This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 730871.

Accelerator Research and Innovation for European Science and Society

ARIES

Experience from the European Instrumentation Network ARIES-ADA Network

ADA: Advanced Diagnostics at Accelerators

Work-package & task leader: Peter Forck GSI

Task leaders: Ubaldo Iriso ALBA, Rhodri Jones CERN, Kay Wittenburg DESY

ALBA CERN DESY GSI Helmholtzzentrum für Schwerionenforschung

Outline of the talk:

- Introduction to ARIES and ARIES-ADA
- Summary of three exemplarily workshops:
  - organization
  - exemplarily content: highlights chosen by my personal perspective
- General considerations related to workshops: my personal perspective

ARIES integrating Activity, ADA Network

Accelerator Research and Innovation for European Science and Society

- 18 work-packages funded by European Union from 2017 to 2021
- 41 participating institutions from 18 countries coordinated by M. Vretenar CERN
- Follow-up by iFAST Innovation Fostering in Accelerator Science and Technology

ARIES consisted of:

- Five **Joint Research Activities** for development of key technologies
- Five **Transnational Access** to provides infrastructure
- Seven **Network Activities** aiming for collaborations and common efforts

ADA = Advanced Diagnostics for Accelerators is (was) one Network Activity

It consists of 5 tasks:

Task 1: Coordination (as for every WP) → Peter Forck GSI
Task 2: Diagnostics at hadron LINACs → Peter Forck GSI
Task 3: Diagnostics at hadron synchrotrons → Rhodri Jones CERN
Task 4: Diagnostics at circular light sources → Ubaldo Iriso ALBA-CELLS
Task 5: Diagnostics at linear light sources → Kay Wittenburg DESY

During execution, it turned out that this is not a practical classification!

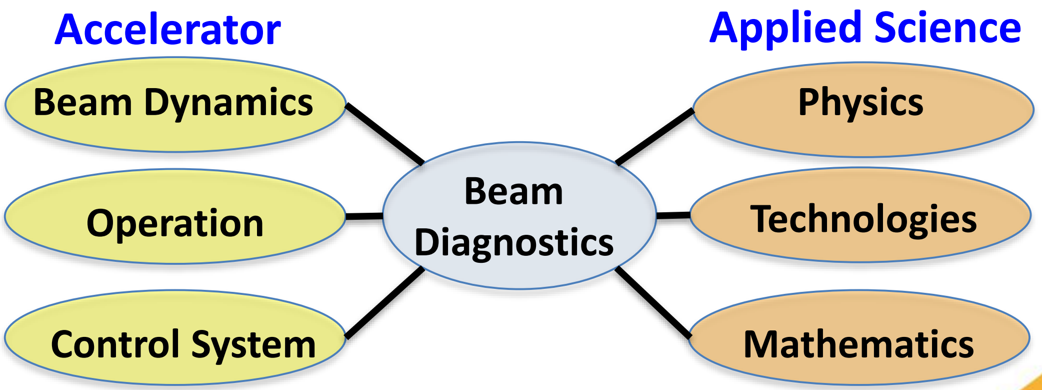
ARIES-ADA Network

ADA = Advanced Diagnostics for Accelerators is (was) one Network Activity

- **Goal:** Initialize and strengthen knowledge transfer & collaboration between experts on various fields
- **Methodology:** Topic workshops on **one dedicated subject** & exchange of personnel
- **Task structure (at proposal time):** Hadron LINAC (GSI), Hadron synch. (CERN) circular light source (ALBA), linear light source (DESY) → changed due to practicalities
- **Budget:** 160 k€ plus administrative overhead shared by ALBA, CERN, DESY & GSI
- **Covid-19:** Interruption of program execution

Requirements for beam diagnostics at novel accelerators:

- Design of adequate diagnostics for existing & novel accelerators
- Instruments are based on different physics and techniques



Workshop goal based on:

- Physicists, engineers, technicians from acc. labs, universities & industry
- Expertise from experts on other fields
- Documentation of state-of-the-art knowledge

ARIES-ADA Workshops

#	Date	Org. & location	Title of workshop	# Part.	Task
1	22-24 May 2017	**GSI Darmstadt**	Simulation, Design & Operation of Ionization Profile Monitors	33	2 & 3
2	29-30 Jan. 2018	**ALBA & DESY Barcelona**	Emittance Measurements for Light Sources and FELs	37	4 & 5
3	14-16 May 2018	**CERN & GSI Geneva**	Extracting information from electro-magnetic monitors in Hadron Accelerators	32	3 & 4
4	25-27 June 2018	DESY & PSI Hamburg	Longitudinal Diagnostics at FELs (co-sponsoring)	45	5
5 & 6	12-14 Nov. 2018	**ALBA & GSI Barcelona**	Next Generation Beam Position Acquisition and Feedback Systems Two in one event: hadron & electron acc.	84	3 & 4
7	1-3 April 2019	**GSI & SOLARIS Krakow**	Scintillation Screens and Optical Technology for transverse Profile Measurements	49	2, 4 & 5
8	3-5 June 2019	ALBA & ESRF Grenoble	Diagnostics Experts of European Light Sources (DEELS 19) (co-sponsoring)	33	4
9	25-29 Jan. 2021	**CIEMAT & GSI Online**	Experiences during Hadron LINAC Commissioning	239	2
10	21-23 June 2021	**CERN & GSI Online**	Materials and Engineering for Particle Accelerator Beam Diagnostic Instruments	205	2, 3, 4 & 5
11	7-8 July 2021	ALBA & SESAME Online	Diagnostics Experts of European Light Sources (DEELS 21) (co-sponsoring)	49	4

red: organized **only** due to ARIES-ADA

Documentation at https://aries.web.cern.ch/wp8

Scintillation Screens and Optical Technology for transverse Profile Measurements

Workshop on 1st to 3rd of April 2019 in Krakow

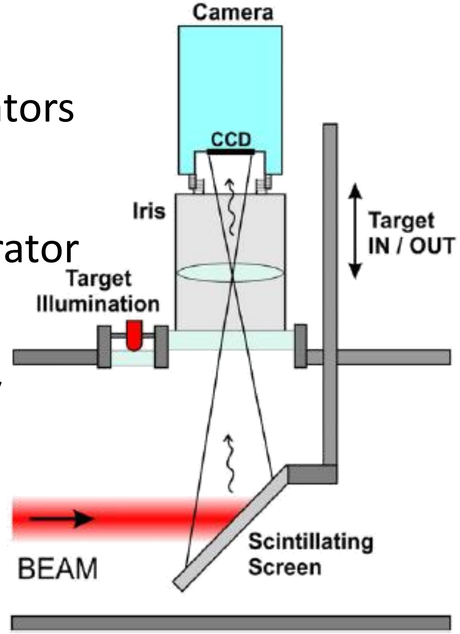
see indico.cern.ch/event/765975/

49 participants (more applications but restriction de to venue)

incl. material research, laser acceleration, industry

- Physics and production techniques of scintillators
- Optics and cameras
- Experiences at hadron accelerators
  - → mainly radiation hardness
- Experiences at electron accelerator
  - → mainly resolution limits
- 29 talks incl. 3 talks by industry

Screens: Simple set-up, but non-trivial physics



Summary by B. Walasek-Höhne (GSI) as invited talk IBIC conference in September 2019

Workshop Scintillation Screens: Profile Measurement versus Detector Appl.

Difference to traditional applications in high energy physics, medical imaging & security:

Parameter	Physics, Medical	Hadron acc.	Electron acc.
Application	Secondary part.	Primary beam transverse profile	
Particle rate	Low	High	Very high
Energy	Up to 10 GeV	10 keV...100 GeV	100 keV...10 GeV
Spot size	10...100 mm	1...50 mm	0.01...1 mm
Spatial resolution	1 mm	100 µm	10 µm
Deposited dose	Low	Very high	Medium
Saturation	None	Expected	Possible
Radiation damage	Low	Very high	High

Corutesy B. Walasek-Höhne GSI, G. Kube DESY

Accelerators:

- Some time same material used e.g. YAG:Ce for electron beams
- Sometimes different requirements e.g. ceramic Al $_2O_3$:Cr (Chromox ‘)
- Quite different demands....

Workshop Scintillation Screens: Topic 1 - Physics of Scintillation

Talks on scintillation process by experts

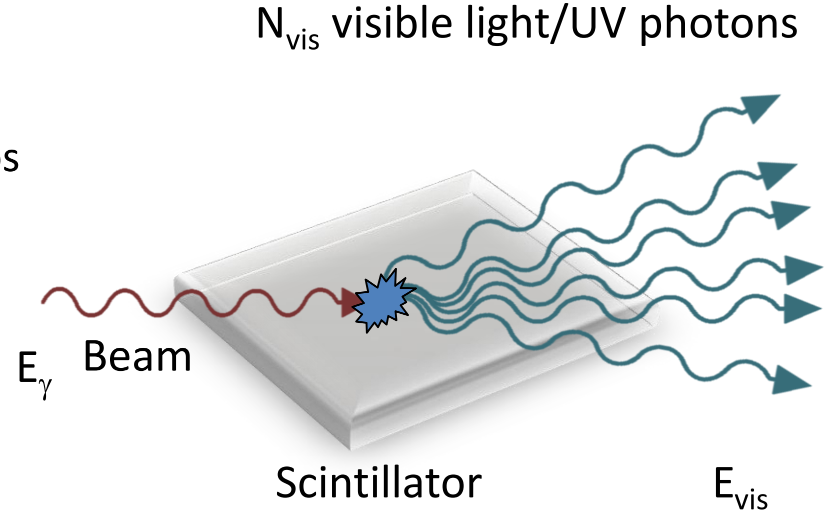
- Liberation of fast electrons by beam particle
- Thermalization within conducting band within ≈ ps
- Trapping at imperfection or dopants ≈ ns
- Light emission ≈ 100 ns

⇒ Material dependent

⇒ Controllable by matrix and dopant

Accelerators: Large energy loss in small volume

→ Informal collaboration established



Courtesy W. Wolszczak TU-Delft & E. Auffray CERN

Talks inorganic scintillator production by industry

- Extensive production method
- Detailed quality assurance required

Accelerators:

- Demands for high energy deposition
- Mechanical stability
- Vacuum capability

⇒ Intensive discussion on material choice

Courtesy J. Parizek CRYTUR

Workshop Scintillation Screens: Topic 2 – Optics & Cameras

Optics: Old principles & recent realization

- Scheimpflug criterion & tele-centric lens
  $\Rightarrow$ no image deformation
- Appropriate camera sensor technology
- Camera digital interface
- Camera cauterization by fixed norm

Accelerators:

$\Rightarrow$ Improved installation at some facilities

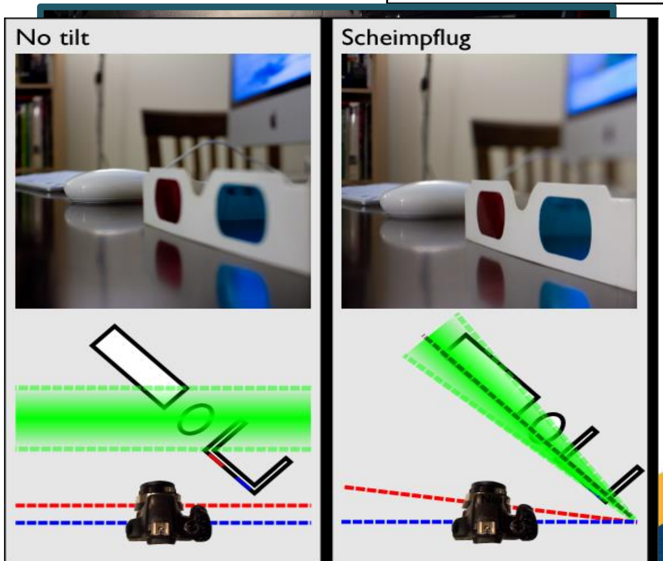
Radiation hardness tests

- Radiation hardness
  e.g. at CERN CHARM with 24 GeV protons
  Result: Digital interface failure of few shots
  Image sensor still acceptable after 500 Gy
- Fibre bundle versus telescope

Accelerators:

$\Rightarrow$ Requirement for radiation-hard digital cameras!

Courtesy S. Gibson RHUL, M. Veronese ELETTRA

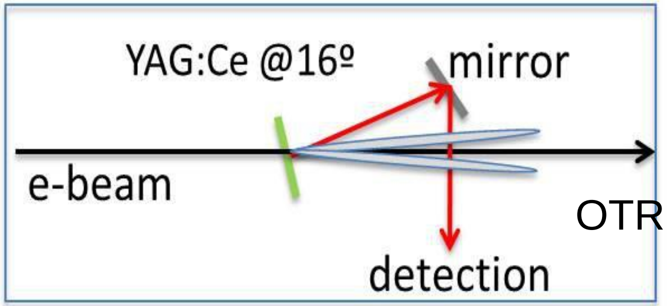


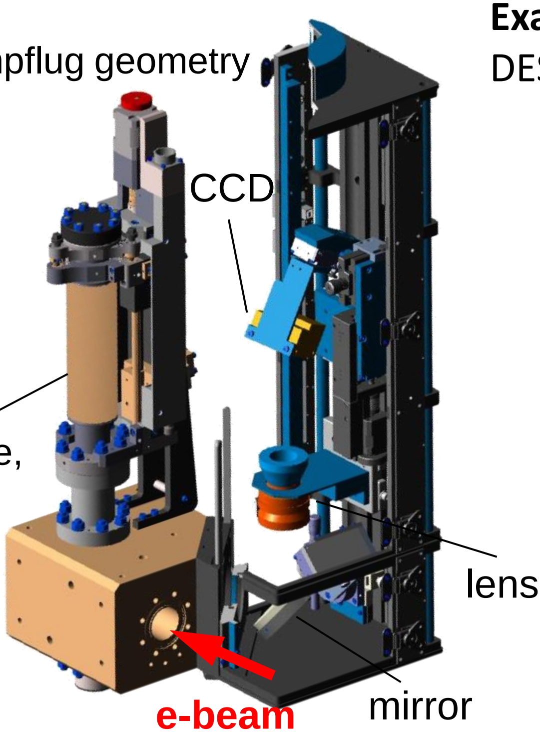
Courtesy S. Burger CERN

Workshop Scintillation Screens: Topic 4 – Applications for Electrons

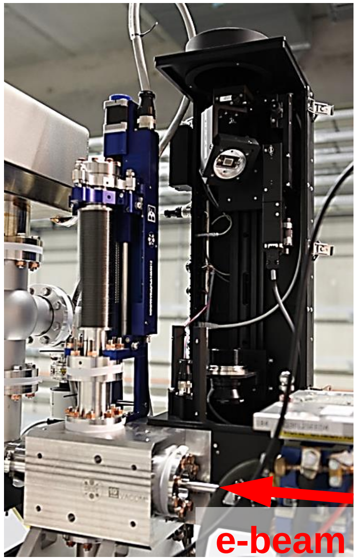
Requirements:

- Resolution at least 10 µm
  $\Rightarrow$ Dedicated optical setups (Scheimpflug & telecentric) discussed
  $\Rightarrow$ Ultra thin screens required
- Coherent OTR suppression for FELs



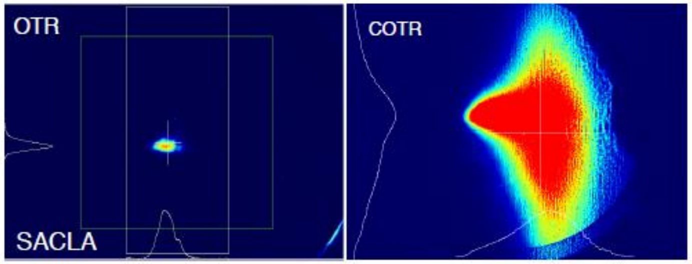


Example:
DESY XFEL design



Courtesy: Ch. Wiebers DESY, M. Verones ELETTRA

- Regular OTR: $N_{photon} \propto N_{beam}$ (forward) $\Rightarrow$ size
- Coherent OTR: $N_{photon} \propto (N_{beam})^2 \Rightarrow$ not size as wavelength $\approx$ bunch size (long.& trans.)



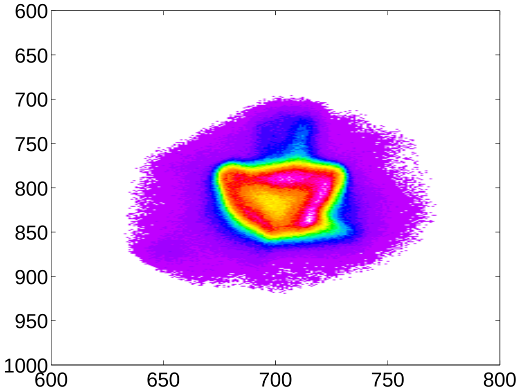
Yuji Otake, SACLA

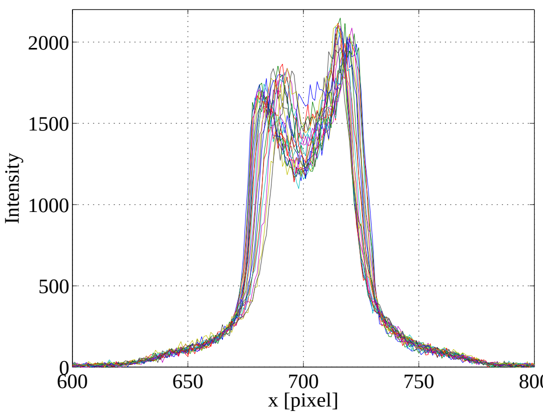
R. Ischebeck et al., Phys. Rev. ST Accel. Beams **18**, 082802

Workshop Scintillation Screens: Topic 4 – Applications for Electrons

Observation:

“Smoke-ring“ shaped profiles @ XFEL for LYSO:Ce scintillator





G. Kube DESY et al., IBIC 2017)

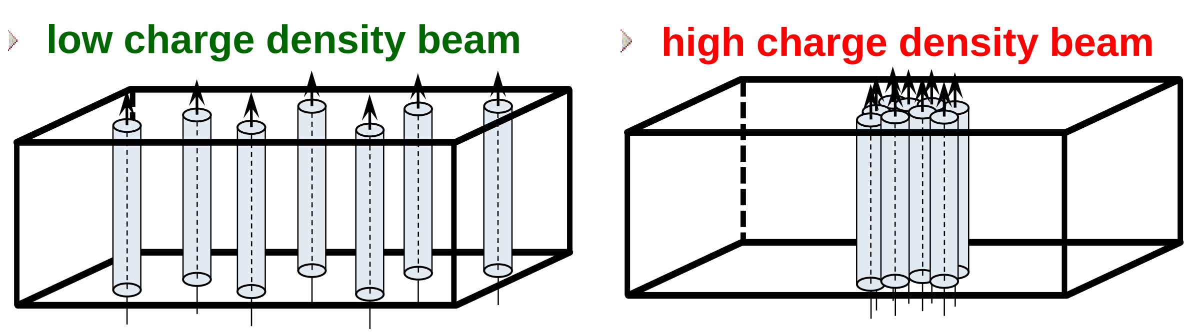
Possible explanation:

- Ionization channel related to secondary electron range
- Saturation close to electron track

⇒ Important for high flux beam (high current, short bunch & transversally focused)

- Same effect for heavy ions due to large dose (?)

Electron passage through scintillator:



Workshop Scintillation Screens: Topic 3 – Applications for Hadrons

Test of different scintillators at high energies

Tpy. scintillators ↔ Phosphor powder ↔ ceramics

Example: Irradiation with ions at GSI

- **Light yield:**

  Very different brightness (here factor 1000)

  Still linear with beam current even for large doses

- **Profile:**

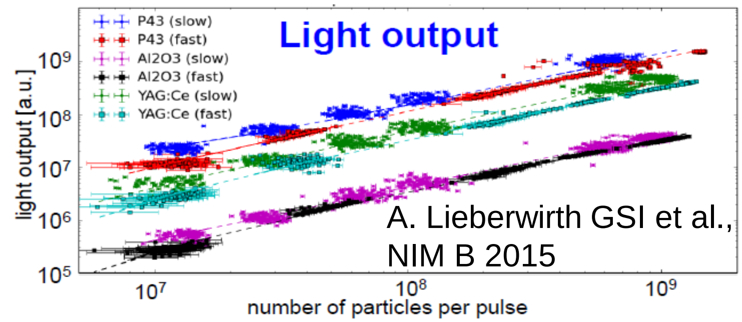
  Most materials show correct results

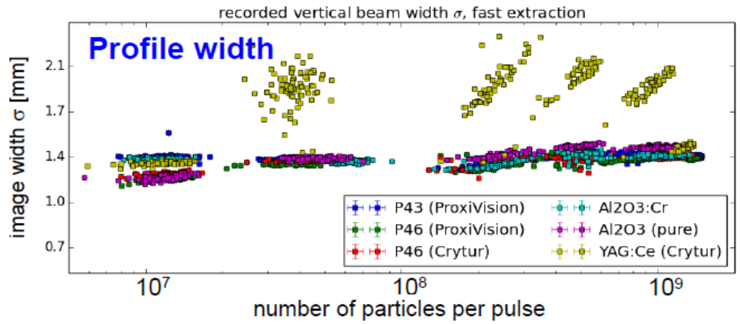
  Deviation understood and possible cures discussed

Accelerators: ⇒ Material choice matched to beam

Beam: Ni @ E_{kin}= 300 MeV/u (GSI synchrotron)

fast (1μs) & slow (0.3s) extraction





Workshop Scintillation Screens: Topic 3 – Applications for Hadrons

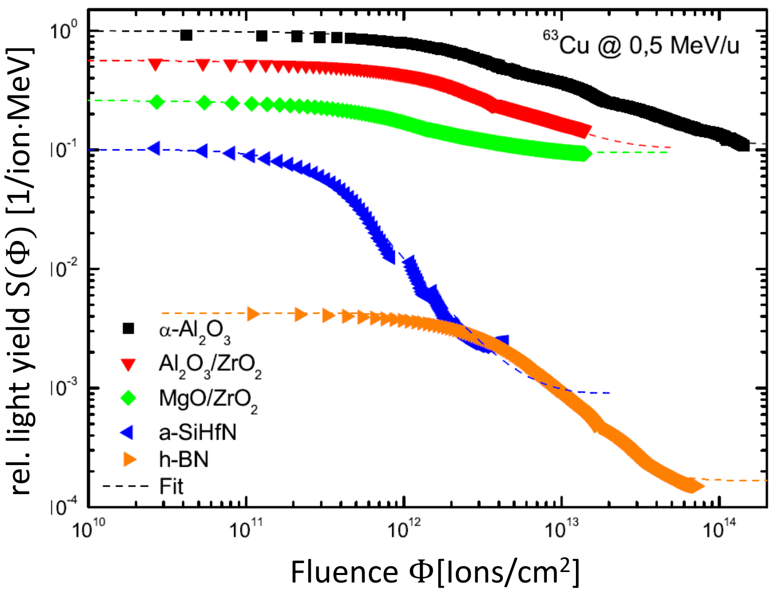
Test of different scintillators at low energies

Example: Ceramic irradiation at TANDEM at HZDR

- **Light yield:**
  Very different for brightness (here factor 500)
- **Profile:**
  Possible deformation due to thermal quenching
- **Radiation damage:**
  Depends strongly on material
  Deviation investigated e.g. by thermal spike model
  Semi-empirical Birks-model discussed with experts
  Possible cures e.g. in-situ annealing by heating

Accelerators: ⇒ Material choice matched to beam

Beam: Cu E_{kin}= 0.5MeV/u, dc beam Range R = 5µm



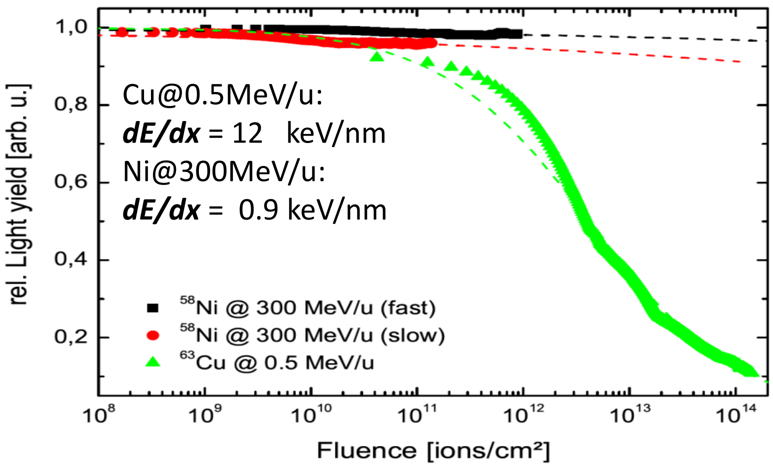
Radiation hardness comparison

Example Al_2O_3: Irradiation by 0.5 MeV/u & 300 MeV/u

- Damage by irritation depends strongly on ion type and energy
- Model (e.g. 'Birks model') discussed with experts

Accelerators:

⇒ Important finding for target diagnostics at SNS or ESS



S. Lederer GSI et al., NIM B 359, 2015

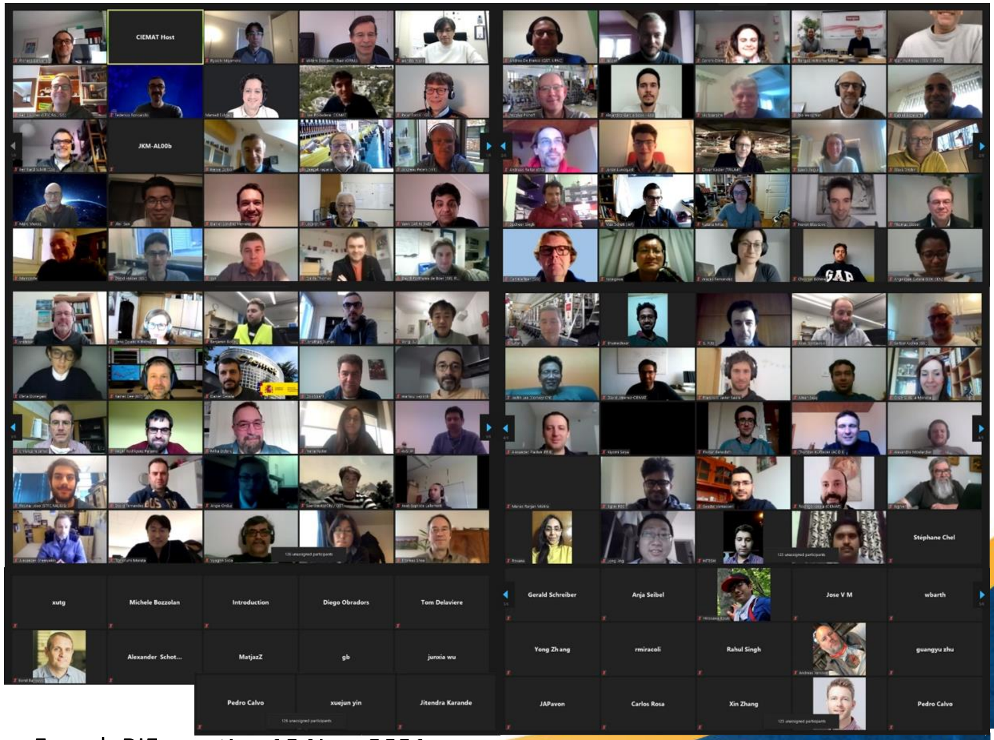
Remote Workshop on ‘Experiences during Hadron LINAC Commissioning’

Workshop from 25th to 29th of January 2021 organized by CIEMAT (Madrid) and GSI

Planned for June 2020 as in-person event; however, postponed as remote with the aims:

- Common efforts by experts on **instrumentation**, beam **dynamics** and **operation**
- Review experiences from commissioning to early operation
- Review initially formulated requirements and final usage of instrumentation
- Explore the balance between detailed measurements on a test bench and fast commissioning

Many proton and ion LINACs are presently realized worldwide



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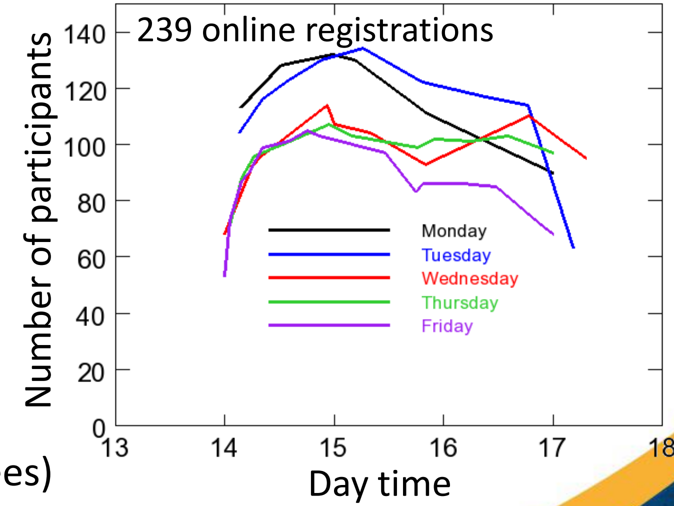
Many proton and ion LINACs are presently realized worldwide

Practical details and statistics:

- **Registrations**: total 239
  Europa: 154 = 70 % | Asia: 47 = 21 % | America: 19 = 9%
  Industry: 36 participants = 15 %
- Meeting time: Monday to Friday from 14:00 to 17:15 CET
  2 x 3 talks + discussion per day
- **Talks:**
  Europa: 18 = 60 % | Asia: 5 = 17 % | America: 7 = 23%
- About 100 people connected in parallel,
  many contribution to discussion (even on Friday 90 attendees)
- No pre-recorded talks to keep life atmosphere

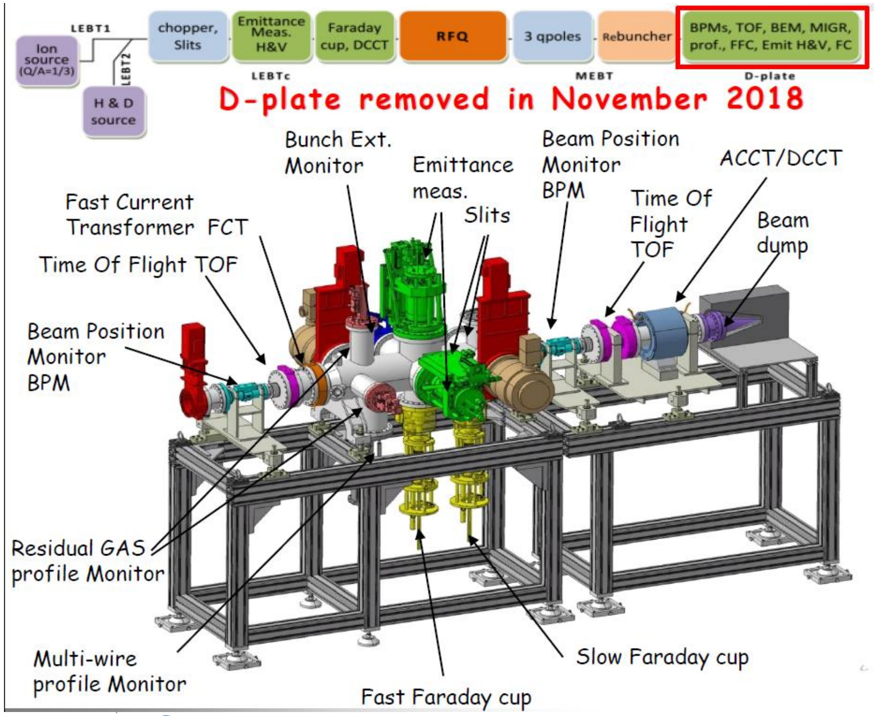


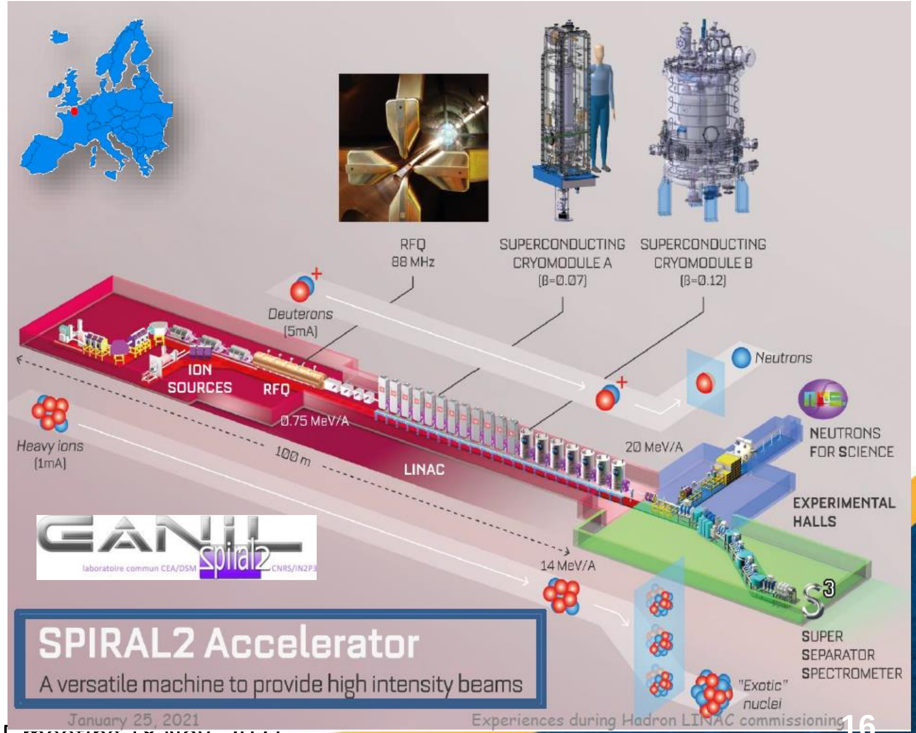
D-Plate & stepwise Commissioning ↔ final Instrumentation

Observation: Some facilities do detailed stepwise commissioning, e.g. Sprial2, other installed large parts of the DTL in one step.

- Stepwise commissioning in particular of versatile ion LINACs; RFQ parameter are crucial
- Measured during stepwise commissioning: transverse emittance, bunch shape and long. emi.
- Wish list from beam dynamics & operation: Test simulation, but often insufficient operation time
- However, installation time is very restricted and does not allow for detailed meas.

D-Plate at **Spiral2** from Christophe Jamet



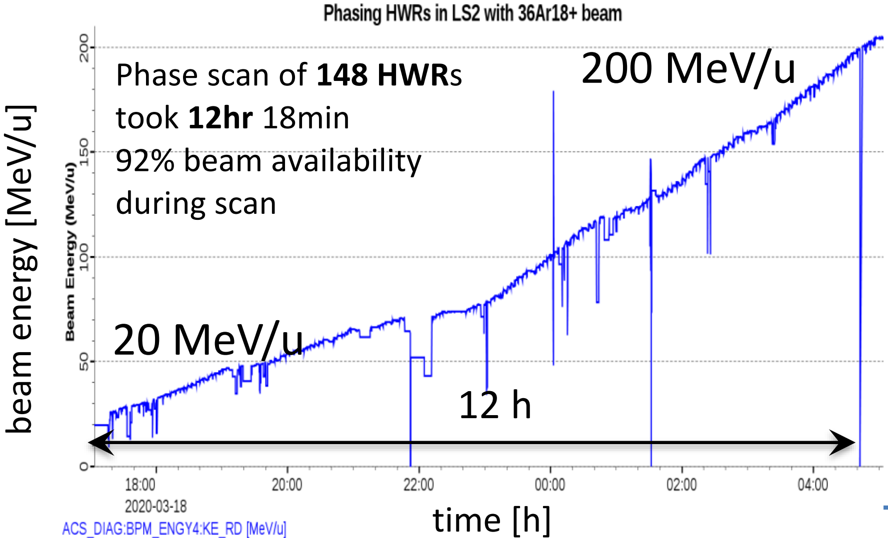


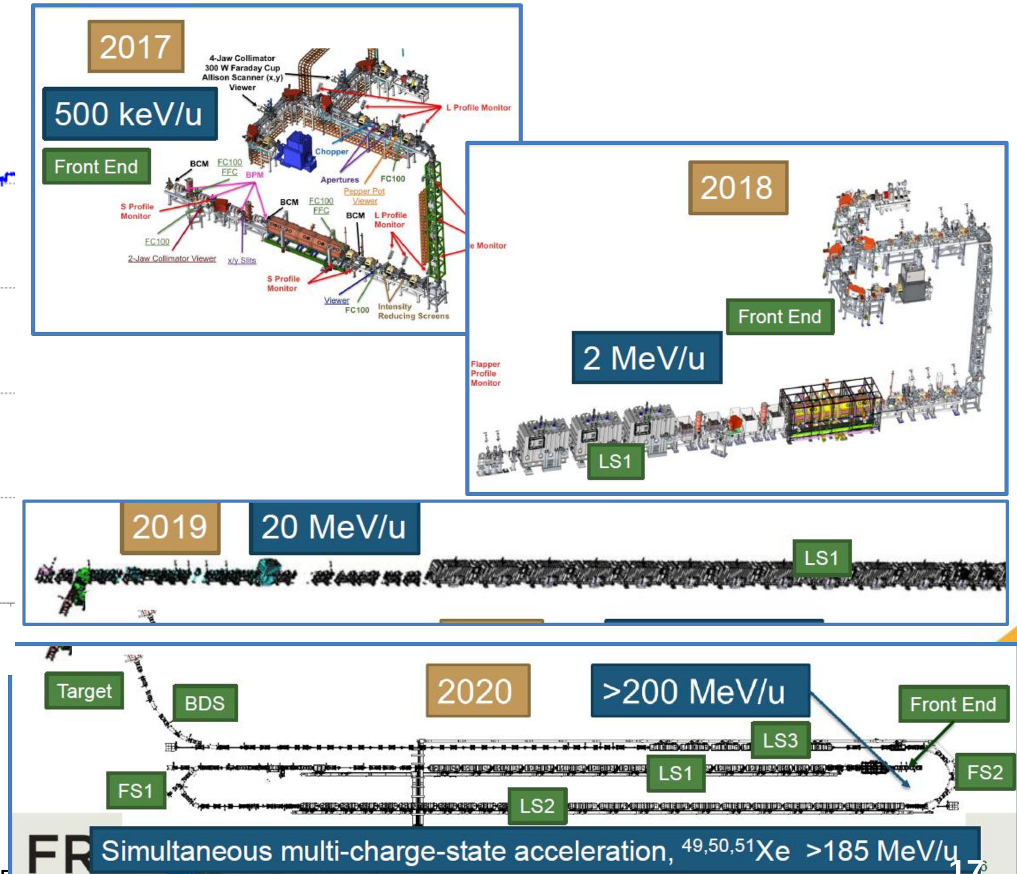
D-Plate & stepwise Commissioning ↔ final Instrumentation

Observation: Some facilities do detailed stepwise commissioning, other installed large parts of the DTL in one step, e.g. FRIB.

- Only few steps at FRIB: Source & LEBT; RFQ, DLT up to 20 MeV/u, 200 MeV/u
- Only few intermediate measurements ⇒ 'empirical settings' aided by automatisms
- Acceleration achieved by automated phase scan
- Ongoing commissioning

FRIB LINAC from Steve Lidia



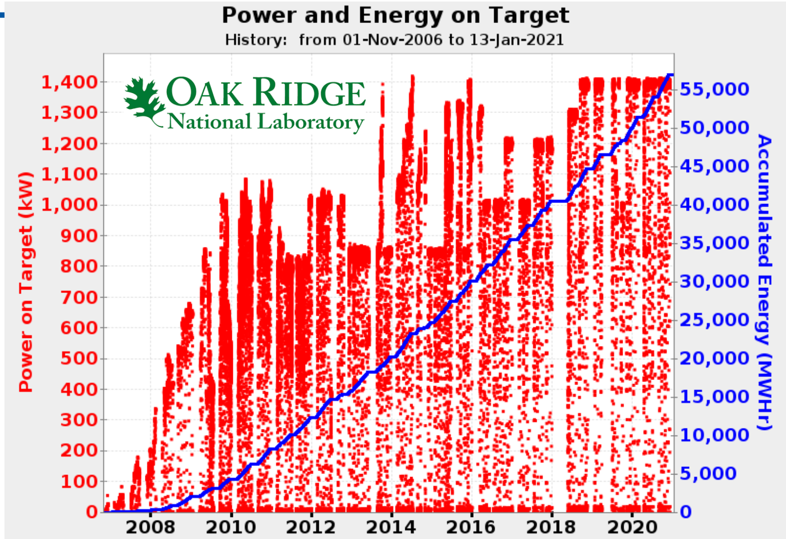


D-Plate & stepwise Commissioning ↔ final Instrumentation

Observation: stepwise com. ↔ fast installation,

Experiences at SNS

- Design values is reached only after many years and 'small step optimization'
- All beam diagnostics were important for improvements
- No clear relation RMS parameters ↔ beam loss



DTL in-line diagnostics at SNS from Alexander Aleksandrov

Instrument	Measured parameter	quantity	Use for commissioning	Use for machine tuning	Use in operation	Use in Beam study
Beam Loss Monitor (BLM)	radiation Ionizing, n	11+12	Yes	Yes	Yes	Yes
Beam Current Monitor (BCM)	beam current	6	Yes	No	No	No
Beam Position Monitor (BPM)	x, y, z position	10	Yes	Yes	No	Yes
Wire scanner (WS)	x, y 1-d profile	6	Yes	No	No	Yes
Differential BCM (DBCM)	In-out beam current	1	No	No	No	No
Faraday Cup with energy degrader (FC)	beam current above energy cutoff	6	Yes	Yes	No	Yes
Laser Emittance Scanner (LES) at SCL only	x,y 2-d emittance; longi. 1-d profile	1	No* added later	No	No	Yes

Longitudinal Emittance Measurement

Observation: At many facilities, the mean energy is measured precisely via ToF by BPMs.

The energy distribution and bunch shape (i.e. long. phase space) is measured rarely.

Mean energy after cavity → important at all facilities:

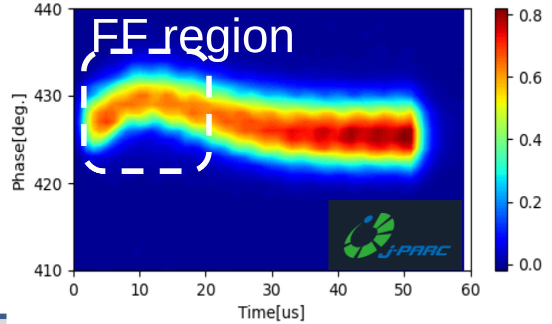
Time-of-flight along the pulse using BPMs

Longitudinal bunch shape measurement

- Bunch Shape Monitor (scanner) is important for beam studies
- Phase space reconstruction using various methods

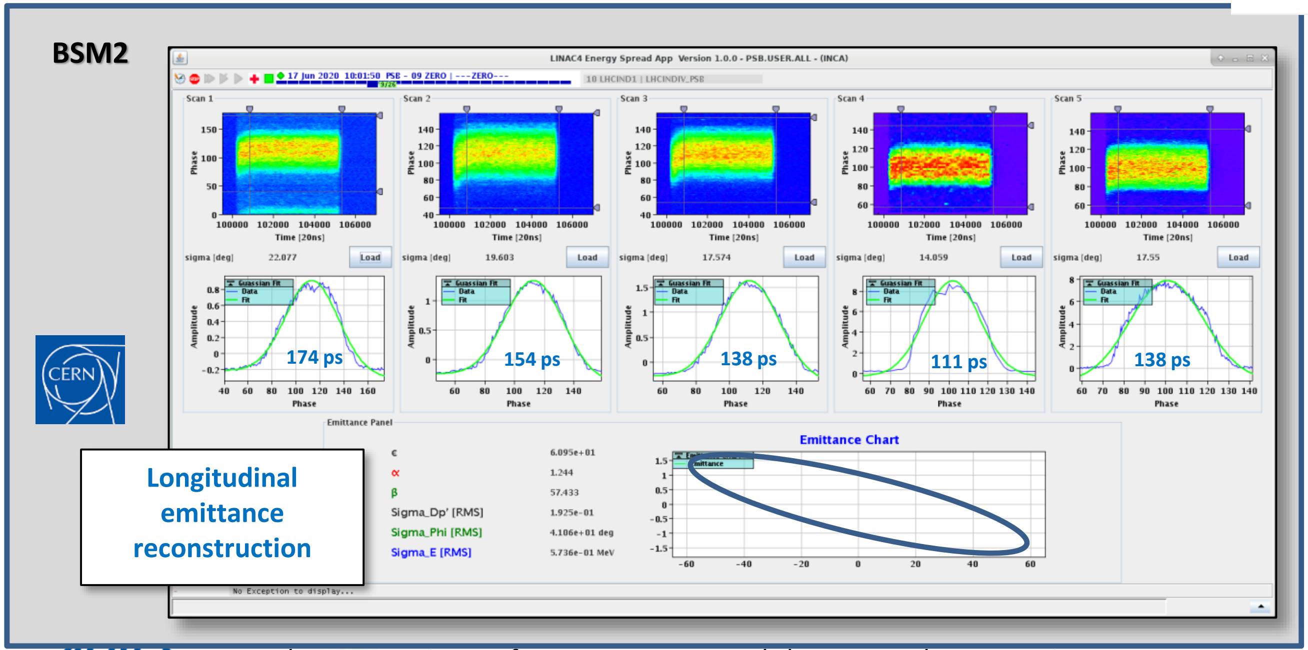
J-PARC bunch shape from Akihiko Miura

Adjustment of the RF-feed forward power



Failure of the RF-feed forward power (example: failure at DTL1, 2 and 3)

CERN LINAC4 from Jean-Baptiste Lallement and Jocelyn Tan



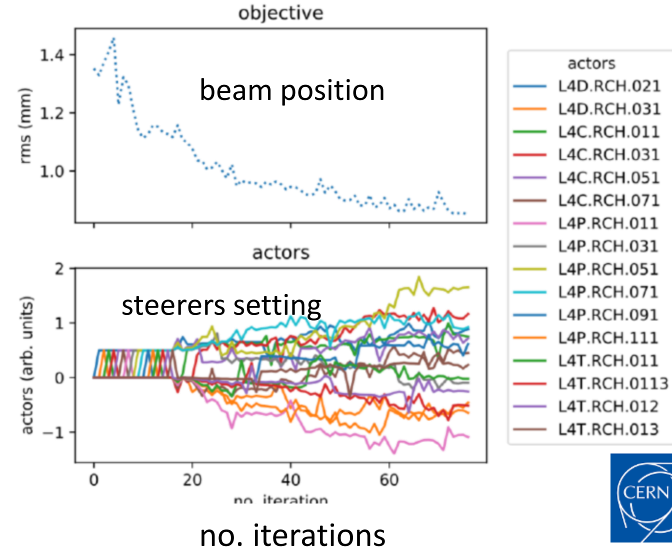
Machine Learning and Reconstruction Algorithms

Observation: Machine Learning and reconstruction algorithms are increasingly important

Machine Learning:

- Machine learning as an operational tool with adaption of existing methods
- Successfully demonstrated, trending technology

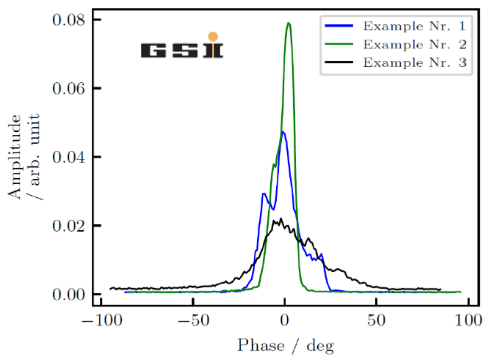
CERN LINAC4 trajectory optimization from Verena Kain

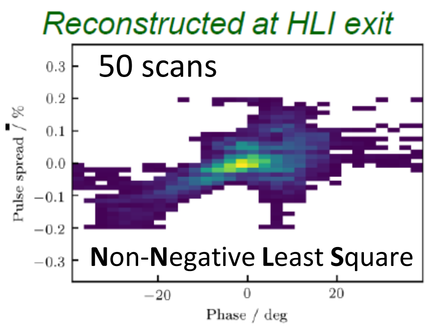


Reconstruction algorithm:

- Measurement for quadrupole or buncher variation reconstruction algorithms for non-Gaussian beams

GSI bunch shape measurement and entrance reconstruction





Conclusion:

- Collection of experiences from almost all hadron LINAC facilities
- Report and documentation of hands-on experiences
- Summary report available

→ conclusion

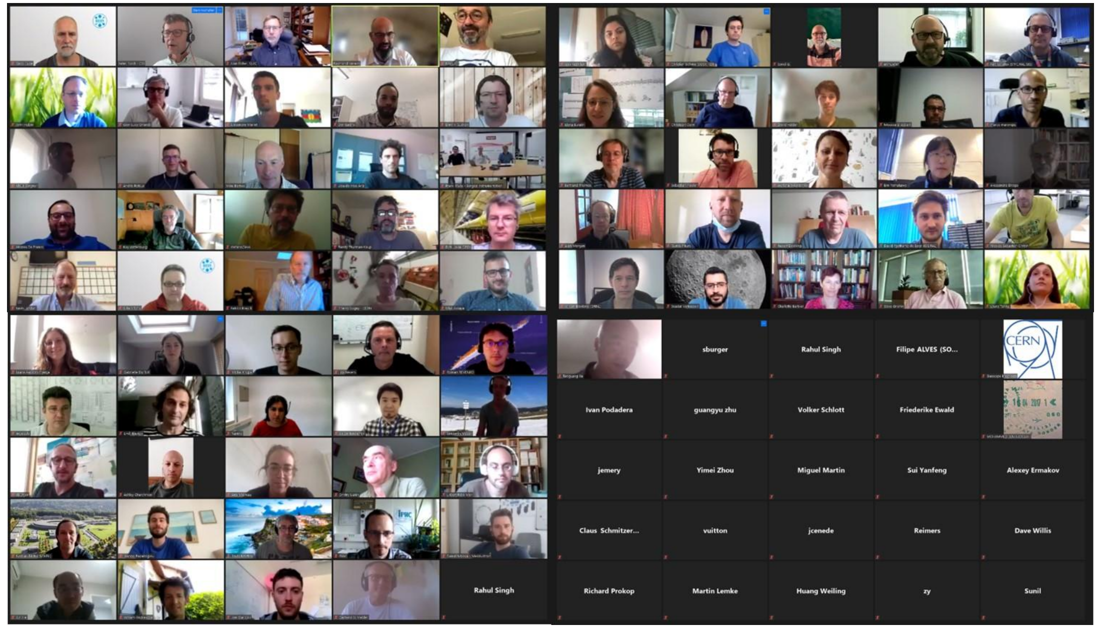
Workshop on Materials and Engineering Technologies

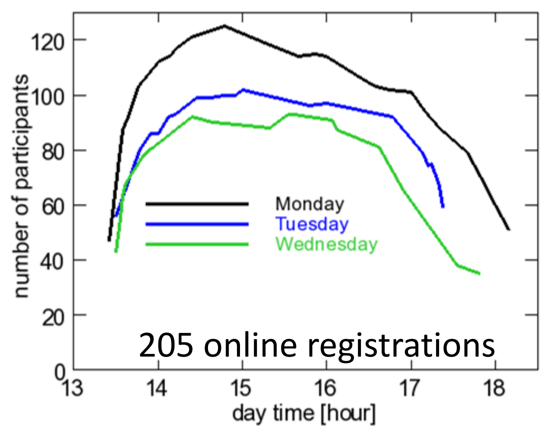
Title: 'Materials and Engineering Technologies for Particle Accelerator Beam Instruments'

Originally planned in Oxford for March 2020,
3 days with 50 attendees and 32 talks

Execution of remote workshop:

- Date: June 21st to 23rd, 2021
- 205 registered participants
  15 Americans, 20 Asian, 170 Europeans
- ≈ 100 simultaneous attendees
- 3 half days at afternoon in Europe
- In total 22 talks, 25 min each
- No pre-recordings
  to keep lively atmosphere
- Break-out rooms for discussion
- Documentation at
  https://indico.cern.ch/event/1031708/





Workshop on Materials and Engineering Technologies

Title: 'Materials and Engineering Technologies for Particle Accelerator Beam Instruments'

→ **Novel applications for accelerator beam instrumentation**

The aims of the Workshop are to review:

- Novel materials and application
- Innovative production methods
- Improved vacuum components
- Information concerning experiences
- Intensify collaborations institutes and industry

Participation of **engineers** (normally not attending conferences) and companies

Summary talk by P. Forck at IBIC September 2021

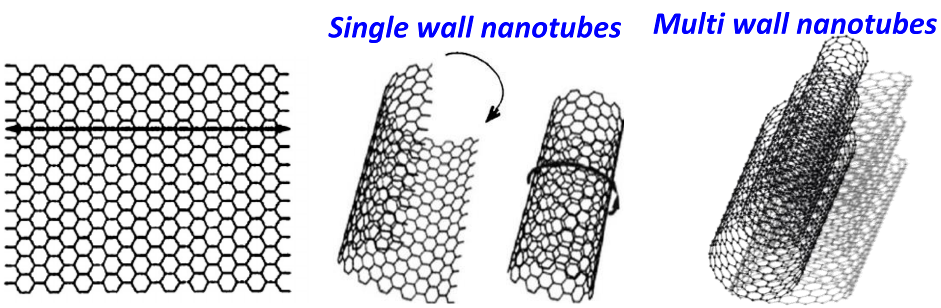
Carbon Nanotubes for fast rotating Wire Scanner

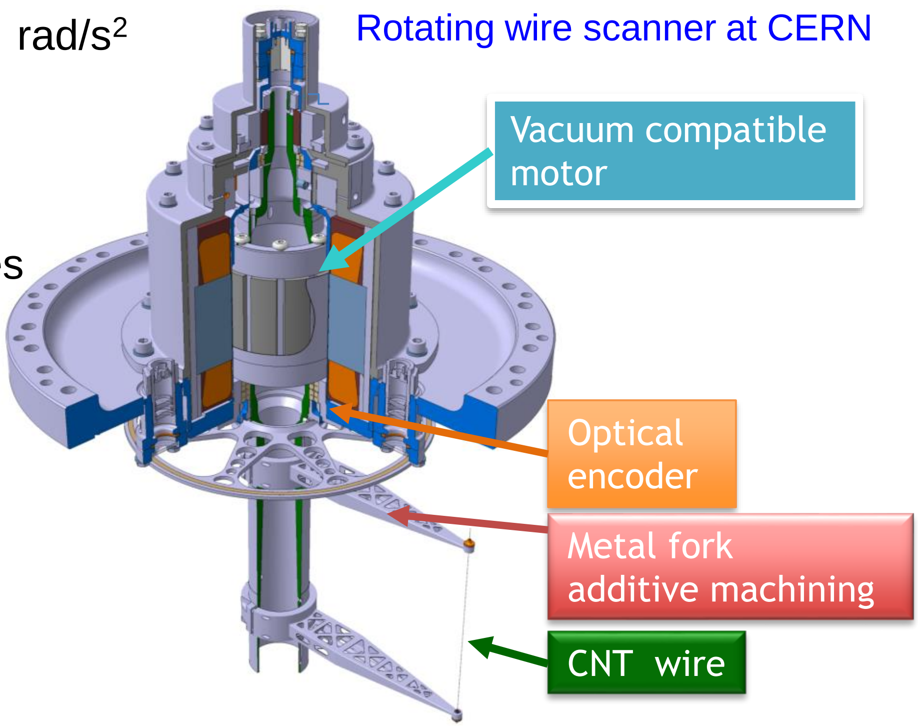
Talk by William Andreazza and Alexandre Mariet on behalf of CERN

Requirements: High speed 20 m/s & acc. 15000 rad/s^2
⇒ mechanical stiffness
⇒ light (low-Z) material
⇒ high temperature tolerance

New techniques for wire: Carbon nanotube wires

Result: CNT wires successfully tested





Mechanical properties of carbon materials

Material	ρ [g.cm^{-3}] Density	σ_{max} [GPa] Tensile strength	E [GPa] Young modulus
CNT (SWNT)[1]	0,02 - 4	up to 150	up to 1e3
Carbon fiber[2]	1,7 - 2,5	0.6 - 4.5	60 - 500
CNT wire[3]	1.1 - 2.1	0.2 - 3.3	20 - 100

'Ashby Diagram': Quantitative Selection Method for Wire Scanner

Talk by John Huber behalf of Engineering Dep. University Oxford and CERN

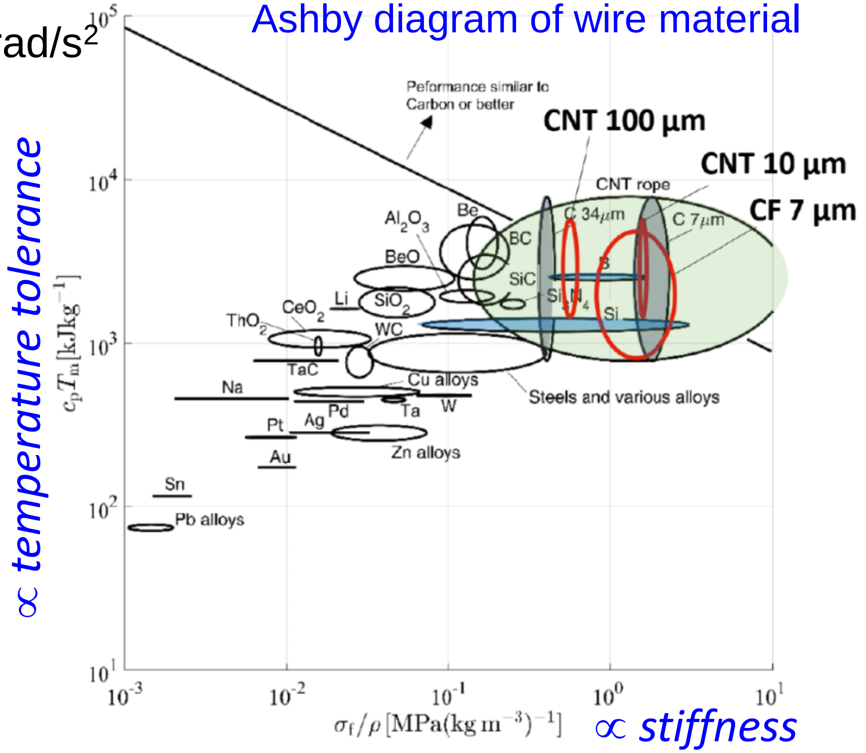
Requirements: High speed 20 m/s & acc. 15000 rad/s²
⇒ mechanical stiffness
⇒ light (low-Z) material
⇒ high temperature tolerance

Quantitative selection method: Ashby diagram

Result:

- Clear selection criteria
- CNT robes have superior performance
- Test of open topics performed
  e.g. stat. variation of breaking strength

Ashby diagram of wire material



Mechanical properties of carbon materials

Material	ρ [g.cm⁻³] Density	σ_{max} [GPa] Tensile strength	E [GPa] Young modulus
CNT (SWNT)[1]	0,02 - 4	up to 150	up to 1e3
Carbon fiber[2]	1,7 - 2,5	0.6 - 4.5	60 - 500
CNT wire[3]	1.1 - 2.1	0.2 - 3.3	20 - 100

Carbon Nanotubes for Stray Light suppression by black Coating

Talk by Ben Jensen on behalf of company NanoSystem in collaboration with CERN

Requirement: In-vacuum suppression of stray light for optical monitors

Method: Spray coating of carbon nanotubes
Post processing by backing

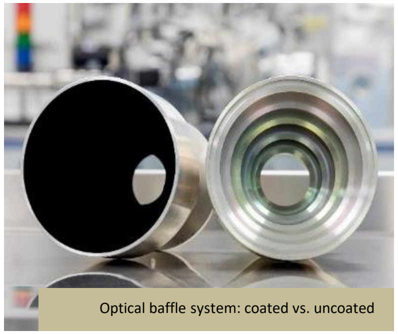
Product: 'Vantablack', several types available

Results:

- Broadband (UV to NIR) reflection below 0.5 %
- Acceptable mechanical properties
- Low vacuum outgassing
- Radiation hard

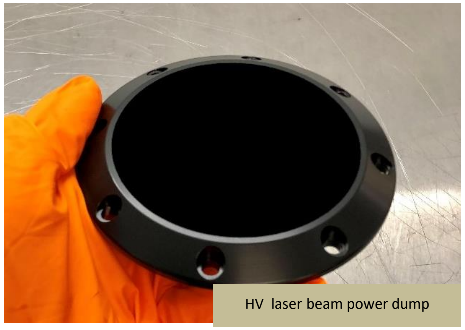
Tests at CERN performed

Production examples



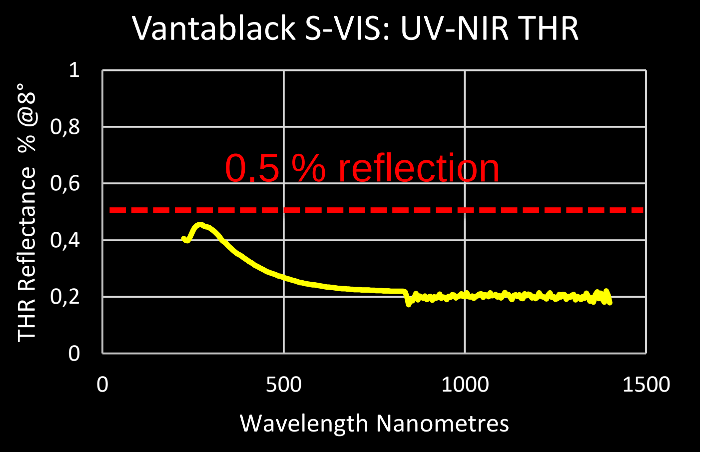
Optical baffle system: coated vs. uncoated

UHV Instrument module coated with S-VIS



HV laser beam power dump

Example: Full hemispheric reflection



Company background
in space technology

Scintillator made of Boron Nitride Nanotubes

Talk by Kavin Jordan on behalf of Jlab, collaboration with BNL, GSI & Rice University

Method: Disk made of ∅ 2- 6 nm Boron Nitride nanotubes BNNT

Advantage of BNNT:

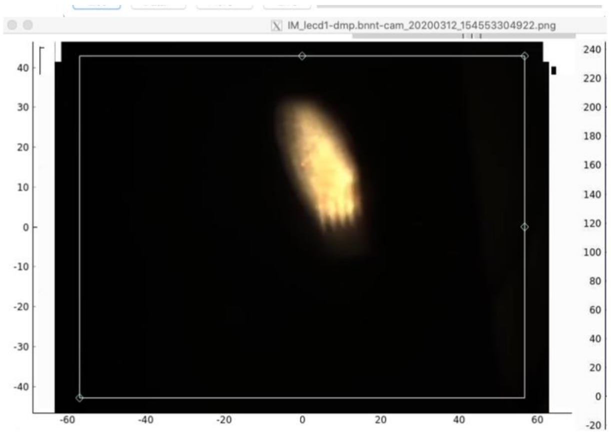
- Low density ⇒ robustness for high power beam
- Good mechanical stability, large size possible
- No blooming due to separated tubes
- Fast decay time ≈ 10 ns

Tests: Electron beam at Jlab & BNL, 1.6 MeV < E_{kin} < 7.4 GeV
Ion beam at GSI, E_{kin} = 4.8 MeV/u

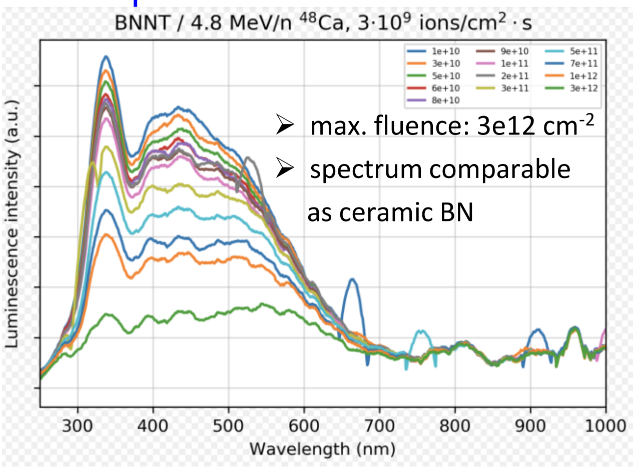
Results:

- Light yield ≈ ¼ compared to Chromox
- Radiation damage tested
  (e.g. 8 % decrease for 80 mC electrons)
- Surface modification investigated

Example: Test at BNL LEReC



Example: Test with ions at GSI



→ conclusion

Adaptive Manufacturing: Example of fast Wire Scanner

Talk by Ana Miarnau on behalf of CERN

Adaptive Manufacturing: Manufacturing parts by adding layer upon layer of material

Examples of methods for metals: DED & EBM

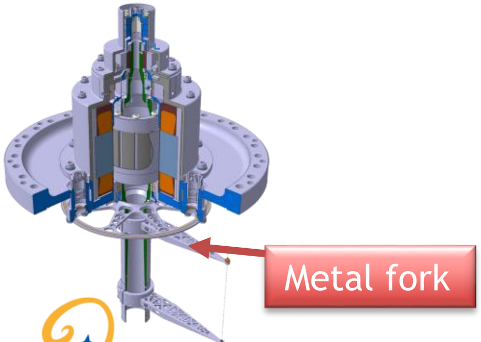
Design of wire scanner fork:

- High stiffness in two planes and
- Low inertia
- Titanium alloy Ti-6Al-4V chosen

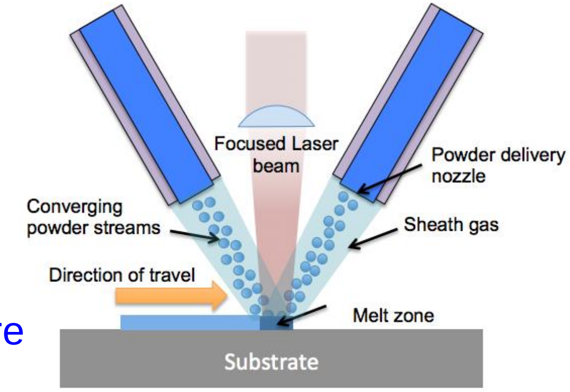
Series of 56 forks produced in 3 batches

Results:

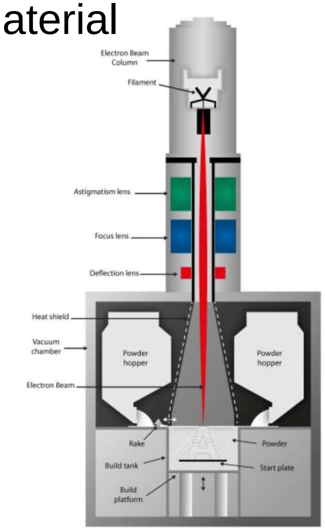
- Fully functional
- Vacuum outgassing comparable to traditional production



Example: Fork for wire scanner at CERN



Powder fed:
Direct
Energy **D**eposition



Powder bed:
Electron **B**eam
Melting

Magnetically coupled Vacuum Drives

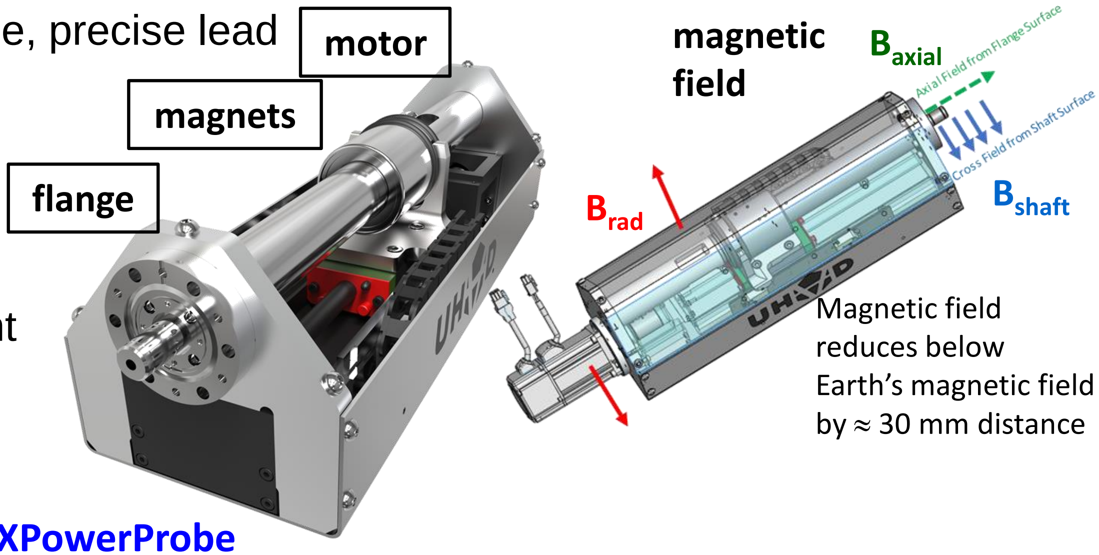
Talk by Nick Clark on behalf of company UHV-Design, collaboration with CERN, PSI

Technique: Magnetically coupled push-pull drives for UHV

Advantages: Bellow-free ⇒ long lifetime, precise lead

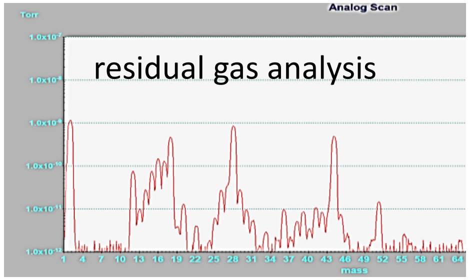
Achievements:

- ➢ Large magnetic coupling force
- ➢ Low residual magnetic field, e.g. 50 µT at 30 mm distance
- ➢ Metal rolling bearing without lubricant
- ➢ Very low outgassing, suited for UHV
- ➢ High speed possible, up to ≈ 10 m/s



Standard PowerProbe

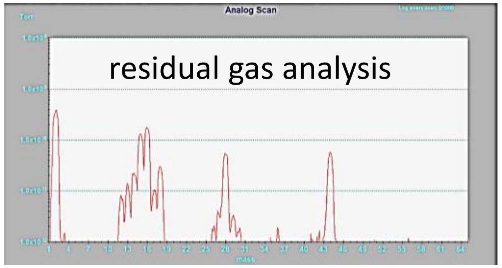
Sliding PEEK bearing arrangement



- May introduce trace levels of organic material
- Pressure increase ~2 decades during translation

XPowerProbe

Metal rolling bearing arrangement



- Ultra-clean operation
- <1 decade pressure increase during translation
- < 0.5 Linear friction of standard Power Probe

Novel Metal Sealing for large Flanges

Talk by Martin Lemke on behalf of DESY

Challenge: No CF-fange-type gaskets possible for large rectangular flanges

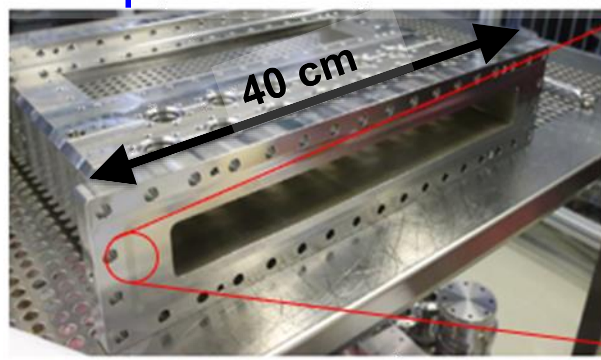
Novel sealing technique: Many small grooves to press gasket

Advantage: Lower precision needed as for flat surface sealing

Result:

- Production method established
- UHV performance approved
- At least 20 time reusability
- Suitable for all flange shapes

Example: XFEL BPM camber



Commercial 'AMF-Writer'

Production on CNC using 'AMF Writer tool '

In-person versus remote Workshop

Pros of virtual meeting:

- Permanently ≈ 100 participants as no travel required
  Face-to-face meeting typically ≈ 50 attendees
- More attendees from oversee
- Good mixture between experts on various subjects
- Contributions to discussion by break-out rooms
- 45 min final discussion with sufficient contributions
- Maybe: people are keen for workshops
  related to many cancellations in 2020 & 2021
- Afternoon acceptable in all continents

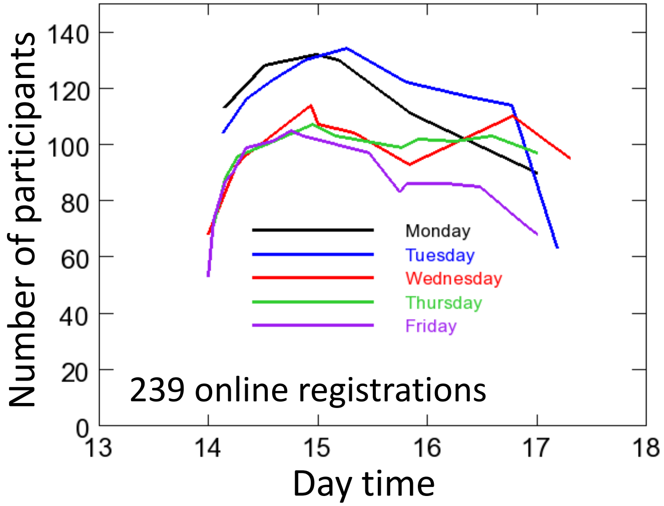
Cons of virtual meeting:

- Much less direct interaction
  as face-to-face meeting
- No initialization of collaborations
- Not much fun as a group event

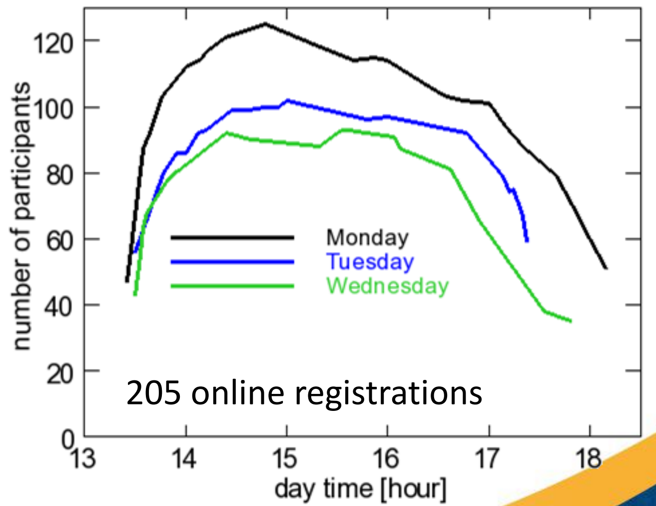
Personal contact cannot be initialized

⇔ we can 'digest' virtual meeting for a period,
but personal contact is mutual in science

Workshop on LINAC commissioning



Workshop on mechanical issues



Other Type of special Workshops

Other special German regular event (not related to ARIES):

Frame: ‘Project oriented Funding’ by Helmholtz Association (BESSY, DESY, GSI, HZDR, KIT)

One dedicated sub-task in accelerator science on ‘Beam control, diagnostics & dynamics’

- Annual meeting organized by Holger Schlarp (DESY) and Erik Bründermann (KIT)
- 2.5 days in-person meeting (2020 & 21 only remote)
- 50…70 mainly young attendees
- Talks, speed talks and posters mainly by Master-, PhD students and post-doc from Helmholtz
- Tutorials by senior scientists

⇒ Networking between students and post-docs

⇒ Well appreciated by young participants

Assessment for ARIES-ADA

Mission accomplished for ARIES-ADA in 2017 to 2021:

- Workshops related to **one** special subject acts as an addition to conferences
- Inclusion of engineers and PhD-students is a central pillar for tech. realization & knowledge transfer
- Focused talks on achievement & failures (you can gain for others: '…don't do a mistake twice…')
- Large interest within the community: ≈ 100 attendees online, discussion in breakout rooms
  ≈ 30 - 90 attendees for in-person meeting
- Well appreciated by the beam diagnostics community: 4 summary talks at IBIC conference

My personal experience and organizational view to ARIES-ADA:

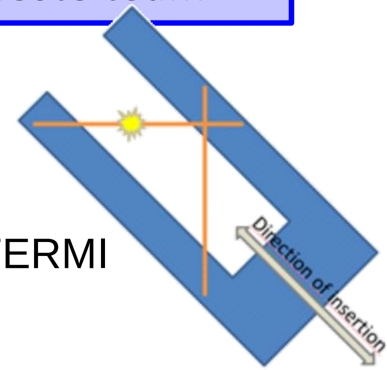
- There are many things to learn from other labs' experiences ⇒ very valuable workshops
- Must be an **actual** topic ⇒ interest by many people to achieve 'critical mass',
  ⇔ should be in the actual interest of the organizers
- No repeating events as subject is too special ⇒ '…you participate either now or never…'
- Pleasure atmosphere & small talks (e.g. **one** hotel to keep people together) are essential for collaborations
- Advantage: Financial budget (in total 160 k€) to cover part of the travel costs
- In-person meeting are required to **establish** collaborations
- Remote meeting: Some advantages (e.g. more attendees) but doesn't support personal contact
- Workshop organization: Large amount of man-power needed (online ≈ 3, in-person ≈ 6 FTE weeks)
- It makes fun to host such workshops and invite people
- **However,** I would not have invested such efforts without 'pressure' via ARIES-ADA

Thank you very much for your attention!

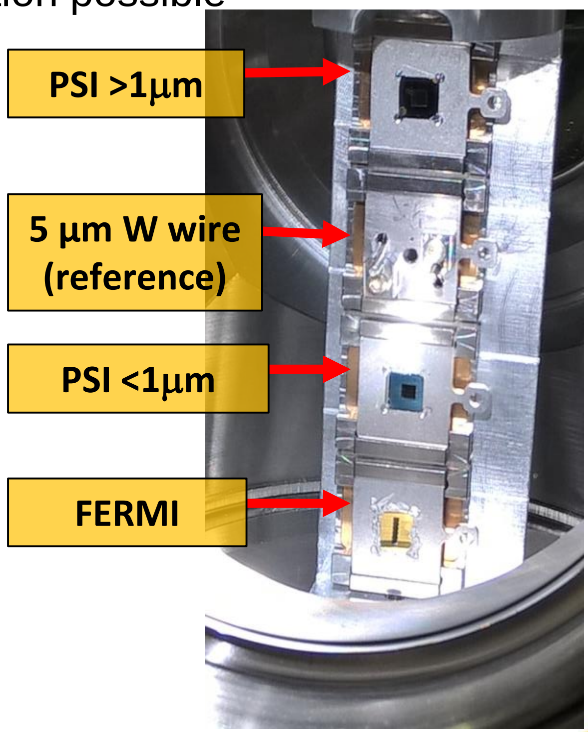
Back-up slides

Ultra-thin Wire for linear Wire Scanner

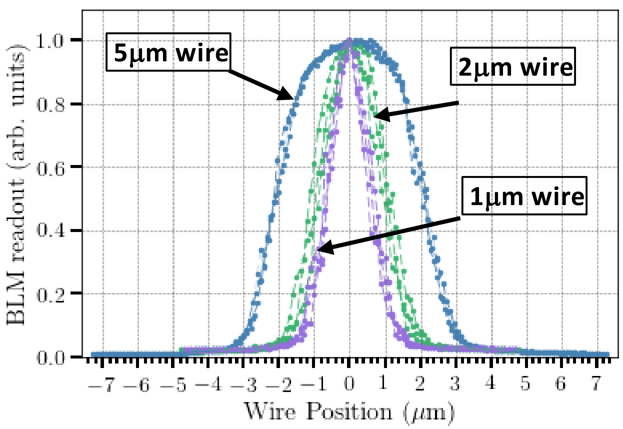
Talk by Gian Luca Orlandi on behalf of PSI, Elettra and IOM-CNR Trieste team



Requirements: Spatial resolution of below 1µm ↔ thinner wire below ∅ 1 µm
New techniques: Fabrication via Nano-lithography
with integration wire+fork in a unique structure
Present status: **Free-standing** WS independently nano-fabricated at PSI & FERMI
Result: Sub-µm spatial resolution ~250 nm, beam clearance ~ 2 mm
Tomography for quadrupole variation possible
Future plans: Beam clearance ~**10 mm**



Test at SwissFEL PSI



Outgassing rates of Polymers for UHV Applications

Talk by Ivo Wevers on behalf of CERN

Challenge: Insulator for UHV applications

Method:

- Pumping speed measurement
- Residual gas analysis
- Comparison of
  Maylar, PEEK, Kapton & Vespel
- Relation to in-air storage

Result:

- Kapton has lowest outgassing
- Decrease outgassing by
  - Baking to 100 – 200^{0}C
  - Storage in dry atmosphere
  - Minimizing exposure to air

Quantitative 3-step model applied
(moisture evaporation and bulk diffusion)
Detailed report available

Example: Outgassing for different sample sizes as a function of time (log-log plot)