The ARIES JRAs:

Innovation, Thin Films, Electron Lenses

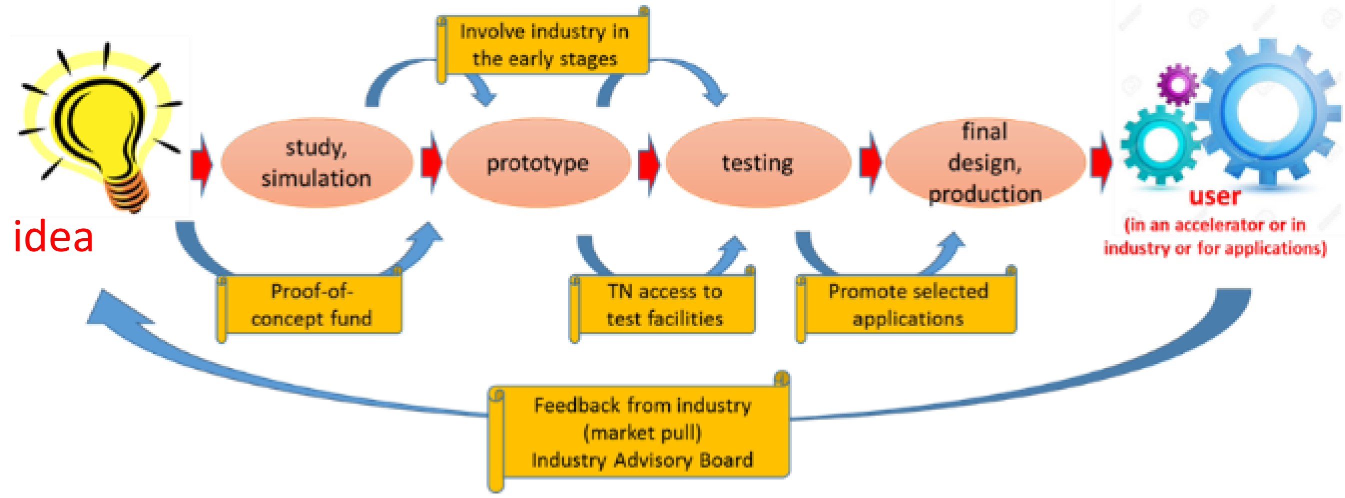
Mid-term Review

25 September 2019

Maurizio Vretenar, CERN, Project Coordinator

ARIES is co-funded by the European Commission Grant Agreement number 730871

The ARIES Innovation Strategy



In ARIES Innovation is a Joint Research Activity

Support to all stages of the innovation process:

- **Proof-of-concept innovation fund**: for Business Plan preparation, market assessment, demonstration in connection with industry of the technological viability of new ideas.
- **Industrial Advisory Board**: provide business consultation (eg. business plans) and support market assessments ("market pull").
- **ARIES meets industry events**
- **3 co-innovation programmes with industry:**

- breakthrough in the cost per kAm of industrial High Temperature Superconductors
- production of materials for extreme thermal management
- production of a standardized timing for medical and industrial applications.

WP14 objectives

Task 14.1. *Coordination and Communication – M.Losasso* → usual management task

Task 14.2. *Proof-of-Concept innovation fund - M.Losasso* → PoC fund is used to demonstrate commercial viability of *selected* technologies investigated in the frame of ARIES, and supported by market assessments, evaluations and business plans.

- *Set-up the innovation criteria for eligibility, selection and award of PoC fund*
- *Monitor the funded project developments.*
- *Support the prior market assessment and the commercial viability of the technologies.*
- *Support perspective studies on industrial application of EUCARD technology.*

Task 14.3. *Collaboration with industry - M.Losasso* → should be the task linking the activity of the industrial partners and ARIES beneficiaries and also the task providing support actions for PoC management.

- *Set-up an Industrial Advisory Board, defining its mandate and scope.*
- *Organize and manage the ARIES meets industry event*
- *Manage the possible IP in ARIES project(s), the licensees and the partnership with industries.*
- *Implement Market pull actions.*
- *Disseminate the output of R&D developed in the project.*

+ 3 additional tasks, one per co-innovation project

PoC: where we are

The ARIES Proof of Concept (PoC) innovation fund is intended to provide financial support to projects at their very early stage or pre-seed stage with the scope of turning research outputs into a proposition that has impact, innovation and technology transfer potential. This deliverable reports the

- Sept 2017 → STC approves **D14.1**, stating criteria and management of PoC, including method for project selection
- End of 2017 → PoC dedicated web site is made public - the call is open, end is March 2018
- May 2018 – Assessment and Evaluation report finalized for the 10 proposals presented.
- June 2018 – STC invites to CERN first 4 projects to present their proposals. Projects received formal awarding on June 15th.
- August 2018 - Project Coordinator notified winners about administrative procedures.

Only 50k budget per project but a lot of interest (10 proposals) – in 3 out of 4 cases this budget has been used to leverage additional budget from other sources, in all cases used to receive more internal support.

Projects awarded

- Atomic Layer Deposition: innovative approach for next generation particle accelerators – CEA -Dr. T. Proslier
- Accelerator Diagnostics using innovative Adaptive Optics (InnoAdo) - University of Liverpool - Prof. C. P. Welsch
- Development of hybrid electron accelerator system for the treatment of marine diesel exhaust gases - RTU - Prof. T. TORIMS
- Investigation of new methods for the manufacturing of Cu-C composites with tailored thermo-physical properties - RHP Technology GmbH – SME - Dr E. Neubauer

PoC: Atomic Layer Deposition

Team: *T.Prosleir,* A.Claire, B. Delatte, R. Dubroeucq - CEA & Zanon

- *Atomic Layer Deposition:*
- Control at the atomic level of thickness and chemical composition of films on large surfaces.
- Excellent conformality complex geometrical structure, aspect ratio up 1:10 000.
- Large Palette of available materials.
- Surface multi-functionalization.
- *Commissioning of the ALD laboratory progressing*:

- Laboratory set up (gases supply, sample oven, computers..) √
- *Students hired* (B. Delatte + R. Dubroeucq)√
- *Funding secured* (Oven for ALD on cavities 135 k€ + Faraday cage 75k€) √
- Design ALD chamber √
- Some parts received (8 weeks delay for the chamber itself and counting - Neyco)
- Design and order (Vacom) adaptative parts for ALD on cavities √
- Oven set up built for clean room gaz thermal treatments. √
- Preparation of 3 x 1,3 GHz (EPV) cavities baseline for ALD depositions √

ALD - deposition

Thermal treatment

PCT - characterization

PoC: InnoAdo

Team: *C.Welsch*, M.Ibison, J.Wolfenden, M.Vujanovic

Advanced Optical Imaging systems based on Digital Micro Mirror Devices → beam diagnostic

D-Beam

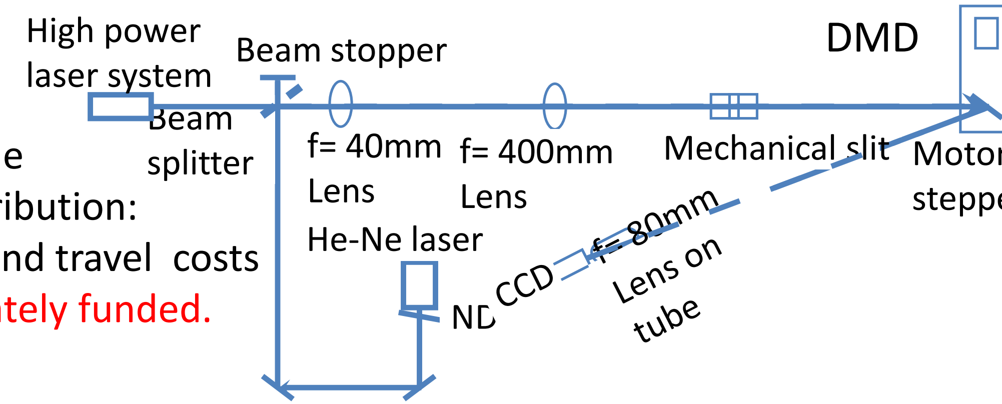
Project Team

Main researcher has also taken on directorship of ***D-Beam*** spin-out company.

Student participation support progress

Expenditure

Estimates based on an 18M total duration of the project; now 6 M intothe project. ARIES contribution: Main researcher (50%) + additional hardware and travel costs (small proportion, to €10k). Other staff separately funded.



Outlook on *Experimental Studies*

Optics prepared for DLS beam-time, delayed but still scheduled for Q2 2019

Alternative facilities investigated for later 2019; progress made with non-beam studies

Outlook on Commercial impact

Initial focus is on light-source sector, building on the existing relationship with DIAMOND; fruitful working contacts established at MAX IV in Lund, through experimental work on optical diagnostics. It is planned to address the linear accelerator/FEL market, through beam-time experience on CLARA at Daresbury and CLEAR at CERN

PoC: investigation of Cu-diamond…..

Team: *E.Neubauer*, M.Kitzmantel, M.Tomut…

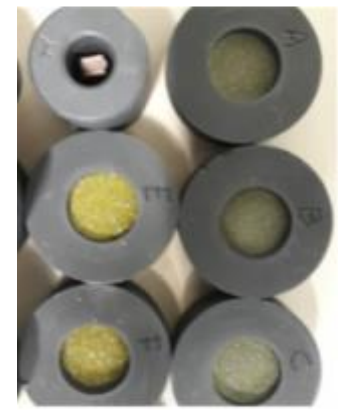
…..composites with tailored thermo-physical properties → collimator, power electronic, cooling systems for high power lasers need materials with high K, low CTE, good electrical conductivity

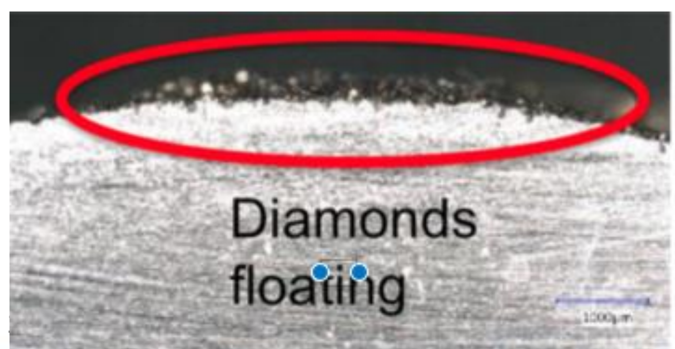
In PoC RHP investigates *Plasma Transferred Arc process and cold gas spraying*.

LoI and expression of interests have been presented by industries working in sector of extrusion machines and power electronic applications

So far progress made on feedstock preparation for further processing.

And working on different Cu alloys, minimization of oxidation of the matrix, reduction of the thermal impact to protect the diamonds, improve uniformity of diamond arrangement





WP14.3 (relations with industry) highlights

- ✓ Set-up the Industry Advisory Board that has participated in the selection of PoC projects and has provided advise on how to address the market.
- ✓ Accelerator-Industry co-innovation Workshop organized on Feb 6/7 2018, in Brussels, jointly with AMICI and TIARA.
- ✓ A workshop organized with AMICI in CERN, on May 16th 2018, with participation of IP experts from 4 EU laboratories, to *address the problematic of IP in collaborations academia-industry.*
- ✓ An industry-academia event organized in Budapest, on March 8th 2019, with participation of about 40 experts from EU laboratories and industries on *Additive Manufacturing.*

tasks in partnership with industries: WP14.4

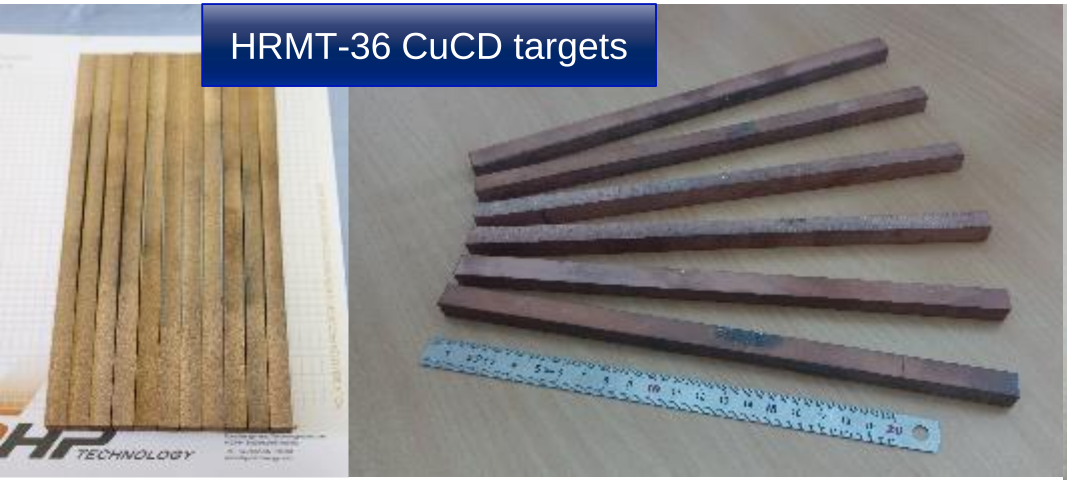
Task 14.4. *Industries for resistant materials – F.Carra*

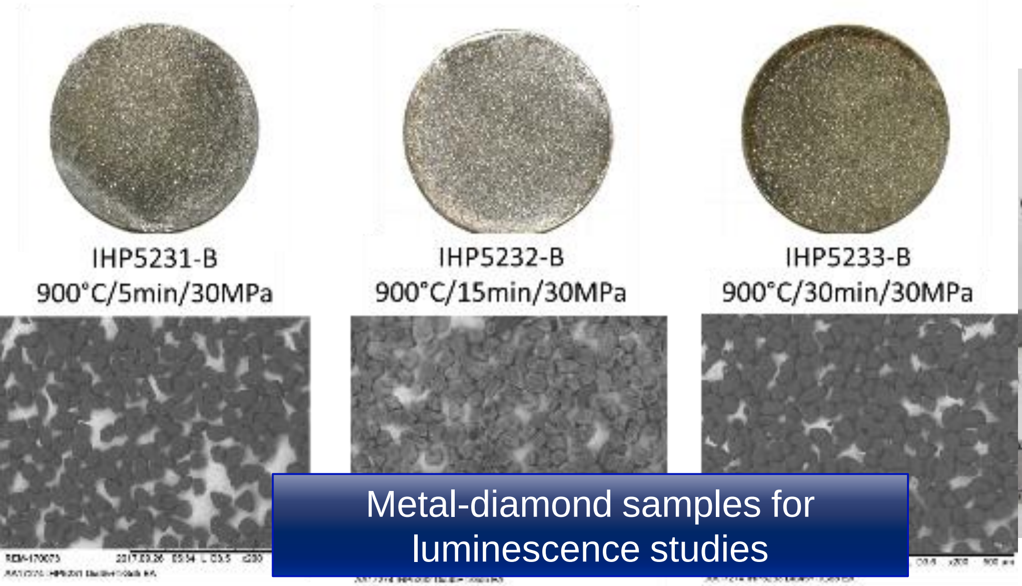
- *Contribute in material development in collaboration with WP17 (Material for extreme thermal management).*
- *Produce samples for the R&D (both for extreme T, than for AM)*
- *Demonstrate feasibility of production for industrialisation (with large dimensions, small tolerances*

….materials for accelerator components, beam instrumentation, new applications

Description	N. samples required	N. samples produced		Composition and envisaged testing method
Carbon-based specimens for collimators	50	36	61	Ceramic-graphite for thermomechanical characterization at CERN
		25		Molybdenum-graphite for dynamic tests at PoliTo
Metal-diamond specimens for collimators	20	11	28	Copper-diamond for beam impact tests at CERN HiRadMat facility
		17		Copper-diamond for thermomechanical characterization at CERN
Metal-diamond specimens for luminescence screens	10	10	10	Diamond-based composites with different metallic substrates for testing at CERN and GSI

WP14.4 - D14.3 highlights



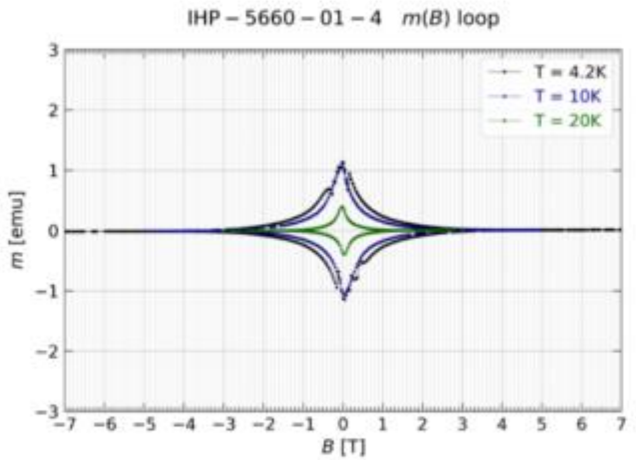


W14.4 - MgB_2 AM

Recent tests in UNIGE provide very encouraging results !!

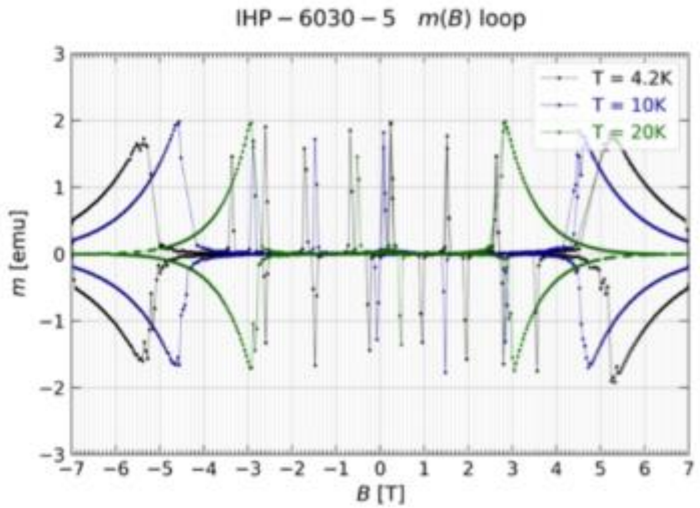
thanks to D.Mattera, C.Senatore (UNIGE)

T_c	27 K
$T_{c\ onset}$	31 K
$B\ (J_c = 10^4 A/cm^2,\ T = 4.2\ K)$	0.20 T
$B\ (J_c = 10^4 A/cm^2,\ T = 10\ K)$	0.10 T
$B\ (J_c = 10^4 A/cm^2,\ T = 20\ K)$	0.00 T



from first batch of samples (October 2018)

T_c	38.3 K
$T_{c\ onset}$	39.2 K
$B\ (J_c = 10^4 A/cm^2,\ T = 4.2\ K)$	5.85 T
$B\ (J_c = 10^4 A/cm^2,\ T = 10\ K)$	5.05 T
$B\ (J_c = 10^4 A/cm^2,\ T = 20\ K)$	3.25 T



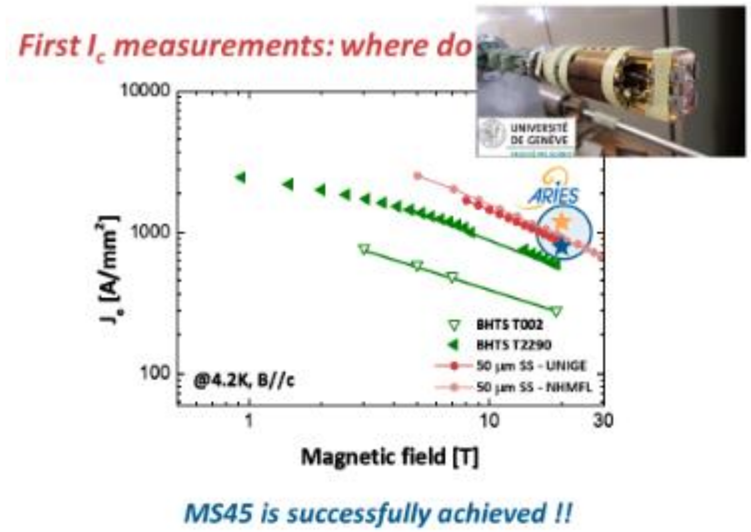
to second batch of samples (March 2019)

WP14.5

Task 14.5. ***HTS cable development for accelerators magnets- L.Rossi*** → *Define the requirements of the new generation higher performance-lower cost HTS tape*

- *Define the new process for halving the production cost and doubling the Jc eng.*
- *Production of pilot production (5 to 15 m long) and verification of higher performance (Jc eng > 600 A/mm2 - vs. 400 for Eucard2 - at 4.2 K and 20 T).*
- *Production of at least two long lengths (80-100 m) and verification of the electrical, mechanical and magnetic properties (see above).*
- *Test of the two long lengths in a dipole magnet capable of 5-8 T*

- In spring 2018 BHTS produced the record J_{eng} on short sample with 50 µm substrate
- BHTS made the first long length (> 25 m) but in two pieces



W14.5: Challenges and plan

- Various attempt to produce very long lenght (from 30 to 100 m): mild result in terms of yield: only 25 m in two pieces with record current
- Strong tape bow with 50 µm thickness; problem not easy to solve in an industrial way.
- In production currently some 200 m of material with reduced coating to keep very high J_{eng} > 600-800 A/mm at 20 T 4.2 K.
- The total material put in working was 1000 m; we expected to have 4-500 m of high current , while the results are less than half (big effort from BHTS).
- So far the technical results are «easier» than industrialization process.
- Discussion with the company to overcome the issues are on-going

WP14.6 : Accelerator Timing System

Task 14.6.–*J.Gutleber* → Industrialization of REDNet Accelerator Timing System

Bring lifecycle and documentation to Identify cost reduction levers, review architecture, design, BOM - Assess market opportunities, identify potential customers - Make specifications, BOM, user documentation openly accessible

Central Timing System is a distributed and scalable system for syncronizing the operation of numerous devices distributed across the accelerator (beam diagnostic, power supplies, i/o digital....)

CTS developed based on CERN know-how.

Cosylab and CERN together developed a similar system called RedNET for the project MedAustron.

In the scope of ARIES, REDNet system has been upgraded, customized and supplied to a specific user (ADAM)

WP14.6 : Accelerator Timing System

Working with industrial customer is helping to identify areas of improvements and perform gap Analysis on existing and expected functionality

In August the first prototype of timing cards with the new Field Programmable Gate Array chip will be developed.

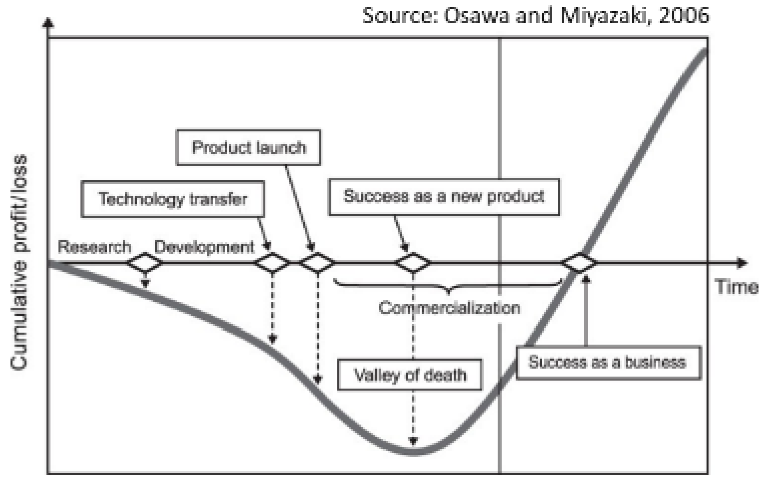
CERN & COSYLAB with AVO-ADAM are porting the FPGA firmware of the timing system from the old FPGA to the new one.

The ship exhaust project – an ARIES flagship

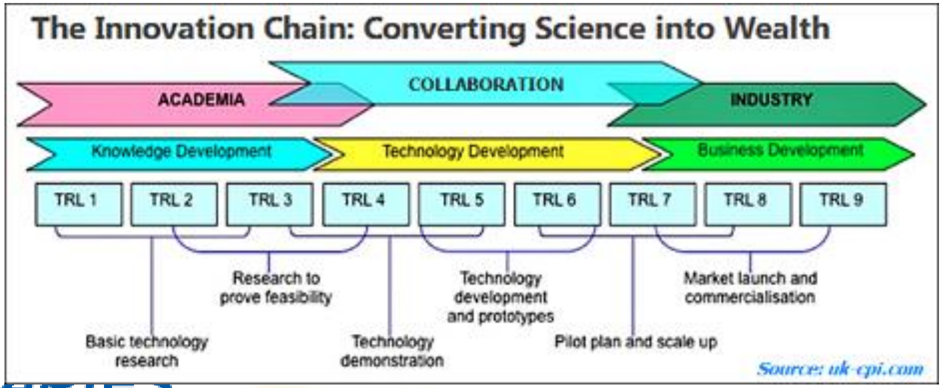
A flagship activity for both content and method

The ship exhaust project – our innovation flagship

Goal: raise the TRL level of an innovative idea of societal use of an accelerator technology and bring it close to market, with only minimum funding available.



In practice:
Cross the valley of death, with no water!

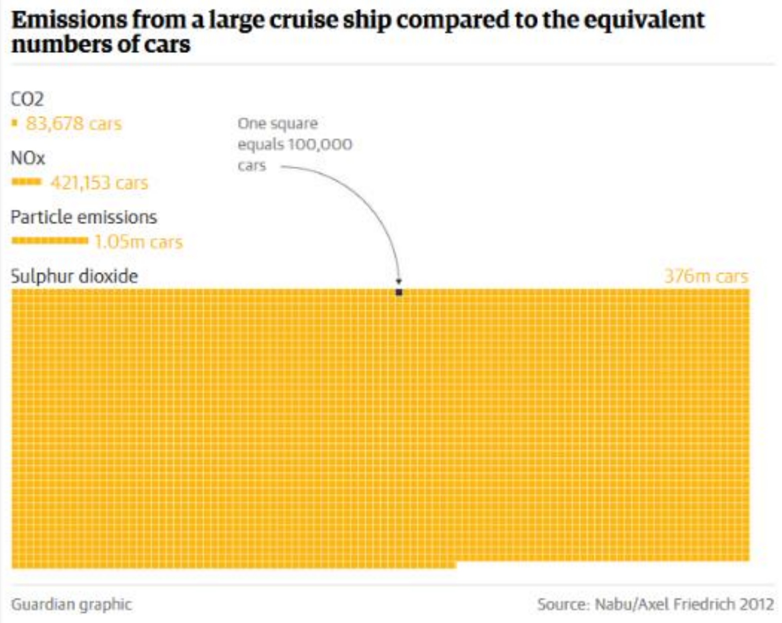


STRATEGY:

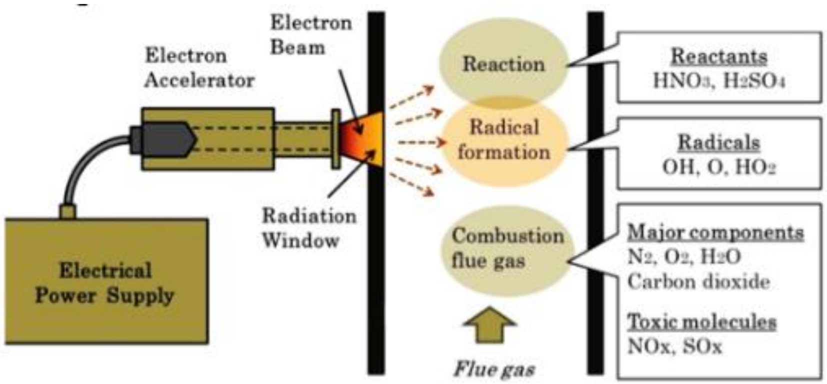
1. The ARIES Network (in this case WP3) identifies the idea, attracts collaborating partners with the required competences, supports the early studies (TRL 2-3).
2. The ARIES Proof-of-Concept supports the early prototype, structures the collaboration, and attracts additional partners and funding (TRL 4-5).
3. Another programme supports the full-scale prototype and the market plan (TRL 6-7).

The idea

PoC Team: *T.Torims*, A.Chmielewski, F-H. Rögner, R.Edgecock, I.Bland, M.Sienkiewicz, A.Pryzowicz,



- Maritime traffic is the largest contributor to air pollution in the world (SOx from heavy oil with high sulphur content, NOx and PM from diesel operation)
- New stringent regulations will be applied from 2020 to limit emissions
- Shipping companies are looking for new solutions to keep their fleet running while complying with the new legislation



Idea from the INCT (Inst. Nuclear Chemistry and Technology) of Warsaw to use a small (few keV) electron accelerator to break the large molecules (SOx, NOx and PM) and then remove the radicals with a small conventional scrubber (water jet cleaning, commonly used for SOx).

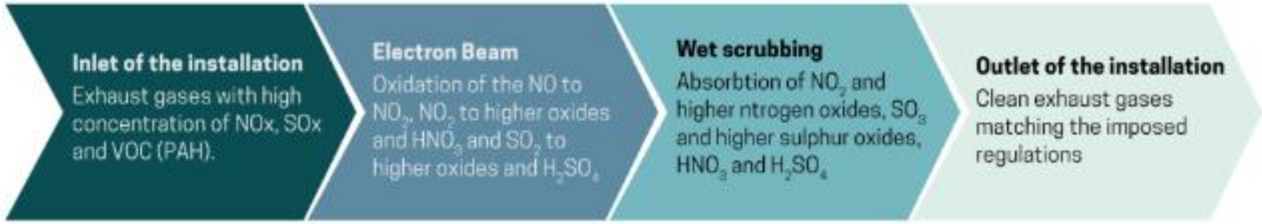
INCT holds a patent on this process, has tested it in a small laboratory environment at the Institute, and presented it in the ARIES WP3

ARIES PoC

The Network has attracted other interested partners (Riga Technical University, with experience in accelerators and maritime world, Fraunhofer Dresden with competences in design and production of industrial electron accelerators, CERN with competence and reputation) that have submitted an application for the PoC (50k from ARIES, about 100k from the partners) to test the system in a real environment.

The Network is used to collect competences and build trust (INCT is sharing the rights to its patent…)

Principle of the hybrid EB-wet scrubber exhaust gas cleaning technology



The PoC test – Riga Shipyard, 5 July 2019

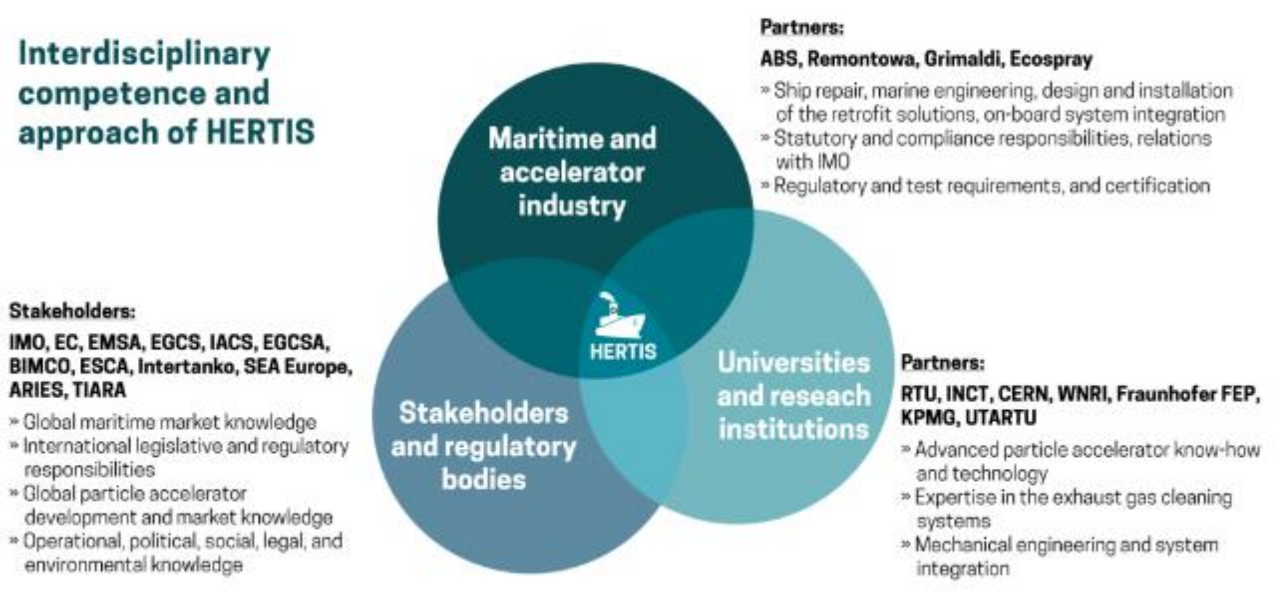
Installation completed just on time to use an electron accelerator system on truck from Fraunhofer Dresden commonly used to treat crops – it had to be back in Germany at mid-July for the start of the harvesting season.
The funnel of an old Latvian tugboat (the Orkāns) was connected via a long pipe to the electron accelerator. The fumes then passed through a small scrubber before being released in the air.

Very encouraging results from the test, the complete report will be published soon

The HERTIS proposal

HERTIS = Hybrid Exhaust Gas-Cleaning Retrofit Technology for International Shipping
Proposal for a 4-year Innovation Action with 5 MEUR EC contribution submitted on 12 September to the H2020 call LC-MG-1-8-2019 “Retrofit Solutions and Next Generation Propulsion for Waterborne Transport” (2-step call, this is the 2nd).

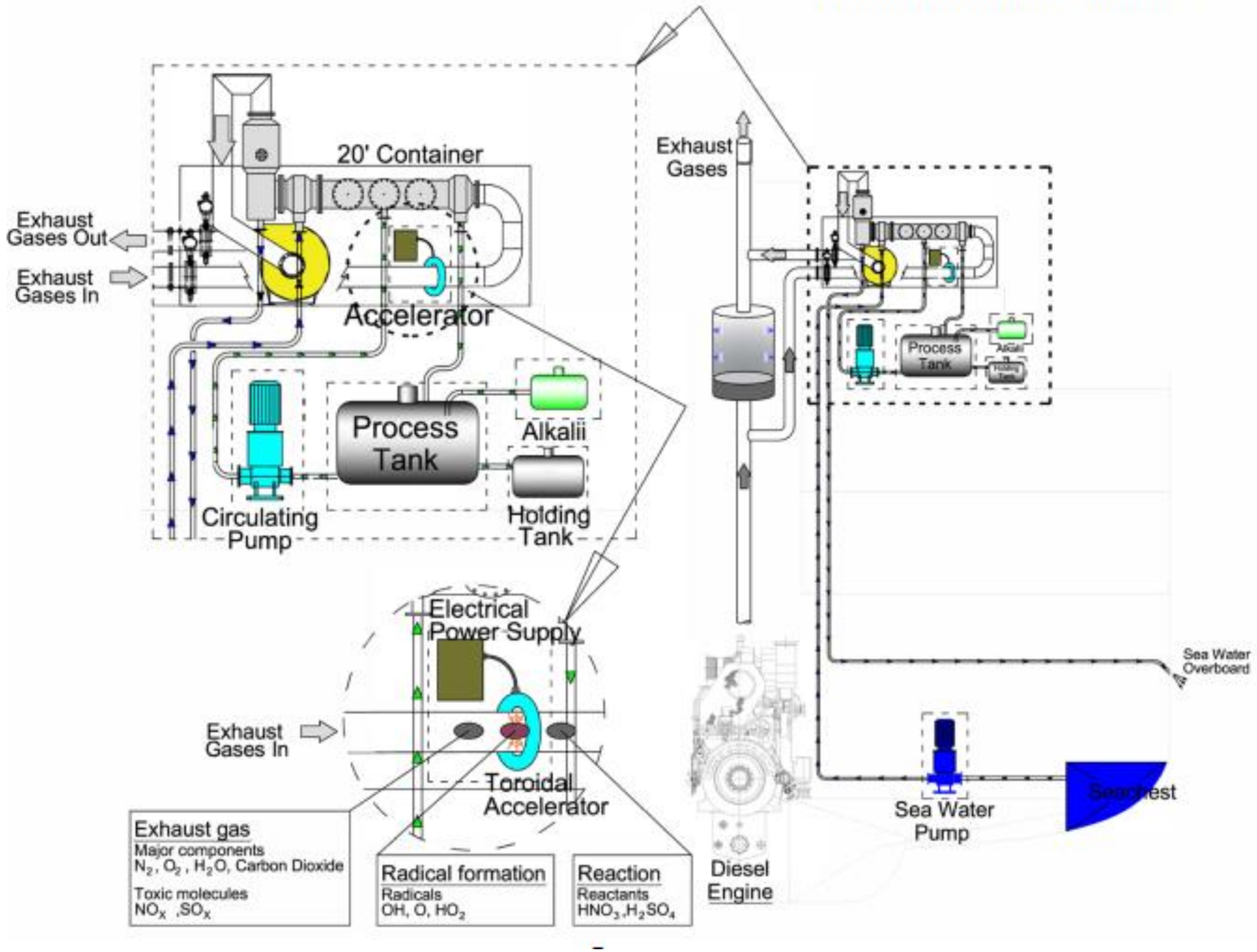
12 partners, including CERN and 6 companies. System proposed as a container that can be installed on existing cargo ships and connected to the exhaust. Development of a dedicated toroidal accelerator. The project will assess the financial viability and test the prototype on a ship provided by the Grimaldi shipping company.



ARIES

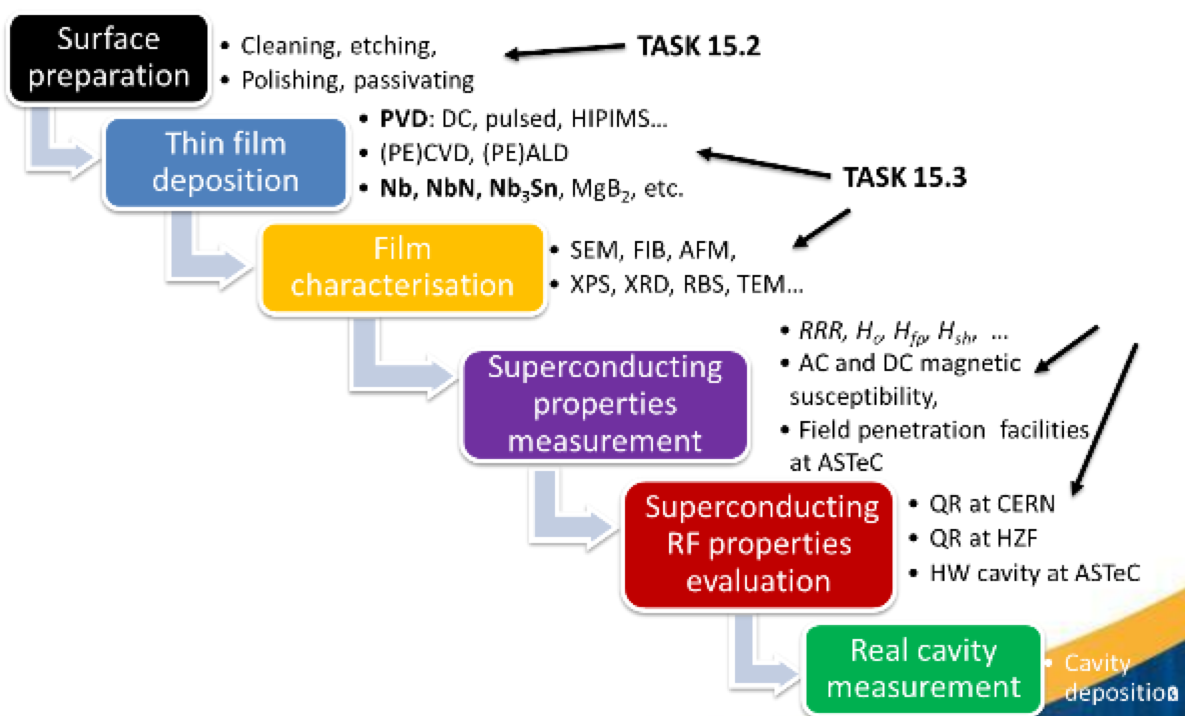
The HERTIS Prototype

Planned prototype schematics



WP 15 – Thin films for superconducting RF cavities

- The aim of this work package is to intensify systematic studies and development of the coating technology of superconducting materials to enable the superconducting coated RF cavities with *Q*(*E*) characteristics better than for the bulk ones.
- The main emphasis will be on a systematic study of correlation between
  - surface preparation,
  - deposition parameters,
  - film structure, morphology, chemistry
  - as well as AC and DC superconductivity parameters (T_c, H_c, H_{fp}, H_{sh}, *RRR of* Nb, NbN, Nb_3Sn, MgB_2, etc., deposited on Cu and bulk Nb,
  - and, finally, the behaviour at radiofrequency with the test cavities recently built at CERN, HZB and STFC.

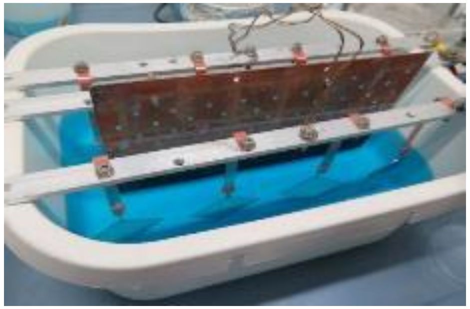


WP15 Partners

	Participants	Leading	Participating
1	CEA (Saclay, France)		Task **4**
2	*CERN (Geneva, Switzerland)*		All tasks
3	IEE-SAS (Bratislava, Slovakia)		Tasks **4**
4	LNL/INFN (Legnaro, Italy)	Task 2	Tasks 1, **2** and **3**
5	Helmholtz-Zentrum Berlin (Berlin, Germany)	Task 4	Tasks 1 and **4**
6	RTU (Riga, Latvia)		Task 2 and **3**
7	University Siegen, (Siegen, Germany)		Tasks **3**
8	ASTeC/STFC (Daresbury, UK)	WP and Tasks 3	All tasks
9	Lancaster University (Lancaster, UK)		Task **4**

Task 15.2. Substrate surface preparation

- 50 planar copper samples with 4 different procedures:
  - 50 samples with a size of 53mm x 53 mm were cut at CERN from the same copper sheet
    - 25 samples were treated at CERN with
      - SUBU solution
    - 25 samples were treated at INFN with
      - SUBU solution,
      - Electropolishing (EP),
      - SUBU+EP,
      - Tumbling

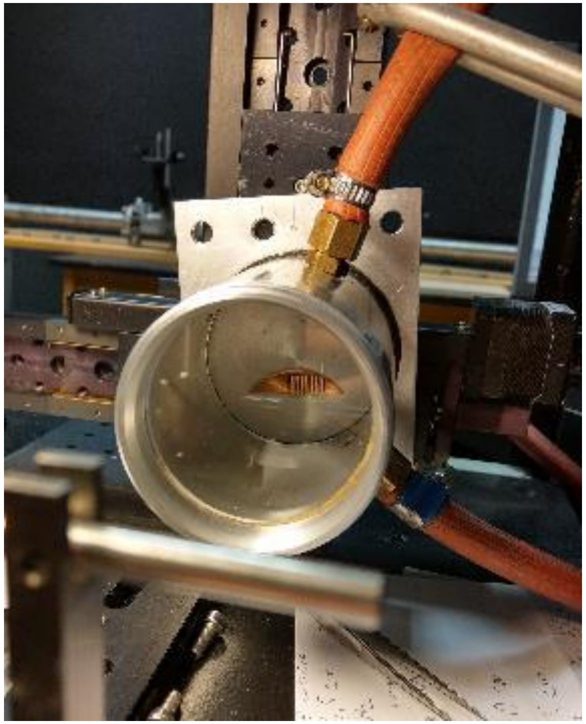



SUBU and Electropolishing treatments
Courtesy of Crisrian Pira (INFN)

- Samples were deposited at 3 different institutes: INFN, Siegen and STFC (Task 15.3)
- Film characterisation in 4 institutes: INFN, RTU, Siegen and STFC
- Superconductivity properties studied in at IEE (Task 15.4)
  - ➢ Main result: EP and SUBU were selected as most promising polishing procedures for future WP15 work

Exploring surface polishing with a laser at RTU

- Laser polishing was not applied to SRF earlier.
- The aim was to explore if there any potential benefits in laser polishing for this application



- Laser radiation leads to decrease of Nb surface roughness (RMS) from 8 nm down to 1 nm.

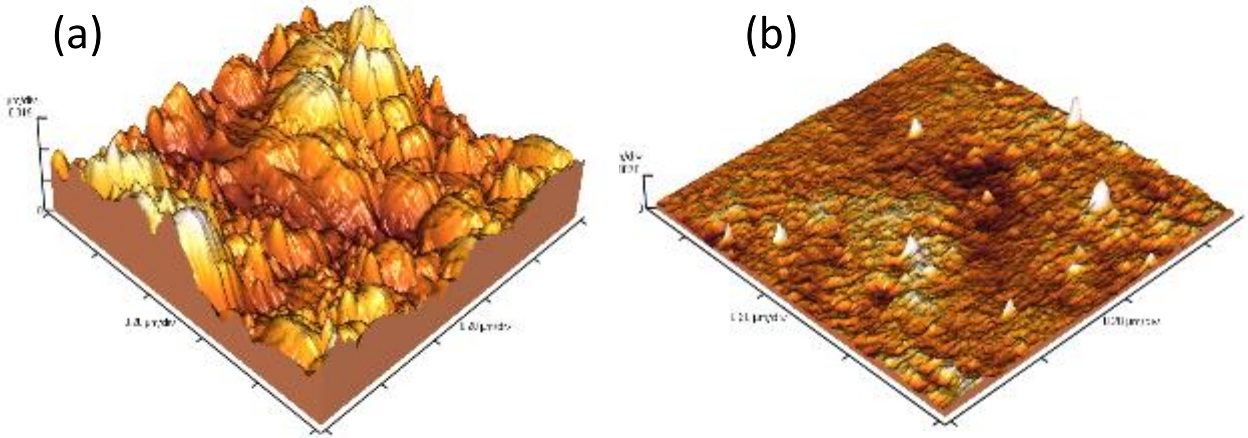


Fig.1. 3D AFM images of Nb/Cu sample (deposited 1/7/16) :
(a)non-irradiated and (b) irradiated by Nd:YAG laser (λ= 1.064 μm, τ =6 ns and intensity I=193.7 MW/cm^2) in scanning mode with step 5μm in Ar atmosphere.

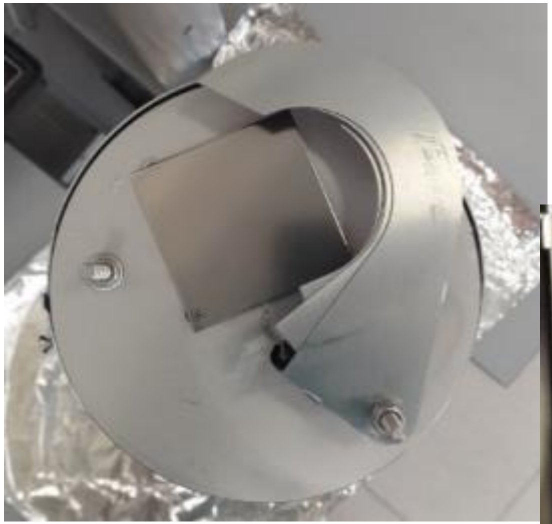
Courtesy of Arturs Medvids, Pavels Onufrijevs and Jevgenijs Kaupuzs

➢<u>Main result</u>: Laser polishing should bee further explored

Task 15.3. Thin film deposition

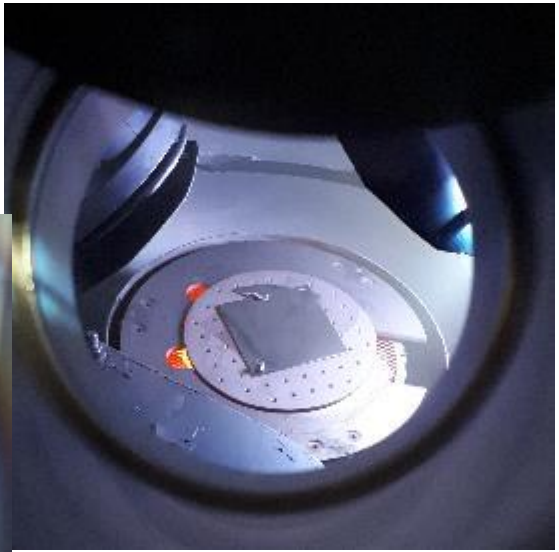
- Deposition at three facilities at different institutes:

LNL/INFN | University Siegen | ASTeC/STFC



A sample in deposition facility at LNL/INFN.
Courtesy of Cristian Pira

A sample and a Nb target in deposition facility at University Siegen.
Courtesy of Michael Vogel



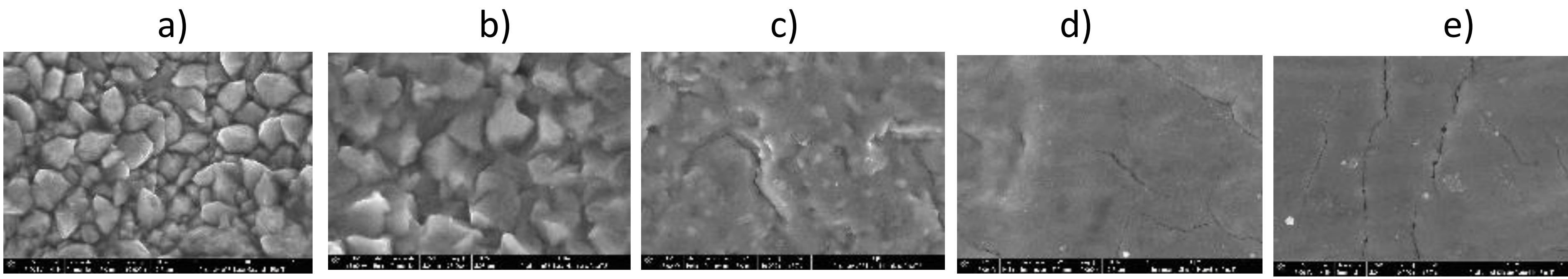
A sample during the Nb deposition at ASTeC/STFC

- Key facilities for the project – **deposition of the sample films**
- The main interest is how different (or similar) the films deposited at different facilities at similar deposition conditions

<u>Main result</u>: quality of Nb films at 3 partners are comparable

Task 15.3. Post deposition laser treatment

- Aims:
  - Increase the grain size of Nb;
  - Increase the adhesion of Nb layer to Cu substrate (Annealing the defects by laser radiation).



SEM images of Nb/Cu structure before irradiation (a) and after irradiation by Nd:YAG laser with I_1 = 140 MW/cm^2 (b); I_2 = 170 MW/cm^2 (c); I_3 = 253 MW/cm^2 (d); I_4 = 320 MW/cm^2 (e).

Courtesy to Arturs Medvids, Pavels Onufrijevs and Jevgenijs Kaupuzs

Preliminary results:

- The sizes of Nb crystals can be increased by laser radiation
- Defects between grains (pinholes) can be eliminated by laser radiation.

Conclusions

- WP15 team works according to agreed plan
  - Cu substrate polishing has been evaluated
  - Nb film deposed at INFN, Siegen and STFC demonstrated similar quality
  - NbN and Nb_3Sn films have been deposited and tested on small samples
  - Small sample evaluation on SC properties is ongoing
  - QPR sample substrates have been produced. Polishing and deposition procedures have been tested and ready for use.
  - QPR facilities at CERN and HZB are ready for testing the samples produced by WP15 team

WP 16 – Intense RF modulated electron beams

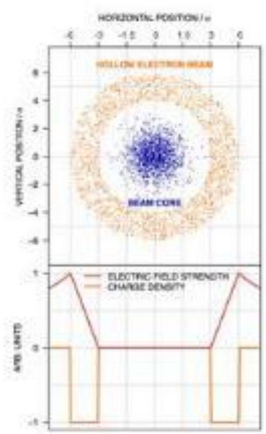
- Manufacturing of an RF modulated electron gun for application in electron lenses
  - High electron currents up to 10 A
  - RF modulated at 0.4 to 1 MHz with a bandwidth of up to 10 MHz
  - Elliptical beam cross section with adjustable aspect ratio
  - Different cathode shapes for matching beam dynamics requirements

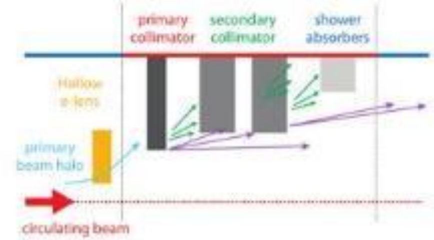
- Operation of a test stand for the RF modulated electron gun
  - Normal conducting solenoids for beam transport
  - Instrumentation for probing transverse and longitudinal electron beam profiles

CERN GSI iAP Institut für Angewandte Physik 1862 RIGA TECHNICAL UNIVERSITY

Electron lenses:

New technique for controlling high-intensi
hadron beams using the fields of an electr
beam.
Can be used for collimation (CERN) or for
space charge compensation (GSI)





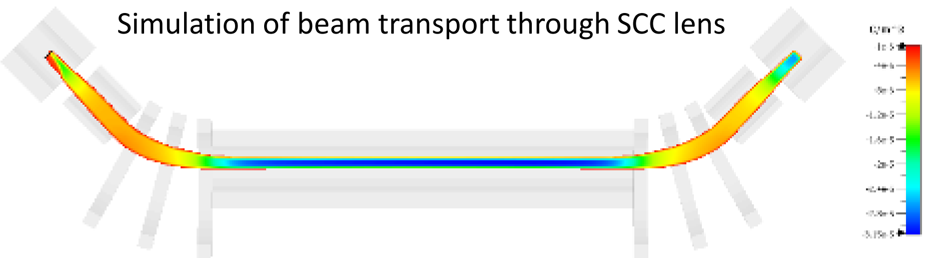
Not enough budget to support a complete test stand, the WP designs and builds the components that are common to the two test stands (CERN and GSI).

ARIES

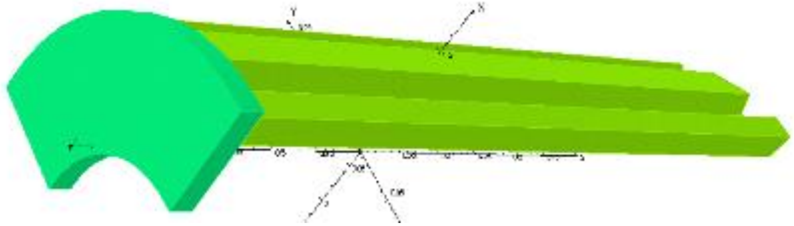
System Integration (16.2): Status

- Goals
  - Layout of a full electron lens for space charge compensation (SCC) in SIS18
  - ✓ Definition of requirements and constraints for SCC gun to be built within ARIES
  - Design of the magnetic system, vacuum system, HV system, diagnostics, support structure, infrastructure
  - ✓ Consideration of ion beam dynamics in presence of SCC electron beam
- Work done in Y2 (GSI)
  - Magnetic layout of lens consistent with electron beam parameters of the SCC gun
    - Electron beam transport simulations performed
    - Magnet aperture and field requirements derived
  - Magnetic design of interaction solenoid
    - Fast ramping for matching adiabatic damping
    - Laminated return yoke to reduce eddy currents
  - Purchasing of gun and collector solenoid started
    - Magnetic design finalized
    - Contract awarded, manufacturing ongoing

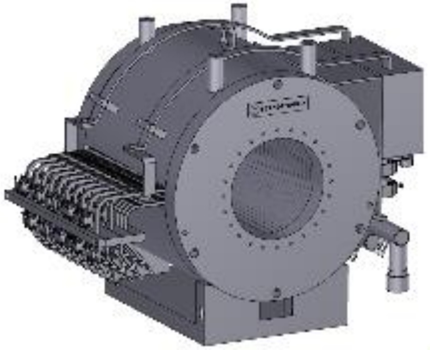
Simulation of beam transport through SCC lens



Design study of interaction solenoid (yoke and end plate)



3-D model of gun solenoid (preliminary)



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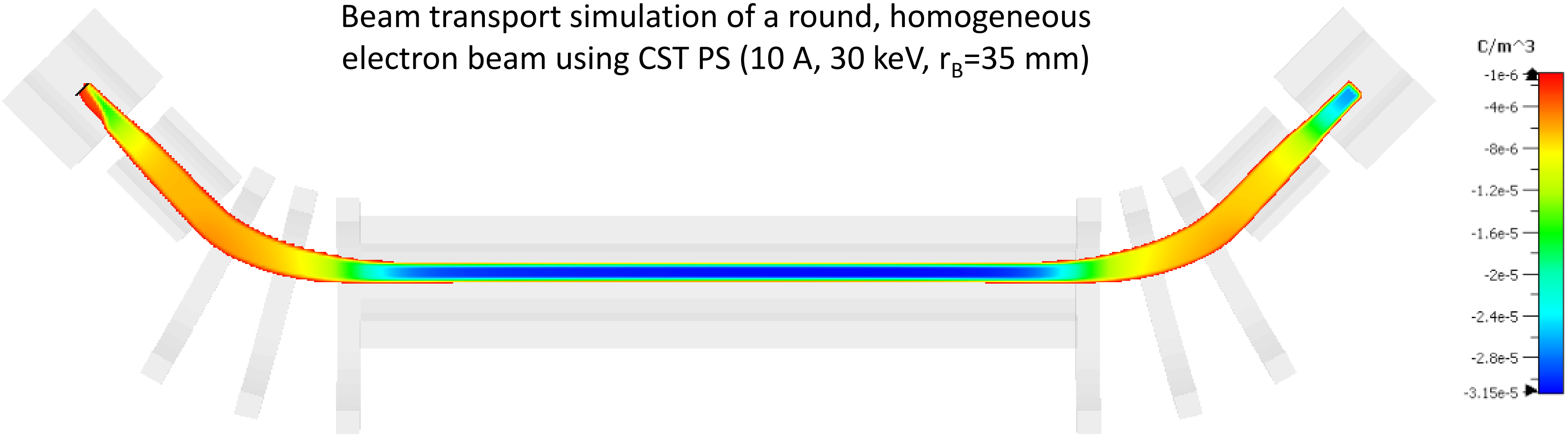
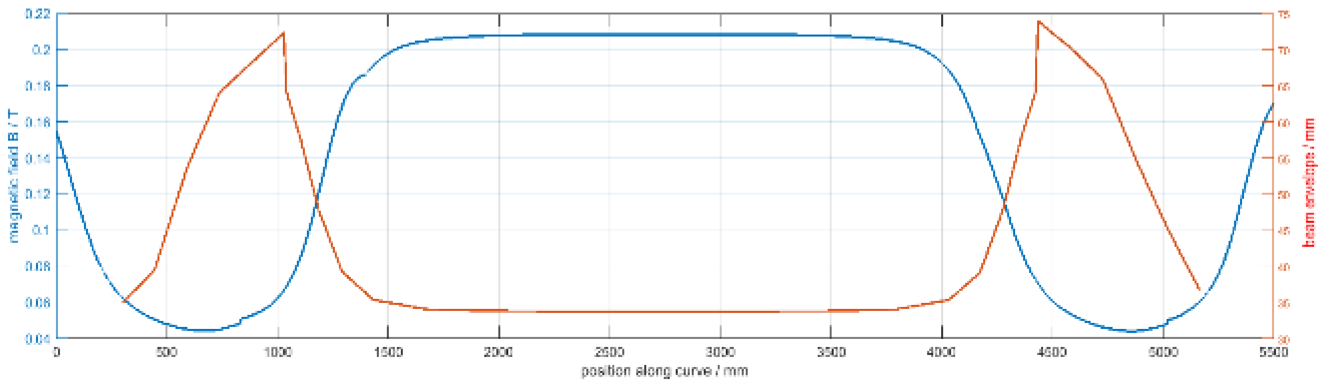
16.2: Magnetic Layout of SCC Lens

Beam transport simulation of a round, homogeneous electron beam using CST PS (10 A, 30 keV, r_B=35 mm)



On-axis magnetic field and beam envelope



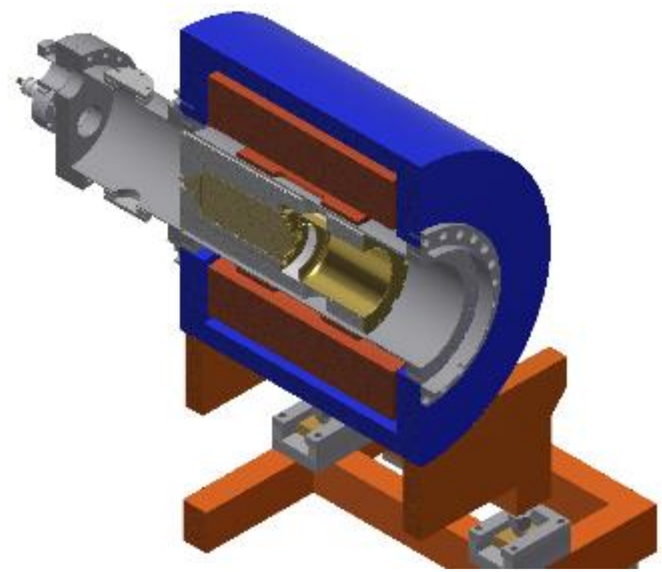
Work performed by K. Schulte-Urlichs

- Magnetic parameters of gun, collector, and interaction solenoid fixed
- Consistent with both round and elliptical beam cross sections
- Magnetic layout of bending sections still preliminary

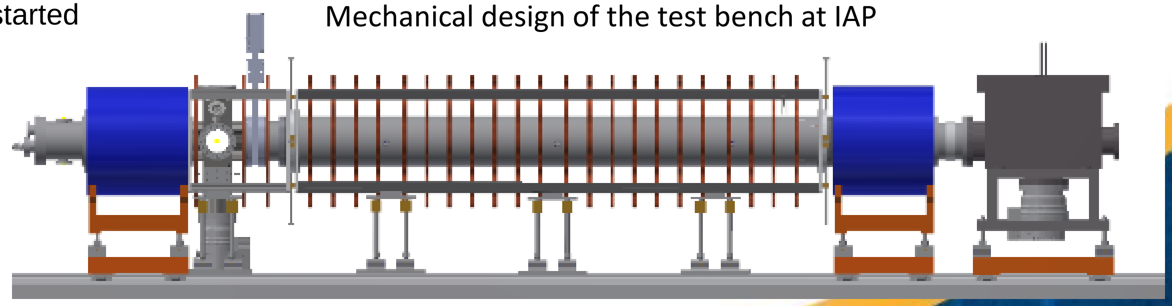
SCC Gun (16.3): Status

- Goals
  - ✓ Design of a gun for the SIS18 SCC lens
    - Grid modulated electron currents up to 10 A
    - Transverse profile matched to elliptical ion beam
    - Full modulation with bandwidth ~ 10 MHz
  - Manufacturing and testing of gun
    - Full gun characterization at CERN test stand
    - Basic powering and performance tests at IAP
- Work done in Y2 (GSI, IAP)
  - Gun design
    - Design of grid-modulated gun for Gaussian transverse profiles finalized
    - Magnetic parameters of gun solenoid and quadrupole for ellipse shaping specified
    - Preliminary engineering design of gun developed
  - Preparation of site for basic tests
    - Layout of test bench completed
    - Installation of test bench components started

Mechanical design of the gun for the SCC lens

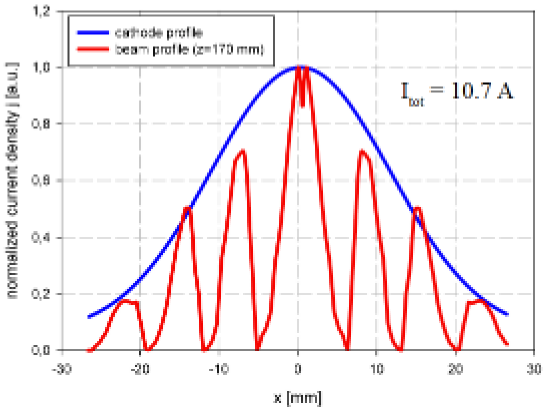


Mechanical design of the test bench at IAP

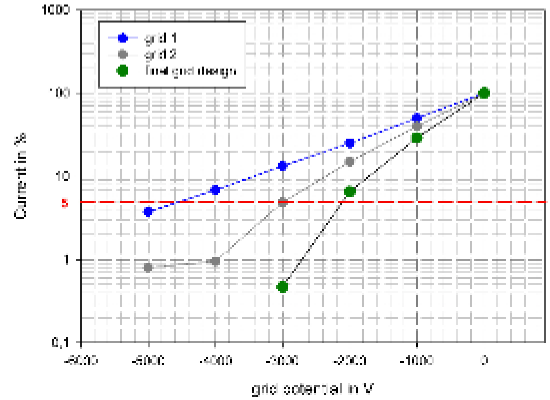


SCC Gun(16.3): Grid Modulation

Final grid design and simulated beam profile

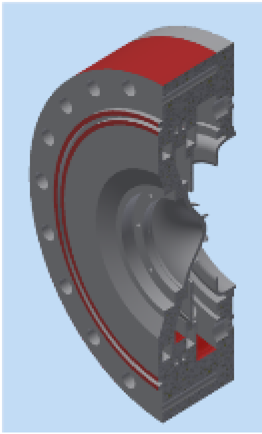


Current vs. voltage for three grid designs



- Reduced power dissipation over anode modulation
- Losses on grid need to be considered
  - Higher extracted currents required (10 A → 16 A)
  - Heat load on grid estimated to be safe for tungsten
- Tests using a Tungsten prototype foreseen at IAP
  - Tungsten cathode and grid received
  - Integration into spare volume ion source planned
  - Ion source‘s filament used for indirect heating
  - Preparations under way

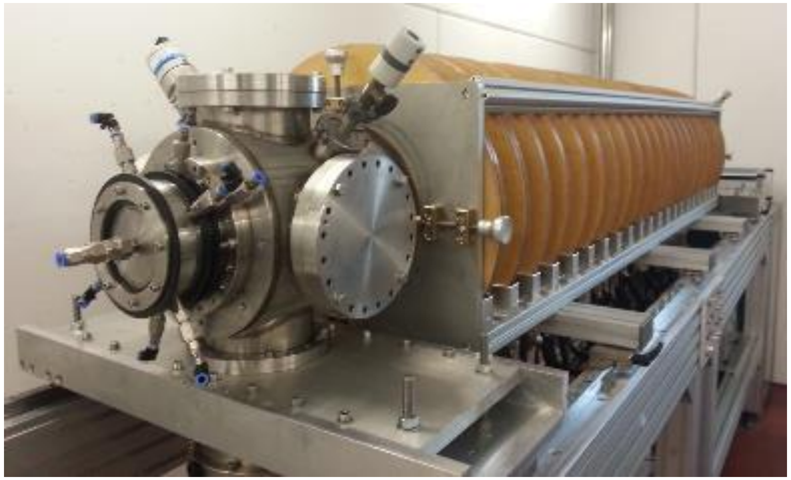
Tungsten prototype for heat load tests



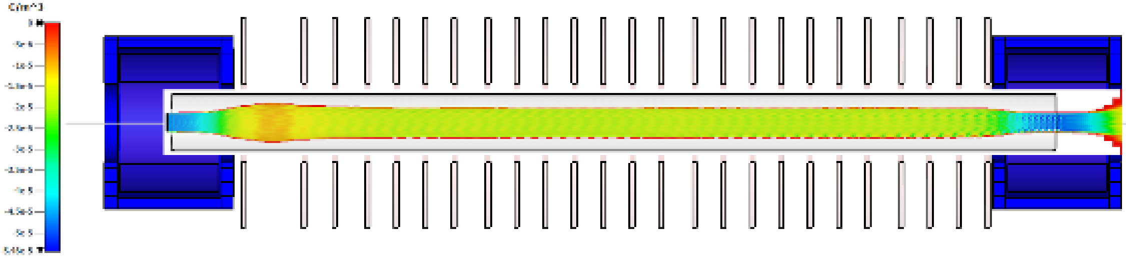
Work performed by K. Schulte-Urlichs

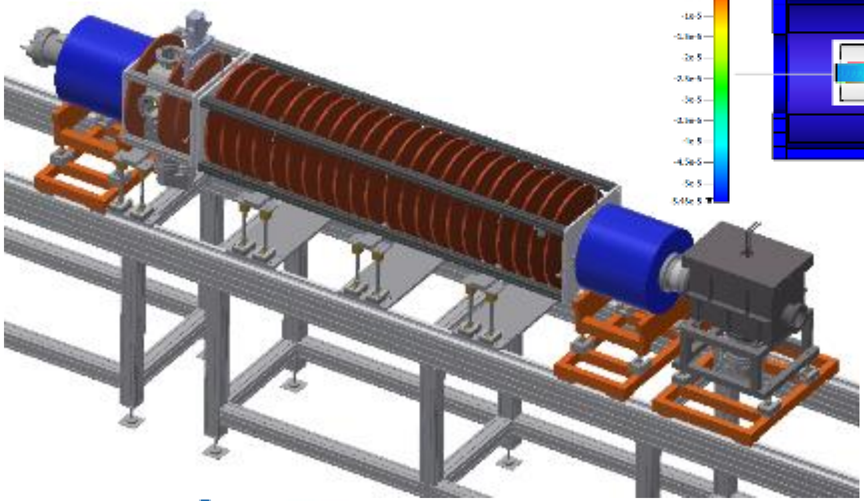
SCC Gun (16.3): IAP Test Bench

- Test bench for the gun at the manufacturing site
  - Basic powering and performance tests
  - Fast turn-around times for optimization of gun design
  - Faraday cup up to 24 kW for long duty cycle tests
- Test bench under preparation
  - Pancake drift solenoid installed
  - Gun and collector solenoids delivered by end of year
- Full characterization of transverse and longitudinal profile at CERN test stand



CST transport simulation for a homogeneous round electron beam (10 A, 30 keV)



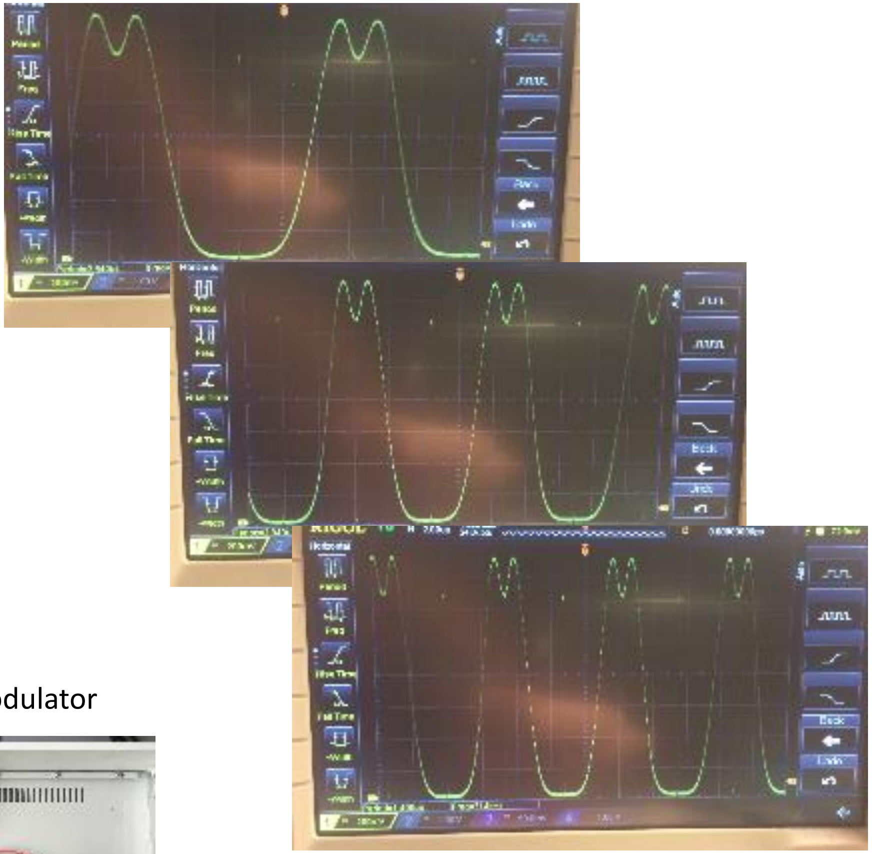


Work performed by K. Schulte-Urlichs

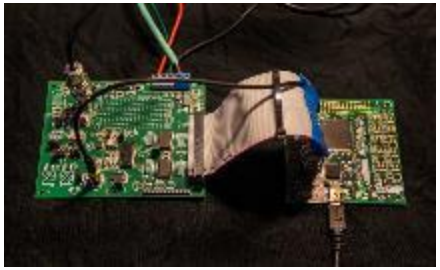
Modulator (16.3): Status

- Goals
  - Modulator for grid modulation of SCC gun
    - Full modulation requiring 3 kV at 0.1 A
    - Bandwidth >= 10 MHz
    - Frequency range 0.4 to 1 MHz
- Work done in Y2
  - Modulator (RTU)
    - Improved prototype built for proof-of-concept
    - Signal generator for sweeping different wave forms over frequency range implemented
    - Tests at IAP next week
  - Proof-of-concept experiment (IAP)
    - Modifications to set-up for proof-of-concept experiment for reduced stray capacitances

Frequency sweep of Gaussian double bump profile



Working prototypes of signal generator and modulator



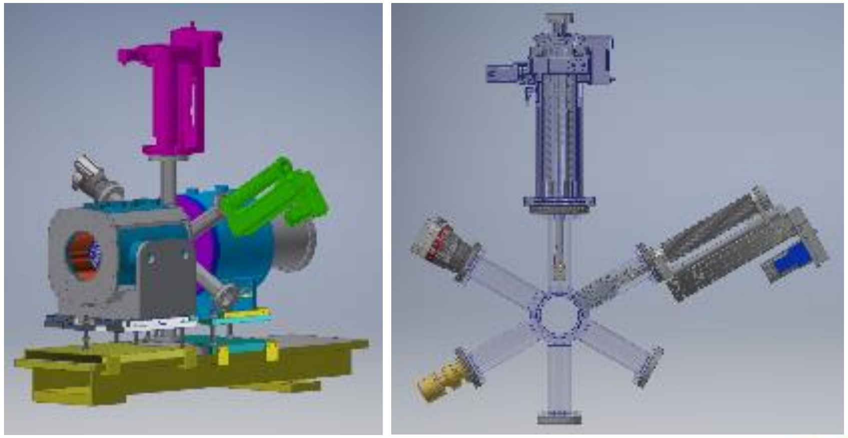
Work performed by P. Apse-Apsitis, I. Streiks, J. Van De Pol

CERN Test Stand (16.4): Status

- Goals
  - Design and construction of test stand for qualifying both CERN HEL gun and GSI SCC gun
  - Characterization of electron beam with respect to longitudinal and transverse beam profiles
- Work done in Y2 (CERN)
  - Design of first stage optimized
  - Facility for test stand prepared
    - Electrical power connection established
    - Cooling water plant installed
  - Test stand under installation
    - Solenoids mounted on test bench
    - Diagnostic box under construction

Solenoids mounted on test stand

Design of test stand and diagnostic box



Work performed by S. Sadovich

Conclusions

- 16.2: System integration
  - Magnetic layout advanced to define boundary conditions and requirements for SCC gun
  - Gun and collector solenoids ordered, magnetic design of main solenoid done
- 16.3: SCC gun and modulator
  - Mechanical design of grid modulated gun with quadrupole for shaping ellipse completed
  - Tungsten prototype of cathode and grid built, soon to be tested with volume ion source
  - Improved modulator and signal generator to be tested next week with mini-gun at IAP
- Electron gun test stand
  - First stage of test stand under installation and commissioning
  - Final adjustments for integration of SCC gun under way

We are at the end!

And thank you for the EC support that made all this possible

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