# Intrinsic and Synaptic properties

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| Parameter | Mean value | Range | Reference | Notes |
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| GoC Excitability | | | | |
| Rheobase | 30 pA |  | *Dieudonne 1998* | Min current to induce spikes |
| Spontaneous frequency | 3 +/- 1.7 Hz | 0.62-5.7 Hz | *“* | 200-300 micron slices |
|  | 9 +/- 5 Hz |  | *Kanichay and Silver 2008* | 200 – 220 um PSG slices |
| F-I slope | 70 +/- 20 Hz/nA |  | “ | 1s pulses, Internal soln with low Ca2+ buffering (BK? Sk?) |
|  | 230 +/- 50 Hz/nA |  | “ | With high Ca buffering |
|  | 250 +/- 20 |  | *Vervaeke et al 2010* | Fit with i=0,100,200 pA |
|  |  |  |  |  |
| Input Resistance | 179 +/- 4 MOhm |  | *Vervaeke et al 2010* | 200 ms, -100 pA pulse, CC |
|  | 330 +/- 70 MOhm |  | *Kanichay and Silver 2008* | 50 ms, current at dV=-5 mV, VC |
| Total capacitance | 37 +/- 14 pF | 10-74 pF | *Kanichay and Silver 2008* |  |
|  | | | | |
| Spontaneous EPSCs | | | | |
| Frequency | 1.6 +/- 1.5 Hz | 0.15 – 6.3 |  | Frequency fell to 80% in presence of TTX -> most are miniature events?? |
| Amplitude | 38+/-9 pA | 47 +/- 11 pA |  | But mossy fibres are cut |
|  | | | | |
| MF- GoC synapses | | | | |
| Current | 62 pA | 28 to 456 pA; 72 pA median | *Cesana et al, JNeuro 2013:* 10.1523/JNEUROSCI.4867-11.2013 | WM stim (300 um away)  **What is the distribution?** |
|  | 66 pA |  | *Kanichay and Silver JNeurosci 2008* |  |
| 20-80% rise | 0.2+/-0.1 ms |  | *Cesana et al 2013* |  |
|  | 0.23 +/ - 0.04 ms |  | *Kanichay and Silver 2008* |  |
| Tau\_rise | 0.1 ms | - | *Kanichay and Silver 2008* |  |
| Weighted decay time | 1.6 +/- 0.5 ms |  |  |  |
| Tau\_decay1 | 0.6 +/ - 0.4 ms | 0.6 +/- 0.2 ms in Cesana 2013 | “ | **0.7 ms in Vervaeke model** |
| Tau\_decay2 | 4.4 +/- 3 ms | 4.9 +/- 3 ms in Cesana 2013 | “ | **3.5 ms in Vervaeke model** |
| Gfast | 0.79 +/- 016 |  | “ |  |
| Gslow | 0.21 +/- 0.14 |  | *“* |  |
| Spatial distribution | 56 um | 20 – 90 um | *Kanichay and Silver 2008* | On basolateral dendrites, little attenuation(filtering) w distance |
| Number per GoC |  |  |  |  |
| NMDA component |  |  | *Cesana et al 2013* |  |
|  | Small conductance/contribution |  | *Kanichay and Silver 2008* |  |
| Amplitude | 27 +/-6pA at +50 mV, -4 pA at -30 mV |  | *Cesana et al 2013* | Glun2A/2b voltage dependence |
| 20-80 rise | 5+/- 3.1 ms |  | *“* |  |
| Tau rise |  |  |  |  |
| Tau decay |  |  |  |  |
|  |  |  |  |  |
| Short-term plasticity | Little effect |  | *Kanichay and Silver 2008* | ~22% at 100 Hz |
|  |  |  |  |  |
| Background inputs in model: | | | | |
| Number | 20 |  | *Vervaeke et al 2010* |  |
| Average rate | 2 Hz |  | *“* | Poisson inputs |
|  | | | | |
| GrC- GoC synapses | | | | |
| Ascending axon synapse: | | | | |
| Current | 45 +/-27 pA | 10-77 pA | *Cesana et al 2013* |  |
| Latency | 1.3 +/-0.3 ms | 0.8-1.93s | *“* |  |
| PPR | 1.46 |  | *“* |  |
| 20-80% rise | 0.3+/-0.1ms |  |  |  |
|  | 0.5 +/- 0.2 ms |  | *Kanichay and Silver 2008* |  |
| Tau rise |  | Integral had tau of 2.5+/-1.7ms | *“* |  |
| Tau\_decay | 1.3  /-0.4 ms | 0.5-2.1ms | *“* | 1 +/- 0.25 ms from Ca by bP AP by PF stim |
| Spatial distribution | 6 of 10 on basolateral |  | *“* | Other 4 may be pf or distal aa contacts |
| Number per GoC | 400-800 |  | *“* | Calculated based on immunohistochemical labelling density and evoked EPSCs |
| Parallel fibre synapse: | | | | |
| Number per GoC | ~1000-1200 | - | Cesana et al 2013 | Calculated based on densities and GoC dendritic surface area |
| Current | 38 ± 9 pA | 10-50 pA | *Dieudonne 1998* |  |
| Tau rise |  |  |  |  |
| Tau decay | 1.06 ms | Single Exp Syn |  |  |
| Tau decay1 | 0.96 ms | Double Exp Syn | *Dieudonne 1998* | 0.5-3.26 –could be dendritic filtering?;  2.7 +/-0.6 ms in Cesana 2013 -> filtering? |
| Tau decay 2 | 4.7 ms |  | *“* |  |
| Weighted Tau decay | 3.4 +/- 1.5 ms |  | *Kanichay and Silver 2008* |  |
| Spatial distribution |  |  |  |  |
| Conductance | 0.9 nS |  | Calculated as peak for ExpSyn (only AMPA?) |  |
| NMDA component: |  |  |  |  |
| Current |  | 0-60 pA |  |  |
| Tau rise |  |  |  |  |
| Tau decay1 | 31 +/- 9 ms |  | *Dieudonne 1998* |  |
| Tau decay | 170 +/- 15 ms |  | “ |  |
| gfast | 0.3 of peak |  |  |  |
| gslow | 0.7 of peak |  |  |  |
|  |  |  |  |  |
| Short term plasticity? | | | | |
| Mechanism | eCB mediated SSE, oR PTP – more at PF-> PC, none for PF-GoC |  | *Bieierlein et al 2007* |  |
|  | PPF = 50% at 25 Hz |  | *Kanichay and Silver 2008* |  |
|  |  |  |  |  |
| Background inputs in model: | | | | |
| Number | 100 |  | *Vervaeke et al 2010* |  |
| Average rate | 0.5 Hz |  | *“* | Poisson inputs |
|  |  |  |  |  |
| GoC-GrC inhibitory synapses | | | | |
| Amplitude | 13.3 +/- 10.2 pA |  |  | disynaptic IPSCs (WMT stim) |
| Rise time | 0.4 +/- 0.2 ms |  |  |  |
| Weighted decay tau | 8 +/- 1 ms |  |  |  |
| Latency | 1.2 +/- 0.1 ms |  |  |  |
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| Network Perturbation | | | | |
| With High Frequency Transient Burst Inputs | | | | |
| Type/Number | 8 random MFs per cell |  | *Vervaeke et al 2010* |  |
| Delay | 0-5 ms onset delays per input |  | *“* |  |
| Frequency | 200 Hz |  | *“* | Poisson trains |
| Duration | 10 ms |  | *“* |  |
| Type/Number | 50 random PFs per cell |  | *“* |  |
| Delay | 0-5 ms onset delays per input + 2 ms after MF |  | *“* |  |
| Frequency | 350 Hz |  | *“* | Poisson trains |
| Duration | 15 ms |  | *“* |  |
| GoC output | Spike doublet/triple at 100-250 Hz |  | *“* |  |
|  |  |  |  |  |
| With Fixed Frequency Stim | | | | |
| MF stim O/I frequency | Sublinear, saturating dependence after 10 Hz stim, precise time of MF spike upto 10 Hz stim |  | *Kanichay and Silver 2008* | Little jitter at onset -> timing rather than rate info? At high rates, the large 50 ms effective refractory period prevents locking |
| MF-evoked spike: min current for Pspike=0.5 | 260 +/- 172 pA = ~ 4 MF inputs |  |  |  |
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# Network connectivity

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| Electrical Coupling | | | | |
| Connection prob function (as %) | P(r)= -1745 + 1836/(1+exp((r-267)/39)) |  | *Vervaeke et al 2010* | Function of pairwise distance r between GoCs |
| Coupling coeff function (as %) | CC(r) = -2.3 + 29.7\*exp(-r/70.4) |  | “ |  |
| GJ from CC | GJg = 0.576\*exp(CC/12.4) +0.00059\*exp(CC/2.79)-0.564 |  | “ | Fit with 2 cell models |
|  | Integral multiple of 1 nS (or 0.94 nS) GJs |  | *Szobozslay et al 2016* | Linear between 2-5 nS (7.5-30% CC) |
|  |  |  |  |  |
|  |  |  |  |  |
| Cell distributions | | | | |
| GoC Density | 4607 cells/mm3 |  |  | Uniform (non-repulsive) sampling |
|  |  |  |  |  |
| Mossy fibres | | | | |
| Glomerular density | 6.6 x10e5 /mm3 |  | *“* |  |
| nGlom\_per\_MF | 2-20 |  | *Billings et al 2014, Litwin-Kumar 2017, Eccles 1967, Fox 1967* | N=2-3 for 80 um cylinder, n= 10 for 250 um, n=20 in large vol |
| MF density | Computed based on size |  |  |  |
| Spatial distribution | 1 rosette/MF uniformly distributed, subsequent rosettes have exponential spatial dependence on pos 1 |  | *Litwin-Kumar et al 2017, (Sultan et al 2001)* | Inter-rosette distance has exp distribution with µ\_x=2µm, µ\_y=58µm, µ\_z=21µm. Sultan 2001 had branches and rosette/branch |
|  |  |  |  |  |
| GrC density | 1.9 x 10e6 /mm3 |  | *Billings et al 2014* |  |
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