

7th Beam Time Retreat

UNILAC – Lessons from the beam time 2024 and outlook to 2025

Hartmut Vormann – Machine Coordinator UNILAC
11th and 12th July 2024
@ Jagdschloß Kranichstein

- Cables for experiments in EH new, due to measurement station removal
- Farady Cup TK7DC3 (leak) replaced 20th October 2023 (Spare by BEA)
- Farady Cup TK4DC3 (leak) replaced 18th October 2023 (Spare by BEA)
- UT2MUX new coil installed end of September 2023
- URMU1/ULMU1 new PS installed
15th January 2024



Overview - main

February

- Carbon from CH3, Titanium, Argon/ECR, Oxygen

March

- Gold from PIG (25 Hz) and from MeVVa,
- Easter-Service Period

April

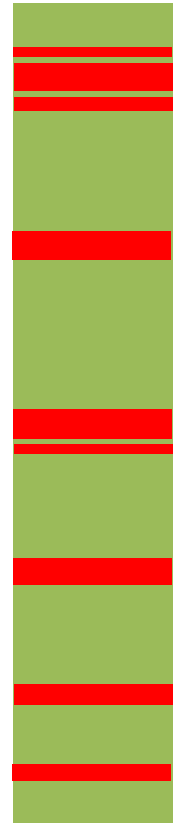
- Iron PIG, Argon/ECR (36Ar HITRAP), Erbium (new!) HFS
- Argon Machine Experiments

May

- Nickel/VARIS, Chrome PIG (52Cr, not 54Cr ECR), Molybdenum (new!)
- Uranium exclusively

June

- Uranium exclusively (H2 gasstripper), Argon for UCW



Feb-15 Alvarez A4 pulse length (X6, solved April 3rd)	9 h
Feb-22 EH Septa water dropping (X8, replaced Mar-28)	24h
Feb-28 A4 instable	15h
Mar-18 EH Dipole PS UXAMU1 PS water dropping (X0)	31h
Apr-18 A2A Shortcut Transmitter	30 h
Apr-19/20 36Ar beam jitter at Tkend (QD11/Erbium)	15h
May-8 beam loss X8, exp valve,	23h
May-31 TK4QD31 water loss, KS01 off	14h
Jun-11 IH1 tube socket shortcut	12 h

- February
 - **Carbon** from CH3 (1 mA@UH1, **0.4 mA** C^{4+/6+}@TK7), **Titanium** (35 µA@UH1, **40 µA**@Y7), **Argon/ECR** (130µA@UN3, 12 µA@X6, reduced), **Oxygen** (3 mA@UH1, **1.7 mA**@TK7)
- March
 - **Gold** from **PIG** (25 Hz, 20-**40 µA**@UH1/UT1, source piano, Exp. reduced 5 µA) and from **MeVVa** (3 mA@UH1, 200/**400µA**@TK7),
 - Easter - Service Period
- April
 - **Iron** PIG (120 µA@UH1, **50 µA**@UT1), **Argon/ECR** (36Ar HITRAP, 120 µA@UN3, 40µA@X6), **Erbium** (**new!**, 170Er³⁺, 23+ Alv, 57+ TK; 1 mA UH1, 400-600 µA UH4, **250 µA** TK7) HFS
 - **Argon** Machine Experiments (**4-5 mA** @TK7)
- May
 - **Nickel**/VARIS (**3 mA** @UH1, 2 mA@UT1, 120 µA@TK7, reduced), **Chrome** PIG (**52Cr**, not 54Cr ECR --- 100µA@UL5DT8, 45-60/ **80 µA** @UX8DT3), **Molybdenum** (**new!**, **400 µA** Mo³⁺@UH1, 60 µA@TK7))
 - Uranium exclusively
- June
 - **Uranium** exclusively (**H2 gasstripper**; 10 mA@UH1, 1.0/**3.5mA** U⁷³⁺@TK7 – „multi charge“ beam), Argon for UCW

Remarkable events February (C, Ti, Ar, O-beam)

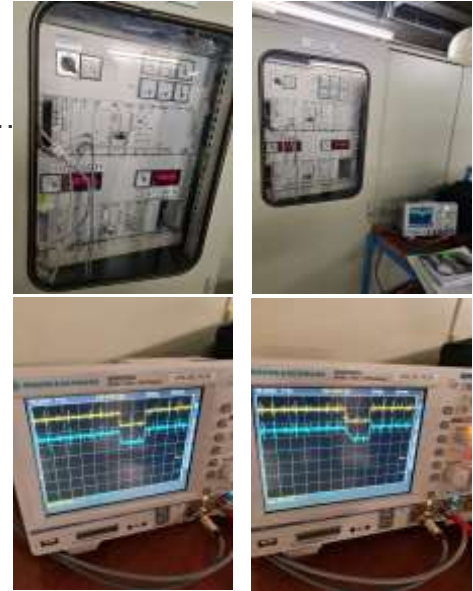
- 9th Feb: Interlock from ECR ion source microwave SPS
- 16th Feb: HSI-RFQ ignitron replaced, 3.5 h.
- 22nd Feb: UT2MUX water loss, automatic pumped bucket, monitored by camera
- 22nd Feb: Vertical beam jitter (X6 SEM grid), quadrupole UT1QD11 switch range >0,5 V...
- 22nd Feb: A4 beam pulse length 1 ms not possible (solved 3rd Apr)



UT2MUX,
22nd Feb



new spare part
ready 26th Feb



UT1QD11 beam jitter

Remarkable events March (Gold beam)



UXAMU1 Power Supply,
water cooled transistor bank,
photos 18th March



Gas stripper section, photo 26th March

- 20.3. Dipole magnet UXAMU1 power supply water leak (30 h loss for X0)
- 25.3.-28.3 Easter break:
 - UT2MUX replaced
 - Gas stripper valve #1 replaced



Damaged UT2MUX,
photos 10th April

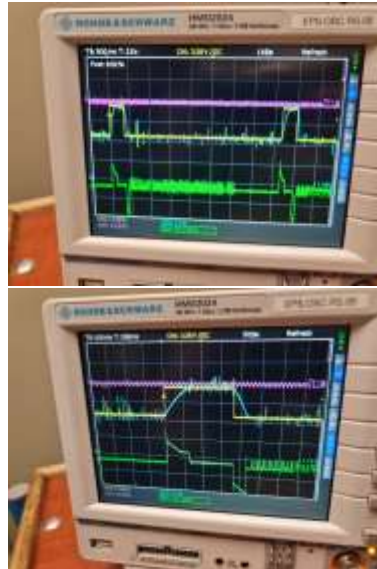


Remarkable events April (Fe, Ar, Erbium-beam)

- 18th Apr, 9 a.m., failure Alvarez A2A, short circuit waveguide to final stage grid, repair lasts until 19th Apr, 3 p.m. (30 hours)
- 20th Apr, beam jittering at transfer channel end (36Ar8+), parallel operation with 170Erbium23+ problematic (UT1QD11?)
- 20th Apr, also TK2MU3 causes beam jittering (like QD11). Switching coil current from 330 A (Erbium) to 199 A (Ar) problematic.



Power Supplies TK1MU1, MU2, TK2MU3
(photo 22nd Apr)



A2A waveguide short.
small PTFE ring...



Remarkable events May (Ni, Cr, Molybdenum-beam)

- 7th May: gas stripper valve #2 replaced (7 hours during planned interruption)
- 31st May („bridge day“, Corpus Christi): water loss TK4QD31, KS01 switch off (14 hours)

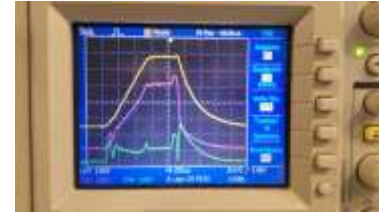


leak copper pipe..., brazed,
... insulated.

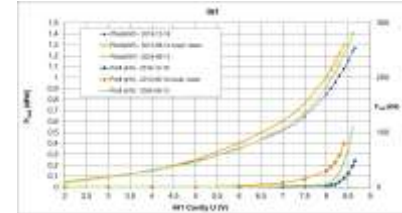


Remarkable events June (U-beam)

- 6th-10th Jun BB12
 - needs multiple switching-on to re-start (1,5 h),
 - 7th Jun, high voltage cable to tube cabinet shortened (3 h),
 - 8th Jun, again failure, then operation without BB12 (only low beam intensity requested),
 - 10th Jun, high voltage cable replaced (new cable, 3 h).
- 10th Jun (and 3x before), HSI-RFQ: RF level failure, sparking (ion getter pumps switching off!), then: reduce voltage from 7.18 to 7.08 V.
- 11th Jun, night (2 a.m.), HSI-IH1 RF failure, tube replaced, tube socket short repaired, anode capacitor replaced (12 h). 1,3-1,8 MW, >200 kW reflected!
- 12th Jun, voltage reduced from 8,568 to 8,403 V.
- 17th Jun, HSI Quadrupole Triplet UH3QT3 water loss and mechanically instable (wobbling), provisionally fixed during SIS down (20-kV-filter AEG)



RF behaviour IH1



Fotos IH1 courtesy G. Schreiber



Tube cabinet IH1



UH3QT3

Gasstripper

- Decision before Christmas: pulsed stripper for beamtime 2024!
- Oil services...
- 17th mar, roots failure, oil failure, 3 hours (2.5 litres re-filled).
- 25th-28th mar, easter shutdown, valve #1 replaced.
- 11th apr, valve #2 defective, permanent-open.
Replaced 7th may, incl. oil service (7 hours)
- from 8th may on: only valve #2, 550 mbar
(=Cr optim., Ni 250, Mo 400 optim)
- from 22nd may Uranium exclusively,
#2, 500 mbar N2, permanent-open - didn't matter.
- 3rd-6th jun H2 stripping gas, valve #1, 6 bar.
- 5th jun: For PIG-Ar-beam to US3 additionally 5 Hz H2-Gas ,
vacuum pressure increases and bunchers BB3+4 switch off
(vac-threshold)
machine exp. postponed to N2 gas next day.



Preconditions and Various

- A2QS105/106 (QS46/47) out of operation (DR105)
- ER1 max 4,5 V, BB4 max. 5,3 V, BB6 max 6 V.
- UN3DC2 sudden drive in beam (06th feb), IL μ Wave...
- special regulations EH from rad. safety department, chains and locks...
- Scada MCR no ion getter pump switching-on for normal operators.
- from 11th apr on: (36Ar8+) HLI RFQ phase jitter, misleading displaying in the MCR RF application.
- 25th apr, Slit/blind UXADS1HL water dripping, provisionally fixed (2 h)
- 13th may, 52Cr14+ for X8 suddenly lost. Dipole UXAMU1?? – UX8VV2T leak (replaced 14th may)



Aufgrund einer aktualisierten Sicherheitsbewertung des TVs durch den Strahlenschutz, gilt der Zugangswächsen zu den Experiment-Caves in der UMLAG-Experimentierhalle ab 12.08.2024 bis auf Weiteres folgender Ablauf:

1. Bei Zugangswächsen werden von der Experimentator direkt an den Strahlenschutz.
2. Der aktuelle Strahlenschützer (Schicht/Rufbereitschaft) meldet sich im 1402 bei der Schichtleitung und formiert
 - a. das Einfahren der Strahlenschutztause
 - b. das Umschalten des installierten Beschleunigers auf Timing-Modus
3. Die Schichtleitung führt beide Aktionen durch und bestätigt dies dem Strahlenschützer.
4. Anschließend gestattet dieser den Zugang.
5. Nach Abschluss der Arbeiten und nachdem das Cave wieder sicher verschlossen ist, meldet der Strahlenschützer über sicheren Zustand an die Schichtleitung zurück.
6. Dazu und nur dazu kann die Strahlenschutztause wieder ausgefahren und der virtuelle Beschleuniger auf Strahlbetrieb geschaltet werden.



EH Caves, locked, regulations



A2QS105+106 out of operation



UXADS1HL water loss

- Beam time was planned carefully!
- Hardware failures, ...some
 - – minor influence
 - – during planned intervention times
 - – or repaired in short time
- Less failures from RF department point of view

- UN5QT4, spare part in production,
 - Dec. 2024 delivery date (then copper coating),
 - Feb. 2025 beam operation $48\text{Ca}10+$ with defective old QT4 (test!).
 - Then replacement if resonable/necessary.
- EH dipole chambers..
- new power supplies UL/UR quadrupoles?? delivery...
- Gas stripper pulsed (valves...) or not pulsed? (Uranium efficiency!)
- ^{54}Cr from PIG or ECR? ($^{54}\text{Cr}^{2+}$...)
- A2DR105 replaced? (If QS105+106 in operation, then all QS in operation.)



Thank you for your attention!

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Aufgrund einer aktualisierten Sicherheitsbeurteilung des TVs durch den Strahlenschutz, gilt bei Zugangswünschen zu den Experiment-Caves in der UMLAC-Experimentierhalle ab 12.08.2024 bis auf Weiteres folgender Ablauf:

1. Bei Zugangswünschen versteht sich der Experimentator direkt an den Strahlenschutz.
2. Der aktuelle Strahlenschützer (Schicht/Rufbereitschaft) meldet sich im HKR bei der Schichtleitung und fordert
 - a. das Einfahren der Strahlenschutztause
 - b. das Umschalten des virtuellen Beschleunigers auf Tiring-Modus
3. Die Schichtleitung führt beide Aktionen durch und bestätigt das dem Strahlenschützer.
4. Anschließend gewährt dieser den Zugang.
5. Nach Abschluss der Arbeiten und nachdem das Cave wieder sicher verschlossen ist, meldet der Strahlenschutz den sicheren Zustand an die Schichtleitung zurück.
6. Dann und nur dann kann die Strahlenschutztause wieder ausfahren und der virtuelle Beschleuniger auf Strahlbetrieb geschaltet werden.