

## **Upgraded UNILAC** - injector for FAIR

FAIR Experiments and Accelerator

Darmstadtium, Dec 15th 2017 LINAC, Sascha Mickat

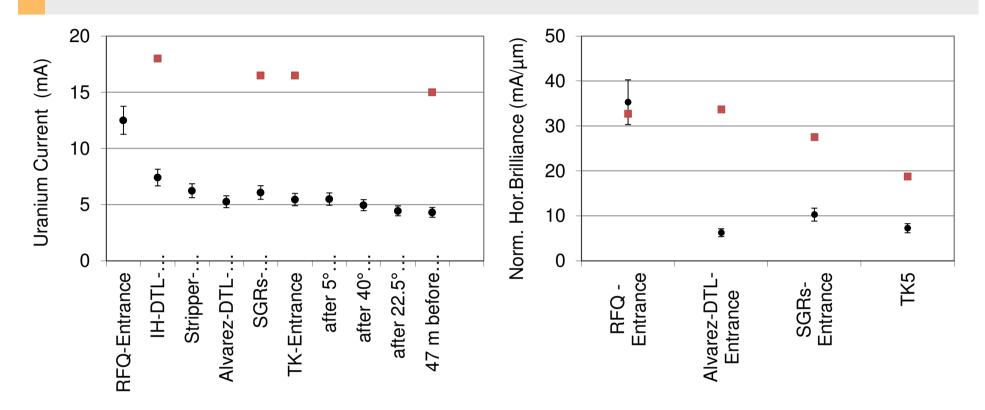
### **Brief workshop history w.r.t. UNILAC**



- 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)

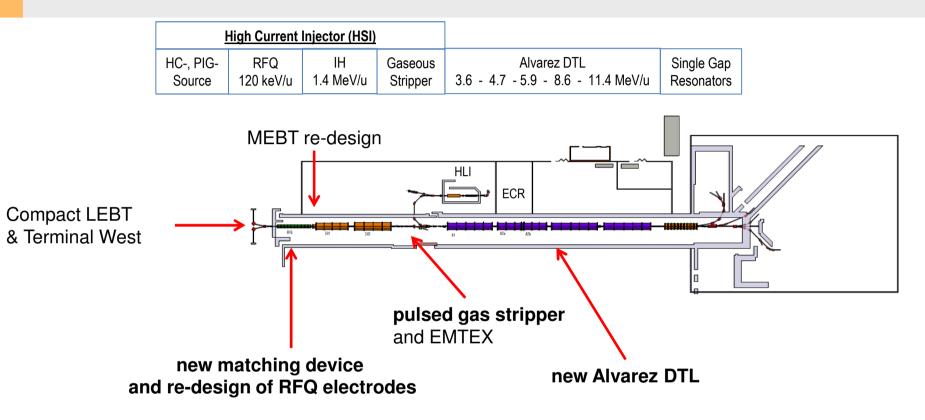




- measurements are performed during a dedicated Uranium beamtime "expert mode"
   no standard operation mode
- no "high current" operation at 5mA in the post-stripper



### What are the upgrade activities?



#### UHV-Upgrade for vacuum controls system

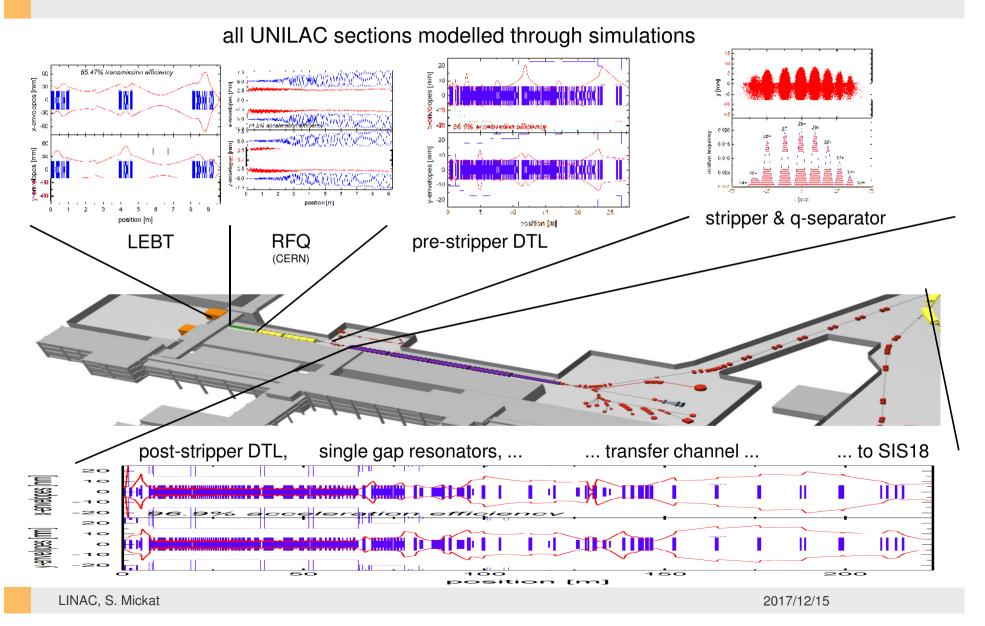
Iaunched in 2016, funded with 790,000€ until 2019/20

#### 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

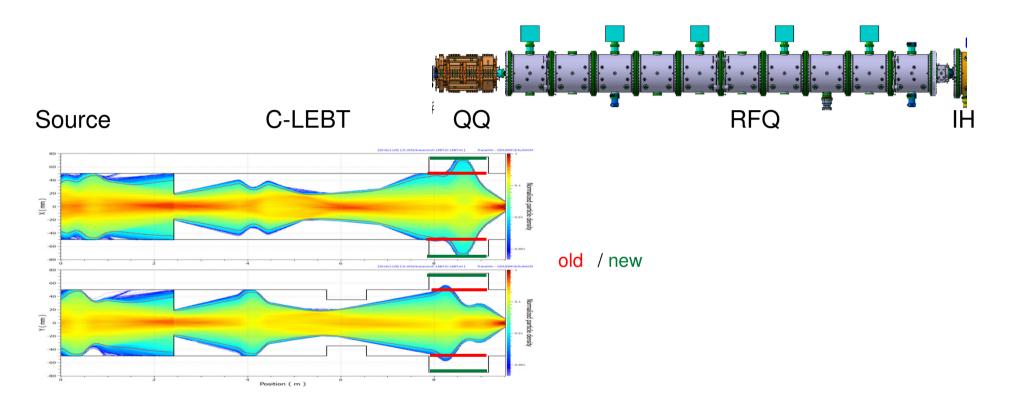


### What is the status of UNILAC – modelling?



## 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-<br>testing is completed |
| QQ theory settings in database | Update during/after commissioning                   |



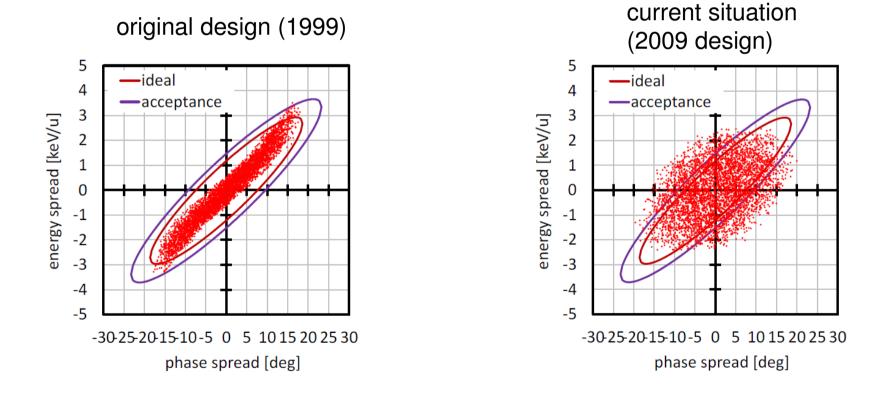
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### What is the motivation for the new RFQ electrodes (&MEBT)?



• 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

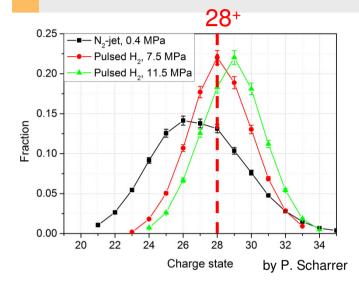


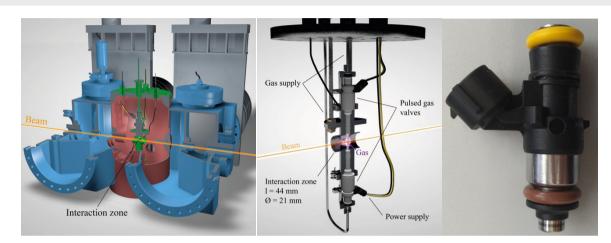
planning: ready for beamtime 2019

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## What is the status of the pulsed gas stripper integration?

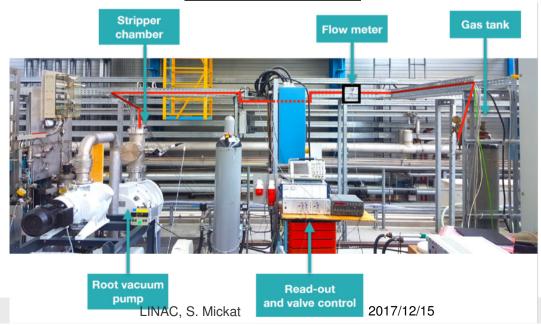






#### on-site teststand

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



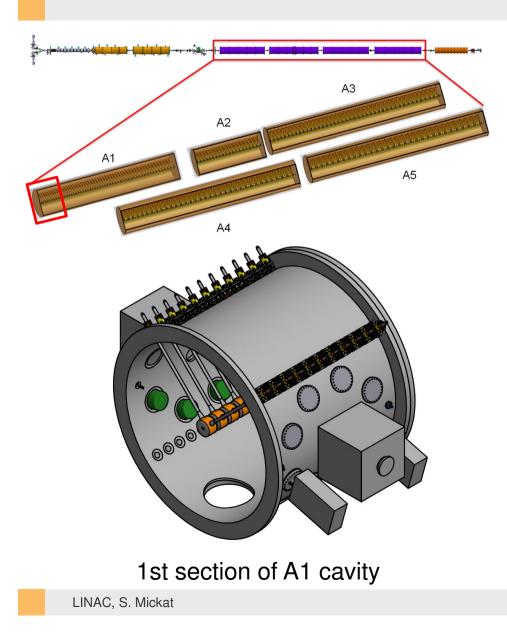
## What is the status of the Alvarez substitution since Aug 2016?



- 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

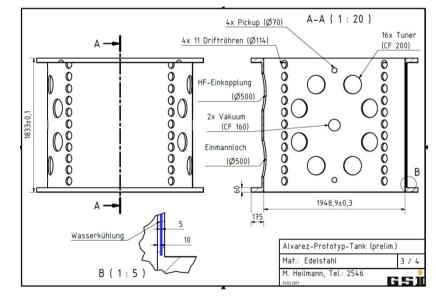


### What is the FoS?



#### three main components

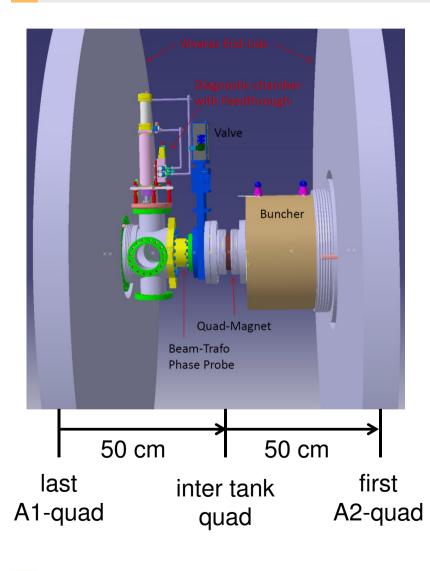
tank section (ordered)

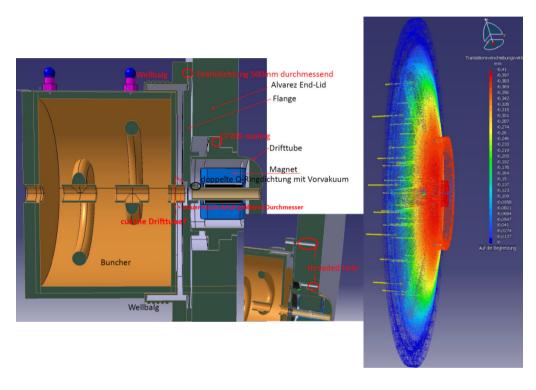


- end plates (next to tender) with ½ drift tubes (2x)
- drift tubes with quadrupoles (11x)



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



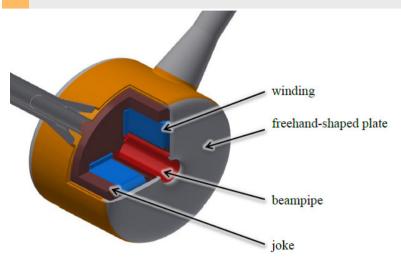


preliminary FEM simulations UH vs. pre vaccum

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



### What is the status of the drifttubes?



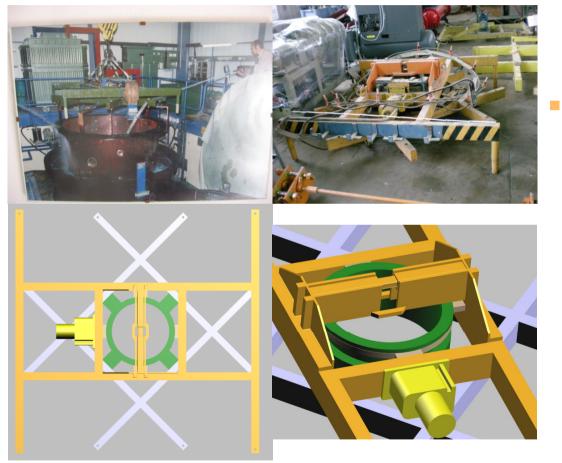
- reference is the double-walled AIII and AIV drifttube
  - in-house fabrication is feasible (spare parts)
- freehand-shape front sides (smooth shape for rf-properties)
- pre-fabricated stem connectors, instead of necking-out
- prototyping incl quadrupole dummy
- procurement starts in 2018



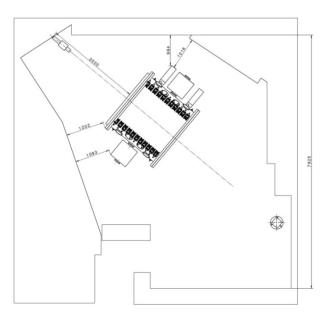


## What are further important aspects?

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<br>Procurement starts                                                                                                           | 45,000 €    |
| 2018 | Delivery of tank section<br>Agreement about FoS location (X4 shelter)<br>Delivery of endplates<br>(1st testing phase with empty cavity) | 900,000 €   |
| 2019 | Assembly of test stand<br>Test campaign starts<br>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 € |

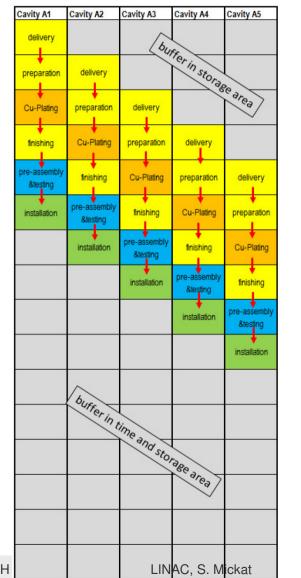
# How the workflow could look like for series production ?

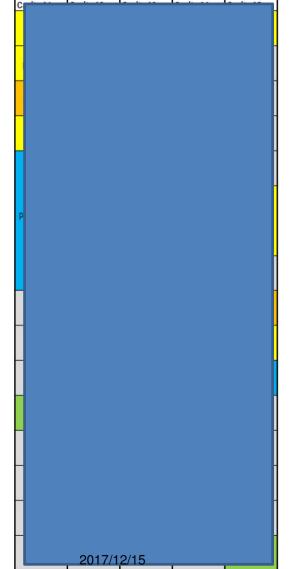


#### strict boundary condition: minimize the downtime

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

-> sequential installation and commissioning





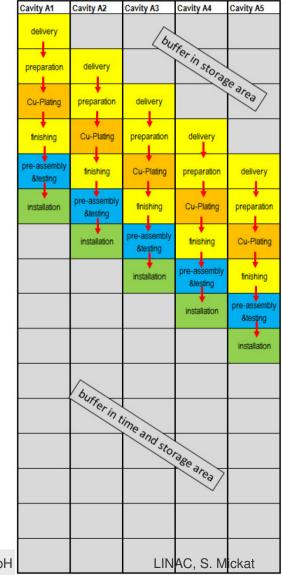
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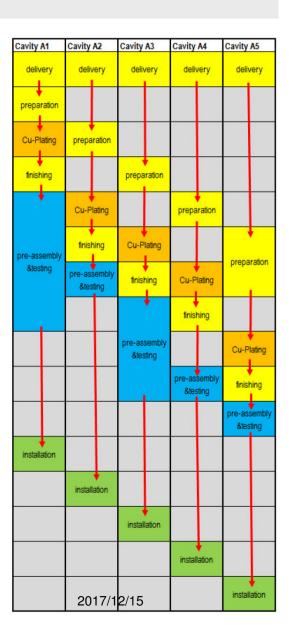


### strict boundary condition: minimize the downtime

-> 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, ...)