Status Report on the DLA Experiments at the SINBAD/ARES Linac.

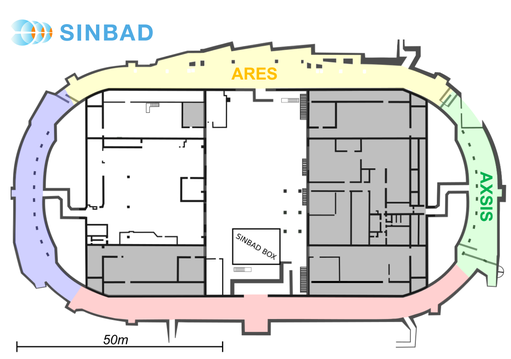
F. Mayet[3], R. Assmann, R. Brinkmann, F. Burkart, H. Cankaya[1], U. Dorda, L. Genovese, I. Hartl, S. Jaster-Merz, F. Kärtner[1], W. Kuropka[3], F. Lemery, C. Mahnke, B. Marchetti, M.Trunk[2]

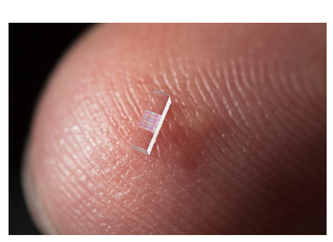
DESY, Hamburg, Germany, [1]CFEL Hamburg, Germany, [2]University of Hamburg, Germany, [3]also at University of Hamburg, Germany

Introduction

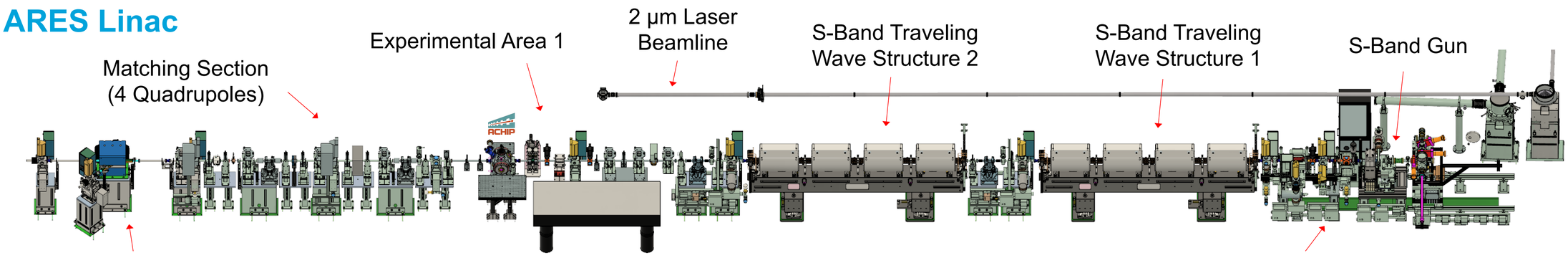
- The Accelerator on a CHip International Program (**ACHIP**) aims to demonstrate a working prototype of a particle accelerator on a chip until 2021
- DESY will conduct related test experiments at its **SINBAD** facility (**ARES linac**)
- **Funded by the Gordon and Betty Moore Foundation**

- **Two main experiments have been internally proposed to be started beginning of 2020 [1]**
  - **Stage 1**: External injection of relativistic ultra-short single bunches into a grating-type DLA
  - **Stage 2**: External injection of relativistic phase-synchronous optical scale microbunch trains

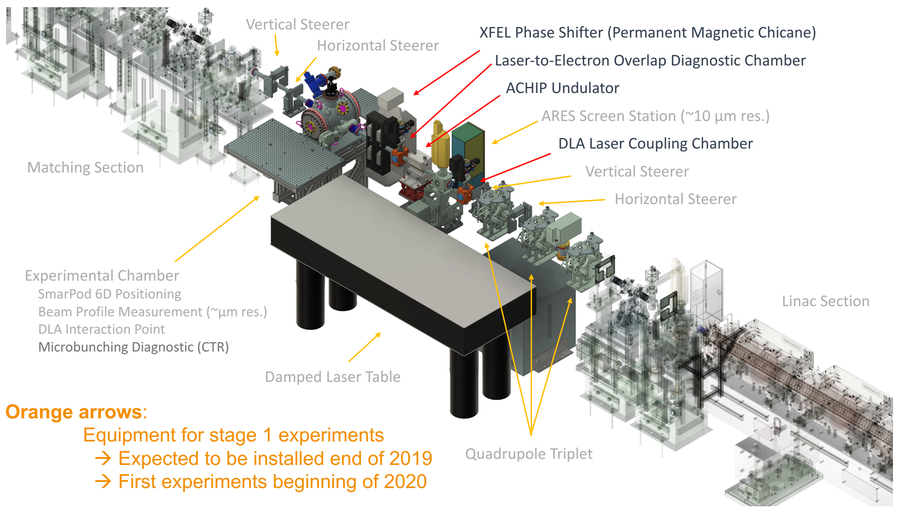




ARES Linac



Experimental Area 1

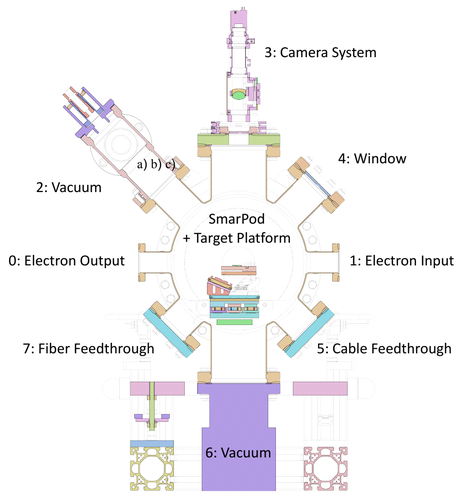


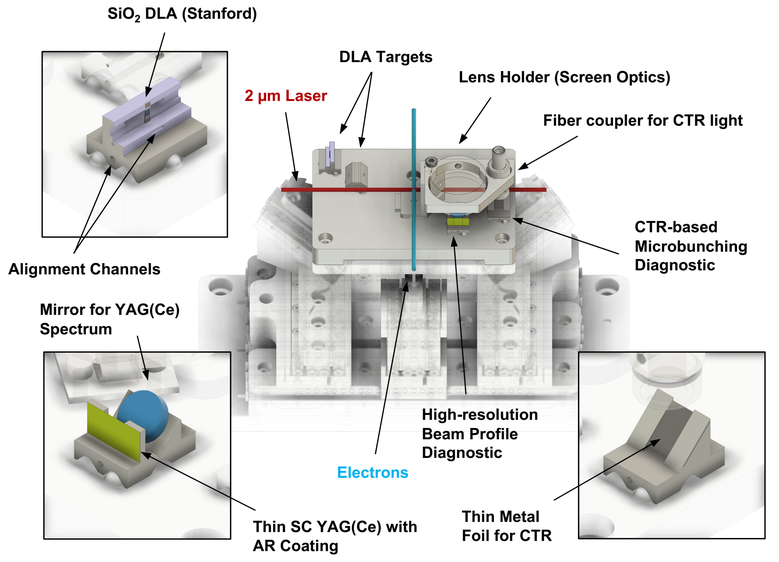
Orange arrows:
Equipment for stage 1 experiments
→ Expected to be installed end of 2019
→ First experiments beginning of 2020

Red arrows:
Additional equipment for stage 2
→ Expected to be installed mid 2020

Experimental Chamber and Target Platform

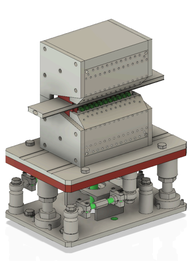
Sample holder base design by Benedikt Hermann (PSI, Switzerland)

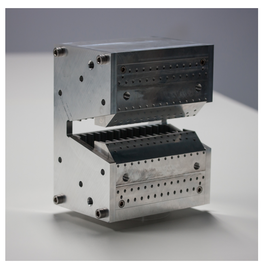


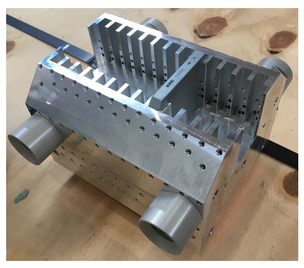


Selected Components and Status

Undulator and Chicane (Microbunching Setup)







Parameter	Value
Magnets	13
Full oscillation periods	5
Fixed gap size	10.7 mm
Entrance angle	0.5°
$\langle B_0 \rangle$	0.61 T
Undulator parameter	1.27
Resonant energy @ 2050 nm	52.42 MeV
Residual field @ 30 cm horizontal distance	50 µT max

- Fixed gap design based on PETRA U23 ✓
- Built by UHH workshop ✓
- Magnets and poles (VAC) already at DESY ✓
- Custom Ti adjustment screws ordered
- Supports being designed by DESY engineers

- Last Prototype of an XFEL Phase Shifter
- Acts like a 4 dipole chicane;
- Sufficient R_{56} for ARES working point (up to 0.7mm @ 50MeV) ✓
- Permanent loan to DESY/SINBAD ✓
- Supports being designed by DESY engineers

Parameter	Value
Min. gap (mm)	10 ($\rightarrow B_0 = 1.49$ T)
Max. gap (mm)	>100 ($\rightarrow B_0 < 10$ mT)
Gap control accuracy (mm)	±0.05
Magnet material	NdFeB
Yoke material	ARMCO, soft iron annealed at 850 °C
Pole material	FeCo, annealed at 850 °C
Phase shifter period length, λ_p (mm)	55

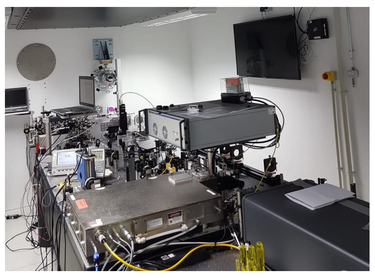
Experimental Chamber

- Built internally at DESY (incl. supports) ✓
- Measured by alignment group ✓
- Permanent loan to DESY/SINBAD ✓
- Currently being prepared by DESY vacuum group

- SmarPod 6D positioning system bought ✓
- Target platform built internally at DESY ✓
- Sample holders (design by PSI colleagues) received ✓
- Custom screen holders to be produced at DESY
- Lens holder in final design phase (UHV-compat.)
- Components for the CTR bought and cleaned for UHV (fiber, coupler, feedthrough) ✓
- High-sensitivity optical spectrometer for MB diag. ✓

- Installation of internal components soon

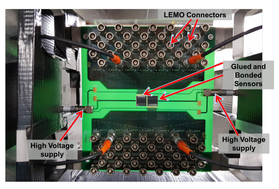
DLA Laser

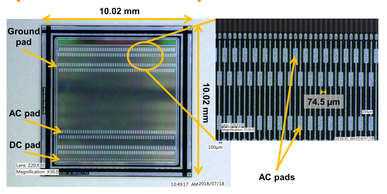


- Installed at ARES cathode laser lab ✓
- Laser beam line received from VAB ✓
- Vacuum transport beam line installation during the week of this conference

Parameter	Value
Type	Ho:YLF
λ	2050 nm
$\Delta\lambda/\lambda$	0.24 %
E_{pulse} (max)	2.2 mJ
E_{pulse} (compressed,max)	1.9 mJ
E_{pulse} (Kagome,max)	0.7 mJ
f_{rep}	1 and 5 kHz
t_{pulse}	3 ps
t_{pulse} (transform limited)	1.25 ps
t_{pulse} (Kagome)	0.4 ps

High-Sensitivity Detector (STRIDENAS)





	Unit	Value
Sensor Size	mm × mm	10.02 × 10.02
Strip Material		n
Bulk Material		p
Number of Strips		103
Strip Pitch	µm	74.5
Sensor Thickness	µm	310

See talk/paper by S. Jaster-Merz (ID 148, Thursday)

- To be installed at the high-energy spectrometer, to be able to detect spectral features with sub-fC charges
- Designed as part of a M.Sc. thesis ✓
- First tests at DESY test beam ✓
- Design currently being altered for UHV

ARES Linac – Timeline

- Gun conditioning on-going, first beam expected in week 39/2019 (was delayed by waveguide problems, which are now solved ✓)
- Linac conditioning (TWS) on-going and on track
- Matching section, incl. supports for the spectrometer installed ✓
- High-energy spectrometer dipole already in the tunnel → to be installed during the week of this conference
- Installation of EA1 until end of 2019
- Installation of the EA1 microbunching setup mid 2020

This work was supported by the Gordon and Betty Moore Foundation under grant GBMF4744 (Accelerator on a Chip).

[1] F. Mayet et al. Simulations and plans for possible DLA experiments at SINBAD. Nuclear Inst. and Methods in Physics Research, A (2018).

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

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