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ANU HIAF 14UD

Progress on the ANU 14UD three-frequency buncher

Linardakis P., Lobanov, N., Tempra. D

SNEAP 2016

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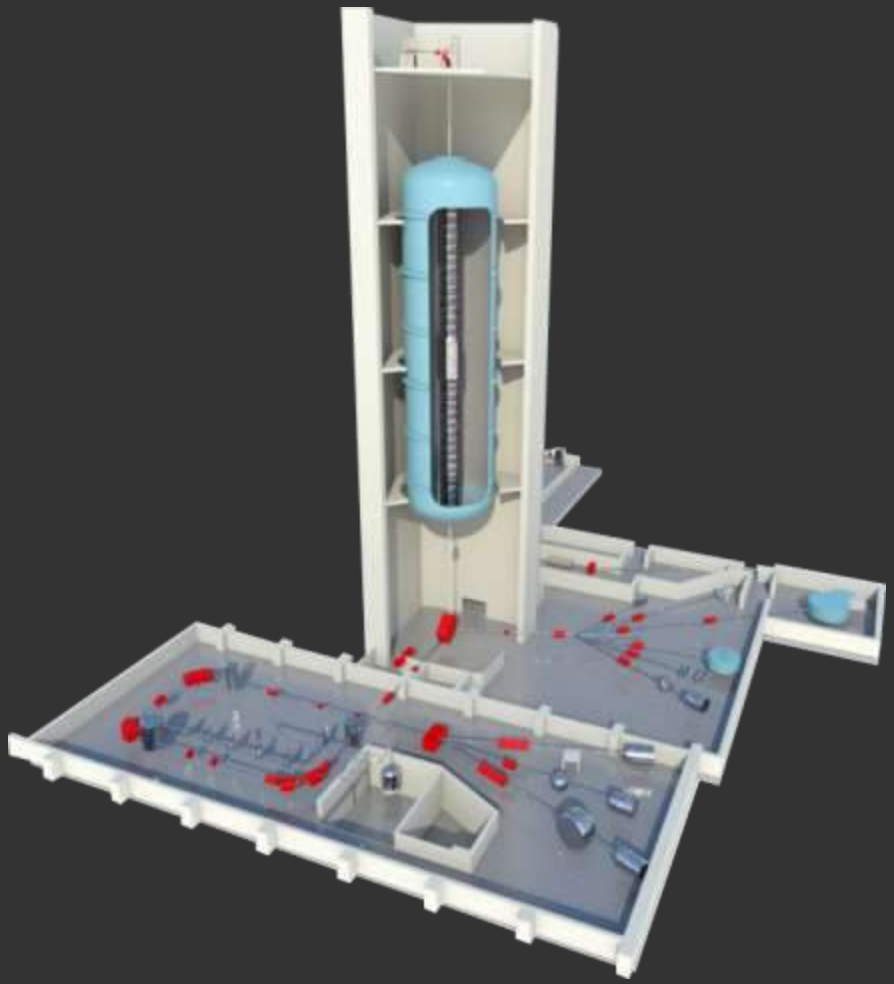
ANU HIAF 14UD



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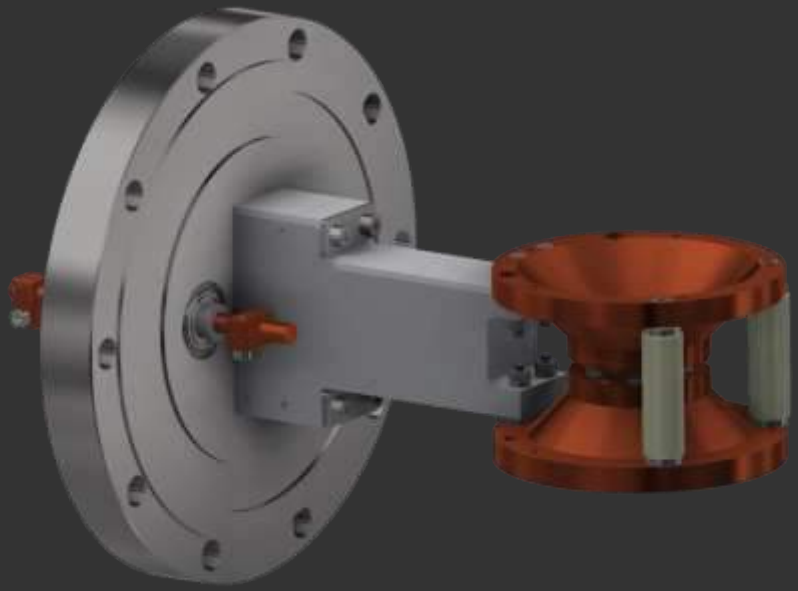
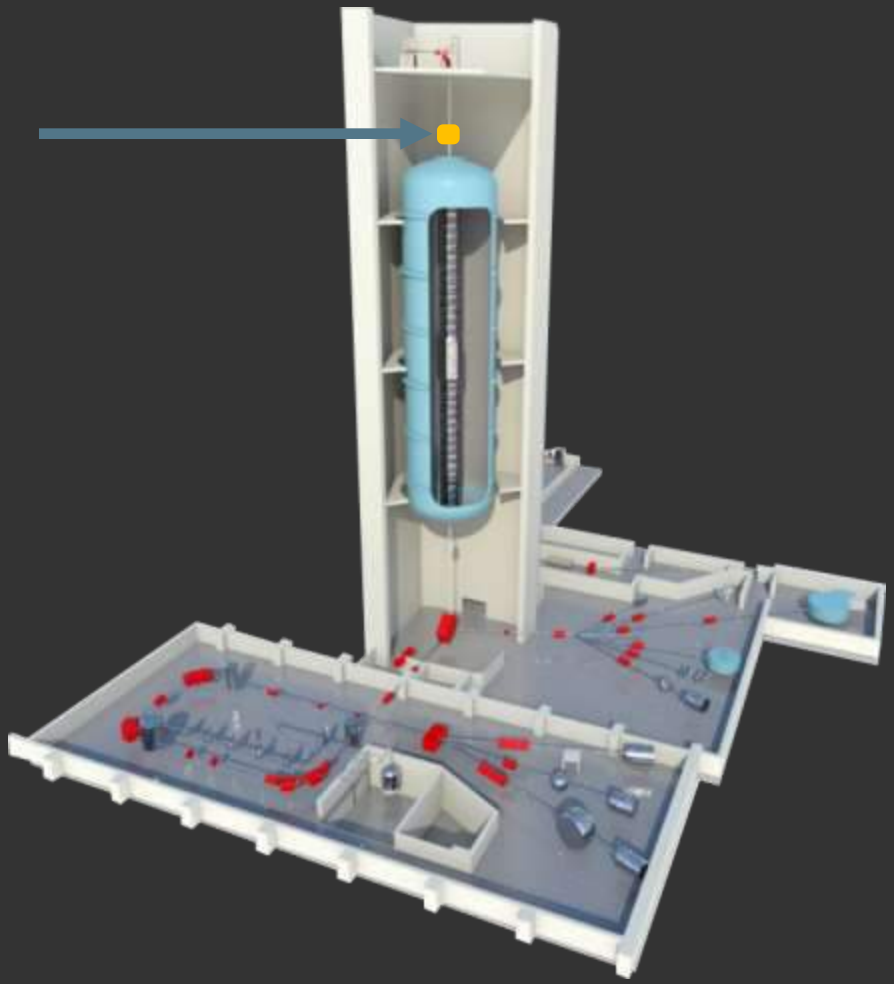
Low-energy buncher





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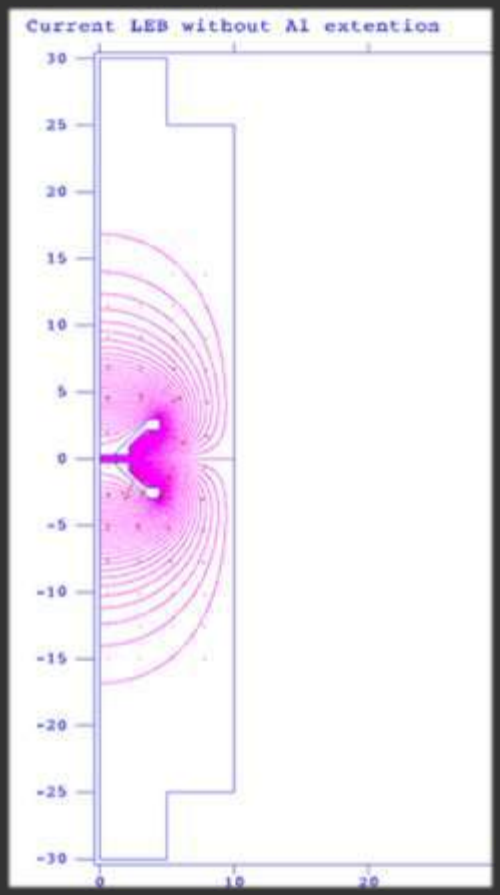
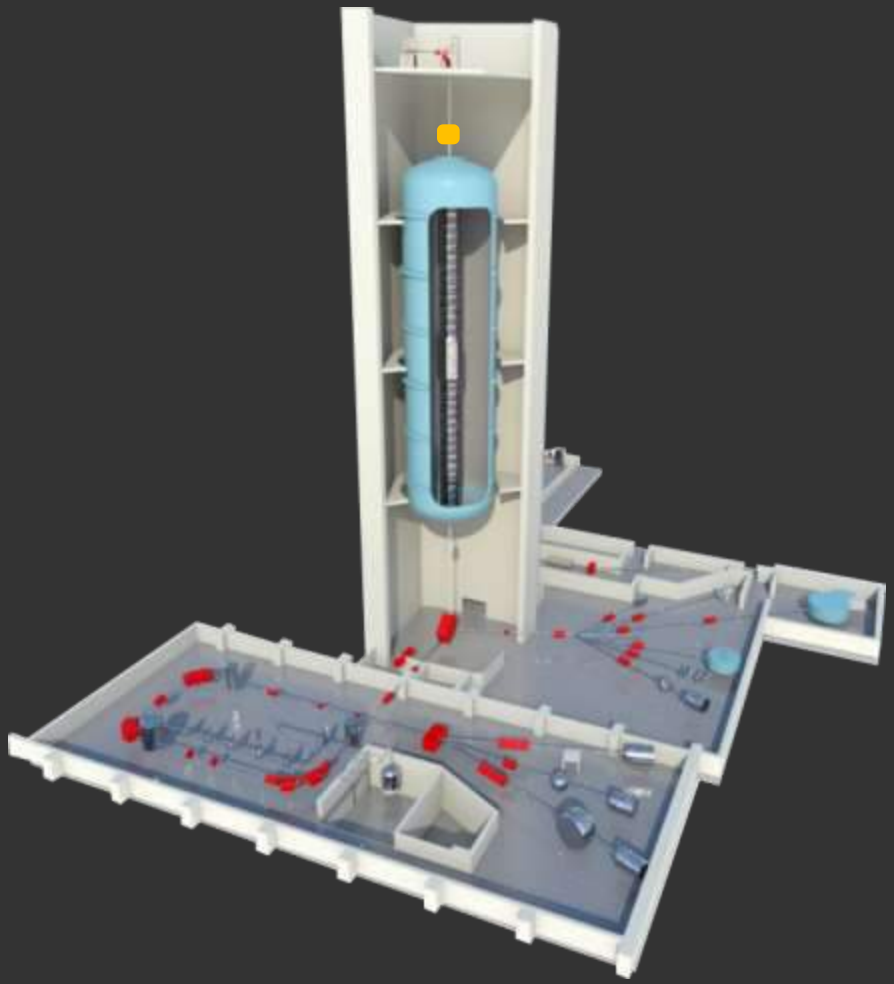
Low-energy buncher





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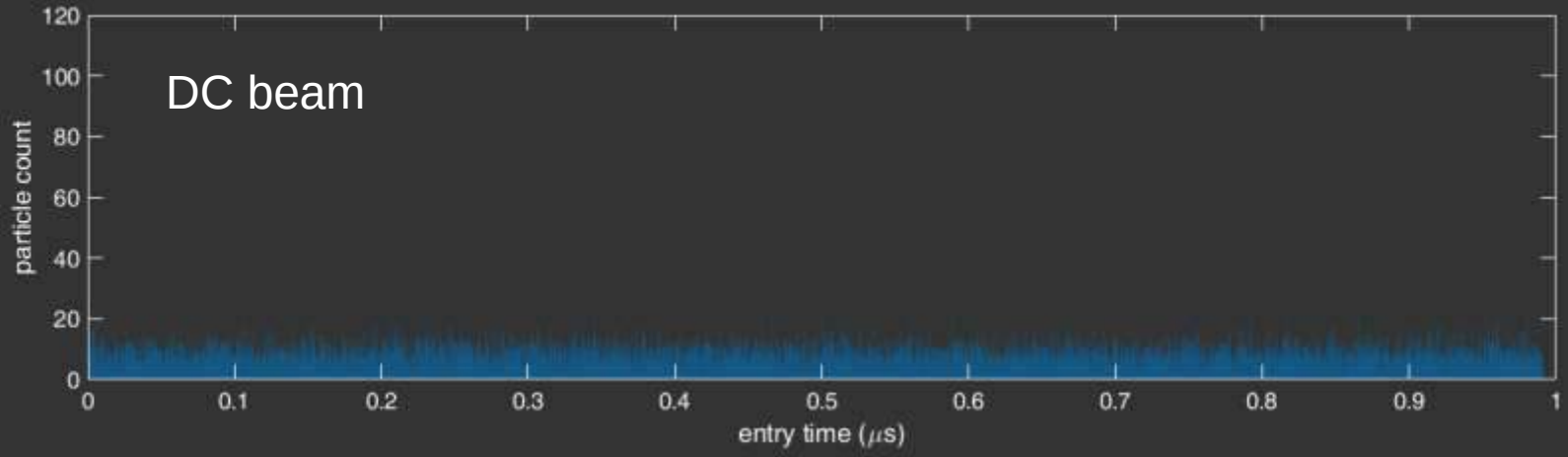
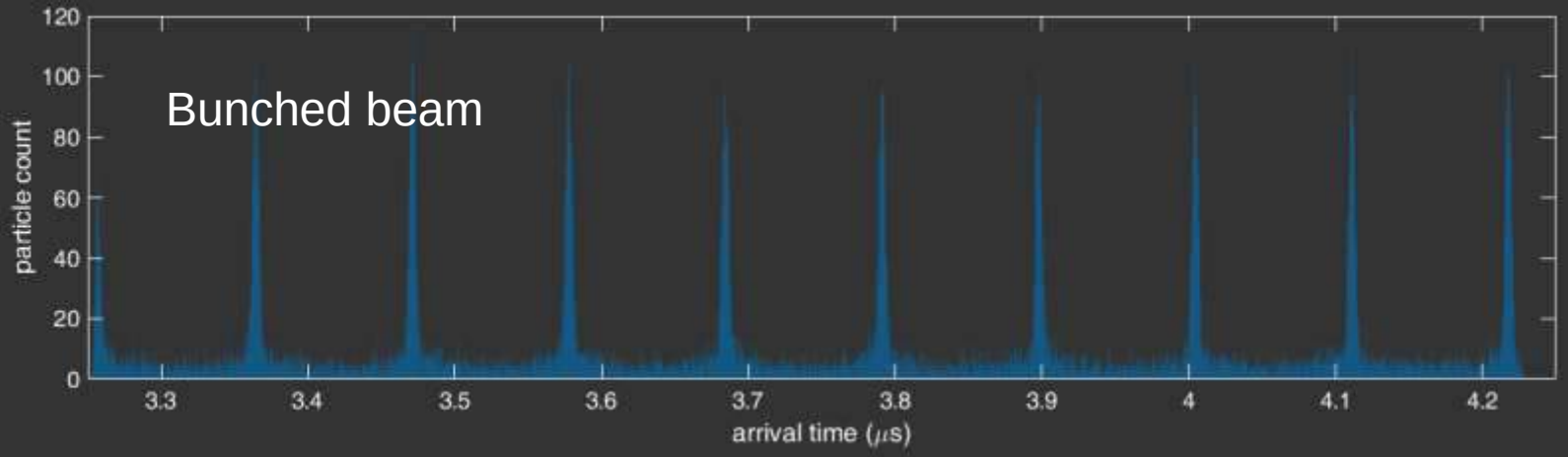
Low-energy buncher





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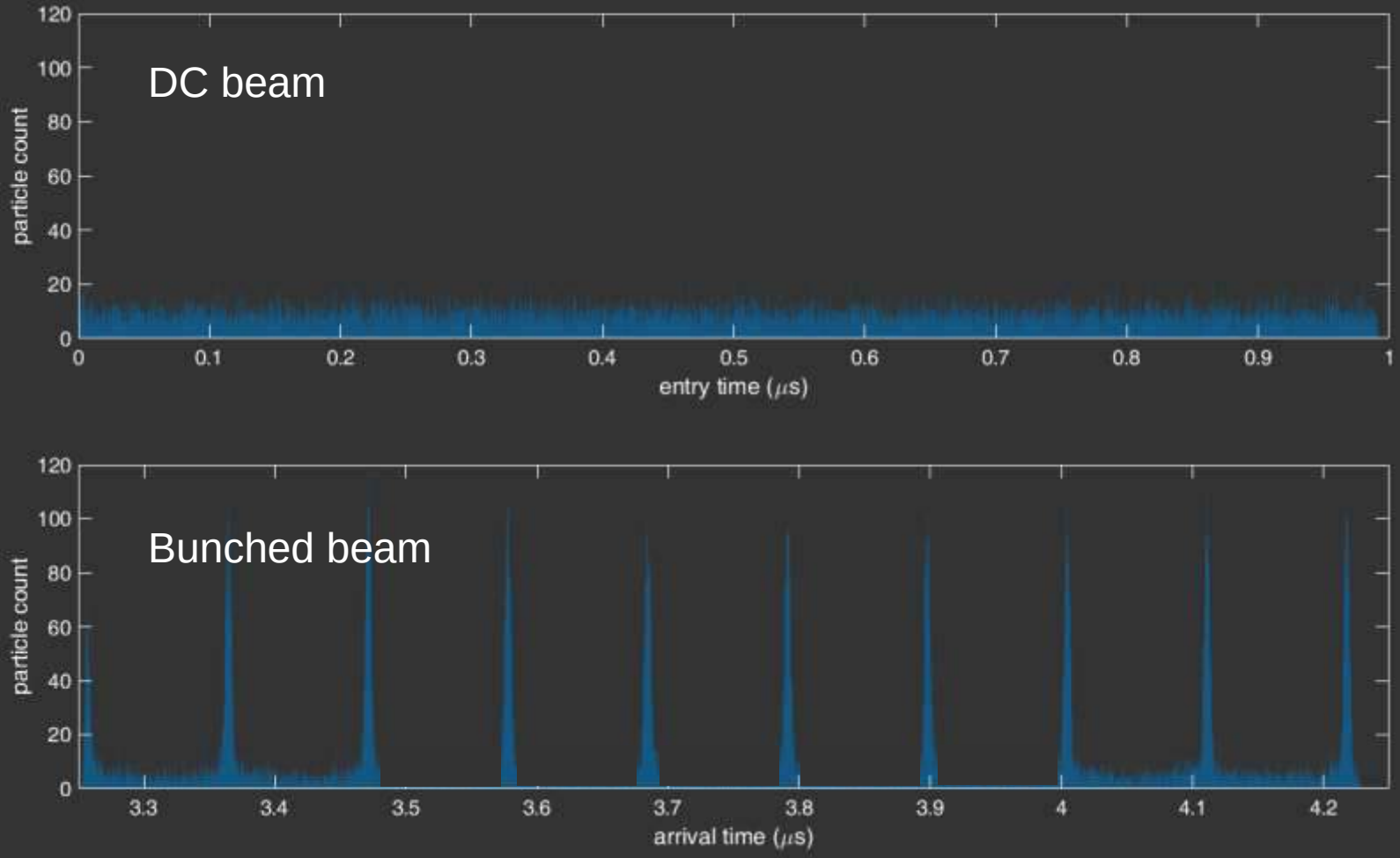
Low-energy buncher



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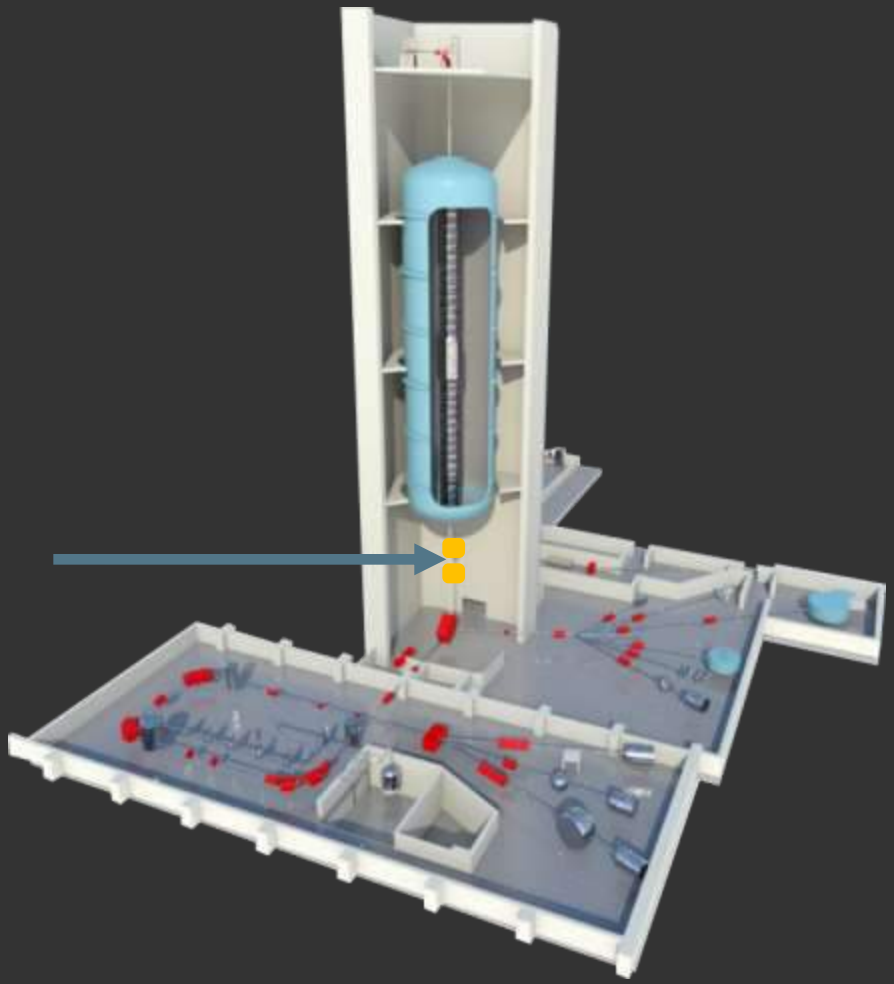
High-energy choppers



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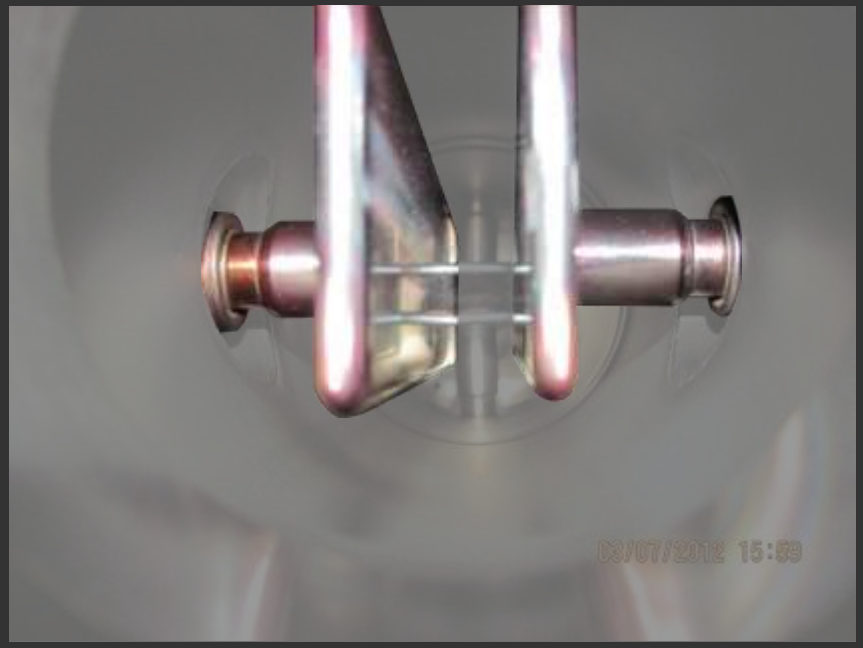
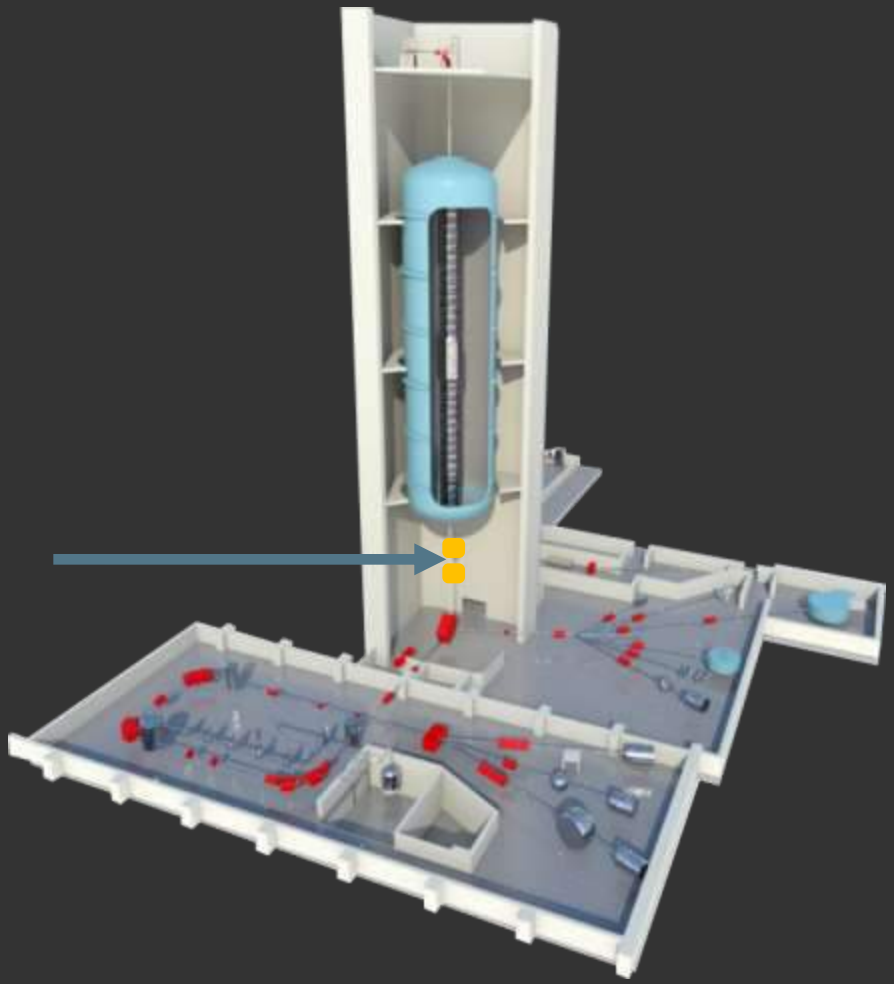
High-energy choppers





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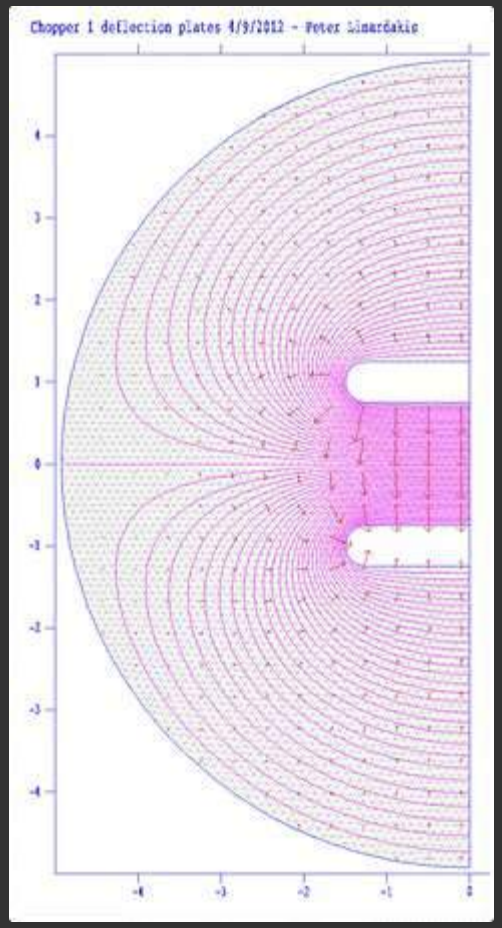
High-energy choppers



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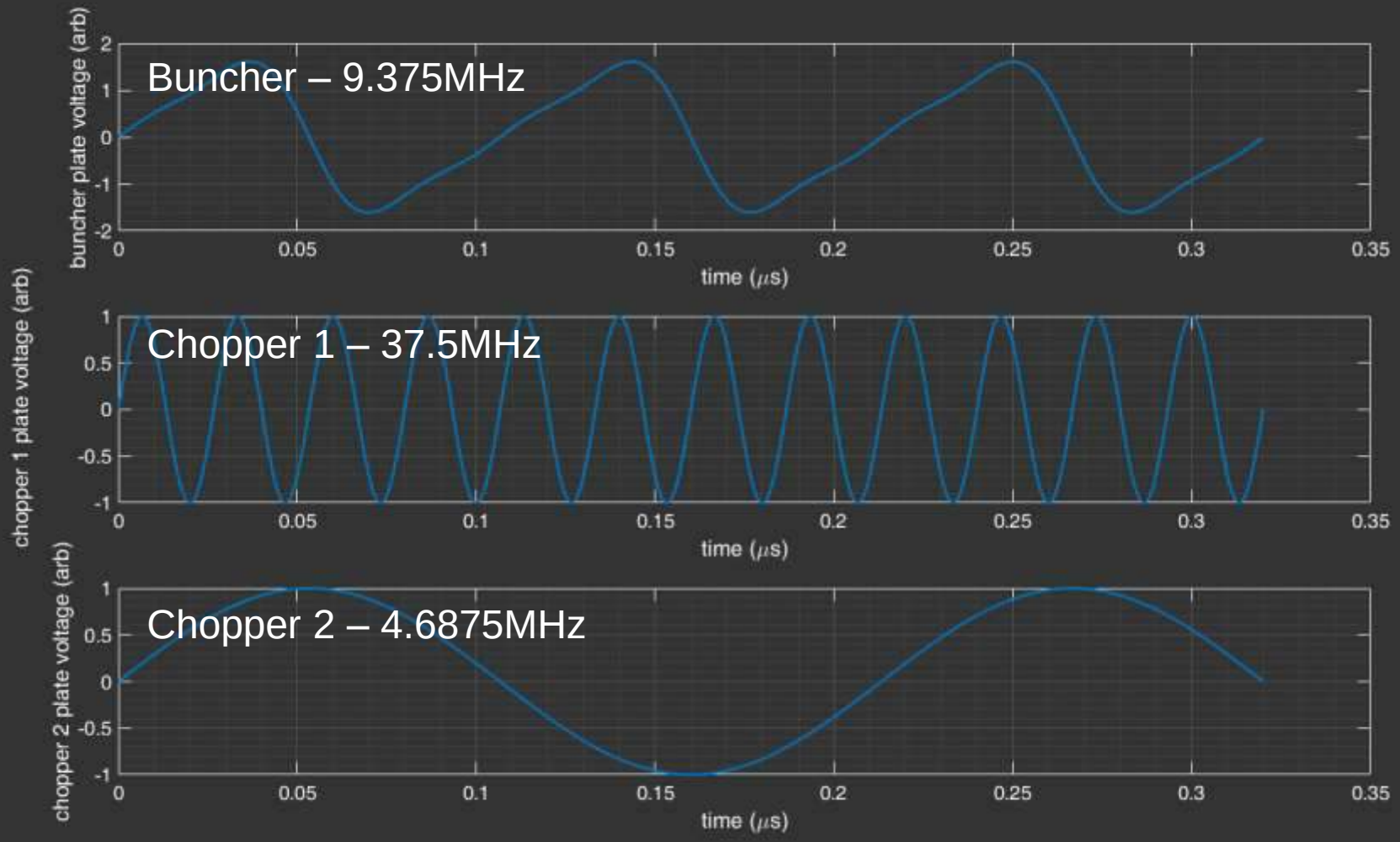
Pulsing system window



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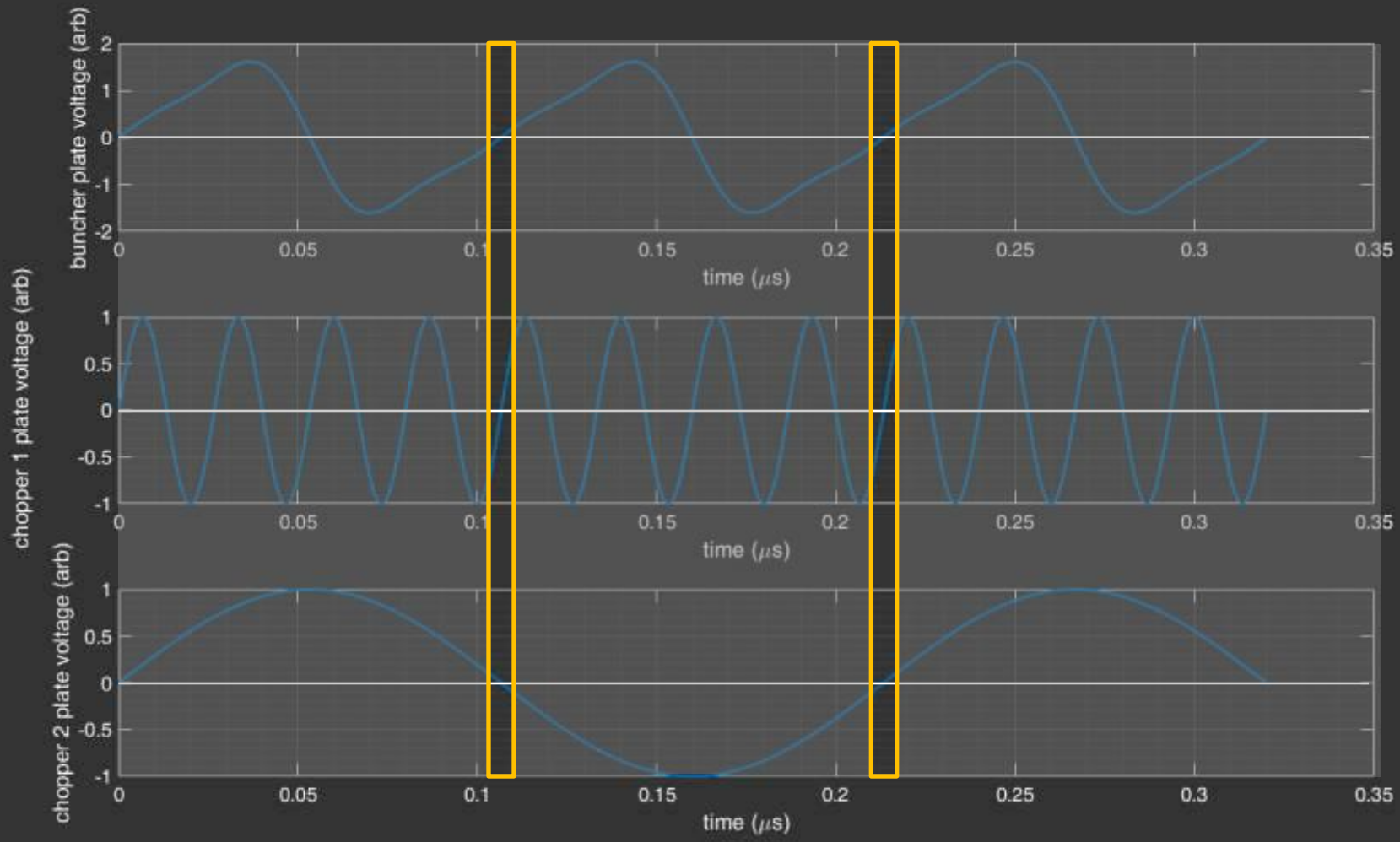
Pulsing system window



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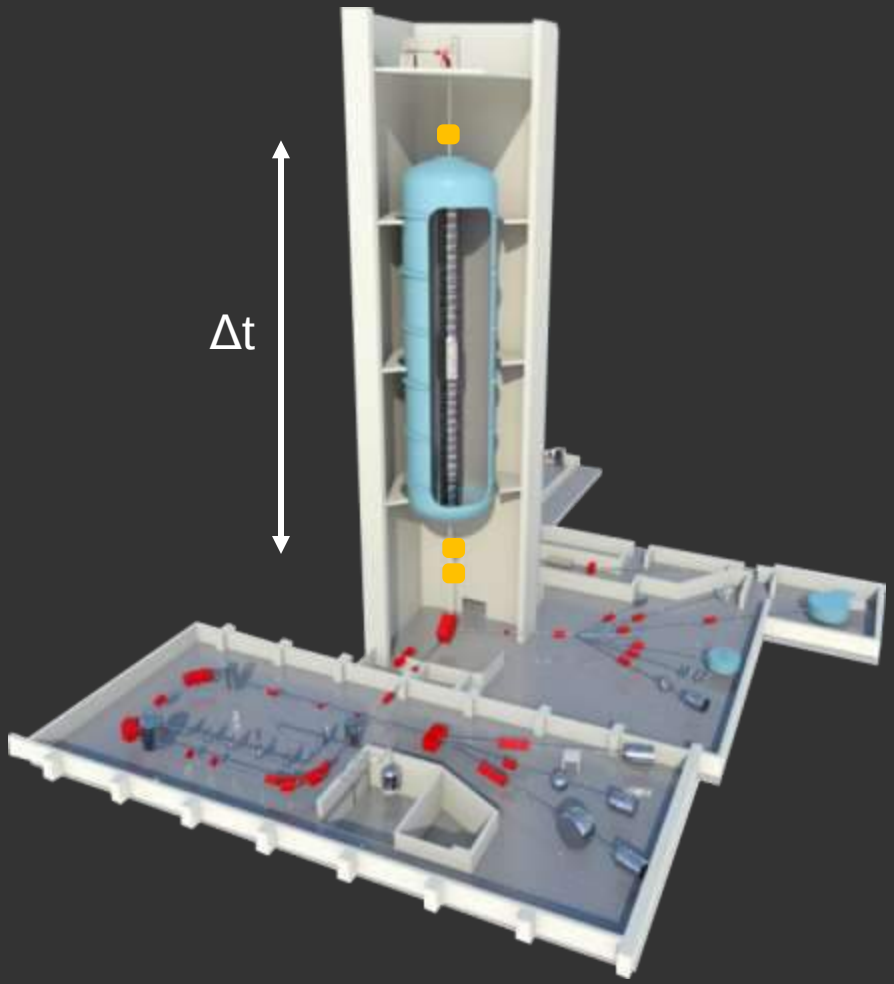
Pulsing system window

- Requires
  - Phase stability
  - Energy stability



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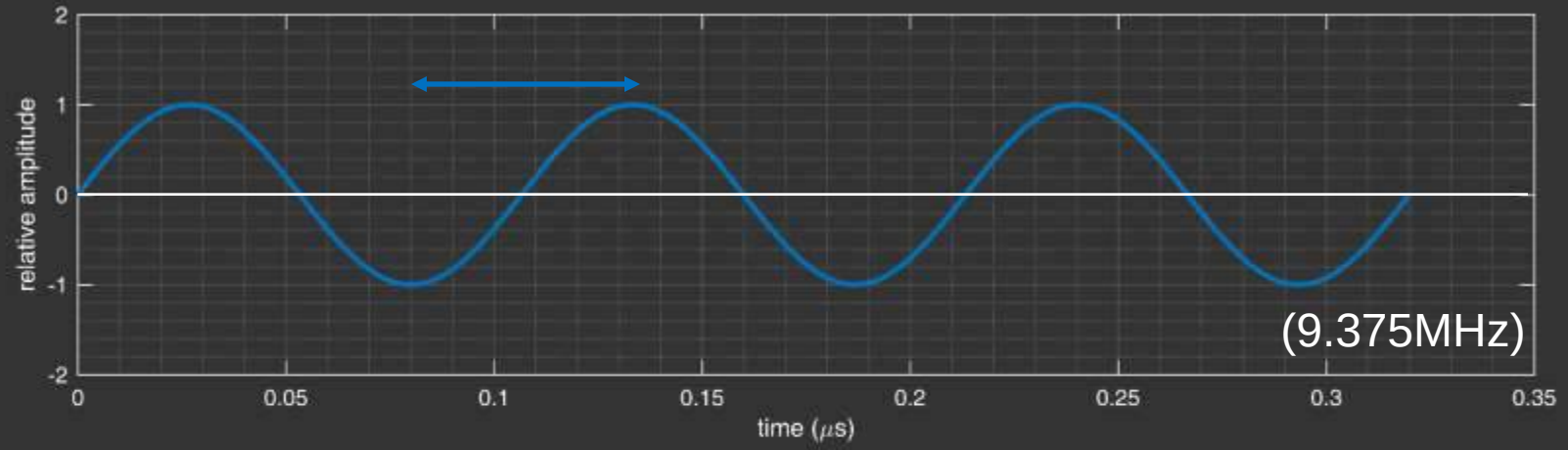
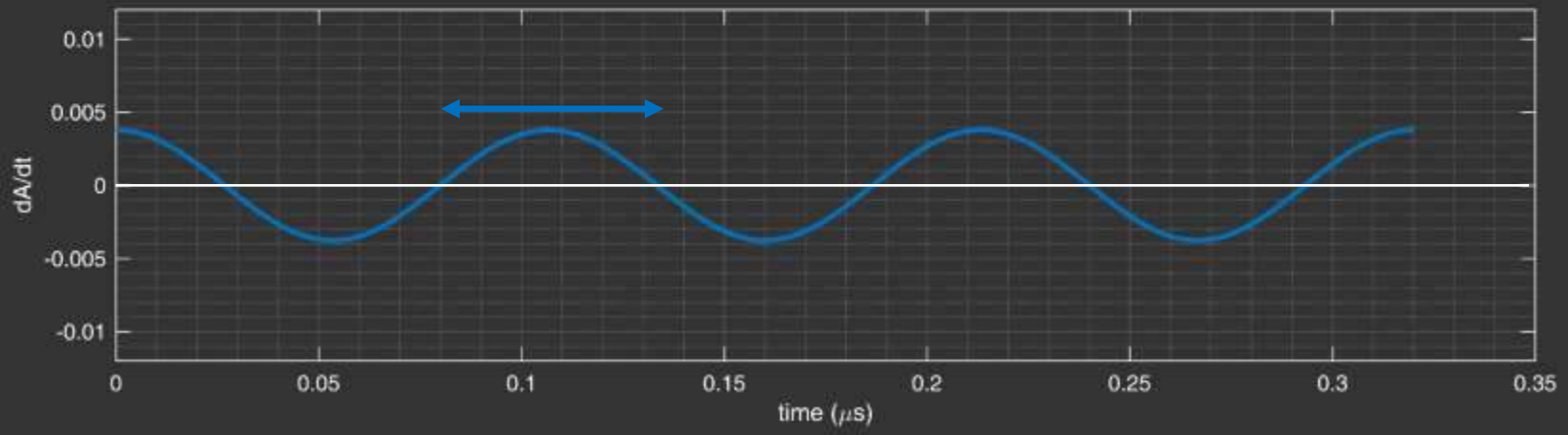
Bunching waveforms – 1 frequency





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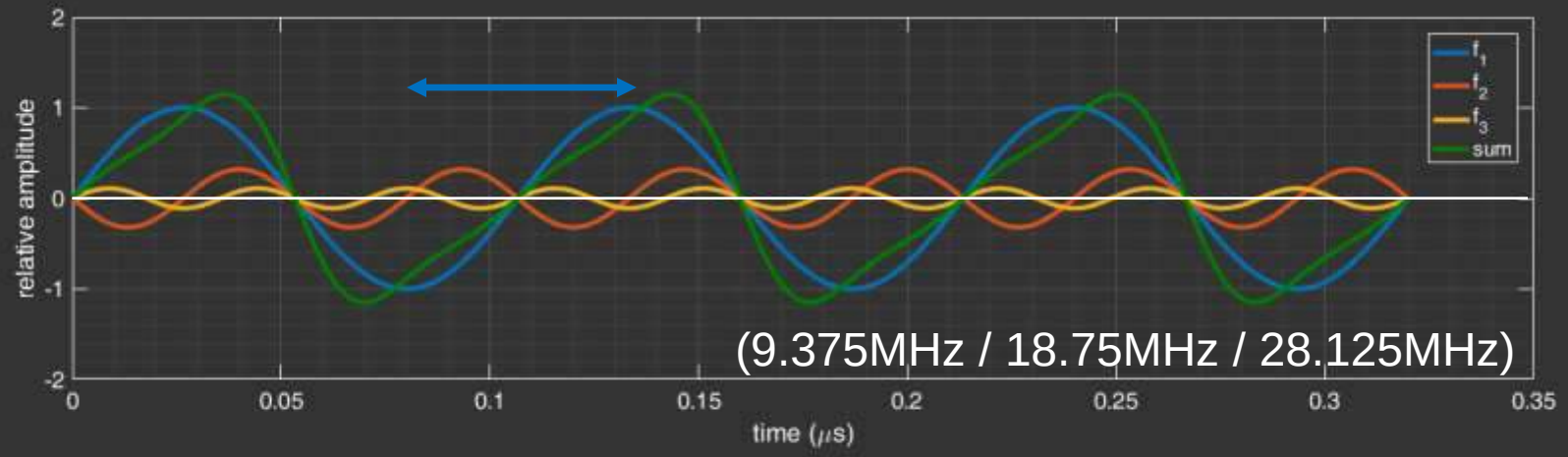
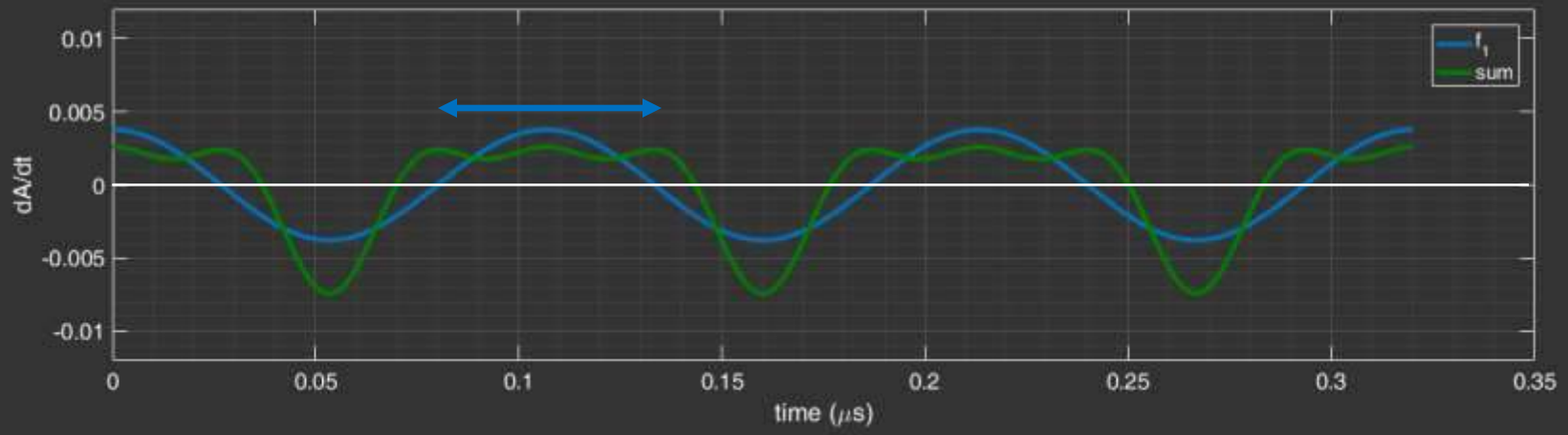
Bunching waveforms – 3 frequencies





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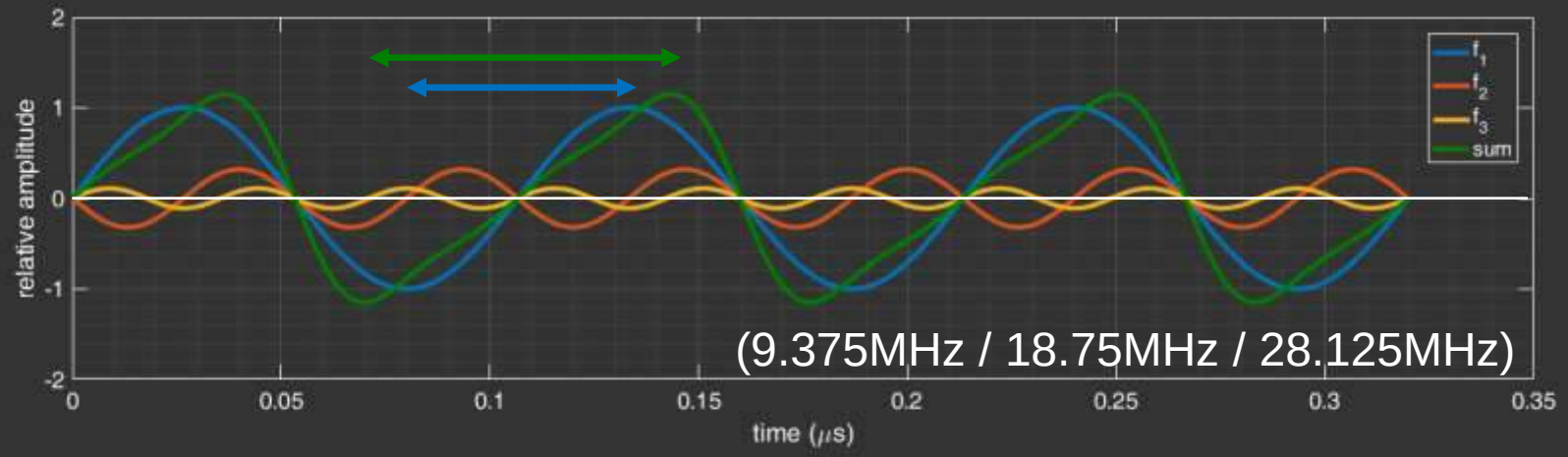
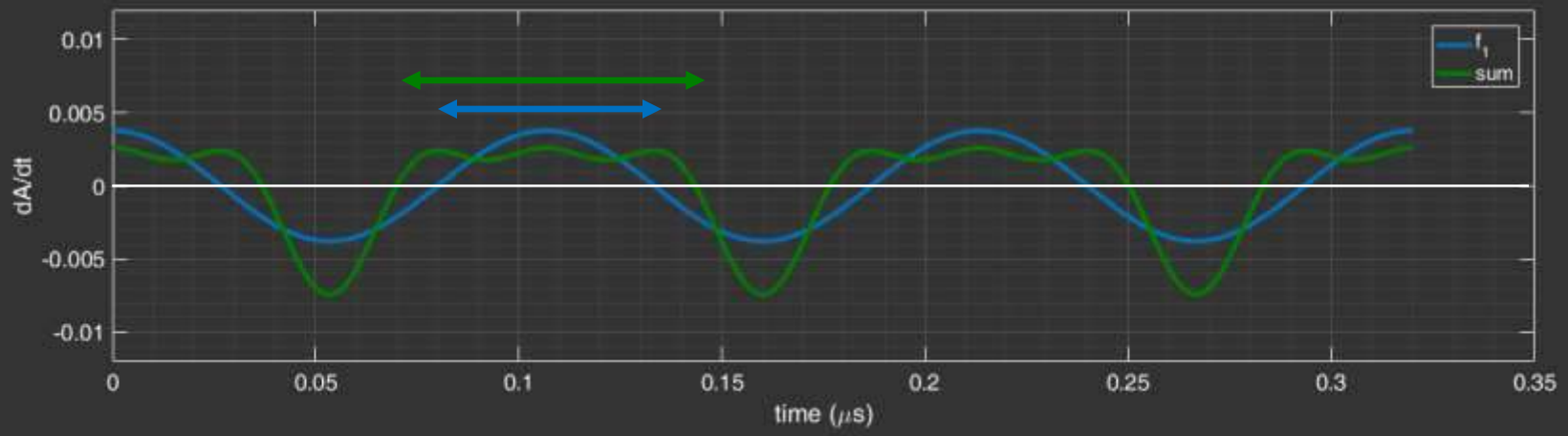
Bunching waveforms – 3 frequencies





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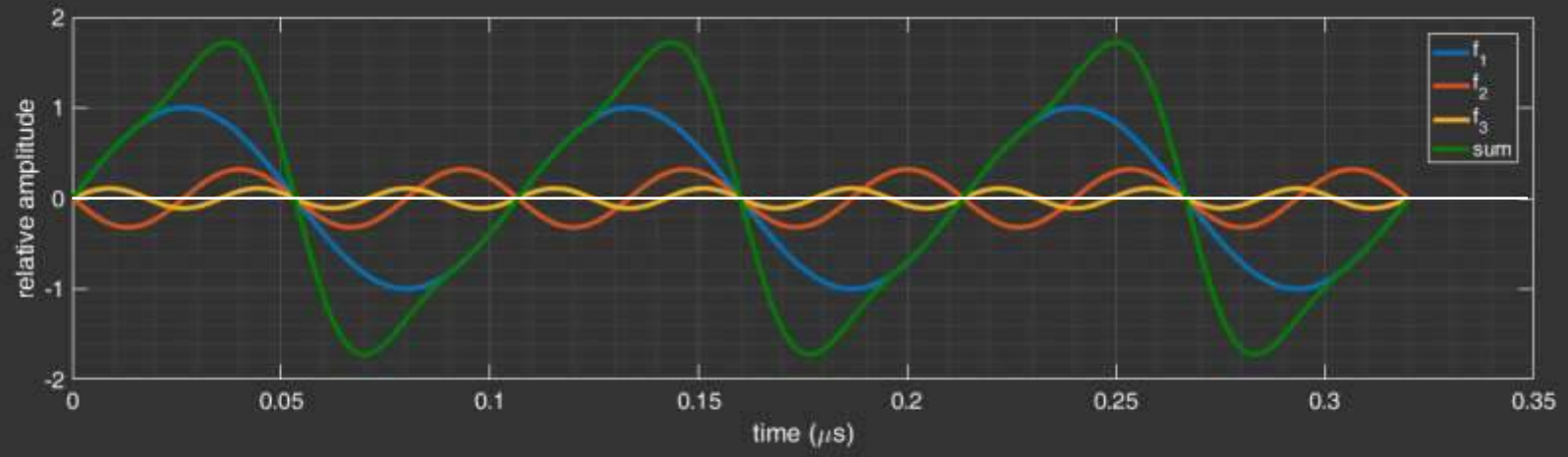
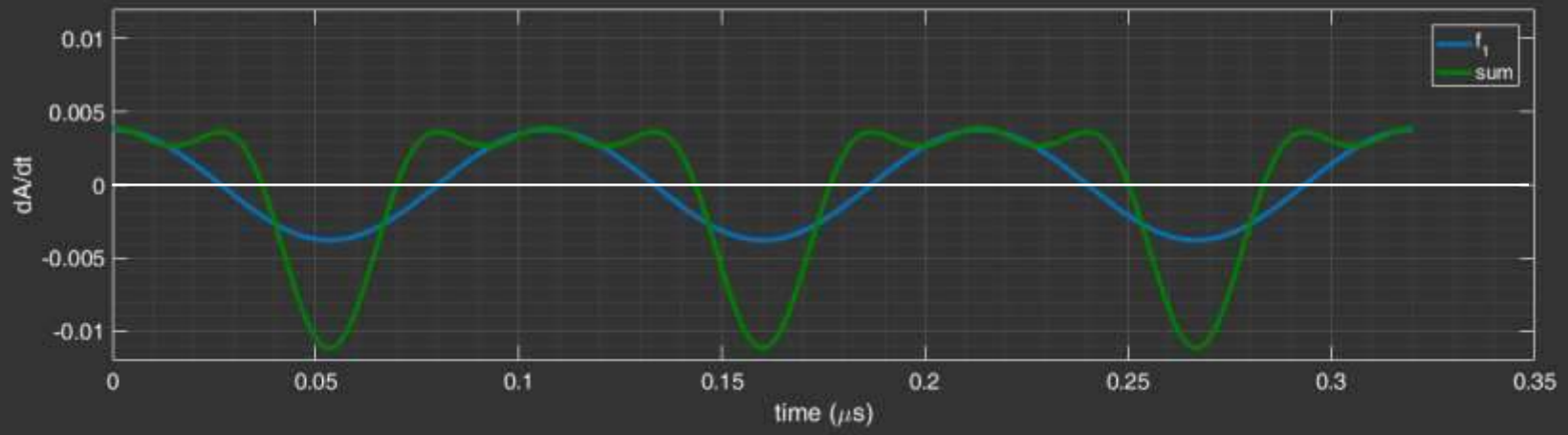
Bunching waveforms – equal slope





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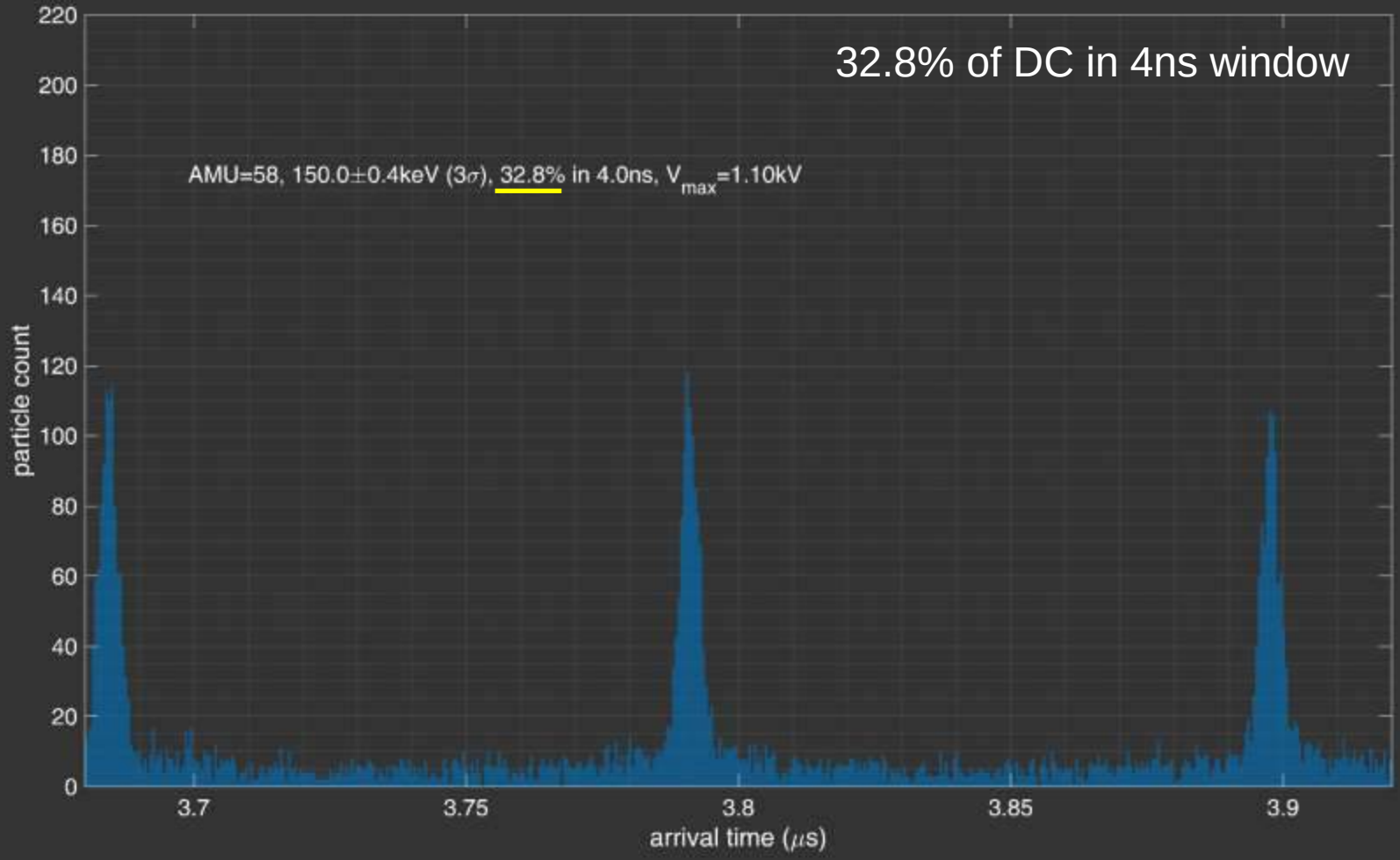
Single frequency bunching



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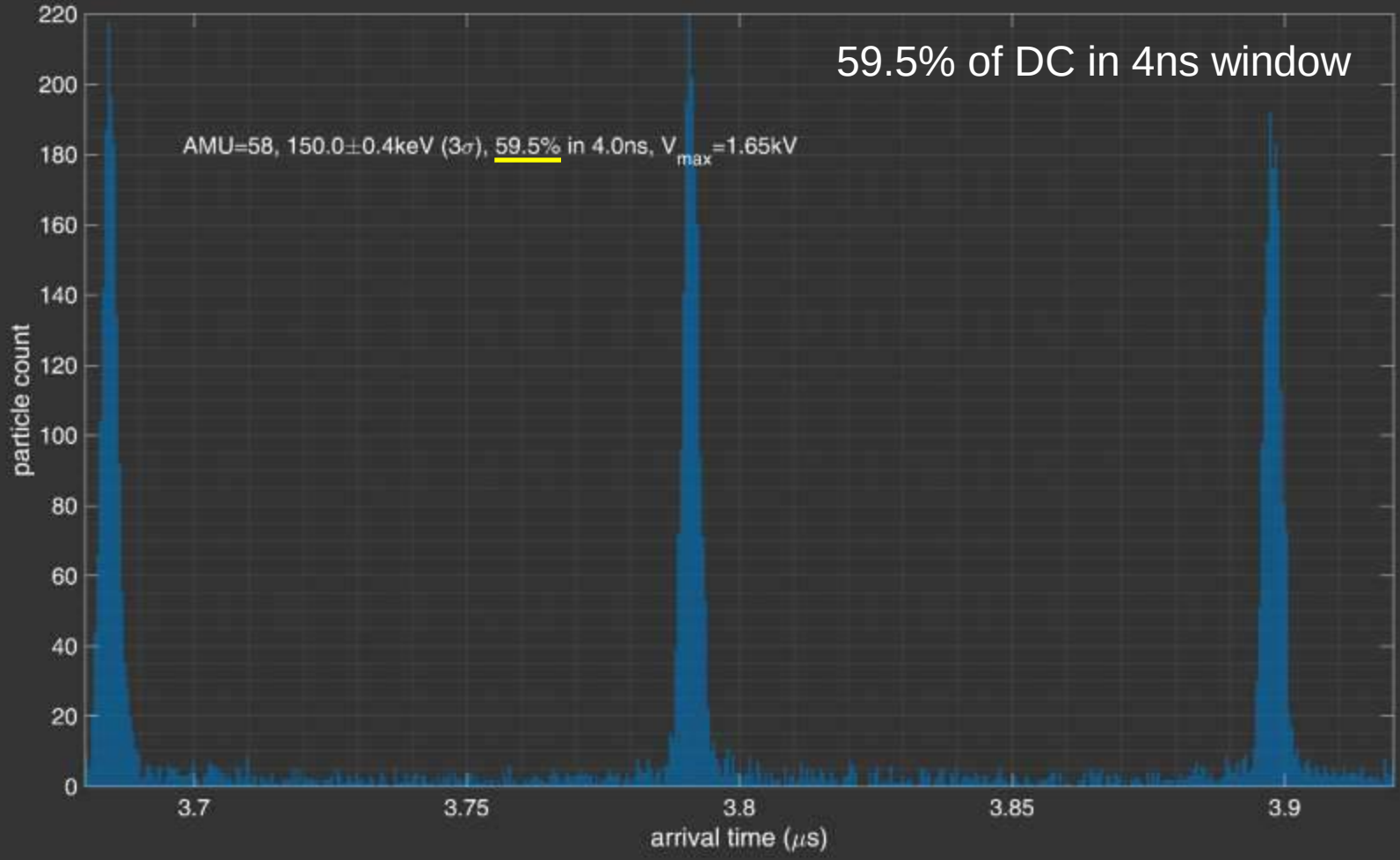
Three frequency bunching



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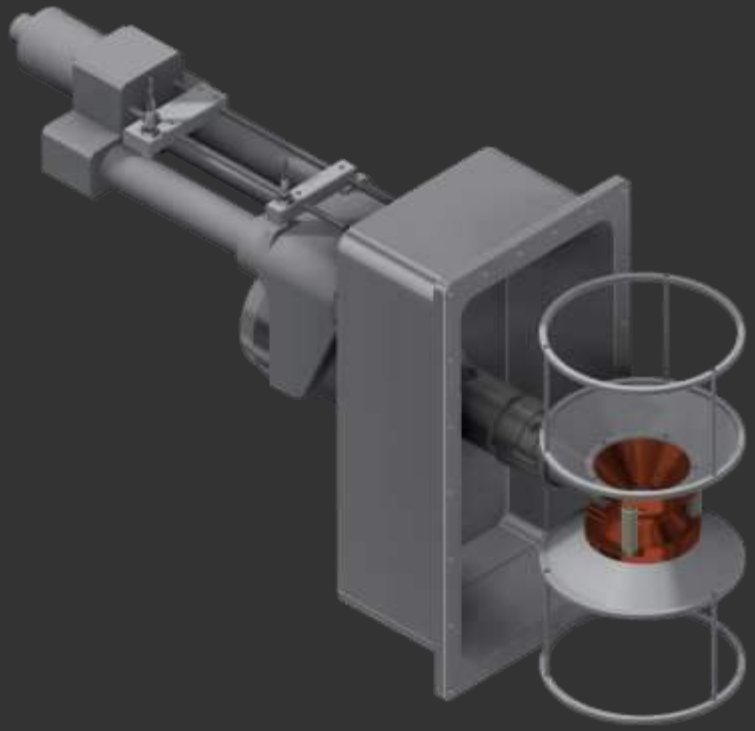
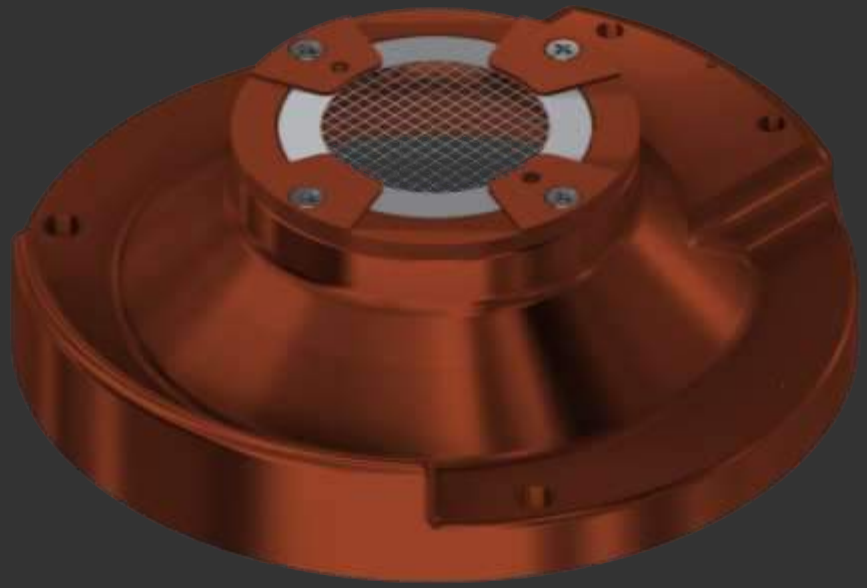
Hardware upgrade





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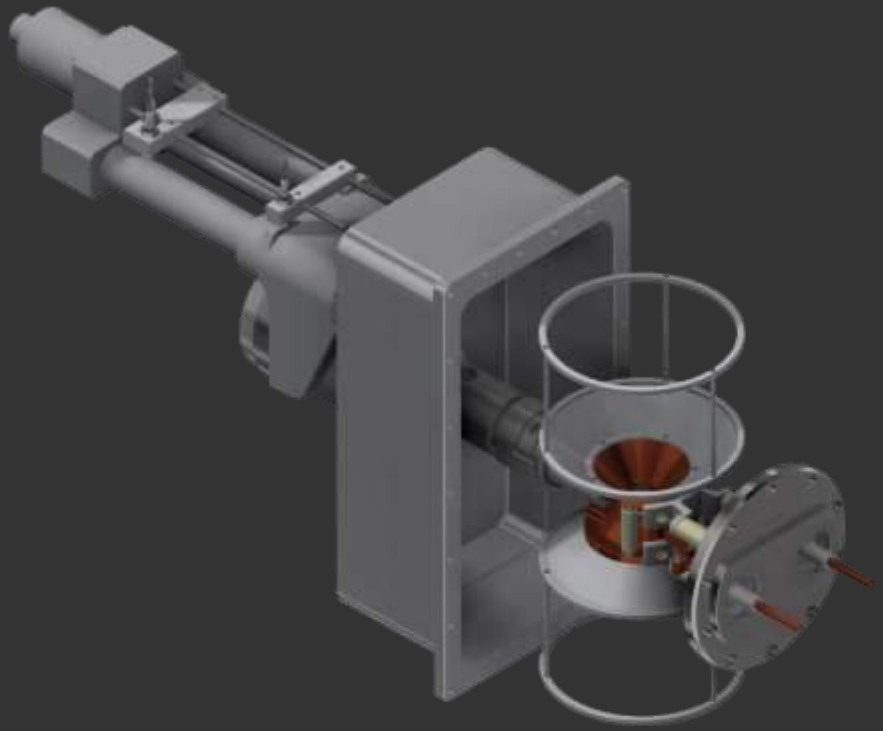
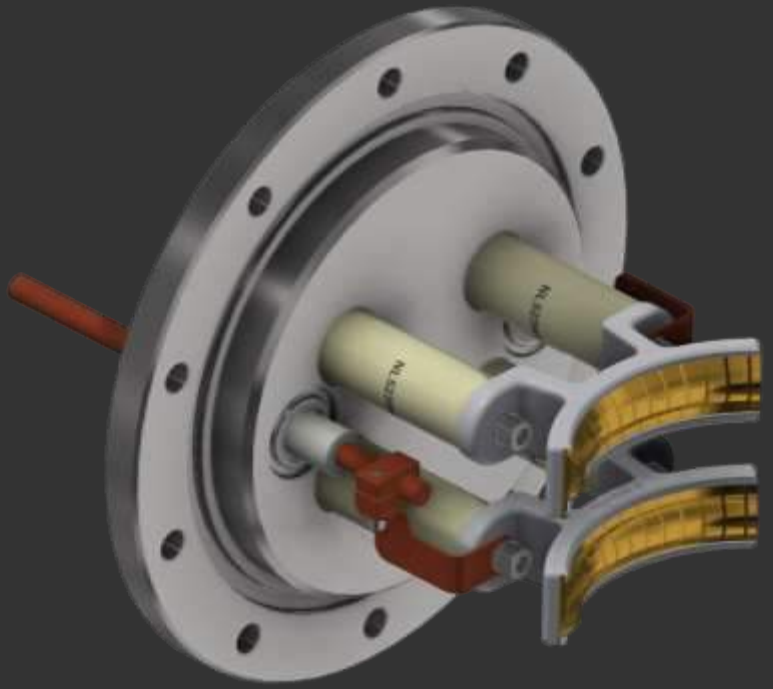
Hardware upgrade





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Hardware upgrade

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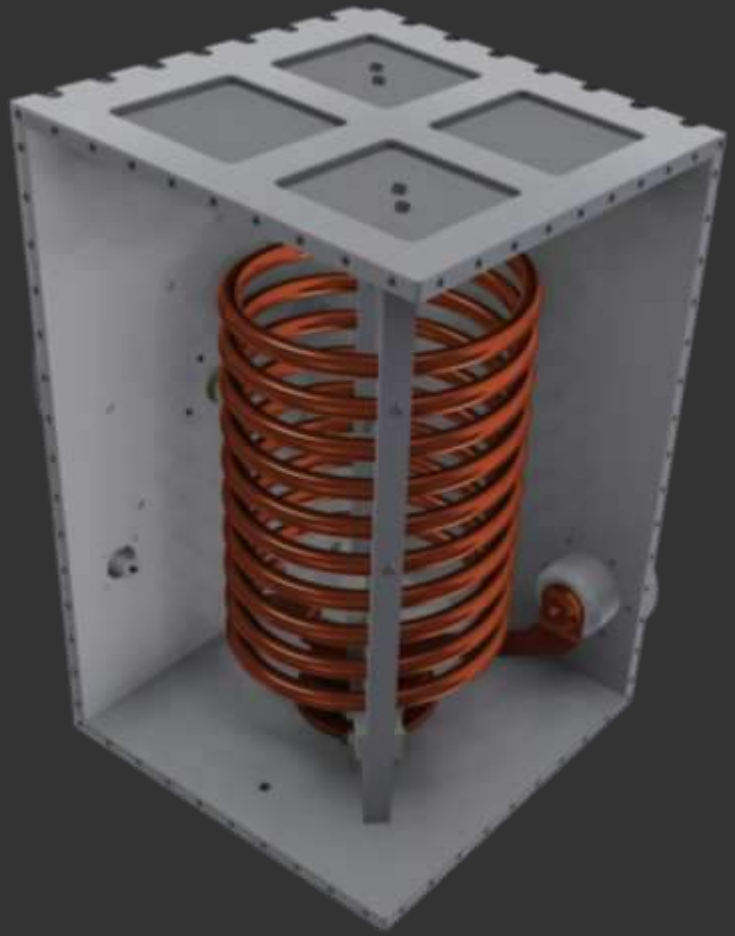
Resonator for f_1/f_3



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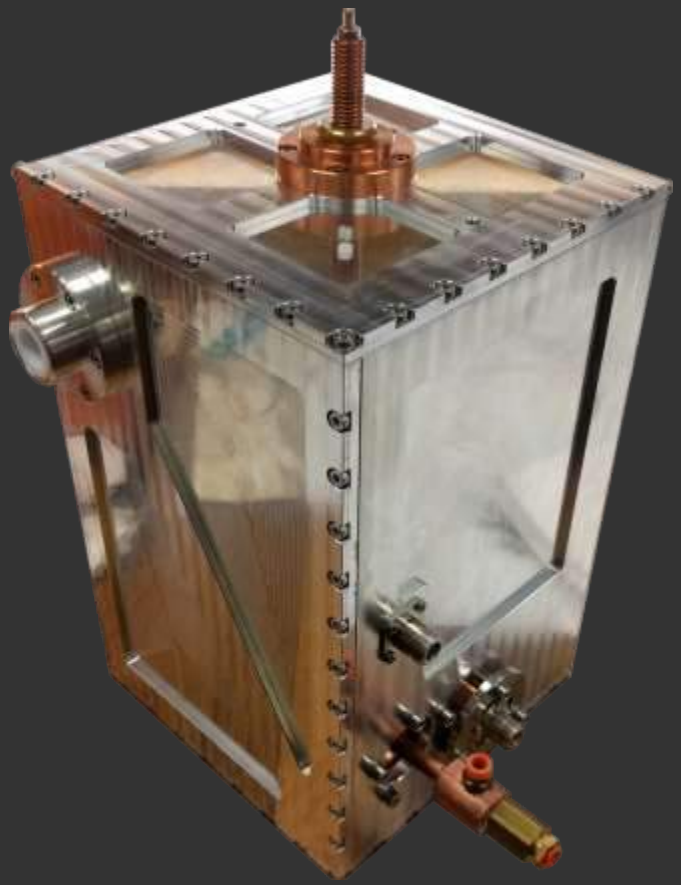
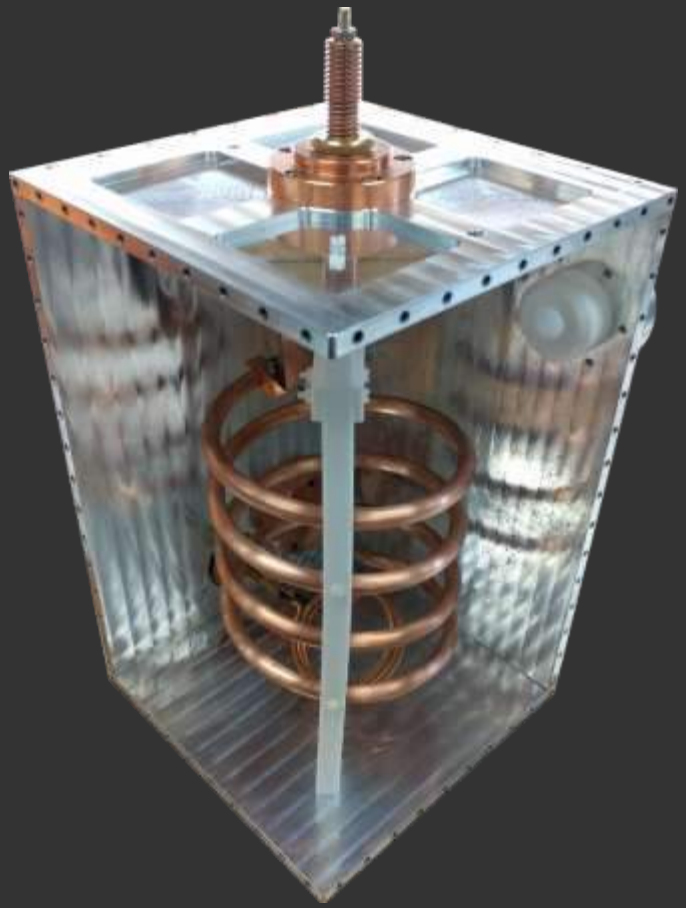
Resonator for f_2





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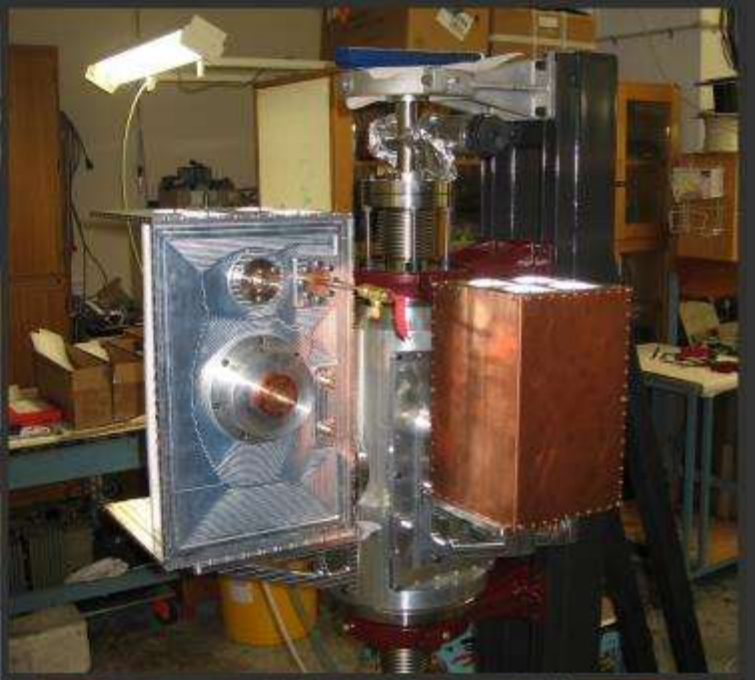

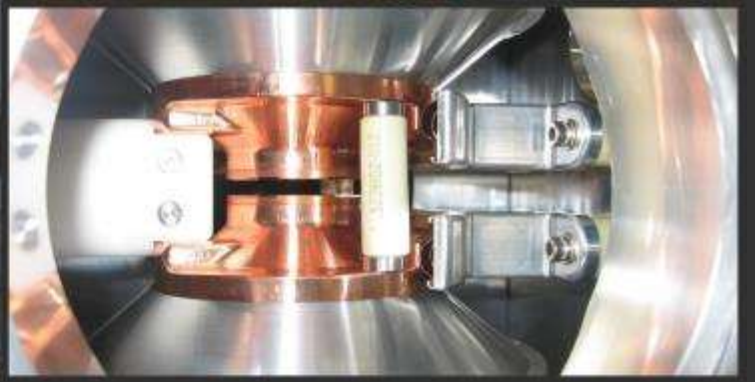

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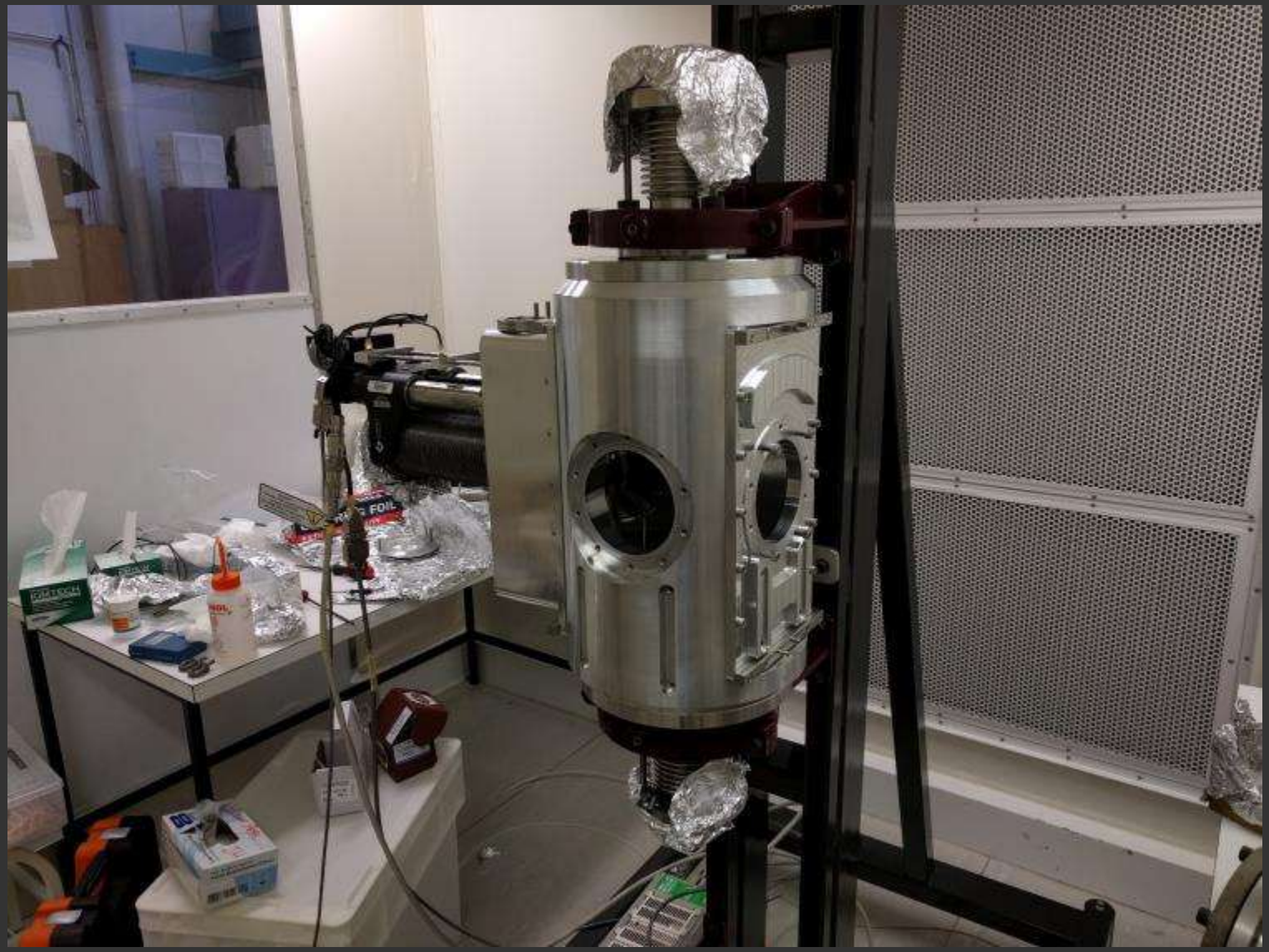

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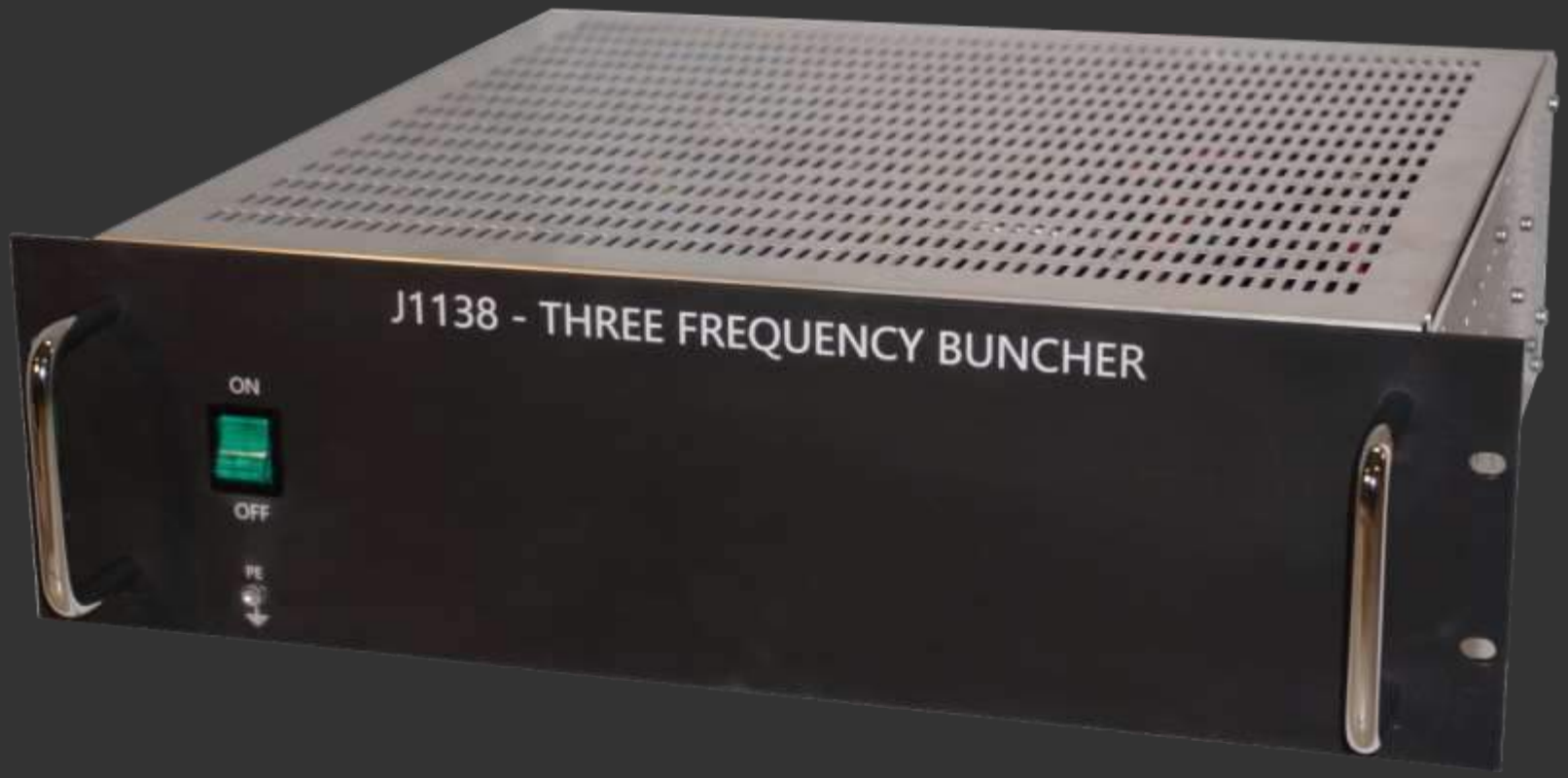
Control system



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Control system

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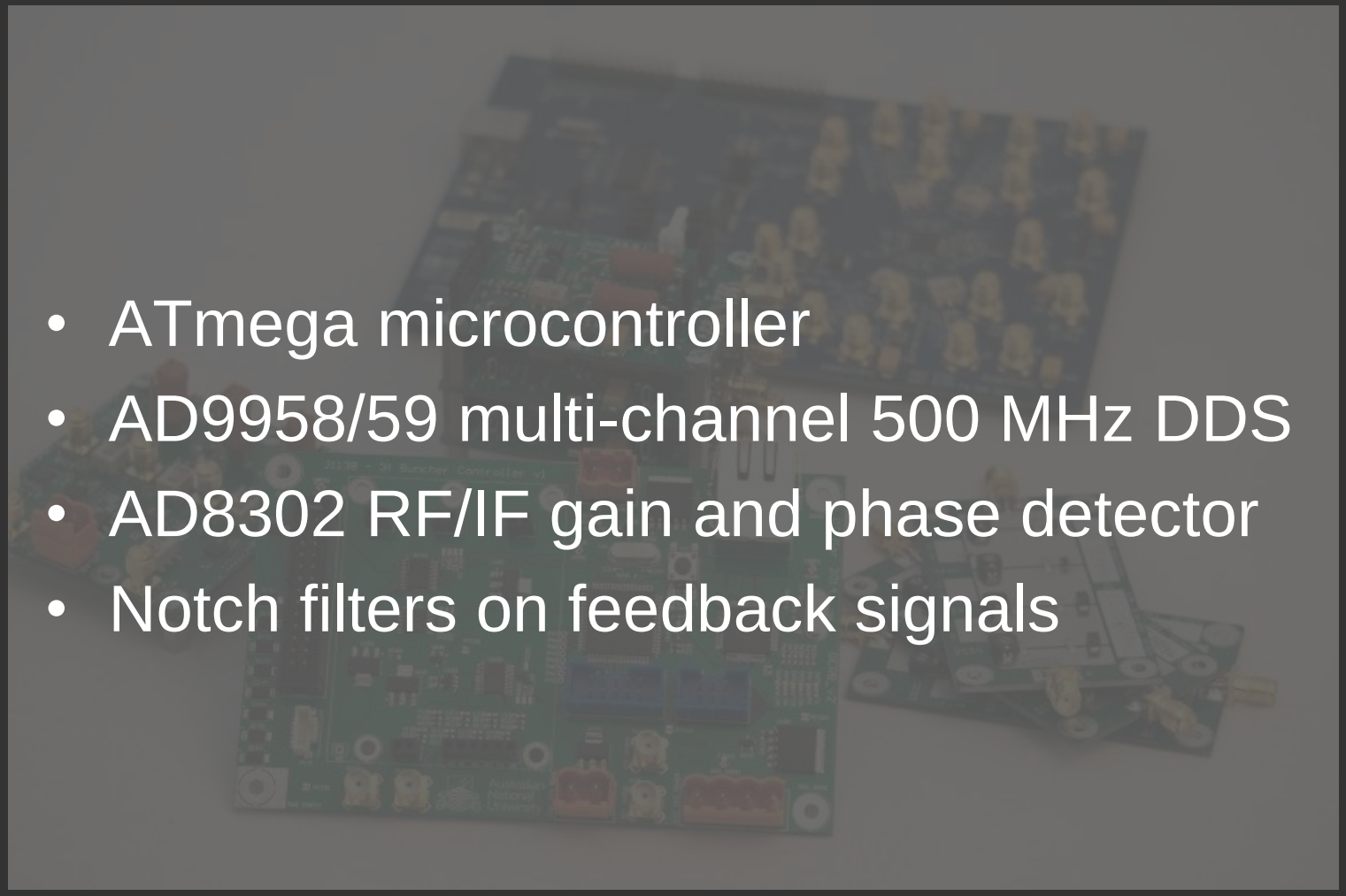

- ATmega microcontroller
- AD9958/59 multi-channel 500 MHz DDS
- AD8302 RF/IF gain and phase detector
- Notch filters on feedback signals

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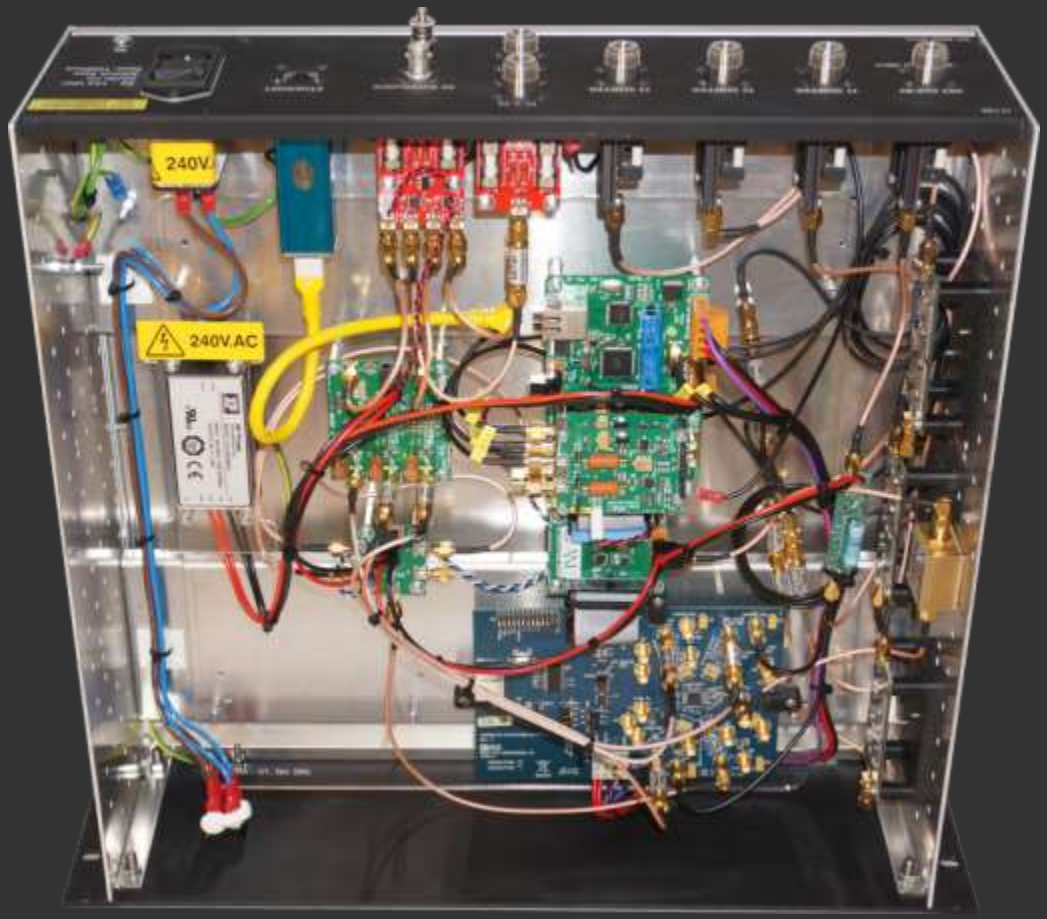
Control system



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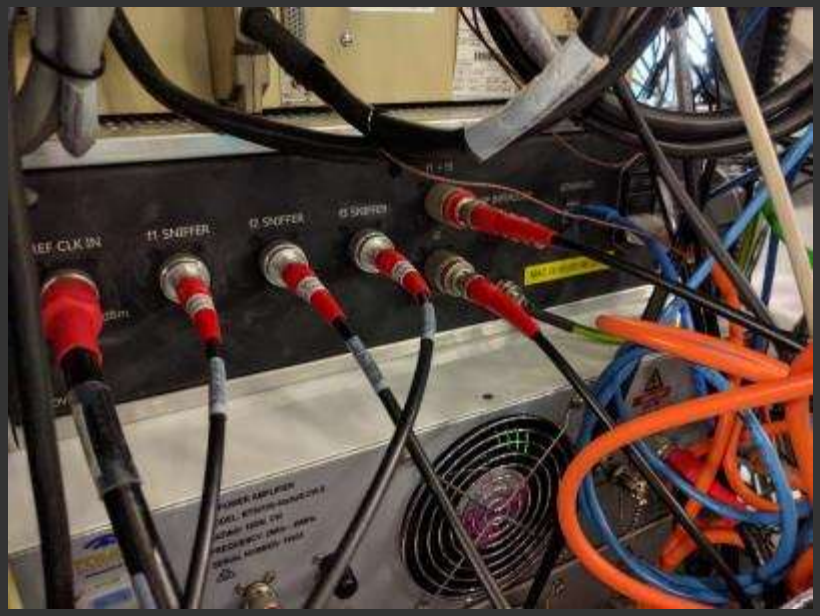
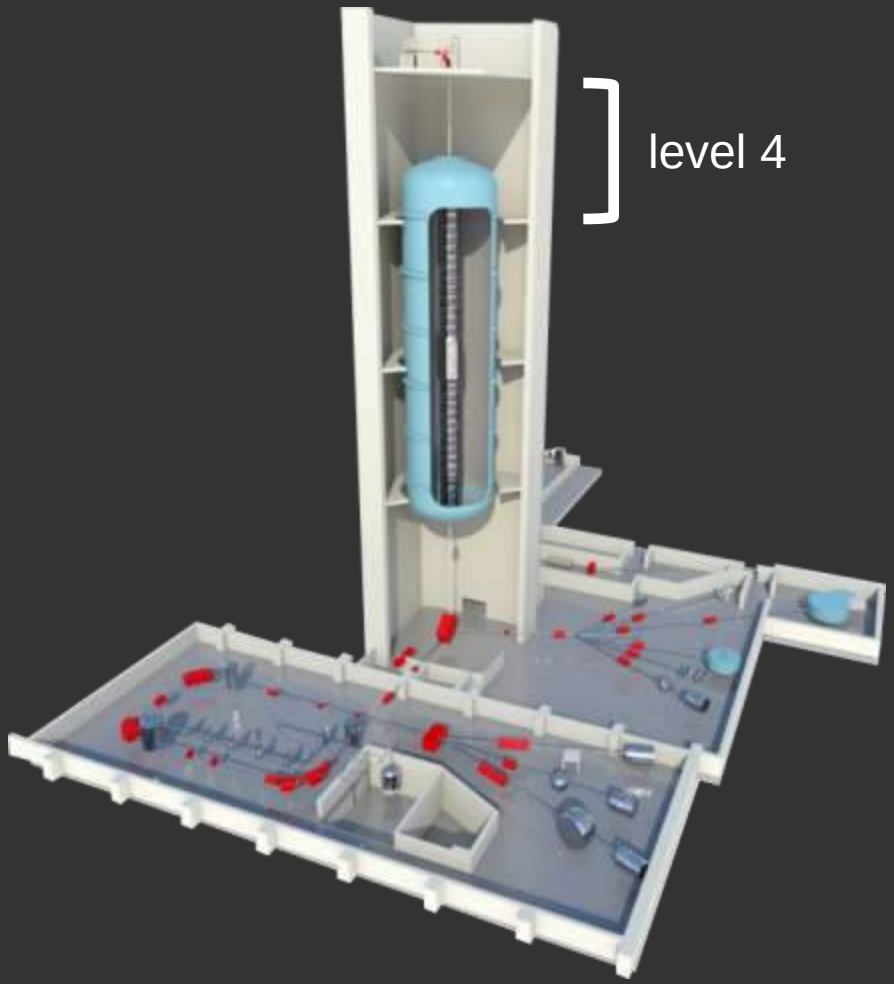
Control system





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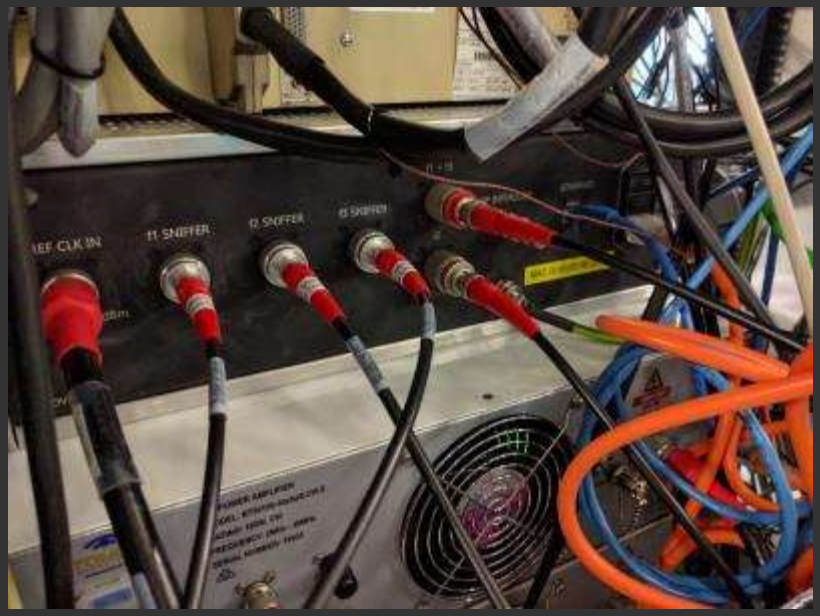
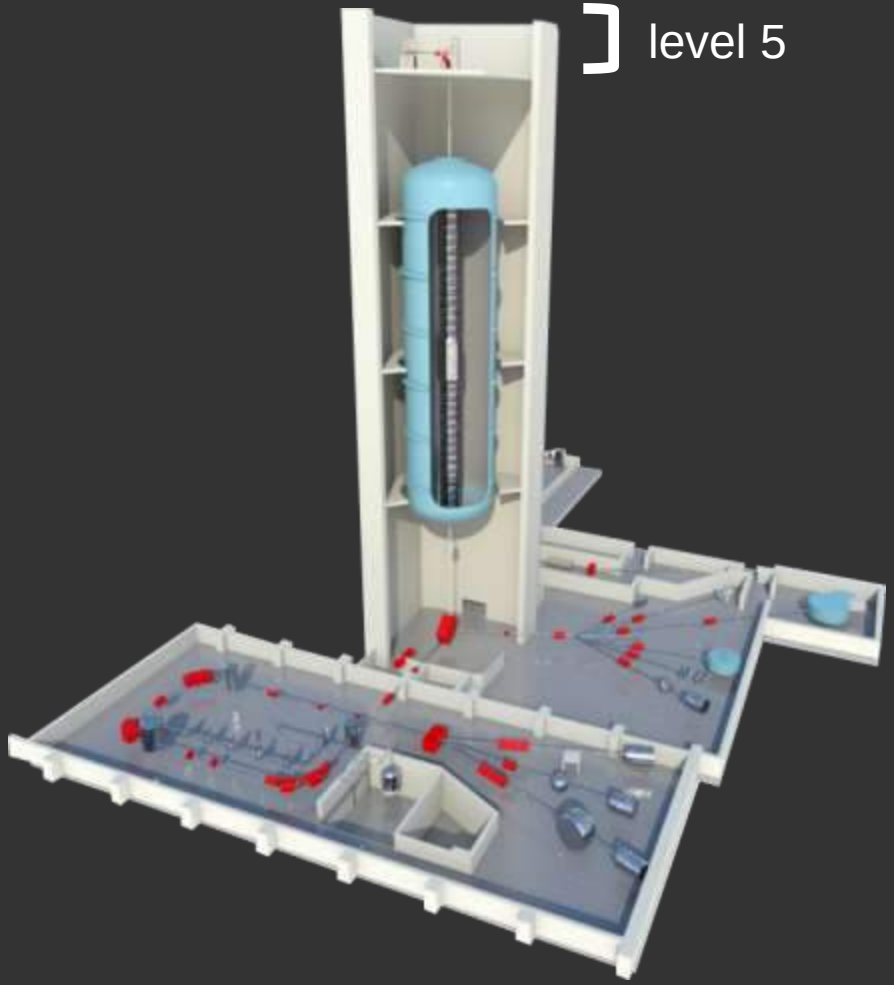
Control system





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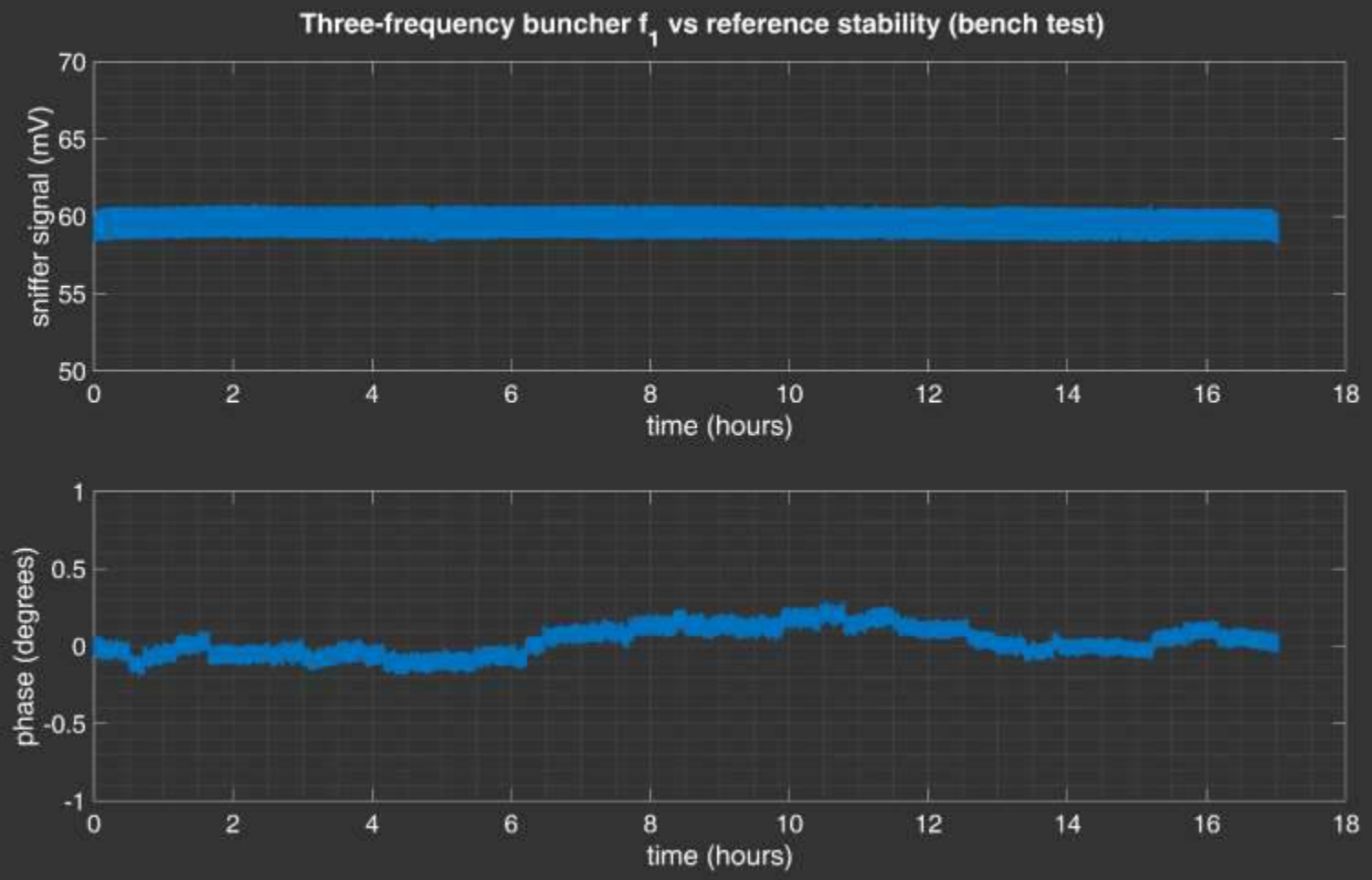

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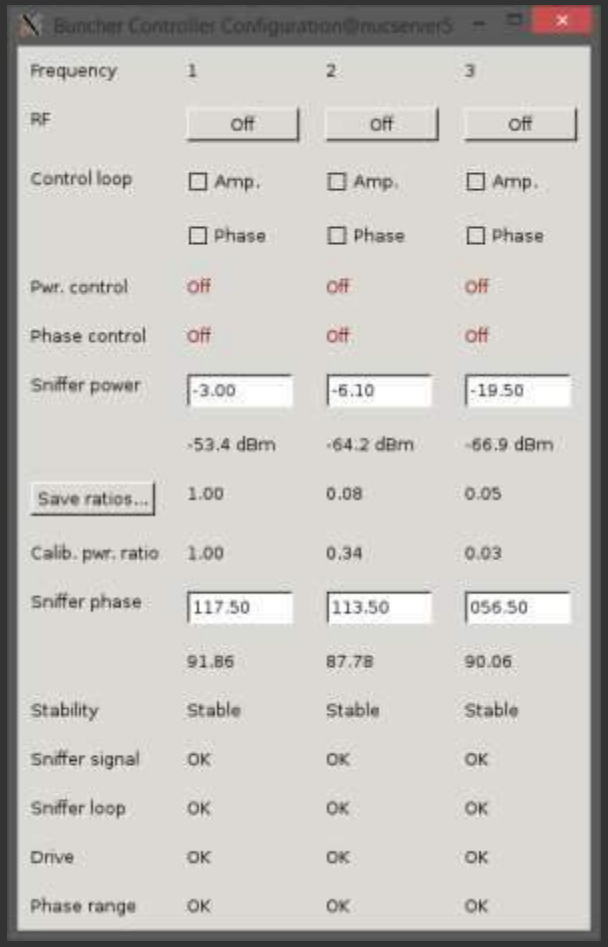
Control system



- EPICS integrated
  - Stream device
  - Ethernet

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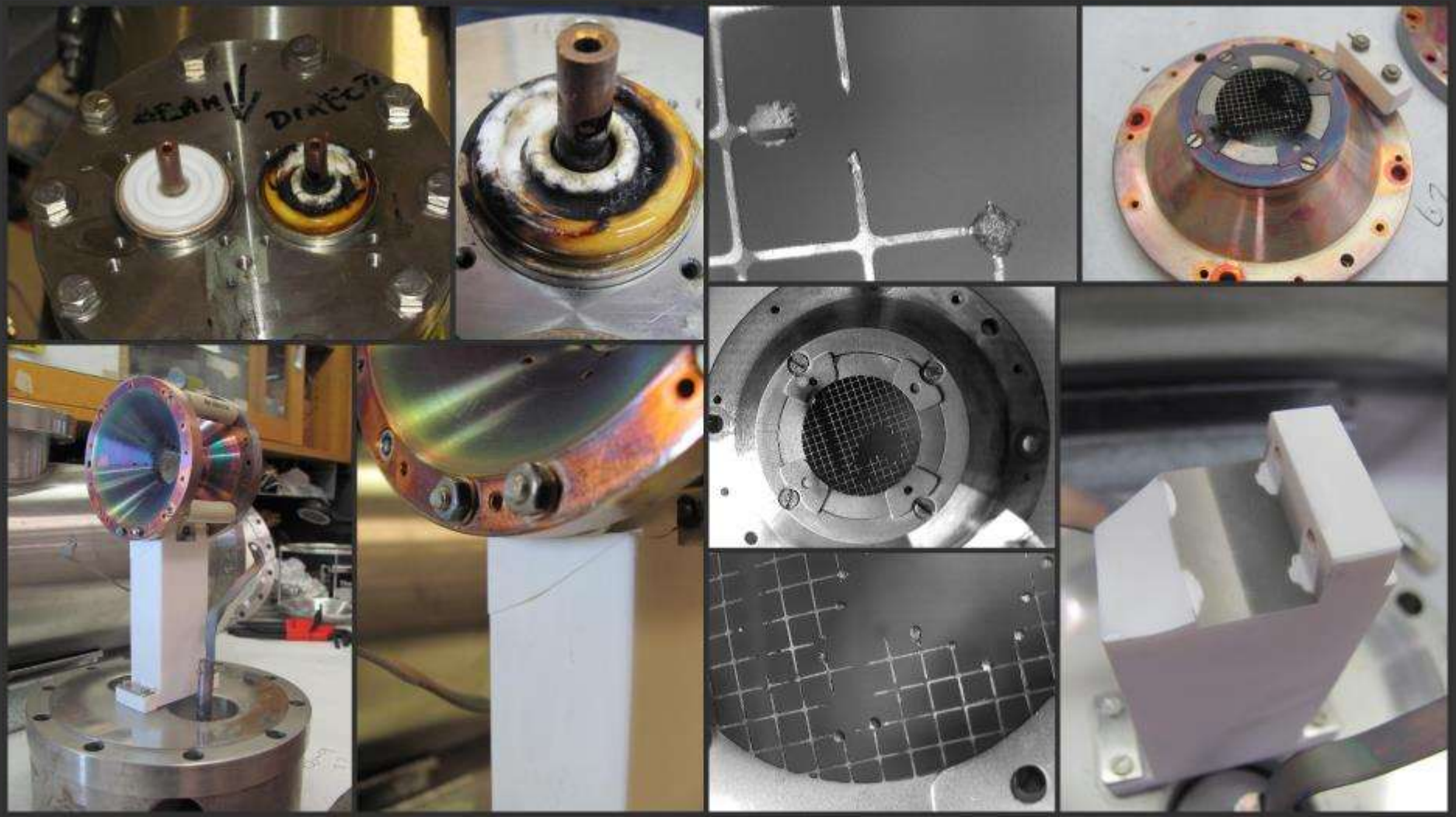
Beam tests – Round 1



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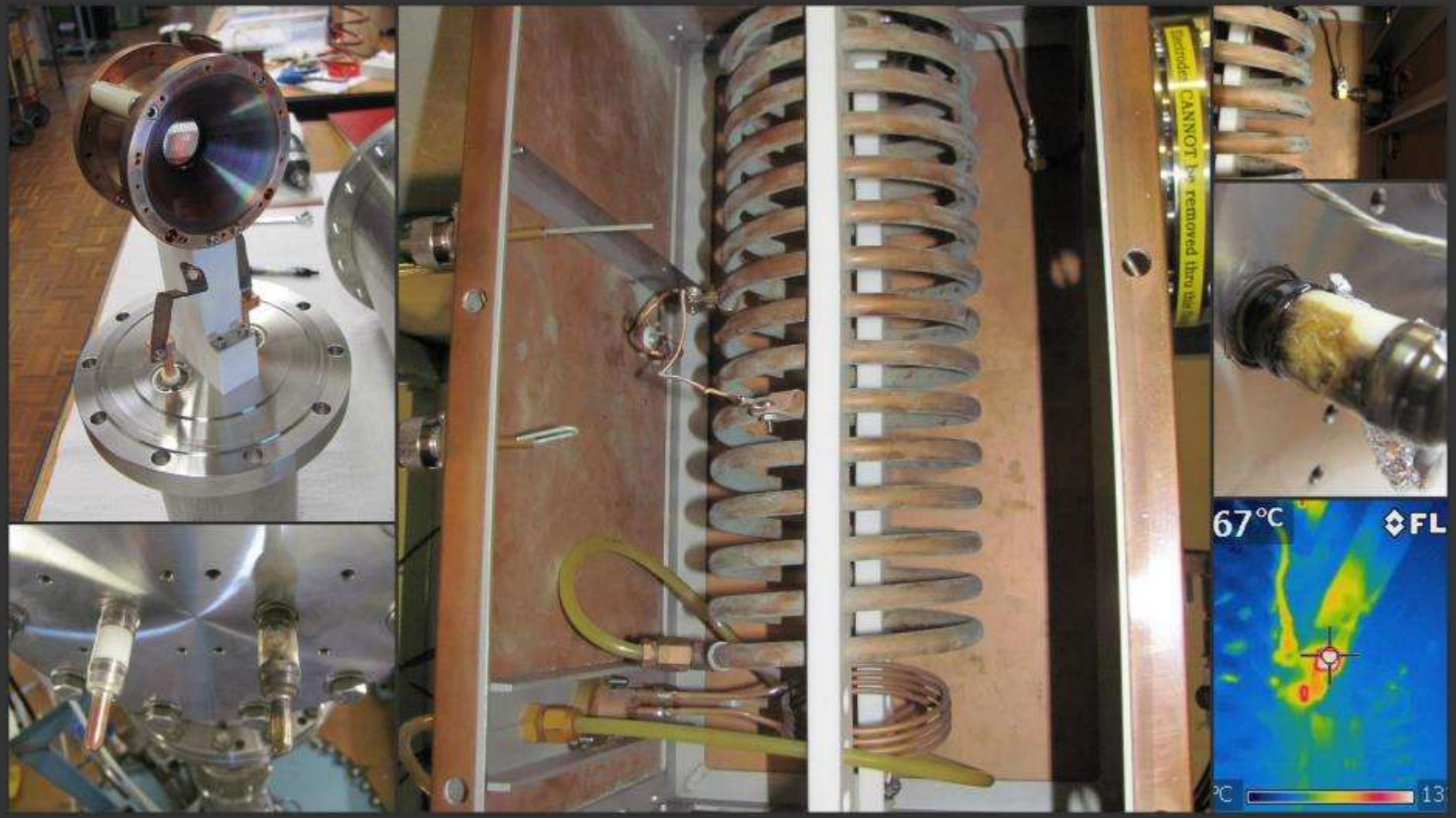
Beam tests – Round 2



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Tomco BT100-AlphaS-CW-S

- 100W CW (P1dB @ 80W)
- 2 – 40MHz

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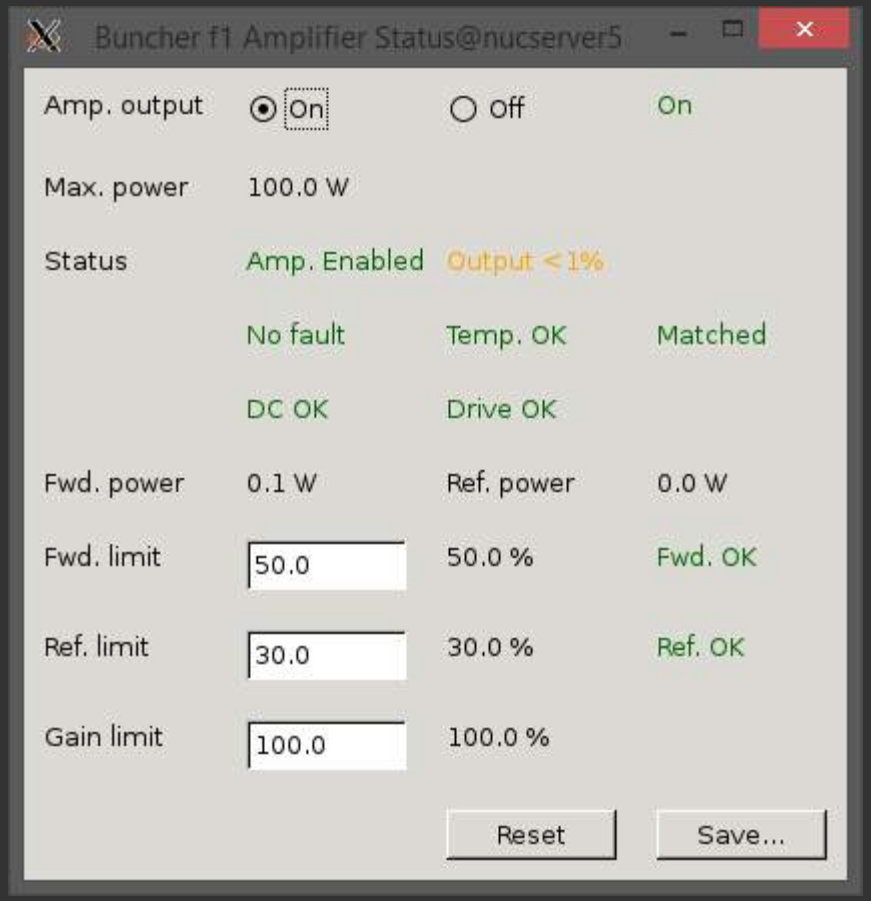
Tomco BT100-AlphaS-CW-S

- EPICS integration
  - RS232/RS485
  - Stream device



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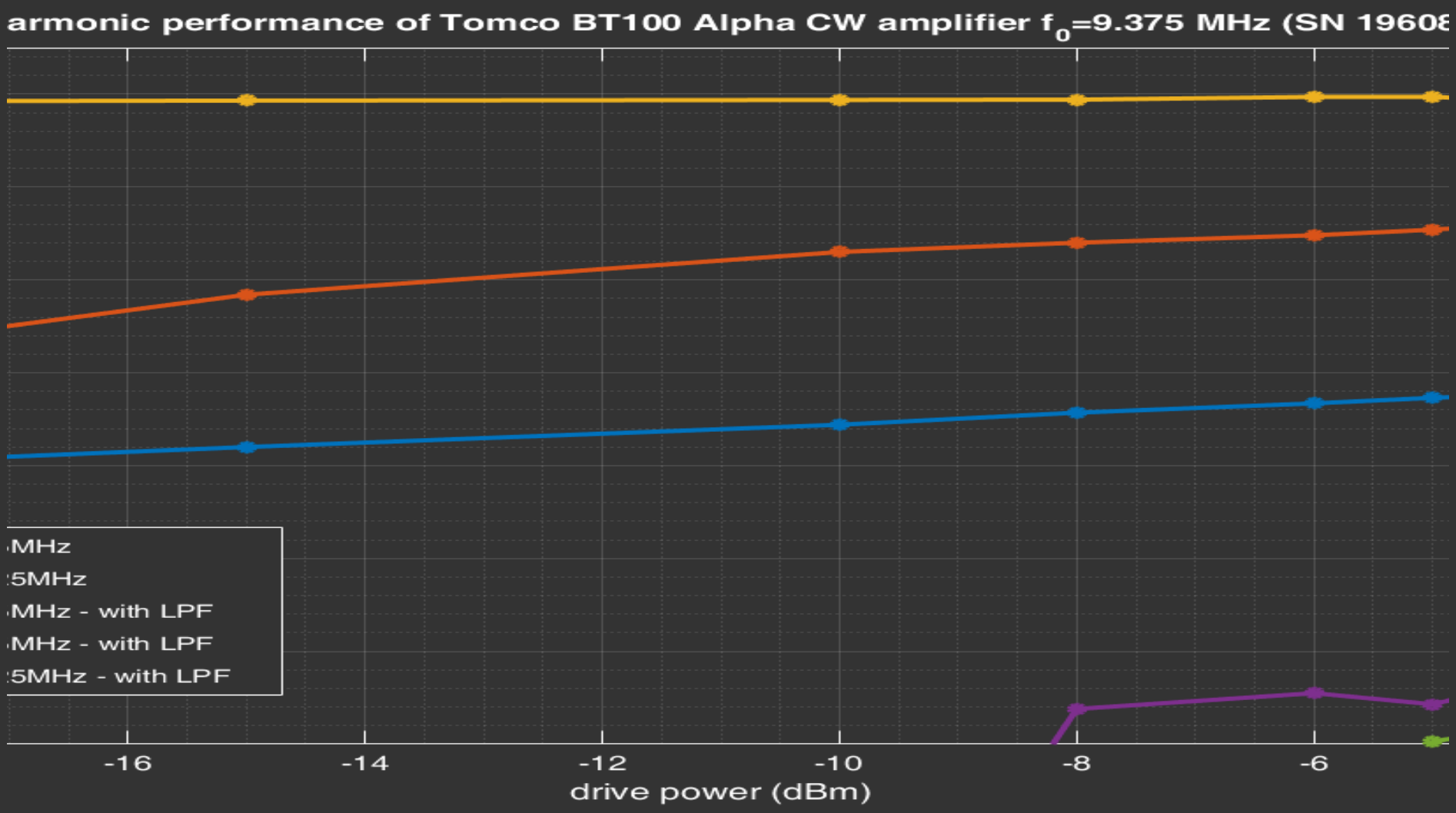

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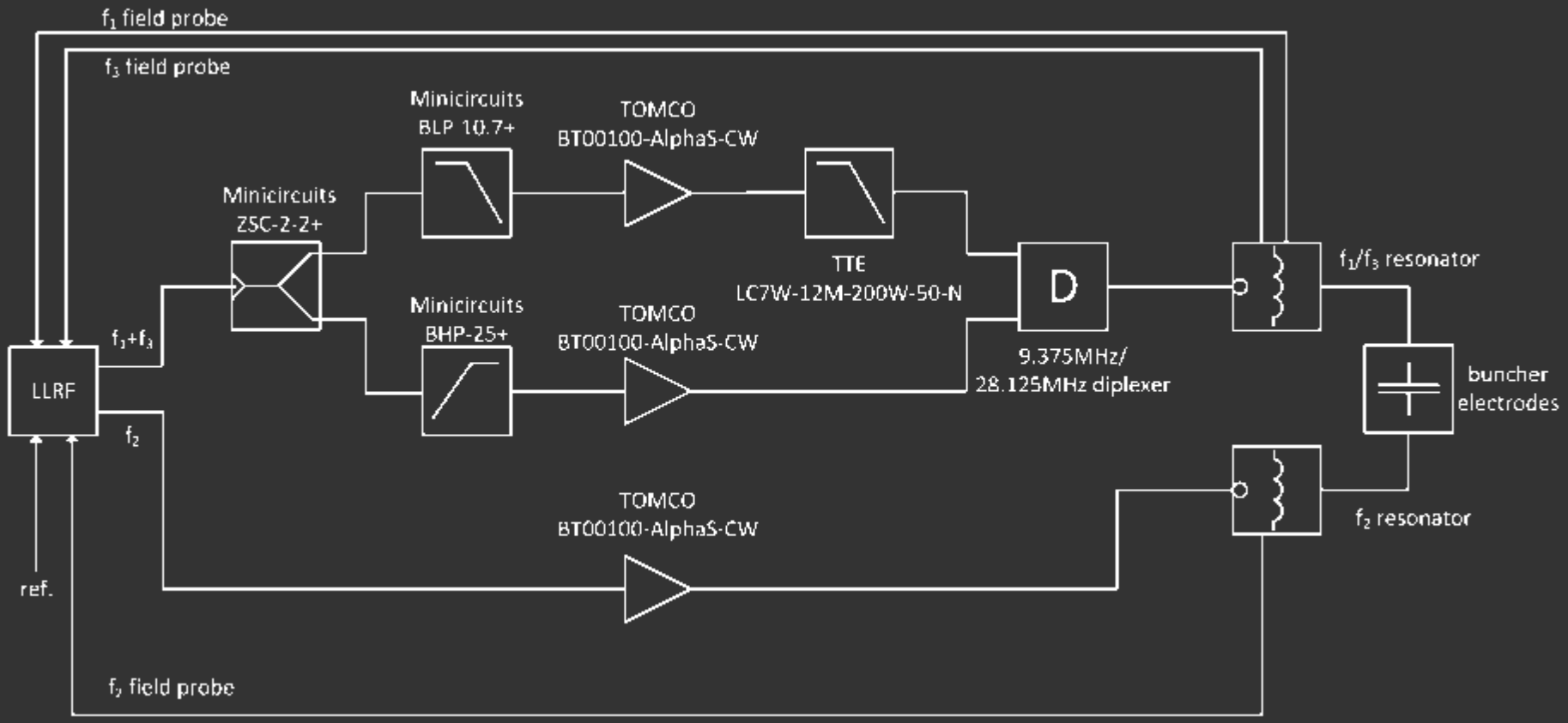
System schematic



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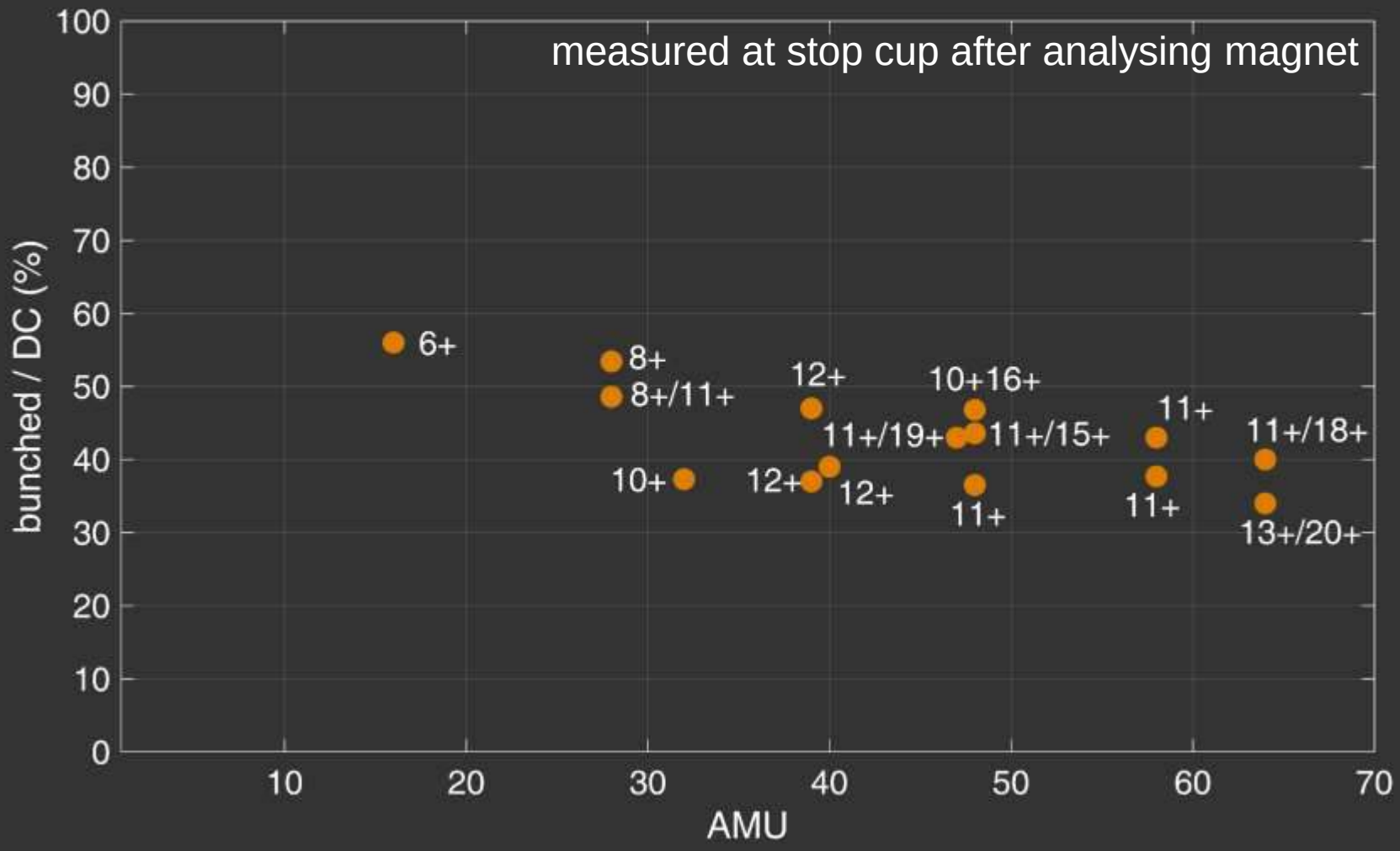
Three-frequency beam test results



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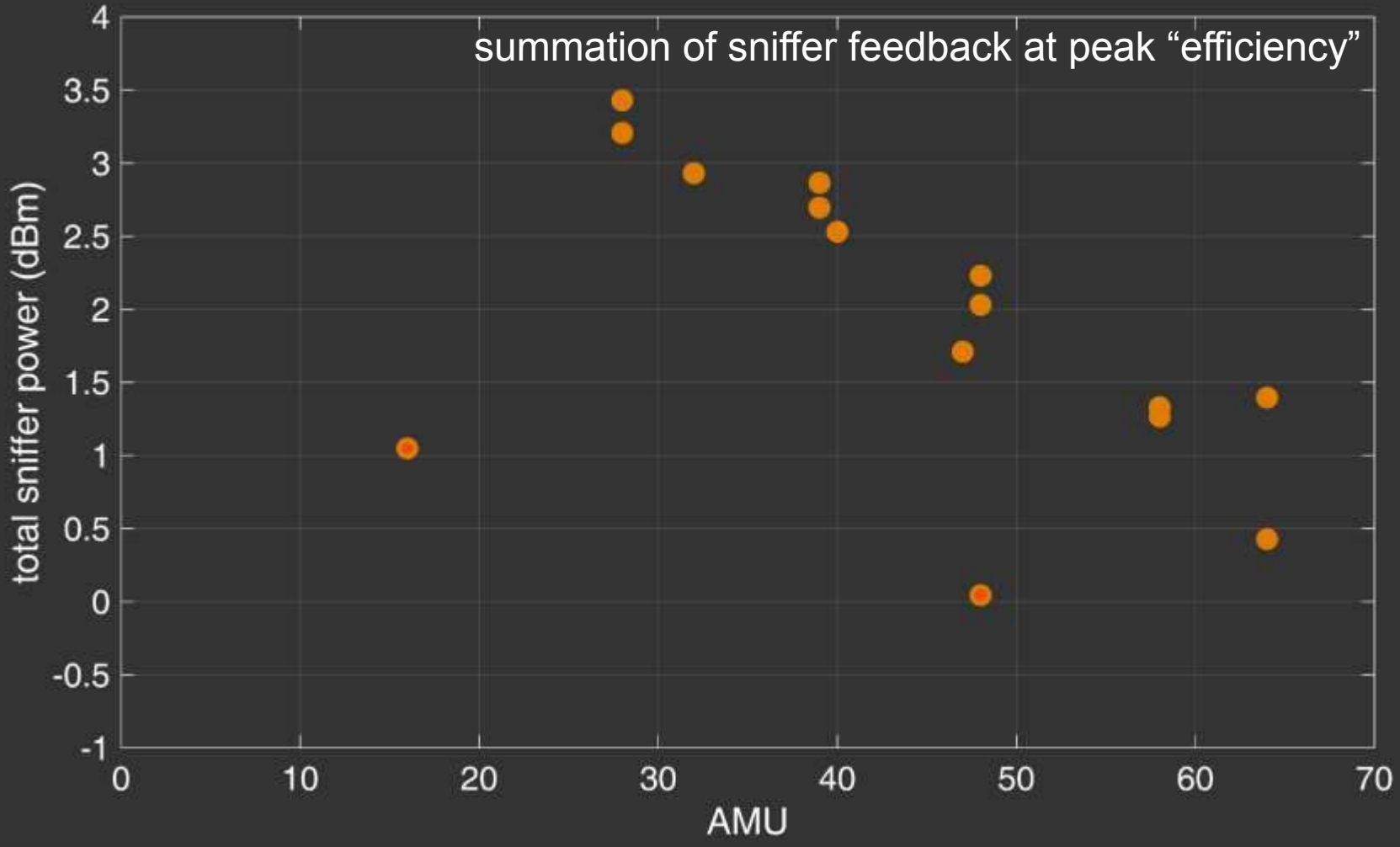
Three-frequency beam test results



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Comparing experimental efficacy

Ion	Energy (MeV)	Charge state	Beam current (single frequency)		Beam current (three frequency)		Efficiency improvement (%)
			DC (nA)	Bunched (nA)	DC (nA)	Bunched (nA)	
28Si	122	8+	210	73	215	115	54
28Si	148	8+/11+	38	11	37	18	68
58Ni	225	11+/18+	46	12.5	40	16	47
39K	187	12+	8	1.8	7.8	2.9	65
48Ti	185	11+	11.5	2.6	11.5	4.2	62

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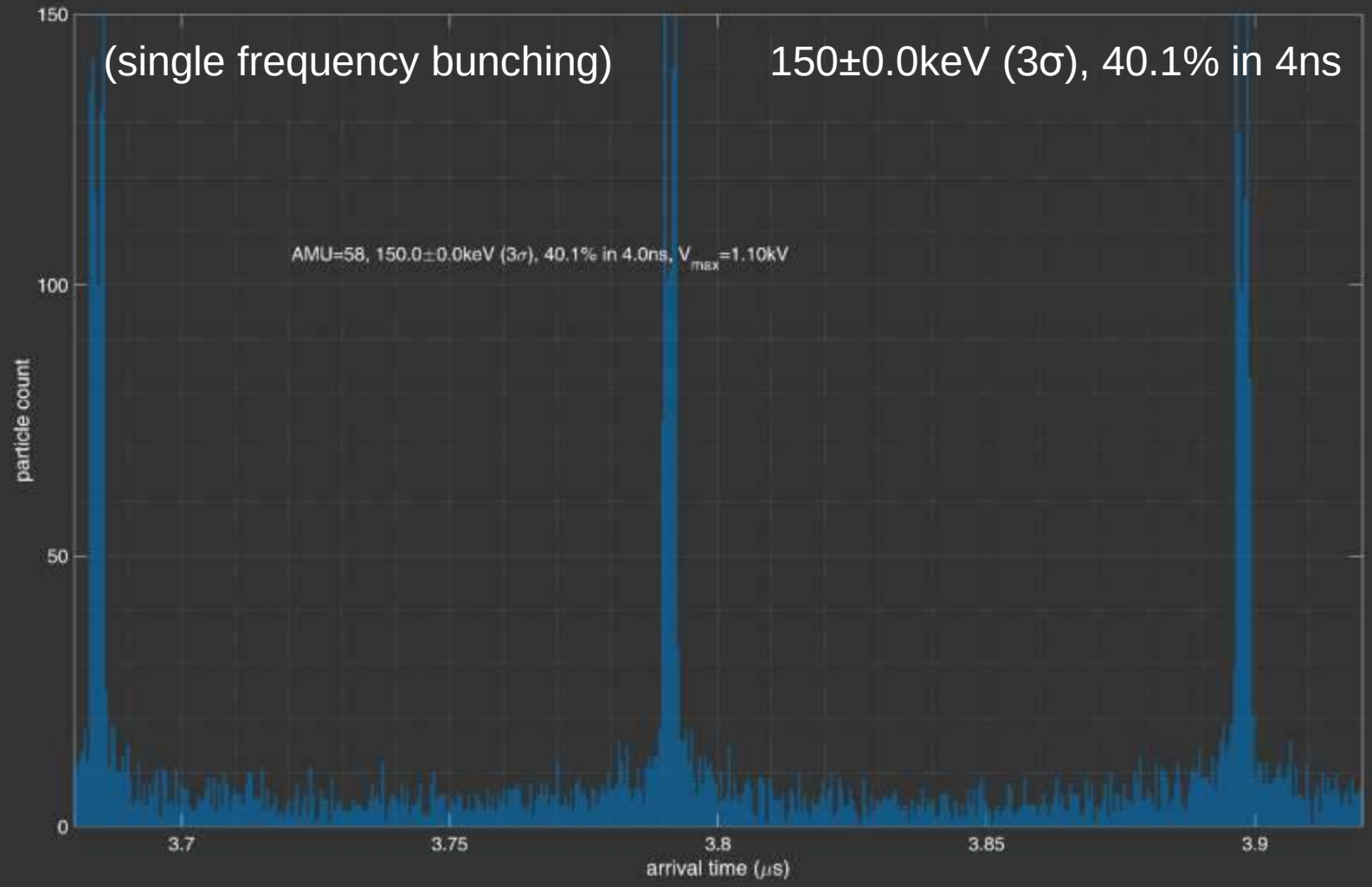
Beam energy distribution impact



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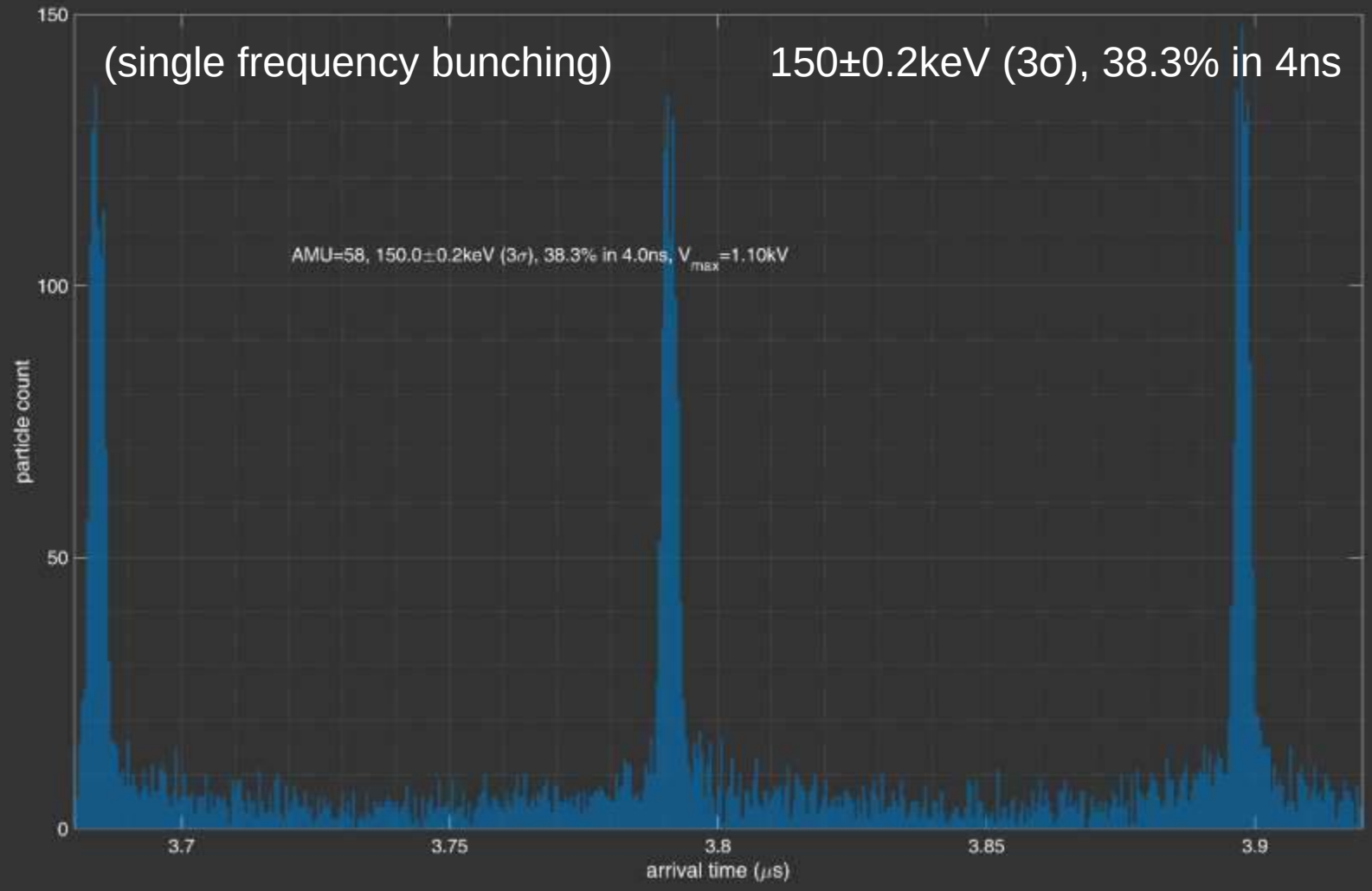
Beam energy distribution impact

(single frequency bunching)

150±0.2keV (3σ), 38.3% in 4ns



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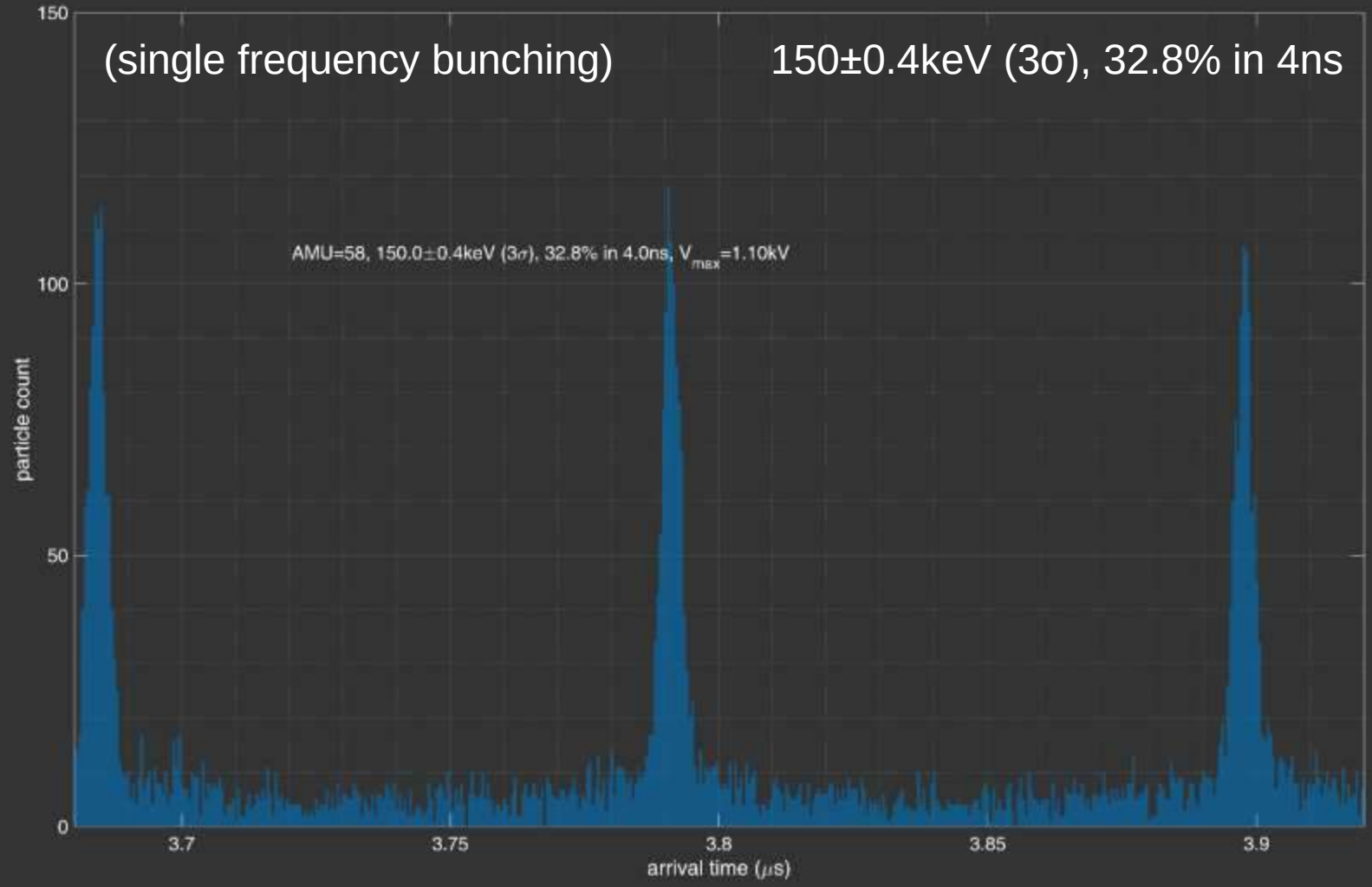
Beam energy distribution impact

(single frequency bunching)

150±0.4keV (3σ), 32.8% in 4ns



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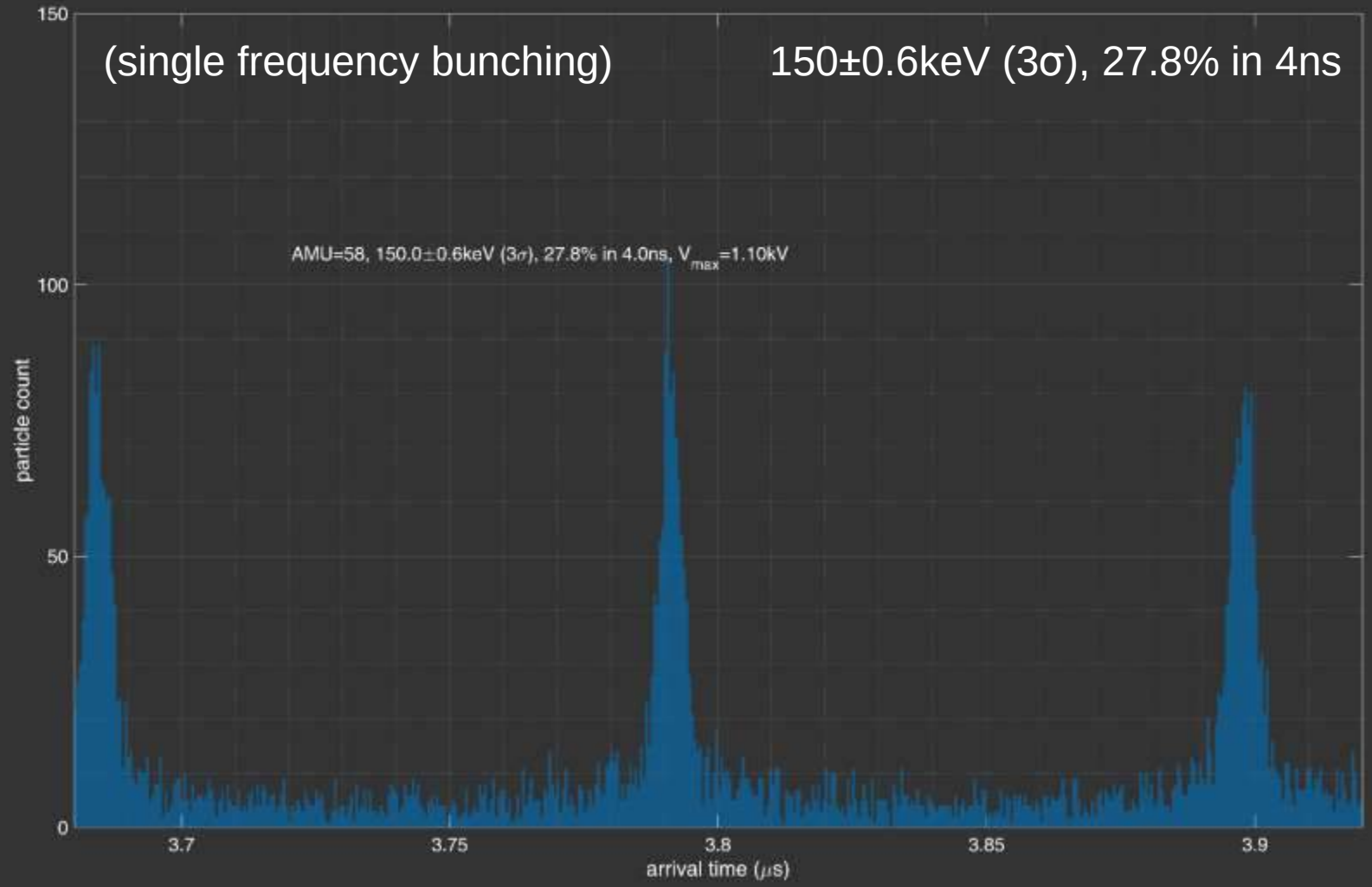
Beam energy distribution impact

(single frequency bunching)

150±0.6keV (3σ), 27.8% in 4ns



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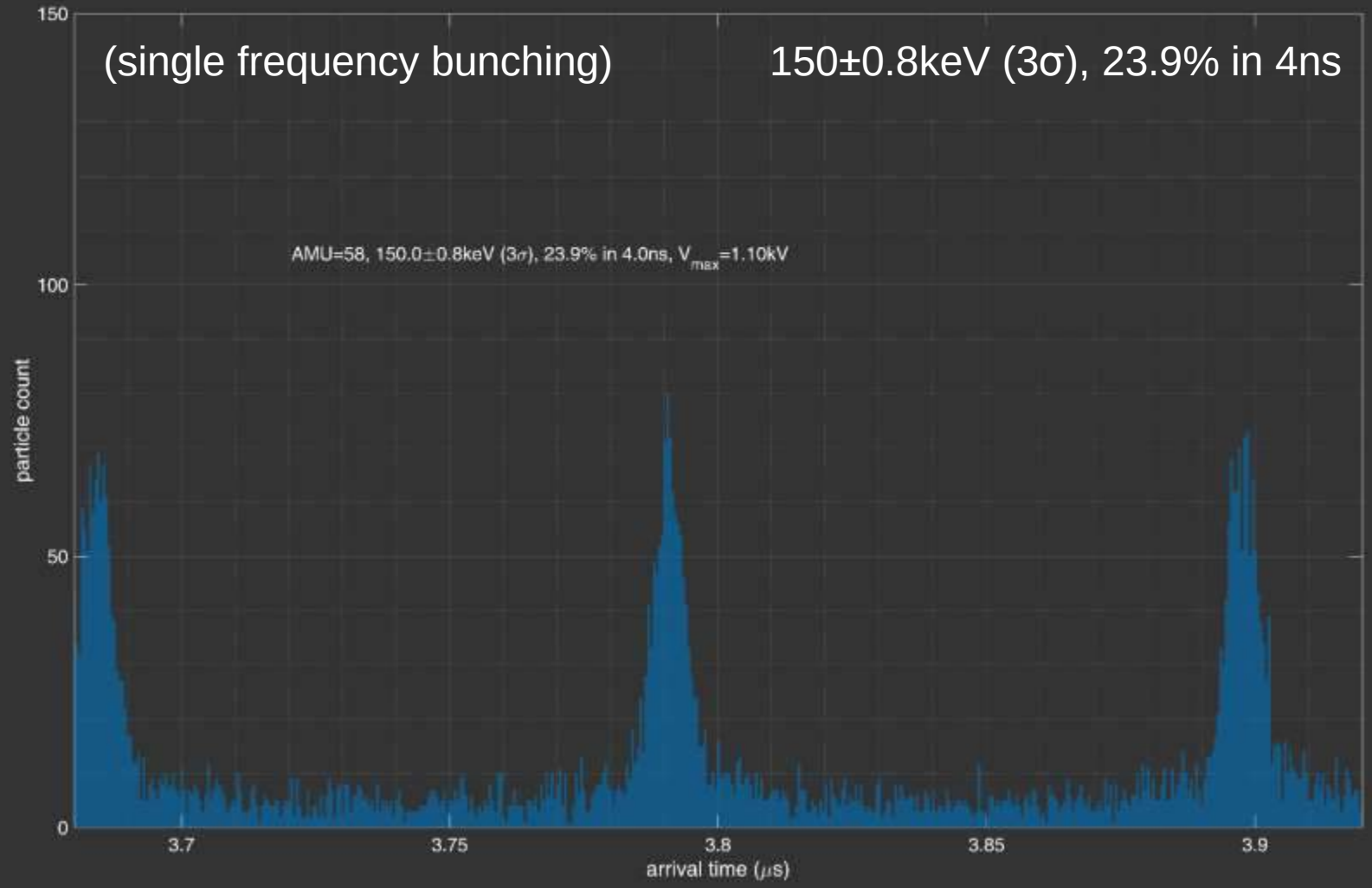
Beam energy distribution impact

(single frequency bunching)

150±0.8keV (3σ), 23.9% in 4ns



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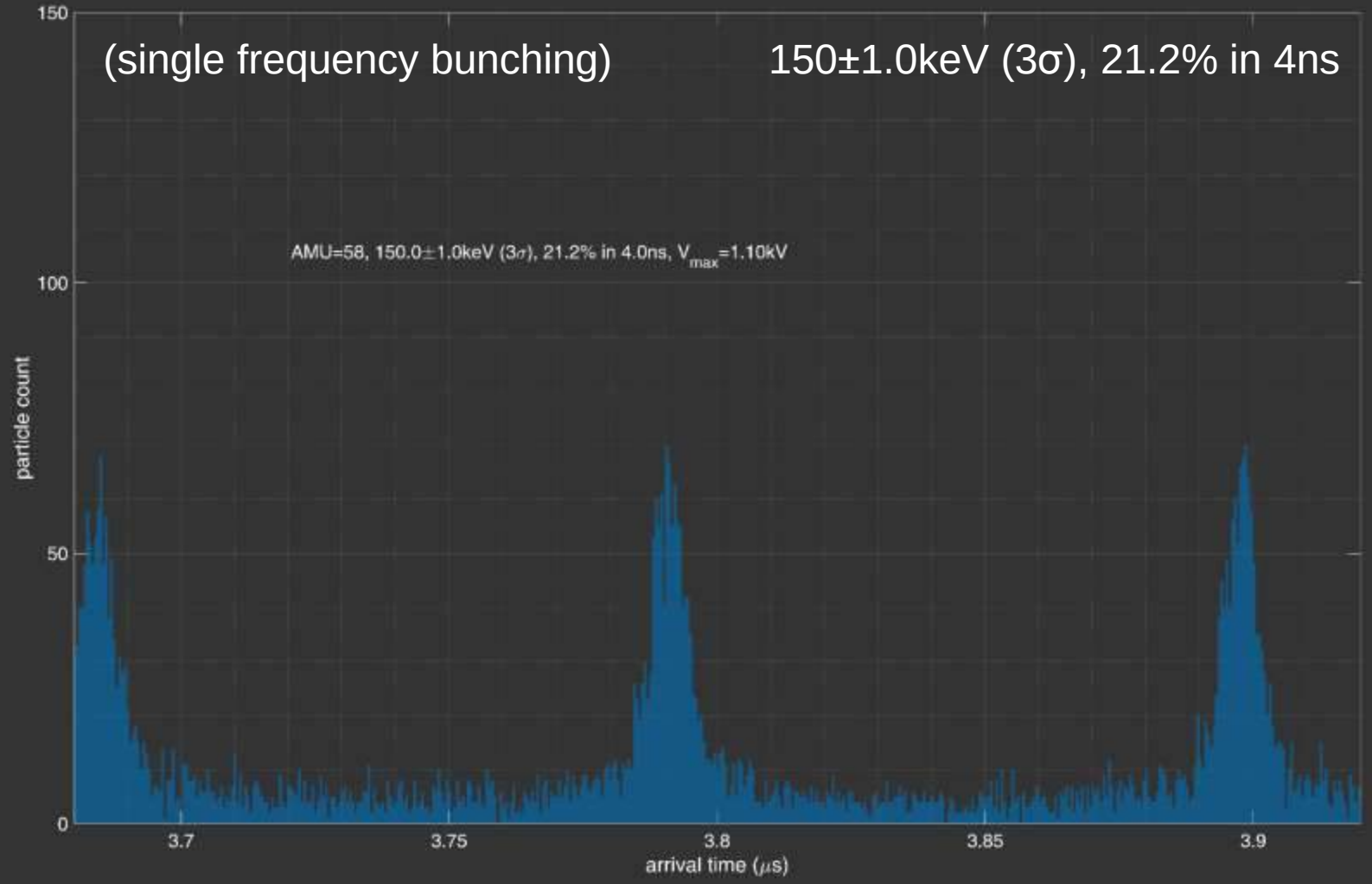
Beam energy distribution impact

(single frequency bunching)

150±1.0keV (3σ), 21.2% in 4ns



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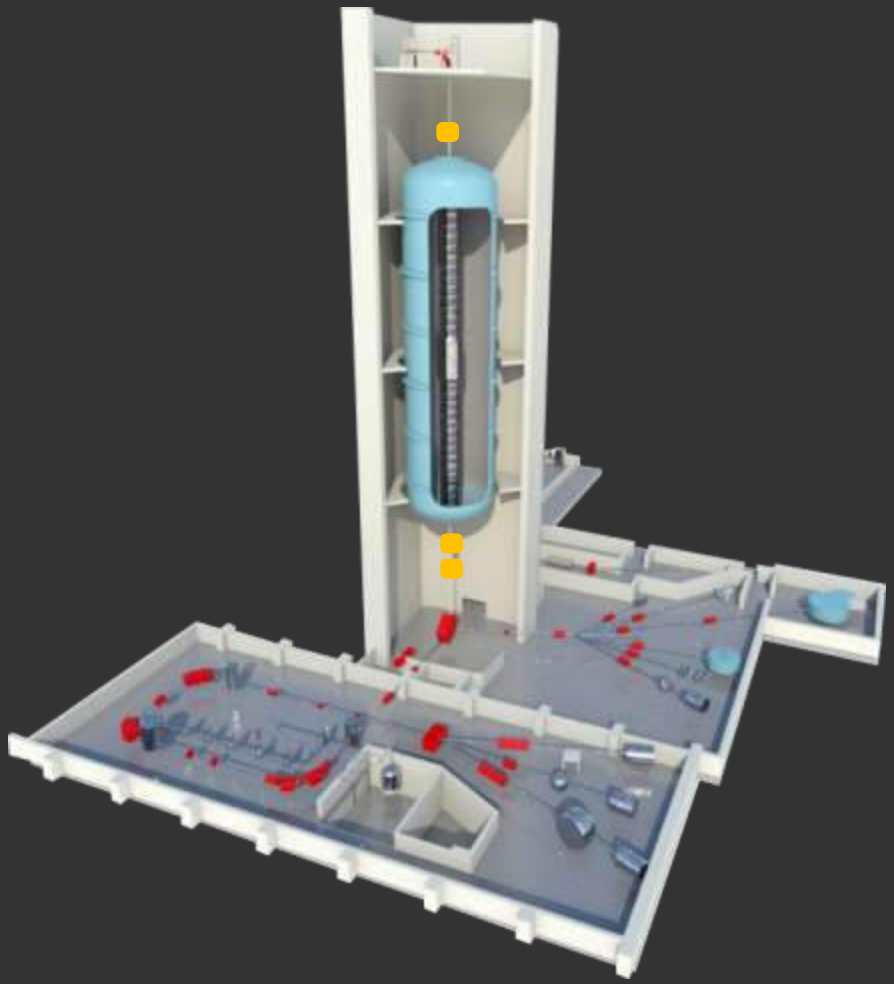
Beam energy distribution impact

- Injection energy
- Machine stability
- Stripper foils
  - terminal foils
  - high-energy midsection



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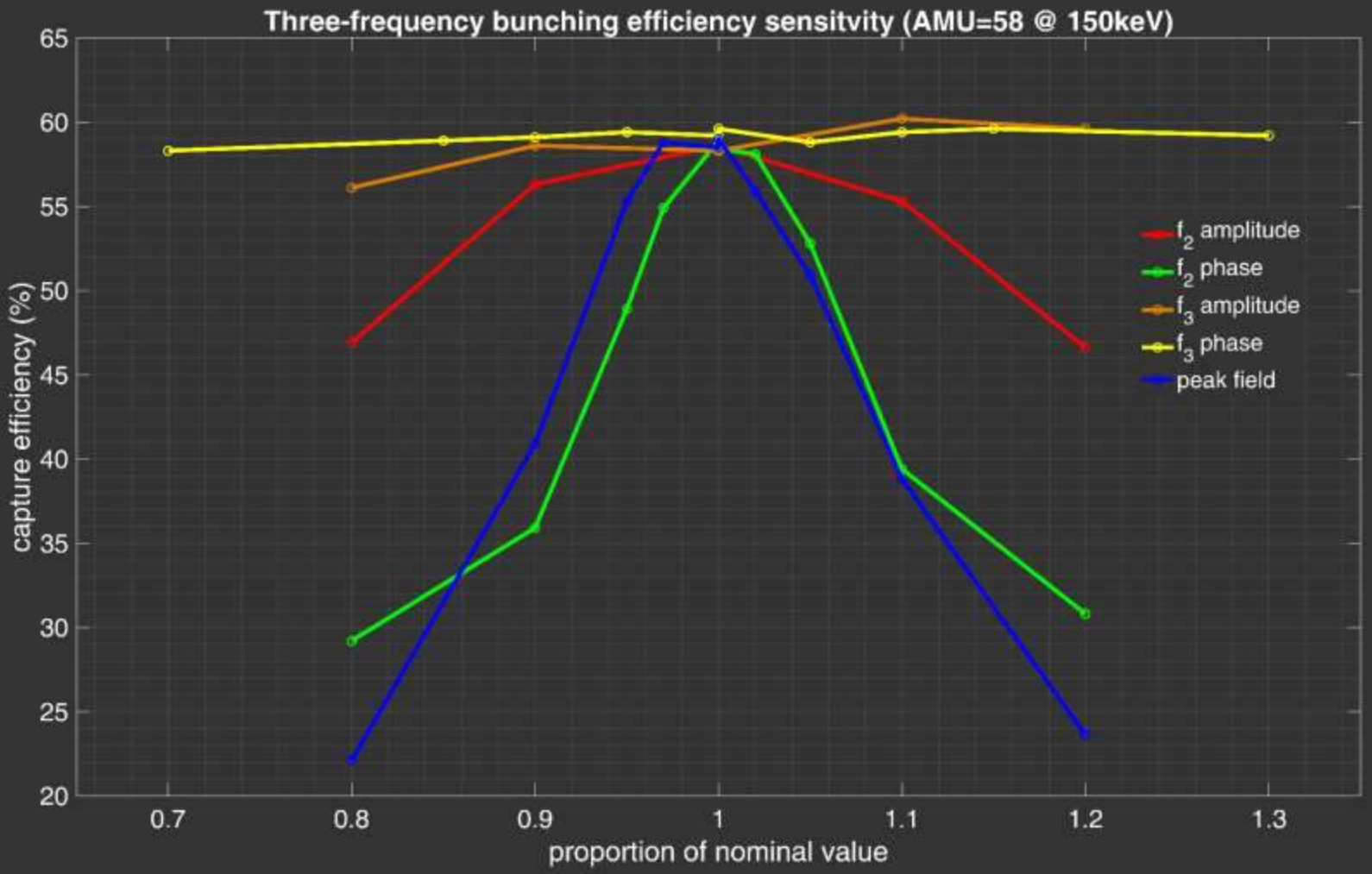

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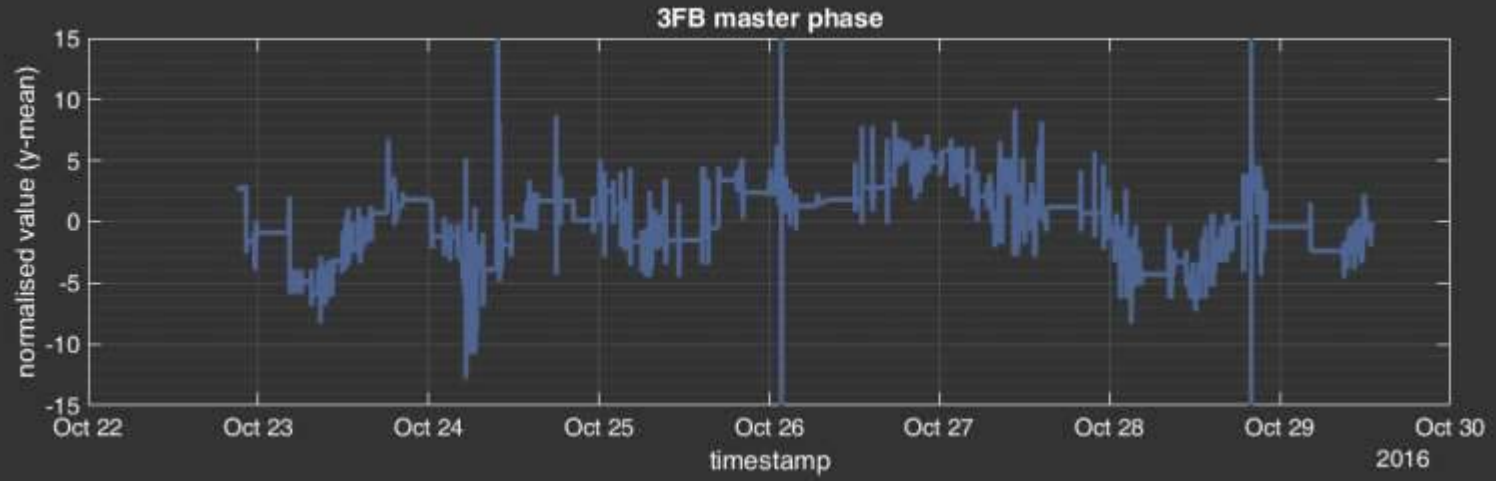
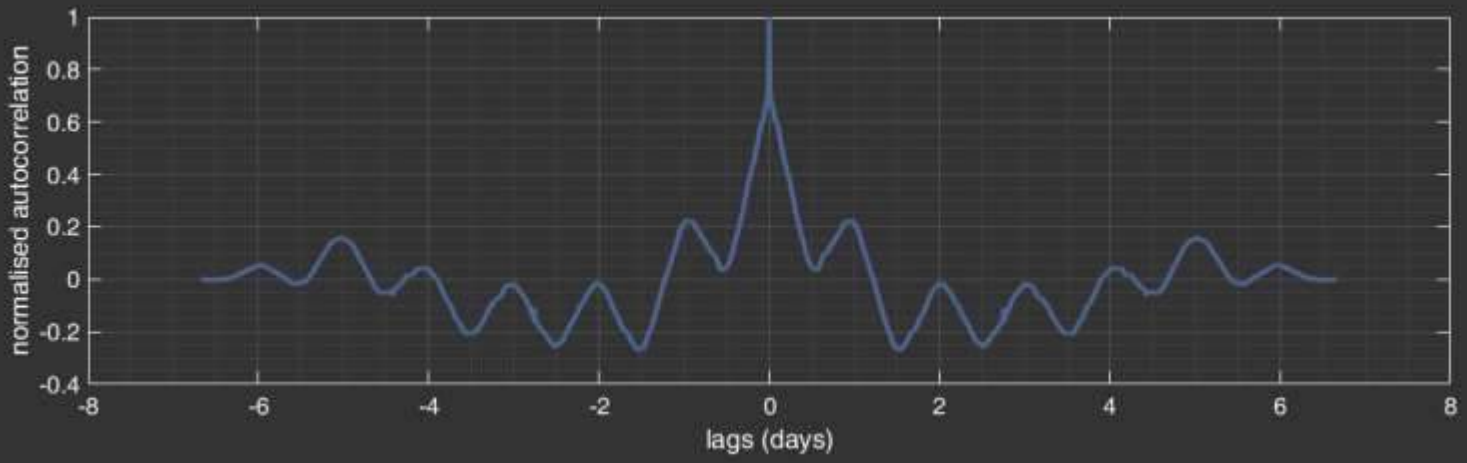
Environmental factors





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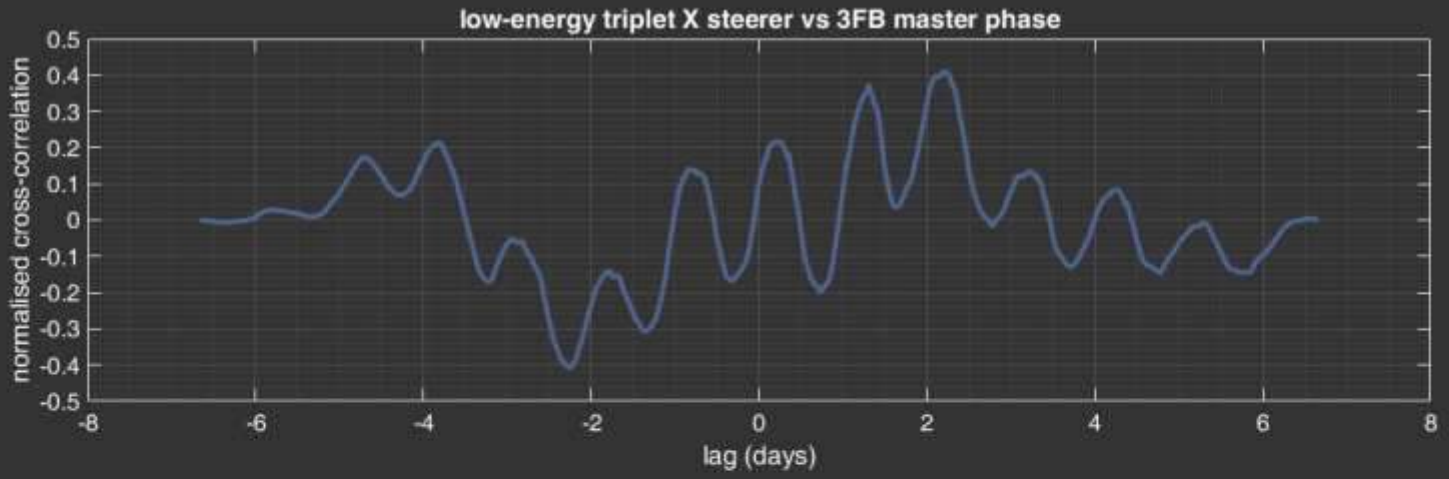
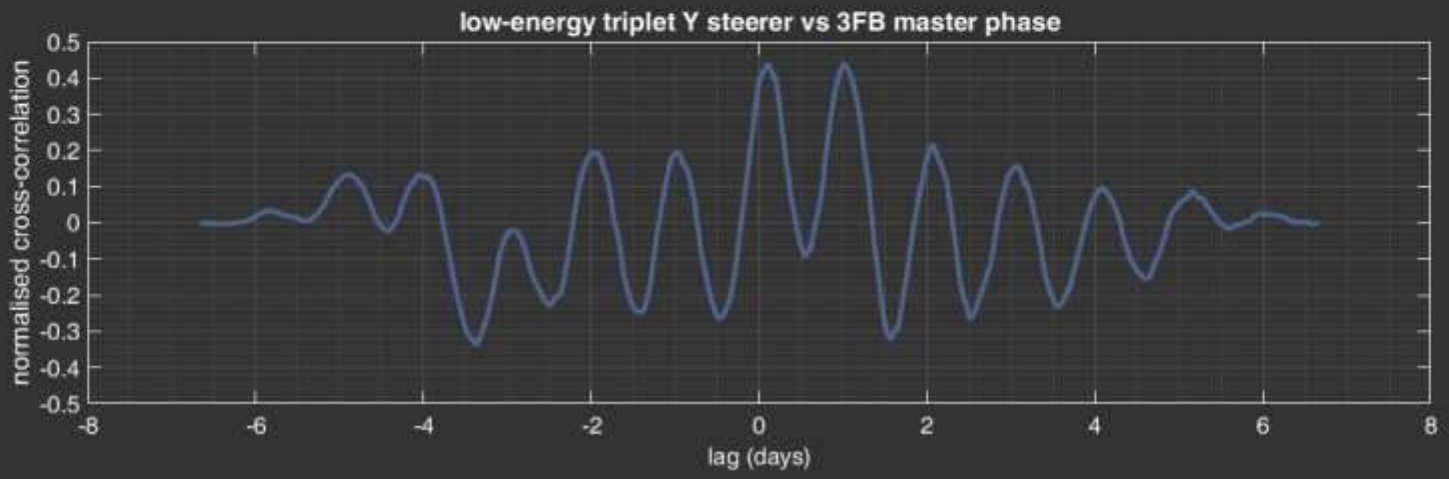
Environmental factors





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Next up…

- Buncher controller v2.0
- Hardware bench test
- Understand machine setting impact on efficiency (slits for example)
- More improvement…

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Thank you