

Upgraded UNILAC - injector for FAIR

FAIR Experiments and Accelerator

Darmstadtium, Dec 15th 2017 LINAC, Sascha Mickat

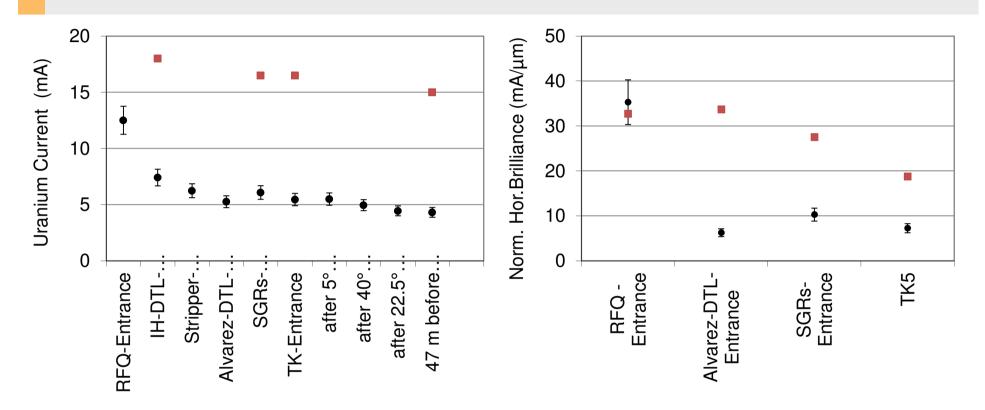
Brief workshop history w.r.t. UNILAC



- July 2015 in HH no dedicated UNILAC talk treated by J. Stadlmann within SIS18 talk discussion with A. Adonin about ion source status
- February 2016 in DA two dedicated talks lon sources status report – R. Hollinger UNILAC – Status, planned upgrade activities – S. Mickat
- Juni 2016 in Geisenheim/Rheingau Ion source road map – A. Adonin Interfacing – S. Appel Post stripper: status and decision – S. Mickat An option for FAIR ion injector – U. Ratzinger Poster: RF modernisation – J. Zappai
- August 2016: Follow-up user meeting @GSI Short / long pulse operation and its consequences
- Today: What is the progress with regard to the UNILAC upgrade / LINAC activities?

Why we need a UNILAC upgrade? U-Measurements (July 2016)

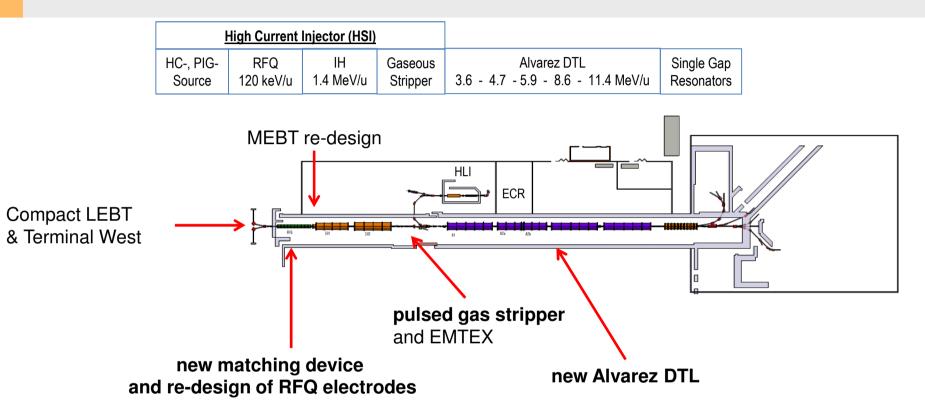




- measurements are performed during a dedicated Uranium beamtime "expert mode"
 no standard operation mode
- no "high current" operation at 5mA in the post-stripper



What are the upgrade activities?



UHV-Upgrade for vacuum controls system

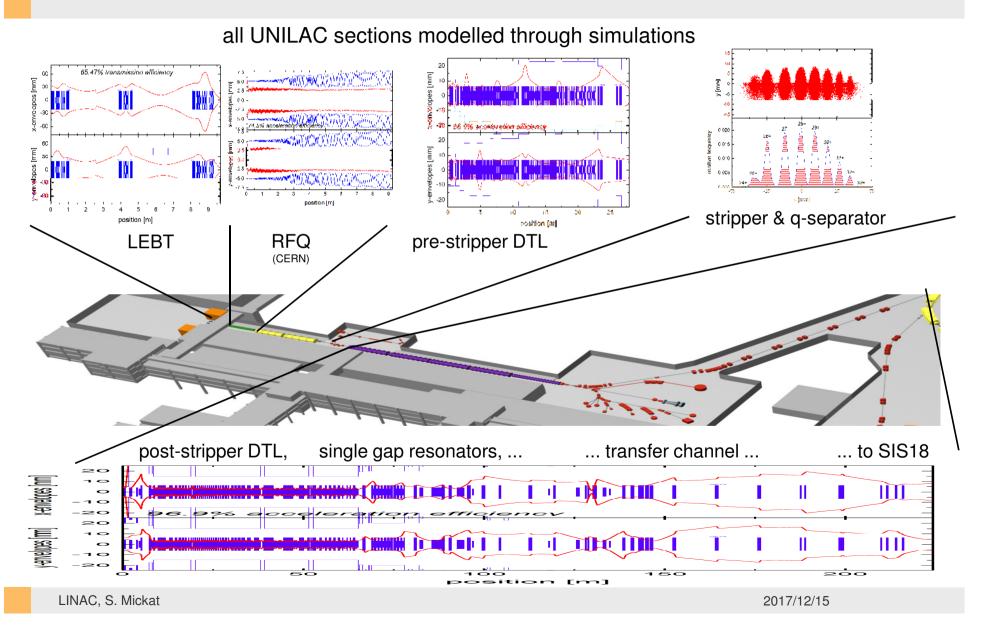
Iaunched in 2016, funded with 790,000€ until 2019/20

front-2-end-simulation

- all activities are backed by systematic beam dynamic simulations in parallel
- can confirm the prediction from 2013: upgraded UNILAC fullfills FAIR requirements
- tool for further optimising, future commissioning and operation

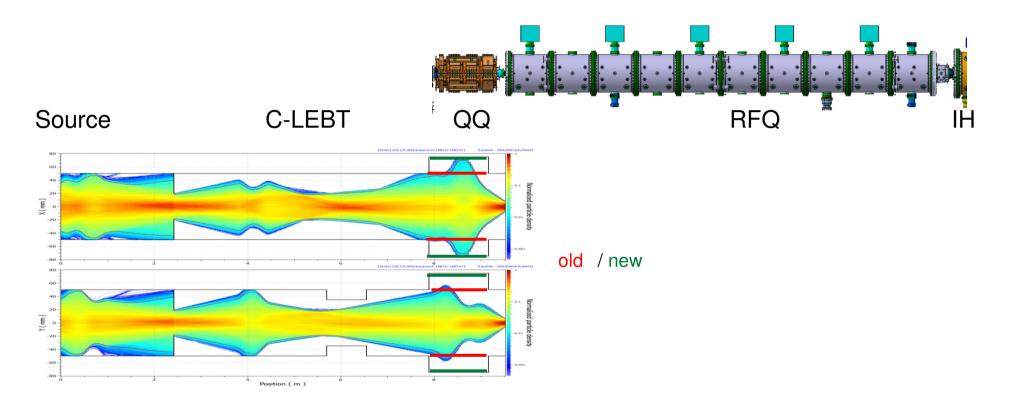


What is the status of UNILAC – modelling?



What is the motivation for the new quadrupole quartet?



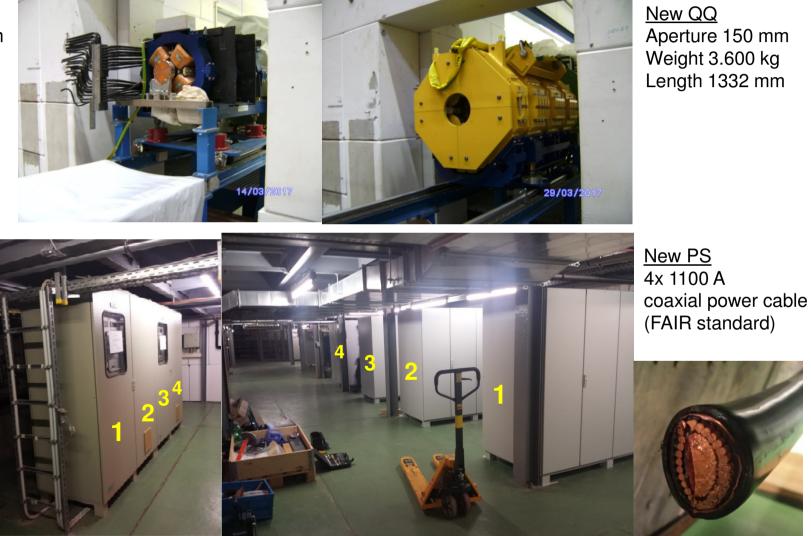


- the beam pipe radius of the old matching device is too small
- this prevents proper matching to the subsequent RFQ and/or caused beam loss
- new QQ has an enlarged pipe radius
- proper matching to the RFQ without losses is expected

What is the difference between the old and new QQ?



Old QQ Aperture 100 mm Weight 900 kg Length 1100 mm



<u>Old PS</u> 4x 400 A

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What is the status of the QQ implementation?





| QQ in beamline | done |
|--------------------------------|---|
| LEBT in beamline | 75% (steerer missing) |
| ACU and IL | cables connected |
| SAT powersupplies | In progress |
| QQ magnet data in database | Done |
| Alignment of LEBT | After installation and pre- testing is completed |
| QQ theory settings in database | Update during/after commissioning |



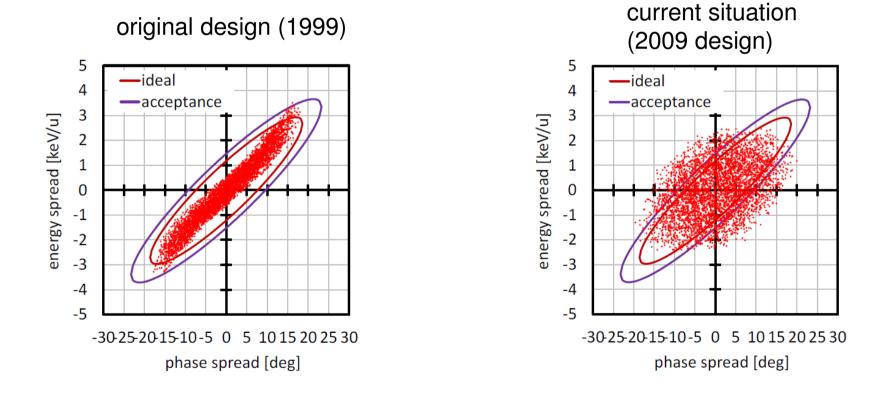
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What is the motivation for the new RFQ electrodes (&MEBT)?



• part of the strategy for providing proper beam to the IH-DTL

longitudinal matching condition to the IH DTL (R. Tiede et al, IAP, 2014)



What is the status of the RFQ re-design?





European Organization for Nuclear Research Organisation européenne pour la recherche nucléaire

20 September 2017

Beam dynamics design for the upgrade of the radio-frequency-quadrupole (RFQ) of GSI's High Current Charge Injector (HSI)

Milestone 1- Conceptual design

Matthew James Garland, Jean-Baptiste Lallement and Alessandra Lombardi

BE-ABP-HSL

- currently intense error studies
- final design expected early in 2018
- in-house fabrication is prepared:
 Cu rods are in-house



- machining tests/surface analysis are done

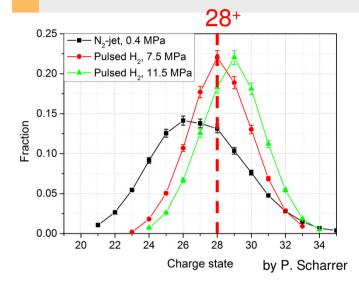


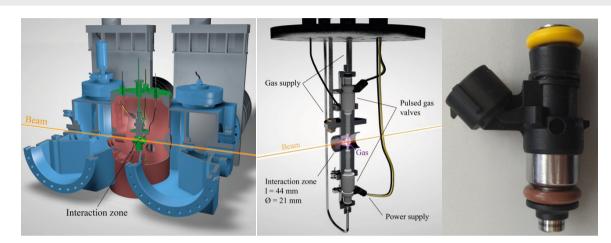
planning: ready for beamtime 2019

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What is the status of the pulsed gas stripper integration?

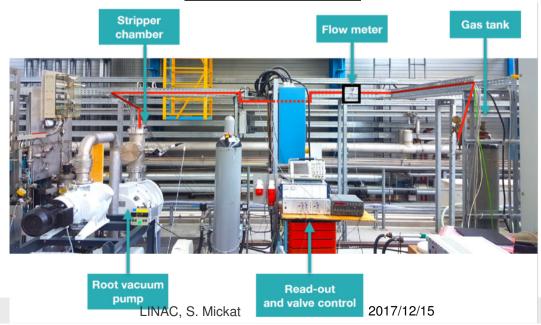






on-site teststand

- 2017: commissioning teststand
- 2018: intense testing (new valves) controls development infrastructure installation starts
- 2019: ready for beamtime



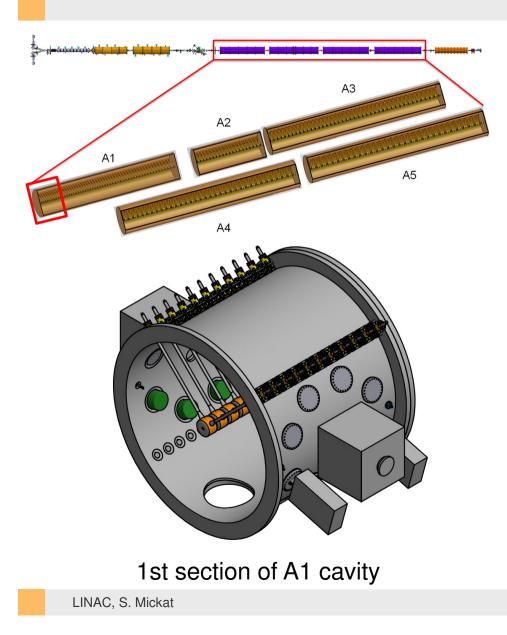
What is the status of the Alvarez substitution since Aug 2016?



- Oct 2016: 2nd international review committee's recommendation (the same as the GSI experts): ...replace the existing Alvarez by a new Alvarez DTL designed for high current beam applications...
- February 2017: Decision of GSI directorate towards a new Alvarez DTL
- Jul/Aug 2017: Funding for FoS is approved 1.5 M€ until 2020/21 (1st section of the new A1 cavity)
- Nov 2017: 1st order is placed (150 k€) (FoS tank section: double walled pipe, d, I ~ 2m)
- still in Dez 2017: CDR will be distributed

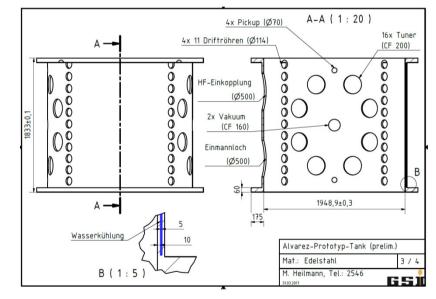


What is the FoS?



three main components

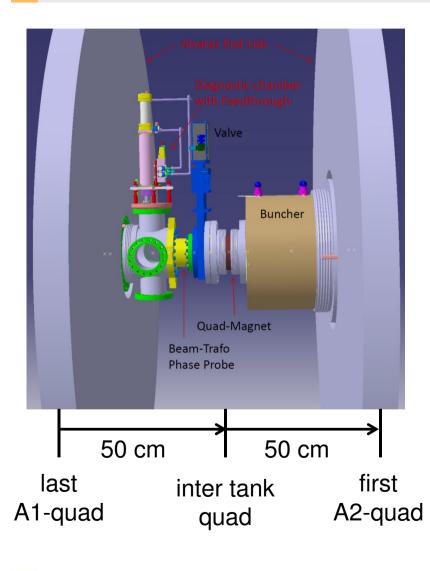
tank section (ordered)

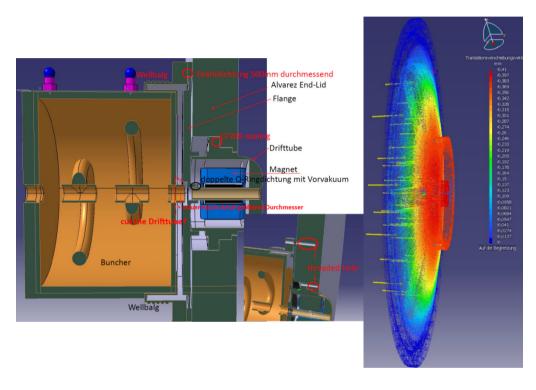


- end plates (next to tender) with ½ drift tubes (2x)
- drift tubes with quadrupoles (11x)



What is the status of the endplates/inter-tank sections?



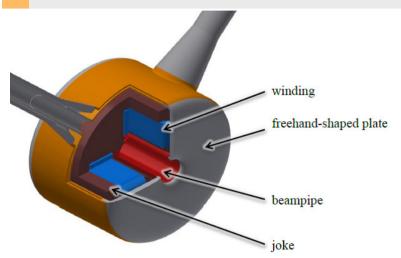


preliminary FEM simulations UH vs. pre vaccum

still in 2017: mechanical concept accepted early in 2018: procurement starts



What is the status of the drifttubes?



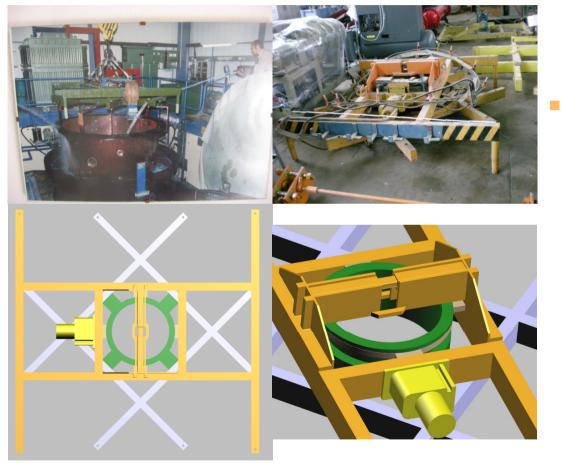
- reference is the double-walled AIII and AIV drifttube
 - in-house fabrication is feasible (spare parts)
- freehand-shape front sides (smooth shape for rf-properties)
- pre-fabricated stem connectors, instead of necking-out
- prototyping incl quadrupole dummy
- procurement starts in 2018



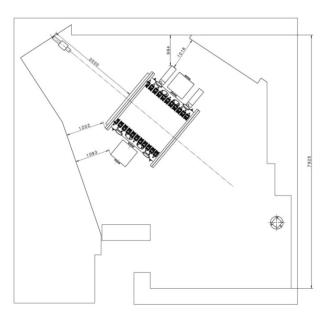


What are further important aspects?

Cu Plating on-site



Shielded location with access to high power rf infrastructure





How the FoS schedule looks like?

| Year | Milestone | Cost flow |
|------|---|-------------|
| 2017 | Funding Procurement starts | 45,000 € |
| 2018 | Delivery of tank section Agreement about FoS location (X4 shelter) Delivery of endplates (1st testing phase with empty cavity) | 900,000 € |
| 2019 | Assembly of test stand Test campaign starts Delivery of drifttubes and magnets | 455,000 € |
| 2020 | Full performance tests (2nd testing phase with loaded cavity) | 100,000 € |
| 2021 | Series preparation | |
| | Total | 1,500,000 € |

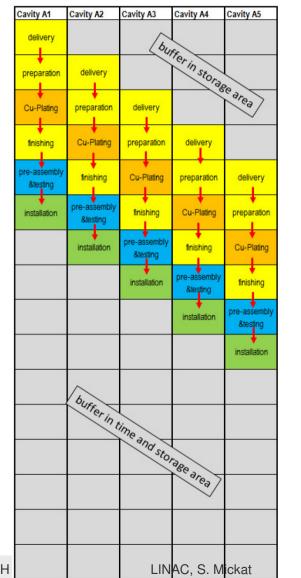
How the workflow could look like for series production ?

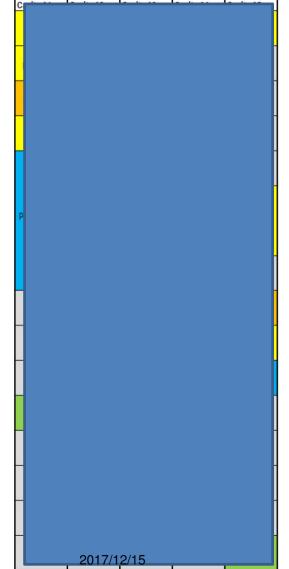


strict boundary condition: minimize the downtime

-> don't touch the existing if there is any uncertainty about the new Alvarez

-> sequential installation and commissioning





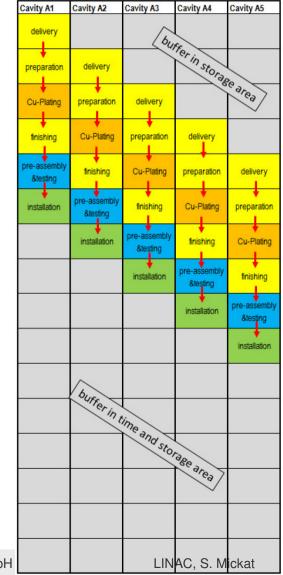
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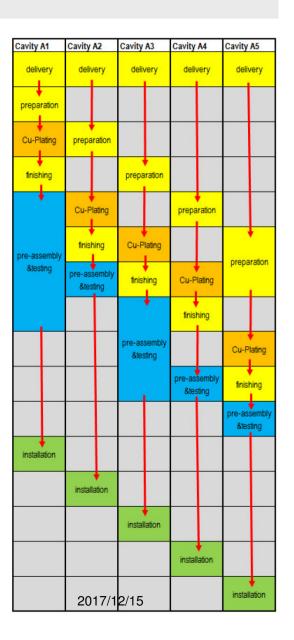


strict boundary condition: minimize the downtime

-> don't touch the existing if there is any uncertainty about the new Alvarez

-> sequential installation and commissioning





What is the progress with regard to the UNILAC upgrade?



- front-2-end simulation: UNILAC incl TK is modelled
- confirm the prediction from 2013: upgraded UNILAC fullfills FAIR requirements
- most of the upgrade projects are launched except re-designed MEBT, C-LEBT and Terminal West
- focus on the Alvarez substitution:

 1st main component of the FoS is ordered (tank section)
 procurement of endplates and drifttubes is in preparation, starts in 2018
 FoS schedule until 2020/21
- conceptual planning for series production in progress
 -> basis of planning (area request, infrastructure, ...)
 -> detailing with GSI experts (processing, resources, ...)