

October  
17-18  
NICE



# Practical VT ablation cases with high density mapping

with the Rhythmia system

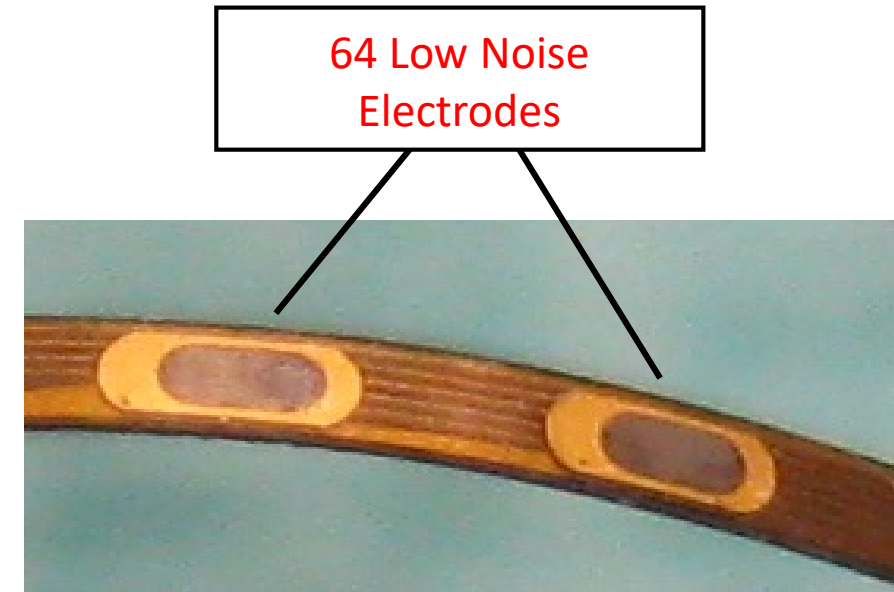
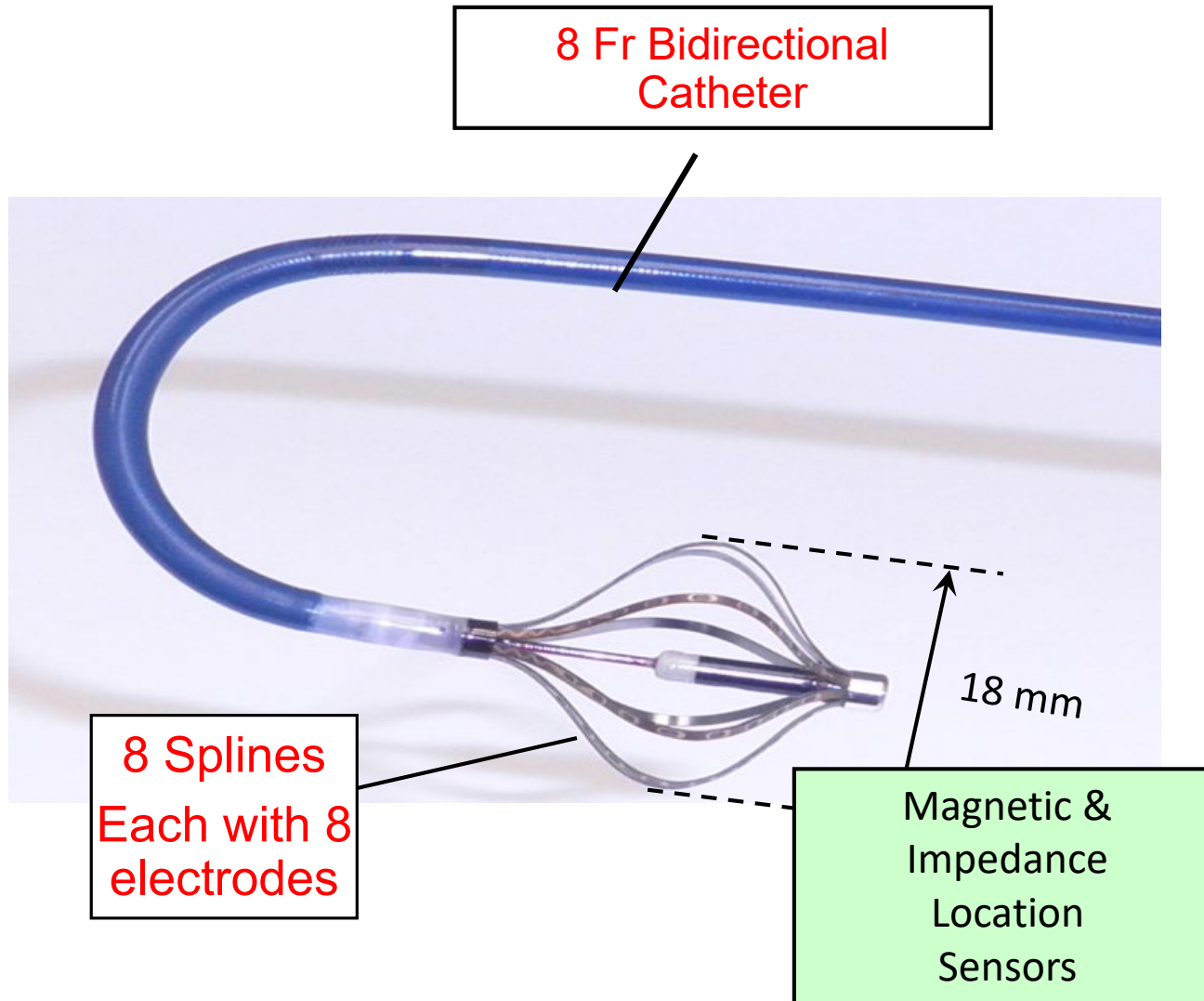
P Maury, University Hospital Toulouse France

## **Disclosure**

P Maury

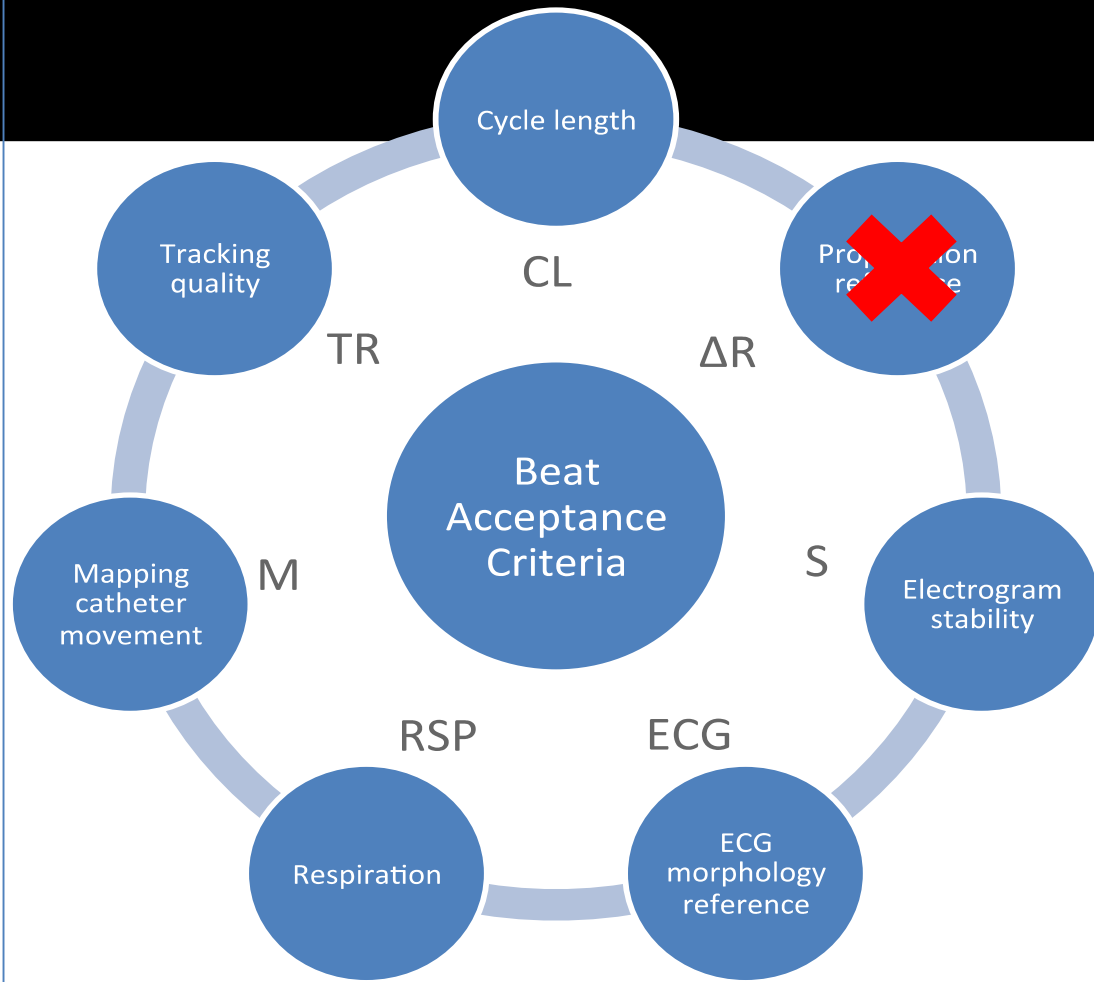
I do not have any potential conflict of interest

## Mini-Basket Electrode Catheter (Orion, Boston Scientific)



2.5 mm inter-electrode

0.4 mm<sup>2</sup>

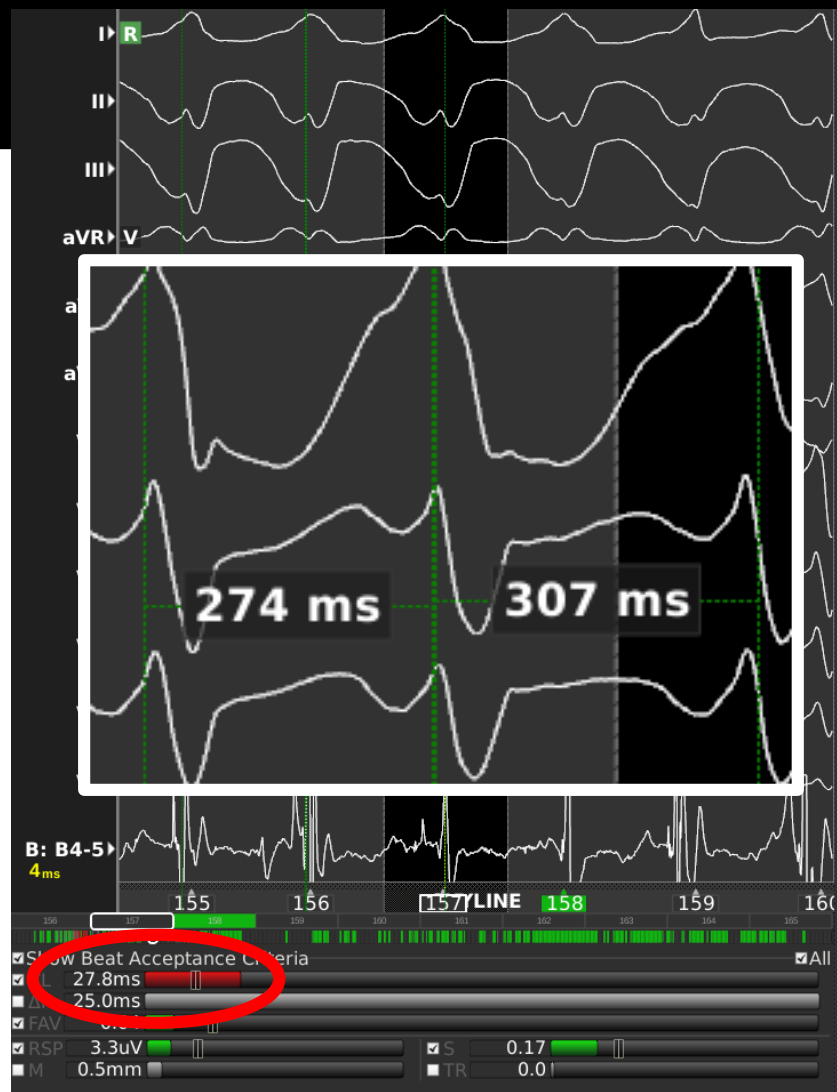


a very solid and clever algorithm for VT

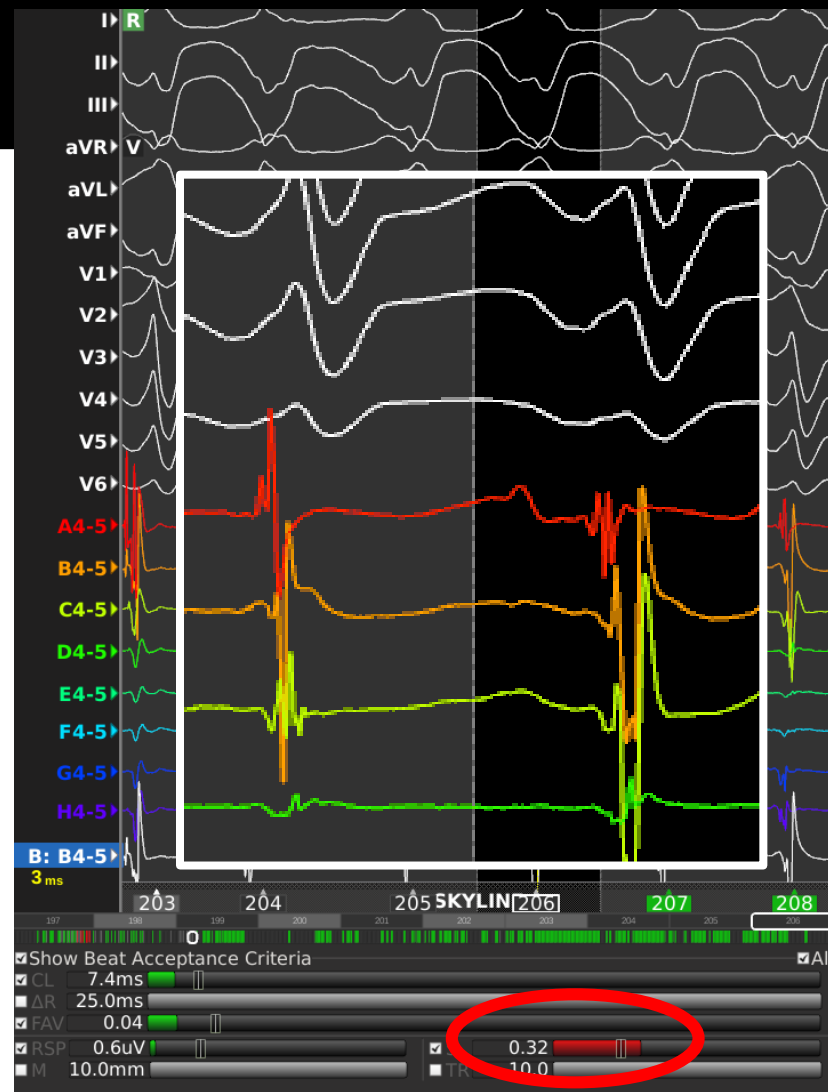
Show Beat Acceptance Criteria  All

<input checked="" type="checkbox"/> CL	21.2ms	<div style="width: 20%; background-color: green;"></div>	<input type="checkbox"/>
<input type="checkbox"/> $\Delta R$	25.0ms	<div style="width: 0%; background-color: gray;"></div>	<input type="checkbox"/>
<input checked="" type="checkbox"/> FAV	0.04	<div style="width: 10%; background-color: green;"></div>	<input type="checkbox"/>
<input checked="" type="checkbox"/> RSP	15.7uV	<div style="width: 80%; background-color: green;"></div>	<input type="checkbox"/>
<input checked="" type="checkbox"/> M	0.1mm	<div style="width: 5%; background-color: green;"></div>	<input type="checkbox"/>
<input type="checkbox"/> S	0.00	<div style="width: 0%; background-color: gray;"></div>	<input type="checkbox"/>
<input checked="" type="checkbox"/> TR	0.0	<div style="width: 0%; background-color: green;"></div>	<input type="checkbox"/>

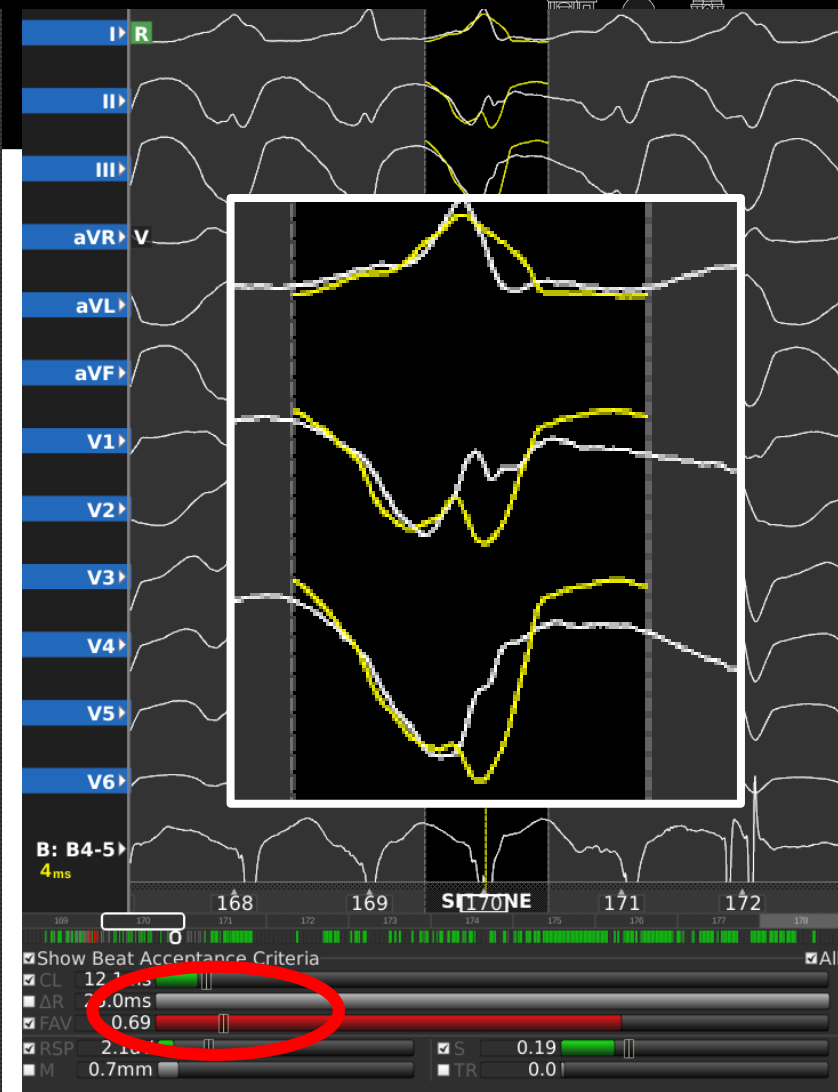




Cycle length

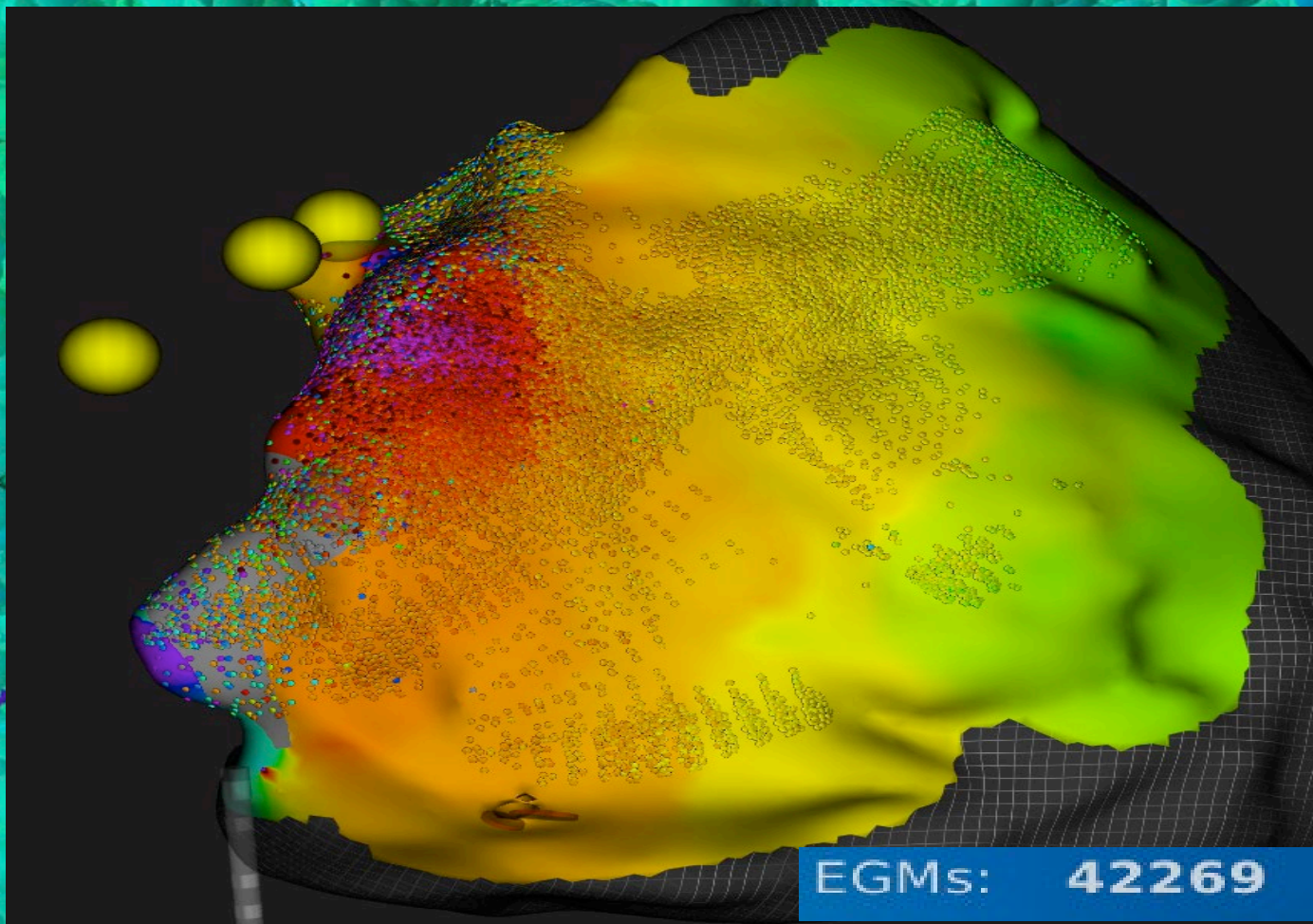


stability



morphology

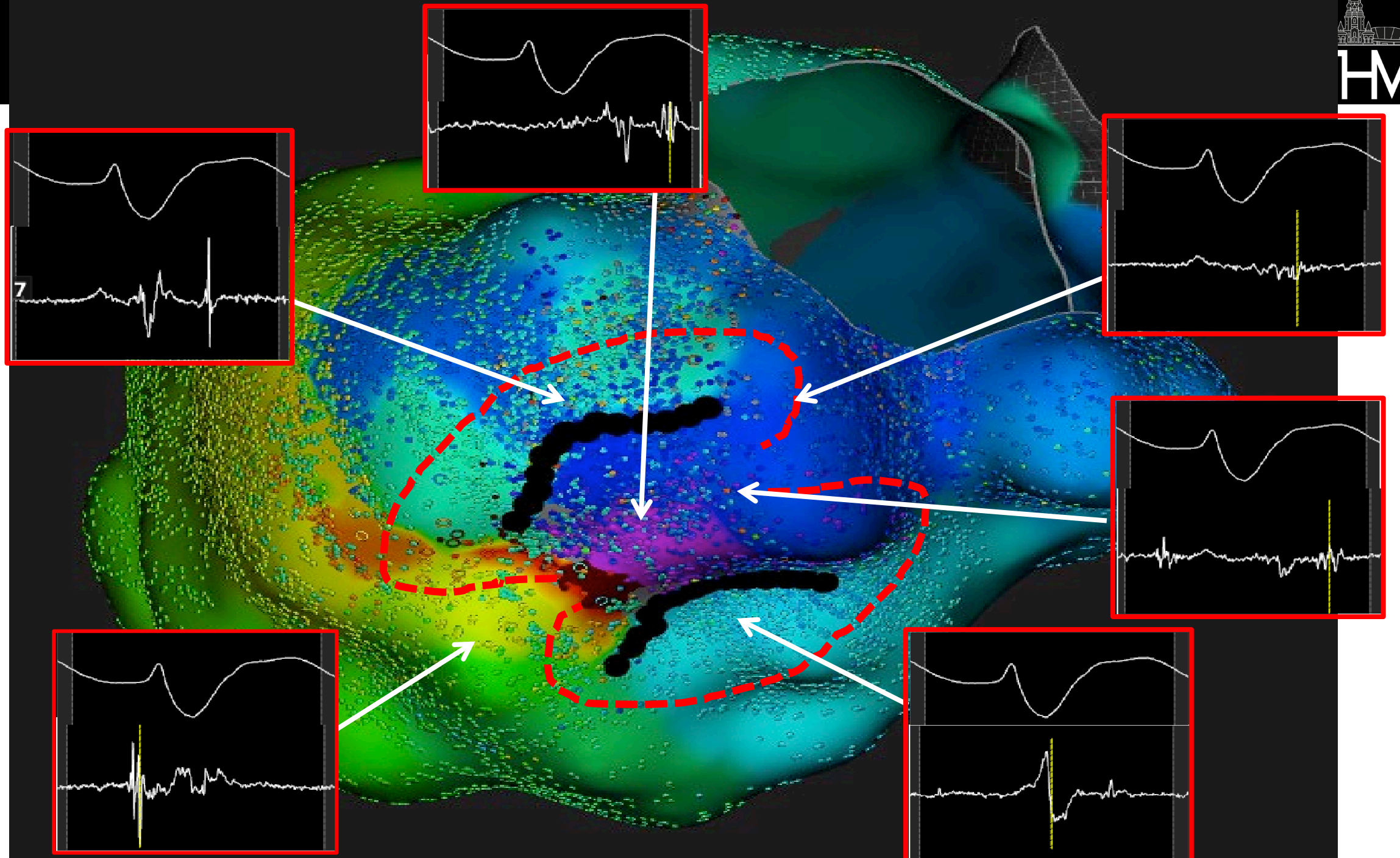


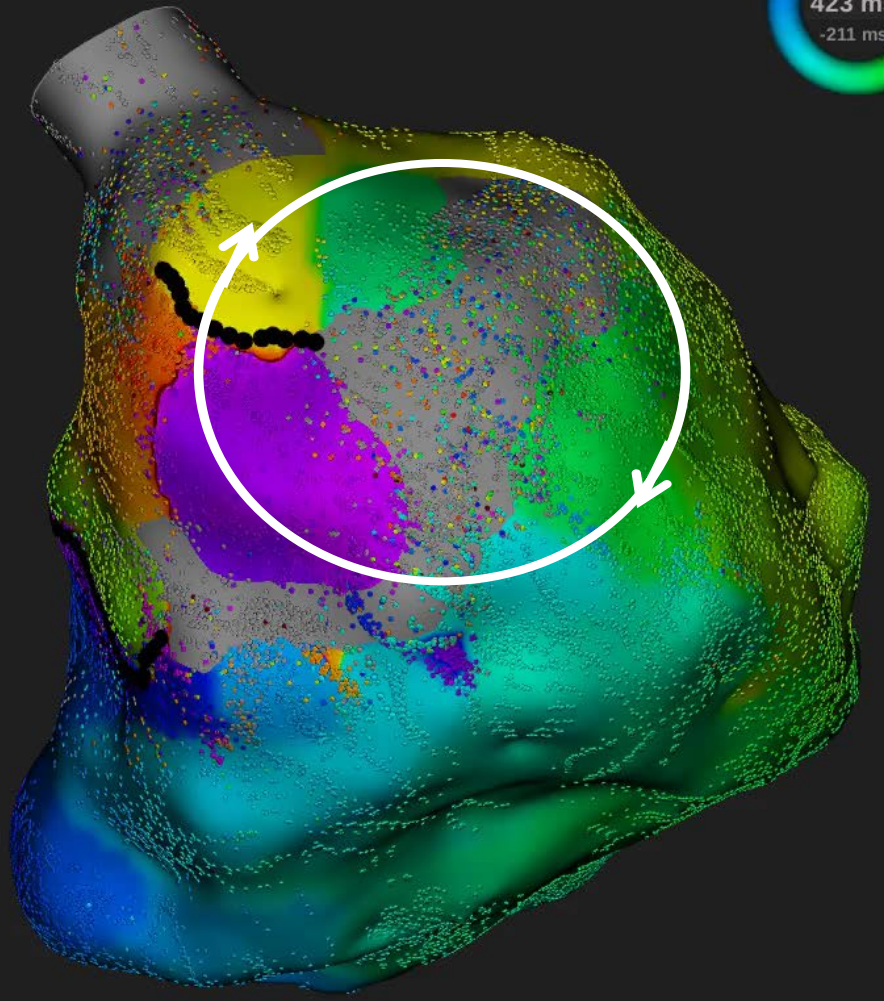
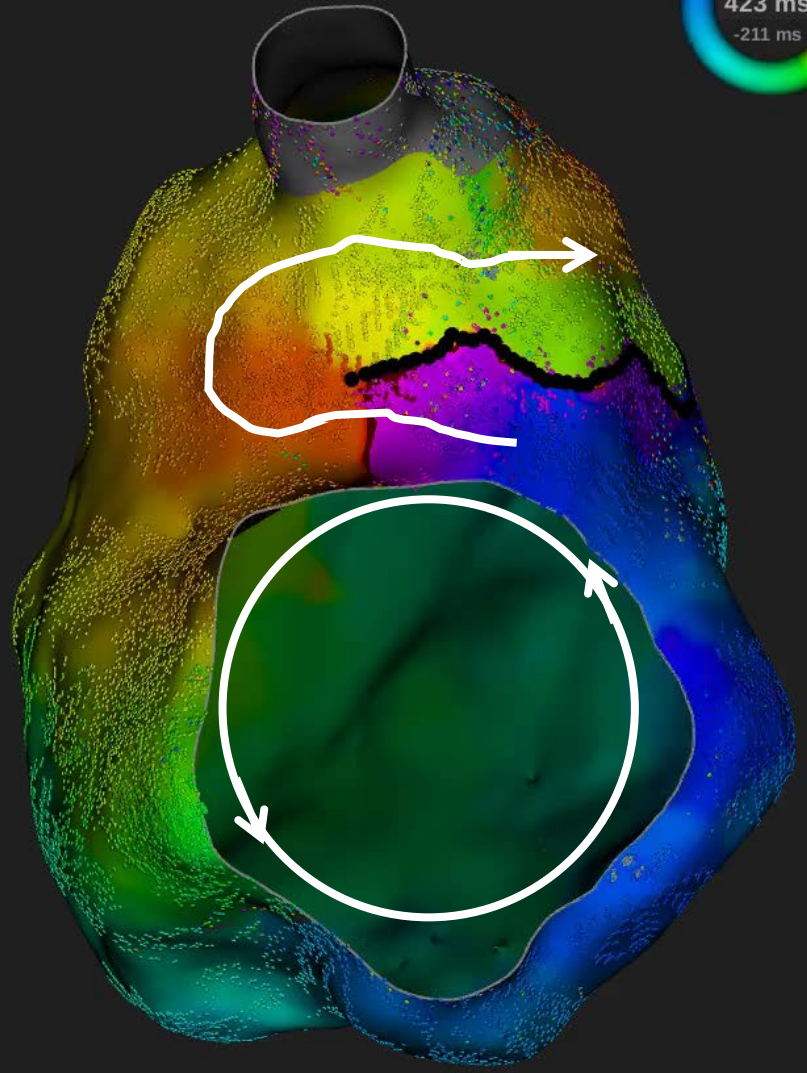
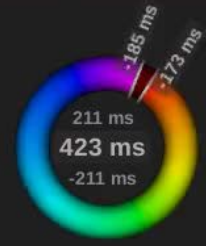


**TO ALLOW ULTRA HIGH DEFINITION**









Auto



INF

SUP

RL

LL

RAO

LAO

PA

AP



Time: 45:18

Beats: 5073

Volume: 607.12 cc

EGMs: 51291



Auto



INF

SUP

RL

LL

RAO

LAO

PA

AP



Time: 45:18

Beats: 5073

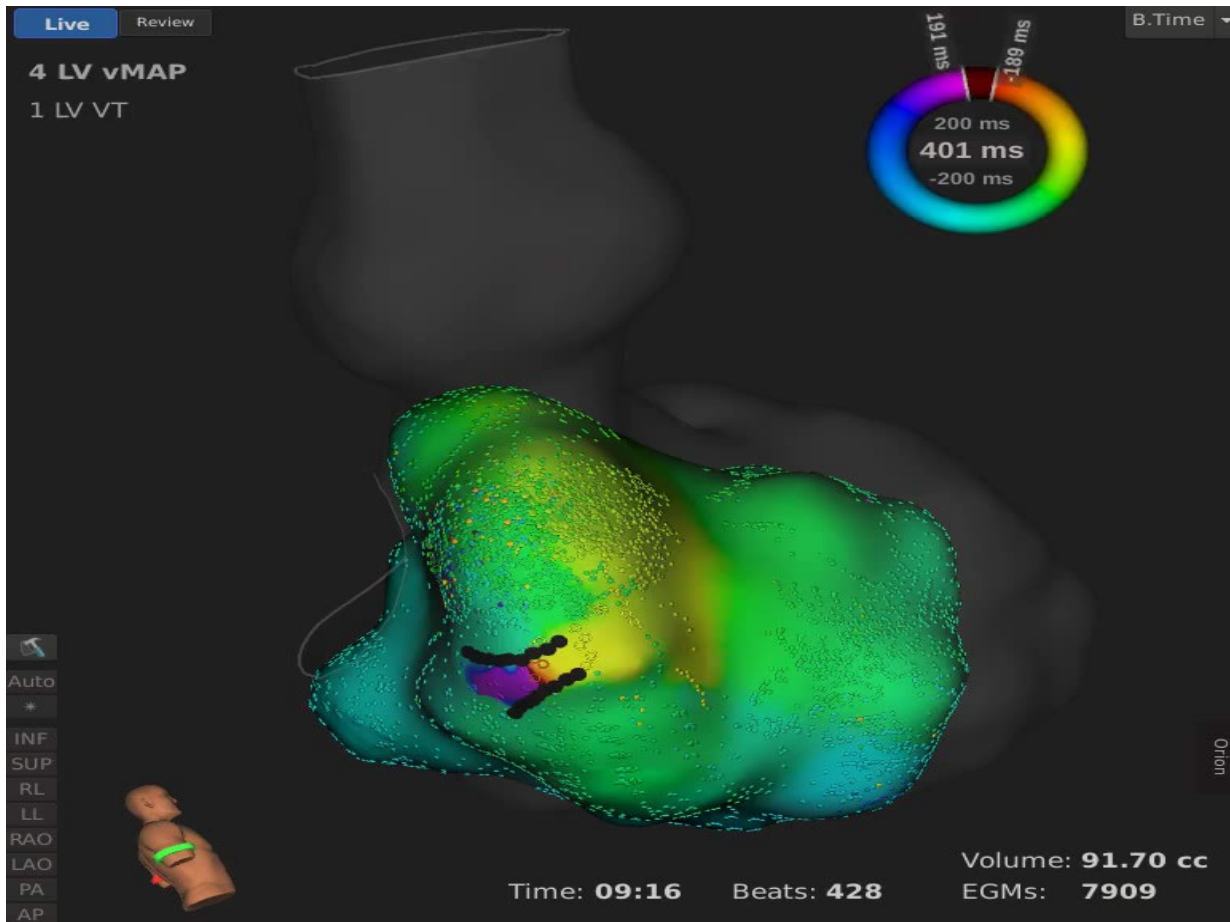
Volume: 607.12 cc

EGMs: 51291

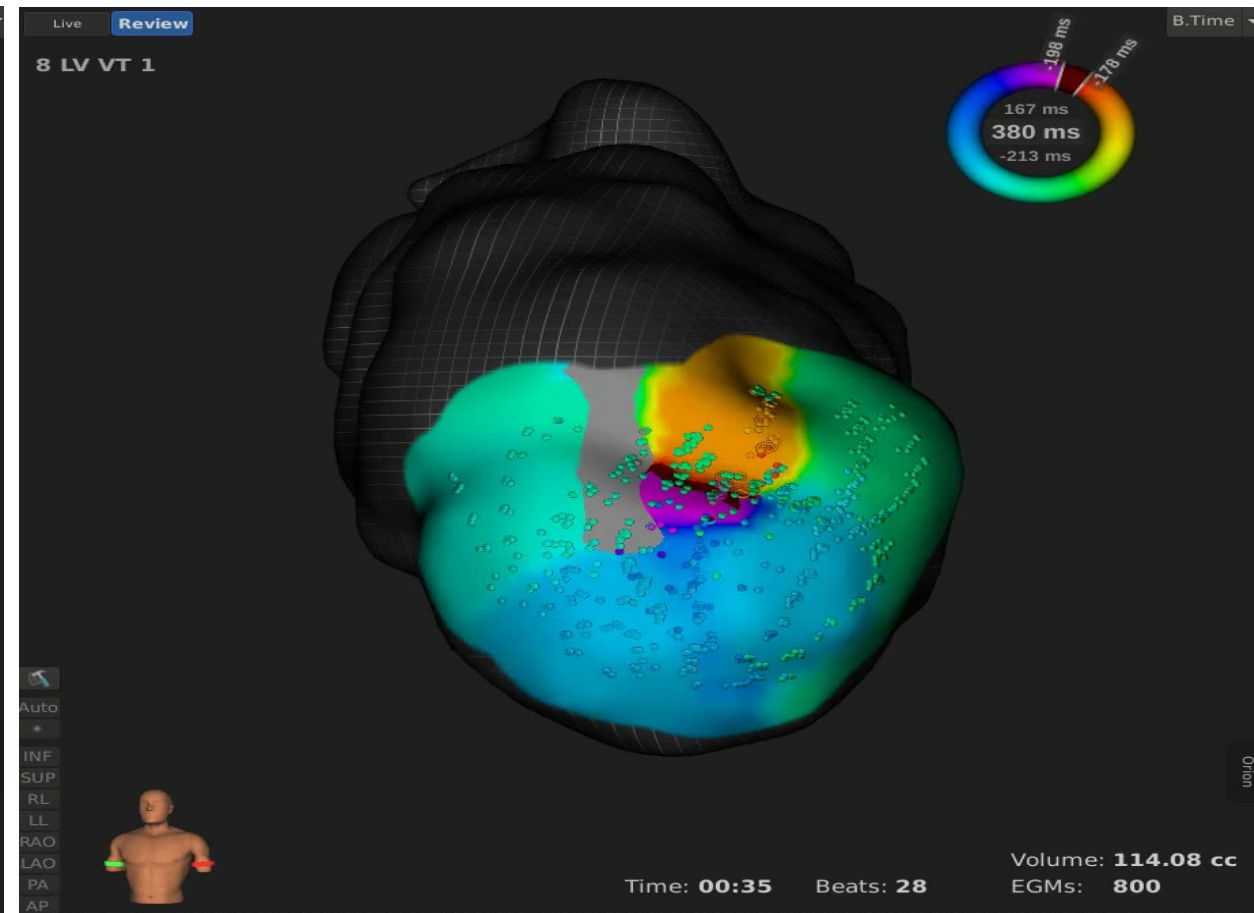
# ... Very Quick Mapping ...



9 min  
8000 points



800 points  
35 sec



courtesy from F Sacher



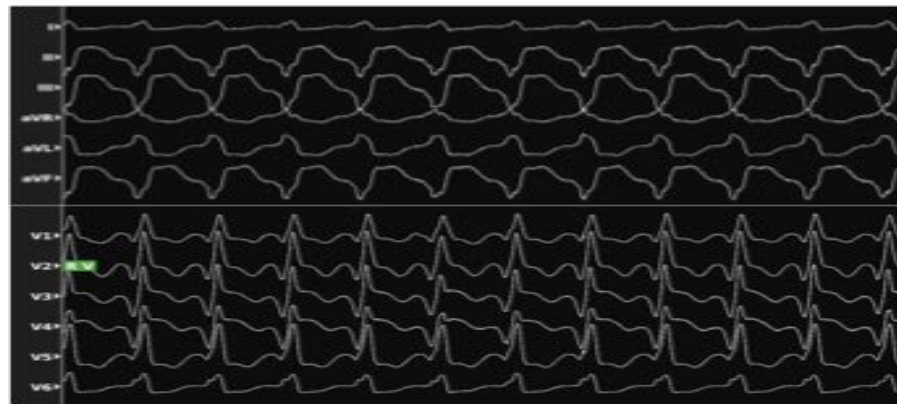
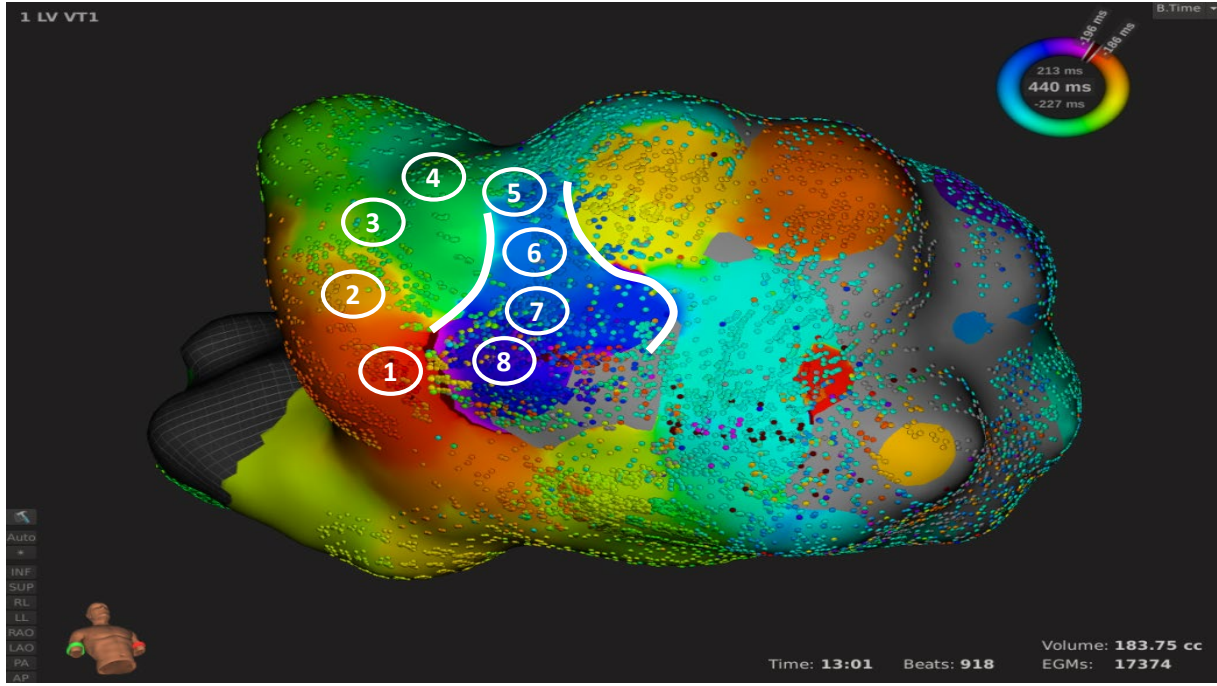
# Analysis of some VT circuits



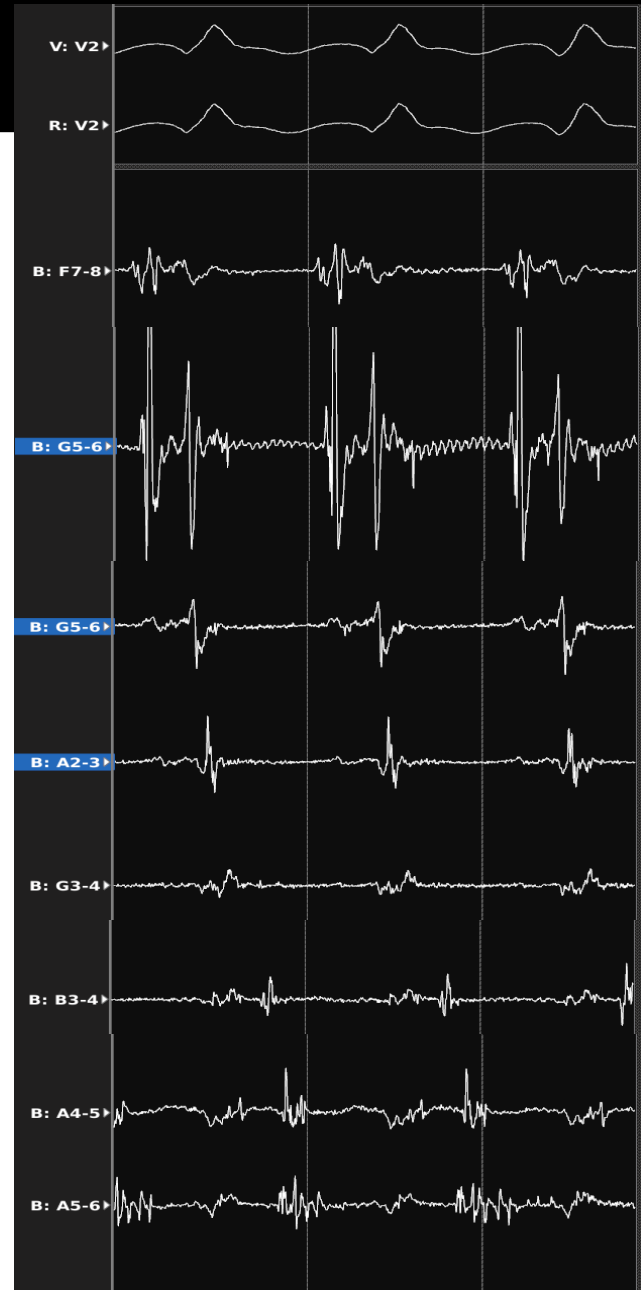
## Crossroads or “Flyovers” novel insights into ventricular tachycardia mechanisms: The path is twisting

Philippe Maury MD<sup>1,2</sup>  | Anne Rollin MD<sup>1</sup> | Xavier Waintraub MD<sup>3</sup> |  
Stefano Capellino BE<sup>4</sup> | Estelle Gandjbakhch MD, PhD<sup>3</sup>

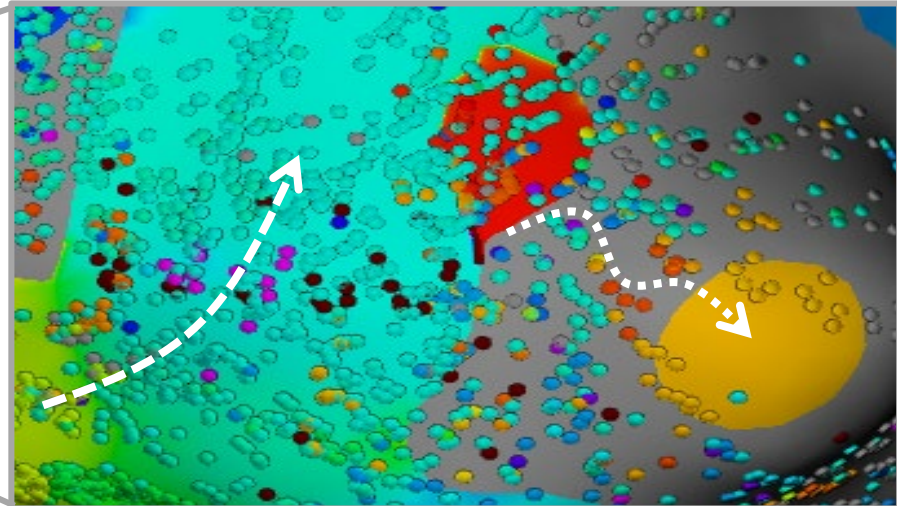
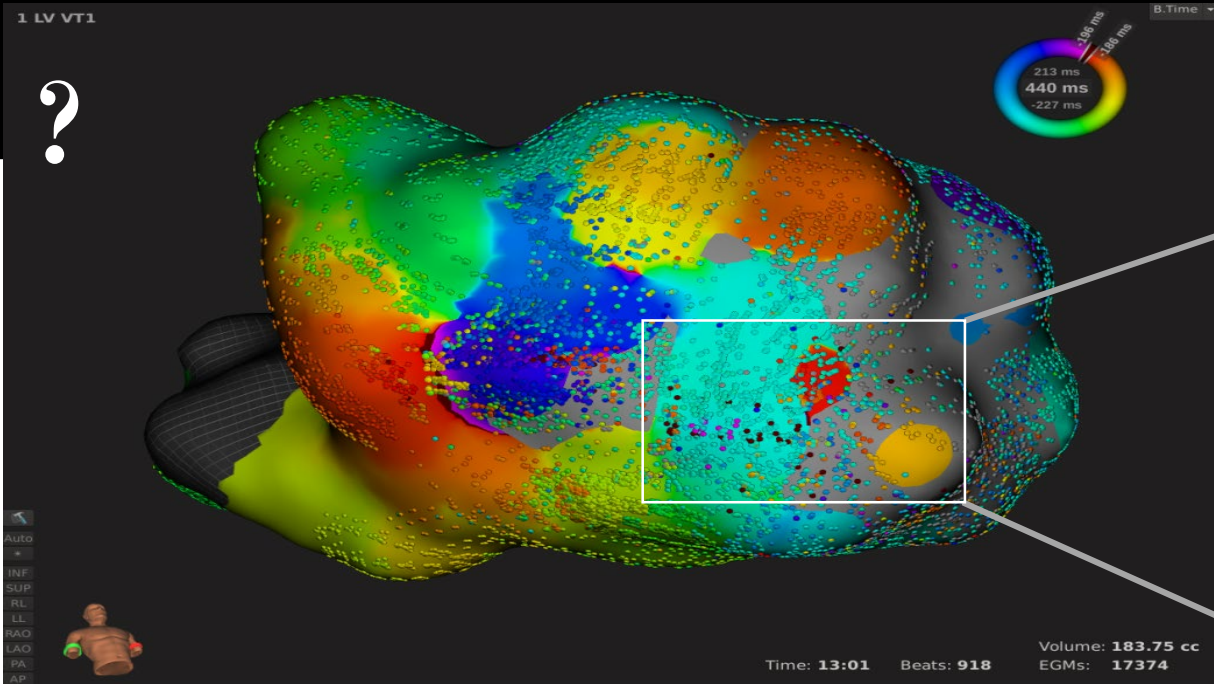
PACE 2018



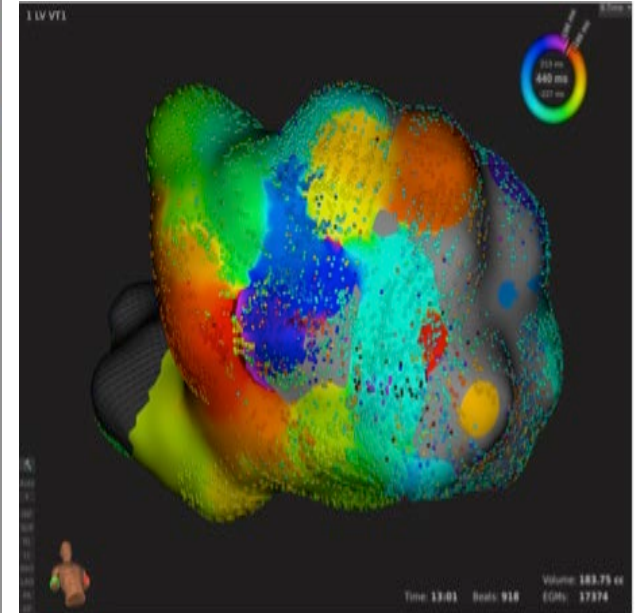
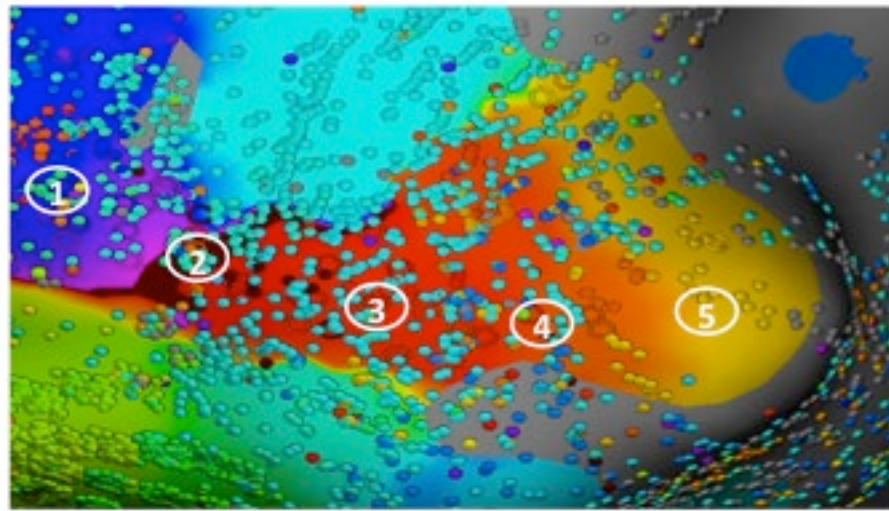
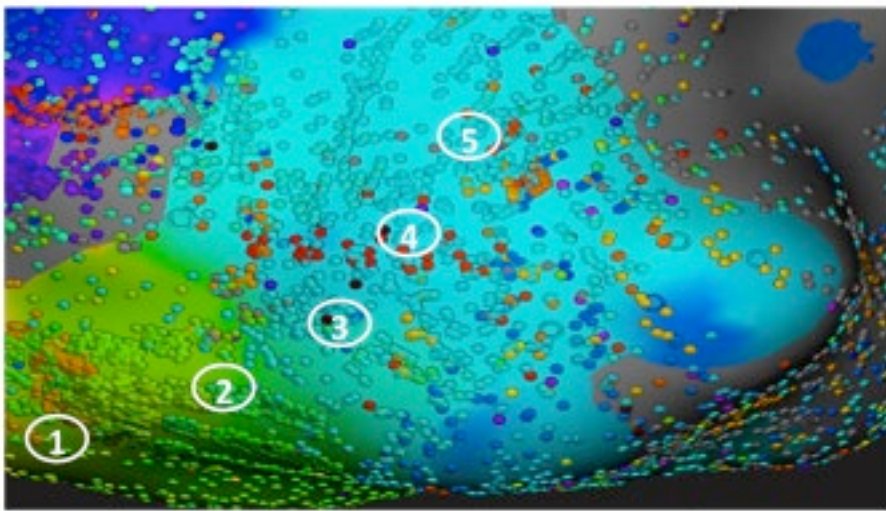
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

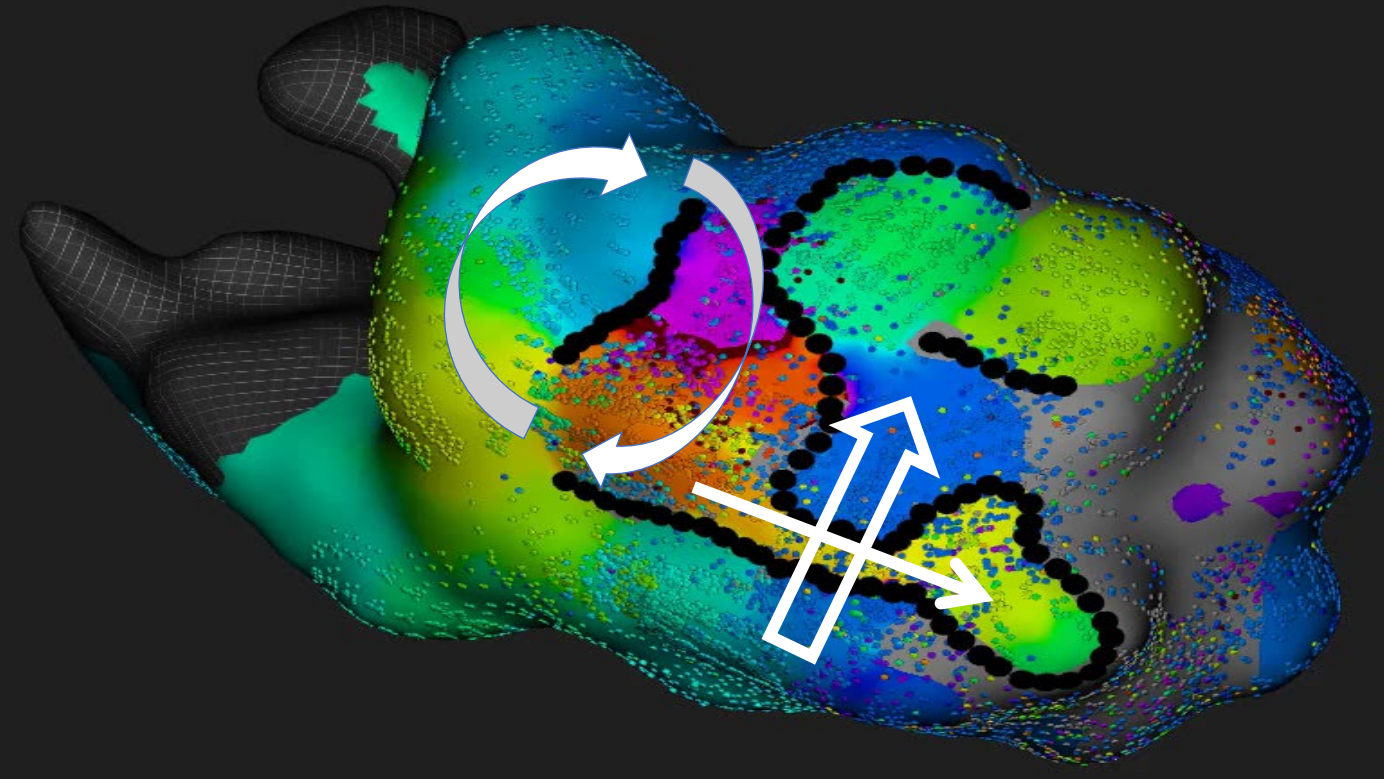












- Auto
- \*
- INF
- SUP
- RL
- LL
- RAO
- LAO
- PA
- AP



Time: 13:01    Beats: 918

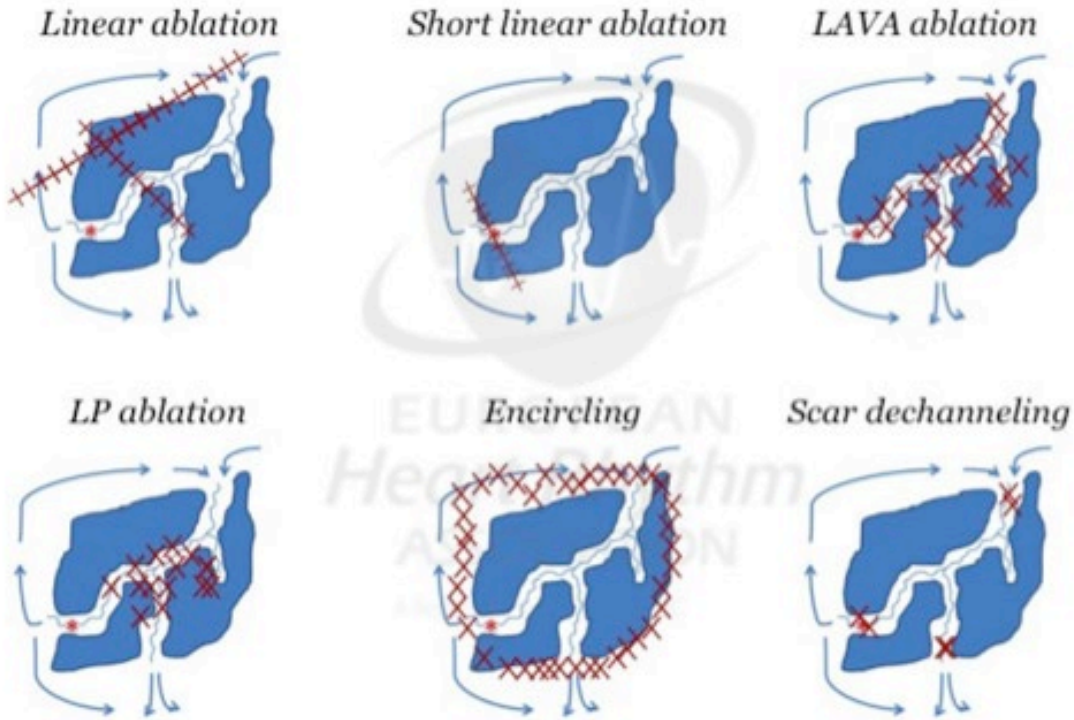
Volume: 190.96 cc  
EGMs: 17211



# Substrate mapping using UHD ?



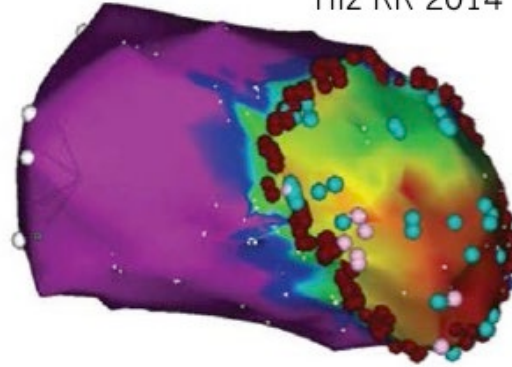
## Substrate ablation – Different Approaches



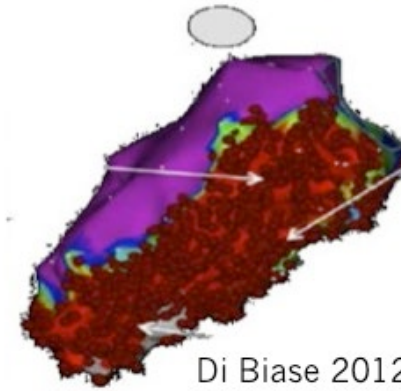
Marchlinski FE, et al. Circulation 2000. Arenal A, et al. Circulation 2003. Reddy VY, et al. JACC 2003. Jais P, et al. Circulation 2012. Jais P, et al. Circulation 2013. Berruezo A et al. Circ AE 2012.

isolation

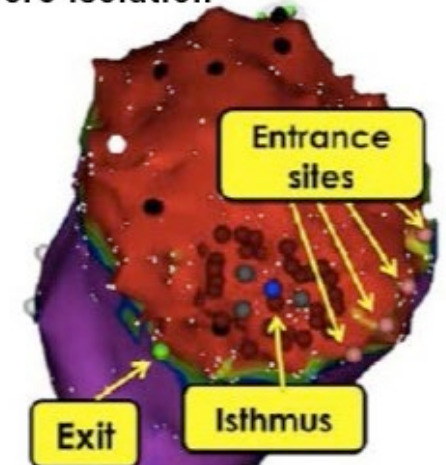
Tilz RR 2014



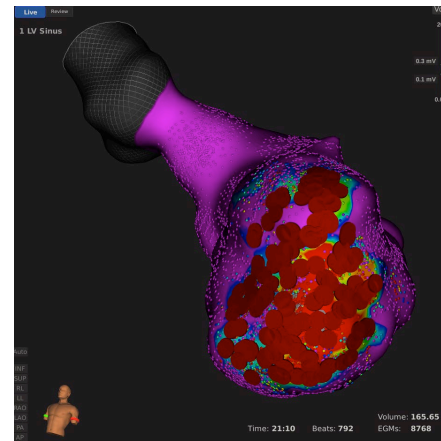
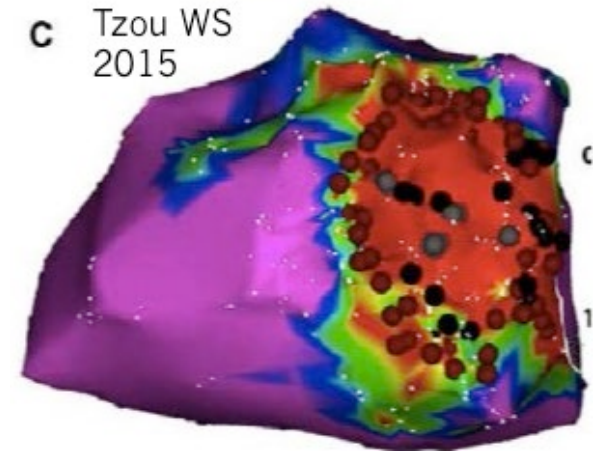
Scar homogenization



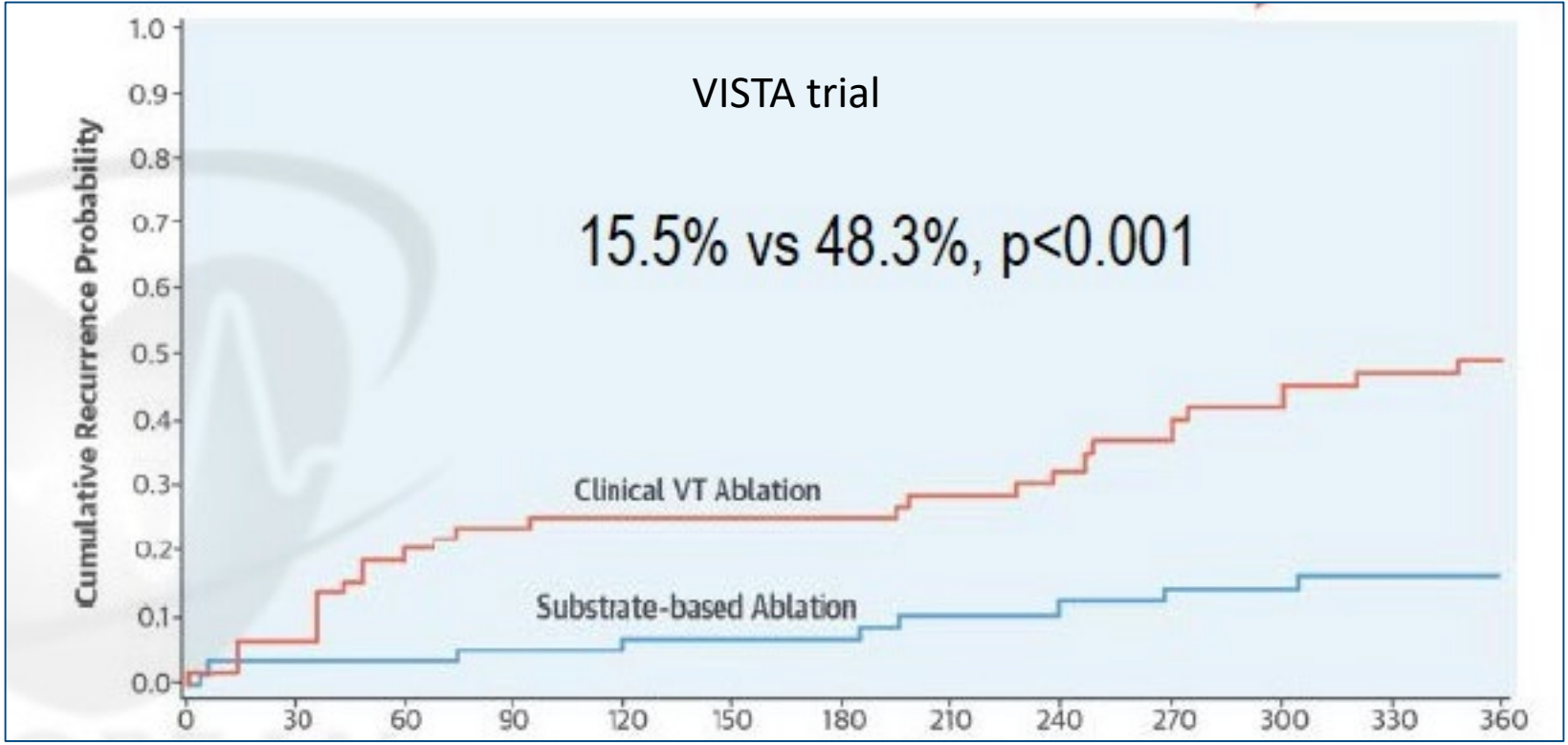
Core isolation



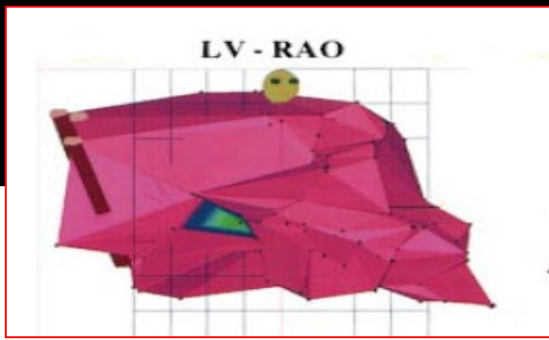
C Tzou WS 2015



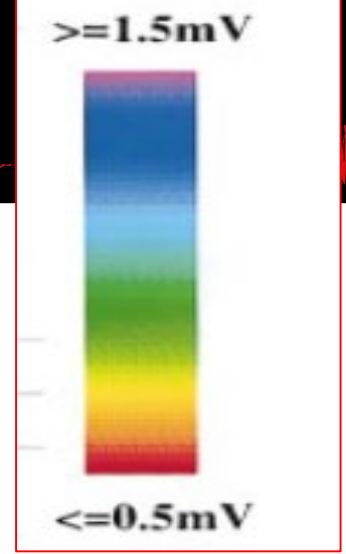
# Substrate vs activation mapping



Di Biase L et al. J Am Coll Cardiol 2015;66:2872-82



« historically »



**reference values for distinguishing normal and abnormal EGMs**

*Carto and Navistar catheter*

RV (4 patients) and/or LV (4 patients) in 6 patients without structural heart disease.  
71 to 168 **endocardial** sites/ventricle

mean bipolar electrogram amplitude normal RV  $3.76 \pm 1.7$  mV

95% of all RV bipolar electrogram  $> 1.44$  mV

mean bipolar electrogram amplitude normal LV  $4.86 \pm 3.1$  mV

95% of all LV bipolar electrograms  $> 1.55$  mV

On the basis of our previous experience with catheter and intraoperative mapping, we then arbitrarily designated a value of  $< 0.5$  mV as consistent with “densely scarred” endocardium

**Linear Ablation Lesions for Control of Unmappable Ventricular Tachycardia in Patients With Ischemic and Nonischemic Cardiomyopathy**

Francis E. Marchlinski, MD; David J. Callans, MD; Charles D. Gottlieb, MD; Erica Zado, PA-C

## bipolar electrogram amplitude



- amount of healthy tissue under electrode
- size of electrode and bipole
- hypertrophy of CM
- direction of activation, dipole orientation
- synchronization of cells
- refractory periods (cycle length)
- contact
- filtering
- impedance
- amplification
- animal model

**only one voltage scale is not correct  
need to be adapted to each case**



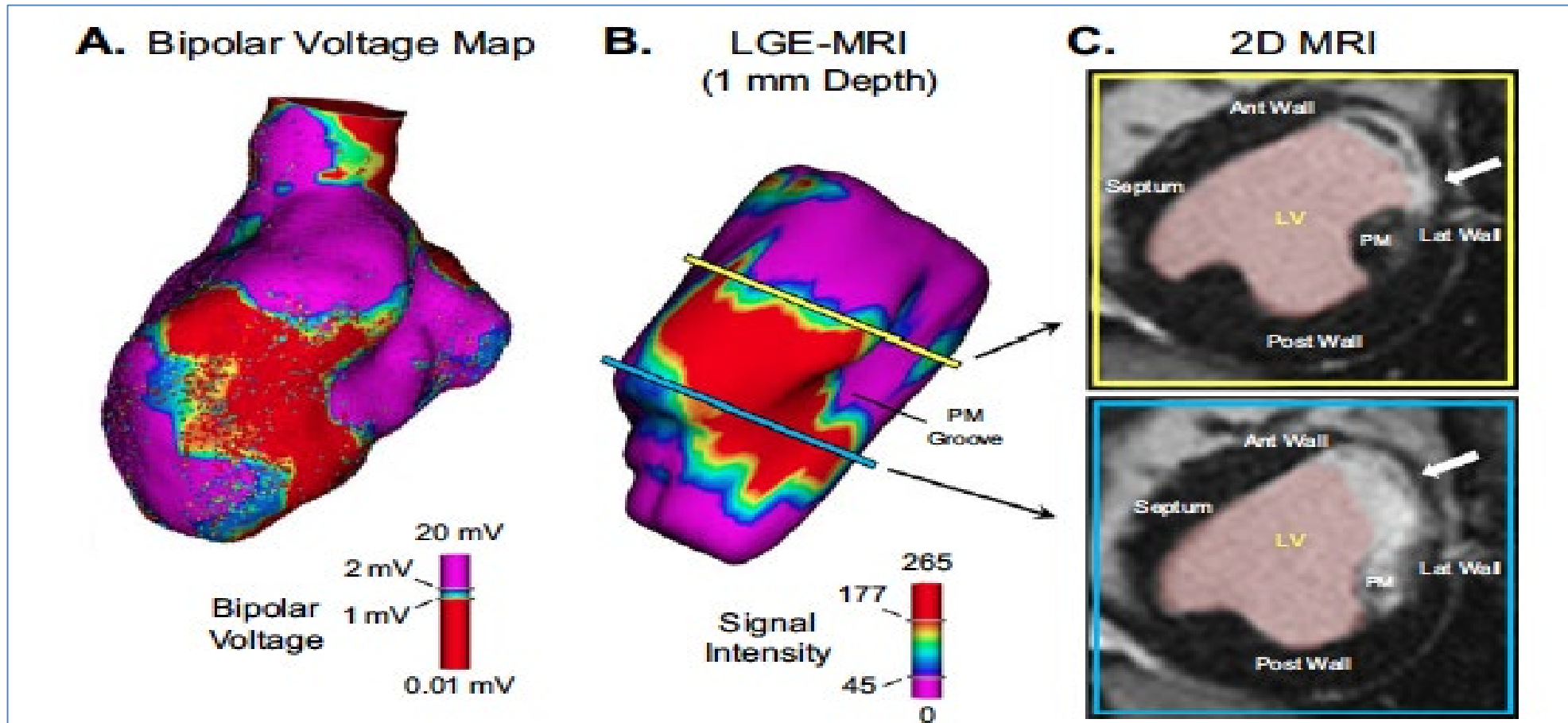
# Correlation of Scar in Cardiac MRI and High-Resolution Contact Mapping of Left Ventricle in a Chronic Infarct Model

ANEES THAJUDEEN, M.D.,\* WARREN M. JACKMAN, M.D.,† BRIAN STEWART, M.S.,‡  
IVAN COKIC, M.D.,§ HIROSHI NAKAGAWA, M.D., Ph.D.,† MICHAEL SHEHATA, M.D.,\*  
ALLEN M. AMORN, M.D.,\* AVINASH KALI, M.S.,§,¶ EZH LIU, M.D.,\*  
DORON HARLEV, M.Sc.,‡ NATHAN BENNETT, M.Eng.,‡  
ROHAN DHARMAKUMAR, Ph.D.,§,¶ SUMEET S. CHUGH, M.D.,\*,\*\*  
and XUNZHANG WANG, M.D.\*



mean resolution of  $2.8 \pm 0.6$  mm

excellent correlation of areas of low voltage and scars on MRI in dog infarctions  
using 1-2 mV scale



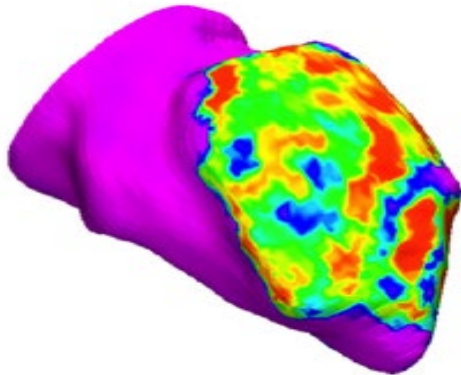


**Utility of high-resolution electroanatomic mapping of the left ventricle using a multispline basket catheter in a swine model of chronic myocardial infarction** ©

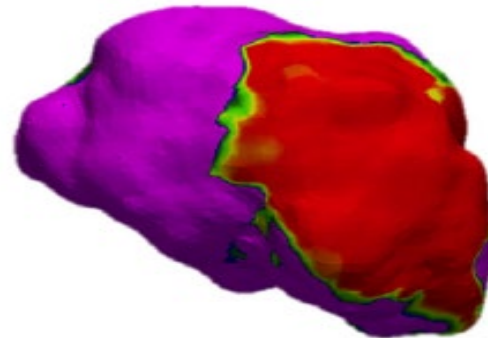
Yasuaki Tanaka, MD, Martin Genet, PhD, Lik Chuan Lee, PhD, Alastair J. Martin, PhD, Richard Sievers, BS, Edward P. Gerstenfeld, MD, FHRS

**Heart Rhythm 2015;12:144–154**

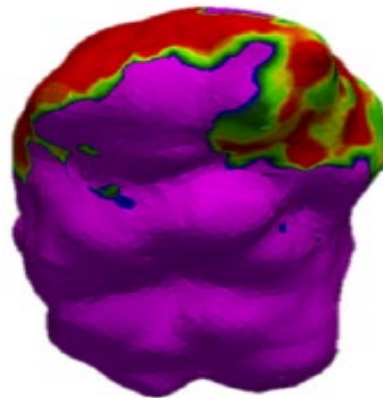
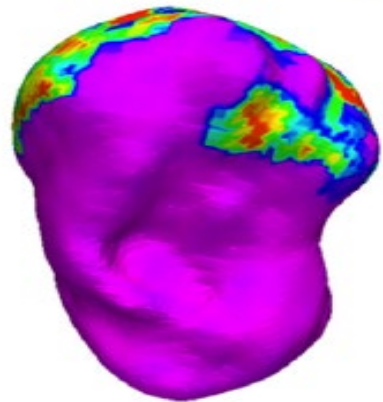
MRI



Basket Voltage Map



RAO

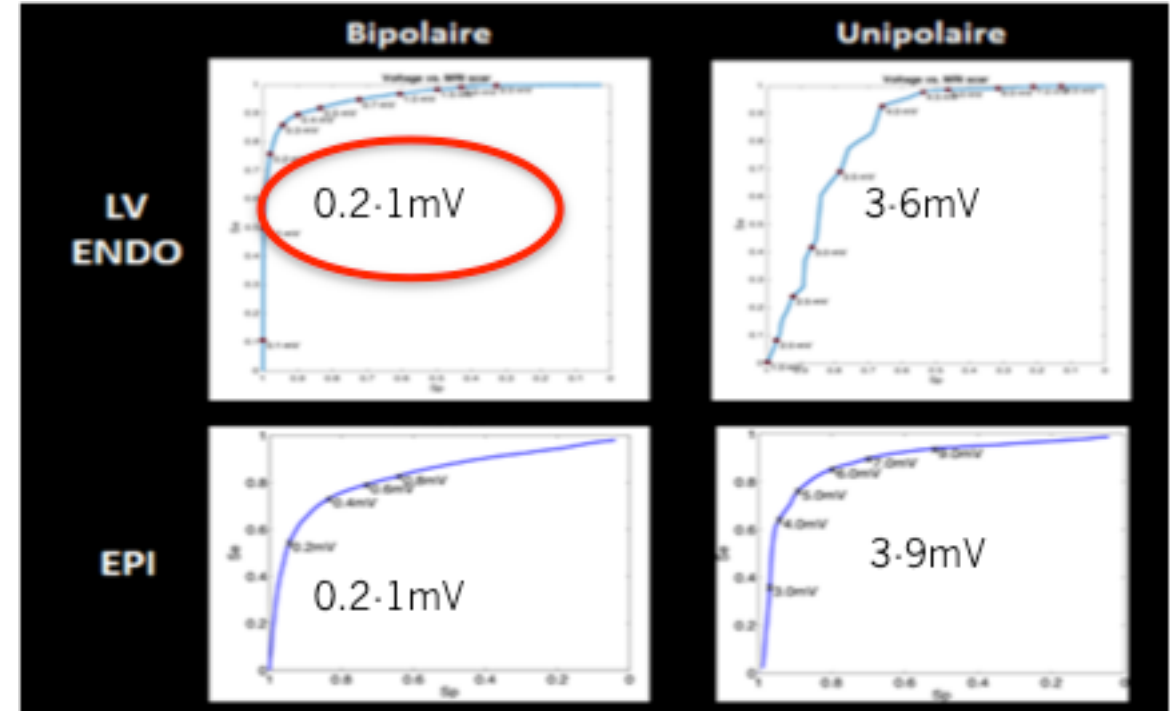
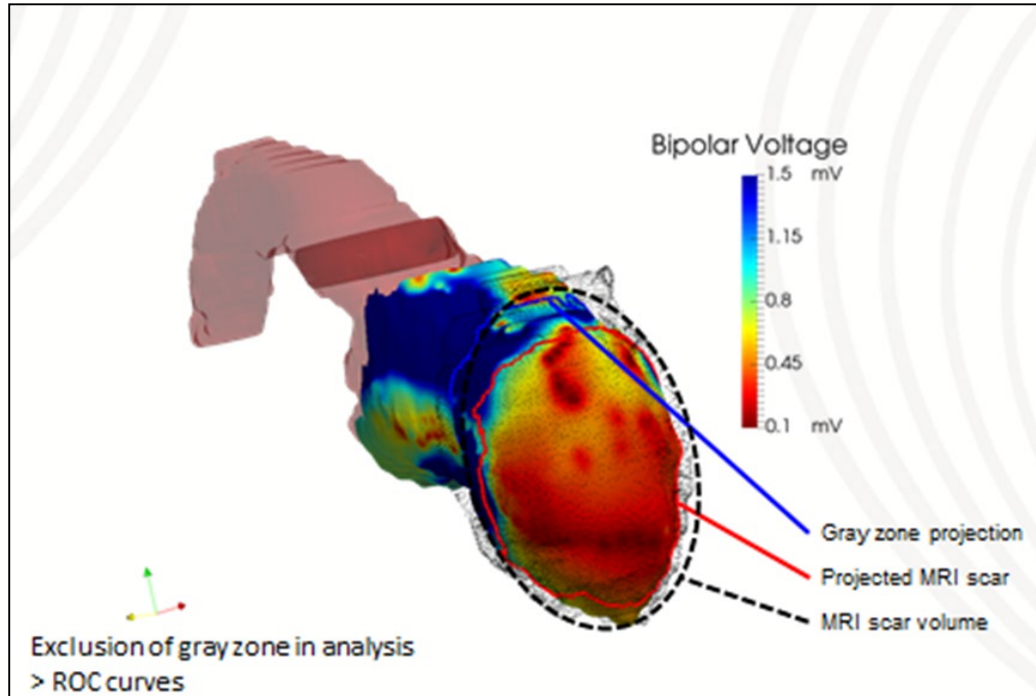


Inferior

scale 0.5-1.5 mV

infarction in swine  
95% normal value  
in healthy myocardium  
**> 1.5 mV**

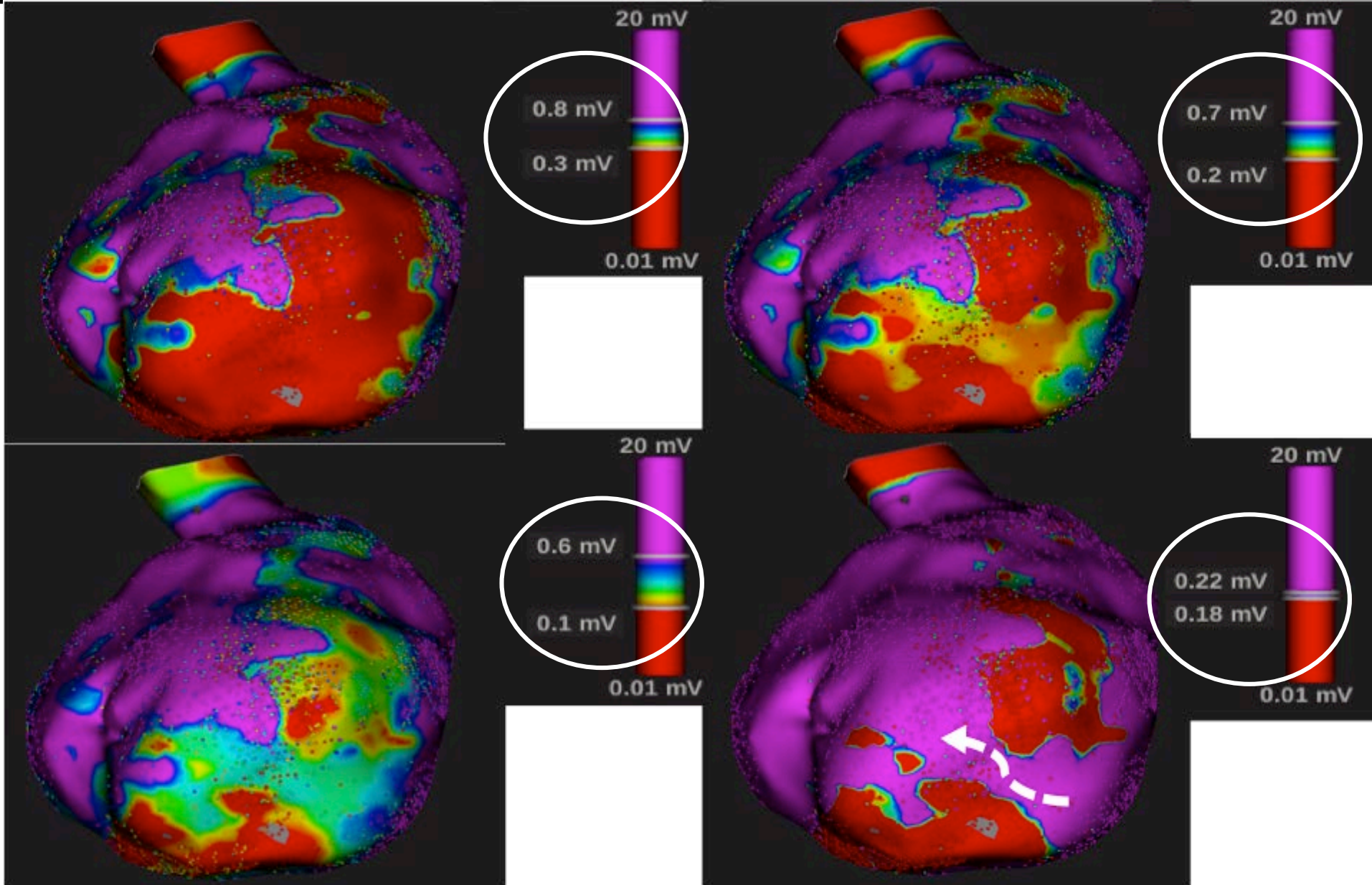
# Voltage Threshold



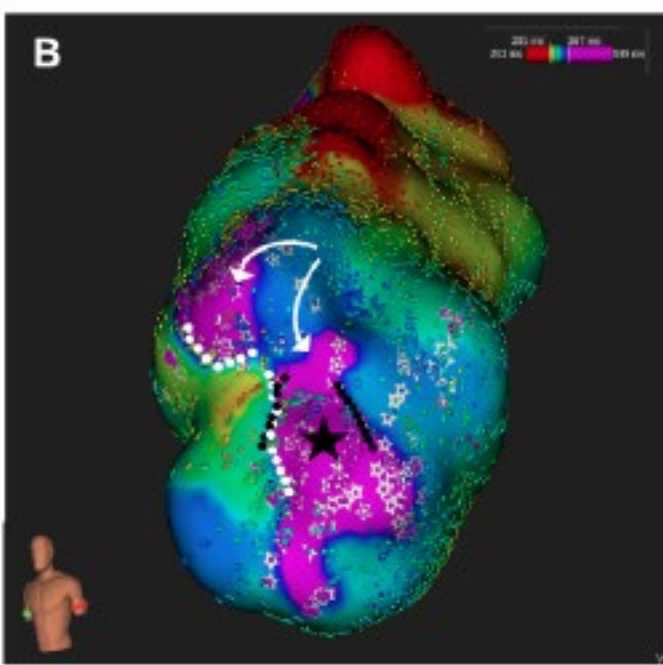
Sacher F. et al. PO 04-130 HRS 2017

- In 8 chronically infarcted ovine
  - MRI
  - Endo-epi map with Orion (Rhythmia system)
  - Endo:  $8012 \pm 3370$  points, Epi:  $30232 \pm 10530$  pts
- Fusion and determination of voltage tsd

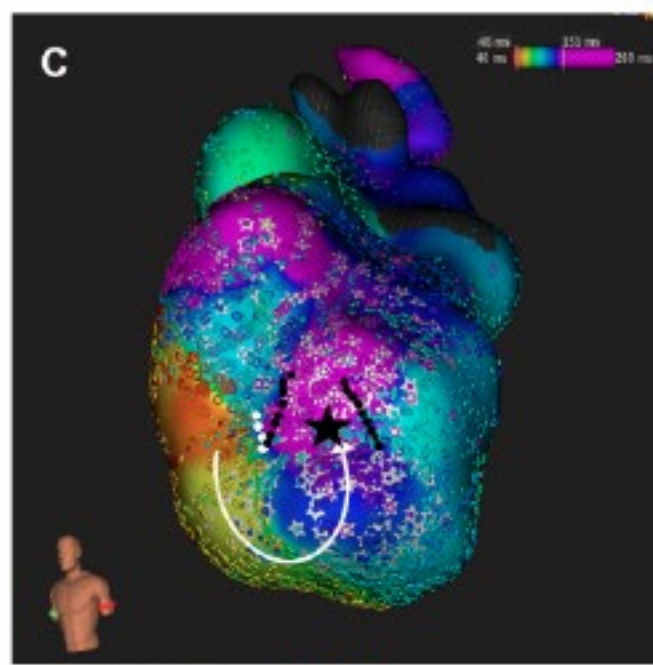
# Voltage Threshold



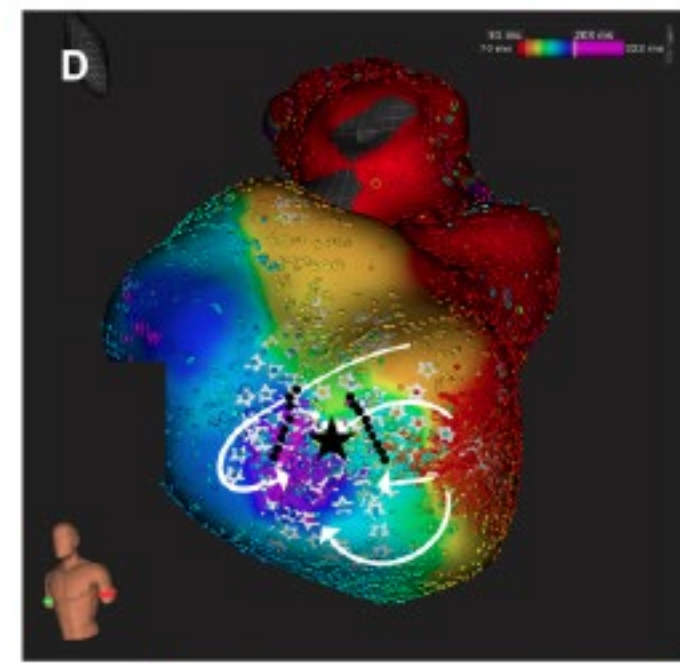




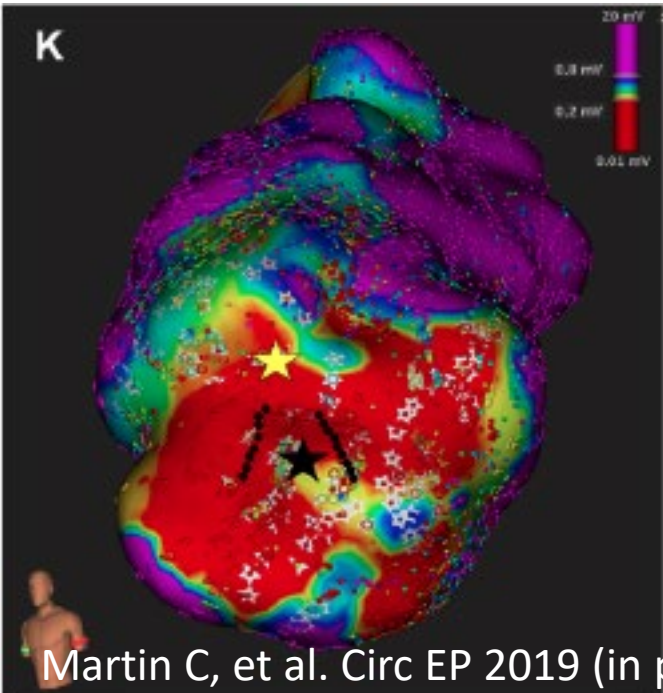
Atrial pacing



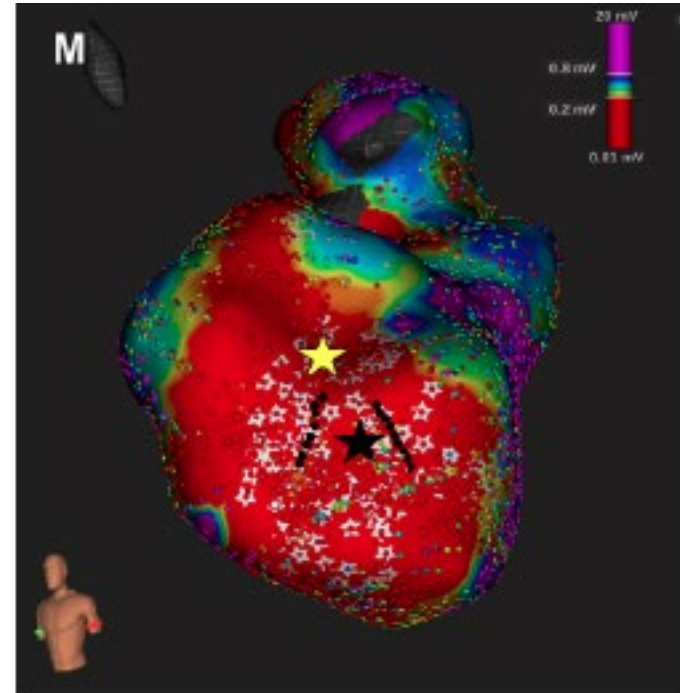
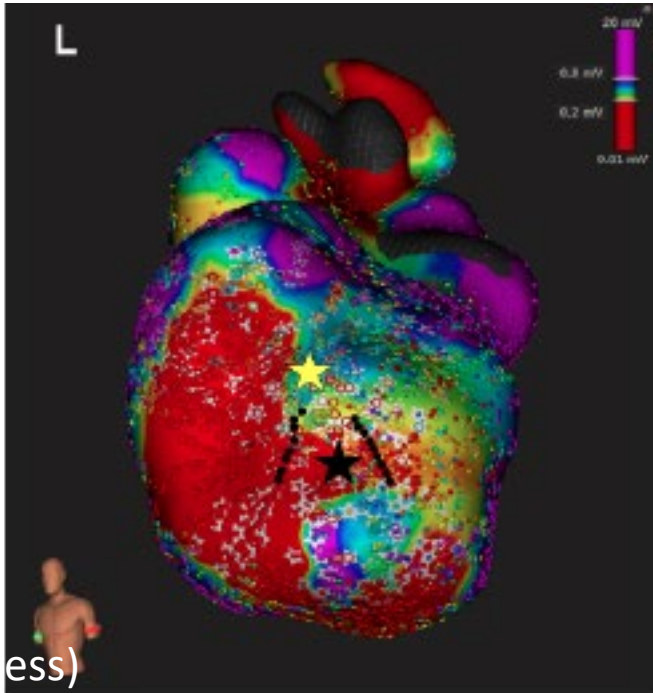
RV pacing

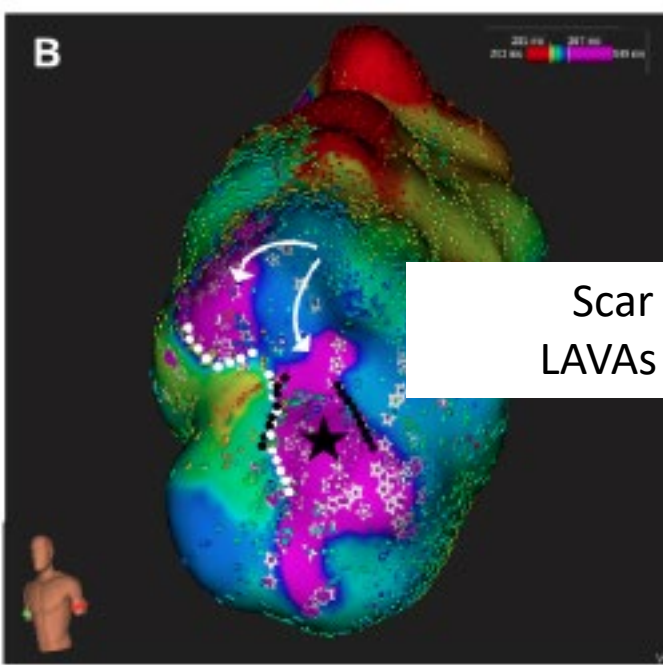


LV pacing

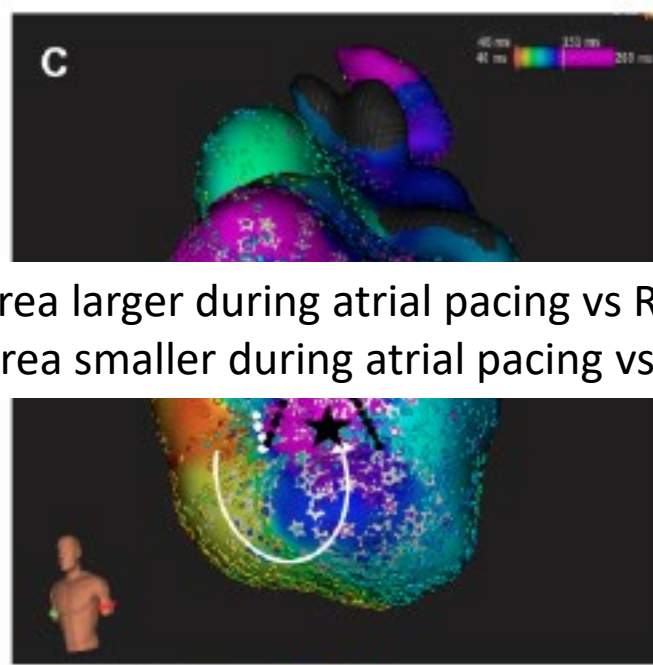


Martin C, et al. Circ EP 2019 (in press)

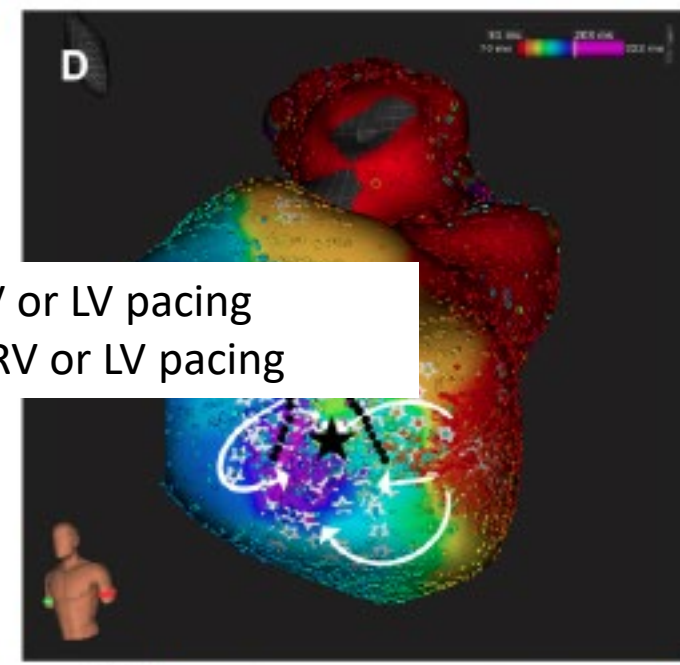




Atrial pacing

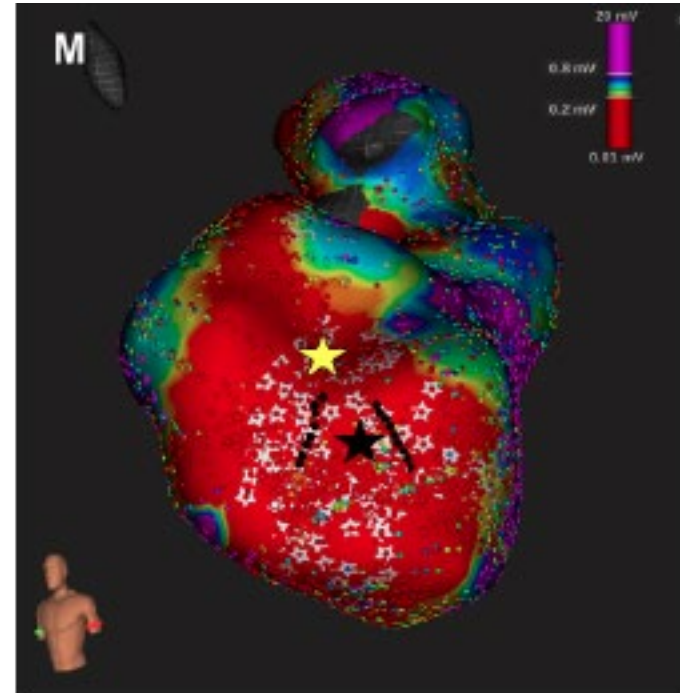
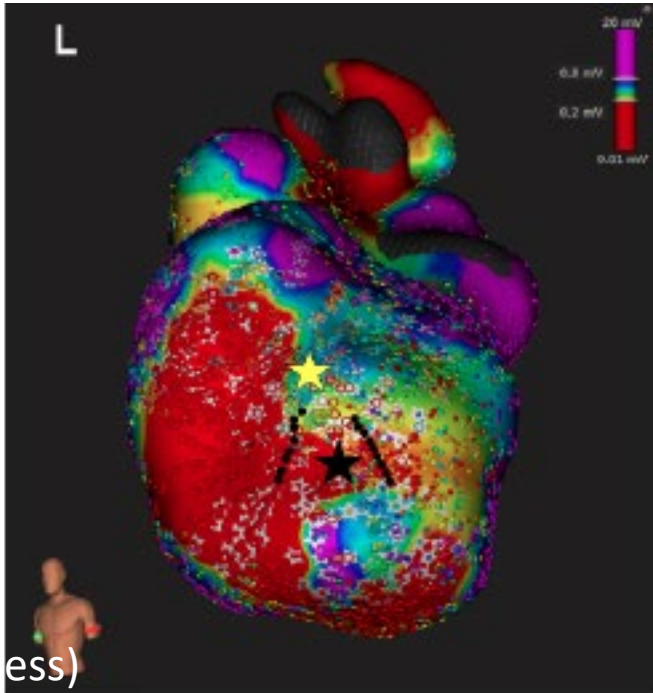
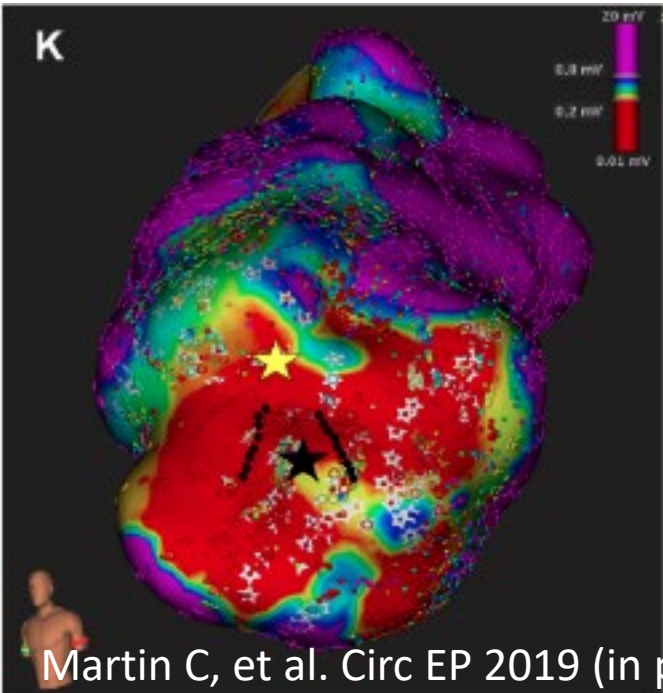


RV pacing



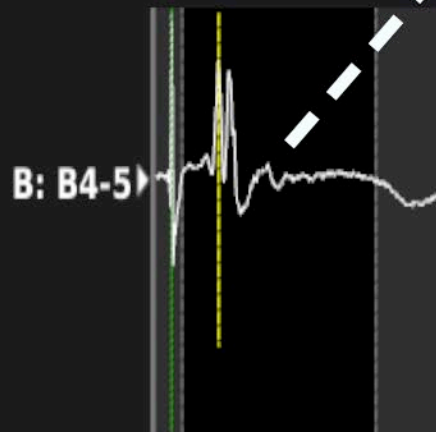
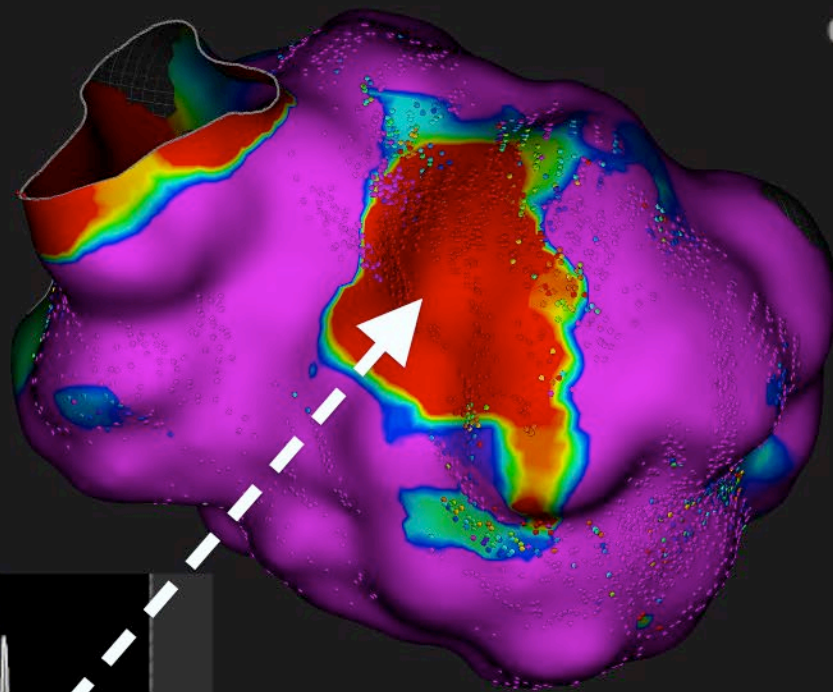
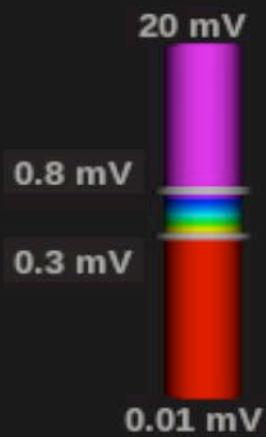
LV pacing

Scar area larger during atrial pacing vs RV or LV pacing  
LAVAs area smaller during atrial pacing vs RV or LV pacing

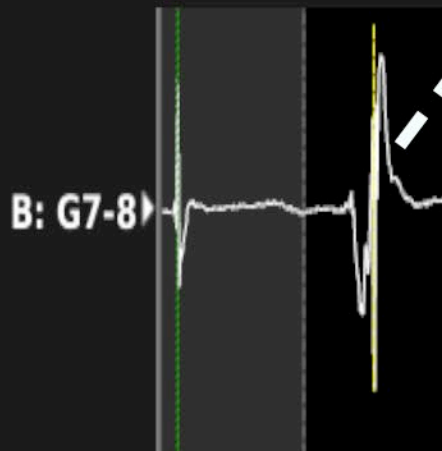
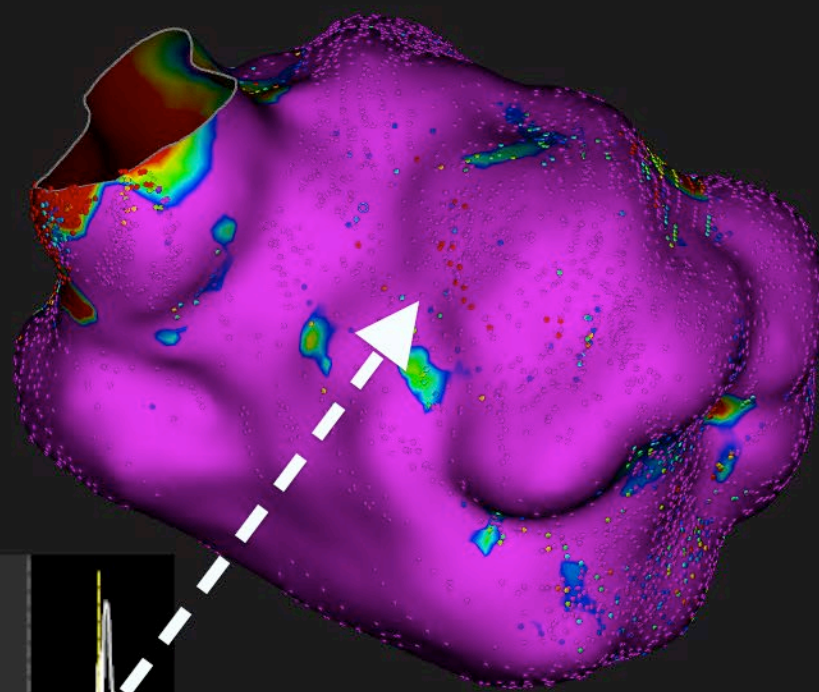
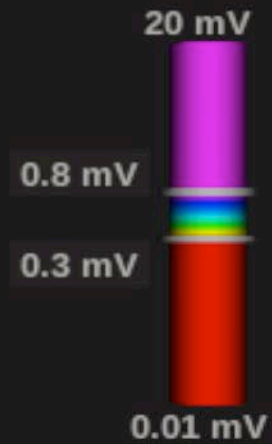


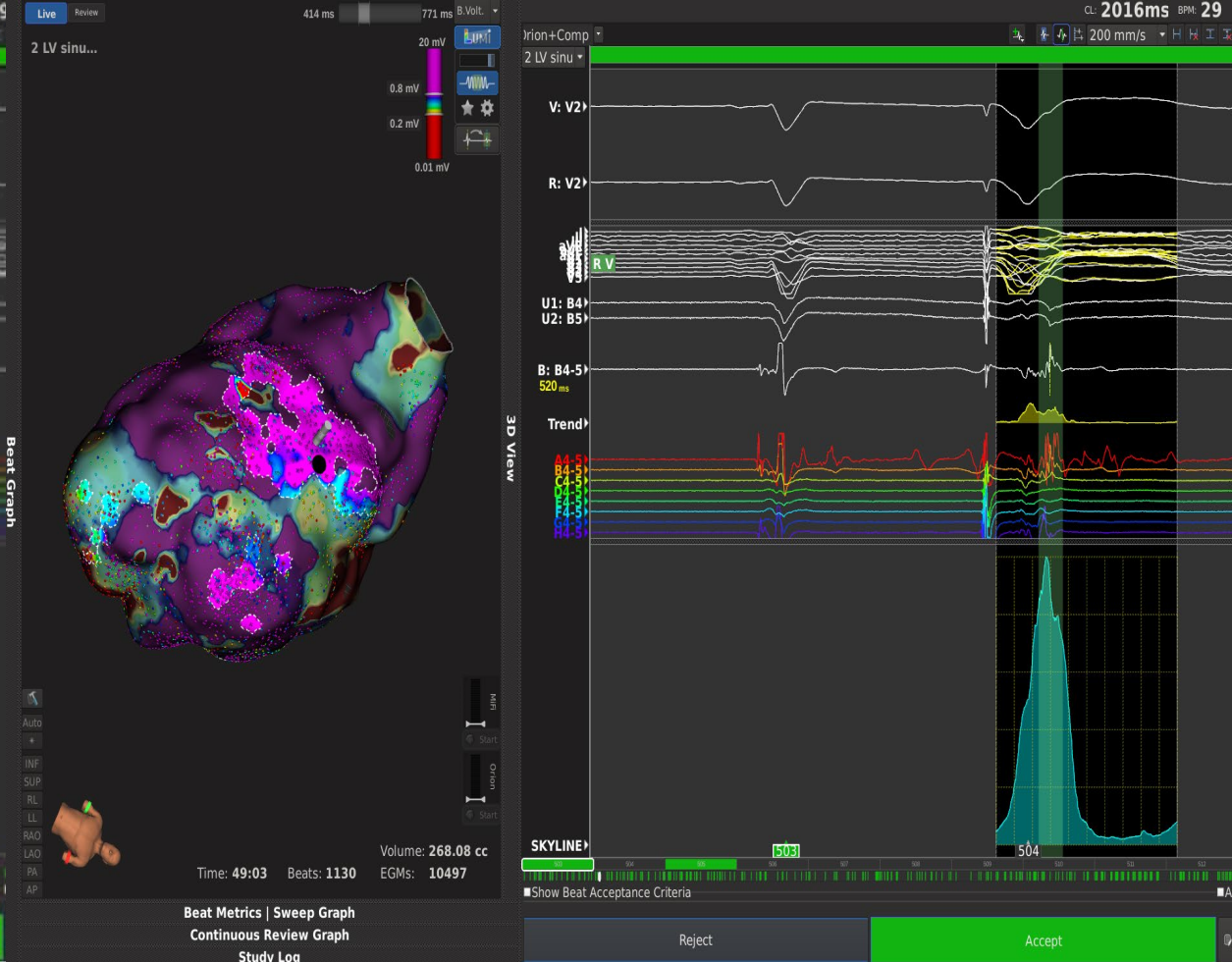
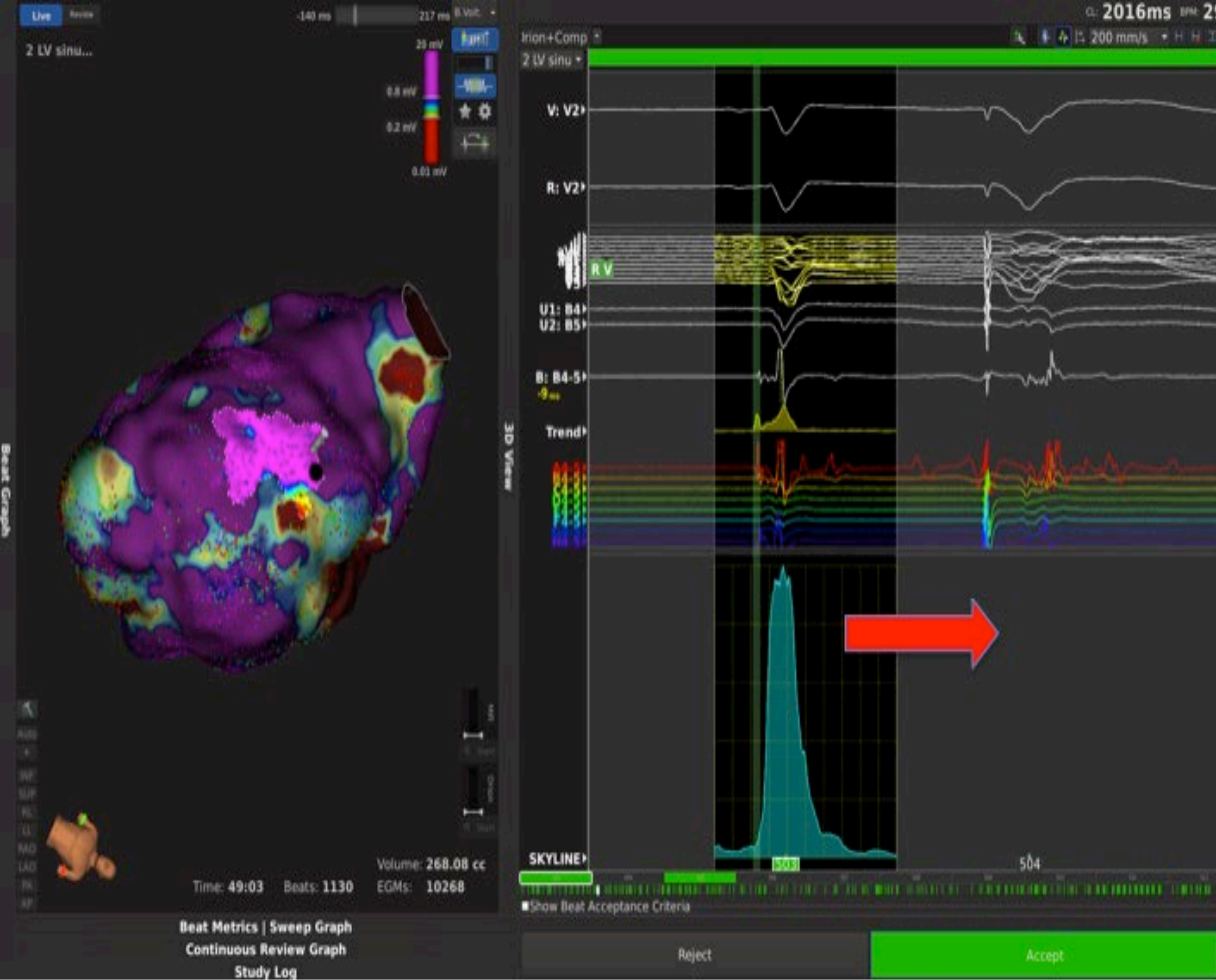


# RV pacing



# atrial pacing



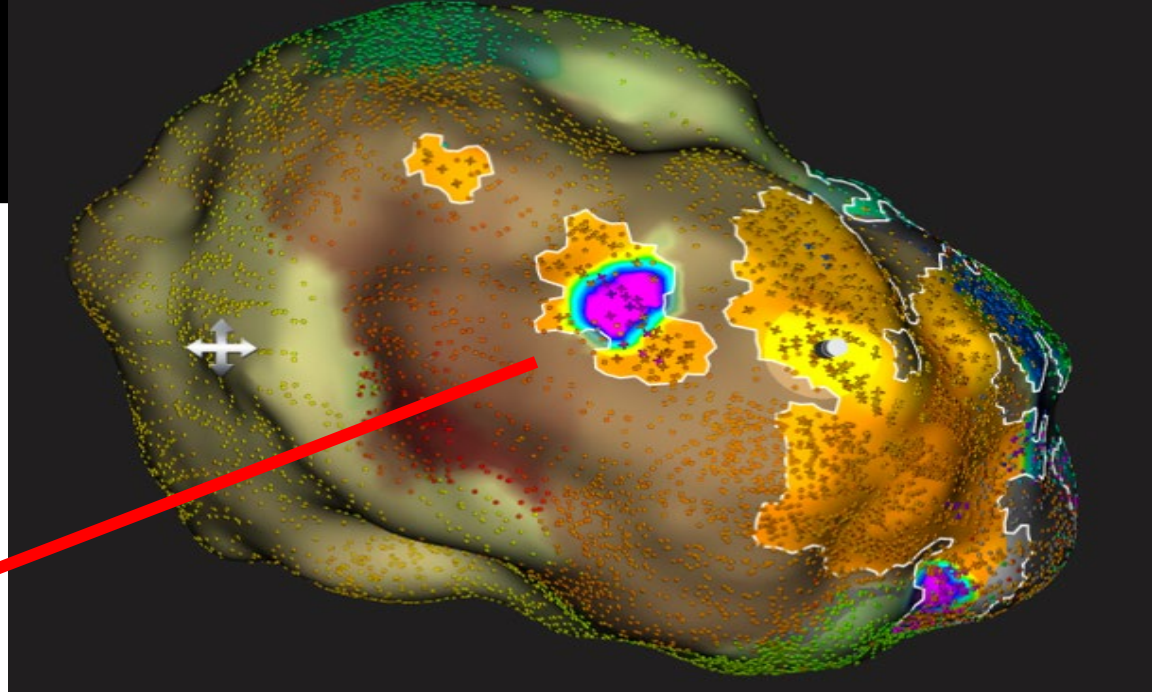




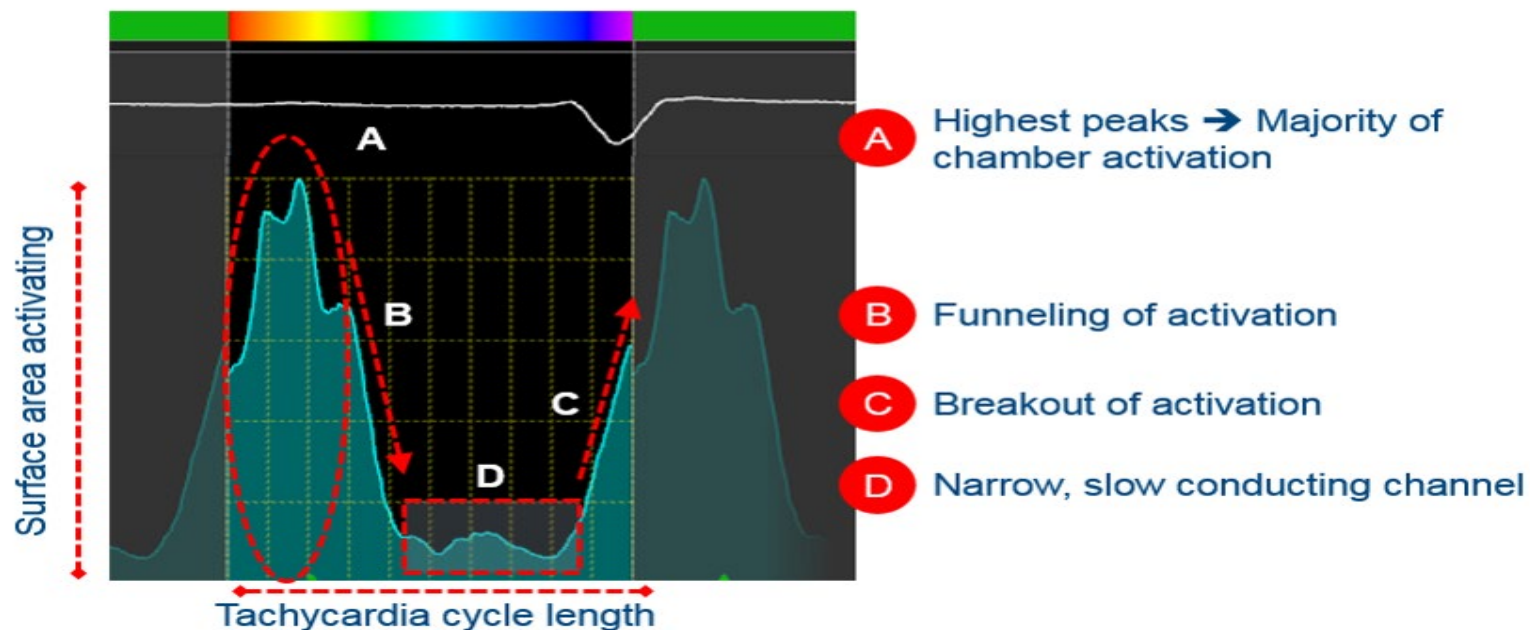
# Automated detection of LAVAs



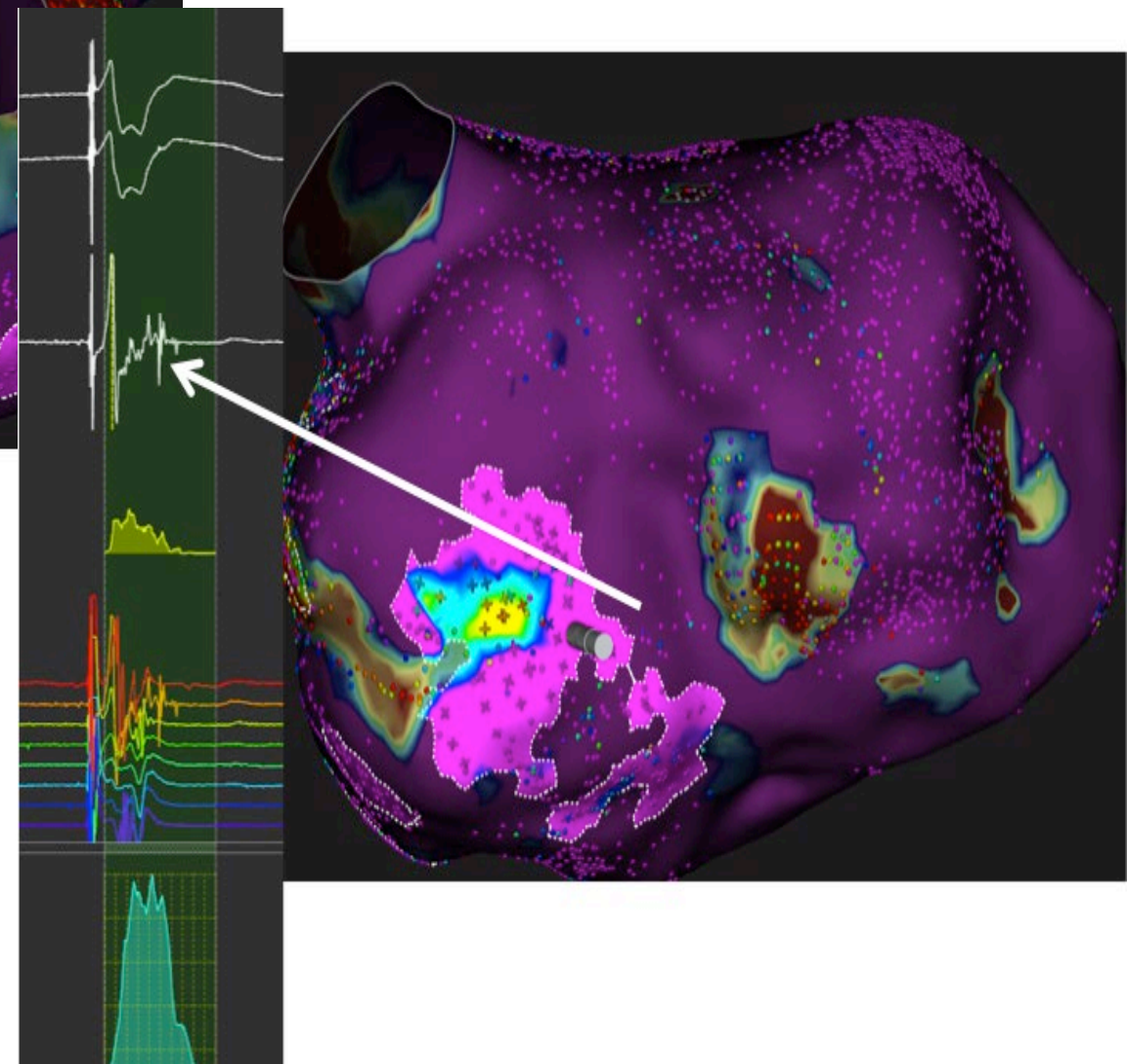
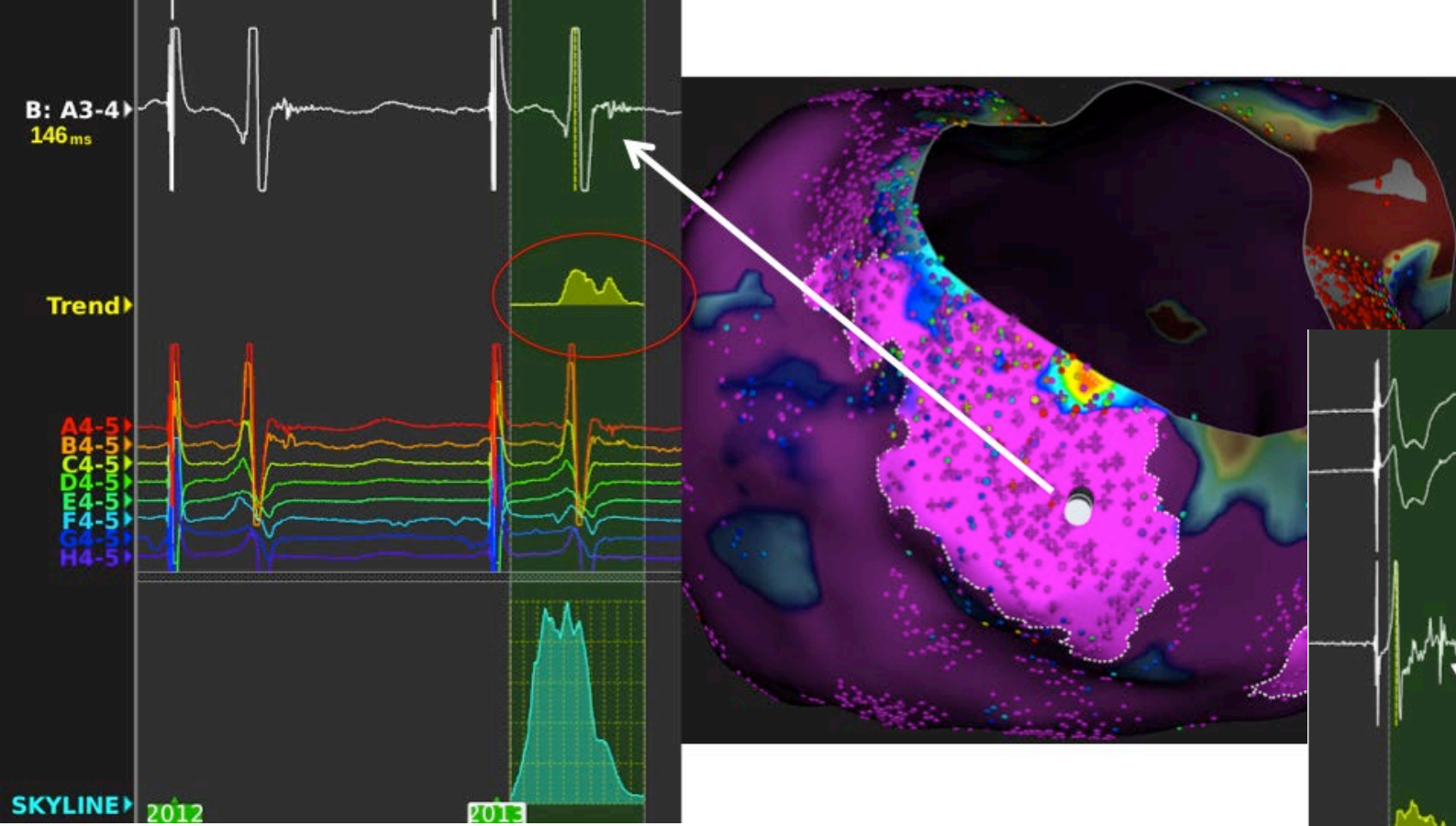
Lumipoint™



Displays the amount of the chamber activating during the tachycardia cycle





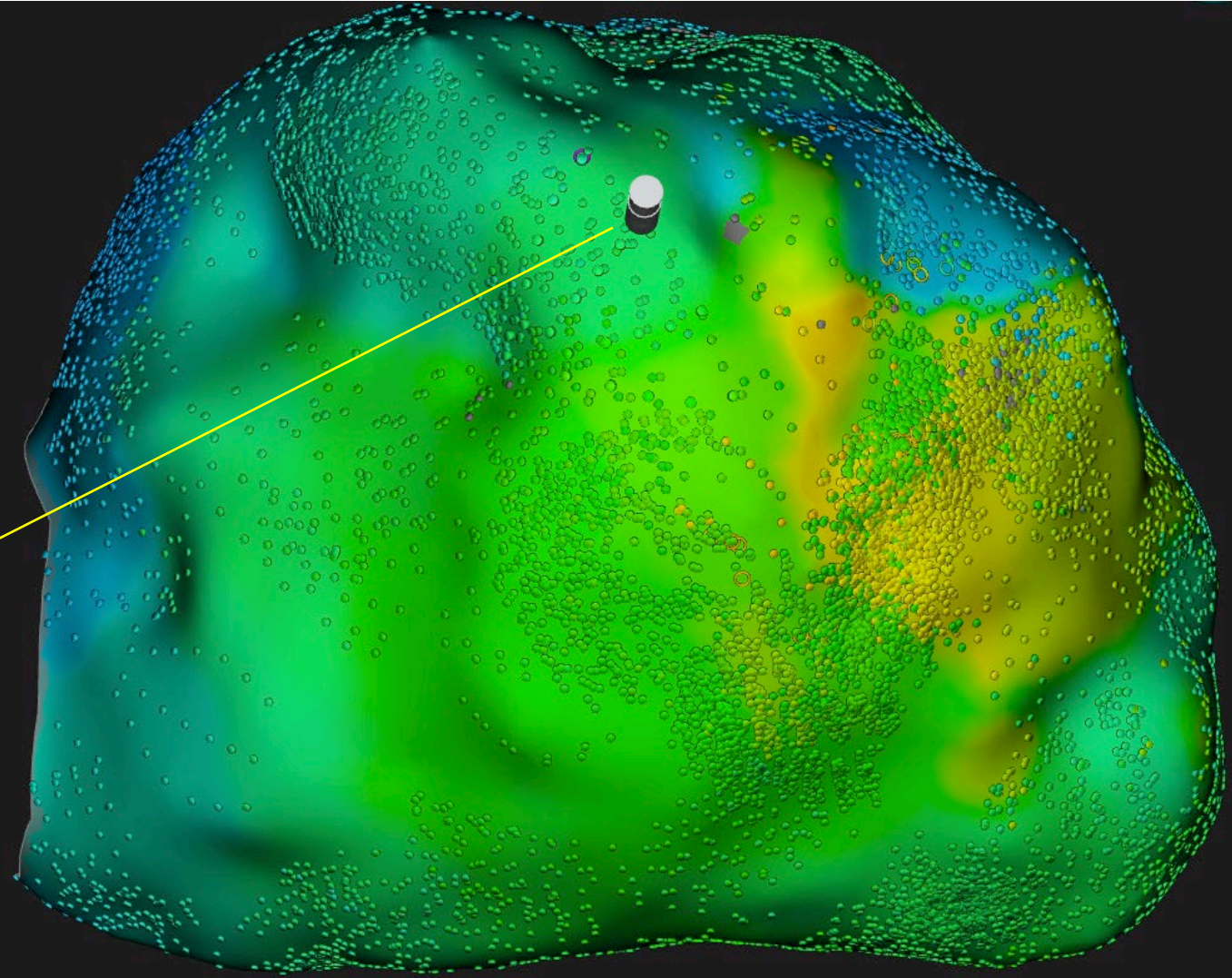
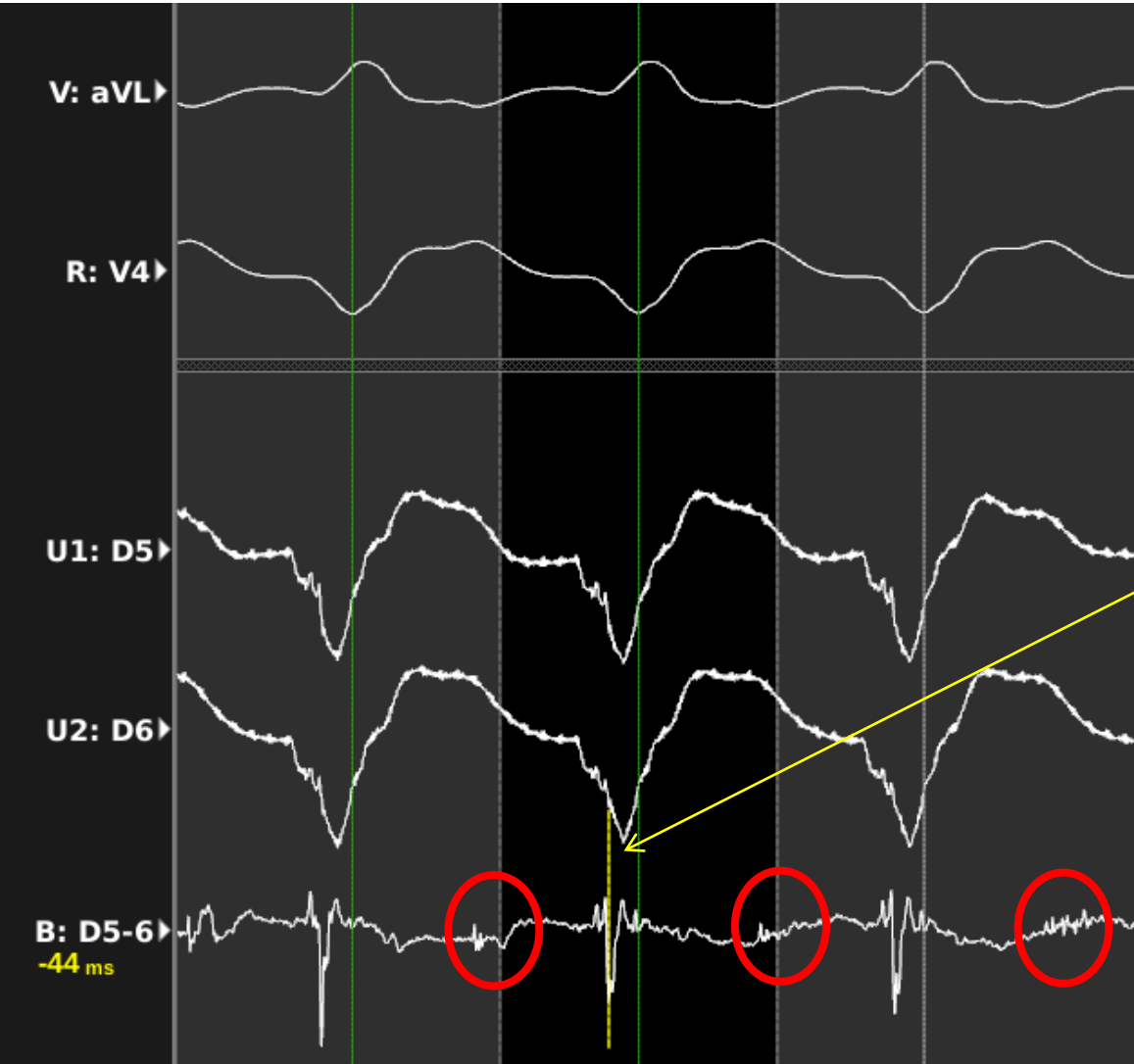


**Automated detection of fractionated potentials**

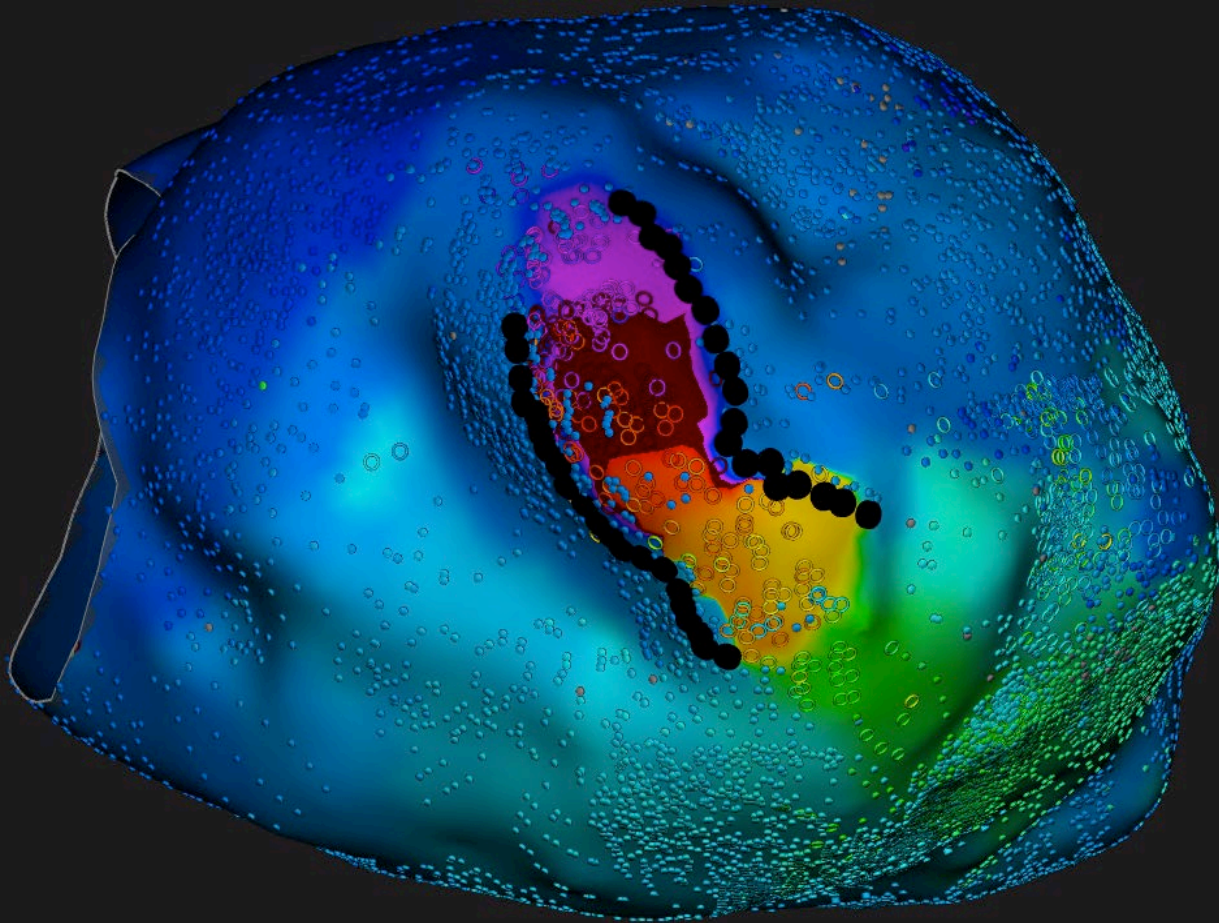
Lumipoint™

# Automated correction of wrong annotations

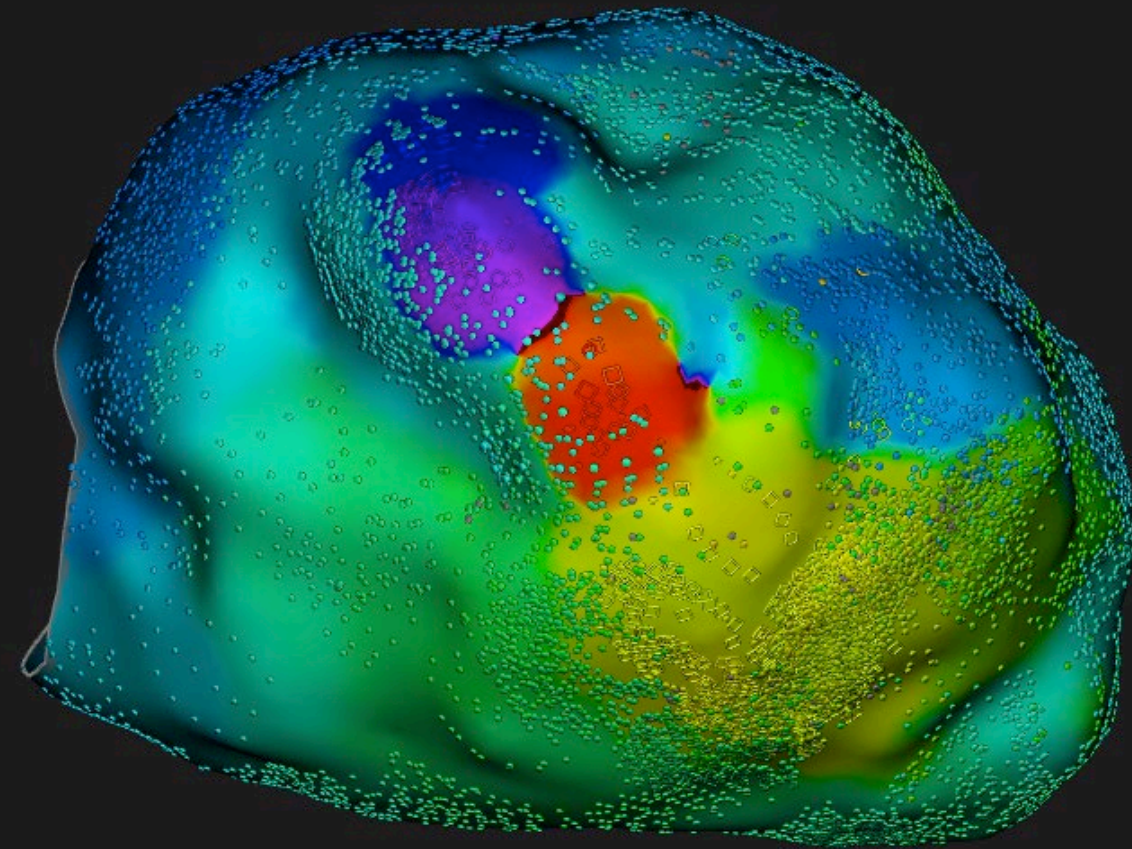
original map





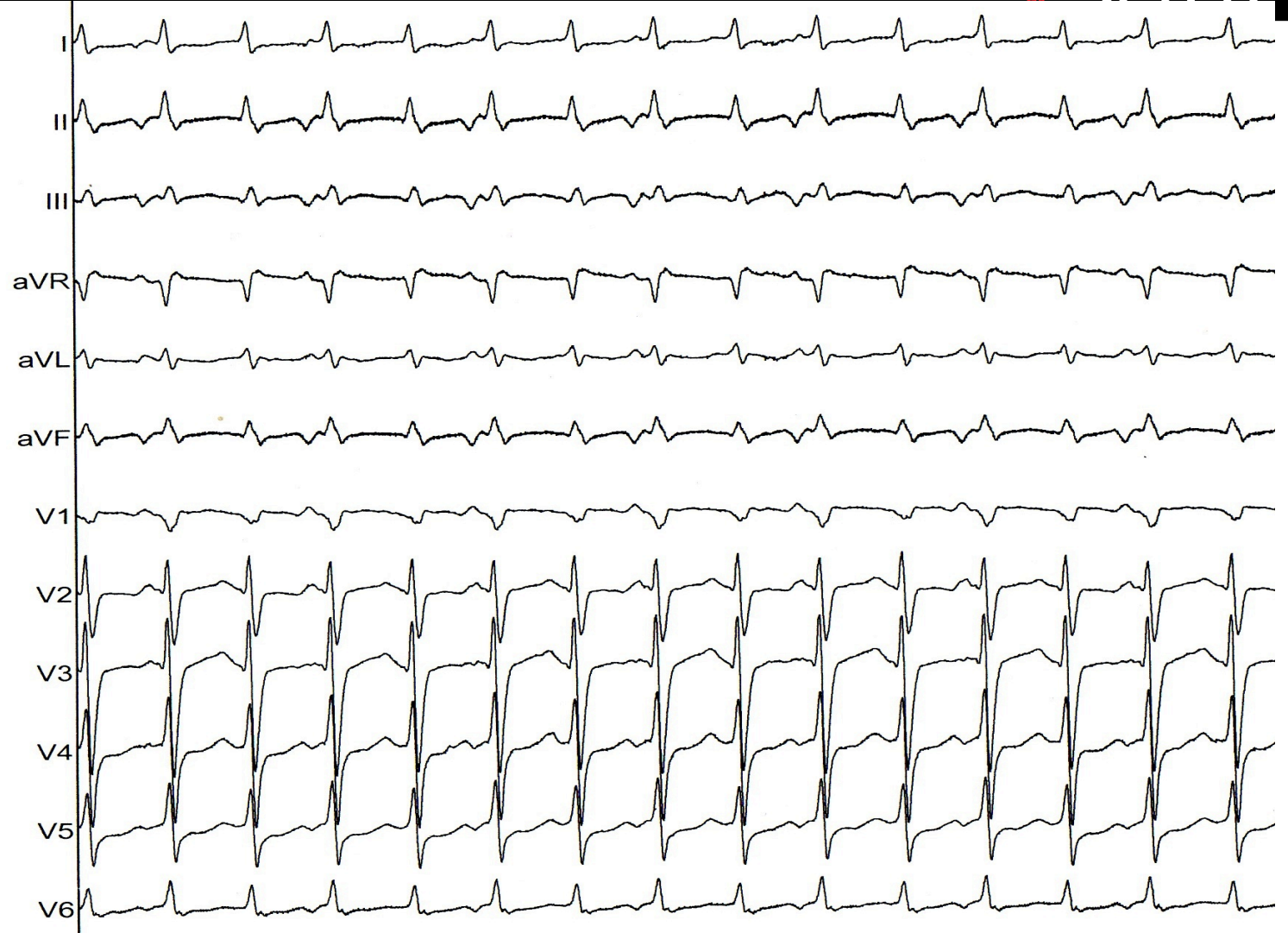
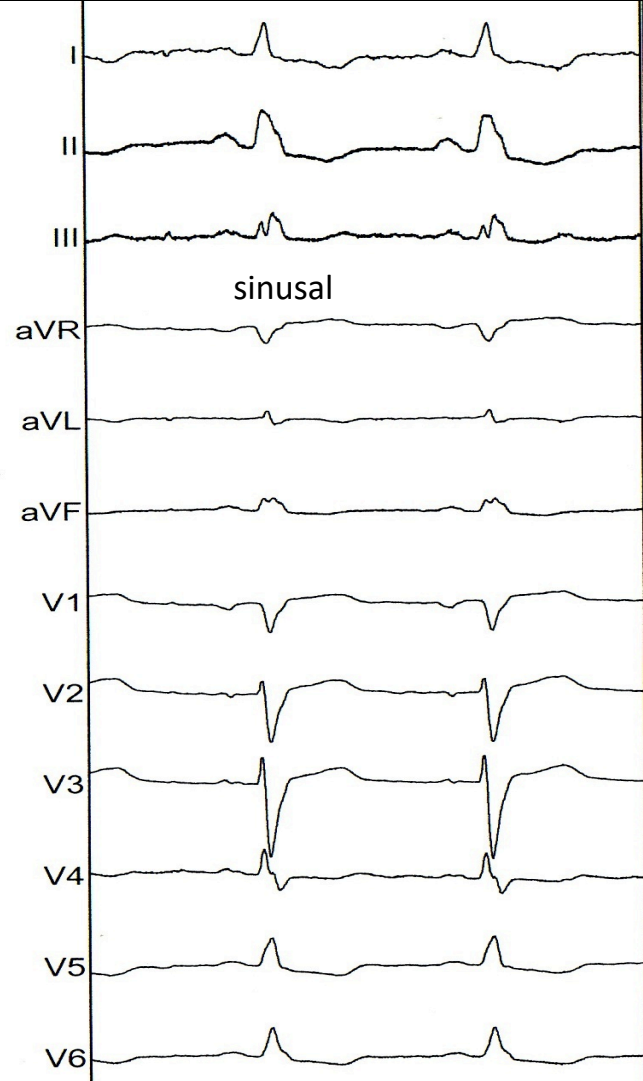


manual reannotation (around 90 min)

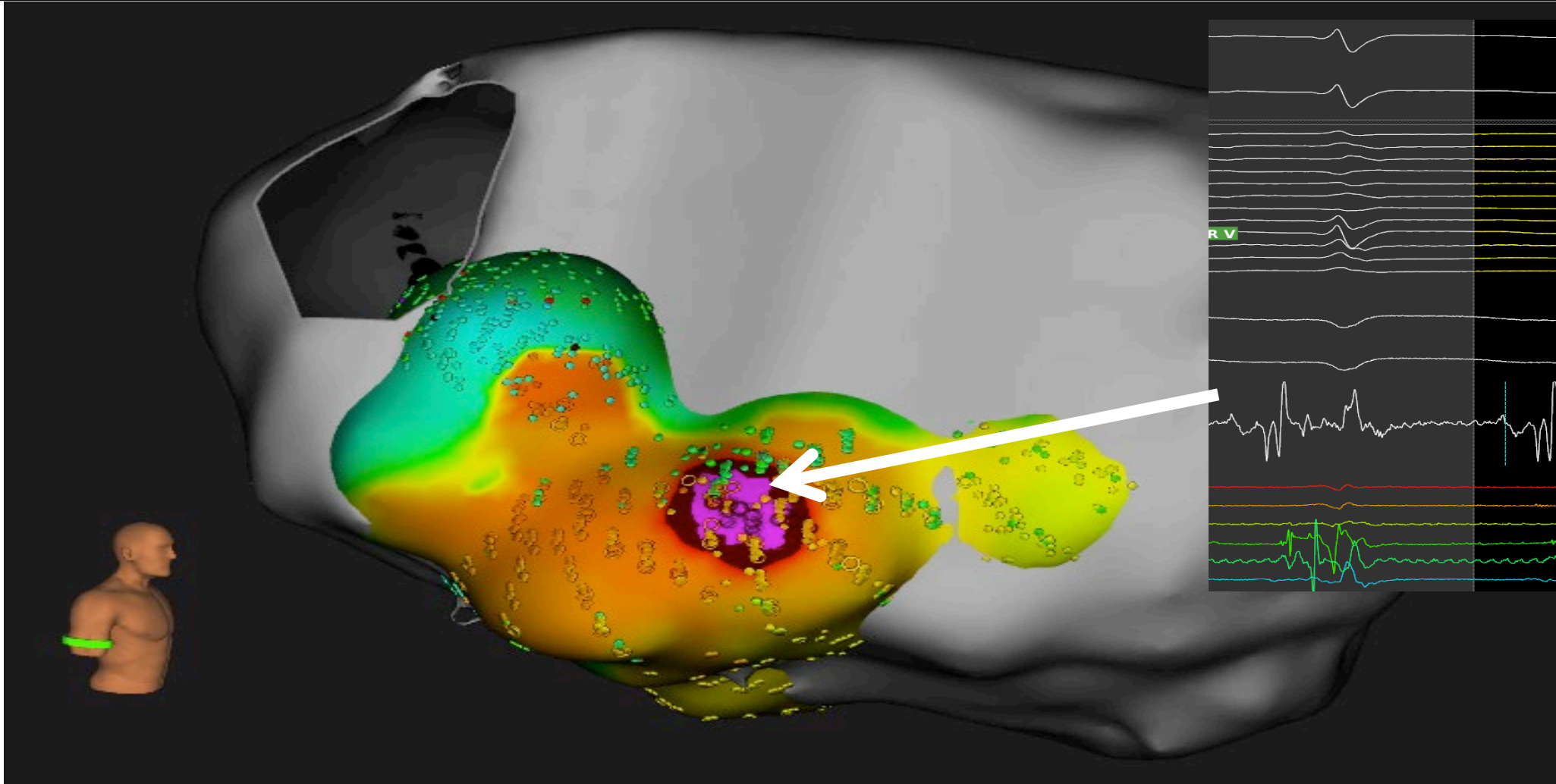


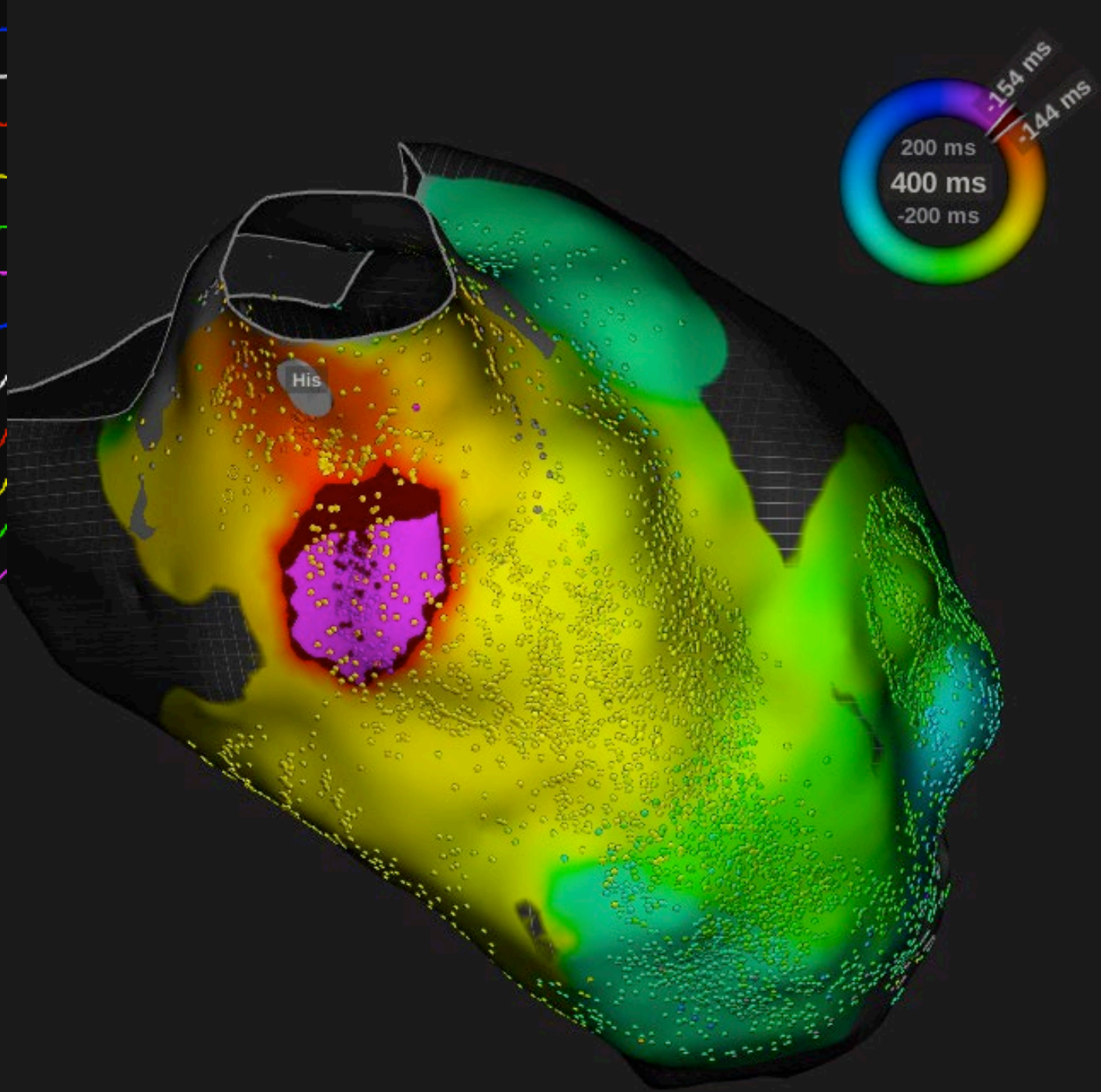
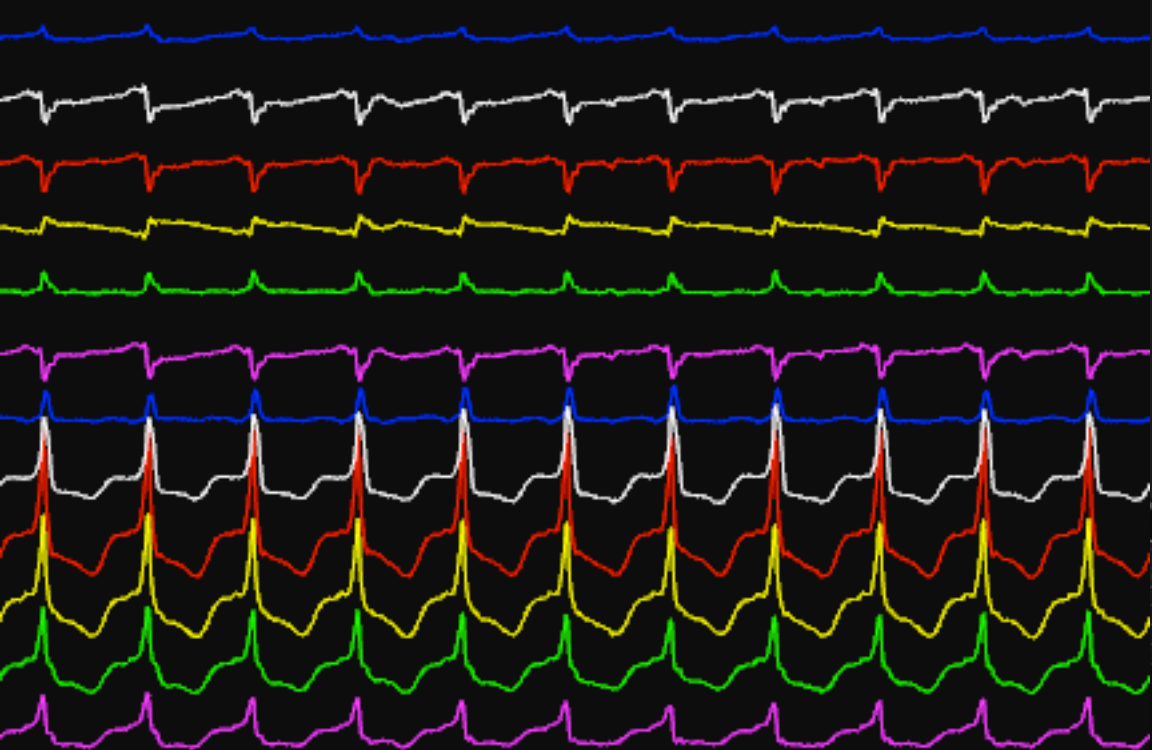
automated reannotation (around 2 min)

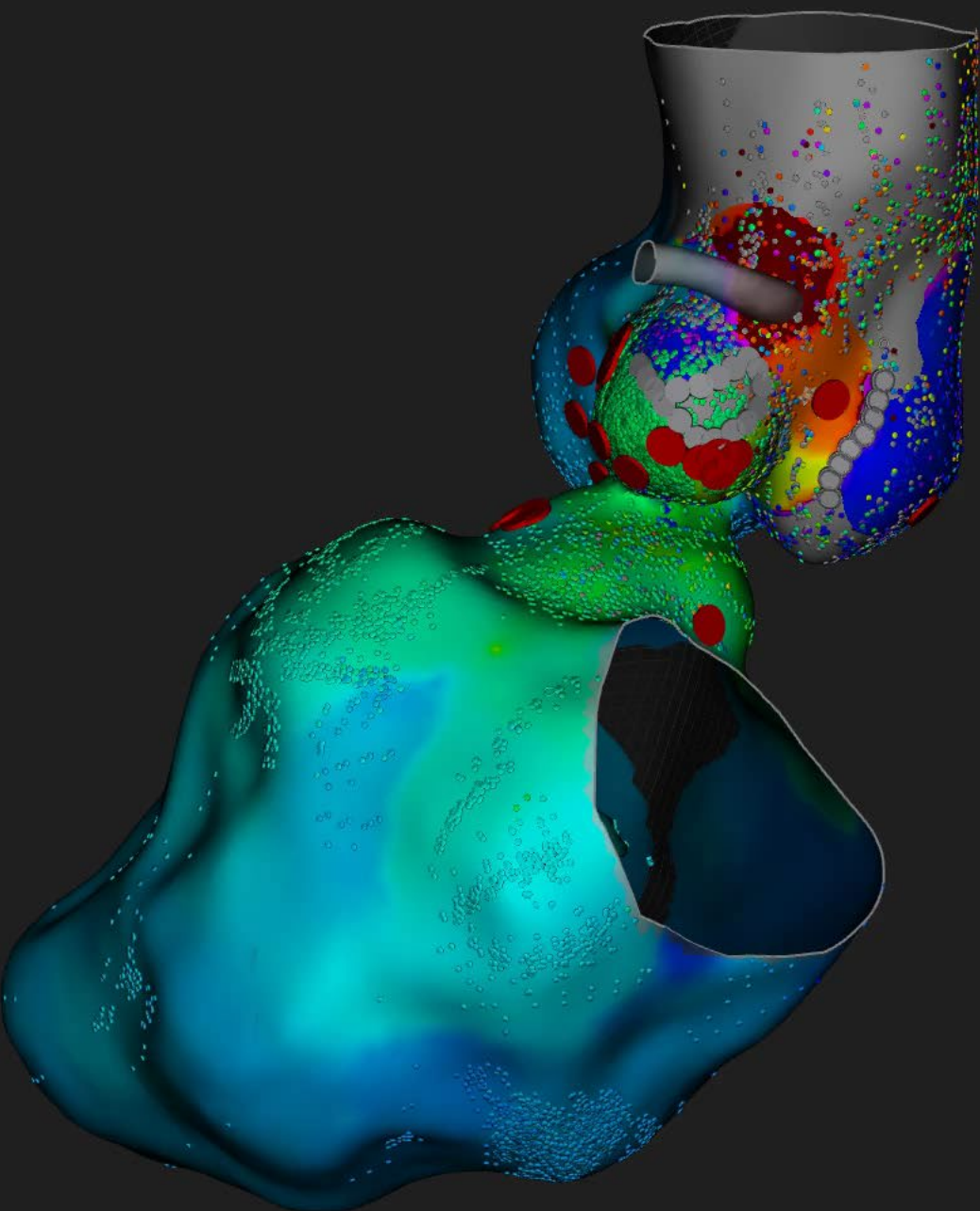
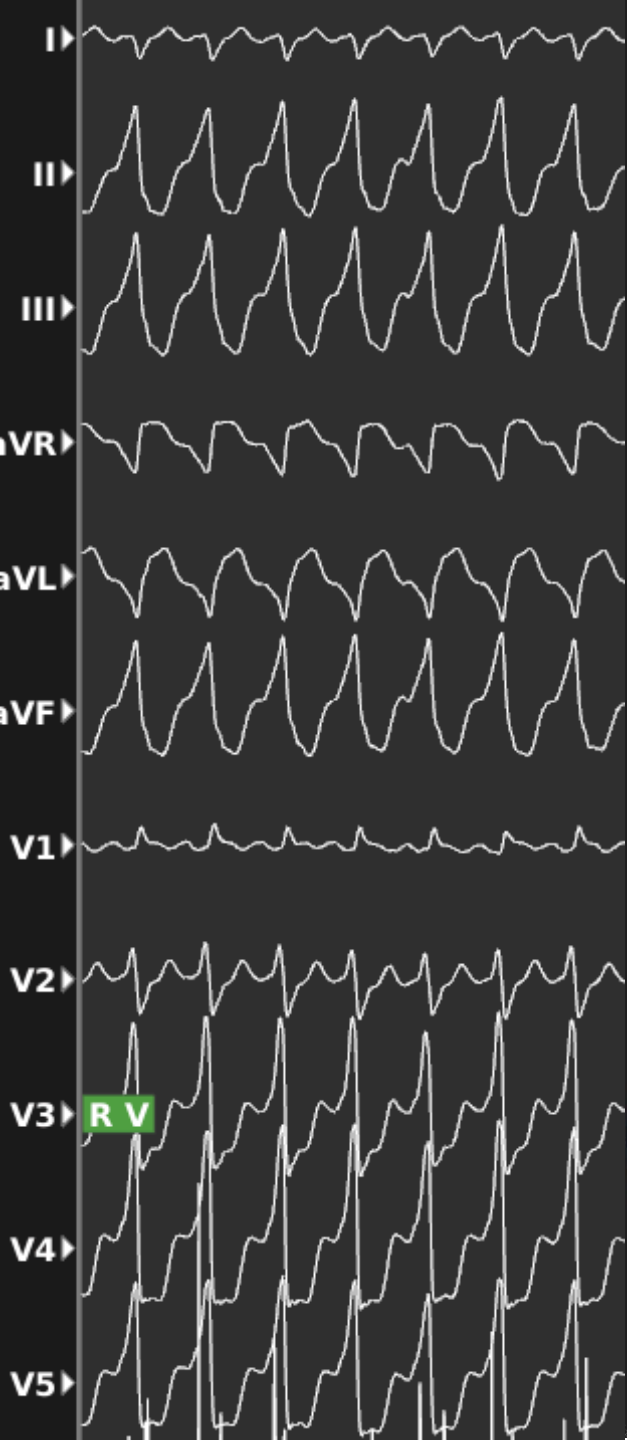
# Narrow QRS VT











Statistics: multiple maps are visible

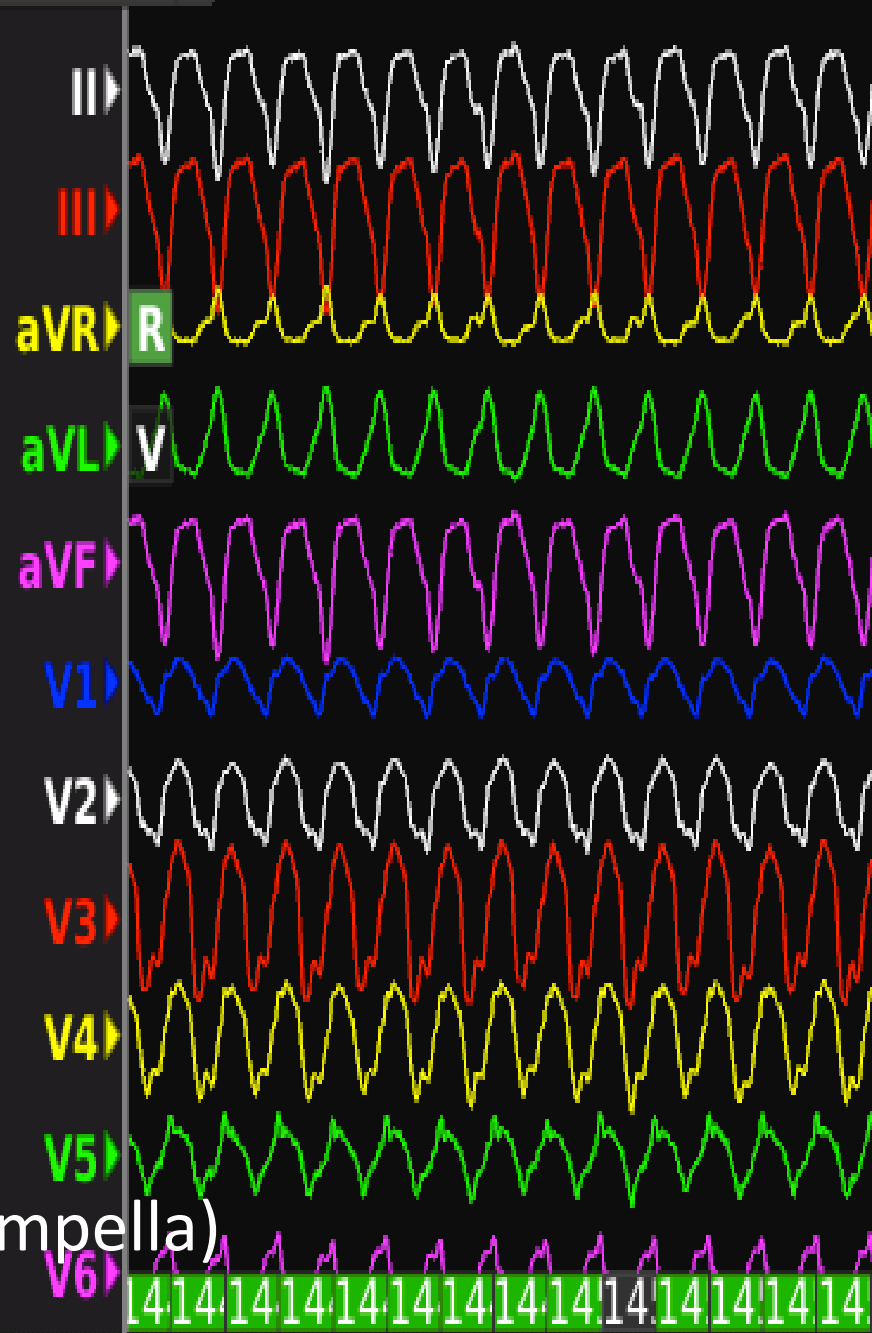
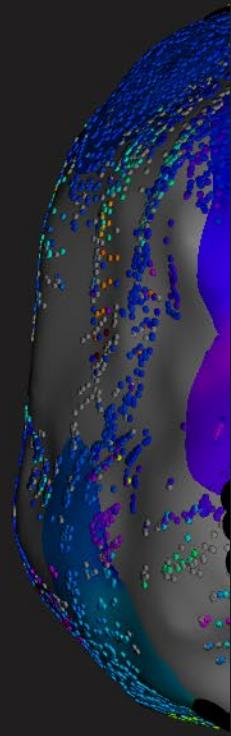
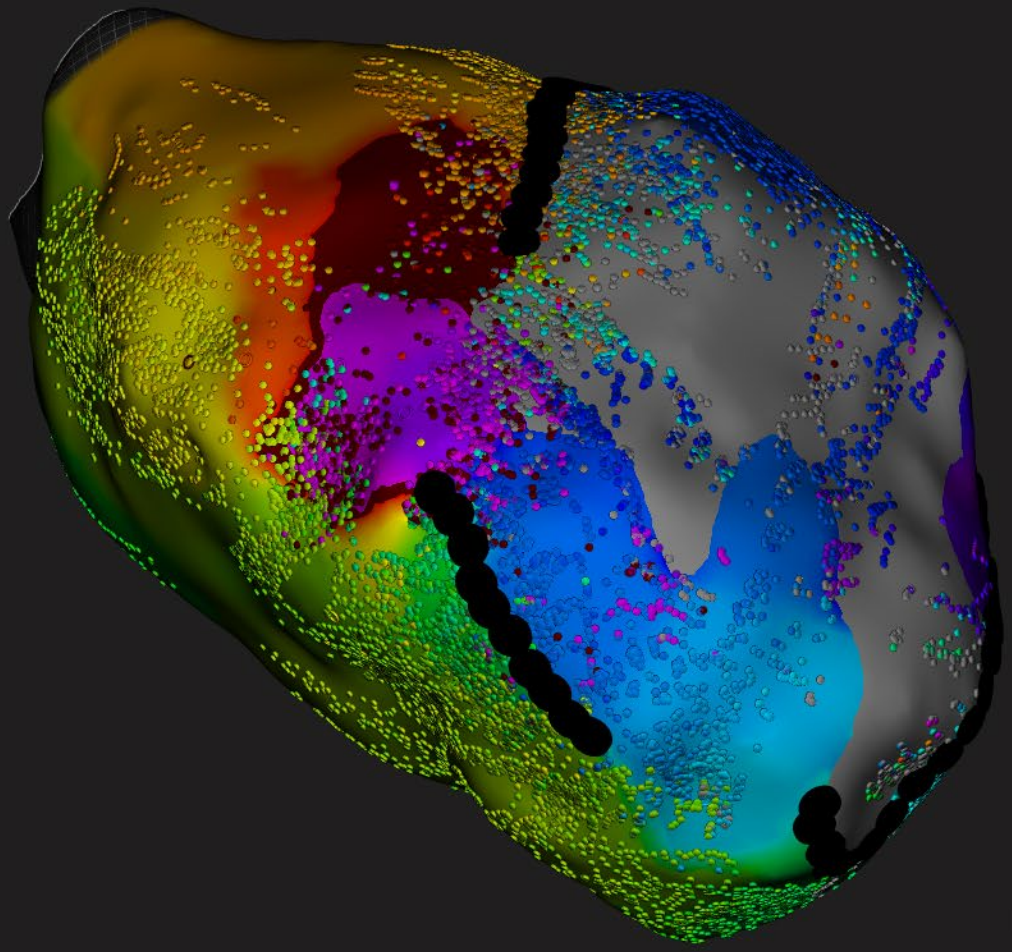


2 LV tv

2 LV tv

2 LV tv

260 bpm



unmappable fast VT (but not while on Impella)

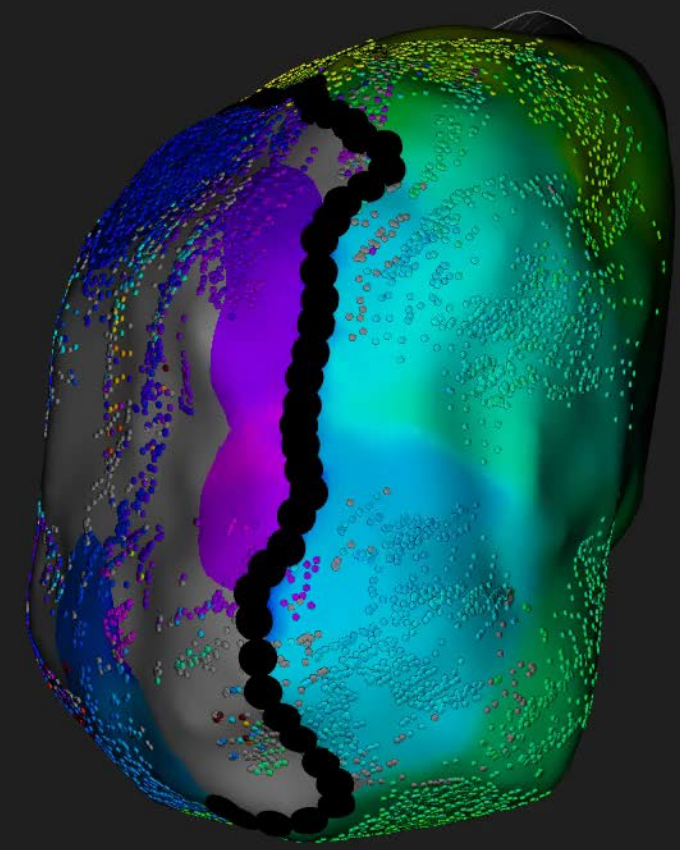
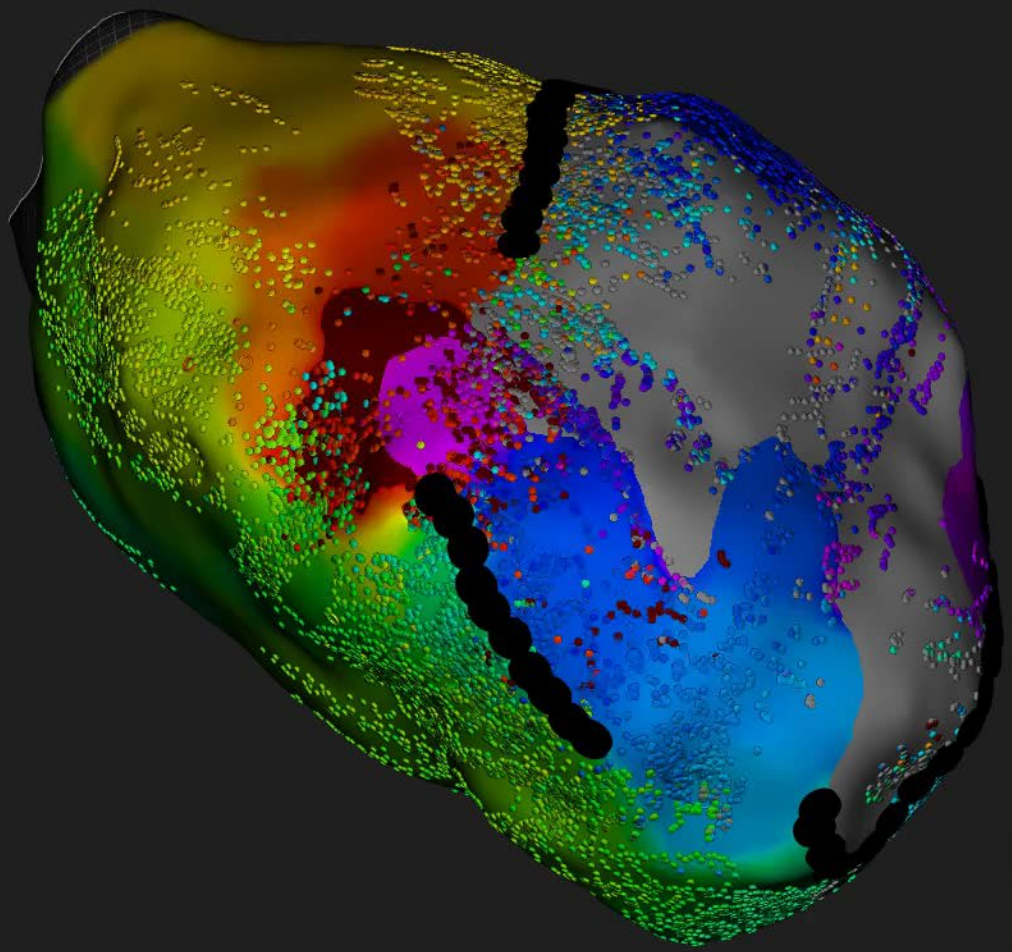
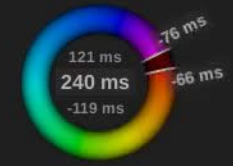
- Auto
- +
- INF
- SUP
- RL
- LL
- RAO
- LAO
- PA
- AP

- MFI
- Start
- Orion

- Auto
- +
- INF
- SUP
- BL
- LL
- RAO
- LAO
- PA
- AP

Time: 09:12    Beats: 1789    Volume: 165.41 cc    EGMs: 18670





- Auto
- \*
- INF
- SUP
- RL
- LL
- RAO
- LAO
- PA
- AP



MFI  
Start  
Orion  
Start

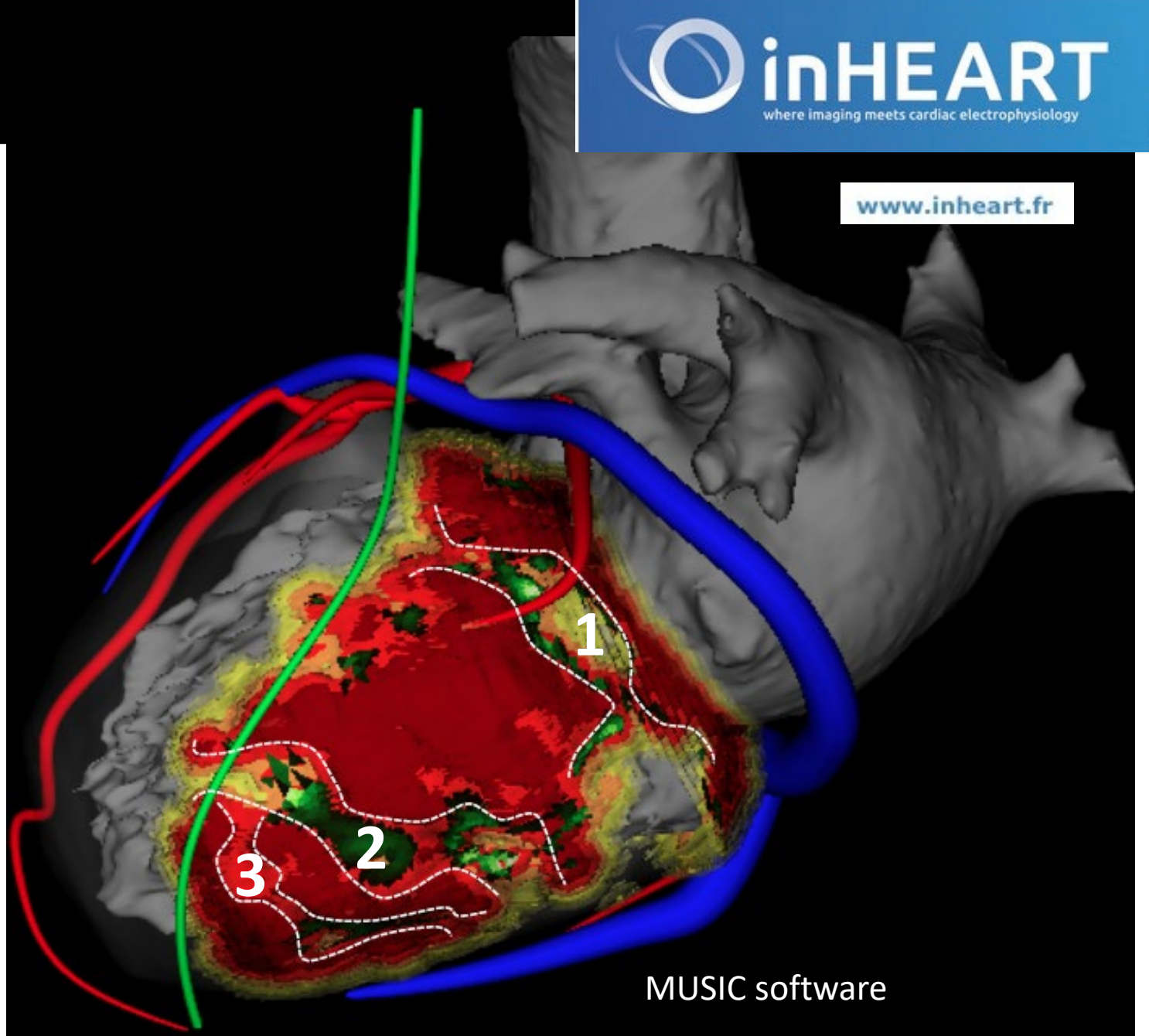
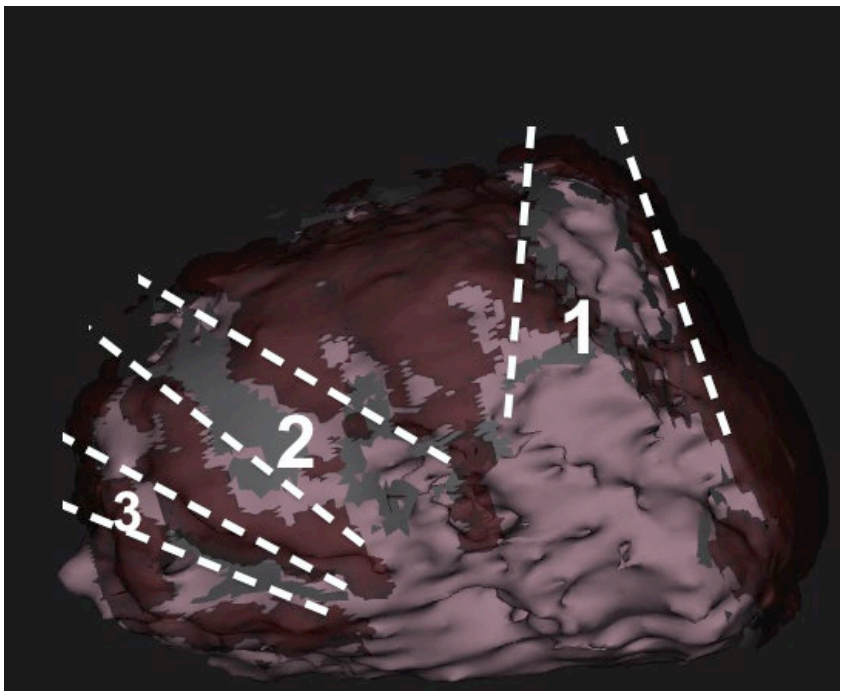
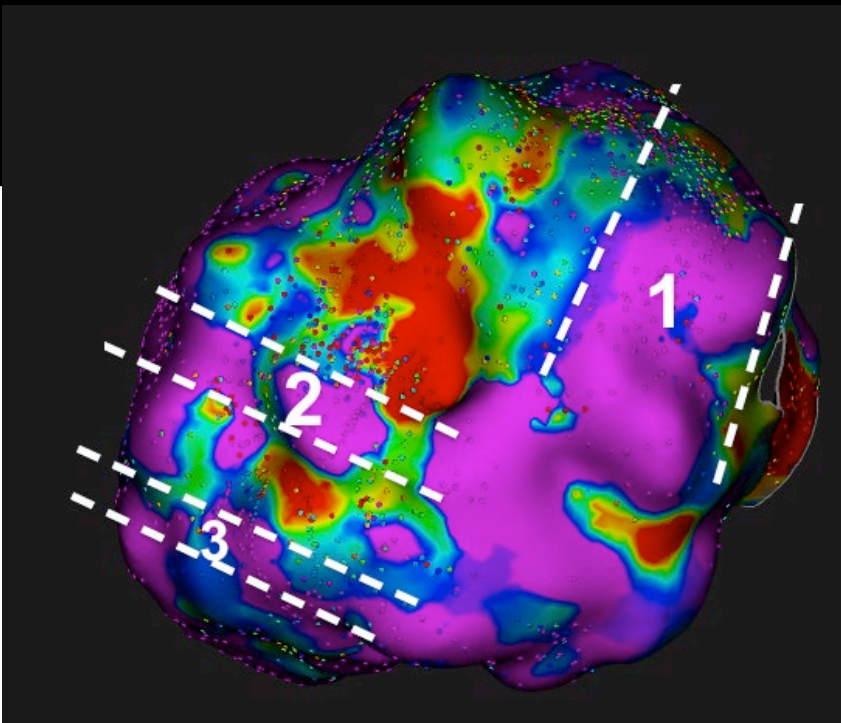
- Auto
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- INF
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- RL
- LL
- RAO
- LAO
- PA
- AP



Time: 09:12    Beats: 1789    Volume: 165.41 cc    EGMs: 18670

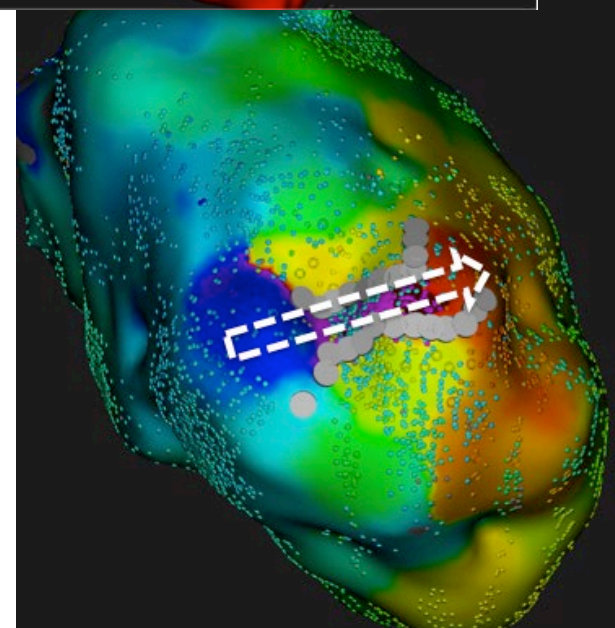
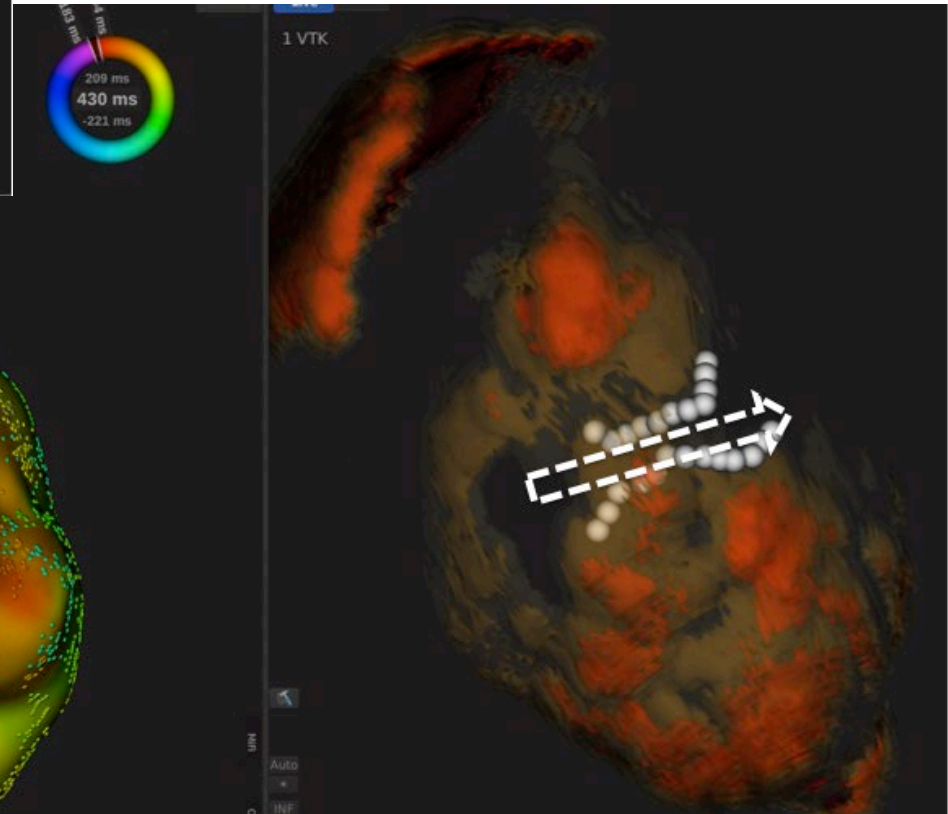
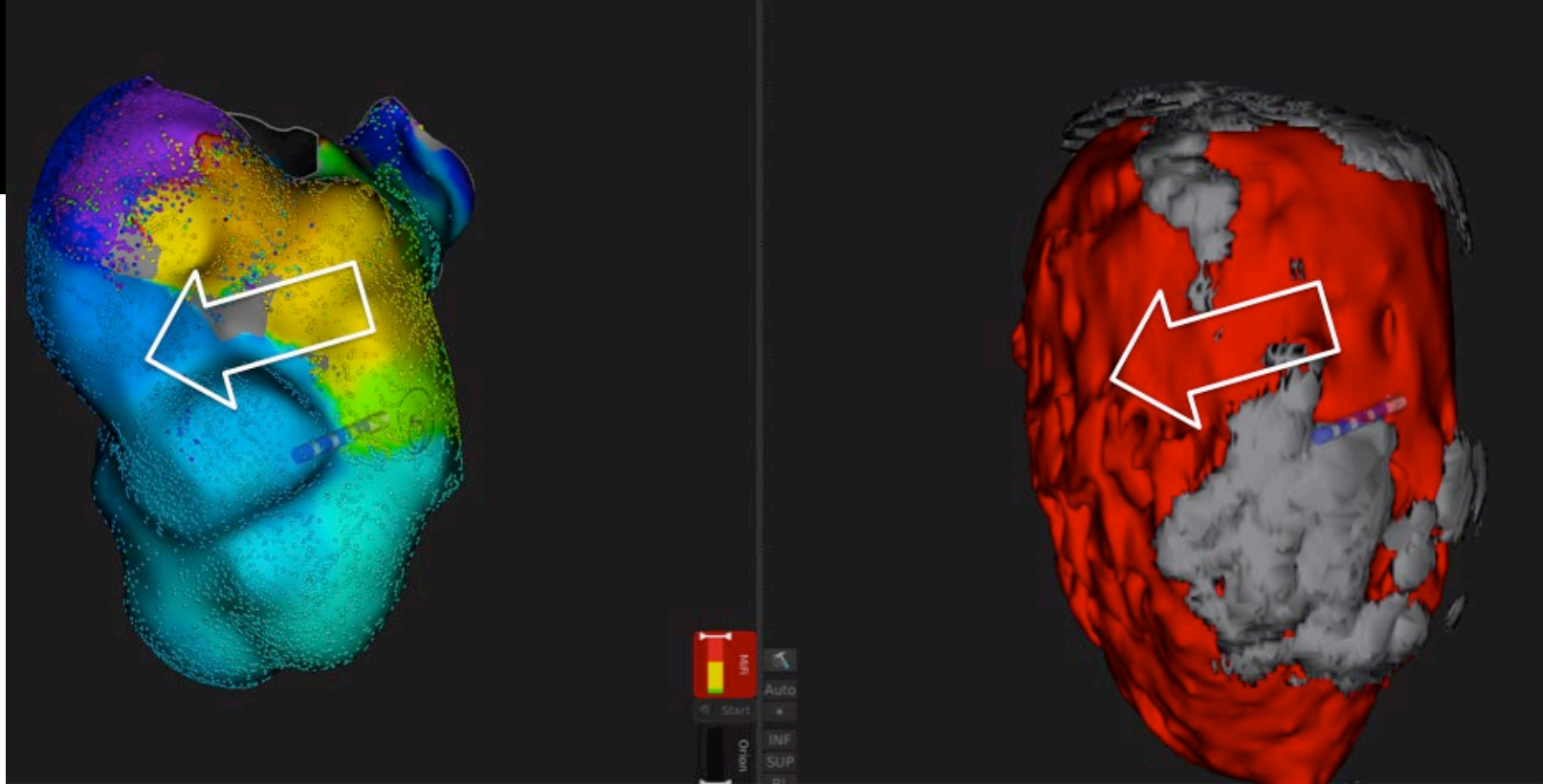
MFI  
Start  
Orion  
Start

Time: 09:12    Beats: 1789    Volume: 165.41 cc    EGMs: 18670



MUSIC software







# Conclusion

Ultra high definition has become mandatory in VT ablation in SHD

the Rhythmia system provides sufficient resolution for highlighting complex VT mechanisms