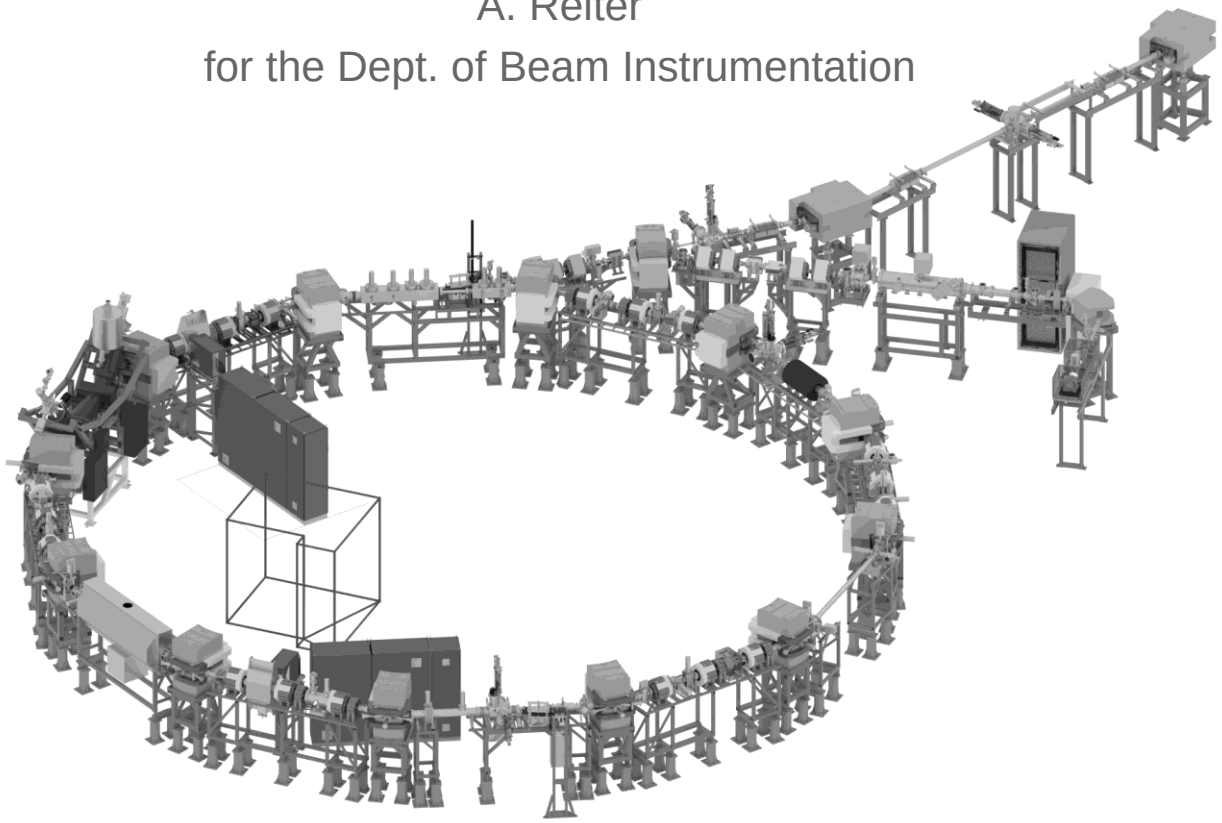
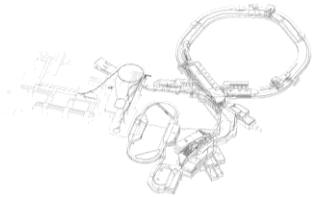
CRYRING Beam Instrumentation

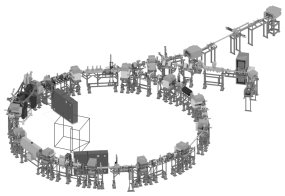
Basic Operational Aspects

A. Reiter
for the Dept. of Beam Instrumentation





Content

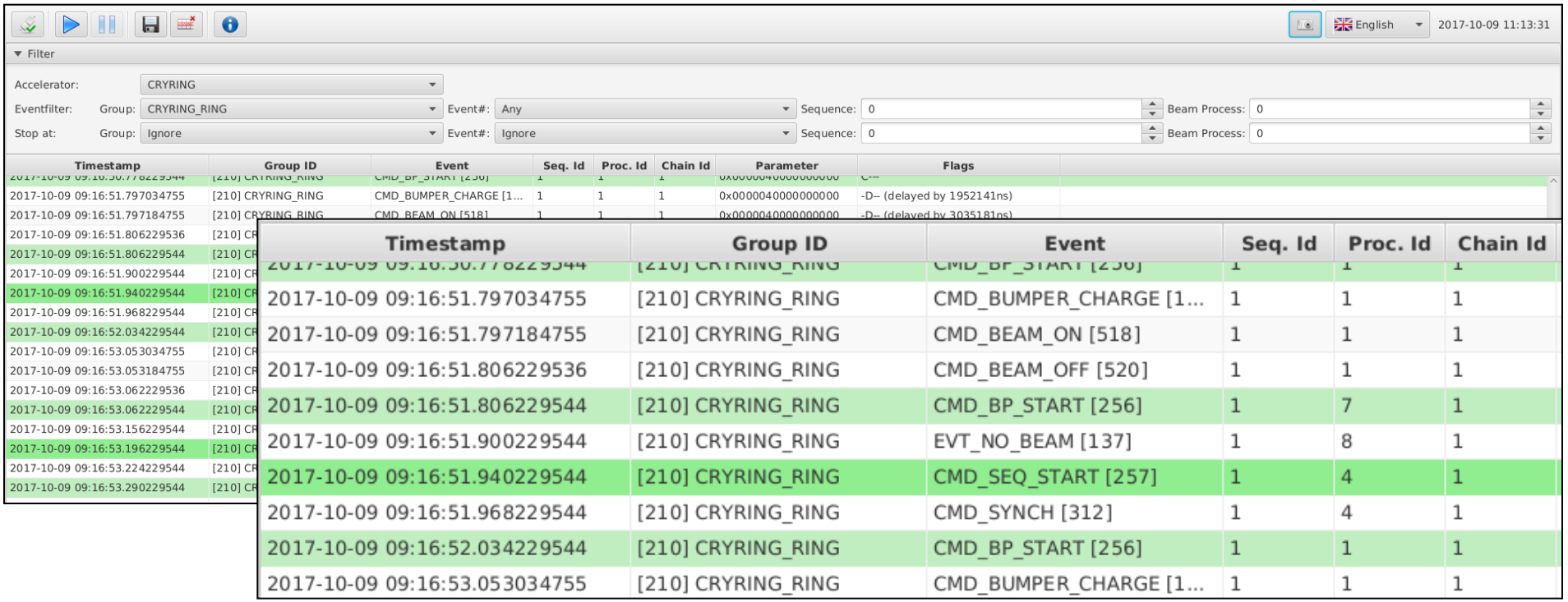


- Timing Aspects: CRYRING@ESR schedule (March 2018)

- Linac Instrumentation Overview
- Instrumentation per device:
  - Source trafo YRT1DT1
  - CUPID for screens
  - Screen & Farady Cup dual-unit
  - Faraday Cup readout
  - RFQ iris (mostly obsolete!)
  - Pickups and energy measurement
  - Injection screens YRT1DF3 and YR01DF3

Snoop tool – the Timing Sniffer
Knowing what`s going on

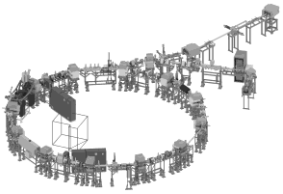
New timing events are characterised by more than one single number:
Timestamp, Group ID, Event Number, Sequence ID, Process ID, Chain ID



by H. Bräuning

- „Simple“ observer GUI connects to data master and dumps event list in tabular form
- Tool features filter options, screenshot, data export, ...
- Available via standard application launchers in control system

CRYRING@ESR March 2018
CRYRING – YRT1IN_TO_YRT1LQ1



English 2018-03-23 22:06:22

Filter

Accelerator: CRYRING

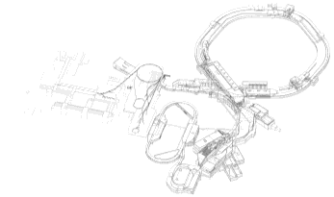
Eventfilter: Group: YRT1IN_TO_YRT1LQ1 Event#: Any Sequence: 0 Beam Process: 0

Stop at: Group: Ignore Event#: Ignore Sequence: 0 Beam Process: 0

Fmt	Timestamp	Group ID	Event	BeamIn	Seq. Id	Proc. Id	Reserved	Chain Id	Parameter	Flags
1	2018-03-23 21:06:36.518731336	[200] YRT1IN_TO_YRT1LQ1	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:36.602731336	[200] YRT1IN_TO_YRT1LQ1	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:36.731381336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_TRIGGER [280]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:36.731431336	[200] YRT1IN_TO_YRT1LQ1	CMD_SOURCE_START [273]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 199344ns)
1	2018-03-23 21:06:36.731631336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_MEAS1 [281]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 176112ns)
1	2018-03-23 21:06:36.733631336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_MEAS2 [282]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:36.733731336	[200] YRT1IN_TO_YRT1LQ1	CMD_SOURCE_STOP [274]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 460152ns)
1	2018-03-23 21:06:43.502731336	[200] YRT1IN_TO_YRT1LQ1	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:43.542731336	[200] YRT1IN_TO_YRT1LQ1	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:43.626731336	[200] YRT1IN_TO_YRT1LQ1	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:43.755381336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_TRIGGER [280]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:43.755431336	[200] YRT1IN_TO_YRT1LQ1	CMD_SOURCE_START [273]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 194056ns)
1	2018-03-23 21:06:43.755631336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_MEAS1 [281]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 121480ns)
1	2018-03-23 21:06:43.757631336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_MEAS2 [282]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:43.757731336	[200] YRT1IN_TO_YRT1LQ1	CMD_SOURCE_STOP [274]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:50.526731336	[200] YRT1IN_TO_YRT1LQ1	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:50.566731336	[200] YRT1IN_TO_YRT1LQ1	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:50.650731336	[200] YRT1IN_TO_YRT1LQ1	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:50.779381336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_TRIGGER [280]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:50.779431336	[200] YRT1IN_TO_YRT1LQ1	CMD_SOURCE_START [273]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 224712ns)
1	2018-03-23 21:06:50.779631336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_MEAS1 [281]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 165032ns)
1	2018-03-23 21:06:50.781631336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_MEAS2 [282]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 568224ns)
1	2018-03-23 21:06:50.781731336	[200] YRT1IN_TO_YRT1LQ1	CMD_SOURCE_STOP [274]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 767080ns)
1	2018-03-23 21:06:57.550731336	[200] YRT1IN_TO_YRT1LQ1	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.590731336	[200] YRT1IN_TO_YRT1LQ1	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:57.674731336	[200] YRT1IN_TO_YRT1LQ1	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:57.803381336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_TRIGGER [280]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.803431336	[200] YRT1IN_TO_YRT1LQ1	CMD_SOURCE_START [273]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 207568ns)
1	2018-03-23 21:06:57.803631336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_MEAS1 [281]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 166880ns)
1	2018-03-23 21:06:57.805631336	[200] YRT1IN_TO_YRT1LQ1	CMD_BI_MEAS2 [282]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 207440ns)
1	2018-03-23 21:06:57.805731336	[200] YRT1IN_TO_YRT1LQ1	CMD_SOURCE_STOP [274]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 869312ns)

INFO [23 Mar 2018 22:05:24,193] (Screenshot.java) - Screenshot: http://clipboard.acc.gsi.de/dav/bi/screenshots//wrsnoop/2018-03-23_22-05-23_asl740.acc.gsi.de_wrsnoop.png

CRYRING@ESR March 2018
CRYRING – YRT1LQ1_TO_YRT1LC1



English 2018-03-23 22:07:27

Filter

Accelerator: CRYRING

Eventfilter: Group: YRT1LQ1_TO_YRT1LC1 Event#: Any Sequence: 0 Beam Process: 0

Stop at: Group: Ignore Event#: Ignore Sequence: 0 Beam Process: 0

Fmt	Timestamp	Group ID	Event	BeamIn	Seq. Id	Proc. Id	Reserved	Chain Id	Parameter	Flags

No content in table

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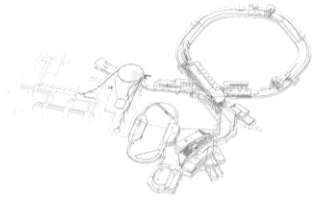
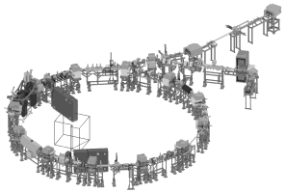
CRYRING@ESR March 2018
CRYRING – YRT1LC1_TO_YRT1MH2





English 2018-03-23 22:06:47

Filter

Accelerator: CRYRING

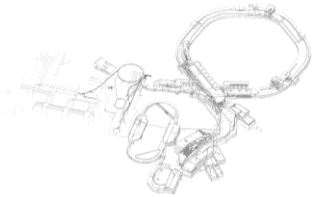
Eventfilter: Group: YRT1LC1_TO_YRT1MH2 Event#: Any Sequence: 0 Beam Process: 0

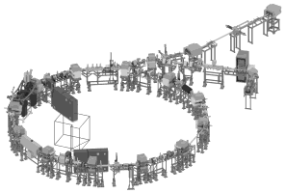
Stop at: Group: Ignore Event#: Ignore Sequence: 0 Beam Process: 0

Fmt	Timestamp	Group ID	Event	BeamIn	Seq. Id	Proc. Id	Reserved	Chain Id	Parameter	Flags
1	2018-03-23 21:06:57.674731336	[202] YRT1LC1_TO_YRT1MH2	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:57.801131336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_PREP_PAUSE [291]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.803731336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_STOP_PAUSE [292]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 290336ns)
1	2018-03-23 21:06:57.804731336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_PREP [290]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.804981336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_TRIGGER [280]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.805231336	[202] YRT1LC1_TO_YRT1MH2	CMD_BEAM_ON [518]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.805232336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_MEAS1 [281]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 171520ns)
1	2018-03-23 21:06:57.805682336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_MEAS2 [282]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 688328ns)
1	2018-03-23 21:06:57.805731336	[202] YRT1LC1_TO_YRT1MH2	CMD_BEAM_OFF [520]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:11.598731336	[202] YRT1LC1_TO_YRT1MH2	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:11.638731336	[202] YRT1LC1_TO_YRT1MH2	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:11.722731336	[202] YRT1LC1_TO_YRT1MH2	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:11.849131336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_PREP_PAUSE [291]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:11.851731336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_STOP_PAUSE [292]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 308984ns)
1	2018-03-23 21:07:11.852731336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_PREP [290]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:11.852981336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_TRIGGER [280]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:11.853231336	[202] YRT1LC1_TO_YRT1MH2	CMD_BEAM_ON [518]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:11.853232336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_MEAS1 [281]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 153112ns)
1	2018-03-23 21:07:11.853682336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_MEAS2 [282]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 322768ns)
1	2018-03-23 21:07:11.853731336	[202] YRT1LC1_TO_YRT1MH2	CMD_BEAM_OFF [520]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 393576ns)
1	2018-03-23 21:07:18.622731336	[202] YRT1LC1_TO_YRT1MH2	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:18.662731336	[202] YRT1LC1_TO_YRT1MH2	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:18.746731336	[202] YRT1LC1_TO_YRT1MH2	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:18.873131336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_PREP_PAUSE [291]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:18.875731336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_STOP_PAUSE [292]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 222856ns)
1	2018-03-23 21:07:18.876731336	[202] YRT1LC1_TO_YRT1MH2	CMD_RF_PREP [290]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:18.876981336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_TRIGGER [280]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:18.877231336	[202] YRT1LC1_TO_YRT1MH2	CMD_BEAM_ON [518]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:18.877232336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_MEAS1 [281]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 178072ns)
1	2018-03-23 21:07:18.877682336	[202] YRT1LC1_TO_YRT1MH2	CMD_BI_MEAS2 [282]	true	1	1	0x40	1	0x0000040000000000	-D-- (delayed by 507920ns)
1	2018-03-23 21:07:18.877731336	[202] YRT1LC1_TO_YRT1MH2	CMD_BEAM_OFF [520]	true	1	1	0x40	1	0x0000040000000000	C---

INFO [23 Mar 2018 22:06:25,154] (Screenshot.java) - Screenshot: http://clipboard.acc.gsi.de/dav/bi/screenshots//wrsnoop/2018-03-23_22-06-24_asl740.acc.gsi.de_wrsnoop.png

CRYRING@ESR March 2018
CRYRING – YRT1MH2_TO_CRYRING





English 2018-03-23 22:07:13

Filter

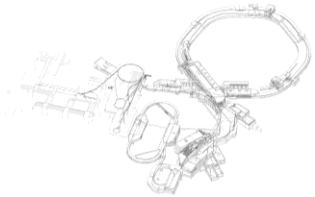
Accelerator: CRYRING

Eventfilter: Group: YRT1MH2_TO_CRYRING Event#: Any Sequence: 0 Beam Process: 0

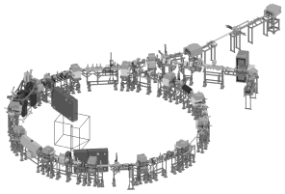
Stop at: Group: Ignore Event#: Ignore Sequence: 0 Beam Process: 0

Fmt	Timestamp	Group ID	Event	BeamIn	Seq. Id	Proc. Id	Reserved	Chain Id	Parameter	Flags
1	2018-03-23 21:06:50.526731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:50.566731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:50.650731336	[203] YRT1MH2_TO_CRYRING	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:50.763231336	[203] YRT1MH2_TO_CRYRING	CMD_SEPTUM_CHARGE [521]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.550731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:06:57.590731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.674731336	[203] YRT1MH2_TO_CRYRING	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:06:57.787231336	[203] YRT1MH2_TO_CRYRING	CMD_SEPTUM_CHARGE [521]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:11.598731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:11.638731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:11.722731336	[203] YRT1MH2_TO_CRYRING	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:11.835231336	[203] YRT1MH2_TO_CRYRING	CMD_SEPTUM_CHARGE [521]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:18.622731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:18.662731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:18.746731336	[203] YRT1MH2_TO_CRYRING	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:18.859231336	[203] YRT1MH2_TO_CRYRING	CMD_SEPTUM_CHARGE [521]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:32.670731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:32.710731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:32.794731336	[203] YRT1MH2_TO_CRYRING	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:32.907231336	[203] YRT1MH2_TO_CRYRING	CMD_SEPTUM_CHARGE [521]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:39.694731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:39.734731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:39.818731336	[203] YRT1MH2_TO_CRYRING	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:39.931231336	[203] YRT1MH2_TO_CRYRING	CMD_SEPTUM_CHARGE [521]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:46.718731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_START [258]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:46.758731336	[203] YRT1MH2_TO_CRYRING	CMD_GAP_END [259]	false	1	1	0x40	1	0x0000040000000000	C---
1	2018-03-23 21:07:46.842731336	[203] YRT1MH2_TO_CRYRING	CMD_SEQ_START [257]	true	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:07:46.955231336	[203] YRT1MH2_TO_CRYRING	CMD_SEPTUM_CHARGE [521]	true	1	1	0x40	1	0x0000040000000000	----

INFO [23 Mar 2018 22:06:49,406] (Screenshot.java) - Screenshot: http://clipboard.acc.gsi.de/dav/bi/screenshots//wrsnoop/2018-03-23_22-06-48_asl740.acc.gsi.de_wrsnoop.png



CRYRING@ESR March 2018
CRYRING – CRYRING_RING



English 2018-03-23 22:02:47

Filter

Accelerator: CRYRING

Eventfilter: Group: CRYRING_RING Event#: Any Sequence: 0 Beam Process: 0

Stop at: Group: Ignore Event#: Ignore Sequence: 0 Beam Process: 0

Fmt	Timestamp	Group ID	Event	BeamIn	Seq. Id	Proc. Id	Reserved	Chain Id	Parameter	Flags
1	2018-03-23 21:03:05.758731336	[210] CRYRING_RING	CMD_GAP_START [258]	false	1	5	0x140	1	0x0000040000000000	----
1	2018-03-23 21:03:05.798731336	[210] CRYRING_RING	CMD_GAP_END [259]	false	1	5	0x140	1	0x0000040000000000	C---
1	2018-03-23 21:03:05.818731336	[210] CRYRING_RING	CMD_SEQ_START [257]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:03:05.846731336	[210] CRYRING_RING	CMD_SYNCH [312]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:03:05.882731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	2	0x80	1	0x0000040000000000	C---
1	2018-03-23 21:03:06.001187315	[210] CRYRING_RING	CMD_BUMPER_CHARGE [1...	true	1	2	0x80	1	0x0000040000000000	-D-- (delayed by 255301ns)
1	2018-03-23 21:03:06.013258315	[210] CRYRING_RING	CMD_BEAM_ON [518]	true	1	2	0x80	1	0x0000040000000000	-D-- (delayed by 422525ns)
1	2018-03-23 21:03:06.020731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	3	0xC0	1	0x0000040000000000	----
1	2018-03-23 21:03:06.198731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	4	0x100	1	0x0000040000000000	-D-- (delayed by 266096ns)
1	2018-03-23 21:03:12.272731328	[210] CRYRING_RING	CMD_BEAM_OFF [520]	true	1	4	0x100	1	0x0000040000000000	----
1	2018-03-23 21:03:12.272731336	[210] CRYRING_RING	CMD_BP_START [256]	false	1	5	0x140	1	0x0000040000000000	-D-- (delayed by 263016ns)
1	2018-03-23 21:03:12.782731336	[210] CRYRING_RING	CMD_GAP_START [258]	false	1	5	0x140	1	0x0000040000000000	----
1	2018-03-23 21:03:12.822731336	[210] CRYRING_RING	CMD_GAP_END [259]	false	1	5	0x140	1	0x0000040000000000	----
1	2018-03-23 21:03:12.842731336	[210] CRYRING_RING	CMD_SEQ_START [257]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:03:12.870731336	[210] CRYRING_RING	CMD_SYNCH [312]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:03:12.906731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	2	0x80	1	0x0000040000000000	C---
1	2018-03-23 21:03:13.025187315	[210] CRYRING_RING	CMD_BUMPER_CHARGE [1...	true	1	2	0x80	1	0x0000040000000000	-D-- (delayed by 255213ns)
1	2018-03-23 21:03:13.037258315	[210] CRYRING_RING	CMD_BEAM_ON [518]	true	1	2	0x80	1	0x0000040000000000	-D-- (delayed by 189397ns)
1	2018-03-23 21:03:13.044731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	3	0xC0	1	0x0000040000000000	----
1	2018-03-23 21:03:13.222731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	4	0x100	1	0x0000040000000000	-D-- (delayed by 263112ns)
1	2018-03-23 21:03:19.296731328	[210] CRYRING_RING	CMD_BEAM_OFF [520]	true	1	4	0x100	1	0x0000040000000000	----
1	2018-03-23 21:03:19.296731336	[210] CRYRING_RING	CMD_BP_START [256]	false	1	5	0x140	1	0x0000040000000000	-D-- (delayed by 433936ns)
1	2018-03-23 21:03:19.806731336	[210] CRYRING_RING	CMD_GAP_START [258]	false	1	5	0x140	1	0x0000040000000000	C---
1	2018-03-23 21:03:19.846731336	[210] CRYRING_RING	CMD_GAP_END [259]	false	1	5	0x140	1	0x0000040000000000	----
1	2018-03-23 21:03:19.866731336	[210] CRYRING_RING	CMD_SEQ_START [257]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:03:19.894731336	[210] CRYRING_RING	CMD_SYNCH [312]	false	1	1	0x40	1	0x0000040000000000	----
1	2018-03-23 21:03:19.930731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	2	0x80	1	0x0000040000000000	C---
1	2018-03-23 21:03:20.049187315	[210] CRYRING_RING	CMD_BUMPER_CHARGE [1...	true	1	2	0x80	1	0x0000040000000000	-D-- (delayed by 249309ns)
1	2018-03-23 21:03:20.061258315	[210] CRYRING_RING	CMD_BEAM_ON [518]	true	1	2	0x80	1	0x0000040000000000	-D-- (delayed by 382749ns)
1	2018-03-23 21:03:20.068731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	3	0xC0	1	0x0000040000000000	----
1	2018-03-23 21:03:20.246731336	[210] CRYRING_RING	CMD_BP_START [256]	true	1	4	0x100	1	0x0000040000000000	-D-- (delayed by 226304ns)

INFO [23 Mar 2018 22:00:56,062] (ClientConnection.java) - connection tcp://sddsc037:13455/0: connected to 'tcp://sddsc037:13455/0'

CRYRING
Event Structure (examples)

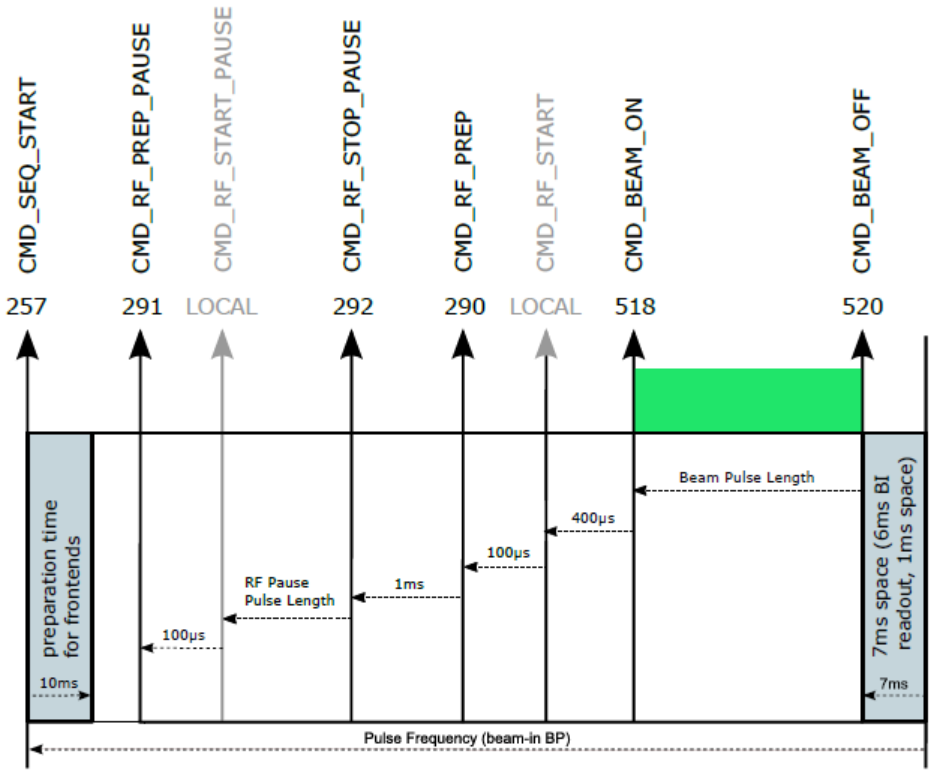


Figure 3: Event structure for YRME (beam-in)

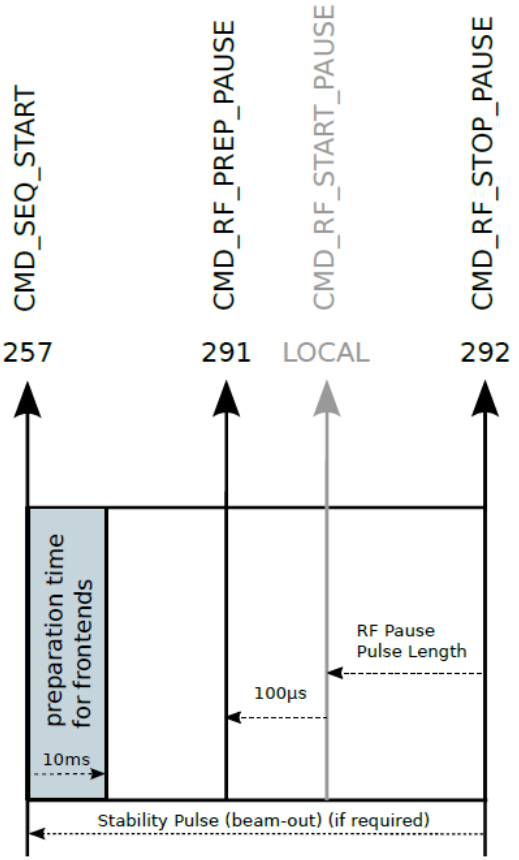
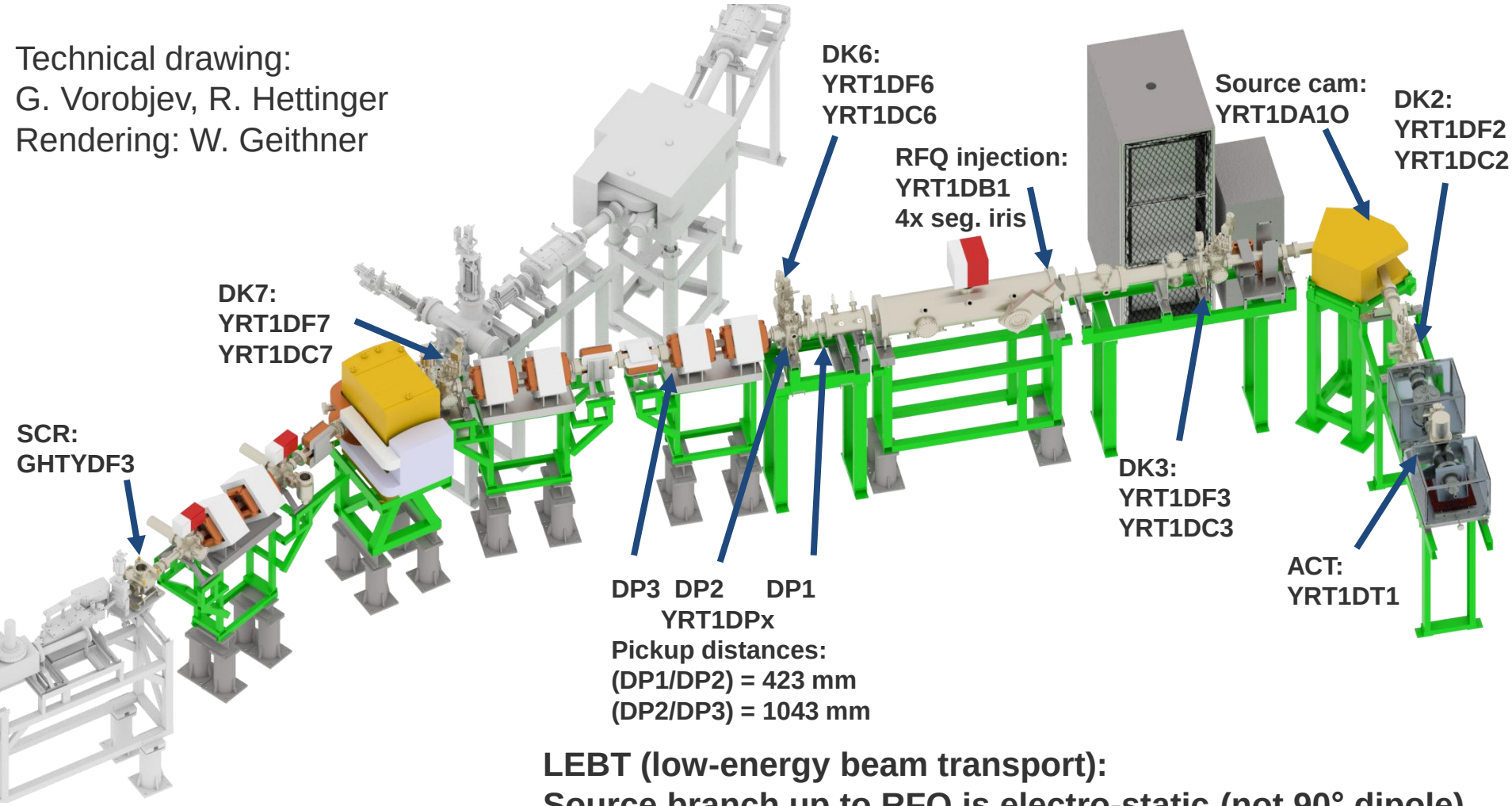


Figure 4: Event structure for YRME (beam-out)

The timing schedules and groups are summarised in
a dedicated document „CRYRING Event Structure“ by N.N. (?????)

Overview
Linac Instrumentation

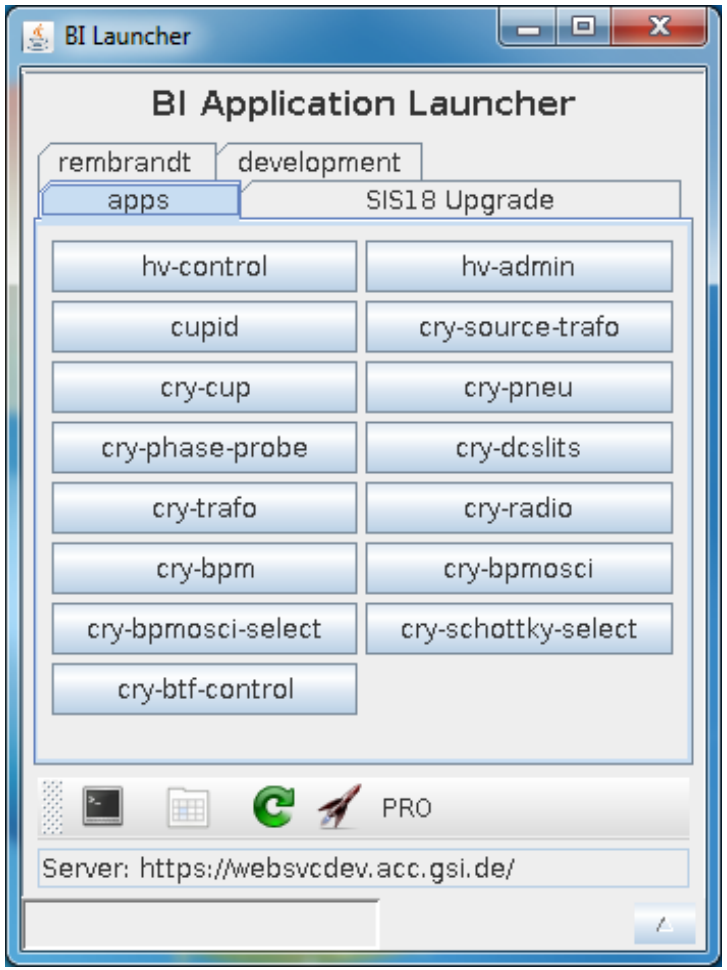
Technical drawing:
G. Vorobjev, R. Hettinger
Rendering: W. Geithner



LEBT (low-energy beam transport):
Source branch up to RFQ is electro-static (not 90° dipole)
Source – ACT – Chopper

Starting BI Expert Applications via BI-Launcher

Hochspannung
Leuchtschirme
Faraday Cups
Linac TOF Messung
Ring Intensitätsmessung
Ring BPMs
Anwahl BPM für Oszi
BTF Signalanwahl

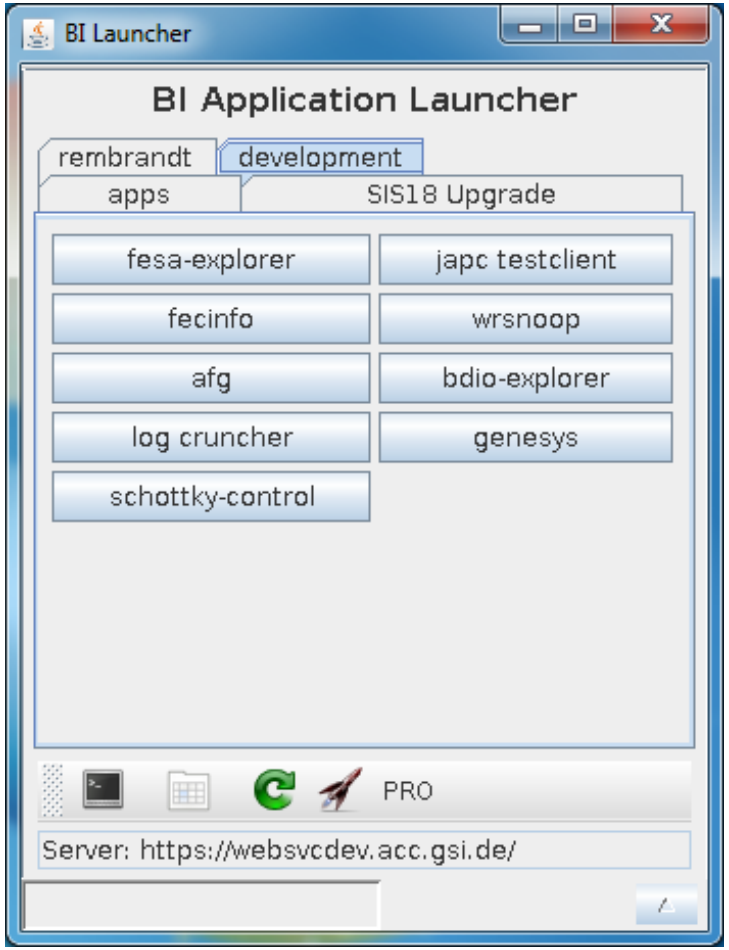


Don`t use!
ACT Quelle
(Pressluftantriebe)
Auslese RFQ Blenden
Ring CryRadio Intensität
BPM Spuren auf Oszi
Schottky (ΔX, ΔY, ΔQ,Σ)

Stepper motor and pneumatic drives can be controlled from DeciveControl (by CSCO).

Starting BI Expert Applications via BI-Launcher

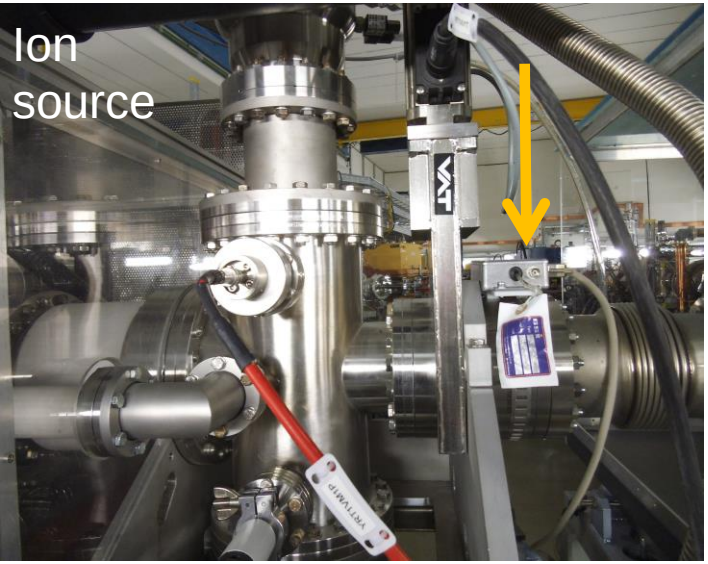
FESA Explorer
(direct connection for experts!)

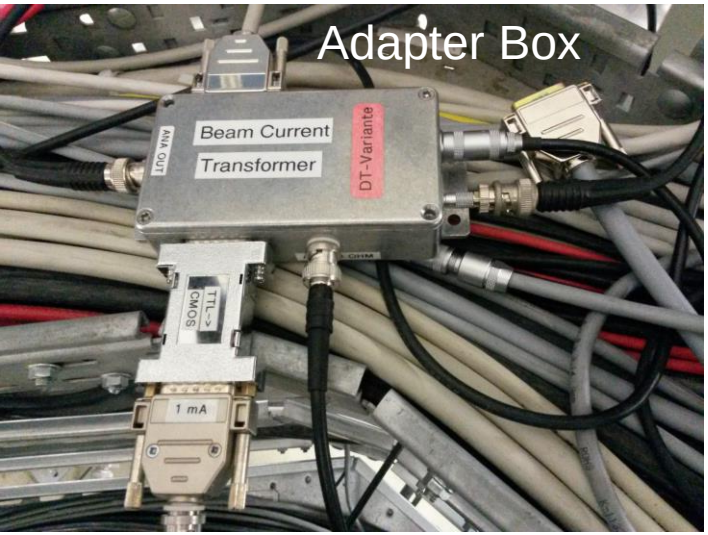


Snoop Tool
TDF file reader
Genesys FTRN configurator

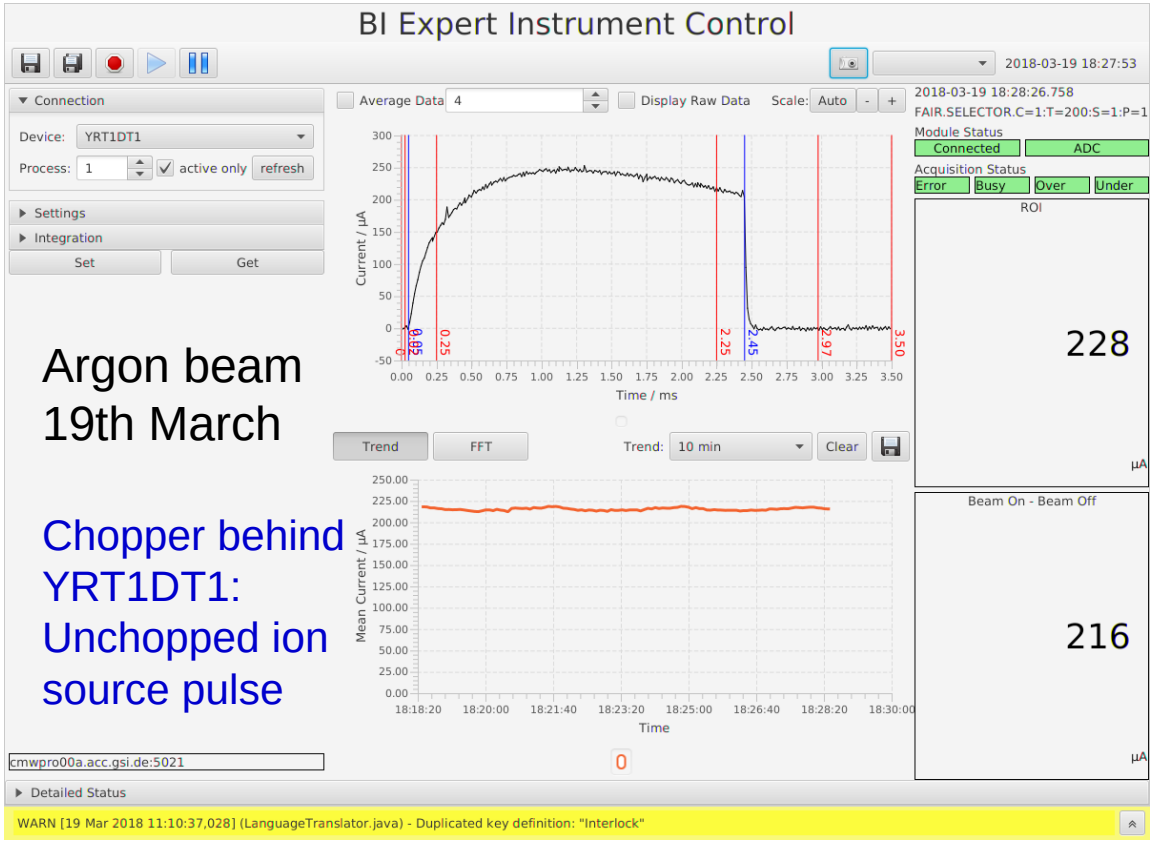
TDF files are binary data files saved by BI DAQ systems

Ion Source Transformer YRT1DT1

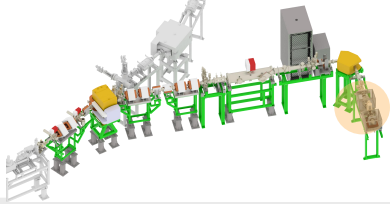




- Hardware: GSI-type AC current transformer UNI-DT 1030
  - Timing controlled by DAQ system
  - Amplifier output adapted to 50 Ohm ADC input (10 MSa/s)
  - Single, 1mA fixed-gain sufficient for operation (at the moment)
- Software: cry-source-trafo

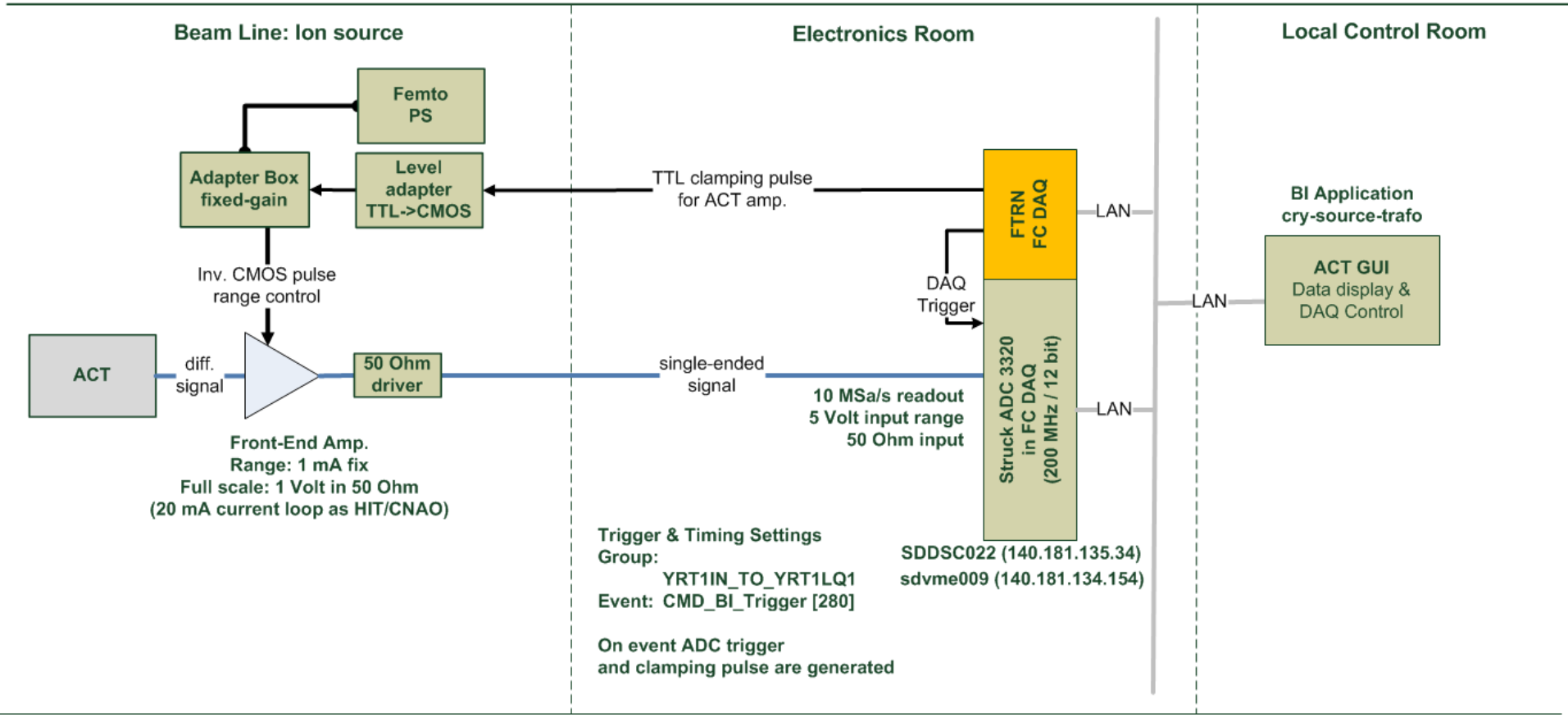


Hardware Scheme YRT1DT1

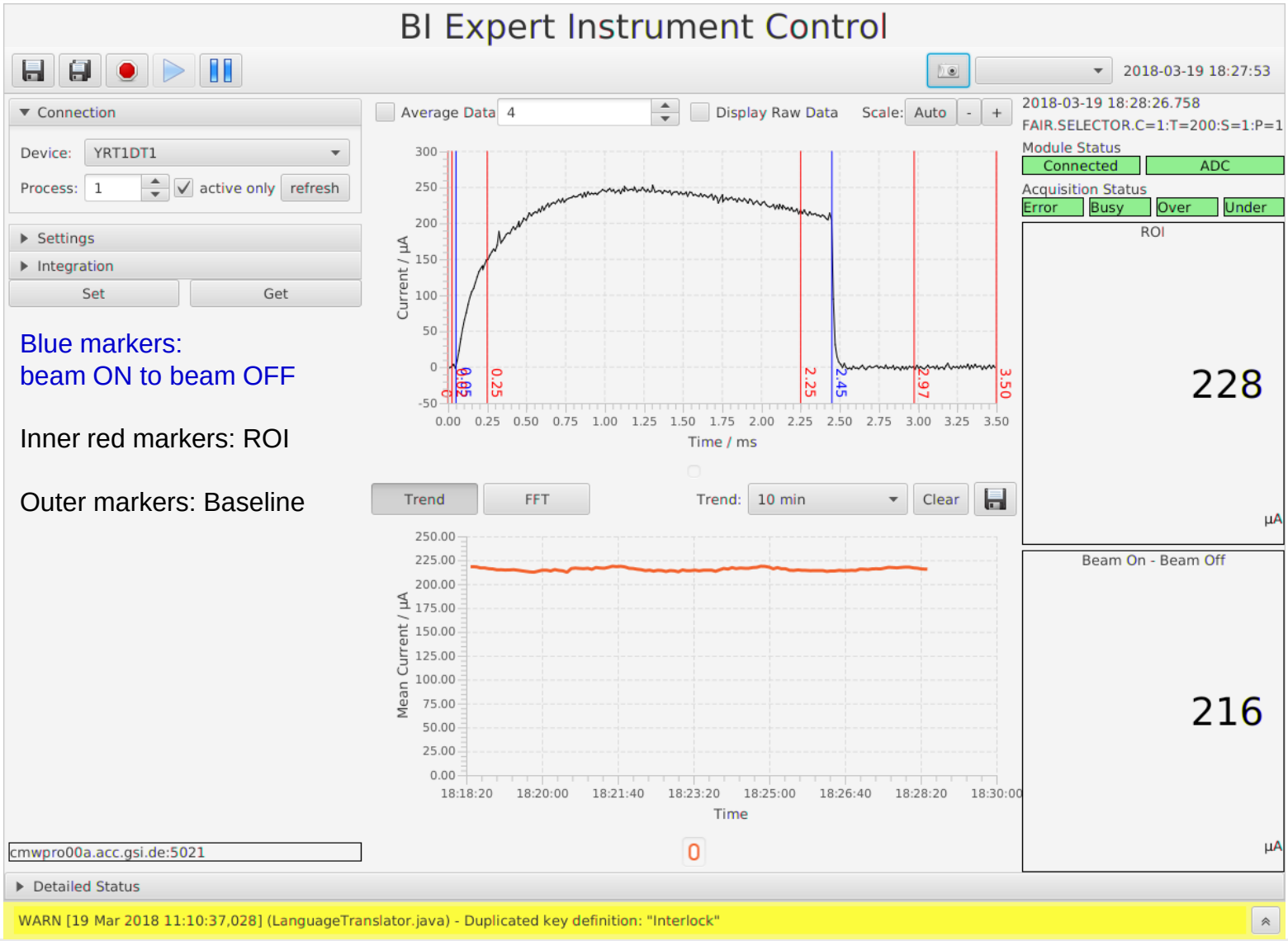


CRYRING Injector Linac
Schematic of AC Transformer Electronics & DAQ

A. Reiter
26th March 2018



Expert GUI application
cry-source-trafo



Blue markers:
beam ON to beam OFF

Inner red markers: ROI

Outer markers: Baseline

Expert GUI application
cry-source-trafo

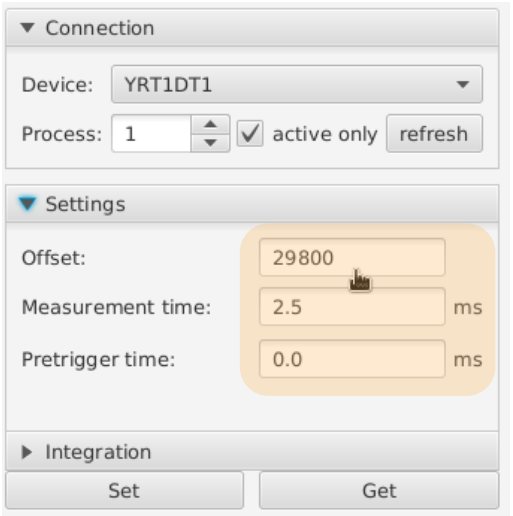
Standard settings

Save data

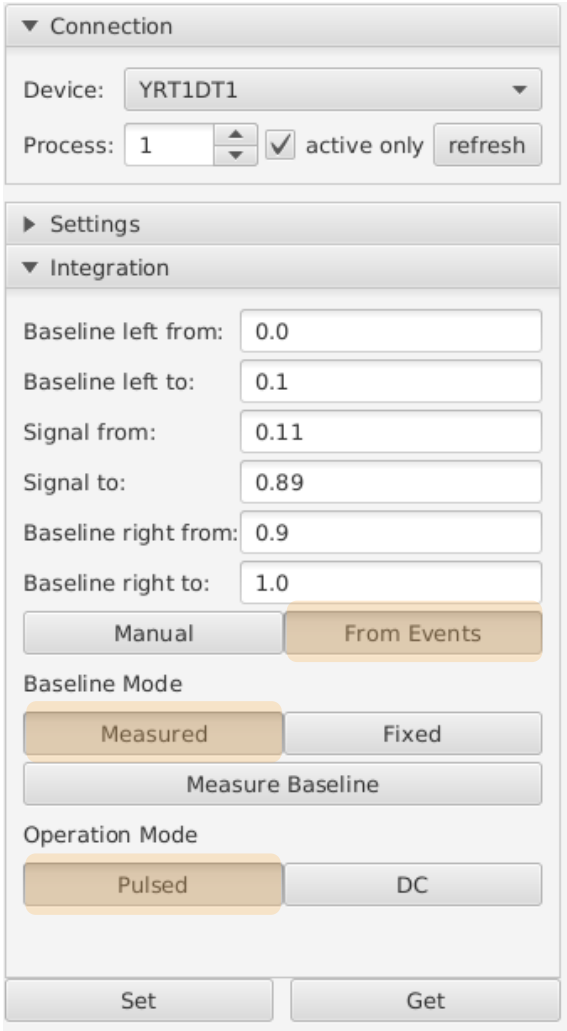
Stop data export

Start/Stop GUI update

Storage area: http://clipboard.acc.gsi.de/bi/data/YRT1DT1/
Screenshots: http://clipboard.acc.gsi.de/bi/screenshots/YRT1DT1/



ADC baseline! Do not touch!



Get: Read information from DAQ system
Set: Send new values to DAQ system

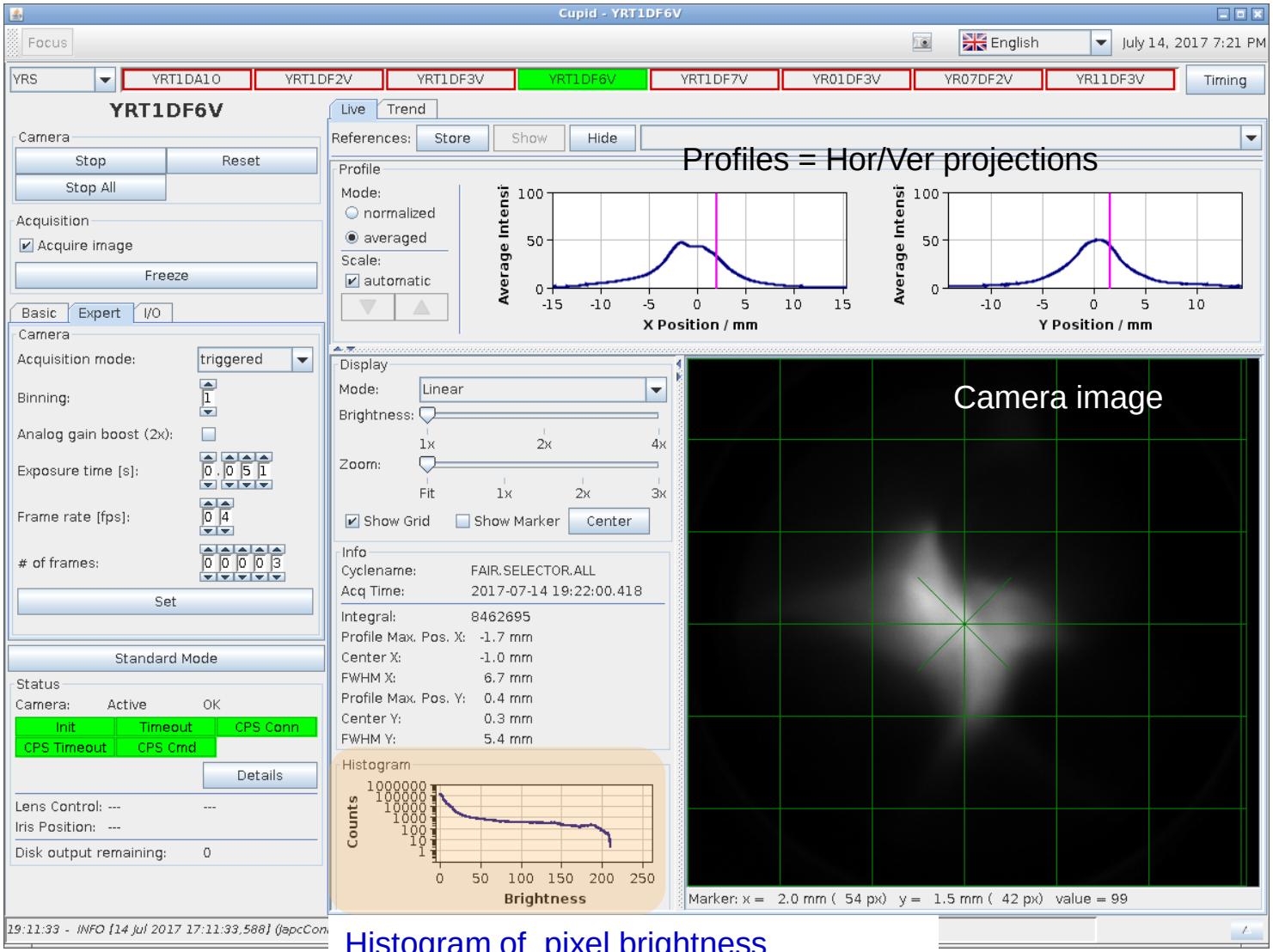
Scintillating Screens
Expert GUI application CUPID

Readout with digital camera system CUPID

LED control for YRT1 cameras to be implemented!!!

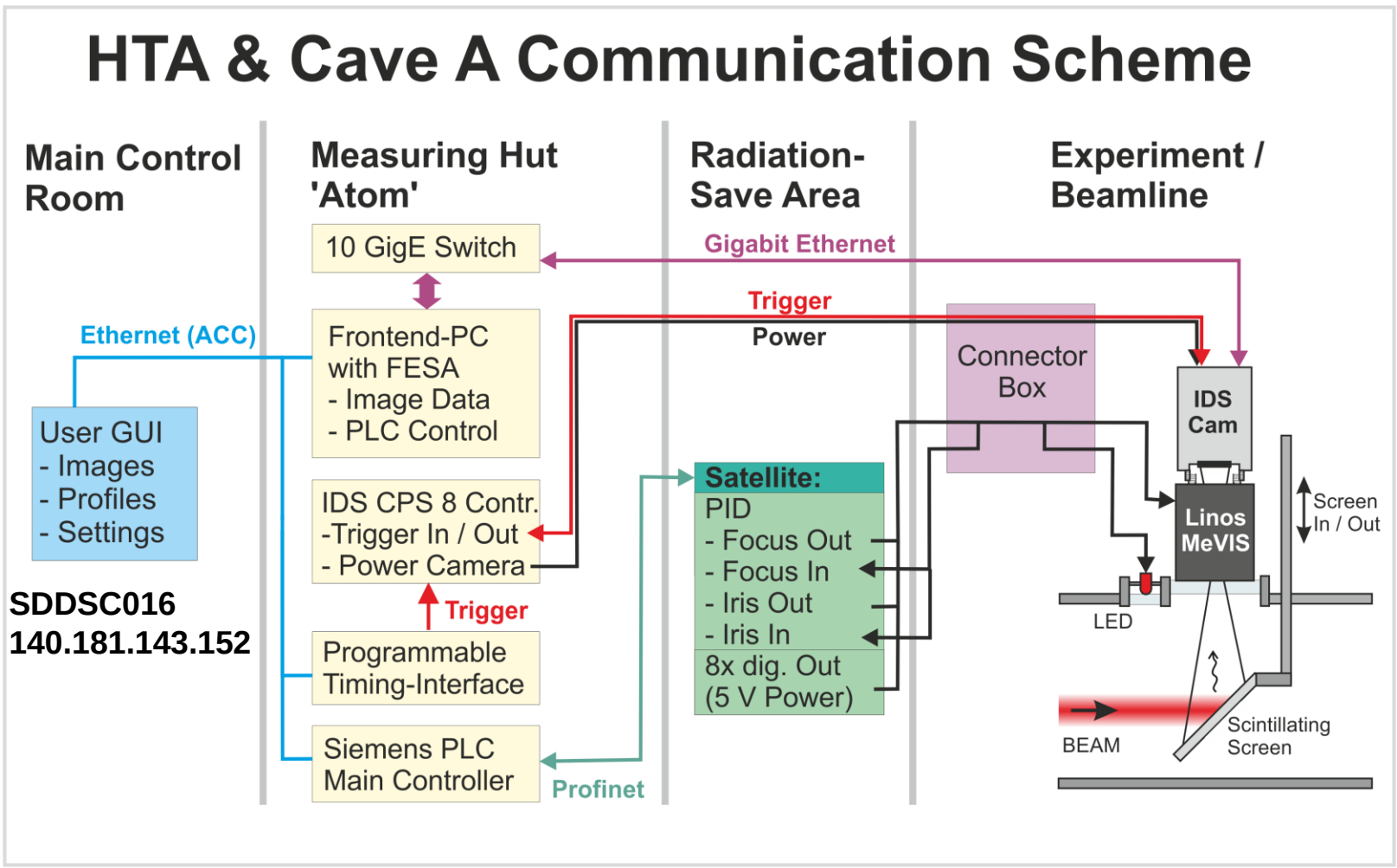
Different screens are used:
- YAG
- Cromox
- P43

4 diagnostic chambers
YRT1DK2
YRT1DK3 (YAG)
YRT1DK6 (P43)
YRT1DK7 (P43)
and
SourceCam
YRT1DA1O which looks into the ion source chamber



Histogram of pixel brightness
-> Use for adjustment of exposure time

Hardware Scheme FAIR screens YR07DF2, YR11DF3, GHTB/GHTY



Screens in YRT1, GHTYDF3, YR01DF3, YRE1DF1 do not have a controllable iris, but do have an LED (control to be implemented in GUI)!

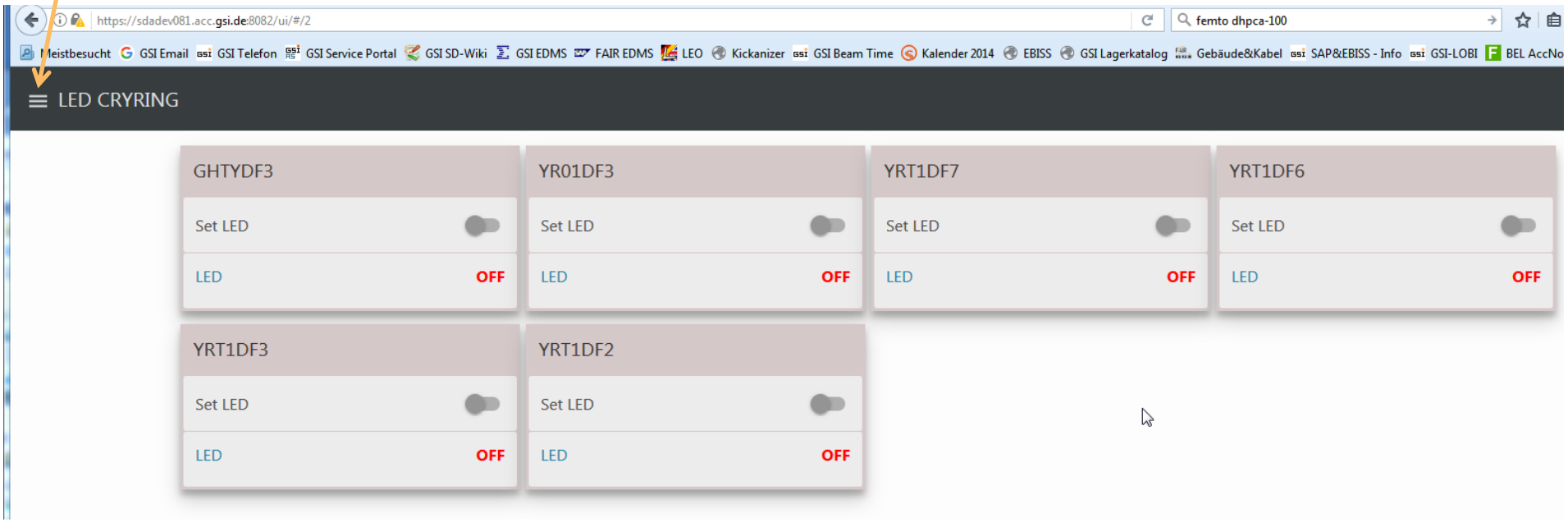
Hardware Scheme
LED Control via browser

https://sdadev081.acc.gsi.de:8082/ui/

user: u....; pwd=

LED control to be implemented in CUPID GUI

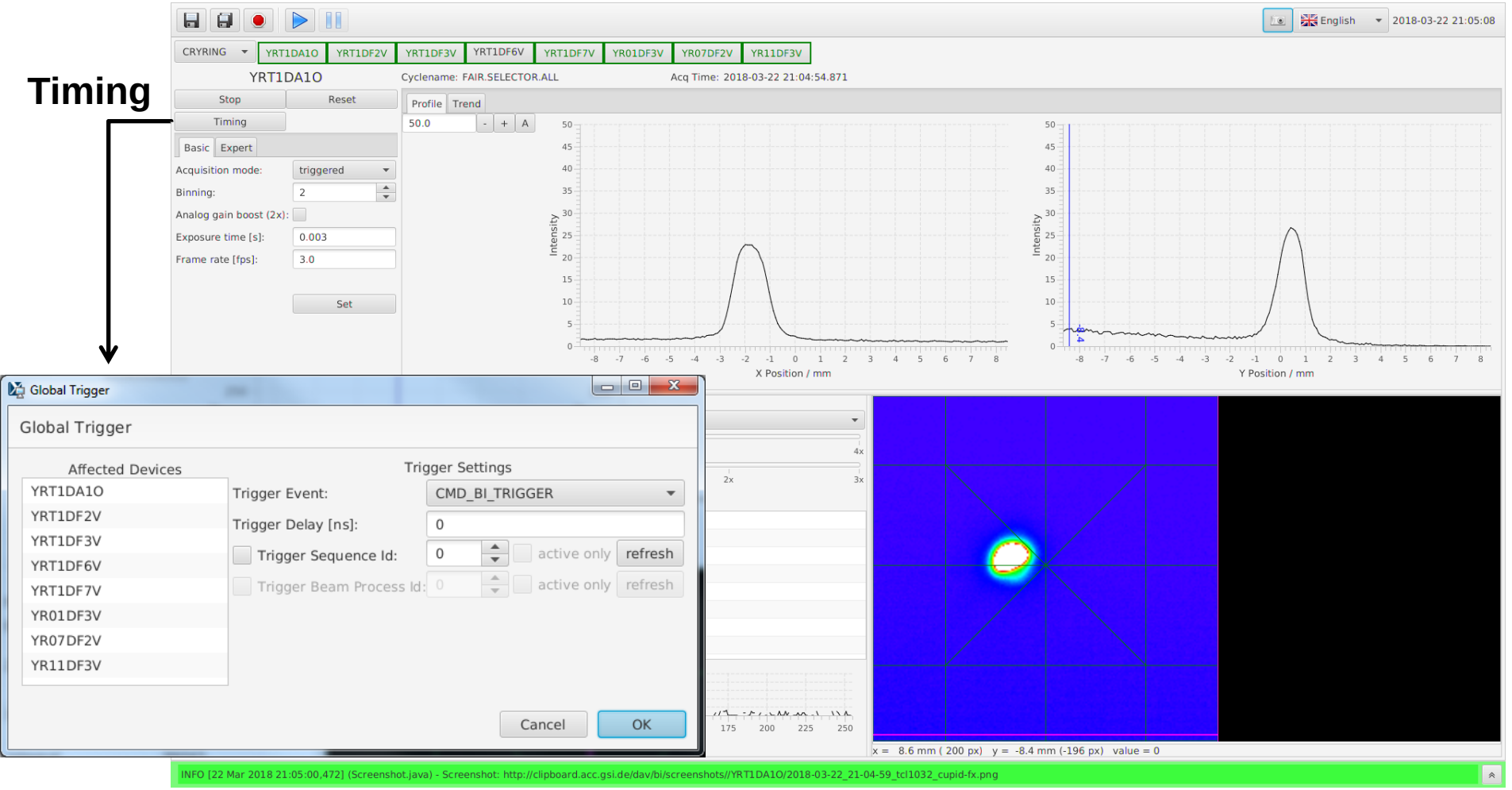
Select „LED CRYRING“ from menu



SourceCam YRT1DA1OV
View into ion source

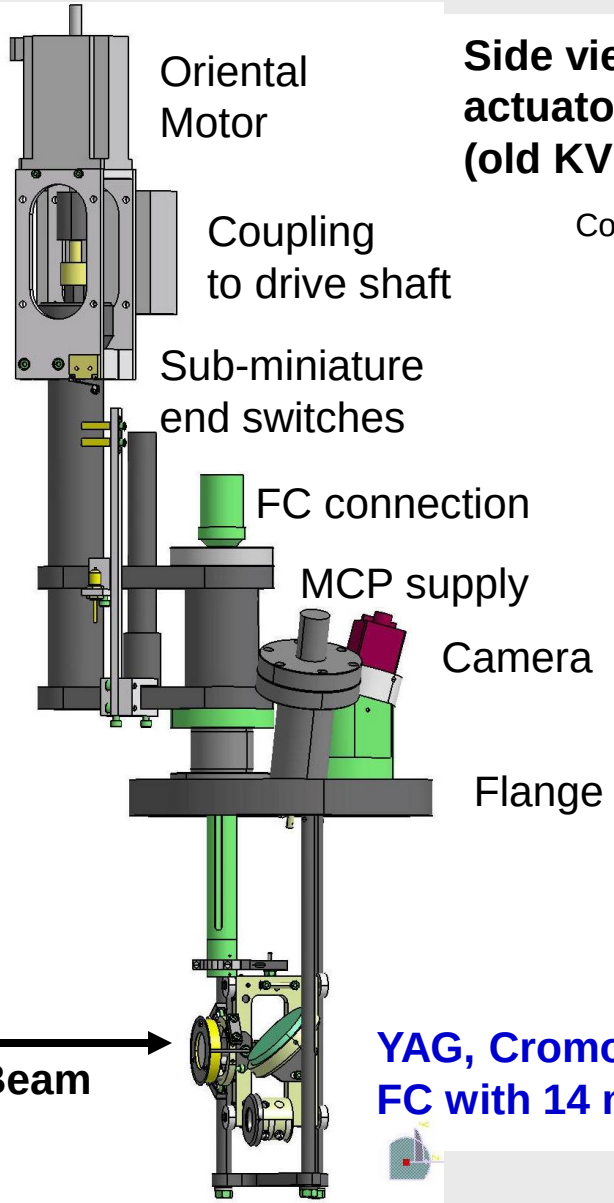
Screenshot shows discharge in ion source during Mg operation.
In other circumstances the glow around the filament can be observed.

Timing



Profile & Current Measurements
Dual Diagnostics Box

- Used at HITRAP
- **Stepper Motor Drive**
  - 100 mm length
  - Modification to FAIR standard (potentiometer, connectors, motor)
  - Application: DeviceControl
- **Profile measurement**
  - Screen: Cromox, YAG or P43 & mirror
  - Digital Camera
  - Test LED, but no iris control
  - Use short chopper window to extend lifetime of screen materials!
- **Current measurement**
  - Faraday Cup
  - Repeller electrode
  - 14 mm diameter (beam spot is larger!)
  - Femto amplifier DHPCA-100



Side view of actuator and detectors (old KVI version)

Courtesy of G. Vorobjev

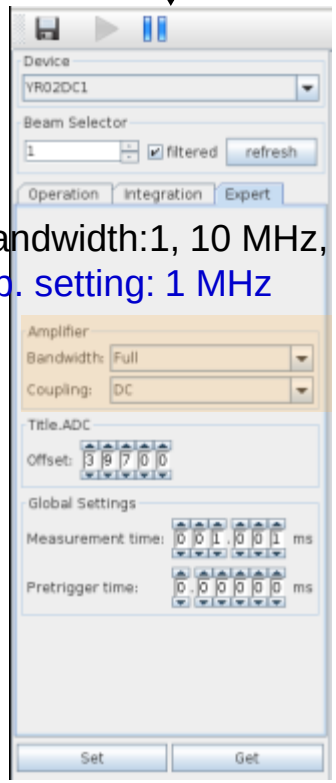
YAG, Cromox, P43 & Mirror
FC with 14 mm ø

Current Measurement
Expert GUI application CryCup

Flight time causes small offset wrt. blue Beam ON/OFF markers

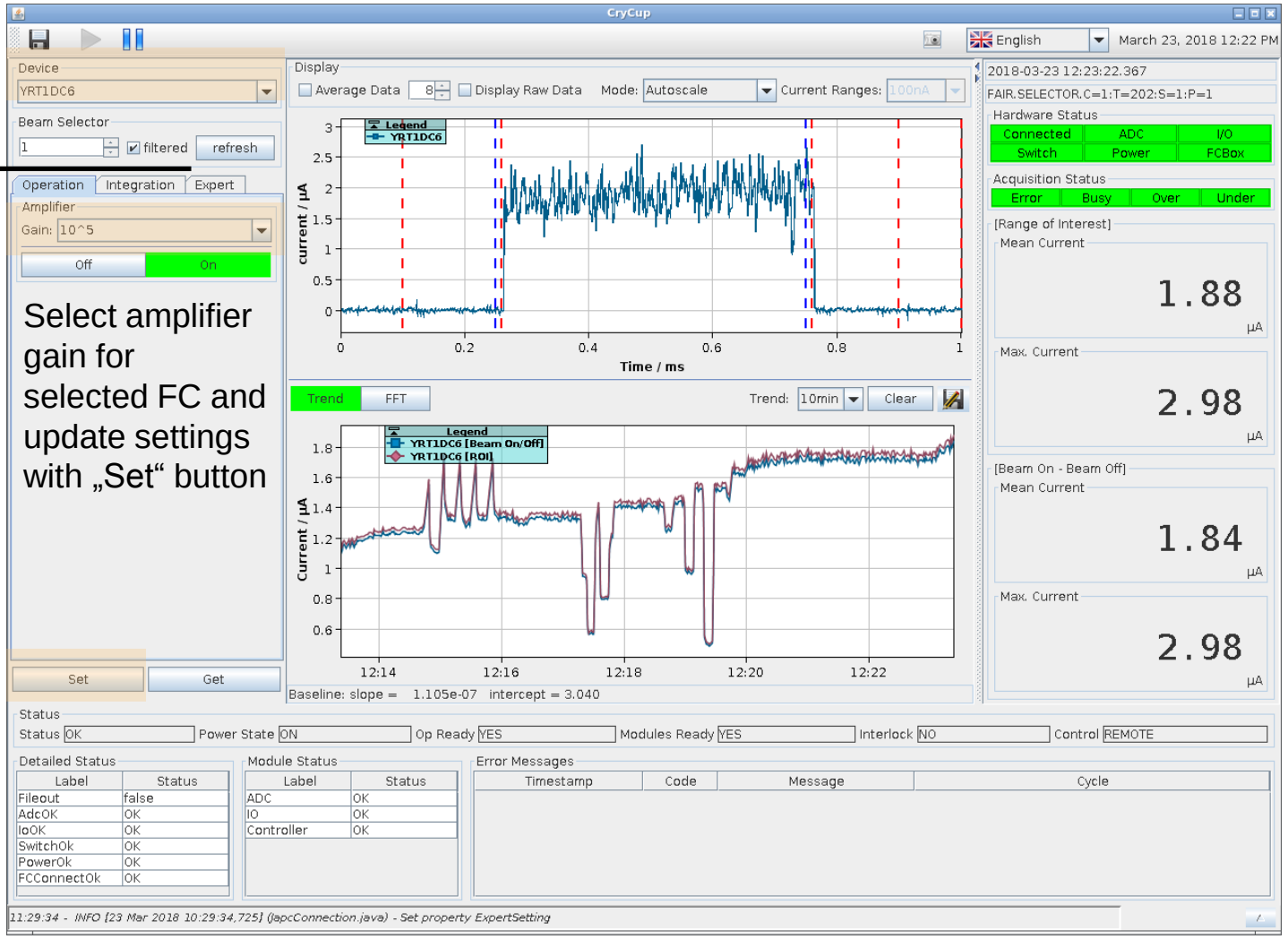
Gain and bandwidth are coupled -> see next slide

Expert



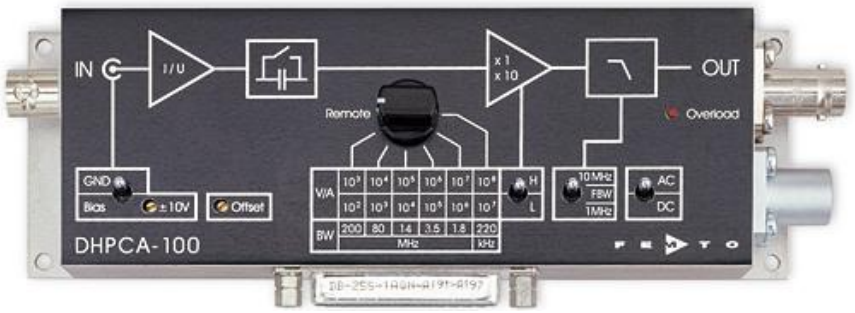
Bandwidth:1, 10 MHz, full
typ. setting: 1 MHz

Select amplifier gain for selected FC and update settings with „Set“ button



Current Measurement
Parameters of Femto amplifier

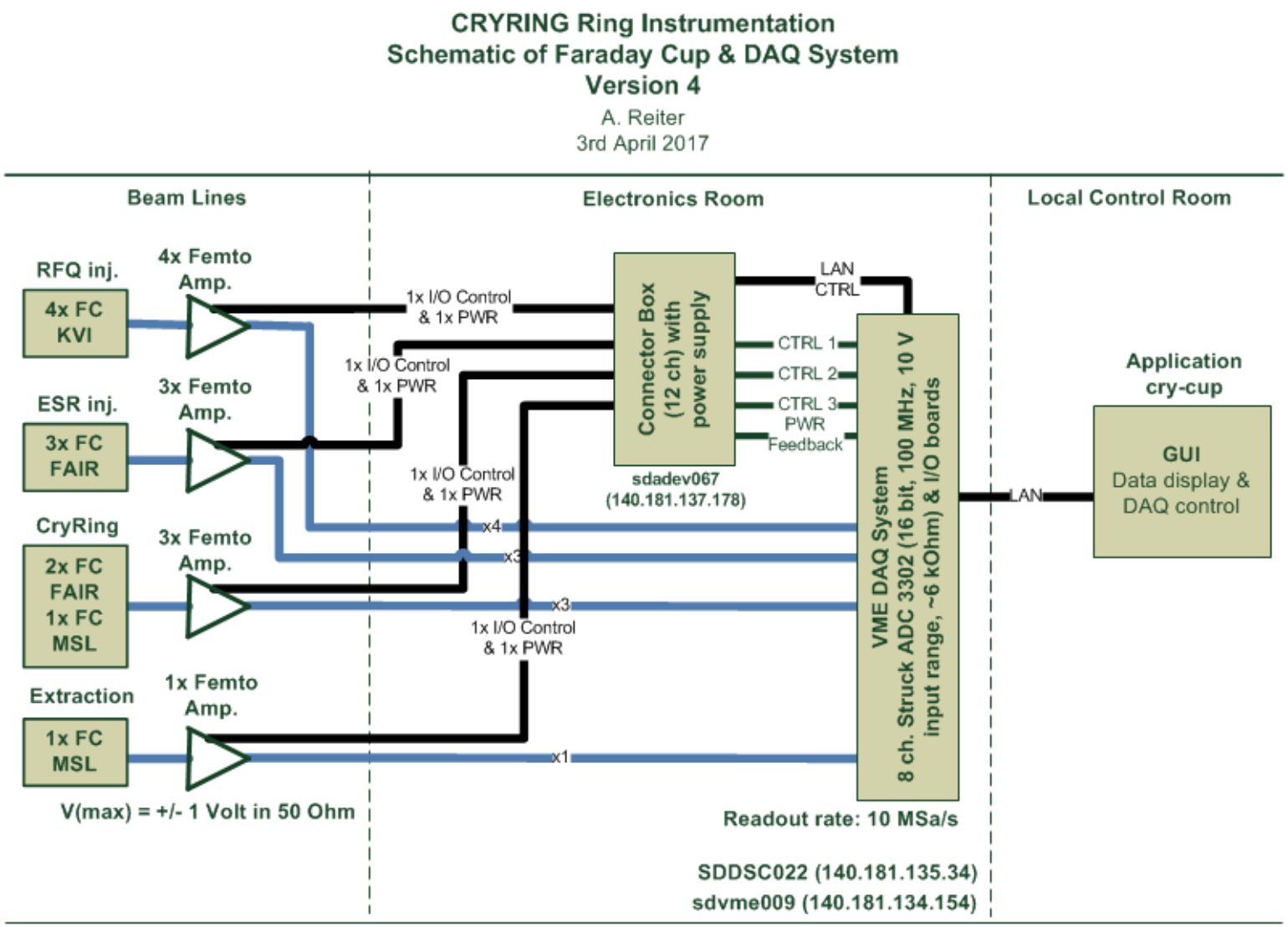
Choice of gain results in settings indicated by the shaded area.
Typical ranges are $10^4 - 10^7$ V/A



Modell	DHPCA-100											
Anwendungsbereich	Low Noise						High Speed					
Transimpedanz [V/A]	10^2	10^3	10^4	10^5	10^6	10^7	10^3	10^4	10^5	10^6	10^7	10^8
3-dB Bandbreite [MHz]	200	80	14	3,5	1,8	0,22	175	80	14	3,5	1,.8	0,22
Anstiegszeit (10%-90%)	1,8 ns	4,4 ns	25 ns	0,1 µs	0,2 µs	1,6 µs	2,0 ns	4,4 ns	25 ns	0,1 µs	0,2 µs	1,6 µs
Equ. Eingangsrauschen [/√Hz]	200 pA	16 pA	2,1 pA	500 fA	170 fA	60 fA	140 pA	6,0 pA	1,5 pA	450 fA	150 fA	55 fA
Genauigkeit	Verstärkung ± 1 %											
Tiefpassfilter	Umschaltbar auf 1 MHz, 10 MHz oder volle Bandbreite											
Ausgang	± 1 V @ 50 Ω Last											
Bias Spannung	± 10 V, max. 22 mA, verbunden mit BNC-Außenleiter, schaltbar auf Masse											
Versorgungsspannung	± 15 V, + 110 mA / - 90 mA typ., ± 200 mA empfohlen											
Steuer Interface	Opto-Koppler geschützte digitale Eingänge, TTL/CMOS kompatibel, sowie ein analoger Eingang zur Steuerung der Offset Spannung											
Gehäuse	170 x 60 x 45 mm (L x B x H), Gewicht 320 g											
Datenblatt	568 kB											

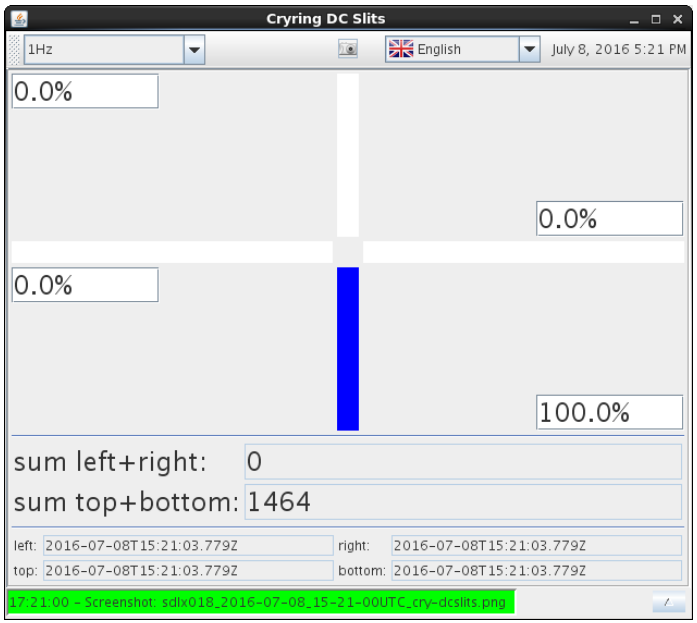
Offset über Trimmer und externe Steuerspannung einstellbar. LED Overload Anzeige. Eingang gegen Transienten bis ±3 kV geschützt. Ausgang kurzschlussfest. Versorgungsspannung ± 15 V über 3-Pin LEMO Buchse. Ein passender Stecker wird mitgeliefert. Passendes Netzteil der Serie PS-15 optional erhältlich. Weitere Einzelheiten siehe Datenblatt.

Current Measurement Hardware Scheme

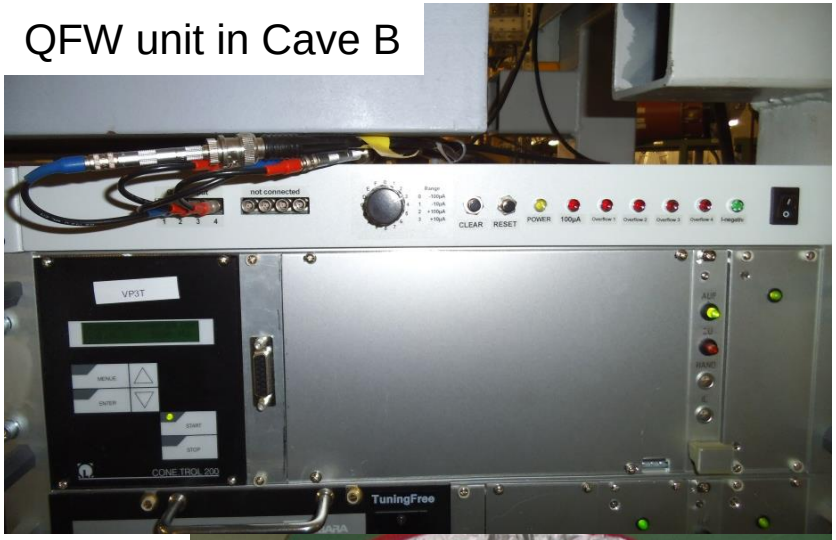


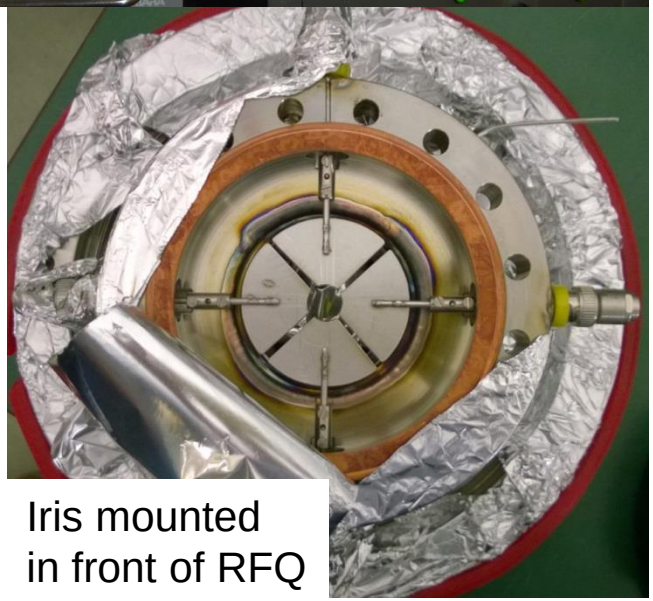
RFQ Iris for injection optimisation
Current readout at RFQ entrance

- **Originally used for DC ion source!**
- **Now only useful, if chopper window long enough. Check background counts carefully!!!**
- 4 channel QFW prototype (charge-to-frequency converter), sensitivity S = 250 fC/count
- 10 µA range with max. output = 40 MHz
- Pulse signals are registered in dedicated scaler of VME DAQ for intensity measurements (PCT, ICT, CryRadio)
- Separate application: cry-dcslits



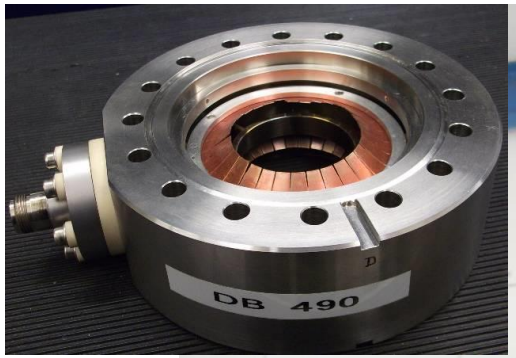
QFW unit in Cave B





Iris mounted in front of RFQ

Diagnostic section after RFQ
Ring pickups for energy measurement



DP3

DP2 DK6 DP1

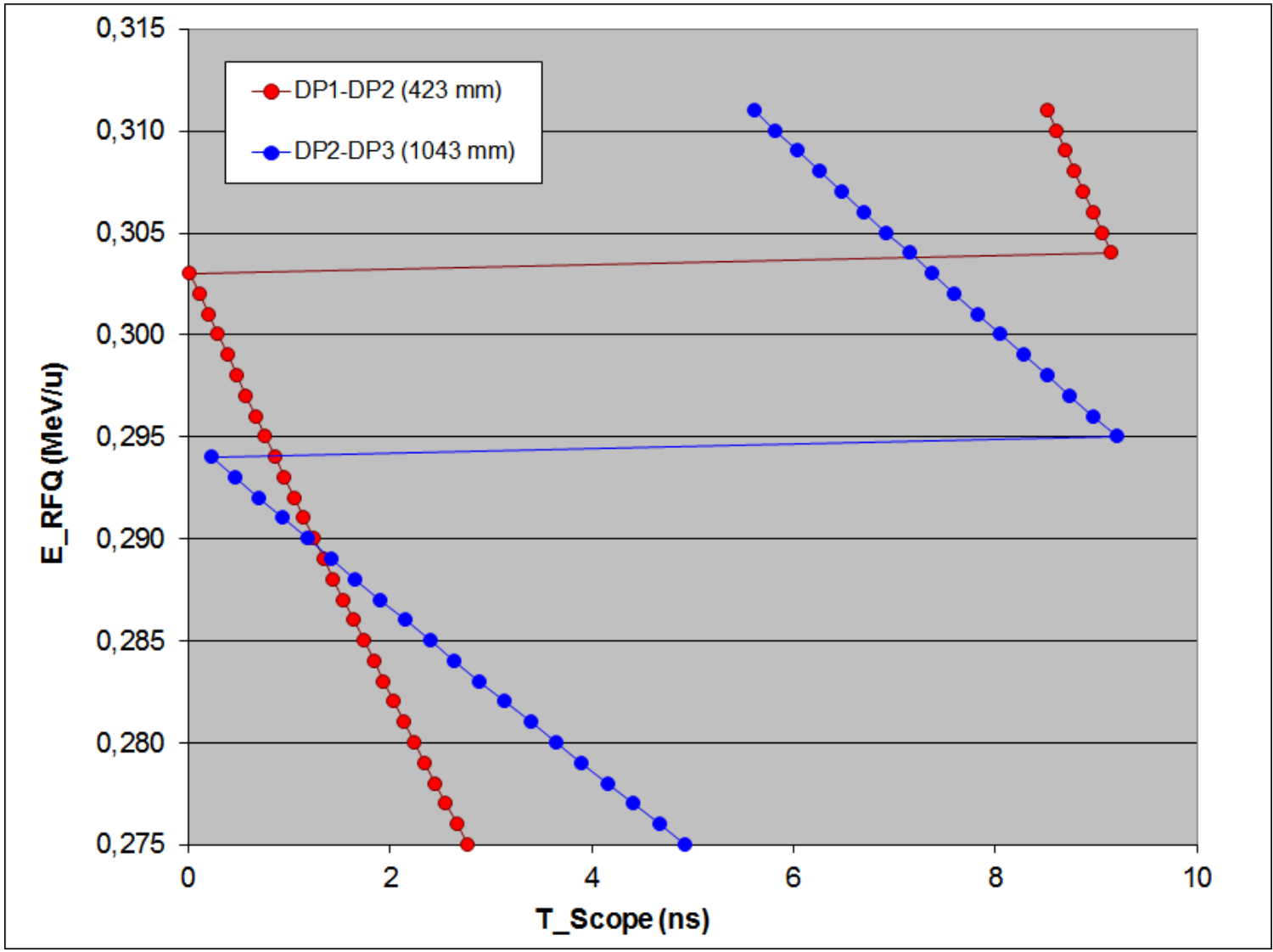
Mag. quad doublet

El-stat. quad doublet

RFQ exit

Beam energy as function of time-of-flight T_Scope

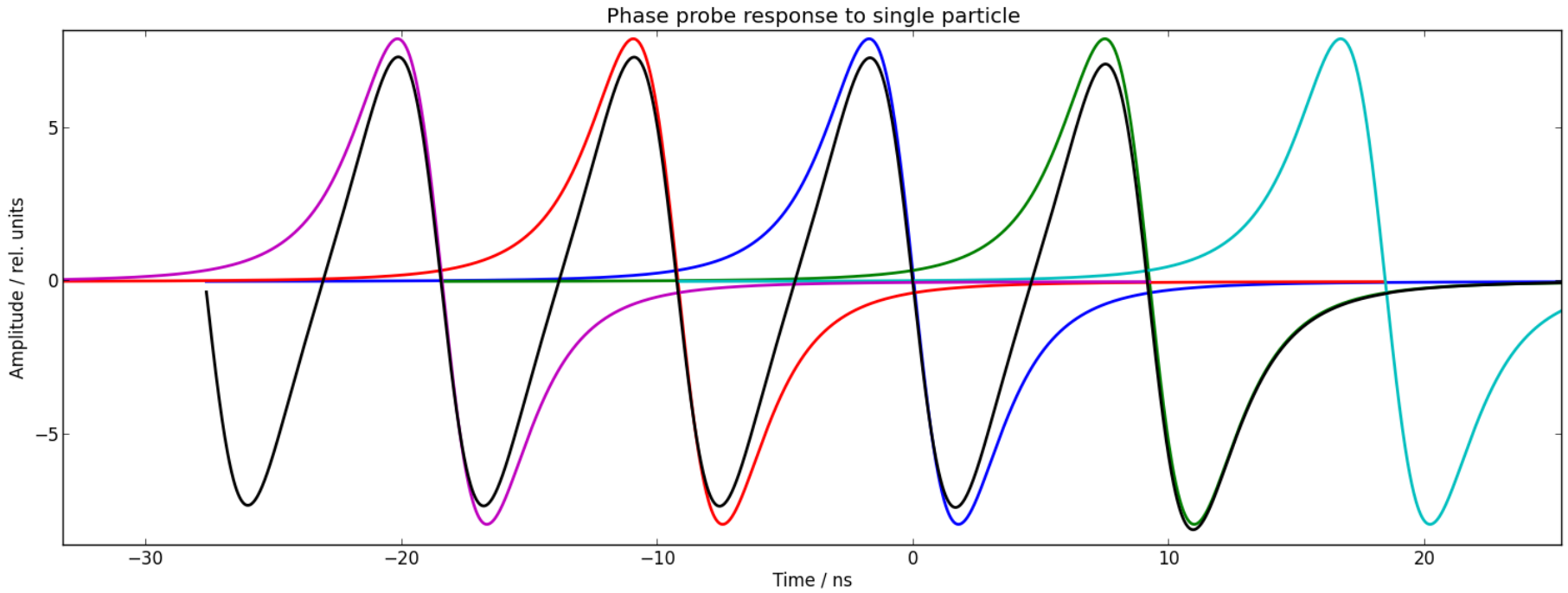
Fractional part of theoretical total flight time converted to energy



Pickup response & signal overlap

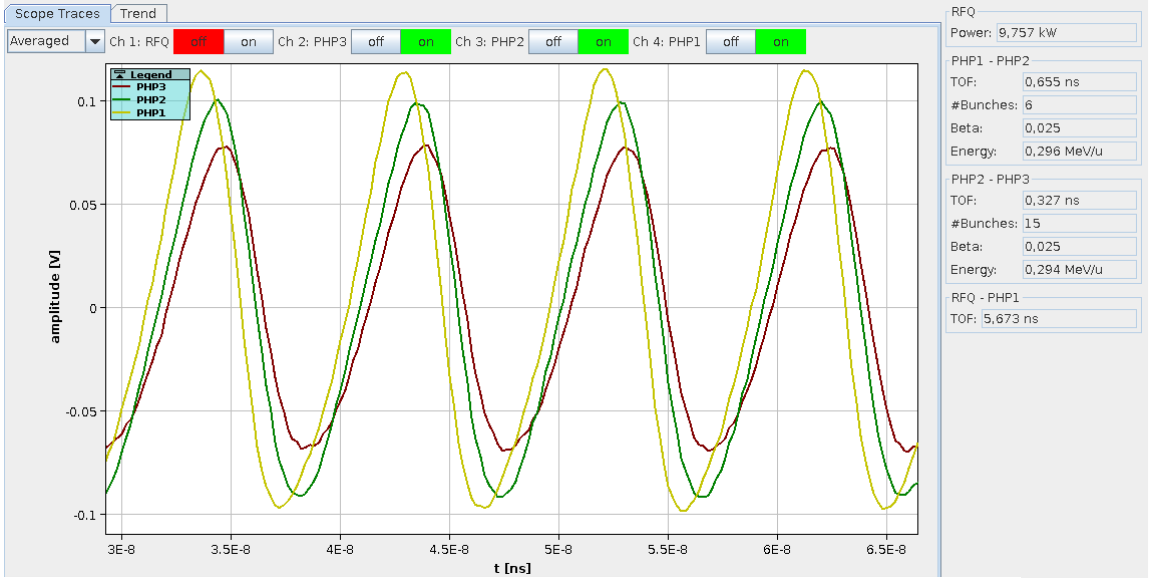
Theoretical reponse for a single particle at rf frequency = 108.48 MHz

RC circuit response will affect signals slightly.
Longer bunches after drift affect the signal amplitude strongly due to overlap of single responses.

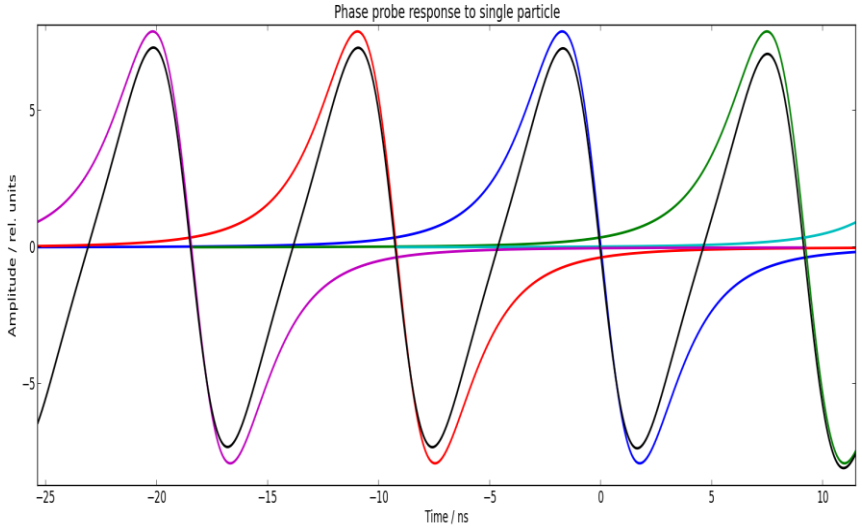


Comparison of theoretical and real signal shapes

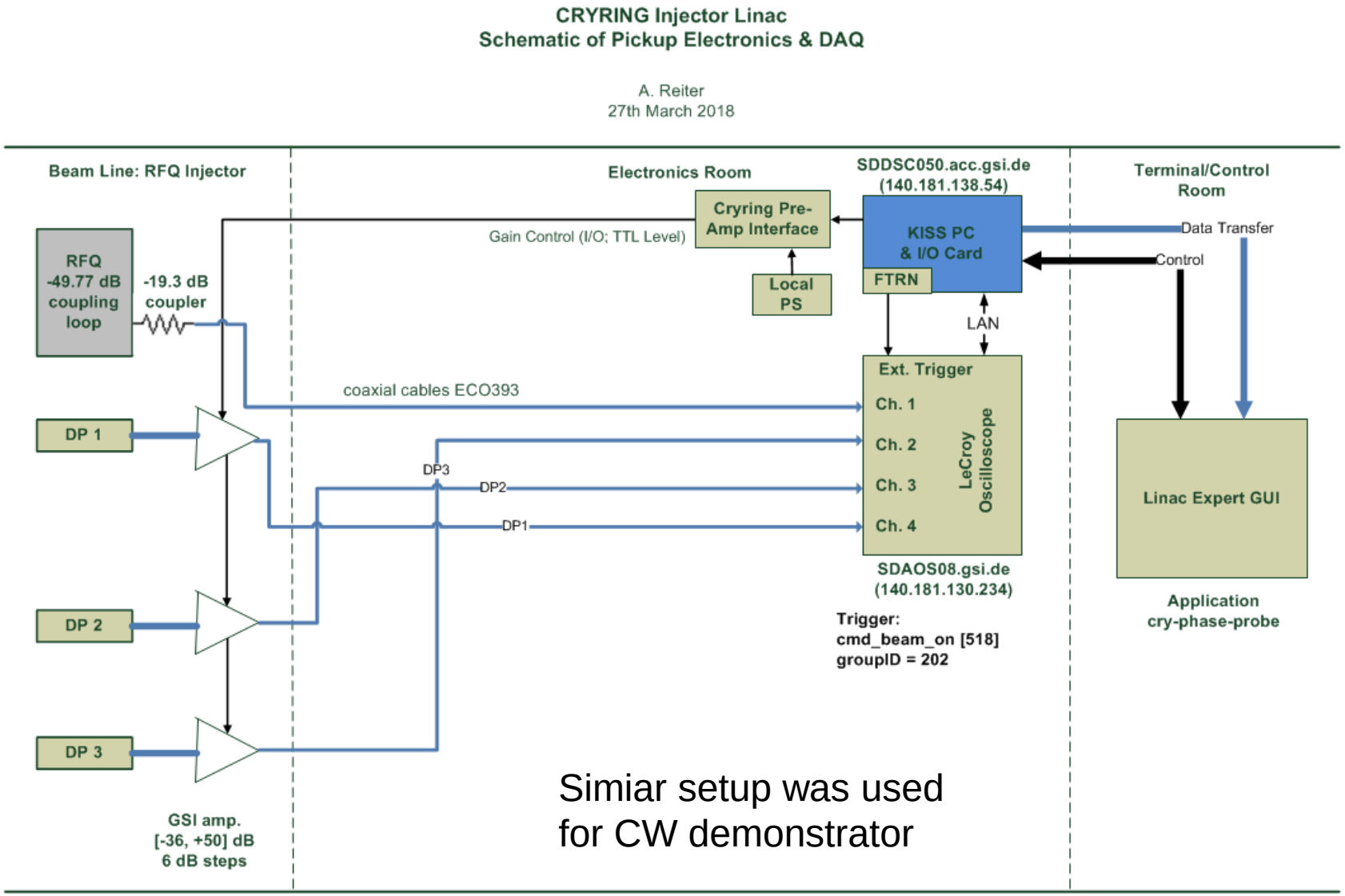
Measured data
DP1, DP2, DP3



Scaled simulated
signal shapes (colour)
and
signal sum (black)



Energy Measurement Hardware Scheme



Simiar setup was used for CW demonstrator

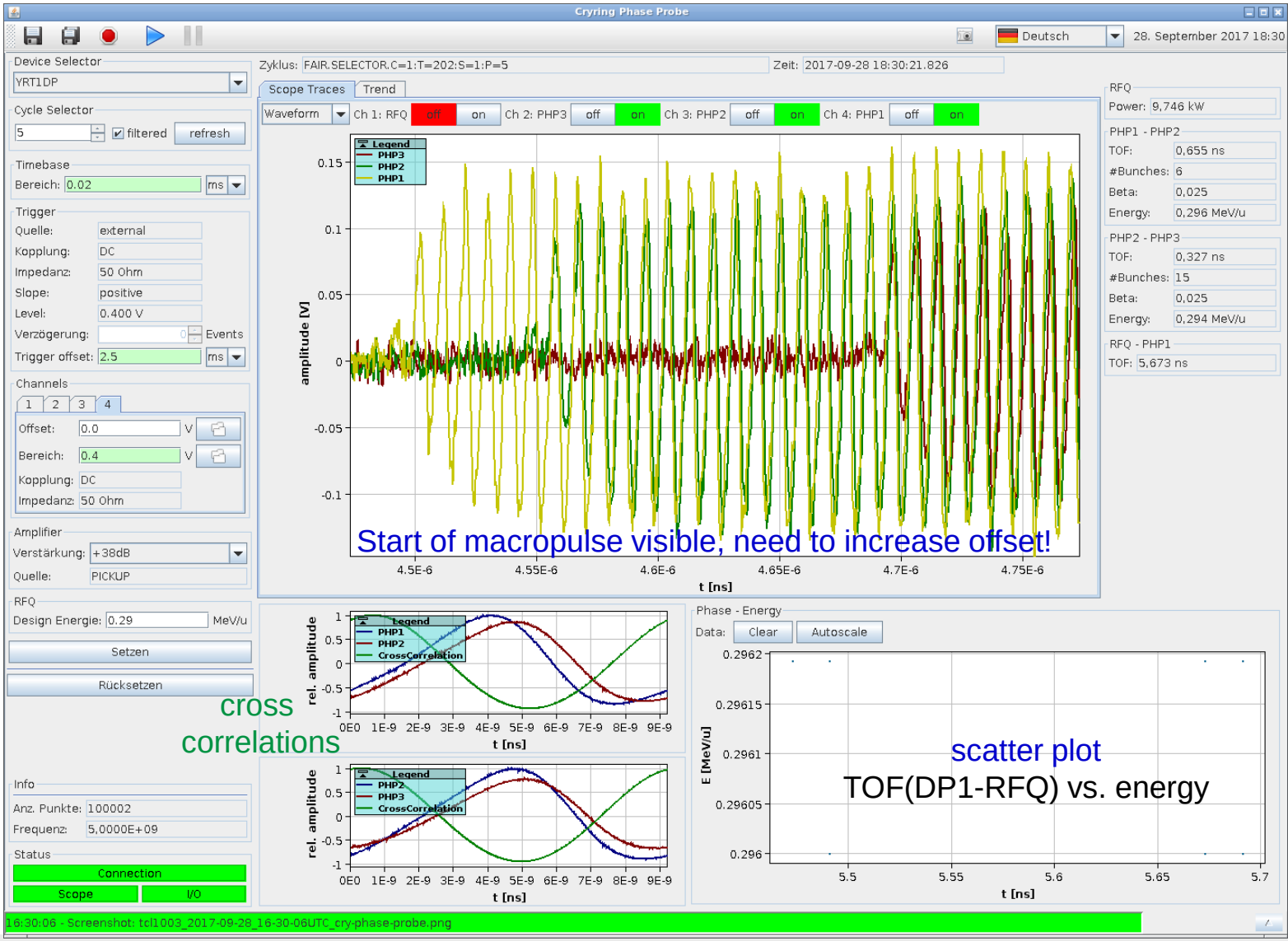
Energy Measurement
Expert GUI application cry-phase-probe

Timebase: 20 µs for standard use

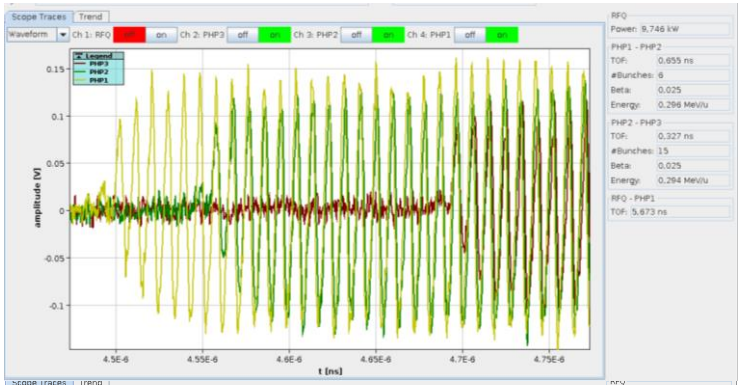
Set trigger offset such that all data are taken in macropulse.

Set full voltage range on scope gain: +38 dB (typically fixed!)

Design energy input defines bunch number for energy calculation

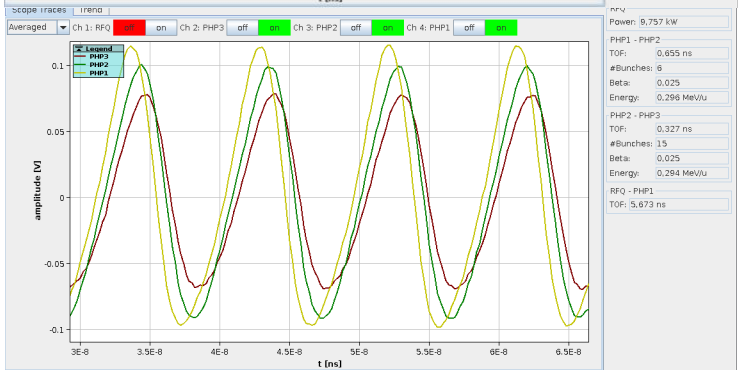


Energy Measurement
Data treatment & display

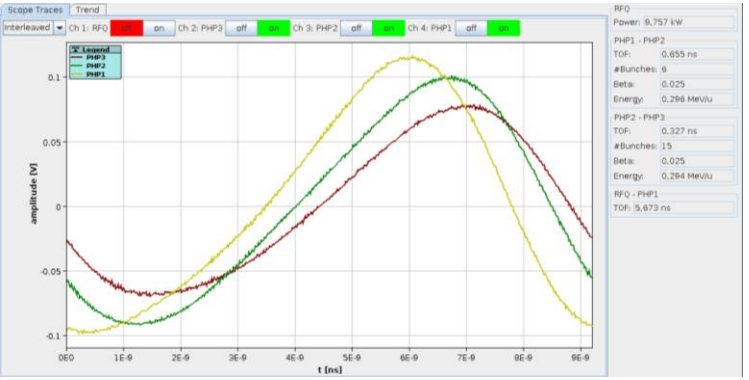


Waveform: Raw data acquired by oscilloscope

Make sure to check for signal overload or ADC saturation in this mode!



Averaged: Average over 11 blocks of 507 samples (~11.2 µs of data)

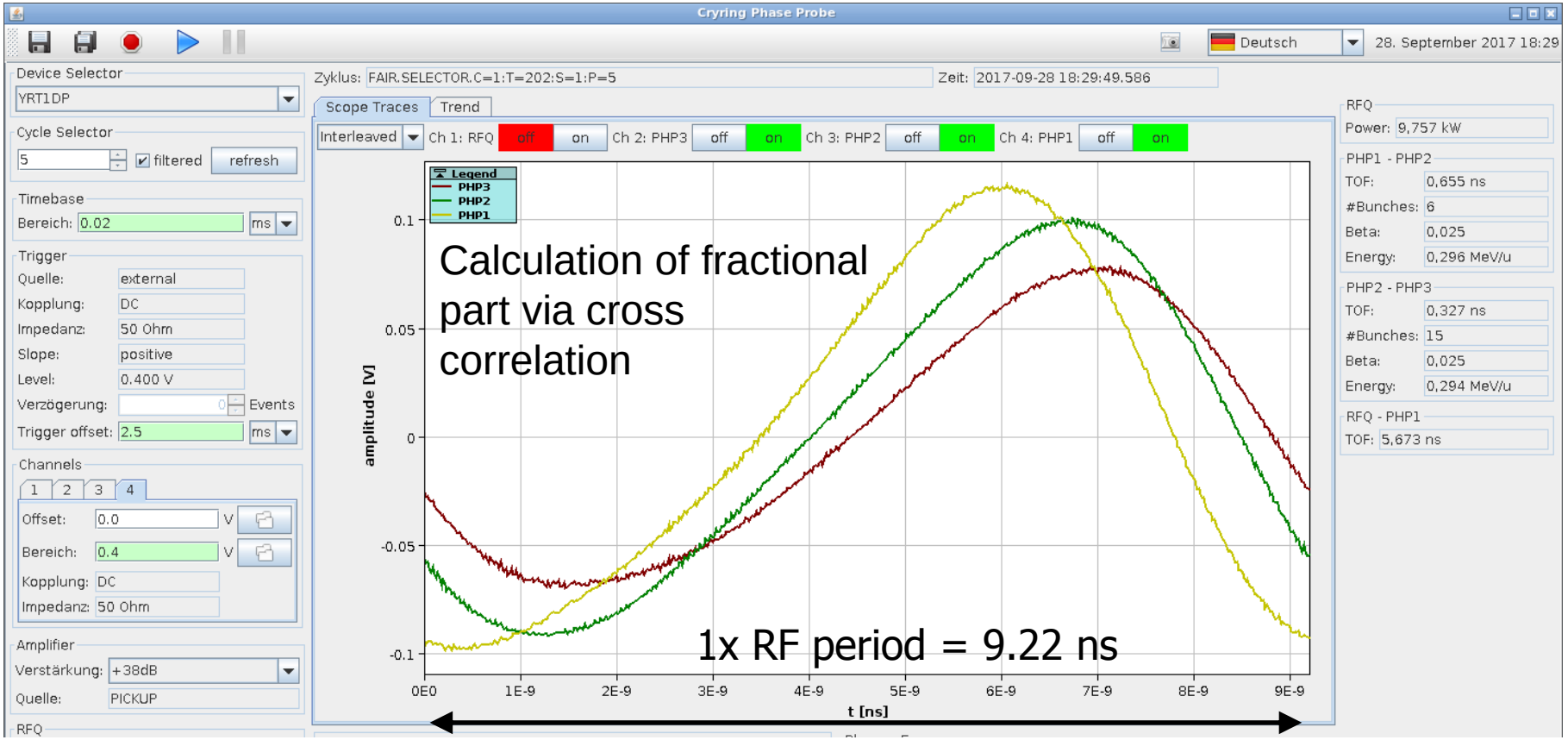


Interleaved: Averaged waveforms folded into one RF period

The cross correlation between interleaved waveforms defines the time-of-flight for the energy calculation.

Energy Measurement
Linac & Ring (Schottky)

- Linac energy from time-of-flight:
  - E(Linac) = 296.2 keV/u (drift=0.42 m) for PHP1–PHP2 -> f(Ring) = 139.53 kHz (L=54.17 m)
  - Schottky frequency f(Ring) = 140.00 kHz (sum signal)
- Note:
  - E(Linac) = 293.6 keV/u for PHP2–PHP3 (ratio~0.991) -> absolute value not better than 1 %



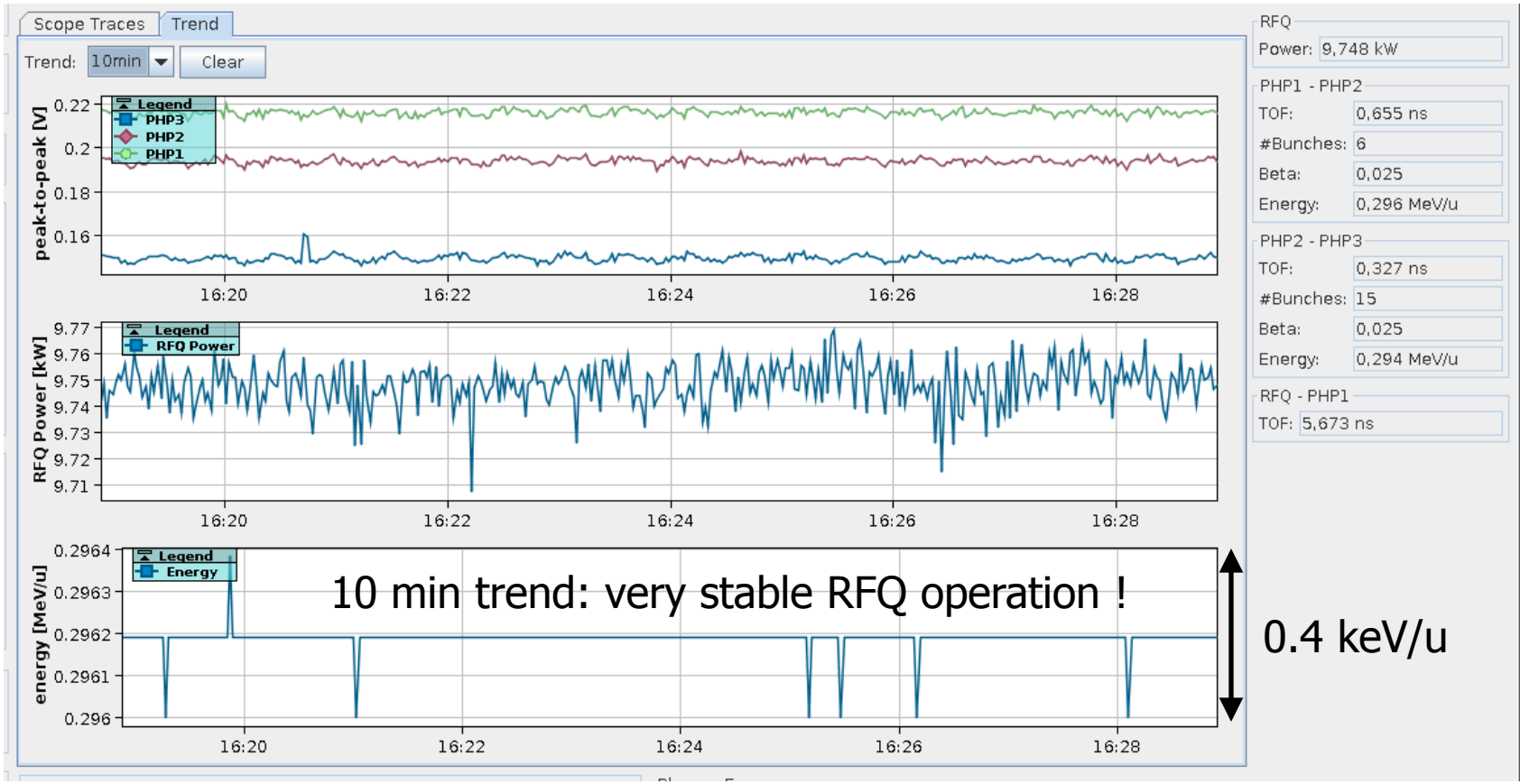
Energy Measurement
Trend data: stability & resolution

- 5 GSa/s signal digitisation -> 200 ps resolution in raw data
- Analysis of 11 RF periods (oversampling): Δt ~20 ps in theory
- ΔE(Δt) ~ 0.2 keV/u at 300 keV/u (see plot below)
- Relative resolution ΔE/E ~ 7×10^{-4} (minimum detectable change)

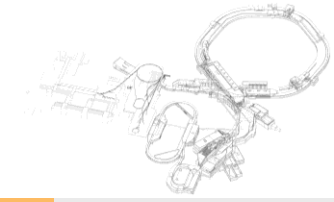
pickup amplitudes = rel. current

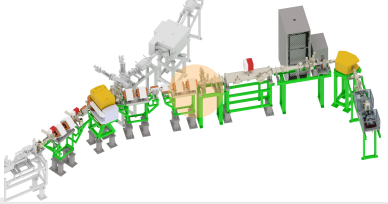
tank signal = absolute RF power

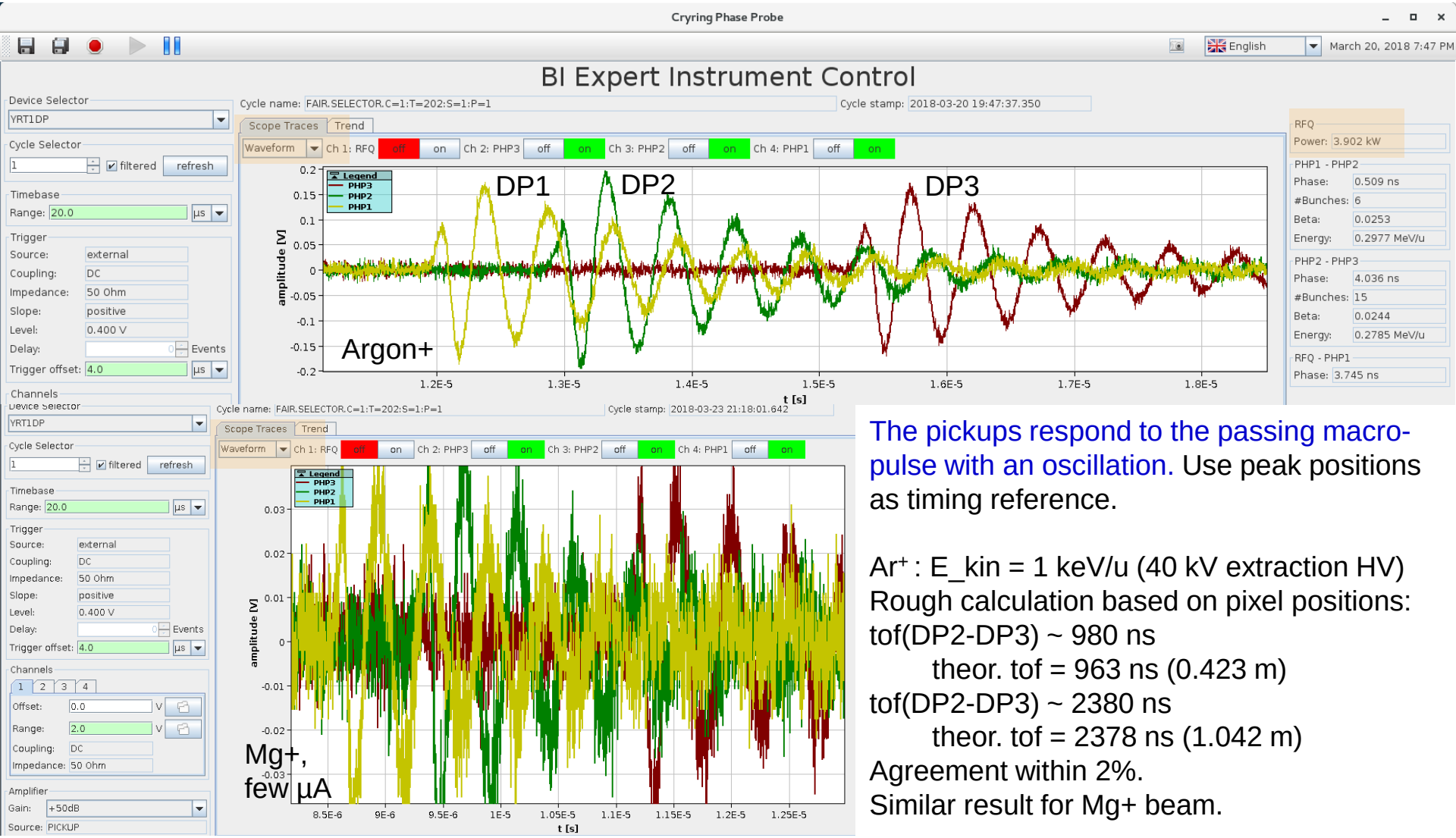
beam energy



RFQ transport mode
No bunches, use Waveforms!



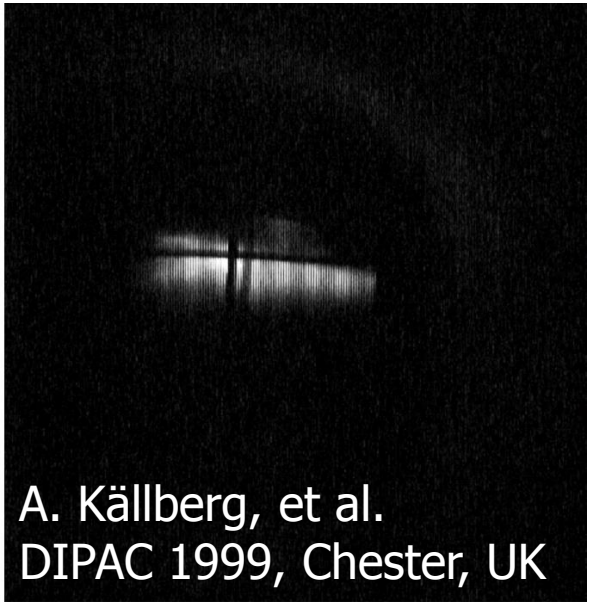


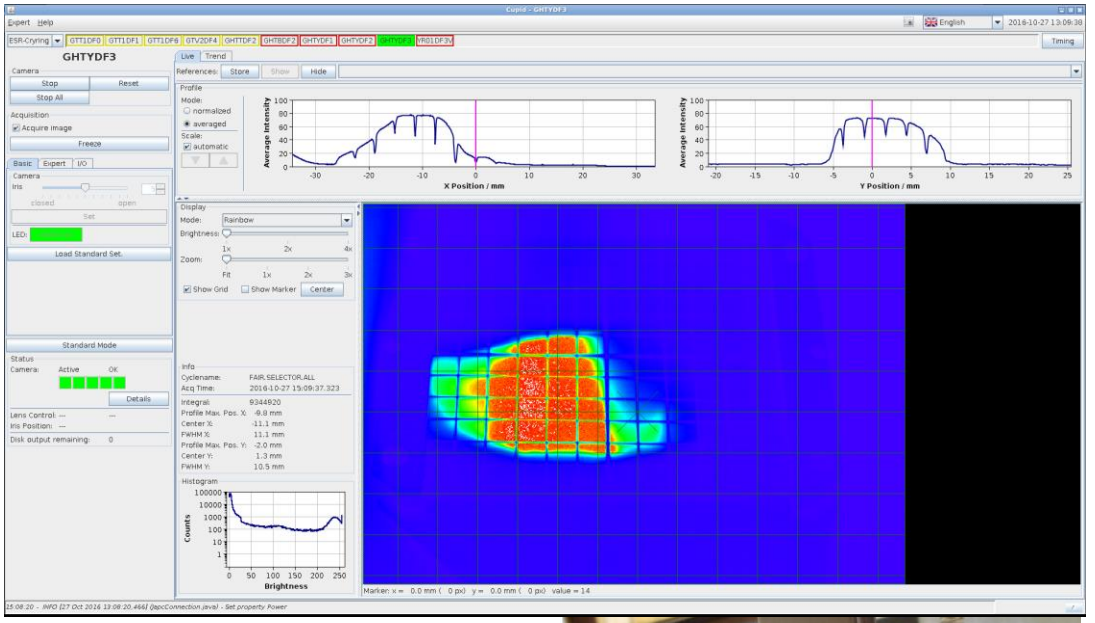


The pickups respond to the passing macro-pulse with an oscillation. Use peak positions as timing reference.

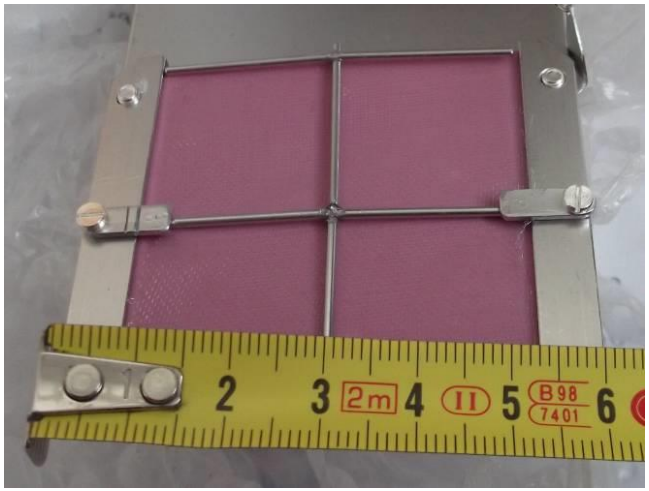
Ar^+ : E_kin = 1 keV/u (40 kV extraction HV)
Rough calculation based on pixel positions:
tof(DP2-DP3) ~ 980 ns
theor. tof = 963 ns (0.423 m)
tof(DP2-DP3) ~ 2380 ns
theor. tof = 2378 ns (1.042 m)
Agreement within 2%.
Similar result for Mg+ beam.

Injection straight before CRYRING GHTYDF3

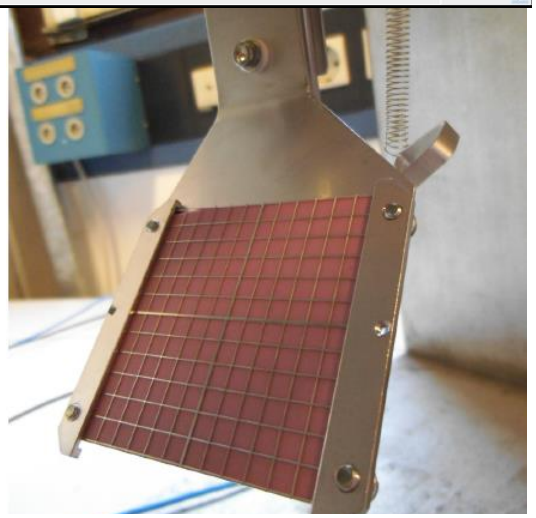




Old MSL screen with fine mesh

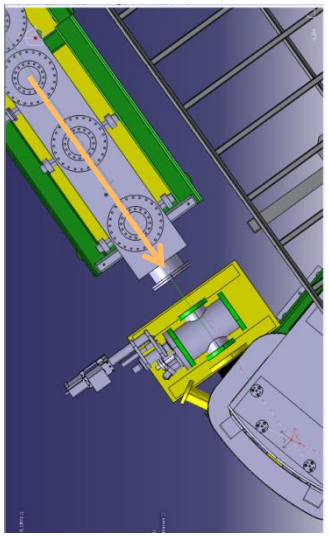


Same screen with modified mesh. Thinner grid version 0.1 mm insdtead of 0.2 mm) now available, but not mounted yet!



1st screen in CRYRING YR01DF3

- Injection screen at end of 1st section



- Variable positions via horizontal stepper motor drive (different injection orbits RFQ/ESR!)
- Material: Cromox
- New Java FX GUI

Grid on cromox screen removed