H.P. Hartung et al,ECTRIMS 2018 Presentation

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# Reduction in the number and volume of new T1 hypointense lesions (Black Holes) through CHANGE-MS and ANGEL-MS

## CHANGE-MS Week 48



\* T1 hypointense lesion  $\geq 14\text{mm}^3$  volume

## ANGEL-MS Week 96

Group	Median percent increase in T1 hypointense lesion volume**
18mg/kg	8.7%
12mg/kg	9.2%
6mg/kg	14.5%
Control Group	21.3%

**-59% (p=0.12)**

\*\*The set-up of ANGEL-MS did not allow to differentiate acute and chronic T1-hypointense lesions, therefore data not directly comparable to CHANGE-MS measure of chronic lesions



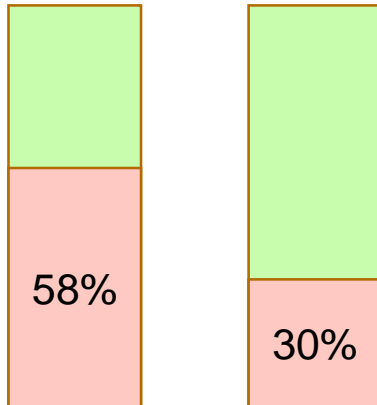
# Reduction in risk of lesions at baseline transforming into new T1Black Holes at CHANGE-MS Week 48

Proportion of patients with T1Gd+ lesions at baseline

Control Group      Temelimab 18mg/kg

N=33

N=23



**- 48%**

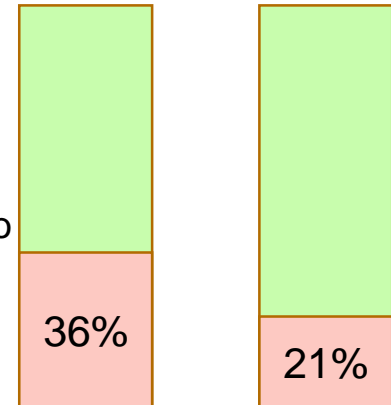
Proportion of patients with T1Gd+ lesions transformed into new T1 BHs at week 48

Proportion of patients with non-enhancing T2 lesions at baseline

Control Group      Temelimab 18mg/kg

N=64

N=61



**- 42%**

Proportion of patients with non-enhancing T2 lesions transformed into new T1 BHs at week 48

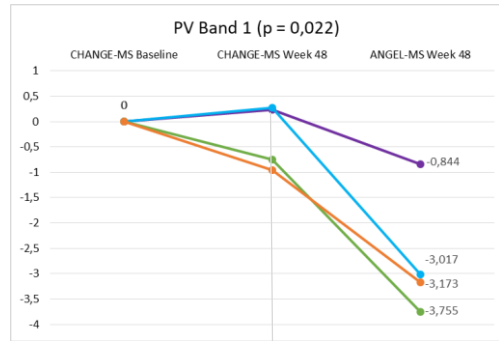


# Temelimab preserves myelin integrity over 96 weeks

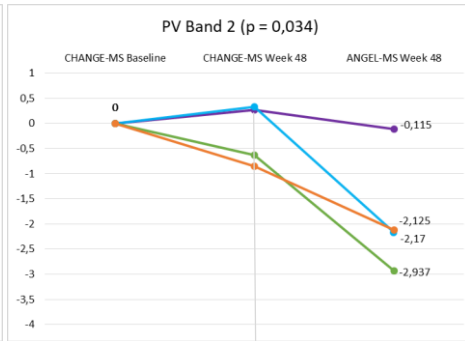
## Normal Appearing White Matter - Original CHANGE-MS Groups

		WEEK 48 ANGEL-MS							
Change in MTR signal from CHANGE-MS BL (% units)		18 mg	12 mg	6 mg	Control	Gain 18 vs 12	Gain 18 vs 6	Gain 18 vs Ctrl	Trend p*
NAWM Band 1	mean	-0.84	-3.02	-3.76	-3.17	2.18	2.91	2.33	0.022
	median	-1.83	-3.55	-3.39	-3.52	1.72	1.56	1.69	
NAWM Band 2	mean	-0.12	-2.17	-2.94	-2.13	2.05	2.82	2.01	0.034
	median	-0.99	-2.70	-2.16	-2.65	1.71	1.17	1.66	
NAWM Band 3	mean	0.74	-1.31	-1.85	-1.11	2.05	2.60	1.86	0.048
	median	-0.32	-1.42	-0.86	-1.35	1.10	0.54	1.03	

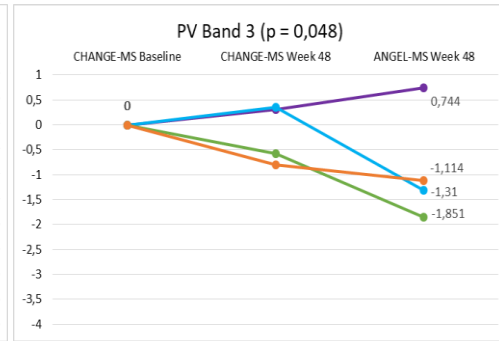
Change in MTR signals (% units) - Mean



← CHANGE-MS    ↘ ANGEL-MS →



← CHANGE-MS    ↘ ANGEL-MS →



← CHANGE-MS    ↘ ANGEL-MS →

\* Dose-effect analyzed by linear regression, SAS analysis proc GLM

— Ctrl    — 6mg/kg    — 12mg/kg    — 18 mg/kg

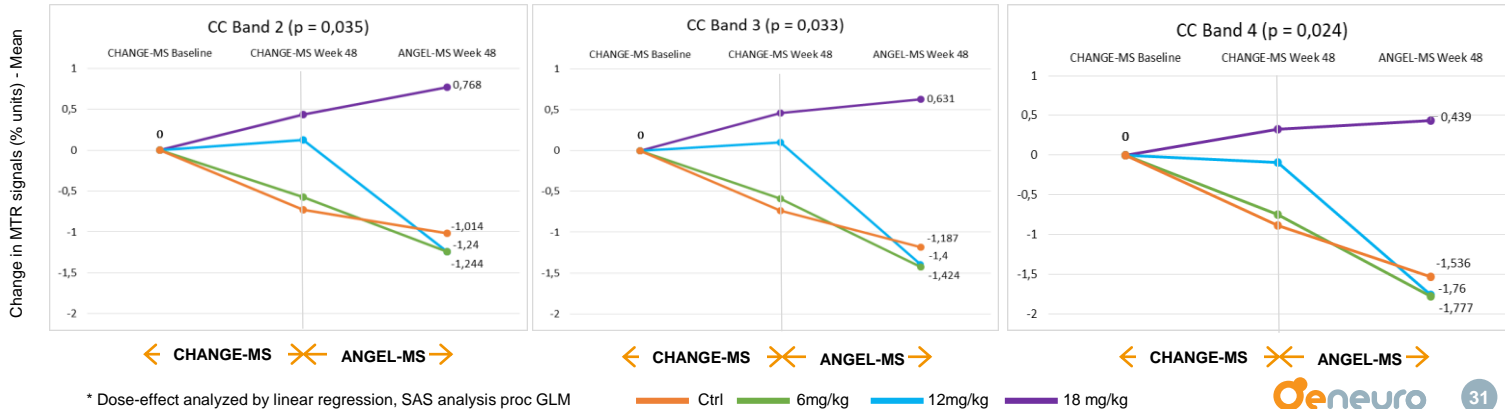




# Temelimum preserves myelin integrity over 96 weeks

## Cerebral Cortex - Original CHANGE-MS Groups

		WEEK 48 ANGEL-MS							
Change in MTR signal from CHANGE-MS BL (% units)		18 mg	12 mg	6 mg	Control	Gain 18 vs 12	Gain 18 vs 6	Gain 18 vs Ctrl	Trend p*
CC Band 2	mean	0.77	-1.24	-1.24	-1.01	2.01	2.01	1.78	0.035
	median	0.00	-0.89	-0.73	-0.96	0.89	0.73	0.96	
CC Band 3	mean	0.63	-1.40	-1.42	-1.19	2.03	2.06	1.82	0.033
	median	-0.01	-0.97	-1.07	-1.20	0.96	1.06	1.19	
CC Band 4	mean	0.44	-1.76	-1.78	-1.54	2.20	2.22	1.98	0.024
	median	0.13	-1.11	-1.12	-1.41	1.24	1.25	1.54	



\* Dose-effect analyzed by linear regression, SAS analysis proc GLM

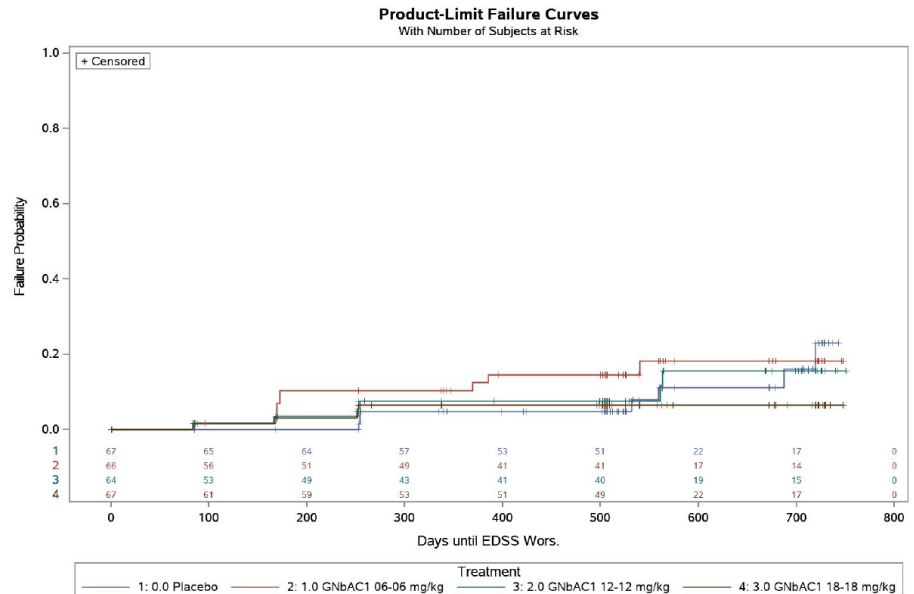


# Lower probability for confirmed disability progression observed - Original CHANGE-MS Groups

	18 mg/kg	12 mg/kg	6 mg/kg	Control
% of patients with 12-week confirmed worsening in neurological disability from CHANGE-MS baseline to week 48 ANGEL-MS	3.8	4.8	8.3	9.1

Lower probability of 12-week confirmed disability progression in the 18 mg/kg group, but not reaching statistical significance:

- Survival Wilcoxon overall test  $p=0.34$
- Log-rank overall test  $p=0.45$
- Hazard ratio 18mg/kg vs control = 0.50, pairwise comparison  $p=0.27$







# Encouraging signs of clinical benefit on Timed 25-Foot Walk

## Original CHANGE-MS groups and Sensitivity analyses

Timed 25-foot walk – Original CHANGE-MS Groups	18 mg/kg	12 mg/kg	6 mg/kg	Control	P-value**
Percentage of patients with worsening $\geq$ 20% in the Timed 25-Foot Walk Test compared to CHANGE-MS Baseline*	2.4	23.1	13.3	10.2	0.03

Timed 25-foot walk – By Dose Groups	18 mg/kg	12 mg/kg	6 mg/kg	P-Value**
Percentage of patients with worsening $\geq$ 20% in the Timed 25-Foot Walk Test compared to CHANGE-MS Baseline*	3.6	16.9	15.0	0.04

Timed 25-foot walk – By 18 vs Others	18 mg/kg	Others	P-value**
Percentage of patients with worsening $\geq$ 20% in the Timed 25-Foot Walk Test compared to CHANGE-MS Baseline*	2.4	15.0	0.03

\*Fifteen outliers (patients with extreme walking disability) removed from analysis – excluded patients distributed equally across treatment groups

\*\*Fisher exact test

# Temelimumab was safe and well tolerated over two years

Number of patients (%)	18 mg/kg (N=77)	12 mg/kg (N=68)	6 mg/kg (N=74)
Adverse Events (AEs)	34 (44.2%)	32 (47.1%)	33 (44.6%)
Serious adverse events (SAEs)	5 (6.5%)	1 (1.5%)	6 (8.1%)
Serious related AEs	3 (3.9%)	0	0
AEs leading to study discontinuation	2 (2.6%)	1 (1.5%)	1 (1.4%)
Fatality*	1 (1.3%)	0	0

\* Patient had previously voluntarily exited the study; the Investigator considered the event as unrelated.



# Efficacy findings are supported by preclinical data

## Clinical observations

- **Reduction of Brain Atrophy**
- **Reduction in new T1 Black Holes**
- **Benefit on Magnetization Transfer Ratio**
  
- **Effects on markers associated with disease progression not due to immune modulation**
- **Promising a **novel** treatment option against neurodegeneration in all forms of MS**



## Supporting pre-clinical data

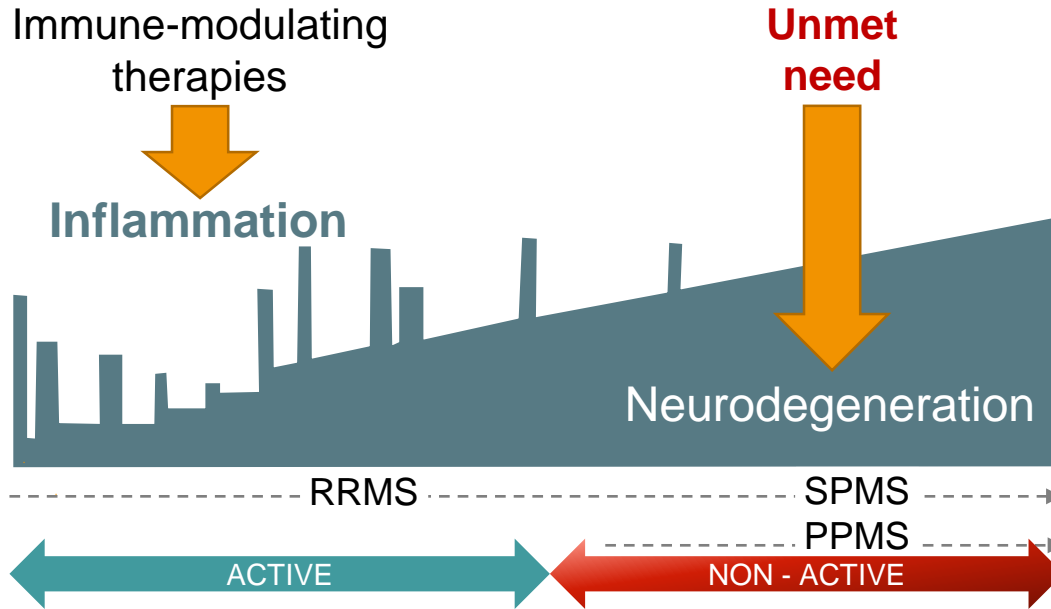
- **Neurodegeneration reduced by**
  - directly **acting on** proinflammatory **microglia**, the key immune cells in PMS, responsible for lesion growth and exacerbation
- **Neuroregeneration enabled by**
  - rescuing the negative impact of pHERV-W Env on **OPC** maturation - the key cells in the remyelination process.
- **No direct effect on T/B lymphocytes** and thereby not compromising adaptive immunity
- **Excellent preclinical safety package** based on a stabilized IgG4 backbone, low immunogenicity and a linear PK at all doses

Sources: Kremer et al., Ann Neurol 2013; Kremer et al., Mult Scler J 2015; \*Luo et al., Neuropsychiatr Dis Treat 2017; Göttle et al. Glia 2018; Küry et al., Trends Mol Med; Kremer et al. presentation at the 2018 Charcot Conference

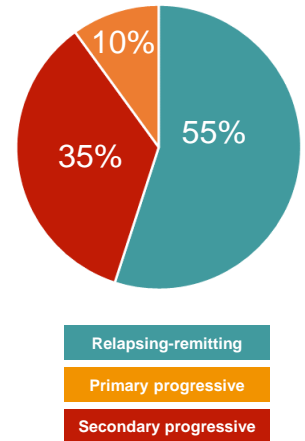


# Temelimab positioning in MS

# Objective: develop a new treatment effective against non-active disease progression



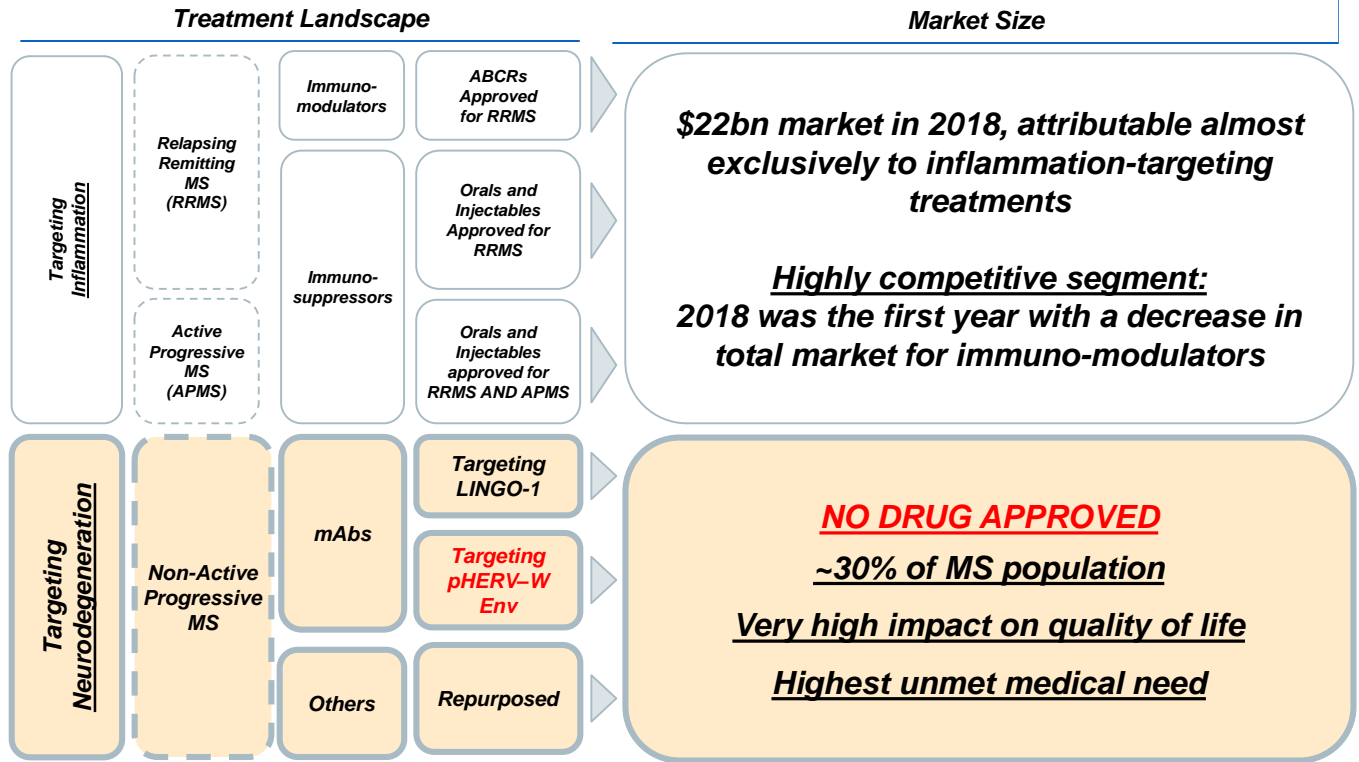
Total MS population



## Distinction recently clarified by the FDA

“Active SPMS is one of the relapsing forms of MS, and drugs approved for the treatment of relapsing forms of MS can be used to treat active SPMS. Later, many patients with SPMS stop experiencing new relapses, but disability continues to progress, a phase called non-active SPMS.”  
FDA Press release on Siponimod approval, March 26, 2019

# GeNeuro Offers a Unique, Unencumbered Opportunity in MS...



Sources: EvaluatePharma, Annual reports of companies active in MS

June 2019



# Drugs in development that specifically target neurodegeneration

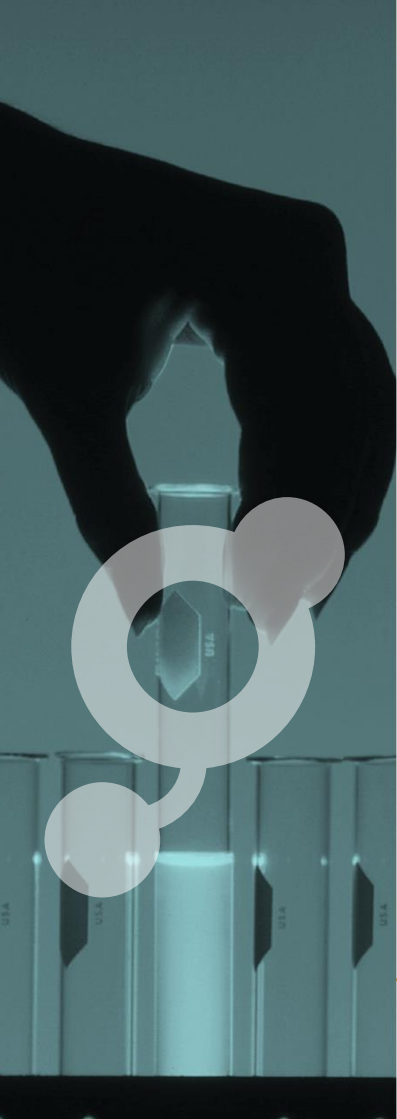
Drug	Company	Pharmacology	Proposed Mode of Action	Dev. Stage
<b>Opicinumab</b>	Biogen	Monoclonal antibody IgG1 neutralizing LINGO-1 protein	Favoring oligodendrocyte differentiation and remyelination	Ongoing Phase IIb
<b>Biotin</b>	MedDay	Vitamin B8/H given at high dose (300mg/day)	Increasing energy supply (ATP, fatty acid) to oligodendrocytes favoring myelin production	Ongoing Phase 3
<b>Ibudilast</b>	MediciNova	Anti-inflammatory drug, approved in Japan for asthma since 1989	Inhibition of macrophage migration, decrease of TNF $\alpha$ , enhancing survival and maturation of oligodendrocytes	Completed Phase IIb
<b>Masitinib</b>	AB Science	Selective tyrosine kinase inhibitor developed in neurology, inflammatory diseases and oncology	Inhibiting mast cell degranulation to avoid proteolysis, secretion of vasoamines and release of pro-inflammatory chemoattractants	Phase III ongoing
<b>Temelimab</b>	GeNeuro	Monoclonal antibody IgG4 neutralizing pHERV-W-Env, associated to MS as a causal factor	Enhancing remyelination and reducing damage by promoting OPC maturation and blocking microglial activation	Completed Phase IIb



# The ANGEL-MS results further support development of temelimab to prevent disease progression in MS

- **Disease progression remains the key unmet medical need in MS**
  - “The greatest remaining challenge for multiple sclerosis is the development of treatments incorporating neuroprotection and remyelination to treat and ultimately prevent the disabling, progressive forms of the condition.”  
Prof. Alan J Thompson, Lancet 2018; 391: 1622–36
- **Development plan**
  - As **monotherapy**, in non-active Progressive MS patients, where the unmet medical need is the highest
  - In **combination** with an existing anti-inflammatory drug, to slow-down / prevent progression on treated Relapsing MS patients (rendered “non-active” by their inflammatory treatment), an area in which current treatments have modest impact
- **GeNeuro is fully committed to further develop temelimab in MS**





Part 2

# Temelimab in T1D

June 2019

# Overview of Type 1 Diabetes

- Type 1 Diabetes is a **chronic disease** associated with autoimmunity that results from the destruction of pancreas' insulin-producing beta cells.
- Represents 5-10% of total diabetes cases (est. >4-6 million worldwide)
- Prevalence of T1D is approximately 1 in 300 in the US by 18 years of age.
- 85% of all T1D diabetes cases have an onset in people under 20 years-old
- Treatments focused on managing glycaemia by insulin injections
- \$6.6bn worldwide sales in 2013; Market growth driven by approval of T2D drugs for T1D (GLP-1s RAs and SGLT-2 inhibitors )
- **No disease modifying therapies** available today
- Several debilitating complications associated with insulin replacement, a life-long treatment
  - >50% of adults with T1D have an A1C >8%
  - Severe consequences of poor glucose level control include renal, ophthalmic, cardiac, vascular and nervous system dysfunctions and deficiencies
  - Significant risk of coma and death by hyperglycemia or hypoglycemia
- Preservation of remaining insulin production :
  - Residual  $\beta$ -cell function may prevent ketoacidosis for many years
  - Preservation of endogenous insulin production is the best prognosis against T1D co-morbidities

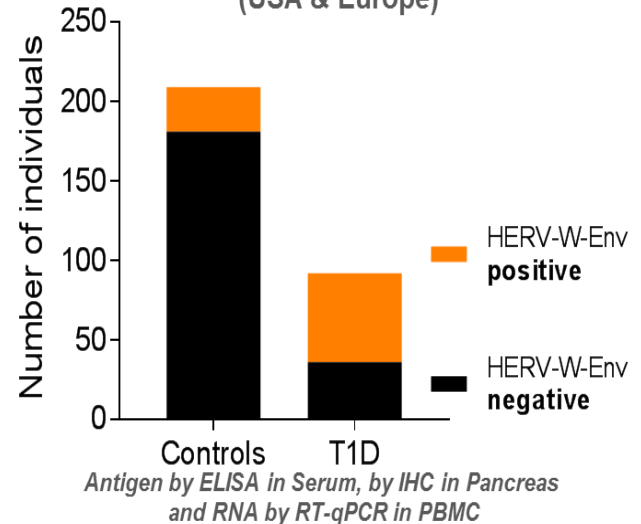
Sources: NIH - Genetics Home reference; JDRF.org; WHO; Endocrinol Metab Clin North Am. D. Maahs et al., 2010

June 2019

# Data support the hypothesis of a causal role of pHERV-W Env in T1D

- Found in the pancreas of over 70% of T1D patients post-mortem. About 60% in blood.
- Dose dependent disruption of insulin production in vitro by pHERV-W Env
- Induction of hyperglycemia and hypoinsulinemia by pHERV-W Env protein in young HERV-W env transgenic mice
- Preliminary results show that Coxsackie virus type B 4E2 strain upregulates pHERV-W Env expression

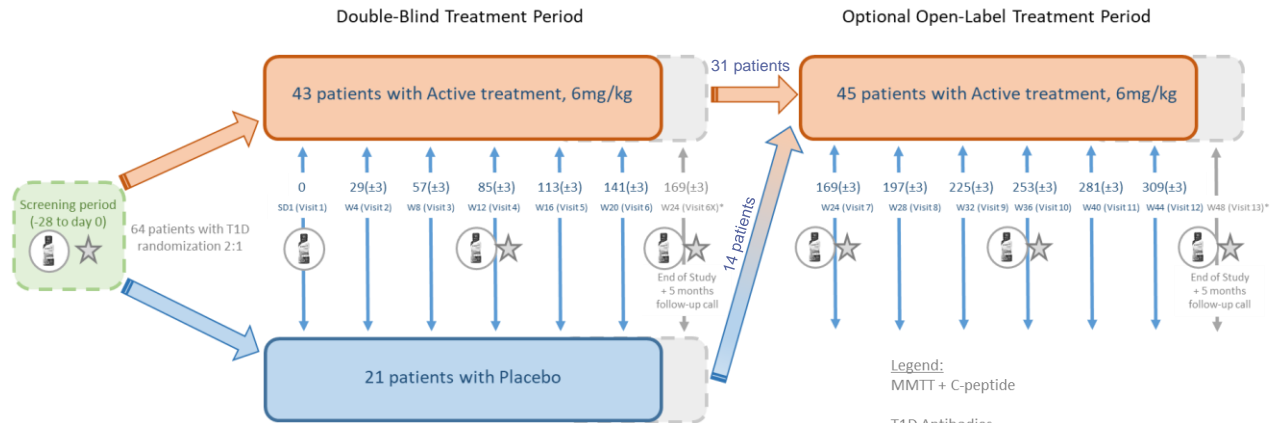
HERV-W-Env prevalence in T1D including 5 cohorts (USA & Europe)



Sources: An ancestral retroviral protein identified as a therapeutic target in type-1 diabetes, S. Levet et al., JCI Insights, September 2017; JDRF/nPOD 2017 Meeting, Fort Lauderdale, USA. ADA 2017 meeting, San Diego, USA.

# RAINBOW-T1D: Phase IIa to assess safety and pharmacodynamics in an adult T1D population

- A 6-month double-blind placebo-controlled study to assess safety and pharmacodynamics in an adult T1D population ;
  - Double Blind Period Weeks 1-24: 1 active (temelimab 6mg/kg) group vs. placebo
  - Open Label Period Weeks 25-48: 1 active dose group (placebo patients switched to temelimab)
- 64 male and female patients, 18–55 years, with T1D diagnosed in the 4 years prior to signed ICF
- Peak stimulated C-peptide of  $\geq 0.2\text{nmol/L}$ ; HbA1c  $\leq 9\%$ ;  $>1$  diabetes-associated auto-antibody



# Week 48 Safety Outcomes in adult T1D population

## Temelimab remains is very well tolerated over 48 weeks

	Temelimab/- (N=12)	Temelimab/ temelimab (N=31)	Placebo/- (N=7)	Placebo/ temelimab (N=14)	Overall (N=64)
Serious adverse events (SAEs)	0	3	1	3	7
Serious related AEs	0	0	0	1*	1
Number of patient with at least one AE (%)	10 (83.3%)	28 (90.3%)	6 (85.7%)	13 (92.9%)	57 (89.1%)
AEs leading to early termination	0	2	0	0	2
AEs leading to death	0	0	0	0	0

\*headache occurring during the placebo period

# Week 48 PD Outcomes - Hypoglycemia

## Confirmed decrease of hypoglycemic episodes

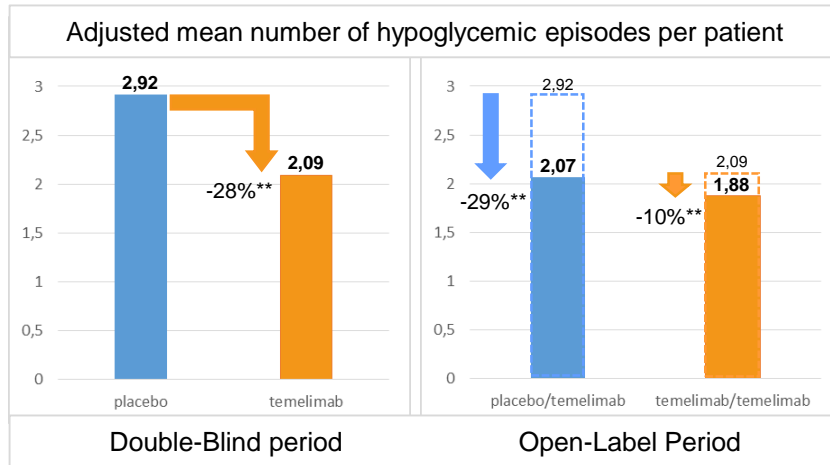
Adjusted mean number of hypoglycemic episodes per patient	Temelimab/temelimab (N=31 out of 43 <sup>**</sup> )	Placebo/temelimab (N=14 out of 21 <sup>**</sup> )	Rate ratio	P-value*
Double-blind Period	2.09	2.92	0.75	0.0001
Extension Period	1.88	2.07	0.91	0.82

### Group treated by temelimab 12 months:

- Reduction of frequencies of hypoglycemia under temelimab in first 6-month (-28%, p<0.0001 vs placebo),
- Further reduction of 10% in the second 6 month period

### Group switching to temelimab from placebo:

- Reduction of hypoglycemia frequency in this group vs the previous placebo period (-29%), reaching the level of reduction observed with temelimab in the first 6 months of treatment



\* Poisson regression analysis

\*\* Patients who continued in the Open-Label period



# RAINBOW-T1D Summary

## Successful study, opening way to early-onset T1D trials

- 12 month study with a 6-month double blind period and a 6-month extension with all patients on temelimab, including patients previously on placebo
- Excellent safety / tolerability of temelimab observed over one year
- Positive temelimab pharmacodynamic observations at 6 months are confirmed in the second period
- No conclusions possible on C-peptide, insulin consumption and HbA1C: small cohort size from a late onset adult population, well treated with low insulin needs, stable during trial
- Study completes its objective of demonstrating safety and pharmacodynamic response in adult T1D patients, opening door to further development in larger early-onset pediatric population



Part 3

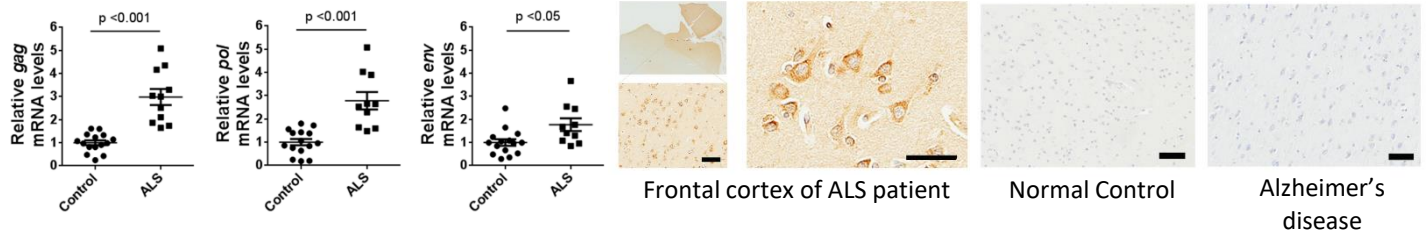
# GeNeuro development in ALS

June 2019

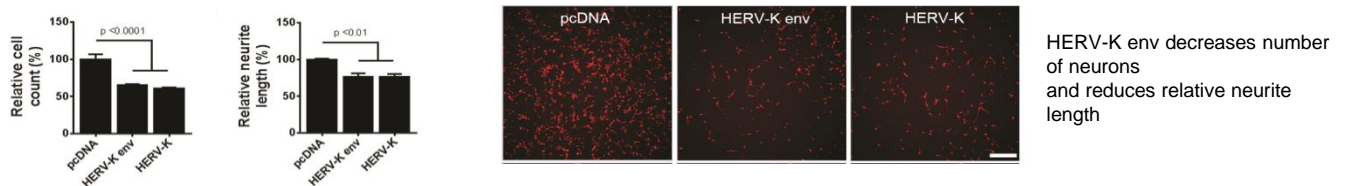


# HERV-K Env is upregulated in ALS, and toxic to neurons

- HERV-K (HML-2) is expressed significantly higher in brain tissue of ALS patients than in healthy controls or other neurological disorders



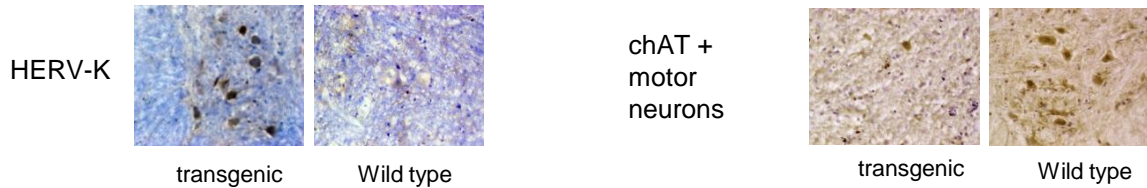
- Expression of HERV-K in neurons is toxic



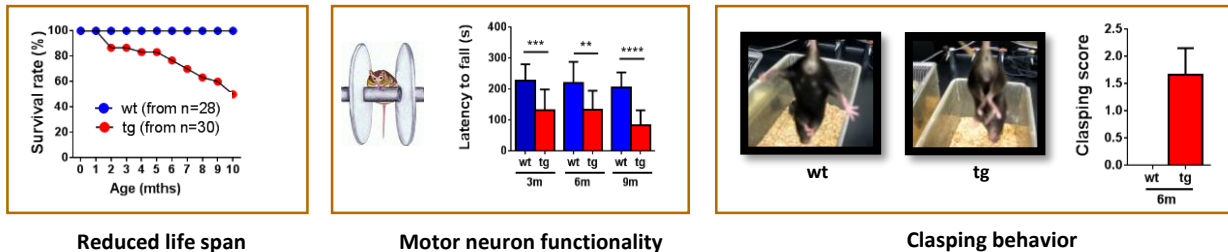
- Genetic investigations reveal that there is dysregulation of HERV-K in a subset of patients with sporadic ALS

# In vivo validation of the HERV-K concept in ALS through transgenic mice

- NINDS developed a transgenic mouse that expresses HERV-K Env in the brain and spinal cord (neurons)



- The phenotype of the transgenic mouse mimics signs and symptoms of clinical ALS



Source: Li, Lee, et al., Science Translational Medicine 2015

# Status of the ALS project

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- Research partnership in 2017 with the National Institute of Neurological Disorders and Stroke (NINDS), part of the U.S. National Institutes of Health (NIH)
  - GeNeuro provides antibodies designed to block the activity of HERV-K envelope protein
  - NINDS tests antibodies in cellular and animal models of HERV-K associated ALS
  - Results validate the potential of GeNeuro's anti pHERV-K antibodies as a new therapeutic approach against ALS
- Following successful results of the research partnership with NIH in ALS models, GeNeuro has signed in October 2018 an exclusive worldwide license with the NIH covering the development rights of an antibody program to block the activity of pHERV-K Env, a potential key factor in the development of ALS
- **GeNeuro has launched the preclinical development of the lead antibody, aiming at IND by mid-2020**



Part 4

# Good basis for growth

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June 2019

# The GeNeuro team



**Jesús Martin-Garcia** | MBA  
Chief Executive Officer – Co-founder

**Strong track-record in creating value in high technology start-ups**

More than 20 years of experience as founder and investor in successful startups

MBA from Harvard Business School



**Dr. François Curtin** | MD, MPhil, MBA  
Chief Operating Officer

**15 years experience in MS, in charge of R&D and clinical development**

Clinical expertise at Merck Serono, previously at Swissmedic ("Swiss FDA")

MD from Geneva Medical School & MBA from Warwick Business School



**Dr. Hervé Perron** | PhD, HDR  
Chief Scientific Officer – Co-founder

**Made the initial key discoveries in the field of human endogenous retroviruses while at INSERM and bioMérieux**

Has published over 120 peer-reviewed papers and patents, mostly on HERVs

PhD in virology and a professorial thesis in neuroimmunology



**Dr. Robert Glanzman** | MD  
Chief Medical Officer

**Over 20 years of clinical, medical affairs and clinical development experience in MS**

13 years as Medical Affairs/Clinical Development Leader at Pfizer, Novartis and Roche. Global Development Lead for Ocrelizumab Phase III

MD with Residency in Neurology from the University of Michigan



**Dr. Thomas Rückle** | PhD, PMP  
SVP, Head of Preclinical Development

**Over 20 years experience in translational science**

Preclinical and early clinical expertise at Merck Serono & MMV. As project director, led several projects from lead to Phase II clinical proof of concept

PhD in Organic Chemistry



**Miguel Payró**  
Chief Financial Officer

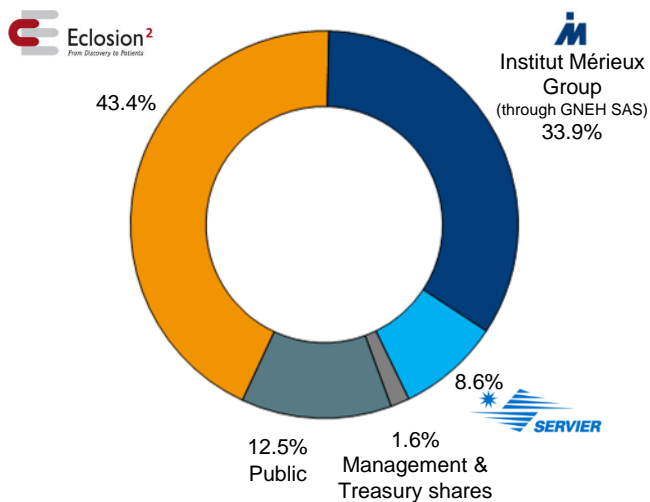
**Experience in international groups & expertise as CFO of a Swiss listed company in the medical sector**

Previously CFO of Groupe Franck Muller & Unilabs, among others

Degree in business administration from the University of Geneva

# Financial Summary

## Share capital as of May 2019



Note: excludes stock options and performance-based option units, representing a maximum 6.9% dilution, with an average exercise price of €10.38 per share

June 2019

## P&L and cash balance (in € '000)

	1Q 2019	FY 2018	FY 2017	FY 2016
<b>Income</b>	n.a.	7,463	14,949	5,918
<b>R&amp;D Expenses</b>	n.d.	(10,930)	(16,161)	(14,419)
<b>G&amp;A</b>	n.d.	(4,686)	(4,597)	(5,535)*
<b>Operating loss</b>	n.d.	(8,089)	(5,740)	(14,037)
<b>Cash &amp; Equivalents</b>	13,300**	16,461**	26,602	34,489

Notes: \* 2016: includes €1,801k of IPO-related fees

\*\* : pro forma, including €7.5 mln line of credit facility with GNEH SAS established Dec. 2018 – of which €2,5 mln was drawn at end of 1Q

# Value enhancing milestones in early 2019

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- ✓ Phase Ic testing higher doses of temelimab for further development 1Q2019
- ✓ ANGEL-MS (2 year results) 1Q2019
- ✓ T1D Phase IIa full 12-month results 2Q2019
- Partnership discussions on temelimab in MS



# Capturing the full value of the HERV platform

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- Cash to deliver on ongoing programs – funded mid-2020
  - MS: ANGEL-MS results – Phase Ic testing safety of higher doses of temelimab
  - T1D: 12-month results of RAINBOW trial with temelimab
  - ALS: preclinical development of new monoclonal antibody against pHERV-K
- Open options for development going forward in MS
  - Partnering discussions ongoing
  - Confirmatory trial to find optimal dose in target non-active progressive population, potentially supporting registration
- Open options for development in other indications, alone or with partners
  - Phase IIb in T1D in a juvenile population
  - IND for anti pHERV-W new monoclonal antibody planned for mid-2020





## Targeting the cause of neurodegenerative and autoimmune diseases

**Jesús Martin-Garcia | CEO**

jmg@geneuro.com

Tel: +41 22 552 4800

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[www.geneuro.com](http://www.geneuro.com)