## SEEG and Multimodality Clinical Applications in Brainstorm

Jay Gavvala, MD, MSCI Associate Professor, Department of Neurology

## UTHealth Houston

No relevant Financial Disclosures

## Outline

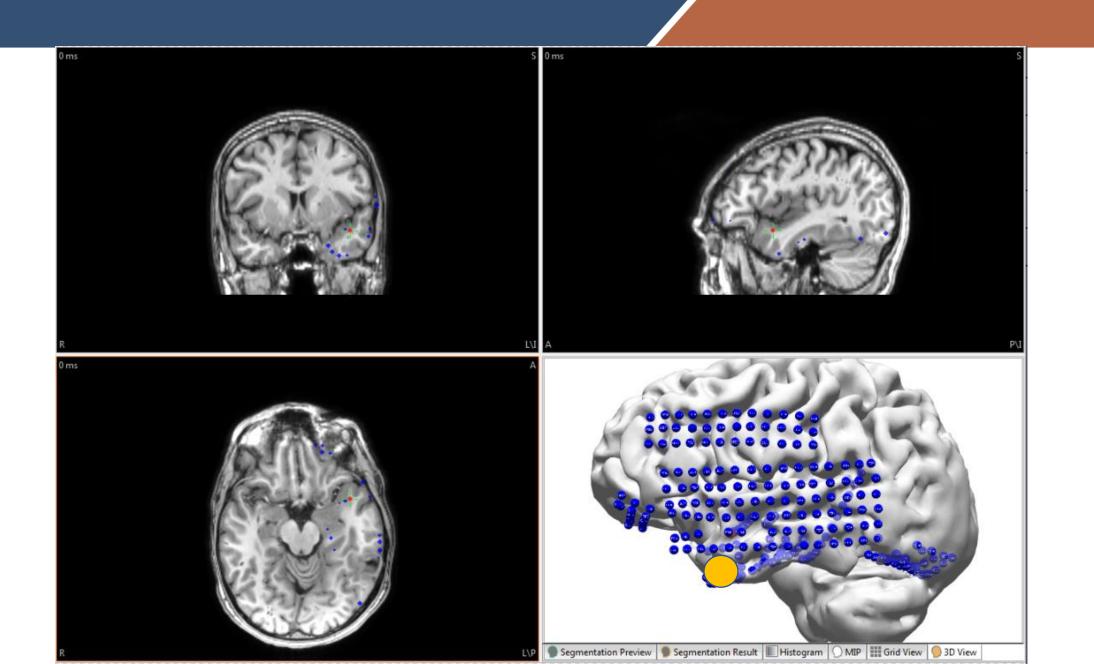
Traditional SEEG analysis Brainstorm Analysis Interictal Ictal Sensor vs Source Level Multimodal Integration

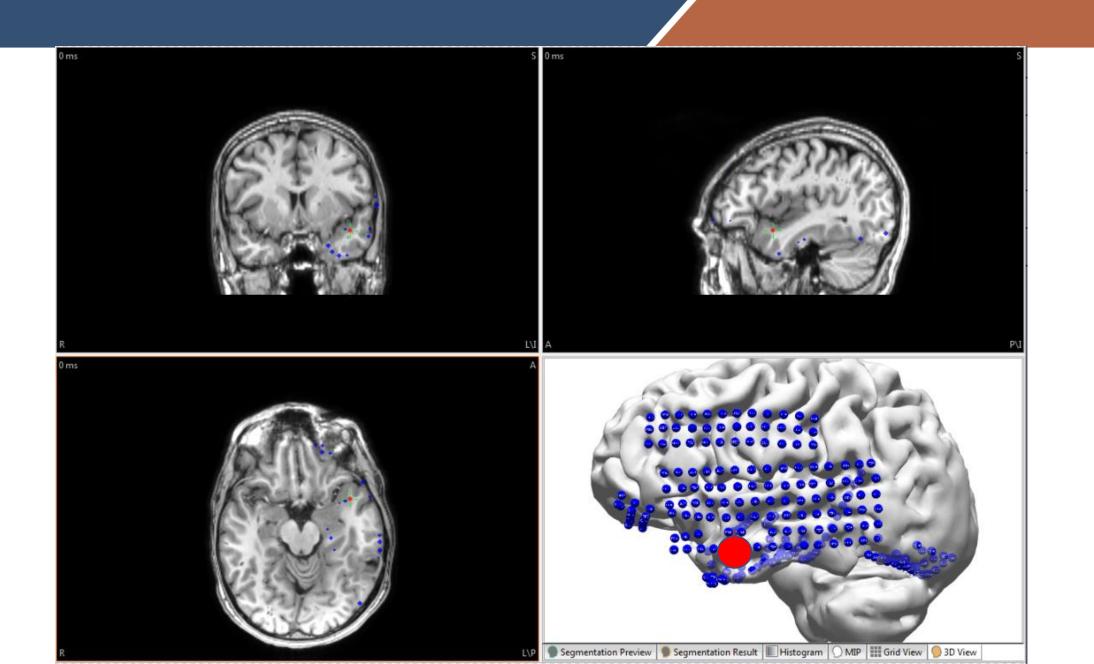
## SEEG: Question of Scale

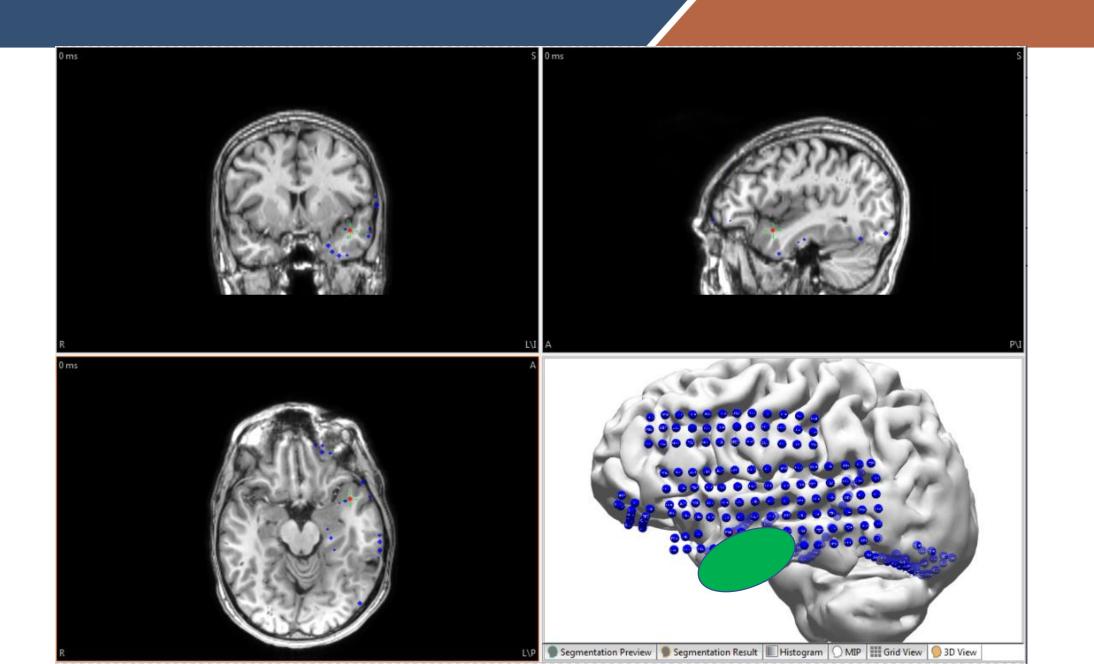
Intracranial EEG commonly referred to as "gold standard"

Recent literature highlights increasing adoption of SEEG as the intracranial EEG modality of choice

However, this trend can be problematic with an expectation to "Apply Subdural EEG principles to SEEG"







#### LESIONAL

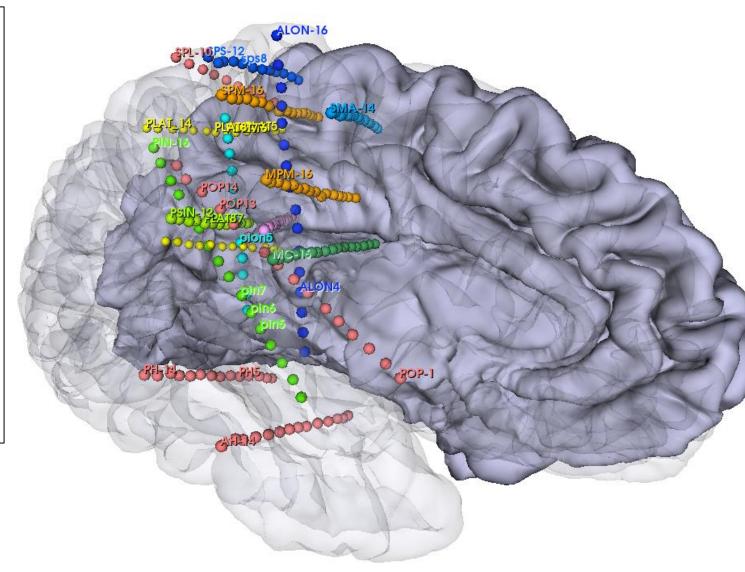
ALAT – Anterior lateral PMG PLAT – Posterior lateral PMG ALON – Anterior longitudinal PMG PLON – Posterior longitudinal PMG

PIN – posterior insula PSIN – posterior superior insula POP – parietal operculum SPL – Superior parietal

SPM – superior primary motor MPM – mid primary motor SPS – Superior primary sensory MPS – Mid Primary Sensory

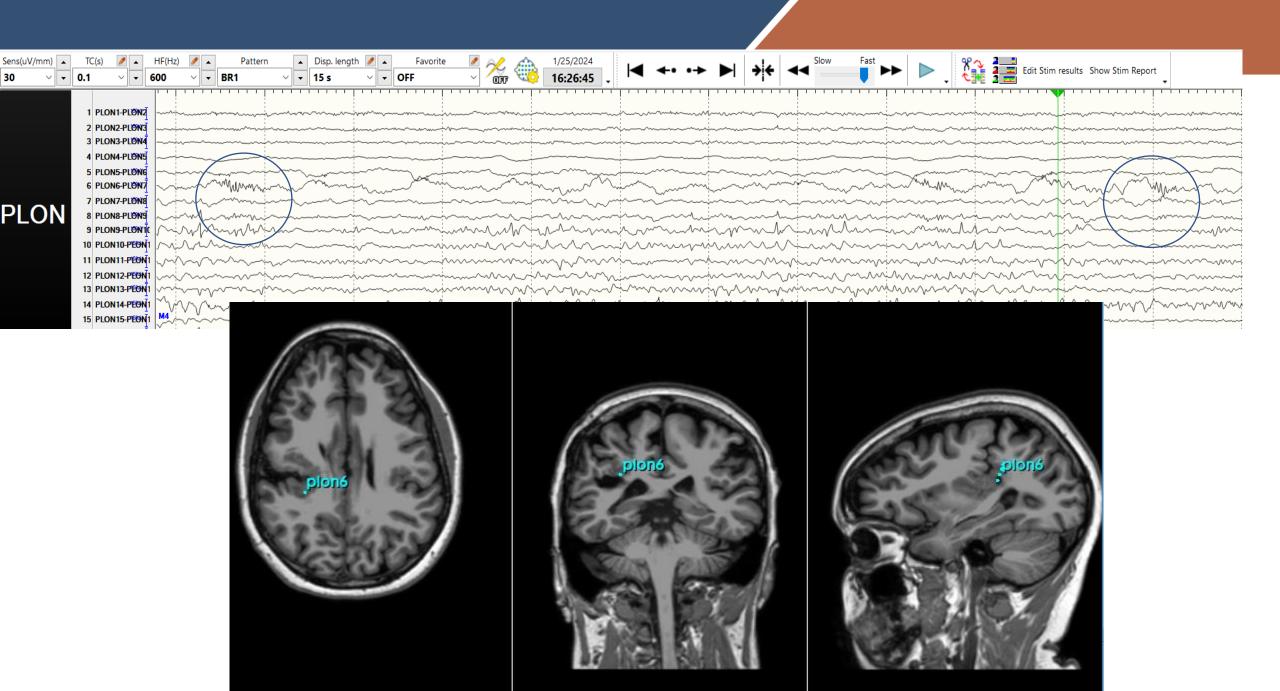
SMA – supplementary motor area MC - Midcingulate AH – Anterior hippocampal

PH – Posterior hippocampal



Right-handed F, with seizure onset at 6 y/o <u>Habitual seizures</u>: left hand tingling → dyscognitive Frequency: 1-2x per week (SS aura daily)

MRI: bilateral perisylvian polymicrogyria and pachygyria, right greater than left.



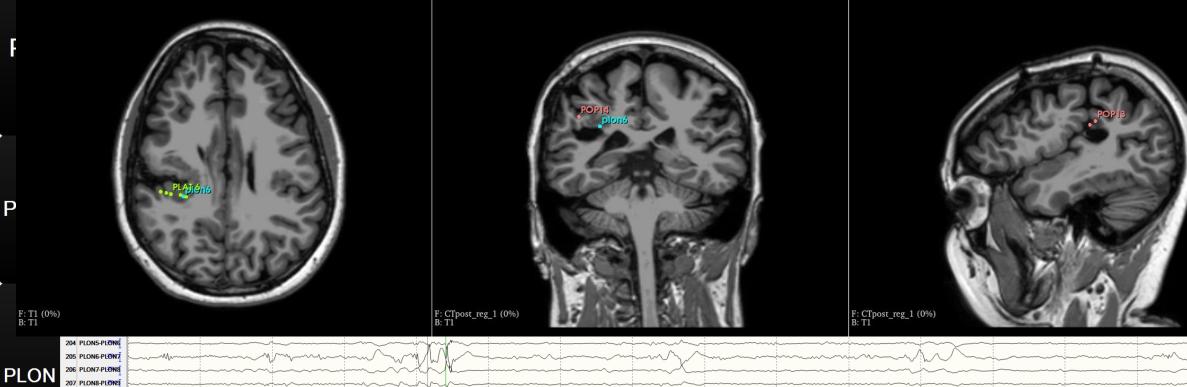
#### Interictal Spikes: POP 12-15, PLAT 2-9, PLON 5-7 20%

Sens(uV/mm)  50		HF(Hz) A Pattern 300 V V CalvinBipola	→ Disp. length 🥖 →	Favorite 🖉 🗡	, 🚯 <sup>1/2</sup> 7 <b>13</b>	25/2024	.  ◀ ↔ ↔	▶ ▶  → + ◄	Slow Fast	▶ ▶ .	Edit Stim	results Show Stim Repo	rt 🗸		
POP	164         POP6-POP7-//           165         POP7-POP8-//           166         POP8-POP9-//           168         POP10-POP11           169         POP11-POP12           170         POP12-POP13           171         POP13-POP14           172         POP14-POP15													Only selected v	raves shown
PIN	173         POP15-POP16           174         PIN1-PIN2®           175         PIN2-PIN3®           176         PIN3-PIN4®           177         PIN4-PIN5®           178         PIN5-PIN6®           179         PIN6-PIN7®           180         PIN7-PIN8®           181         PIN10-PIN7P*           184         PIN11-PIN3P*           185         PIN12-PIN3*           186         PIN13-PIN4*           188         PIN13-PIN4*           189         PIN13-PIN4*           180         PIN13-PIN4*														
PLAT	195 PLAT7-PLÄT8 196 PLAT8-PLÄT9 197 PLAT9-PLÄT10 198 PLAT10-PEAT 199 PLAT11-PEAT														
PLON	200 PLON1-PLON2 201 PLON2-PLON3 202 PLON3-PLON4 203 PLON4-PLON5 204 PLON5-PLON6 205 PLON6-PLON7 206 PLON7-PLON6 207 PLON8-PLON6 208 PLON9-PLON6 209 PLON10-PEON 209 PLON10-PEON 210 PLON11-PEON 211 PLON12-PEON 212 PLON13-PEON 213 PLON14-PEON 213 PLON14-PEON			OP. PLAT. PL						Patiens		<u>E</u> <u>C</u> <b>1000 − − − − − − − − − −</b>	Te li	-3.363mm → Y # D =	-010-

R

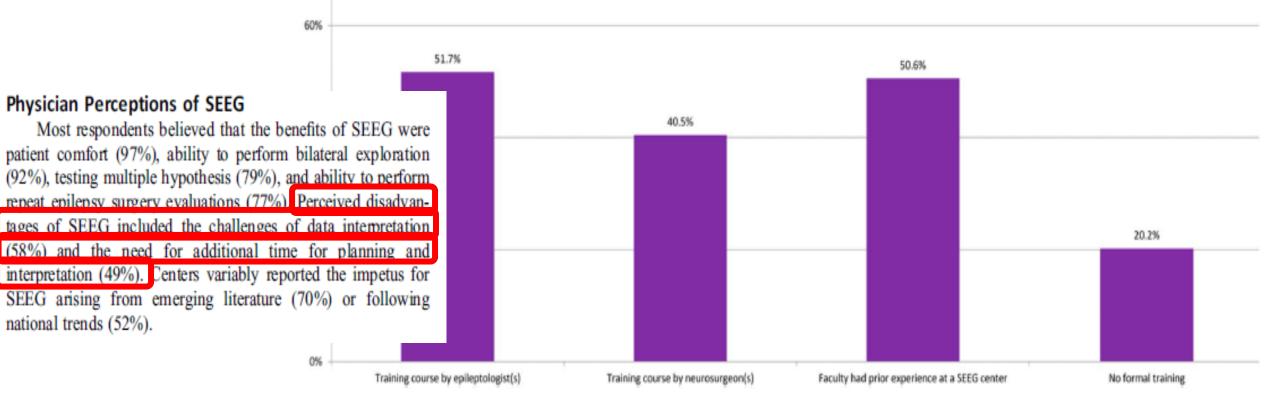
#### Interictal Spikes: POP 12-15, PLAT 2-9, PLON 5-7 20%

Sens(uV/mm)	▲ TC(s) 🖉 ▲ ▼ 0.03 ∨ ▼	HF(Hz) A Pattern	→ Disp. length 🥖 →	FF Vorite	<sup>/25/2024</sup> ↓ ► ←•	•• • • • • • • • • • •	w Fast <b>&gt;&gt; And Constant State</b> Edit Sti	m results Show Stim Report	
	164 POP6-POP7								
	165 POP7-POP8		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		······································		A many and the second	Only selected waves shown
	166 POP8-POP9		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	man and a second a	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
	168 POP10-POP11				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~		~~~~~~	
FUF	169 POP11-POP12		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		M				
	170 POP12-POP13 171 POP13-POP14				m	Aim			
	172 POP14-POP15	Ŭ.	mm	man	Kamma		- hX	m	· ······
• R # C				32.0008mm			-0.3643mn	• Y ≇⊡	-36.753



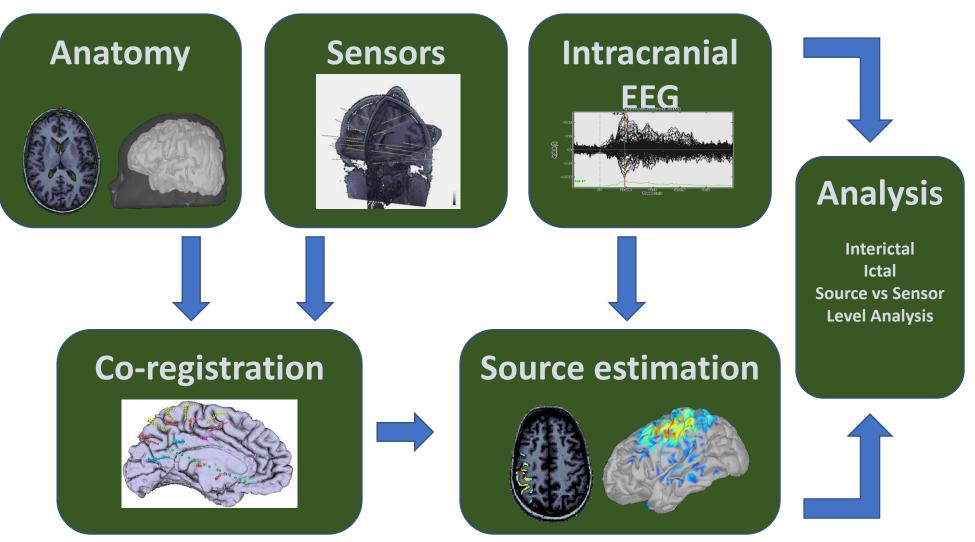
20	15 PLOI	NG-PLON7	m		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~ ~~	m.	ЛW	la m			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	 ·	jammer and the second s	$\sim \sim$				~
20	6 PLO	N7-PLONE				~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~	~~~	$\sim$	-m	X			~		 	human					~
20	7 PLO	N8-PLON9				~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~	~~~~r	$\sim$	~~~~~			~~~		 						-
20	8 PLO	N9-PLONT					~~~~~~				~~~~	~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	 						-
20	9 PLO	N10-PEON1	~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~					~~~~	~~~~~~					 						-
21	IO PLOP	N11-PEON		~~	~~~~	$\sim$	~~~~~	$\sim$	~~~	$\sim$	~				$\sim$		 		÷	+			-
21	1 PLOP	N12-PEON	~~~~~~	$\longrightarrow$	~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim$		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	 ·						-
21	2 PLO	N13-PEON				~~~~	~~~~F	≥0p	PLAT	PHON	(j						 	·~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		+			-
21	3 PLO	N14-PEON	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim\sim$	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim$			$\sim \sim \sim$	$\sim$	·~~	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		$\sim$	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	 m	$\sim$		hannen	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		2
• .		1		- E					v. v	· · ·						· ·			· • • • ~ ~	~		250.0	

## SEEG practice in the US



Gavvala et al Stereotactic EEG practices Journal of Clinical Neurophysiology 2022

### Workflow



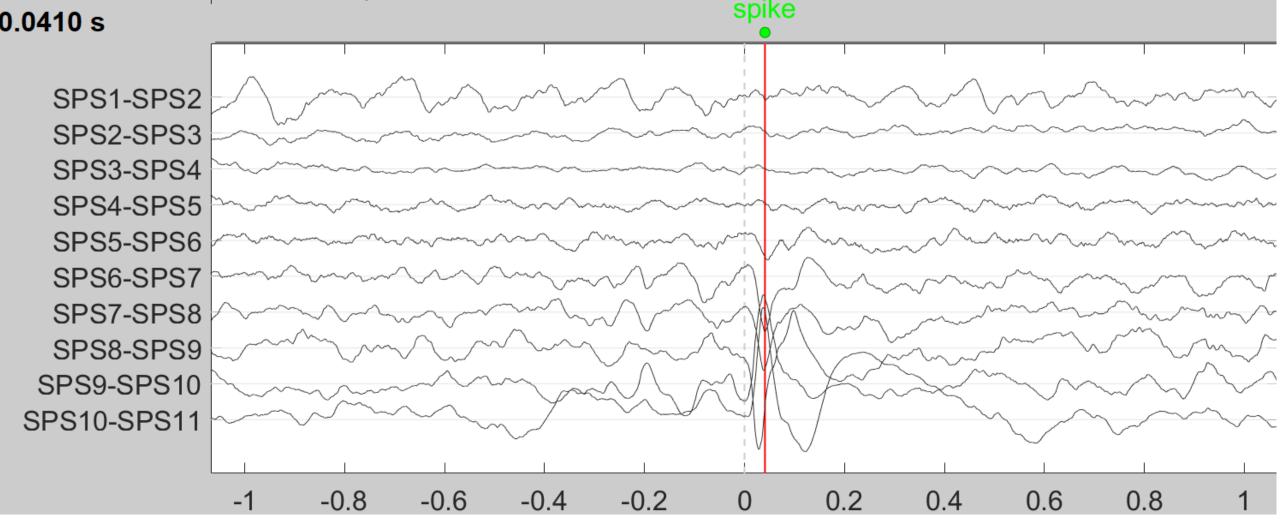
## **Interictal Processing**

2D Spike Layout Source Localization of waveform (Is SNR sufficient?) Source Level Interictal Processing (Frequency Band specific)

### SEEG analysis: Interictal Spike

m) ▲ TC(s) ℓ ▲ HF(Hz) ℓ ▲ ∨ ▼ 0.03 ∨ ▼ 300 ∨ ▼	CalvinBipoli ~ 🔹 15 s 🛛 👻 🕶 OFF	A the second	··· I I I I I I I I I I I I I I I I I I	Edit Stim results Show Stim Repo	•	
164 POP6-POP7		www.				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
165 POP7-POP8		······		Annon Annon	Only se	lected waves show
166 POP8-POP9				And some		
						~
POP10-POP11 169 POP11-POP12	·····					
170 POP12-POP13		manh	- AN. A.	han madama and		- in the second
171 POP13-POP14			All All All			
172 POP14-POP15	100010 0000000000	X A A A A A	- A A A A A A A A A A A A A A A A A A A		hanna hannan	
173 POP15-POP16						
174 PIN1-PIN2 <sup>50,0</sup>						
175 PIN2-PIN3****						
176 PIN3-PIN4 <sup>50,0</sup>						
177 PIN4-PIN5 <sup>50,0</sup>						
178 PIN5-PIN6500 [		warming and the second			man was a series of the series	
179 PIN6-PIN7 <sup>50//</sup>	~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	+	hard the second se	
183 PIN10-PIN11						
184 PIN11-PIN12/				+		
185 PIN12-PIN13'						
186 PIN13-PIN14/		~~~~	~~~~	+		
187 PIN14-PIN15/	~~~~~			+		$\rightarrow$
188 PIN15-PIN16/		~~~~~				
189 PLAT1-PLAT2						
190 PLAT2-PLAT3		minim	million and the second se	+		
191 PLAT3-PLAT4						
192 PLAT4-PLAT5		min	man man man man	manning		-
193 PLAT5-PLAT6		a mall a man	man Anna Anna			_
194 PLAT6-PLAT7			man and and have the			
195 PLAT7-PLÄT8						
196 PLAT8-PLAT9						
- I		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
197 PLAT9-PLÄŦ1Ŏ						
198 PLAT10-PEAT						
199 PLAT11-PEAT ]:						
200 PLON1-PLONZ		www.internet.	and a second and a s			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
201 PLON2-PLON3						~
202 PLON3-PLON4				·/·····		
203 PLON4-PLON5				+		
204 PLON5-PLONG			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	·	~~~~	
205 PLONG-PLON7	man Mannan		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		hr hand have been have bee	m
206 PLON7-PLON8 207 PLON8-PLON9		my hand		+		
207 PLON8-PLON9						
208 PLON9-PLONT						~
209 PLON10-PEON1						
210 PLON11-PEON1	mhunnhan	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		hannen		
211 PLON12-PEON1						
212 PLON13-PEON1	DOD BIO					
	POP.PD					

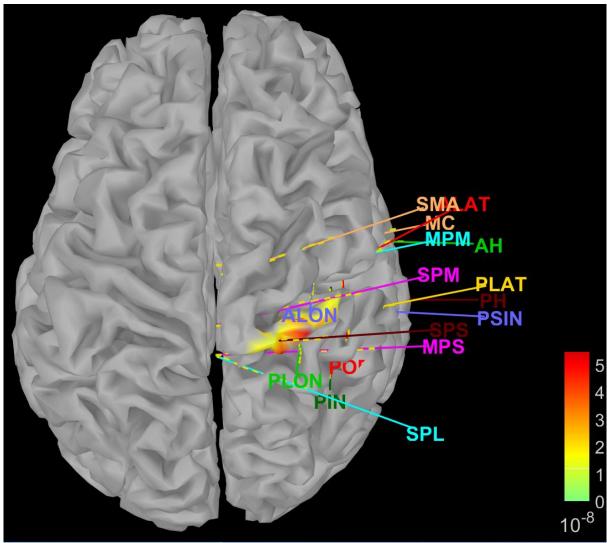
### SEEG analysis: Interictal Spike

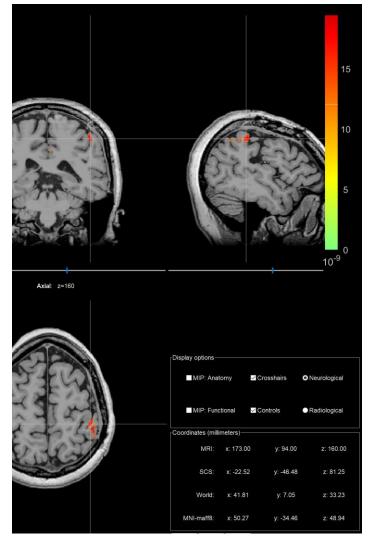


### SEEG analysis: Interictal Spike 2D layout

AH whype was some and a star and a star and and and and and a star and a star
ALATTE and the with more many more many more many more than and
ALONia men may my my my with and a with any and a with anyte and the and the and the and the anythe
MC was and and and more when when when a
MPM man more and and and and and and the more more more more more more more mor
MPS me when man my when min my when when when more more only only
PH
PIN more very very very very why why why when a more more when when when when we we we
PLATion was the who the same sup while who was non non
PLON
POP was adon more saint saway more some when more when more again and the bythe more which we
PSIN ~~ ~~ ~~ ~~ ~~ ~~ ~~ ~~ ~~ ~~ ~~ ~~ ~~
SMA more more more more with more with the with high with any
SPL more more what water more more more more
SPM now men men want work work anythe angle angle my
SPS many more more more more mary miley mile and and and

### sLORETA on cortex and MRI viewer

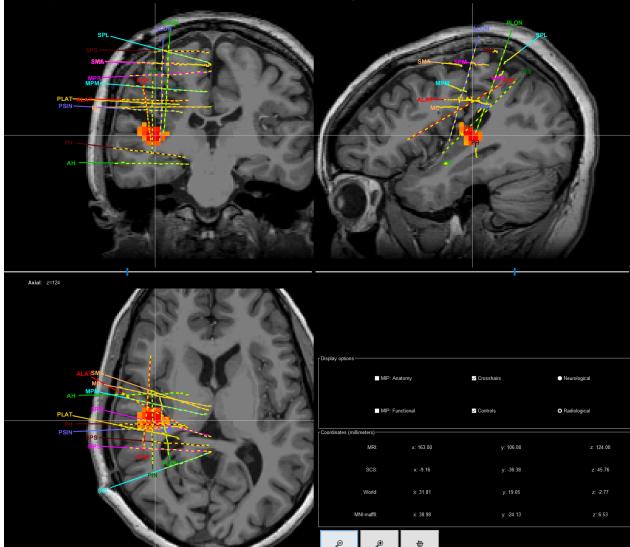




### SEEG analysis: Low voltage Fast

<ul> <li>✓ ▼ 0.03 ✓ ▼ 30</li> </ul>		▲ Disp. length      ▲     ▲     ↓     15 s ∨ ▼ OF	Favorite 🗾 🔀	1/29/2024 12:50:58	◀ ↔ •→		v Fast	> , 👬 🚼	Edit Stim results Show Stim	n Report		
160 POP2-POP3 <sup>•</sup>		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	www.	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	M	w	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
161 POP3-POP4								~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Only selected waves
162 POP4-POP5 <sup>W</sup> 163 POP5-POP6 <sup>W</sup>			www.	+~~~~+	~~~~		min	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		·····
163 POP5-POP6		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
										~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
165 POP7-POP8 <sup>W</sup> 166 POP8-POP9 <sup>W</sup>		m_min_	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				MANA A			min
168 POP 10-POP 11		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		hanne	~~~~~				min to m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	hanne	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
169 POP11-POP12	man har her har her her her her her her her her her he				man							
170 POP12-POP13	many	1 mm		in	1 Com		$\sim$	min	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		mmm	man
171 POP13-POP14	Munin	min		+	- Marine	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim\sim\sim\sim\sim$	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	mmm	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
172 POP14-POP15	howww	M. M.	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	+	v Kunnin	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	minn	min	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	immini	~~~~~
173 POP15-POP16	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		++		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~ <u>†</u> ~~~~~	~~		
174 PIN1-PIN2 <sup>50,0</sup>	······································			man			m		~~~		winther man	
175 PIN2-PIN3 <sup>50</sup>	~~~~~					~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
176 PIN3-PIN4 <sup>50,1</sup>							man from				manne	
177 PIN4-PIN5	Lun line line line line line line line lin							~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				
179 PIN6-PIN7 <sup>50</sup>												
181 PIN8-PIN9****												
180 PIN7-PIN8**** 181 PIN8-PIN9**** 182 PIN9-PIN18****										_		
183 PIN10-PINT	······	~				Zoom				×		
184 PIN11-PIN12/						Menu Tool						
185 PIN12-PIN13	~											
186 PIN13-PIN14						173 POP 15-POP 16	لسنيمط يبسيسهم	- American	when when a			
187 PIN14-PIN15/						~~			~			
188 PIN15-PIN16'				procession of the second se		PIN1-PIN2			dama .	·······	+	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
189 PLON1-PLONZ				trong		174	- man	mon which	Margare	and the second s		
190 PLON2-PLON3		~~~~	~+	+	n francisco fra	~~~					-+	
191 PLON3-PLON4				~~~~~~		175 PIN2-PIN3	monter	monorman	manimum	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
192 PLON4-PLON5		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		·	~~~						+	
193 PLON5-PLONG		and my and			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	176 PIN3-PIN4		n in				
194 PLONG-PLONZ	m w w w		-ih	immer in the second	mannin	176	whencessian	man malin	my	- man	imm white	
195 PLON7-PLONE	manun	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			~~~~	~~~						~~~~~~
196 PLON8-PLON9 197 PLON9-PLON9						177 PIN4-PIN5	min al	minin	manimum	Ser		
198 PLON10-PEON1								· · · · · ·				
199 PLON11-PEON1						DINE DINC						
200 PLON12-PEON1						178 PIN5-PIN6	varminum	mound	manyman	~~		
201 PLON13-PLON1	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~											~~~~
202 PLON14-PEON1		man man		Iman	man and	179 PING-PIN7	al a carda mars	a ama a a a a a a	and a share of	mann	hanna	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
203 PLON15-PLON1							V.G.C. 100					
204 PLAT1-PLAT2		m										
205 PLAT2-PLAT3	man man	mm mm		hanne	m	180 PIN7-PIN8	<u> </u>		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		il month	
206 PLAT3-PLAT4	manum	minim			~~~~~							
207 PLAT4-PLAT5	montheman	mm	m	m	m		m		min	m		
	mmmmmmm	mm			n from		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~	minun		mon	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
208 PLAT5-PLAT6	mont	min		m	m	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		minim	~~~~~~	mon	
210 PLAT7-PLAT8	mmmm	mmm		man	Anni	man	min	min	minn	him	minn	m
211 PLAT8-PLAT9	· ····································	min			min					min		
212 PLAT9-PLAT10	m			hand						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
212 FUAIS-FUATIO												
212 PLATS-FDATIO 213 PLAT10-PEATI 214 PLAT11-PEATI				h					min		i i i i i i i i i i i i i i i i i i i	

### sLORETA of a specific frequency band



## Ictal Processing

Source Localization of waveform (Is SNR sufficient)?

Sensor level Ictal processing

Epileptogenic Index

Epileptogenic Fingerprint

Source Level Ictal Processing

Frequency Band specific

**Restricted Region of Interest** 

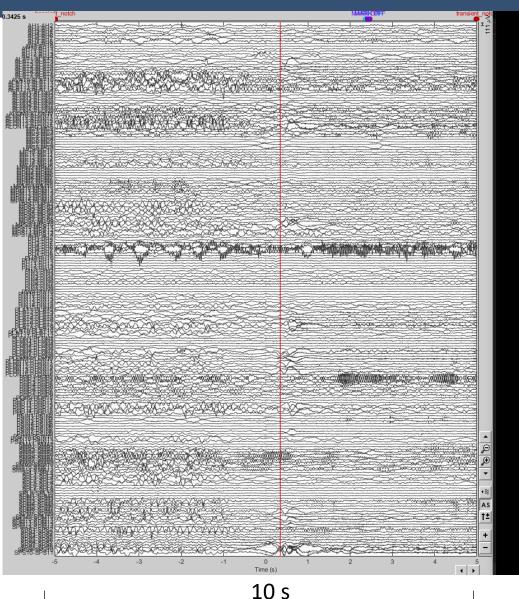
#### Sz type 1 (left hand aura): Onset SPS 7-10/PLON 6-16/PLAT 6-8

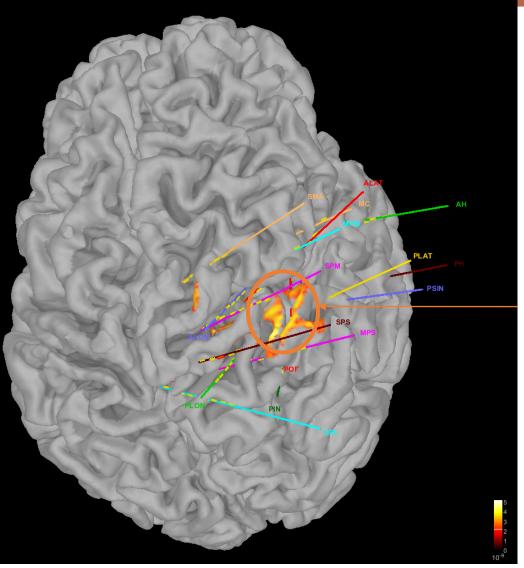
Sens(uV/mm)	TC(s)		Pattern BR1	→ Disp. len		Favorite OFF	in the second se	1/25/20 16:27:		<b>←• •</b>	▶	Slow	Fast	Þ j 🕌	Edit Stim results Show Stim Report
PLON	4 PLON4-PLONE 5 PLON5-PLONG 6 PLON5-PLONG 7 PLON5-PLONS 8 PLON8-PLONS 9 PLON8-PLONS 10 PLON10-PLON 11 PLON11-PLON 12 PLON12-PEON 13 PLON13-PLON 14 PLON14-PEON 15 PLON15-PLON 16 PLON16-ACON														
SPS	17 SPS1-SPS2 18 SPS2-SPS3 20 SPS4-SPS3 21 SPS5-SPS6 22 SPS6-SPS7 23 SPS7-SPS8 25 SPS7-SPS8 25 SPS9-SPS10 26 SPS10-SPS11 27 SPS11-SPS12 37 POP10-POP11	· more						with the second se			Man and a start an				
POP	38 POP11-POP12 39 POP12-POP13 40 POP13-POP14 41 POP14-POP15 42 POP15-POP16 47 SPM5-SPM6 <sup>47</sup> 48 SPM6-SPM7 <sup>47</sup> 49 SPM7-SPM8 <sup>47</sup> 50 SPM8-SPM9 <sup>47</sup> 51 SPM9-SPM10														
SPM MPS	52 SPM10-SPM11 53 SPM11-SPM12 54 SPM12-SPM13 55 SPM13-SPM14 56 SPM14-SPM15 57 SPM15-SPM16 60 MPS3-MPS40 63 MPS6-MPS77 64 MPS7-MPS80 65 MPS8-MPS90 66 MPS9-MPS10 67 MPS10-MPS10 68 MPS11-MPS12														the second with the second sec
PLAT	69 MPS12-MPS13 70 MPS13-MPS14 71 MPS14-MPS15 72 MPS15-MPS16 86 PLAT1-PLAT2 87 PLAT2-PLAT3 89 PLAT4-PLAT3 90 PLAT5-PLAT4 91 PLAT6-PLAT5 91 PLAT6-PLAT5 93 PLAT8-PLAT4 93 PLAT9-PLAT4 94 PLAT9-PLAT4														
ALON	96 PLAT11-PLAT 101 ALONS-ALONG 102 ALONG-ALONG 103 ALONG-ALONG 104 ALONG-ALONG 105 ALONG-ALONG 106 ALON10-AEON 107 ALON11-ALON 108 ALON12-AEON 109 ALON13-ALON				www.	and a second	million	many and the	man make when	when when when		Mark	Martin Mar	Mr. Alexhada 1734	

#### Sz type 1 (left hand aura): Onset SPS 7-10/PLON 6-16/PLAT 6-8

Sens(uV/mm)	i A a a b b bi Ai A a b b bi Ai A a b b bi Ai A a b b bi Ai A a b b bi Ai A a b bi A
30 ~ • 0.1 ~ •	
4 PLON4-PLO 5 PLON5-PLO 6 PLON6-PLO 7 PLON7-PLO	Only objected waves shows
PLON8-PLO 9 PLON9-PLO 10 PLON10-PE 11 PLON11-PE	
12 PLON12-PE 13 PLON13-PE 14 PLON14-PE 15 PLON15-PE	
16 PLON16-AE 17 SPS1-SPS2 18 SPS2-SPS3 19 SPS3-SPS4	
20 SPS4-SPS5 21 SPS5-SP56 22 SP56-SPS7 23 SP57-SP58 24 SP58-SP59	
25 SPS9-SPS1 20 SPS4-SPS5	
21 SPS5-SPS6 22 SPS6-SPS7	www.server.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m
23 SPS7-SPS8 24 SPS8-SPS9	with a way with the way when the
25 SPS9-SPS1 26 SPS10-SPS	or my an and many many many many many many many many
27 SPS11-SPS	
60 MPS3-MPS4 62 MPS5-MPS6 63 MPS6-MPS7 64 MPS7-MPS8 65 MPS8-MPS9 66 MPS9-MPS1 66 MPS9-MPS1 66 MPS9-MPS1 67 MPS10-MPS	
68 MPS11-MPS 69 MPS12-MPS 70 MPS13-MPS 71 MPS14-MPS 72 MPS15-MPS 86 PLAT1-PLA	
97 РІАТЯРИ 87 РІАТЯРИ 88 РІАТЯРИ 90 РІАТЯРИ 90 РІАТЯРИ 91 РІАТЯРИ 91 РІАТЯРИ	13     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1 </th
93 PLATA-PLA 93 PLATA-PLA 94 PLAT3-PLA 95 PLAT10-PU 96 PLAT11-PU 96 PLAT11-PU	
101 ALON5-ALO 102 ALON6-ALO 103 ALON7-ALO 104 ALON8-ALO 105 ALON9-ALO	
ALON ALON ALON ALON ALON ALON ALON ALON	

### sLORETA on Cortex





Focus of source Localized power

## sLORETA results on MR/volume (sz 1)



ø

0

Cancel

Save

Check for updates

#### Epileptogenicity of brain structures in human temporal lobe epilepsy: a quantified study from intracerebral EEG

Fabrice Bartolomei,<sup>1,2,3</sup> Patrick Chauvel<sup>1,2,3</sup> and Fabrice Wendling<sup>4,5</sup>

The "Connectivity Epileptogenicity Index" (cEI), a method for mapping the different seizure onset patterns in StereoElectroEncephalography recorded seizures

Alexandra Balatskaya<sup>a</sup>, Nicolas Roehri<sup>a</sup>, Stanislas Lagarde<sup>a,b</sup>, Francesca Pizzo<sup>a,b</sup>, Samuel Medina<sup>a,b</sup>, Fabrice Wendling<sup>c,d</sup>, Christian-George Bénar<sup>a,1</sup>, Fabrice Bartolomei<sup>a,b,\*,1</sup>

<sup>a</sup> Aix Marseille Univ, INSERM, INS, Inst Neurosci Syst, Marseille, France <sup>b</sup> APHM, Timone Hospital, Epileptology and Cerebral Rhythmology, Marseille, France <sup>c</sup> INSERM UI 099, LTSI, Rennes, France <sup>d</sup> Université de Rennes 1, LTSI, Rennes, France

#### RESEARCH ARTICLE

### The role of quantitative markers in surgical prognostication after stereoelectroencephalography

Julia Makhalova<sup>1,2,3</sup>, Tanguy Madec<sup>1</sup>, Samuel Medina Villalon<sup>1,2</sup>, Aude Jegou<sup>2</sup>, Stanislas Lagarde<sup>1,2</sup>, Romain Carron<sup>4</sup>, Didier Scavarda<sup>5</sup>, Elodie Garnier<sup>2</sup>, Christian G. Bénar<sup>2</sup> & Fabrice Bartolomei<sup>1,2</sup>

<sup>1</sup>APHM, Timone Hospital, Epileptology and Cerebral Rhythmology, Marseille, France
 <sup>2</sup>Aix Marseille Univ, INSERM, INS, Inst Neurosci Syst, Marseille, France
 <sup>3</sup>Aix Marseille Univ, CNRS, CRMBM, Marseille, France
 <sup>4</sup>APHM, Timone Hospital, Functional, and Stereotactic Neurosurgery, Marseille, France
 <sup>5</sup>APHM, Department of Pediatric Neurosurgery, Marseille, France

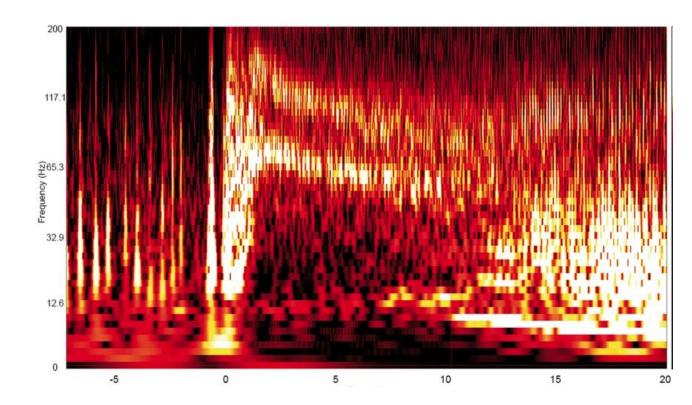
Epileptogenic zone quantification offers real advantages for facilitating SEEG interpretation and predicting surgical outcome. Ictal (EI, cEI) or combined ictal–interictal (Spikes  $\times$  EI, Spikes  $\times$  cEI) SEEG markers overperformed the classical interictal markers (Spikes, HFO, Spikes  $\times$  HFO), both for detecting the EZ and predicting the seizure freedom. Combining ictal and interictal markers in a single measure improved detection accuracy. Spikes  $\times$  EI showed the best precision against the clinical analysis. The resection rate of the EZ defined by ictal markers and by Spikes  $\times$  EI significantly correlated with surgical prognosis. However, complete EZ resection was not mandatory to control seizures.

117

### A fingerprint of the epileptogenic zone in human epilepsies

Olesya Grinenko,<sup>1,\*</sup> Jian Li,<sup>2,\*</sup> John C. Mosher,<sup>1</sup> Irene Z. Wang,<sup>1</sup> Juan C. Bulacio,<sup>1</sup> Jorge Gonzalez-Martinez,<sup>1</sup> Dileep Nair,<sup>1</sup> Imad Najm,<sup>1</sup> Richard M. Leahy<sup>2</sup> and Patrick Chauvel<sup>1</sup>

- Characteristic time-frequency pattern emerged for contacts located inside epileptogenic zone.
- single or multiple pre-ictal sharp transient(s) or spike(s)
- narrow frequency bands of fast activity
- simultaneous suppression of slow pre-ictal frequencies.

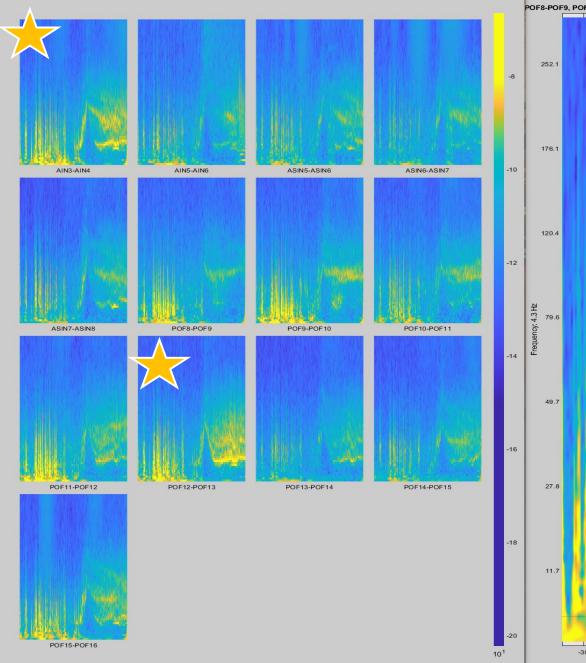


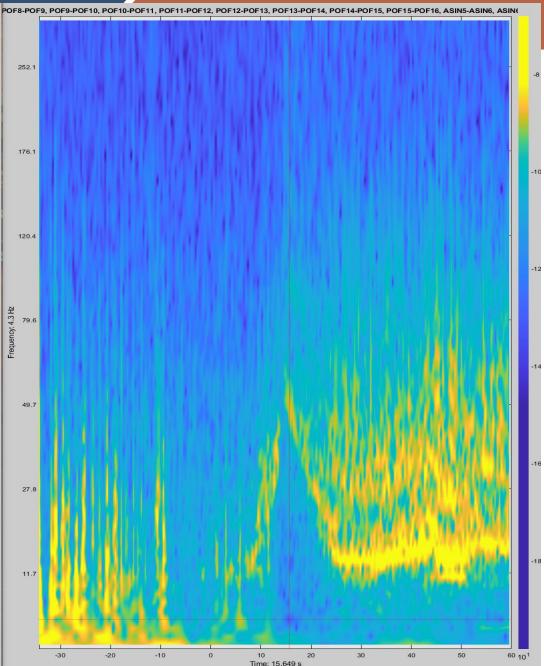
#### Sz onset – AIN 3-6, POF 9-16, ASIN 5-8

#### [SENS \*30 HF \*600 TC \*0.1 CAL \*50]

SENS *30	HF *600 TC *0.	1 CAL *50]
AIN	1         AIN1-AIN2         1500/           2         AIN3-AIN4         1500/           3         AIN5-AIN6         1500/           4         AIN7-AIN8         1500/           5         AIN9-AIN10         1500/           6         AIN1-AIN12         1500/           7         AIN13-AIN14         1500/           8         AIN15-AIN16         1500/	
POF	10         POF1-POF2         150.0/           11         POF3-POF4         150.0/           12         POF5-POF6         150.0/           13         POF7-POF8         150.0/           14         POF9-POF10         150.0/           15         POF11-POF12/150.0/         16           16         POF13-POF16/150.0/         17	
ASIN	19 ASIN1-ASIN2 <sup>150,07</sup> 20 ASIN3-ASIN4 <sup>150,07</sup> 21 ASIN5-ASIN6 <sup>150,07</sup> 22 ASIN7-ASIN8 <sup>150,07</sup>	
ТР	24         TP1-TP2         150.07           25         TP3-TP4         150.07           26         TP5-TP6         150.07           27         TP7-TP8         150.07           28         TP9-TP10         150.07           29         TP11-TP12         150.07	
ABT	31         ABT1-ABT2         150.07           32         ABT3-ABT4         150.07           33         ABT5-ABT6         150.07           34         ABT7-ABT8         150.07           35         ABT9-ABT10         150.07	
AH	37         AH1-AH2         150//           38         AH3-AH4         150//           39         AH5-AH6         150//           40         AH7-AH8         150//           41         AH9-AH10         150//           42         AH11-AH12         150//           43         AH13-AH14         150//           44         AH15-AH16         150//	
PH	46         PH1-PH2         150//           47         PH3-PH4         150//           48         PH5-PH6         150//           49         PH7-PH8         150//           50         PH9-PH10         150//           51         PH11-PH12         150//           52         PH13-PH14         150//           53         PH15-PH16         150//	
AMY	55         AMY1-AMY2         150.0/           56         AMY3-AMY4         150.0/           57         AMY5-AMY6         150.0/           58         AMY7-AMY8         150.0/           59         AMY9-AMY10         150.0/           60         AMY11-AMY1250.0/         61           61         AMY13-AMY1650.0/         62	
EKG	64 EKG2-EKG1 1500/ 65 EKG3-EKG1 1500/ 66 EKG4-EKG1 1500/	REPARENTIA 64

SENS *30	HF *600 TC *0.	1_CAL *50]
AIN	1 AIN1-AIN2 1500/ 2 AIN3-AIN4 1500/ 3 AIN5-AIN6 1500/ 4 AIN5-AIN8 1500/ 5 AIN9-AIN10 1500/ 6 AIN11-AIN12 1500/	
POF	7 AIN13-AIN14 <sup>150,0</sup> 8 AIN15-AIN16 <sup>150,0</sup> 10 POF1-POF2 <sup>150,0</sup> 11 POF3-POF4 <sup>150,0</sup> 12 POF5-POF6 <sup>150,0</sup> 13 POF7-POF8 <sup>150,0</sup> 14 POF9-POF10 <sup>150,0</sup> 15 POF11-POF12 <sup>150,0</sup>	
ASIN	16         POF13-POF14 <sup>(50,)</sup> 17         POF15-POF16 <sup>(50,)</sup> 19         ASIN1-ASIN2 <sup>(50,)</sup> 20         ASIN3-ASIN4 <sup>(50,)</sup> 21         ASIN5-ASIN6 <sup>(50,)</sup> 22         ASIN7-ASIN8 <sup>(50,)</sup>	
ΤР	24         TP1-TP2         150.0/           25         TP3-TP4         150.0/           26         TP5-TP6         150.0/           27         TP7-TP8         150.0/           28         TP9-TP10         150.0/           29         TP11-TP12         150.0/	
ABT	31 ABT1-ABT2 1500/ 32 ABT3-ABT4 1500/ 33 ABT5-ABT6 1500/ 34 ABT5-ABT6 1500/ 35 ABT9-ABT8 1500/ 35 ABT9-ABT10 1500/	
AH	37         AH1-AH2         150.0           38         AH3-AH4         150.0           39         AH5-AH6         150.0           40         AH7-AH8         150.0           41         AH9-AH10         150.0           42         AH11-AH12         150.0           43         AH13-AH14         150.0           44         AH15-AH16         150.0	
PH	46         PH1-PH2         150.07           47         PH3-PH4         150.07           48         PH5-PH6         150.07           49         PH7-PH8         150.07           50         PH9-PH10         150.07           51         PH11-PH12         150.07           52         PH13-PH14         150.07           53         PH15-PH16         150.07	
AMY	55 AMY1-AMY2 1500/ 56 AMY3-AMY4 1500/ 57 AMY5-AMY6 1500/ 58 AMY7-AMY8 1500/ 59 AMY9-AMY10 1500/ 60 AMY11-AMY12500/ 61 AMY13-AMY14500/ 62 AMY15-AMY16500/	Onset +15 sec
EKG	64 EKG2-EKG1 <sup>150,JV</sup> 65 EKG3-EKG1 <sup>150,JV</sup> 66 EKG4-EKG1 <sup>150,JV</sup>	





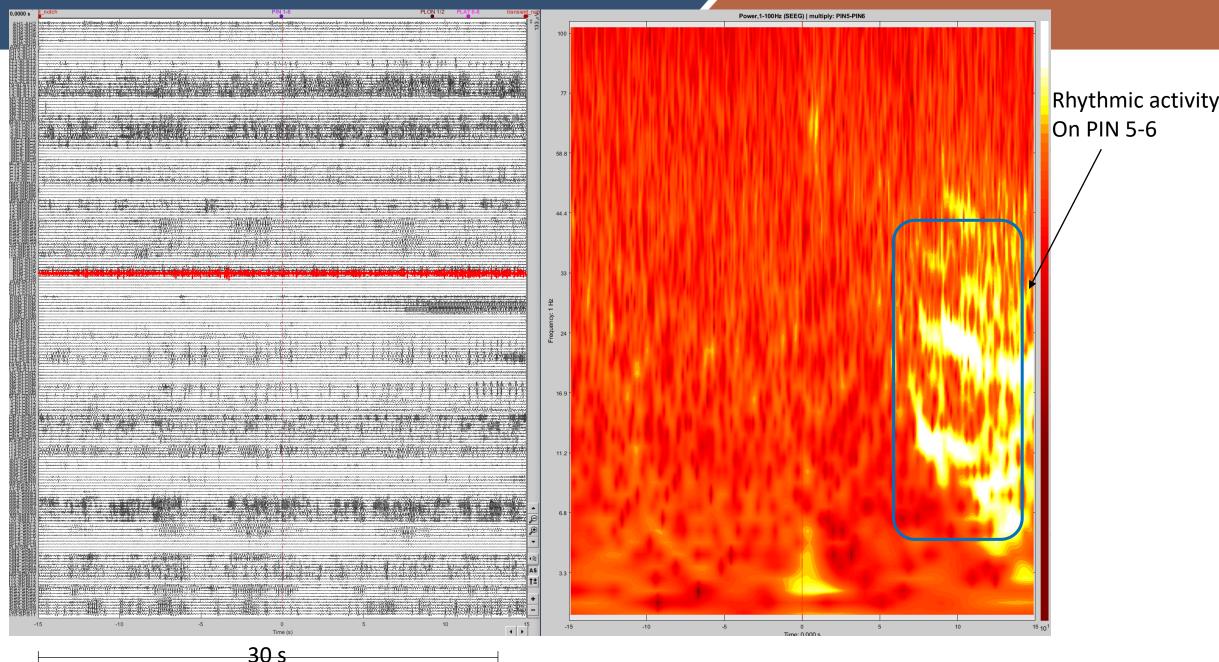
#### Source Level Ictal Analysis

Sens(uV/mm)	TC(s) ▲ 0.03 ∨ ▼	HF(Hz) 🖉 🔺 600 ~ 🗸	Pattern  CalvinBipol:	Disp. length 🥖 . 15 s 🗸 🗸	Favorite  Favorite  Favorite	× 🖓 🍓	1/27/2024 08:44:22	. ◄ ⊷	•• •	→++ → <sup>Slow</sup>	Fast <b>&gt;&gt;</b>	Edit S	tim results Show Stim Report	•			
ALON	120 ALON1-ALON2 121 ALON2-ALON2 122 ALON3-ALON4 123 ALON4-ALON4 124 ALON5-ALON6 125 ALON6 ALON7 126 ALON7-ALON6 134 ALON15-ALON6															m	selected waves shown
POP	135 POP1-POP2- 136 POP2-POP3- 137 POP3-POP4- 138 POP4-POP5- 139 POP5-POP5- 140 POP6-POP3- 141 POP7-POP8- 142 POP8-POP9- 144 POP10-POP1- 145 POP11-POP4- 146 POP12-POP4- 146 POP12-POP4- 147 POP13-POP4- 148 POP14-POP5- 149 POP15-POP6- 149 POP1-POP5- 149 POP1-POP5- 149 POP1-POP5- 149 POP1-POP5- 149 POP5-POP5- 149 POP5- 149 POF5- 149 POF5- 149 POF5- 149 POF5- 14					min											MM Min Min
PIN	150         PIN1-PIN25001           151         PIN2-PIN35001           152         PIN3-PIN35001           153         PIN4-PIN35001           154         PIN5-PIN35001           155         PIN5-PIN35001           156         PIN7-PIN35001           157         PIN8-PIN35001           158         PIN3-PIN36001           159         PIN1-PIN1701           159         PIN1-PIN1711           161         PIN12-PIN1371           162         PIN13-PIN1471           163         PIN13-PIN1471           164         PIN13-PIN1471										nthenillesen anne an anne Marine anne an an anne an anne Marine anne anne anne anne anne Marine anne anne anne anne	al Marine and Andrew All Andrew All Andrew All Andrew Andrew Andrew Andrew Andrew Andrew Andrew Andrew Andrew A Andrew Andrew Andrew Andrew Andrew					
PLAT	165 PLAT1-PLAT2 166 PLAT1-PLAT3 167 PLAT3-PLAT3 167 PLAT3-PLAT4 168 PLAT4-PLAT5 169 PLAT5-PLAT6 170 PLAT6-PLAT7 171 PLAT7-PLAT8 172 PLAT8-PLAT9 173 PLAT9-PLAT1 180 PLON5-PLON6													COR-16			
PLON	181 PLON6-PLON7 182 PLON7-PLON8 183 PLON8-PLON8													2001 2001	10 10 100 10 10 10 10 10 10 10 10 10 10		
SPS	197 SPS7-SPS80												14.722imm 9 0 9 10 mm			inn Y V D	
SMA	203 SMA2-SMA3 204 SMA3-SMA3 205 SMA4-SMA3 205 SMA5-SMA5 207 SMA6-SMA7 208 SMA7-SMA8 208 SMA7-SMA8 209 SMA8-SMA70 210 SMA9-SMA70 211 SMA10-SMA71 213 SMA12-SMA71 213 SMA12-SMA72 214 SMA13-SMA74 M															P. CTOM. 192, 1 (99)	

#### Source Level Ictal Analysis

Sens(uV/mm)  30			Pattern Dis vinBipol: ~ - 15	p. length 🖉 🔺 s 🗸 🗸 🗸 O	Favorite 🖉	1/27/202 08:44:2	•• • • •	Slow Fast	▶ ▶ .	Edit Stim re	sults Show Stim Report		
ALON	120 ALON1-ALÓN2 121 ALON2-ALÓN3 122 ALON3-ALÓN4 123 ALON4-ALÓN5 124 ALON5-ALÓN6 125 ALÓN6-ALÓN4 126 ALON7-ALÓN8 134 ALON15-ALÓN8											150uv	Only sefected waves shown
POP	135 POP1-POP2** 136 POP2-POP3** 137 POP3-POP4** 138 POP4-POP5** 139 POP5-POP6** 140 POP6-POP7** 141 POP7-POP8** 144 POP10-POP1*1 145 POP11-POP4*1 146 POP12-POP4*3 147 POP13-POP4*1 148 POP14-POP4*3 149 POP13-POP4*5												~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
PIN	150         PIN1-PIN2500           151         PIN2-PIN3500           152         PIN3-PIN4500           153         PIN4-PIN5500           154         PIN5-PIN5500           155         PIN7-PIN8500           156         PIN7-PIN8500           157         PIN8-PIN9500           158         PIN3-PIN1600           159         PIN10-PIN179           160         PIN12-PIN179           161         PIN12-PIN179           162         PIN12-PIN179           163         PIN14-PIN179           164         PIN15-PIN176							the second se	en han har an har	ine municipation and and a second a			
PLAT	165 PLAT1-PLAT2 166 PLAT2-PLAT3 167 PLAT3-PLAT4 168 PLAT3-PLAT4 168 PLAT4-PLAT5 170 PLAT5-PLAT6 170 PLAT5-PLAT6 171 PLAT7-PLAT8 172 PLAT8-PLAT9 173 PLAT9-PLAT1 180 PLON5-PLON6												
PLON	<ul> <li>181 PLONG-PLON7</li> <li>182 PLON7-PLON8</li> <li>183 PLON8-PLON9</li> <li>184 PLON9-PLON1</li> <li>185 PLON10-PLON</li> <li>186 PLON11-PLON</li> <li>187 PLON12-PLON</li> <li>188 PLON13-PLON</li> <li>189 PLON14-PLON</li> </ul>											aloni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni Suoni	
SPS	190 PLON15-PEON 197 SP57-SP58** 198 SP58-SP53** 199 SP59-SP510* 200 SP510-SP511 201 SP511-SP512 202 SMA1-SMA2** 203 SMA2-SMA3**										in the second second		
SMA	204 SMA3-SMA <sup>4+</sup> 205 SMA4-SMA <sup>5+</sup> 206 SMA5-SMA <sup>6+</sup> 207 SMA6-SMA <sup>7+</sup> 208 SMA7-SMA <sup>8+</sup> 209 SMA8-SMA <sup>9+</sup> 210 SMA9-SMA <sup>10</sup> 211 SMA10-SMA <sup>11</sup> 212 SMA11-SMA <sup>12</sup> 213 SMA12-SMA <sup>12</sup> 214 SMA13-SMA <sup>12</sup> M	mmmmm					inaman	A AMAIA ANIS ANS IN			P. Cipera est 1 UPU		2 [Tport.pr.1 (96)

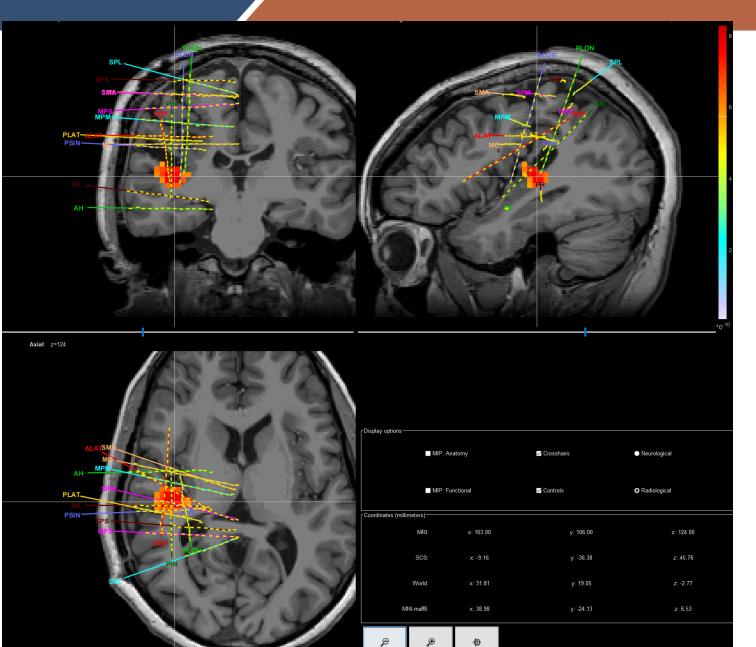
### Time-frequency decomposition on PIN 5-6



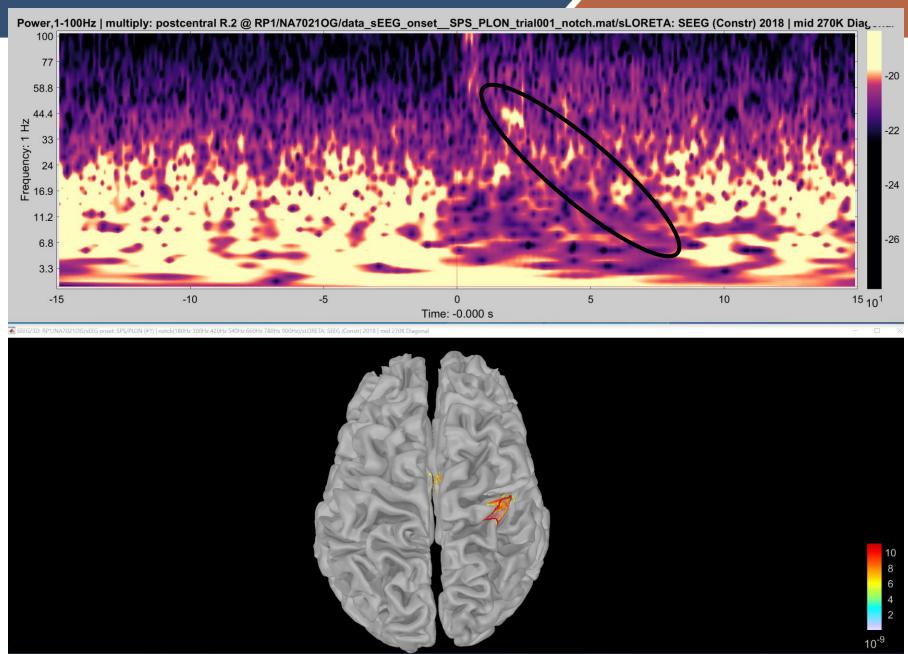
### sLORETA of rhythmic activity using filter (5-55 Hz)

3.9580 s	PLON 1/2
CO CONTRACTOR OF CONTRACTOR CONTRACTOR OF CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACT	
	7.5 8 8.5 9 9.5 10 10.5 Time (s)

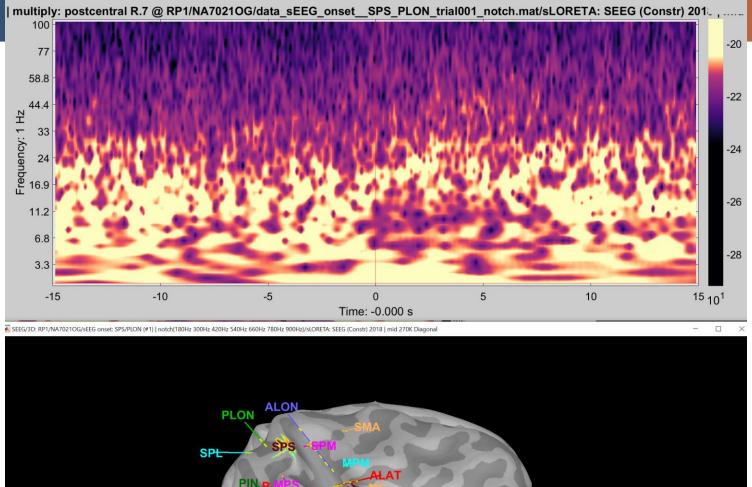
**२** ९



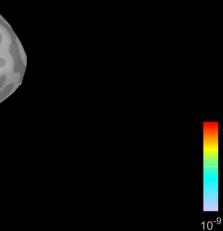
### Seizure fingerprint on Source Level



### Seizure fingerprint on Source Level



PH



### Multimodal Analysis: Case Example

Right-handed male onset of seizures as a child. Semiology: Staring, right arm immobility, left hand automatisms, unresponsiveness and hypermotor movements with post-ictal aphasia

MRI with L frontal opercular cortical dysplasia.

Underwent a phase II subdural evaluation ~ 15 years ago and was told he wasn't a resective surgery candidate

## Repeat Surgical Evaluation (External)

<u>EMU:</u>

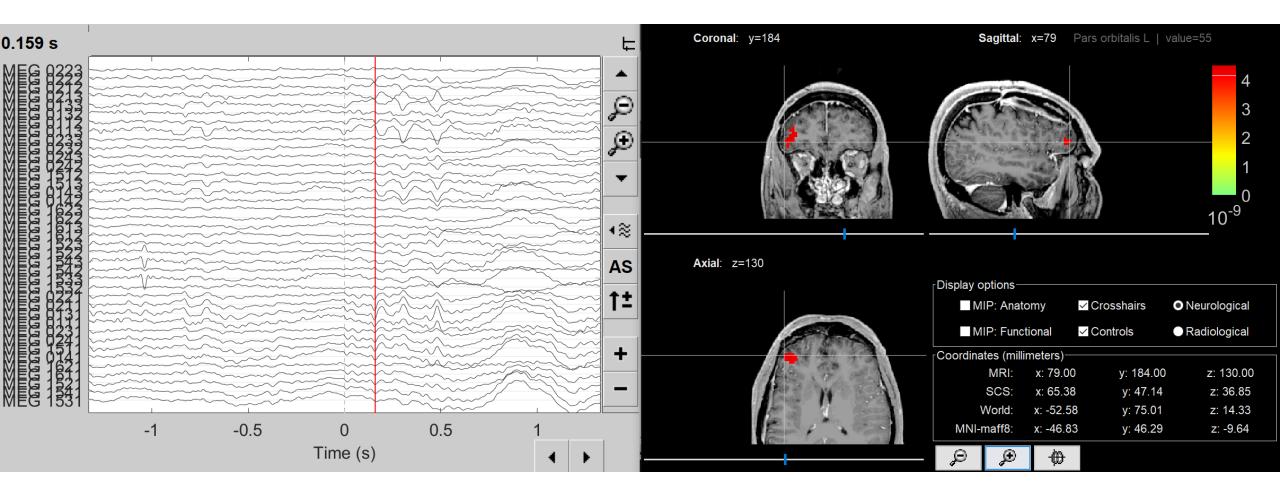
- Interictal abnormalities: Sharp waves: Left temporal
- Ictal:
  - Semiology: Staring, right arm immobility, left hand automatisms, unresponsiveness and hypermotor and post-ictal aphasia
  - EEG Seizure pattern: Left temporal delta activity

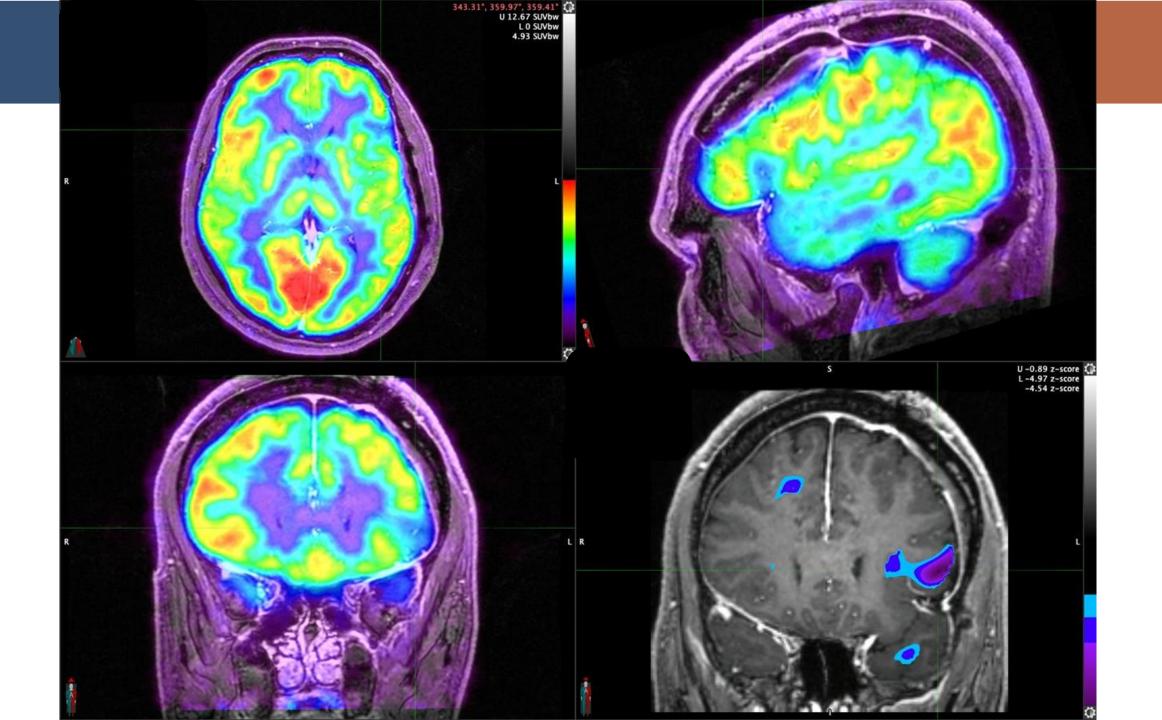
<u>MRI:</u> Post surgical changes of left craniotomy, no clear evidence of dysplasia

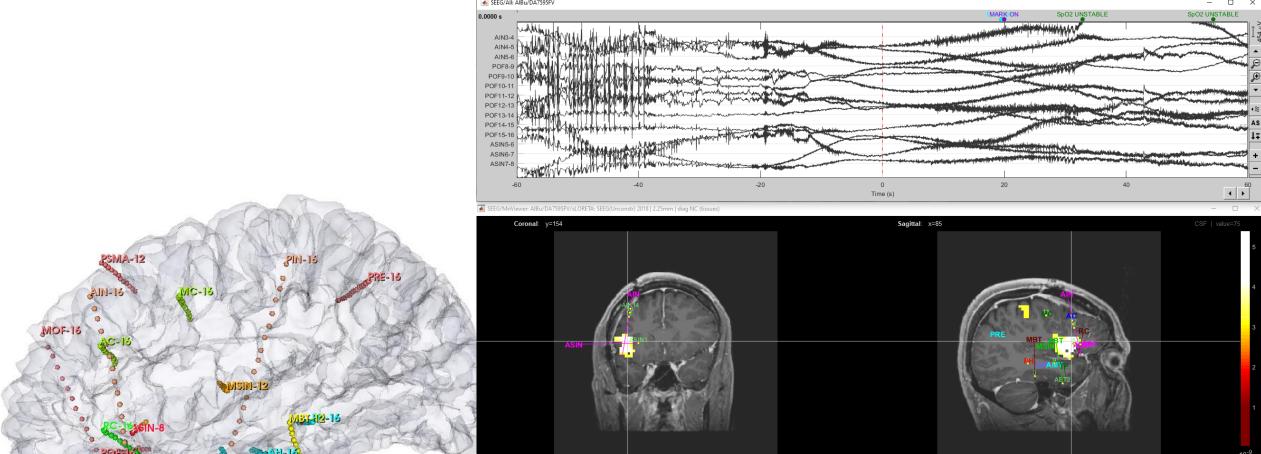
<u>PET:</u> left mesial/anterior temporal lobe hypometabolism

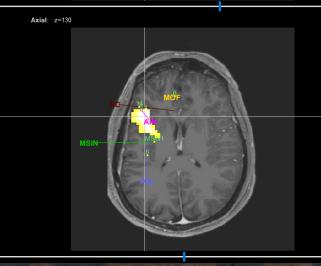
MEG: left temporal spike cluster











13 0

.....

ABT-10

Cisplay options							
MIP: Anatomy			atomy	Crosshairs	O Neurolog	O Neurological	
		MIP: Fun	octional	Controls	Radiolog	gical	
Coordinates (millimeters)							
MRI:		U:	x: 85.00	y: 154.	00	z: 130.00	
SCS:		S:	x: 37.14	y: 40.2	25	z: 46.38	
World:		d:	x: -46.58	y: 45.0	01	z: 14.33	
MNI-maff8:		8:	x: -40.30	y: 19.4	12	z: 1.13	
P	æ	⊕			Cancel	Save	

Q.⊕. •

AS

ļ∓

10<sup>-9</sup>

### **Future Directions**

# Statistical Parameters to Validate the Reliability of Modeling Result

- Confidence Volume Ellipsoids
- Taking into account density of SEEG sampling

**Automated Processing** 



The University of Texas Health Science Center at Houston

#### Texas Institute for Restorative Neurotechnologies



### Acknowledgements



Yash Vakilna, MS Research Associate



Johnson Hampson, MSBME Biomedical Engineering Manager