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WP11: electron and proton beam testing

ARIES annual meeting, RIGA 22 - 25 May 2018

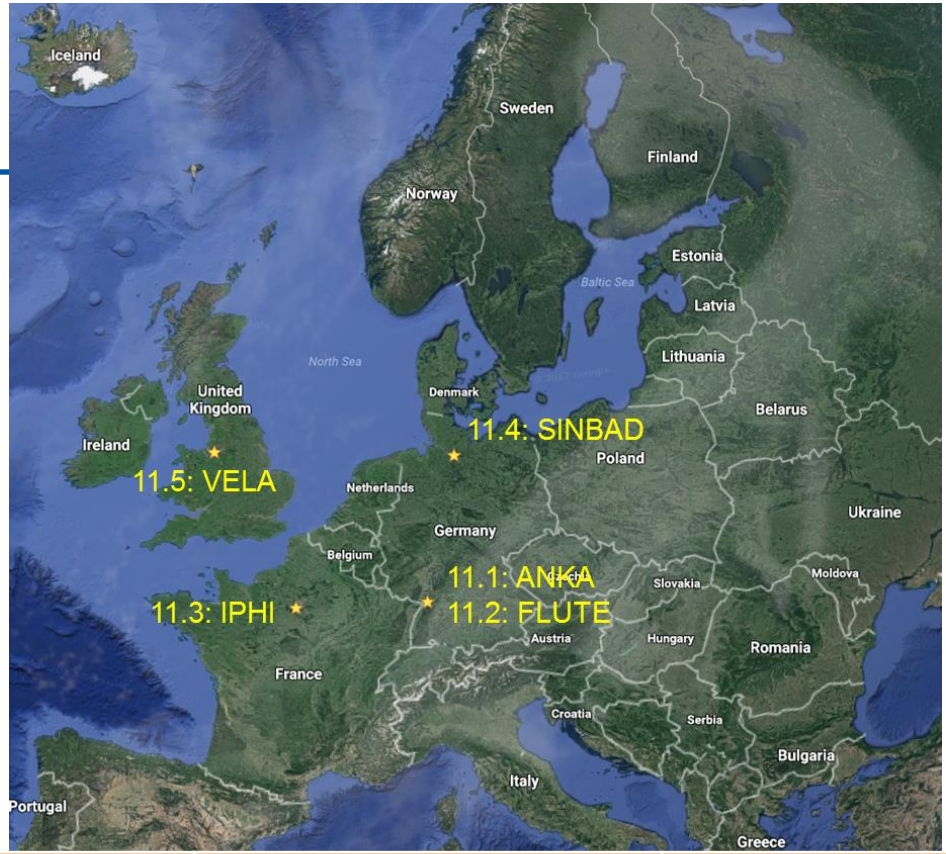
J. Schwindling / CEA Paris - Saclay

Thanks to R. Ruprecht (KIT), U. Dorda (DESY), A. Gleeson (STFC)

Goal of WP11

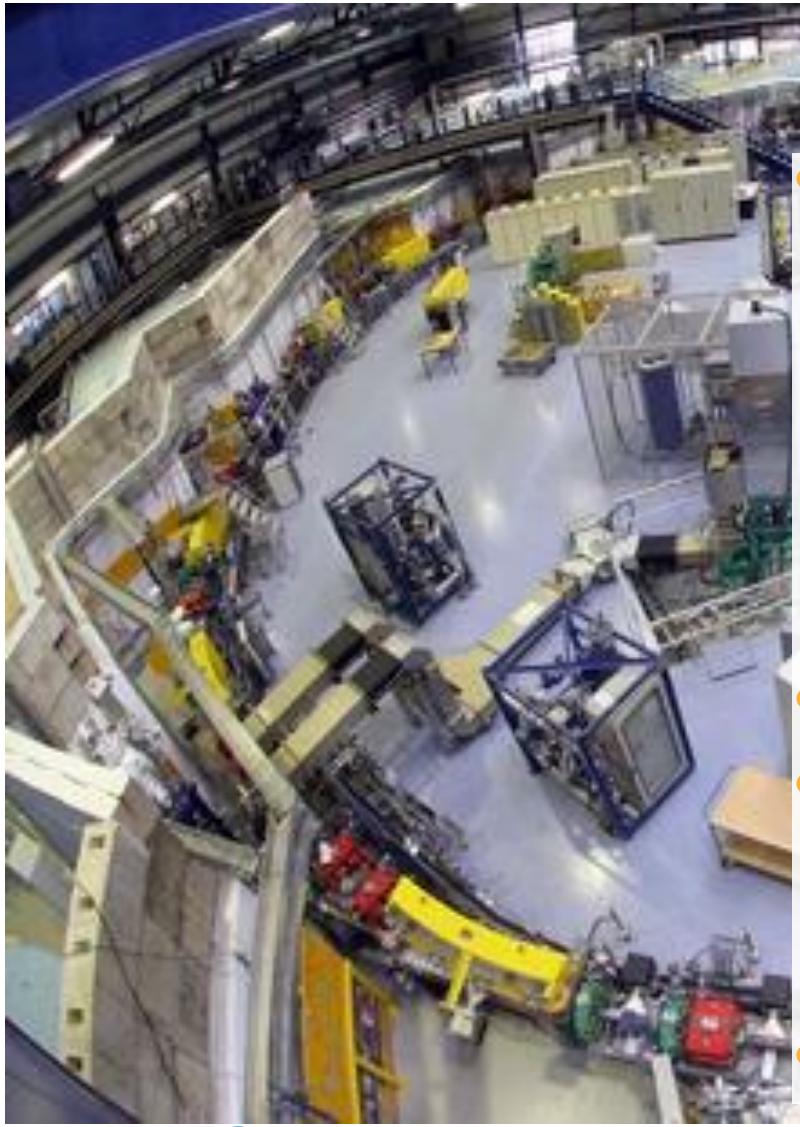
- Testing of instrumentation, beam optics, RF equipment, accelerator components with low-medium energy proton and electron beams

- 5 installations: ANKA, FLUTE, IPHI, SINBAD, VELA



Task	Installation	Location	Task leader	Beam periods	In operation
11.1	ANKA / KARA	KIT	marcel.schuh@kit.edu	8 periods x 2.5 days x 24 h	Since 15 years
11.2	FLUTE	KIT	marcel.schuh@kit.edu	8 periods x 5 days x 8 h	Mid 2018
11.3	IPHI	CEA Saclay	jerome.schwindling@cea.fr	12 periods x 5 days x 8 h	Since a few months
11.4	SINBAD	DESY	ulrich.dorda@desy.de	9 periods x 5 days x 14 h	Spring 2019
11.5	VELA	STFC Daresbury	anthony.gleeson@stfc.ac.uk	14 periods x 3 days x 8 h	Q4 2018

KARA, the Karlsruhe Research Accelerator of the KIT synchrotron (ANKA)



- Key parameters
  - Energy range: 0.5 - 2.5 GeV
  - Beam current up to 200 mA
  - 500 MHz RF system
  - Revolution frequency: 2.715 MHz
  - Custom filling pattern
  - Different optics, e.g. low-α_c (LOA)
  - RMS bunch length: 50 down to few ps
- Synchrotron light users at 2.5 GeV
- R&D Topics
  - Superconducting insertion devices
  - Synchronized ps-fs diagnostics
  - Beam dynamics and analysis
- Accelerator test facility

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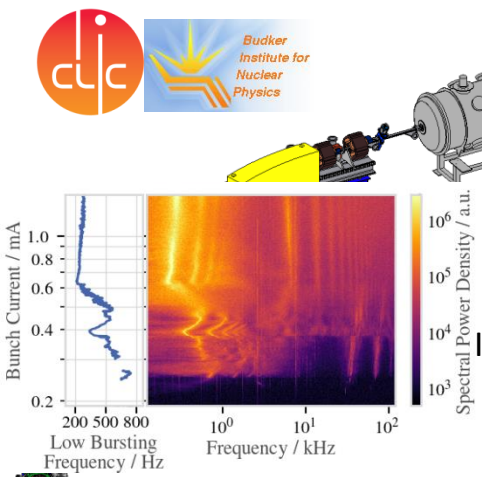
Research activities at KARA

Beam dynamic measurements with CLIC damping ring wiggler prototype



IPAC18: THPAK029

FCC-hh vacuum chamber tests

IPAC18: MOZGBE5

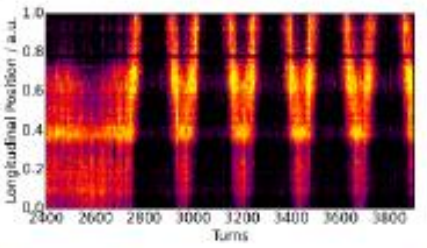
Installed and commissioned SCU20

IPAC18: THPMF066

Synchronized single shot electron beam diagnostics

- Combine different detectors
- Towards time resolved phase space tomography

EO methods



P. Schönfeldt et al.

Fast THz detectors

Fast THz detectors

Streak camera
Fast gated camera

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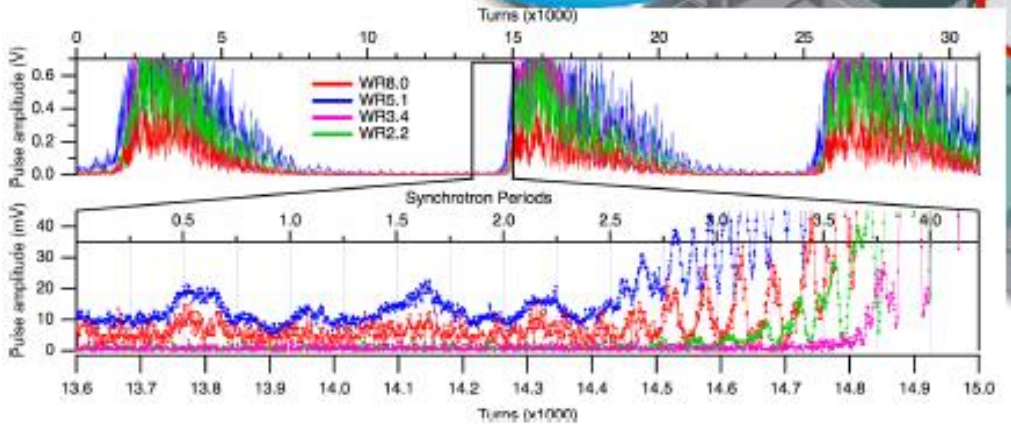
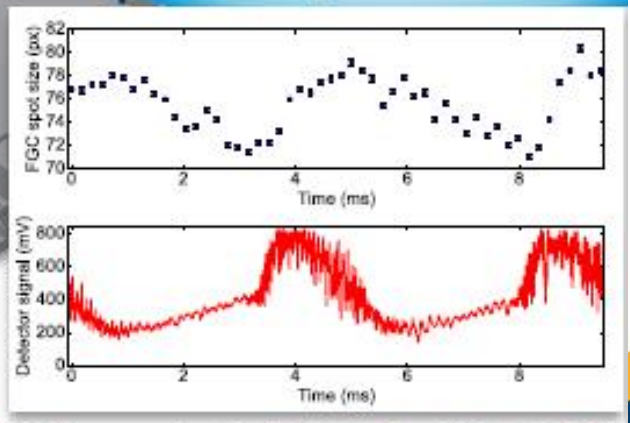




J.L. Steinmann et al., IPAC17, MOPAB056

B. Kehrer et al., IPAC17, MOOCB1

Karlsruhe Institute of Technology

ARIES

Possible experiments within ARIES

- ARIES presentation 23/05/2018, 16:30
  “Optics characterisation at ANKA including the high wiggler field”
  Panagiotis Zisopoulos (CERN) present turn-by-turn data of tune and chromaticity at KARA / ANKA of July 2017

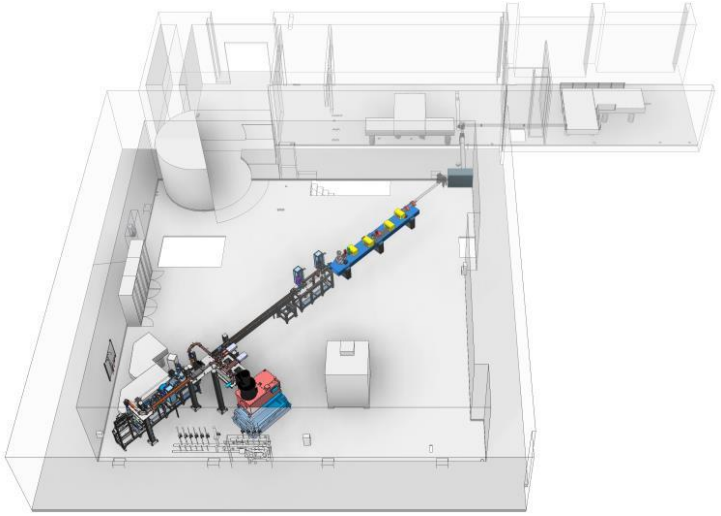
- Based on former experiments of Lille University at KARA / ANKA, Lille discuss possibilities with KIT for higher signals on EO Monitor

- Further experiments at KARA planned for the vacuum chamber of the future FCC above the plan and budget of the H2020-project EuroCirCol

- Proposals for TNA in discussion with CERN, Lille University and others

Test Facility FLUTE at KIT

- FLUTE (Ferninfrarot Linac- Und Test-Experiment)
  - Test facility for accelerator physics
  - Experiments with THz radiation



- R&D topics
  - Serve as a test bench for new beam diagnostic methods and tools
  - Develop single shot fs diagnostics
  - Synchronization on a femtosecond level
  - Systematic bunch compression and THz generation studies

Final electron energy	~ 41 MeV
Electron bunch charge	0.001 - 3 nC
Electron bunch length	1 - 300 fs
Pulse repetition rate	10 Hz
THz E-Field strength	up to 1.2 GV/m

M. Nasse et al.; Rev. Sci. Instrum. 84, 022705 (2013)

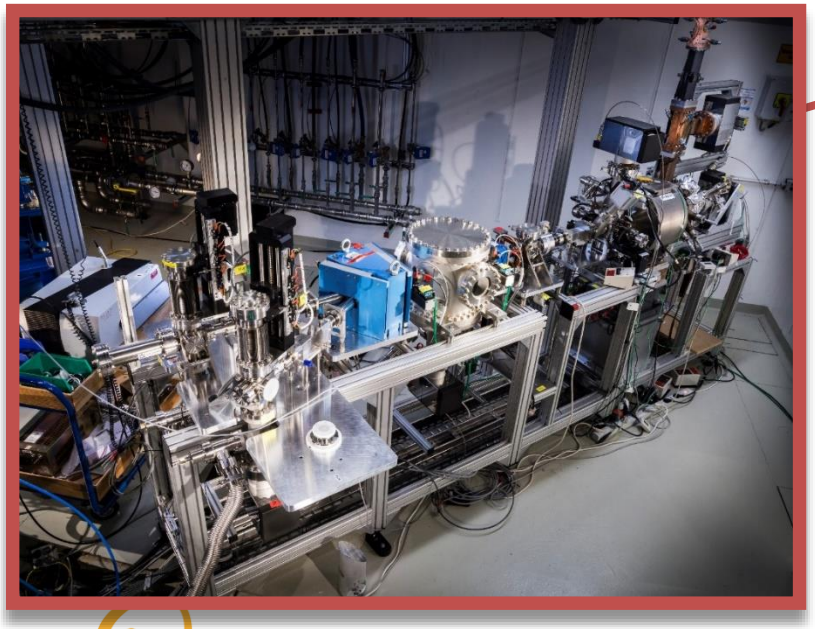
A. Malygin et al.; IPAC18, THPMF068

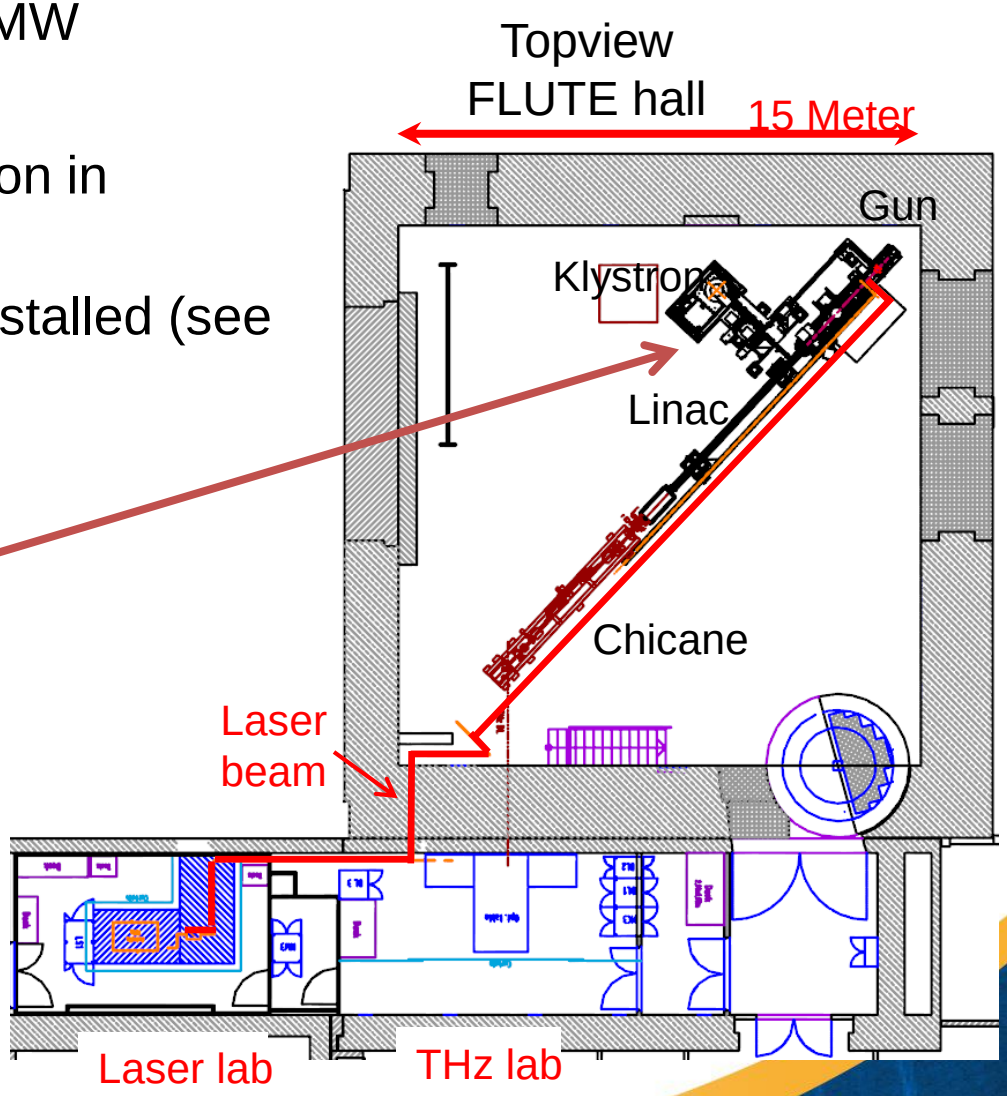
M. Yan et al.; IPAC18, WEPAL029

www.ibpt.kit.edu/flute

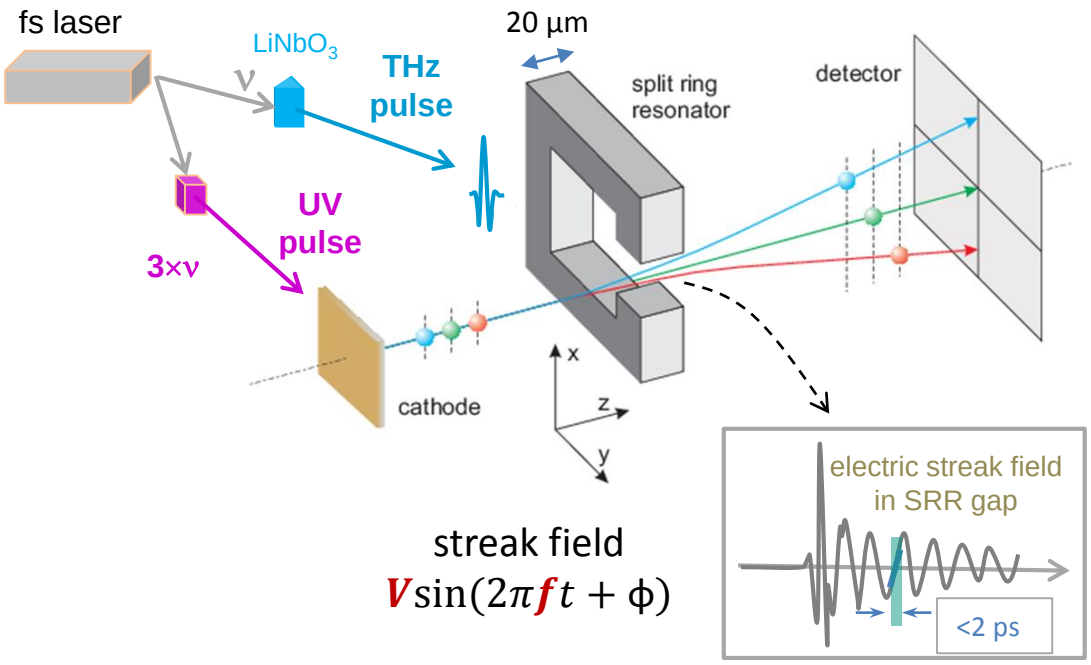
FLUTE commissioning status

- RF system operational with 5 MW
- Laser on cathode
- Gun and first diagnostics section in commissioning
- ARIES experiment chamber installed (see next slide)

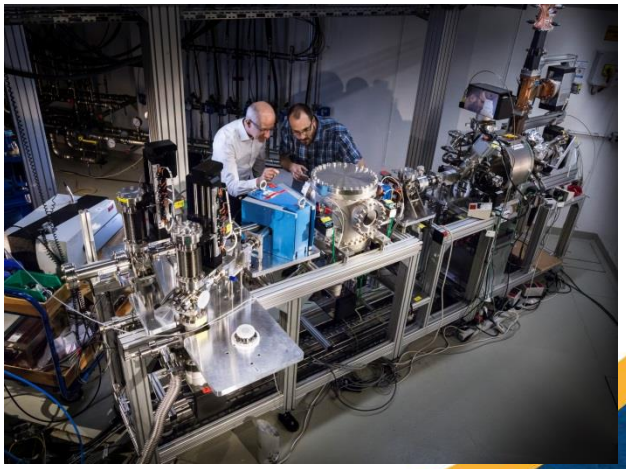




First proposal in preparation: Split ring resonator experiment



- Linear mapping of the long. axis onto the transverse plane
- Temporal resolution $R_t \propto \frac{1}{f\,V}$
  - THz-range
    $\Rightarrow$ high frequency f
  - Field enhancement in SRR gap
    $\Rightarrow$ large streaking voltage V



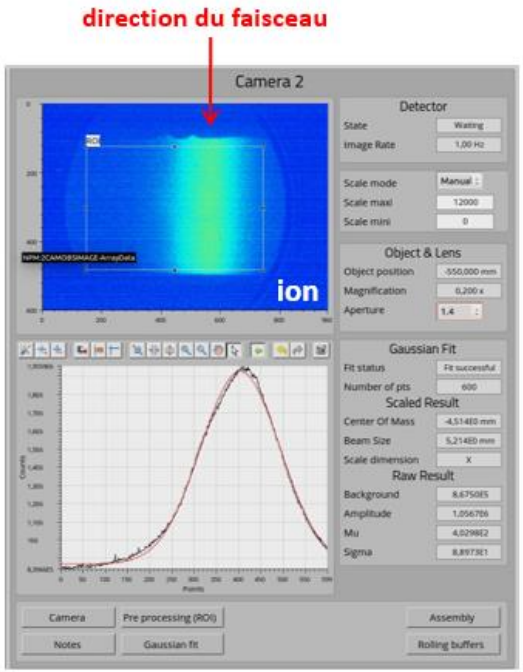
International collaboration with the University of Bern and PSI [2) 3)]

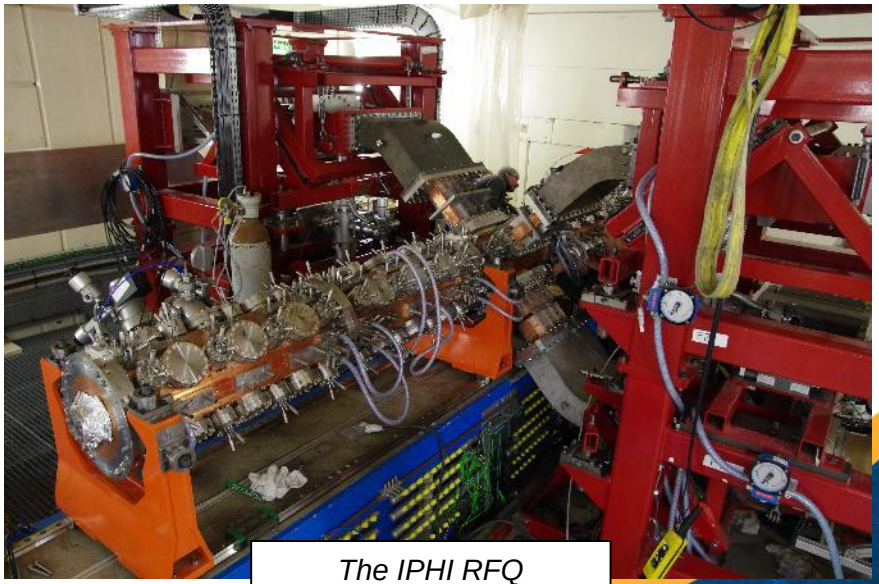
[2)] J. Fabiańska et. al., *Sci. Rep.* **4**, 5645 (2014)
[3)] M. Yan et. al., *IPAC'16*, TUPG56 (2016)

- **Status of Split Ring Resonator Experiment**
  - chamber installed and THz generation demonstrated
  - preparing split ring resonator in progress at Bern
- **Possible first TNA experiment at FLUTE**

IPHI at CEA Saclay

- The High Intensity Proton Injector was built and is being commissioned at CEA Saclay through a CEA – CERN – IN2P3 collaboration
- Design performances are 3 MeV – 100 mA – CW proton beam (300 kW)
- Beam restarted end 2017 after upgrade of the cooling system
- Two internal experiments at duty cycle 1E-4 beginning 2018 (see Claude Marchand's talk)

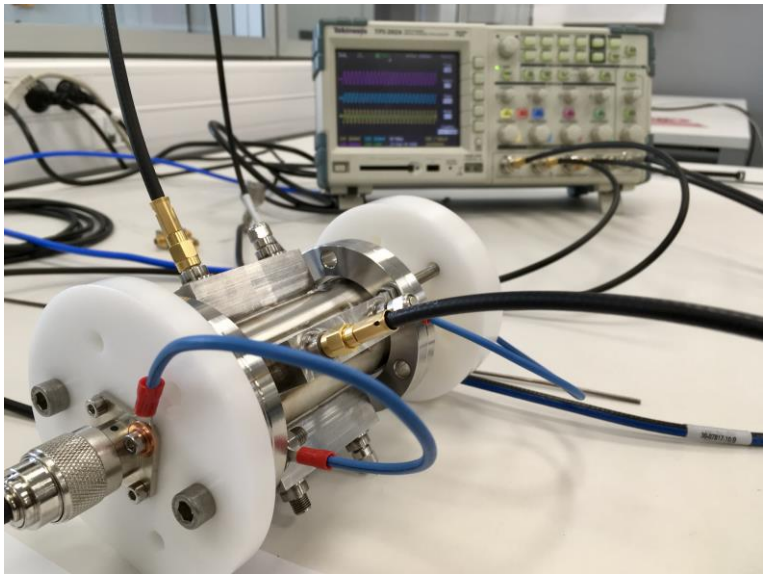




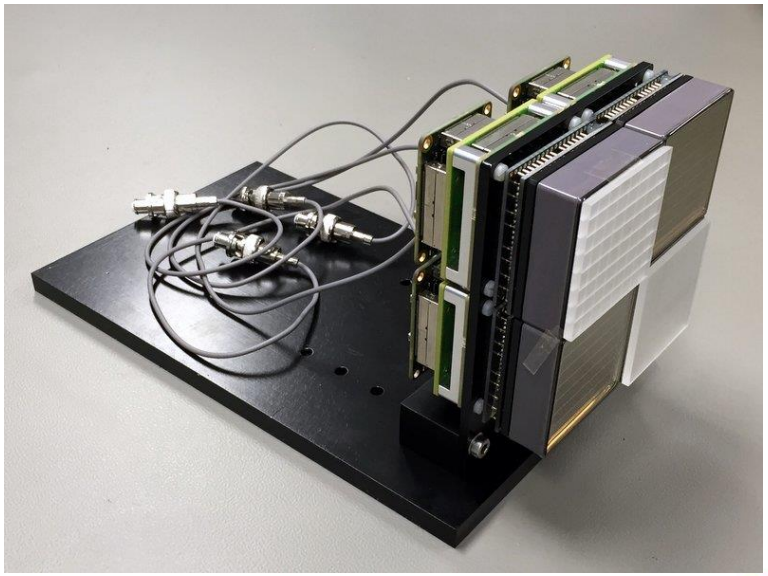
The IPHI RFQ

IPHI at CEA Saclay

- RF conditioning will continue during summer: goal = 4% (ESS)
- Proton beam available in September for ~1 month, then installation of target / shielding for neutron production, neutron production early 2019
- Discussions with 2 potential users:
  - ESS Bilbao: tests of ESS MEBT BPMs + electronics → September
  - Jülich Forschungszentrum: tests of SoNDe detector → beg 2019



ESS Bilbao BPM



SoNDe detector

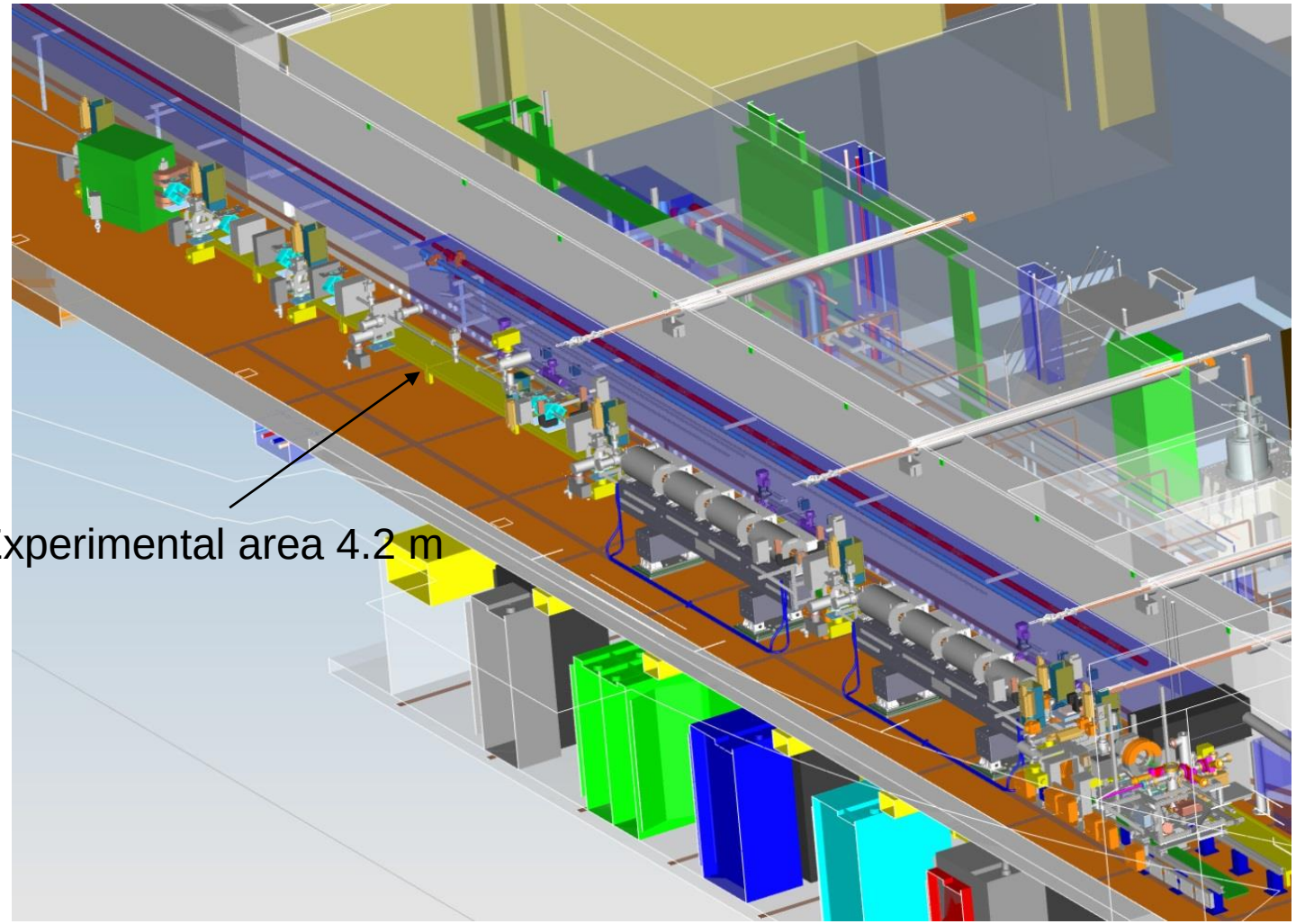
SINBAD at DESY, Hamburg

- A dedicate accelerator R&D facility currently under construction at DESY
- Reusing the old DORIS tunnel to set up multiple independent experiments
- E = 100 MeV, charge: 0.5 - 20 pC, bunch length: few fs, transverse norm. emittance < 0.5 mm*mrad, arrival time jitter stability < 10 fs RMS, rep-rate: < 50 Hz
- Outside TNA, SINBAD will be used to study compression methods, inject into advanced acceleration schemes, diagnostics development, …

SINBAD: status

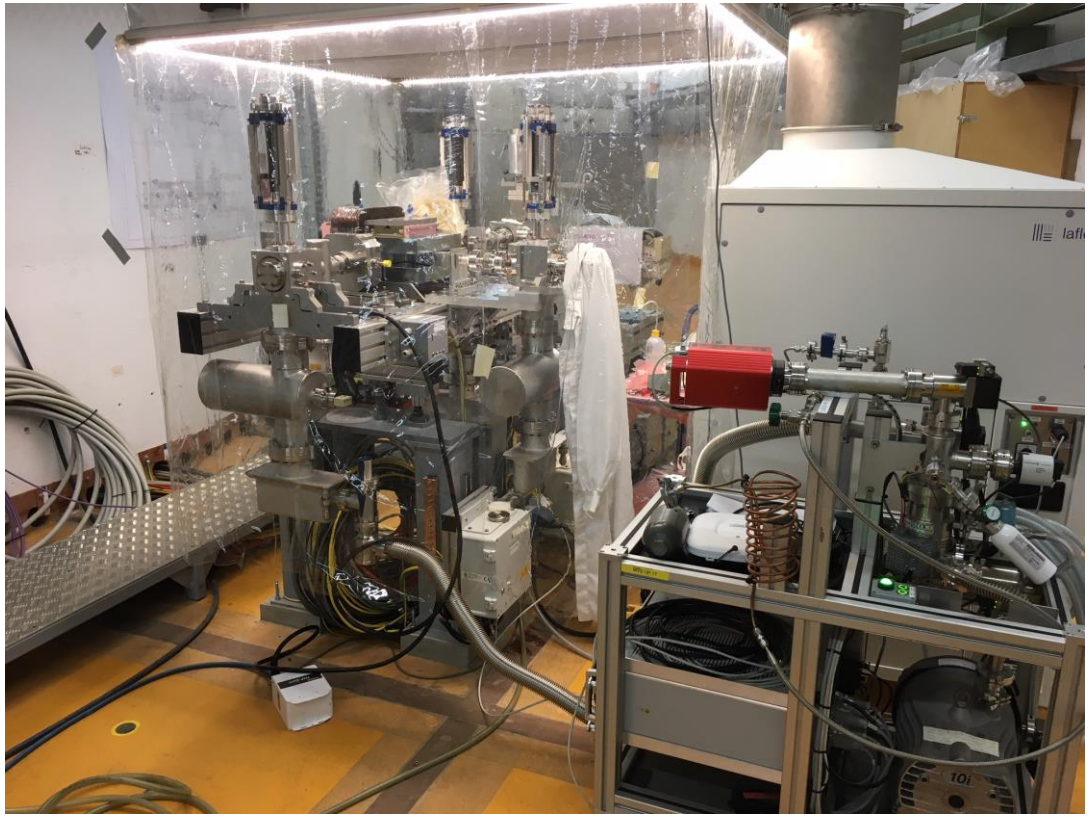
- Installation of gun region ongoing, linac stage installation fall 2018
- Starting detailed planning of experimental area (vacuum tank incl. movers, instrumentation, …)
- Available for TNA: spring 2019
- Users
  - Advertised in talks, presentations…
  - So far only one first contact to potential interested user, hoping for more once running...

SINBAD: status



SINBAD: status

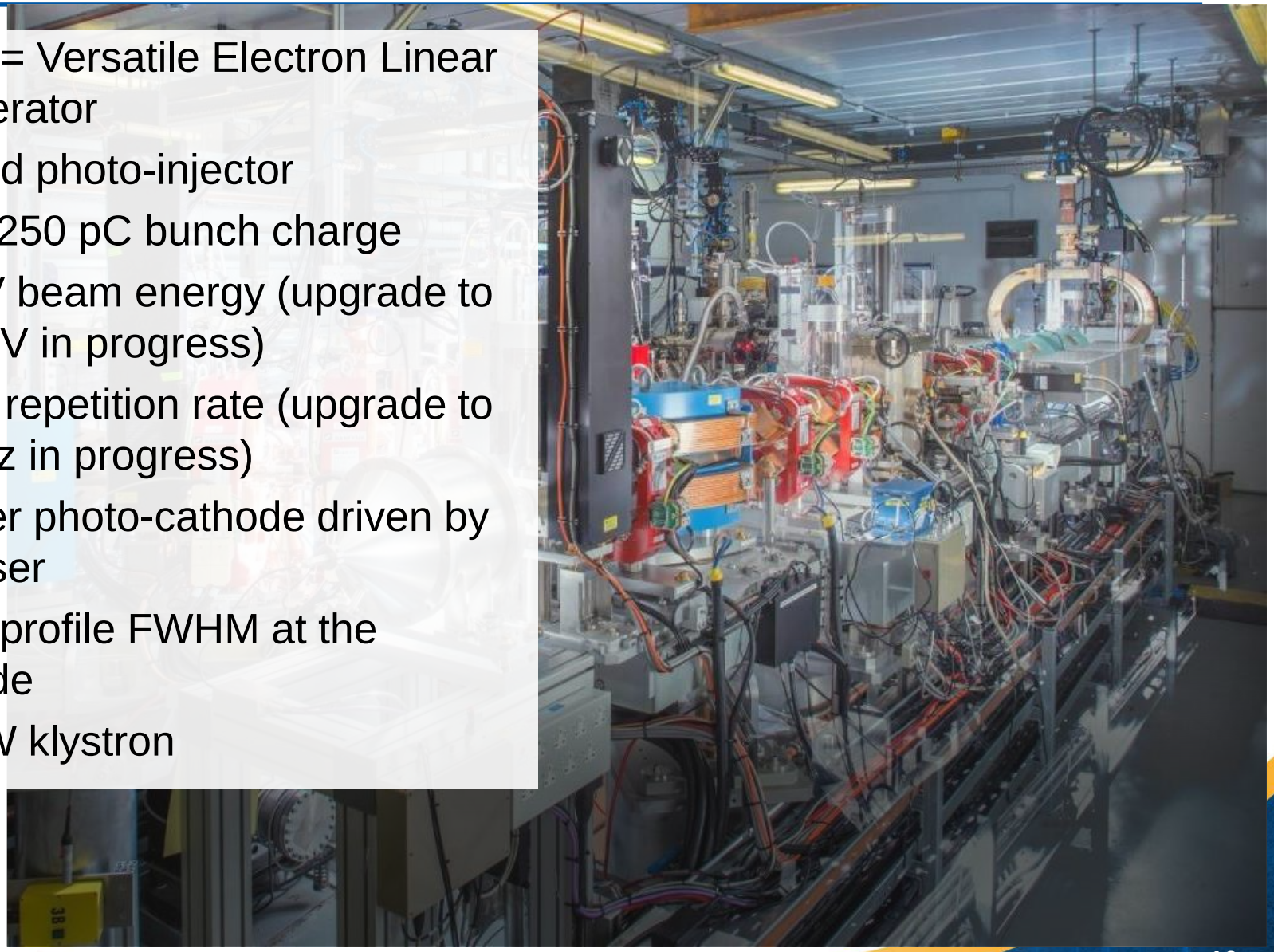
2nd may



22nd may

VELA at STFC Daresbury

- VELA = Versatile Electron Linear Accelerator
- S-Band photo-injector
- Up to 250 pC bunch charge
- 6 MeV beam energy (upgrade to 40 MeV in progress)
- 10 Hz repetition rate (upgrade to 100 Hz in progress)
- Copper photo-cathode driven by UV laser
- 1 mm profile FWHM at the cathode
- 10 MW klystron



VELA: status

- VELA has been unavailable to users, because of co-activity with the CLARA FEL testbed currently under development.
- Current Status, May 2018: Recommissioning
- Anticipated availability for ARIES TNA programme: September 2018
- Two groups are preparing requests submission (plasma wakefield acceleration, material testing)
- Further beamtime allocations will be available to the TNA programme in 2019.

Conclusion

- A lot of progress in installing / commissioning the facilities
  - KARA, IPHI: running
  - FLUTE, VELA: commissioning
  - SINBAD: Spring 2019

- Contacts with several groups for access within ARIES

- Hope to show ARIES results next year !

Please advertise these facilities within your institution !