

M13Rec001, signature a609cf0a

Recording

Mouse heart, spiral wave and optogenetic termination. 64 × 55 px, 9,267 frames, 1 kHz, 133 μm/px, deposit checks: negative values, nan mask all frames, temporal smoothing, spatial smoothing. Source 10.5281/zenodo.10228296; publication 10.1371/journal.pcbi.1011660; licence CC-BY-4.0; Hussaini, Sayedeh; Luther, Stefan; Lädke, Sarah L.. sha256 3f8f2e1b8f776633089b33ccd4bf3fccb4f13140b71991f1dcd0e0a12bb48cbc.

Run

e21e4827-a6ed-4197-9e87-98959ab51755, 2026-10-27 23:37 UTC to 2026-10-27 23:42 UTC, status done. Protocol Mouse whole heart optical mapping (Luther lab), parameters v3 set by developer (not a domain scientist). Code 905d5bebbb29da7ad46cd5045db14330695037c3 (uncommitted changes), 9 workers.

Methods

Recording Mouse heart, spiral wave and optogenetic termination (M13Rec001) (doi:10.5281/zenodo.10228296; 64x55 px, 9267 frames, 1000 Hz) was analysed over frames 500-8767. Deposit shows signs of prior processing (provisional): negative values, non integer, nan mask all frames, temporal smoothing, spatial smoothing. Each pixel was baseline-corrected by subtracting a 901-frame centered moving average; NaN pixels were set to zero. Dye polarity (inverted) was taken from the sign of the median per-pixel skew of dV/dt . For phase only, each frame was spatially filtered with a Gaussian (sigma 1.0 px, truncated at 4.0 sigma); no temporal low-pass was applied. Phase was the angle of the Hilbert transform with 500 frames of padding on each side. Phase singularities were plaquettes with $|winding| > 0.9$ turns at least 3 px inside the tissue edge; they were tracked across frames (same charge, ≤ 4.0 px per frame, gaps ≤ 5 frames), and a persistent rotor was a track lasting ≥ 52 frames (1 cycle(s) of the fastest segment) within 3.0 px of an opposite-charge singularity in no more than 50% of its frames. Acquisition log (LED trigger channel, provisional interpretation): illumination on over frames 500-4977 of the analysed frames 500-8767. Segments (provisional, project lead (not a domain scientist), following the paper's design): illumination with arrhythmia frames 500-3170 (expected persistent rotors: present); illumination after termination frames 3170-4977 (expected persistent rotors: absent); light off frames 4977-8767 (expected persistent rotors: absent). Sensitivity: baseline 2712, 1356, 678, 901 frames x sigma 0.5, 1.0, 2.0 px, and tracker variants. singularities: across filters holds (provisional). persistent rotors: across filters holds (provisional); across trackers holds (provisional). persistent rotors fraction superseded: across filters does not hold (provisional); across trackers does not hold (provisional). All thresholds and criteria are provisional pending review by a domain scientist.

Verdict

Reportable as provisional descriptive findings: singularity presence during illuminated arrhythmia is stable, persistent-rotor presence during illuminated arrhythmia and absence in light_off and illuminated_after_termination are stable, and stable descriptive values with no cited ranges include light_off persistent rotors 0, light_off persistent_rotor_count_max 0, light_off dominant_freq_hz 2.375 Hz, illuminated_after_termination persistent rotors 0, illuminated_after_termination persistent_rotor_count_max 0, and illuminated_after_termination dominant_freq_hz 2.214 Hz; not reportable as single values are light_off.singularity_frames_frac 0.0029023746701846965-0.02955145118733509, illuminated_arrhythmia.persistent_rotors 4.0-15.0, illuminated_arrhythmia.persistent_rotor_count_max 1.0-2.0, illuminated_arrhythmia.dominant_freq_hz 15.356-19.85 Hz, illuminated_after_termination.singularity_frames_frac 0.0005534034311012728-0.014941892639734366, and persistent_rotor_tracks 4.0-15.0; the persistent-rotor threshold result agrees for 52 frames and for the paper-context 50 frames derived from the cited 20.0 Hz rotation period, with context from DOI 10.1371/journal.pcbi.1011660, while review is still needed for the processed-data label, frame 3170 event interpretation, illumination/baseline artifacts, and provisional thresholds; the cited ranges, the stability threshold, and the criteria are provisional. physiology_ok: None; send back: False. Reviewer sign-off: pending.

Parameters (as run)

```
% Mouse whole heart optical mapping (Luther lab), v3, read-only
% set by developer (not a domain scientist); provisional, REVIEW_NEEDED 16
baseline_frames = 901;      % >= 2 x slowest cycle (415, MAP): ok
pad_frames      = 500;      % each side, outside the window
spatial_sigma   = 1.0;      % px, Gaussian, phase only
spatial_truncate = 4.0;      % kernel radius, sigma
lowpass         = [];       % none
polarity        = -1;       % measured, skew of dV/dt
rotor_threshold = 0.9;      % turns, |winding| per plaquette
rotor_erode_px  = 3;        % px from tissue edge ignored
link_px         = 4.0;      % tracking, max step per frame
max_gap         = 5;        % frames a track may vanish
min_cycles      = 1.0;      % own rotations, min_frames = 52
pair_dist_px    = 3.0;      % opposite-charge pairing
paired_frac     = 0.5;      % max paired fraction of a track
render_step     = 4;        % movie only
```

Segments

Segment	Defined	Analysed	Cycle, frames	Expected rotors	Bounded by
Illumination with arrhythmia	0-3,170	500-3,170	52 (n = 53)	present	LED on before frame 0 (DAQ) → termination step (image, ±17 frames)
Illumination after termination	3,170-4,977	3,170-4,977	415 (n = 4)	absent	termination step (image, ±17 frames) → illumination off (DAQ, ±11 frames)
Light off	4,977-9,267	4,977-8,767	411 (n = 10)	absent	illumination off (DAQ, ±11 frames) → recording end

Metrics

Metric	Unit	Illumination with arrhythmia	Illumination after termination	Light off	Physiological range
Rhythm					
Dominant frequency	Hz	15.356-19.850 (unstable)	2.214	2.375	18.75-20 Hz, one recording provisional
Rotors					
Persistent rotors	count	4-15 (unstable)	0	0	none cited
Max concurrent persistent rotors	count	1-2 (unstable)	0	0	none cited
Frames with a singularity	fraction	0.479	0.001-0.015 (unstable)	0.003-0.030 (unstable)	none cited
Beats, where a global rhythm exists					
Beats	count	57	4	9	none cited
Global amplitude ratio	ratio	0.72	0.95	0.95	gate ≥ 0.30 provisional
APD50	ms	14	16	16	none cited
APD90	ms	25	76	75	none cited
Conduction velocity	cm/s	31.3	58.5	60.0	none cited

Criteria and reportable values

Item	Rule or segment	Result
Singularities present where the design expects them, absent elsewhere	each 'present' segment: $\text{frac} \geq 0.1$ and $\geq 2.0 \times \text{max frac}$ over 'absent' segments, at every setting	holds at 12 filter settings (provisional)
Persistent rotors present where the design expects them, absent elsewhere	each 'present' segment: $\text{count} \geq 1$; each 'absent' segment: $\text{count} \leq 0$, at every setting	holds at 12 filter settings and 3 trackers (provisional)
Persistence threshold, paper context	lifetime ≥ 52 frames (measured cycle) and ≥ 50 frames (cited agree (provisional) 20 Hz)	
persistent rotor tracks	all	4–15 count, unstable, not reportable
dominant freq (Hz)	light off	2.375 Hz, no cited range
persistent rotors	light off	0 count, no cited range
singularity frames fraction	light off	0.0029–0.0296 fraction of frames, unstable, not reportable
persistent rotor count max	light off	0 count, no cited range
dominant freq (Hz)	illuminated arrhythmia	15.4–19.9 Hz, unstable, not reportable
persistent rotors	illuminated arrhythmia	4–15 count, unstable, not reportable
dominant freq (Hz)	illuminated after termination	2.214 Hz, no cited range
singularity frames fraction	illuminated arrhythmia	0.479 fraction of frames, no cited range
persistent rotors	illuminated after termination	0 count, no cited range
persistent rotor count max	illuminated arrhythmia	1–2 count, unstable, not reportable
singularity frames fraction	illuminated after termination	0.000553–0.0149 fraction of frames, unstable, not reportable
persistent rotor count max	illuminated after termination	0 count, no cited range

Provisional rules behind this signature

Rule	Description	Expert	Status
protocol_parameter_set worker/voltage/protocol_params.py (developer_defaults, set_params)	Each protocol's fixed, versioned analysis parameters (version 1 = developer defaults); no run or agent may deviate	optical mapping analyst	provisional
baseline_window_rule worker/voltage/baseline_rule.py (FACTOR, evaluate)	A run proceeds only if the protocol's baseline window is $\geq 2\times$ the slowest segment's cycle, the cycle from the MAP channel when a DAQ log exists, else from per-pixel dominant frequency on linearly detrended pixels; otherwise the run is held by code	optical mapping analyst	provisional
filter_defaults worker/voltage/preprocess.py (Params)	Default baseline window (frames) and spatial Gaussian sigma/truncate for phase	optical mapping analyst (cardiac electrophysiology)	provisional
tissue_mask worker/voltage/io.py (tissue_mask)	Tissue = not NaN in frame 0 and nonzero temporal std	optical mapping analyst	provisional
polarity worker/voltage/preprocess.py (polarity)	Dye polarity from sign of median per-pixel skew of dV/dt	optical mapping analyst / voltage dye chemist	provisional
singularity_detection worker/voltage/preprocess.py (Params.rotor_threshold, rotor_erode_px)	Phase singularity = $ winding > \text{threshold turns}$, $\geq$ erode px from tissue edge	computational cardiac electrophysiologist (phase mapping)	provisional
rotor_persistence worker/voltage/rotors.py (TrackParams)	Track linking distance/gap and minimum lifetime for a persistent rotor	computational cardiac electrophysiologist (phase mapping)	provisional
chirality_pairing worker/voltage/rotors.py (TrackParams.pair_dist_px, paired_frac)	Opposite-charge singularities within pair distance are a pair; tracks paired most of their life are excluded from rotors	computational cardiac electrophysiologist (phase mapping)	provisional
sensitivity_grid worker/voltage/sensitivity.py (SIGMAS, BASELINE_MULTIPLES, baseline_levels)	Filter levels tested: spatial sigma and baseline window values	optical mapping analyst	provisional
analysis_window worker/voltage/runs.py (default_window)	Frames analysed: whole recording minus one filter pad at each end (unless the plan narrows it)	cardiac electrophysiologist familiar with the dataset	provisional
prior_processing_flags worker/voltage/inspect.py (prior_processing)	Thresholds for flagging depositor processing (normalization, masking, temporal/spatial smoothing)	imaging scientist (camera acquisition and noise)	provisional
baseline_step_detection worker/voltage/events.py (detect_baseline_step)	Baseline step = consensus upward step in tissue-mean raw baseline (cause not inferred; first misread as light onset, contradicted by the DAQ)	optical mapping experimentalist	provisional

Provisional rules behind this signature

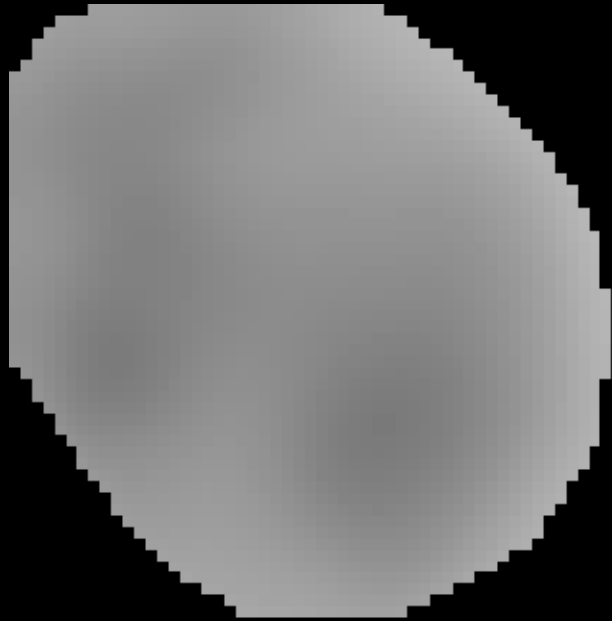
Rule	Description	Expert	Status
daq_interpretation worker/voltage/daq.py	DAQ channel names from depositor notebook; frames = first N triggers of closest burst; midpoint thresholds	experimentalist who recorded the data (or the depositor)	provisional
segment_definitions worker/voltage/annotations.py (MOUSE_SEGMENTS)	Mouse segments bounded by DAQ light events and the baseline step, interpreted as spiral termination under illumination (project lead, from Hussaini et al. 2023)	cardiac electrophysiologist (ideally the depositing authors)	provisional
rotor_finding_criterion worker/voltage/sensitivity.py (MIN_FRAC, MIN_RATIO)	Singularity before/after finding holds if $\text{frac}(\text{before}) \geq \text{min_frac}$ and $\geq \text{min_ratio} \times \text{frac}(\text{after})$ at every setting (also kept, superseded, for persistent rotors)	cardiac electrophysiologist + biostatistician	provisional
persistent_rotor_criterion worker/voltage/sensitivity.py (MIN_ROTORS_PRESENT, MAX_ROTORS_ABSENT)	Persistent-rotor finding holds if every 'present' segment has ≥ 1 persistent rotor and every 'absent' segment has none, at every setting	cardiac electrophysiologist	provisional
physiology_reference_rates worker/voltage/physiology.py (RANGES, TOLERANCE_FRAC)	Cited physiological ranges (single-study values widened by a 25% tolerance), applied to segments by their expected rhythm; used by the critic and for frame-rate sanity checks	cardiac electrophysiologist per species	provisional
stability_rule worker/agents/critic.py (STABLE_FRAC, stability)	A metric is reportable only if its spread across all sensitivity settings is $\leq 25\%$ of its median (zero spread when all values are 0); otherwise 'unstable, not reportable'	biostatistician + optical mapping analyst	provisional
persistence_threshold_variants worker/agents/critic.py (persistence_variants)	The persistent-rotor rule is run at two lifetimes, one measured cycle of the fastest segment and the paper's cited rotation period; both verdicts stored, disagreement flagged	computational cardiac electrophysiologist (phase mapping)	provisional

Review items

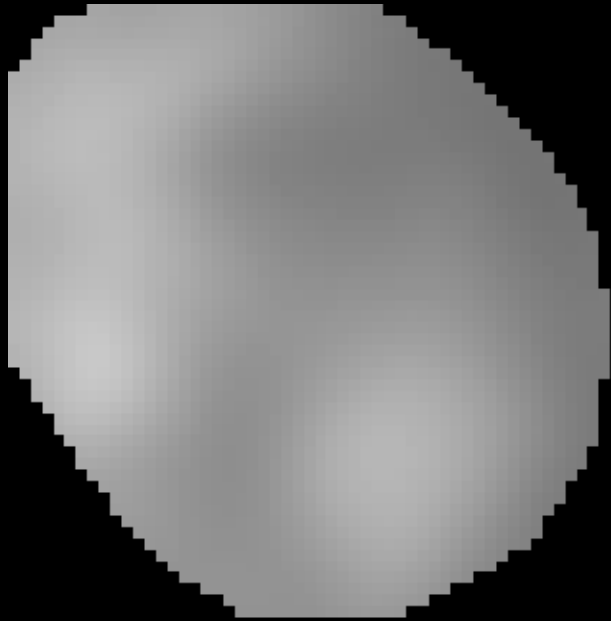
Topic	Detail	Severity
unstable:light_off.singularity_frames_frac	Range across settings is 0.0029023746701846965–0.02955145118733509, so this fraction should not be reported as a single value.	warn
unstable:illuminated_arrhythmia.persistent_rotors	Range across filters and trackers is 4.0–15.0; report robust presence only, not the exact count.	warn
unstable:illuminated_arrhythmia.persistent_rotor_count_max	Range across settings is 1.0–2.0, so the maximum concurrent count is not a stable single value.	warn
unstable:illuminated_arrhythmia.dominant_freq_hz	Range across baseline windows is 15.356–19.85 Hz; although DOI 10.1371/journal.pcbi.1011660 gives context of approximately 20 Hz and approximately 18.75 Hz for the study, this metric is not reportable as a single value here.	warn
unstable:illuminated_after_termination.singularity_frames_frac	Range across settings is 0.0005534034311012728–0.014941892639734366, so this fraction should not be reported as a single value.	warn
unstable:persistent_rotor_tracks	Range across filters and trackers is 4.0–15.0, so the exact track count is unstable and not reportable.	warn
Pre-deposit processing / raw-data label	The README labels M13Rec001 as raw experimental data, but notebook documentation and prior-processing flags indicate masking, spatial smoothing, temporal smoothing, and normalization; do not treat this as raw camera photon-count data.	warn
Event interpretation at frame 3170	Frame 3170 is an image baseline_step only; illumination began before frame 0 and ended at frame 4977, so frame 3170 should not be treated as light onset, and the spiral-termination label remains provisional.	warn
Baseline and illumination artifact	The publication reports blue-light crosstalk and re-normalization, and this recording has a large slow baseline range and a baseline step; amplitude or baseline-dependent analyses need artifact-aware review.	warn
Provisional tool thresholds	Event detection, processing flags, SNR, rhythm, and reference-rate thresholds are provisional and not yet reviewed by a domain scientist.	info

Mouse heart, spiral wave and optogenetic termination (M13Rec001)

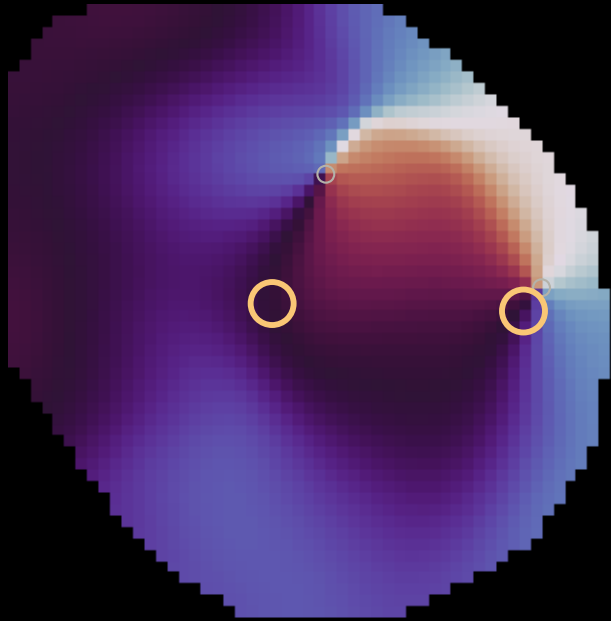
camera: frame as deposited



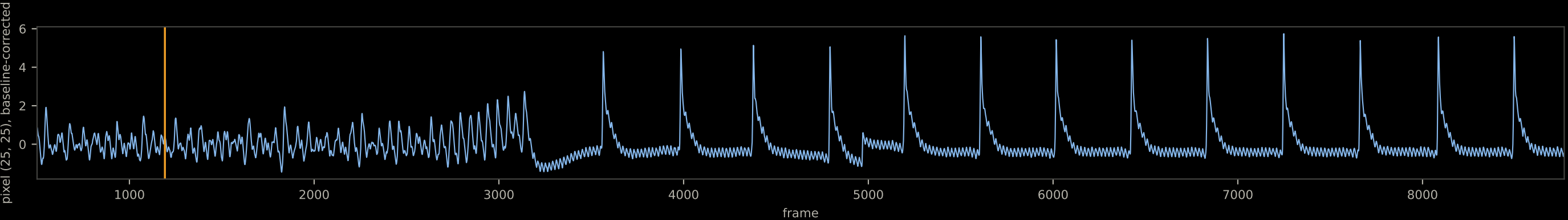
voltage: baseline-corrected only



phase: singularities (small), persistent rotors (ring)



frame 1192



Data: Public reference recording, Hussaini, Luther, Lädke (MPI Göttingen), CC-BY 4.0. doi:10.5281/zenodo.10228296. 64x55 px, 9267 frames; shown 500-8767 every 1. Frame rate: 1000 Hz.
Camera: values as deposited (may include the depositor's processing), linear gray -6.04 to 3.6, NaN black; nothing subtracted or filtered by us.
Voltage: baseline-corrected only (901-frame centered moving average subtracted), polarity x-1, no spatial filter, gray +/-2.93 (99th pct |V|).
Phase: Hilbert, on spatial Gaussian sigma=1.0 px (truncate 4.0) of the voltage signal, 500-frame pad. Singularity (small circle): |winding| > 0.9 turns, >= 3 px from tissue edge. Persistent rotor (large ring): tracked same-charge singularity lasting >= one cycle, not mostly in a close opposite-charge pair. Thresholds provisional.
Temporal low-pass: none. Display: native pixels, nearest-neighbour, no interpolation or boundary smoothing.
Opening frame 1192: display choice: frame with the most concurrent persistent rotors (2) in illumination with arrhythmia, midpoint of the longest such stretch.

Provenance

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        "label": "illumination with arrhythmia",
        "defined": [
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          3170
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        "analysed": [
          500,
          3170
        ],
        "citation": {
          "ref": "10.1371/journal.pcbi.1011660",
          "quote": "t stimulus with LI = 3.44 \u03bcW/mm2 and PL = 5 s. Fig 2C shows a
monophasic action potential (MAP) signal (in black) before, during, and after illumination.
It shows the sinus rhythm returns after 3190 ms of illumination. Fig 2D presents a closer
look at the MAP signal of the heart during the last few rotations of arrhythmia and the
first few action potentials of sinus rhythm. Fig 2E illustrates a"
        },
        "defined_by": "project lead (not a domain scientist), following the paper's design",
        "segment_id": "f6ca0bce-f7e9-437d-84b6-1bb1b24f80ba",
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    "expected_persistent_rotors": "present"
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    "defined": [
      3170,
      4977
    ],
    "analysed": [
      3170,
      4977
    ],
    "citation": {
      "ref": "10.1371/journal.pcbi.1011660",
      "quote": "t stimulus with LI = 3.44 \u03bcW/mm2 and PL = 5 s. Fig 2C shows a
monophasic action potential (MAP) signal (in black) before, during, and after illumination.
It shows the sinus rhythm returns after 3190 ms of illumination. Fig 2D presents a closer
look at the MAP signal of the heart during the last few rotations of arrhythmia and the
first few action potentials of sinus rhythm. Fig 2E illustrates a"
    },
    "defined_by": "project lead (not a domain scientist), following the paper's design",
    "segment_id": "c1444c59-1863-45aa-b6f3-2208392bf55a",
    "end_event_id": "db2ad5f3-9b96-4ec1-9ccd-9c82c3425609",
    "start_event_id": "46c59a51-1a01-4aed-8021-db9a63720a1d",
    "expected_persistent_rotors": "absent"
  },
  {
    "name": "light_off",
    "label": "light off",
    "defined": [
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      9267
    ],
    "analysed": [
      4977,
      8767
    ],
    "citation": {
      "ref": "10.1371/journal.pcbi.1011660",
      "quote": "t stimulus with LI = 3.44 \u03bcW/mm2 and PL = 5 s. Fig 2C shows a
monophasic action potential (MAP) signal (in black) before, during, and after illumination.
It shows the sinus rhythm returns after 3190 ms of illumination. Fig 2D presents a closer
look at the MAP signal of the heart during the last few rotations of arrhythmia and the
first few action potentials of sinus rhythm. Fig 2E illustrates a"
    },
    "defined_by": "project lead (not a domain scientist), following the paper's design",
    "segment_id": "4eedfd6-84c2-40d3-8a4a-8758716d02d9",
    "end_event_id": null,
    "start_event_id": "db2ad5f3-9b96-4ec1-9ccd-9c82c3425609",
    "expected_persistent_rotors": "absent"
  }
],

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    "illumination": "Acquisition log (LED trigger channel, provisional interpretation):
illumination on over frames 500-4977 of the analysed frames 500-8767.",
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    "frame_rate_source": {
        "ref": "10.1371/journal.pcbi.1011660",
        "kind": "publication",
        "note": "Camera frames are 64 x 64 in the paper; the deposit is 64 x 55 (cropped).
Consistent with the DAQ: 10 samples per frame and a 5 s light pulse spanning 50,001 samples
imply a 10 kHz DAQ.",
        "quote": " 775 \u00b1 70nm bandpass filter (FF01\u2013140-25, Semrock) and finally
by the camera (EMCCD, Cascade 128+, Photometrics) with a spatial resolution of 64 \u00d7 64
pixels (133 \u03bcm per pixel) at 1 kHz. Optical Mapping recordings were acquired with
software MultiRecorder and analysed with software PythonAnalyser (both developed by Research
Group Biomedical Physics). Electrical s",
        "section": "Materials and methods: Optical mapping experiments on ventricular
arrhythmia and its termination in the intact mouse heart"
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        "illuminated_arrhythmia": 52,
        "illuminated_after_termination": 452
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    "max_gap": 5,
    "min_cycles": 1.0,
    "min_frames": 52,
    "paired_frac": 0.5,
    "pair_dist_px": 3.0
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"pad_frames": 500,
"phase_method": "angle of scipy.signal.hilbert along time, on spatially filtered signal",
"spatial_sigma": 1.0,
"rotor_erode_px": 3,
"spatial_method": "scipy.ndimage.gaussian_filter per frame, mode=reflect; NaN set to 0
before filtering, non-tissue zeroed after",
"baseline_frames": 901,
"baseline_method": "scipy.ndimage.uniform_filter1d, mode=reflect, subtracted per pixel",
"polarity_method": "sign of median per-pixel skew of dV/dt on baseline-corrected signal",
"rotor_threshold": 0.9,
"spatial_truncate": 4.0,
"spatial_applies_to": "phase/activation only; displayed voltage is baseline-corrected
only"
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"criteria_status": {
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            "expert": "optical mapping analyst",
            "status": "provisional",

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"values": {
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  "protocol": "Mouse whole heart optical mapping (Luther lab)",
  "protocol_id": "f65d786f-f194-4be2-88b8-10d3dd25d674",
  "params_version": 3
},
"decision": null,
"location": "worker/voltage/protocol_params.py (developer_defaults, set_params)",
"reviewed": false,
"reviewer": null,
"description": "Each protocol's fixed, versioned analysis parameters (version 1 =
developer defaults); no run or agent may deviate",
"reviewed_at": null
},
{
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  "expert": "optical mapping analyst",
  "status": "provisional",
  "values": {
    "ok": true,
    "factor": 2.0,
    "source": "MAP channel (DAQ log)",
    "required_min_frames": 830,
    "slowest_cycle_frames": 415
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  "decision": null,
  "location": "worker/voltage/baseline_rule.py (FACTOR, evaluate)",
  "reviewed": false,
  "reviewer": null,
  "description": "A run proceeds only if the protocol's baseline window is >= 2x the
slowest segment's cycle, the cycle from the MAP channel when a DAQ log exists, else from
per-pixel dominant frequency on linearly detrended pixels; otherwise the run is held by
code",
  "reviewed_at": null
},
{
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  "expert": "optical mapping analyst (cardiac electrophysiology)",
  "status": "provisional",
  "values": {
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    "baseline_frames": 901,
    "spatial_truncate": 4.0
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  "decision": null,
  "location": "worker/voltage/preprocess.py (Params)",
  "reviewed": false,
  "reviewer": null,
  "description": "Default baseline window (frames) and spatial Gaussian sigma/truncate
for phase",
  "reviewed_at": null
},
{

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    "id": "tissue_mask",
    "expert": "optical mapping analyst",
    "status": "provisional",
    "values": {
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    "decision": null,
    "location": "worker/voltage/io.py (tissue_mask)",
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    "reviewer": null,
    "description": "Tissue = not NaN in frame 0 and nonzero temporal std",
    "reviewed_at": null
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{
    "id": "polarity",
    "expert": "optical mapping analyst / voltage dye chemist",
    "status": "provisional",
    "values": {
        "method": "median skew of dV/dt",
        "result": -1
    },
    "decision": null,
    "location": "worker/voltage/preprocess.py (polarity)",
    "reviewed": false,
    "reviewer": null,
    "description": "Dye polarity from sign of median per-pixel skew of dV/dt",
    "reviewed_at": null
},
{
    "id": "singularity_detection",
    "expert": "computational cardiac electrophysiologist (phase mapping)",
    "status": "provisional",
    "values": {
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        "rotor_threshold": 0.9
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    "decision": null,
    "location": "worker/voltage/preprocess.py (Params.rotor_threshold, rotor_erode_px)",
    "reviewed": false,
    "reviewer": null,
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tissue edge",
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    "expert": "computational cardiac electrophysiologist (phase mapping)",
    "status": "provisional",
    "values": {
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        "max_gap": 5,
        "min_cycles": 1.0,
        "min_frames": 52
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    },
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    "reviewer": null,
    "description": "Track linking distance/gap and minimum lifetime for a persistent
rotor",
    "reviewed_at": null
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    "id": "chirality_pairing",
    "expert": "computational cardiac electrophysiologist (phase mapping)",
    "status": "provisional",
    "values": {
      "paired_frac": 0.5,
      "pair_dist_px": 3.0
    },
    "decision": null,
    "location": "worker/voltage/rotors.py (TrackParams.pair_dist_px, paired_frac)",
    "reviewed": false,
    "reviewer": null,
    "description": "Opposite-charge singularities within pair distance are a pair; tracks
paired most of their life are excluded from rotors",
    "reviewed_at": null
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  {
    "id": "sensitivity_grid",
    "expert": "optical mapping analyst",
    "status": "provisional",
    "values": {
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        "default": 1.0,
        "heavier": 2.0
      },
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          10
        ],
        "strict": [
          2.0,
          1
        ],
        "default": [
          4.0,
          5
        ]
      }
    },
    "baselines": {
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      "3x_cycle": 1356,
      "6x_cycle": 2712,
      "1.5x_cycle": 678
    }
  }

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  },
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baseline_levels)",
  "reviewed": false,
  "reviewer": null,
  "description": "Filter levels tested: spatial sigma and baseline window values",
  "reviewed_at": null
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  "expert": "cardiac electrophysiologist familiar with the dataset",
  "status": "provisional",
  "values": {
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    "f1": 8767
  },
  "decision": null,
  "location": "worker/voltage/runs.py (default_window)",
  "reviewed": false,
  "reviewer": null,
  "description": "Frames analysed: whole recording minus one filter pad at each end
(unless the plan narrows it)",
  "reviewed_at": null
},
{
  "id": "prior_processing_flags",
  "expert": "imaging scientist (camera acquisition and noise)",
  "status": "provisional",
  "values": {
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      "non_integer",
      "nan_mask_all_frames",
      "temporal_smoothing",
      "spatial_smoothing"
    ],
    "thresholds": {
      "int_frac": 0.5,
      "neg_frac": 0.01,
      "dv_autocorr": 0.5,
      "neighbour_corr": 0.8
    }
  },
  "decision": null,
  "location": "worker/voltage/inspect.py (prior_processing)",
  "reviewed": false,
  "reviewer": null,
  "description": "Thresholds for flagging depositor processing (normalization, masking,
temporal/spatial smoothing)",
  "reviewed_at": null
},
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    "id": "baseline_step_detection",
    "expert": "optical mapping experimentalist",
    "status": "provisional",
    "values": {
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        3170
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    "decision": null,
    "location": "worker/voltage/events.py (detect_baseline_step)",
    "reviewed": false,
    "reviewer": null,
    "description": "Baseline step = consensus upward step in tissue-mean raw baseline
(cause not inferred; first misread as light onset, contradicted by the DAQ)",
    "reviewed_at": null
  },
  {
    "id": "daq_interpretation",
    "expert": "experimentalist who recorded the data (or the depositor)",
    "status": "provisional",
    "values": {
      "events": [
        "illumination_on@0",
        "arrhythmia_termination@3153",
        "illumination_off@4977"
      ]
    },
    "decision": null,
    "location": "worker/voltage/daq.py",
    "reviewed": false,
    "reviewer": null,
    "description": "DAQ channel names from depositor notebook; frames = first N triggers of
closest burst; midpoint thresholds",
    "reviewed_at": null
  },
  {
    "id": "segment_definitions",
    "expert": "cardiac electrophysiologist (ideally the depositing authors)",
    "status": "provisional",
    "values": {
      "light_off": [
        4977,
        9267
      ],
      "illuminated_arrhythmia": [
        0,
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      "illuminated_after_termination": [
        3170,
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    "decision": null,

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    "location": "worker/voltage/annotations.py (MOUSE_SEGMENTS)",
    "reviewed": false,
    "reviewer": null,
    "description": "Mouse segments bounded by DAQ light events and the baseline step,
interpreted as spiral termination under illumination (project lead, from Hussaini et al.
2023)",
    "reviewed_at": null
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{
    "id": "rotor_finding_criterion",
    "expert": "cardiac electrophysiologist + biostatistician",
    "status": "provisional",
    "values": {
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        "min_ratio": 2.0
    },
    "decision": null,
    "location": "worker/voltage/sensitivity.py (MIN_FRAC, MIN_RATIO)",
    "reviewed": false,
    "reviewer": null,
    "description": "Singularity before/after finding holds if frac(before) >= min_frac and
>= min_ratio x frac(after) at every setting (also kept, superseded, for persistent rotors)",
    "reviewed_at": null
},
{
    "id": "persistent_rotor_criterion",
    "expert": "cardiac electrophysiologist",
    "status": "provisional",
    "values": {
        "expect": {
            "light_off": "absent",
            "illuminated_arrhythmia": "present",
            "illuminated_after_termination": "absent"
        },
        "max_absent": 0,
        "min_present": 1,
        "spanning_rotor": "counts in every segment it overlaps",
        "min_lifetime_frames": 52
    },
    "decision": null,
    "location": "worker/voltage/sensitivity.py (MIN_ROTORS_PRESENT, MAX_ROTORS_ABSENT)",
    "reviewed": false,
    "reviewer": null,
    "description": "Persistent-rotor finding holds if every 'present' segment has >= 1
persistent rotor and every 'absent' segment has none, at every setting",
    "reviewed_at": null
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    "id": "physiology_reference_rates",
    "expert": "cardiac electrophysiologist per species",
    "status": "provisional",
    "values": {
        "ranges": [
            "mouse_spiral_rotation_hz"

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    ],
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    "segment_rhythm_rule": "expected persistent rotors 'present' -> spiral arrhythmia"
  },
  "decision": null,
  "location": "worker/voltage/physiology.py (RANGES, TOLERANCE_FRAC)",
  "reviewed": false,
  "reviewer": null,
  "description": "Cited physiological ranges (single-study values widened by a 25%
tolerance), applied to segments by their expected rhythm; used by the critic and for frame-
rate sanity checks",
  "reviewed_at": null
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{
  "id": "stability_rule",
  "expert": "biostatistician + optical mapping analyst",
  "status": "provisional",
  "values": {
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      "light_off.singularity_frames_frac",
      "illuminated_arrhythmia.persistent_rotors",
      "illuminated_arrhythmia.persistent_rotor_count_max",
      "illuminated_arrhythmia.dominant_freq_hz",
      "illuminated_after_termination.singularity_frames_frac",
      "persistent_rotor_tracks"
    ],
    "stable_frac": 0.25
  },
  "decision": null,
  "location": "worker/agents/critic.py (STABLE_FRAC, stability)",
  "reviewed": false,
  "reviewer": null,
  "description": "A metric is reportable only if its spread across all sensitivity
settings is <= 25% of its median (zero spread when all values are 0); otherwise 'unstable,
not reportable'",
  "reviewed_at": null
},
{
  "id": "persistence_threshold_variants",
  "expert": "computational cardiac electrophysiologist (phase mapping)",
  "status": "provisional",
  "values": {
    "measured_cycle": 52,
    "paper_rotation": 50
  },
  "decision": null,
  "location": "worker/agents/critic.py (persistence_variants)",
  "reviewed": false,
  "reviewer": null,
  "description": "The persistent-rotor rule is run at two lifetimes, one measured cycle
of the fastest segment and the paper's cited rotation period; both verdicts stored,
disagreement flagged",
  "reviewed_at": null
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],
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"position": 1,
"name": "illuminated_arrhythmia",
"label": "illumination with arrhythmia",
"start_frame": 0,
"end_frame": 3170,
"expected_persistent_rotors": "present",
"definition": "from recording start to spiral termination (interpreted; under
illumination)",
"defined_by": "project lead (not a domain scientist), following the paper's design",
"citation": {
"ref": "10.1371/journal.pcbi.1011660",
"quote": "t stimulus with LI = 3.44 \u03bcW/mm2 and PL = 5 s. Fig 2C shows a monophasic
action potential (MAP) signal (in black) before, during, and after illumination. It shows
the sinus rhythm returns after 3190 ms of illumination. Fig 2D presents a closer look at the
MAP signal of the heart during the last few rotations of arrhythmia and the first few action
potentials of sinus rhythm. Fig 2E illustrates a"
},
"evidence": {
"end": {
"kind": "baseline_step",
"frame": 3170,
"label": "spiral termination (interpreted; under illumination)",
"source": "image",
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"evidence": {
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"per_window": [
{
"z": 7.62002552466645,
"step": 1.6427573561668396,
"frame": 3170,
>window": 101
},
{
"z": 7.940594943178843,
"step": 1.7134565711021423,
"frame": 3154,
>window": 151
},
{
"z": 7.899171431654551,
"step": 1.732661247253418,
"frame": 3186,
>window": 201
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}
}
}
}

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```

],
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  3120
],
"post_window": [
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  3470
],
"baseline_pre": -0.5335609912872314,
"baseline_post": 1.2153877019882202,
"interpretation": "mean fluorescence changed; cause not determined from the image",
"beat_amplitude_p5_p95": 1.4402662966400377
},
"uncertainty_frames": 17
},
"start": {
  "illumination": {
    "timing": "before_first_frame",
    "daq_sample": 53144,
    "led_level_after": 0.0784302,
    "led_level_before": -0.000305176,
    "photodiode_after": 0.0177002,
    "photodiode_agrees": true,
    "photodiode_before": 0.015564,
    "frames_before_first_frame": 23.0
  }
}
},
"provisional": true
},
{
  "id": "c1444c59-1863-45aa-b6f3-2208392bf55a",
  "position": 2,
  "name": "illuminated_after_termination",
  "label": "illumination after termination",
  "start_frame": 3170,
  "end_frame": 4977,
  "expected_persistent_rotors": "absent",
  "definition": "from spiral termination (interpreted; under illumination) to
illumination_off",
  "defined_by": "project lead (not a domain scientist), following the paper's design",
  "citation": {
    "ref": "10.1371/journal.pcbi.1011660",
    "quote": "t stimulus with LI = 3.44  $\mu\text{W}/\text{mm}^2$  and PL = 5 s. Fig 2C shows a monophasic
action potential (MAP) signal (in black) before, during, and after illumination. It shows
the sinus rhythm returns after 3190 ms of illumination. Fig 2D presents a closer look at the
MAP signal of the heart during the last few rotations of arrhythmia and the first few action
potentials of sinus rhythm. Fig 2E illustrates a"
  },
  "evidence": {
    "end": {
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      "frame": 4977,

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"label": null,
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"event_id": "db2ad5f3-9b96-4ec1-9ccd-9c82c3425609",
"evidence": {
  "timing": "during_recording",
  "daq_sample": 103145,
  "led_level_after": -0.000610352,
  "led_level_before": 0.0784302,
  "photodiode_after": 0.015564,
  "photodiode_agrees": true,
  "photodiode_before": 0.0177002
},
"uncertainty_frames": 11
},
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  "frame": 3170,
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  "source": "image",
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        "step": 1.6427573561668396,
        "frame": 3170,
        "window": 101
      },
      {
        "z": 7.940594943178843,
        "step": 1.7134565711021423,
        "frame": 3154,
        "window": 151
      },
      {
        "z": 7.899171431654551,
        "step": 1.732661247253418,
        "frame": 3186,
        "window": 201
      }
    ],
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      2870,
      3120
    ],
    "post_window": [
      3220,
      3470
    ],
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    "baseline_post": 1.2153877019882202,
    "interpretation": "mean fluorescence changed; cause not determined from the image",
    "beat_amplitude_p5_p95": 1.4402662966400377
  }
}

```

```

    },
    "uncertainty_frames": 17
  }
},
"provisional": true
},
{
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  "position": 3,
  "name": "light_off",
  "label": "light off",
  "start_frame": 4977,
  "end_frame": 9267,
  "expected_persistent_rotors": "absent",
  "definition": "from illumination_off to recording end",
  "defined_by": "project lead (not a domain scientist), following the paper's design",
  "citation": {
    "ref": "10.1371/journal.pcbi.1011660",
    "quote": "t stimulus with LI = 3.44  $\mu$ W/mm2 and PL = 5 s. Fig 2C shows a monophasic action potential (MAP) signal (in black) before, during, and after illumination. It shows the sinus rhythm returns after 3190 ms of illumination. Fig 2D presents a closer look at the MAP signal of the heart during the last few rotations of arrhythmia and the first few action potentials of sinus rhythm. Fig 2E illustrates a"
  },
  "evidence": {
    "end": {
      "recording_end_frame": 9267
    },
    "start": {
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      "frame": 4977,
      "label": null,
      "source": "acquisition_log",
      "event_id": "db2ad5f3-9b96-4ec1-9ccd-9c82c3425609",
      "evidence": {
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    "label": null,
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    "kind": "arrhythmia_termination",
    "frame": 3153,
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    "kind": "baseline_step",
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    "uncertainty_frames": 17,
    "method": "consensus upward step in running-median baseline of tissue-mean raw signal"
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  {
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    "frame": 3170,

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    "label": null,  
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    "uncertainty_frames": 17,  
    "method": "consensus upward step in running-median baseline of tissue-mean raw signal"  
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