THE QUALITY of ELETTRA IKC for the ESS WIRE SCANNER ACQUISITION SYSTEM

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on behalf of the Elettra-ESS IKC WS Team

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ESS IKC WS ACQUISITION SYSTEM

2 DELIVERIES – 1

4.1.2 Partner SoW ESS-0044053_2016.09.22

The Partner shall develop (i.e. design) and to deliver to ESS ERIC the following part of the system:

a) The analog front end electronic (AFE) for both SEM current (13x) and scintillator readout (OFE) (12x);
b) The OFE for the SCINT fast WS readout (6x);
c) The Back End modules for both AFE and OFE front ends (31x);
d) The power supplies needed for wire polarization and photo detector biasing (included into the BE).

OFE is 2 channel unit:, therefore numbers dived by 2

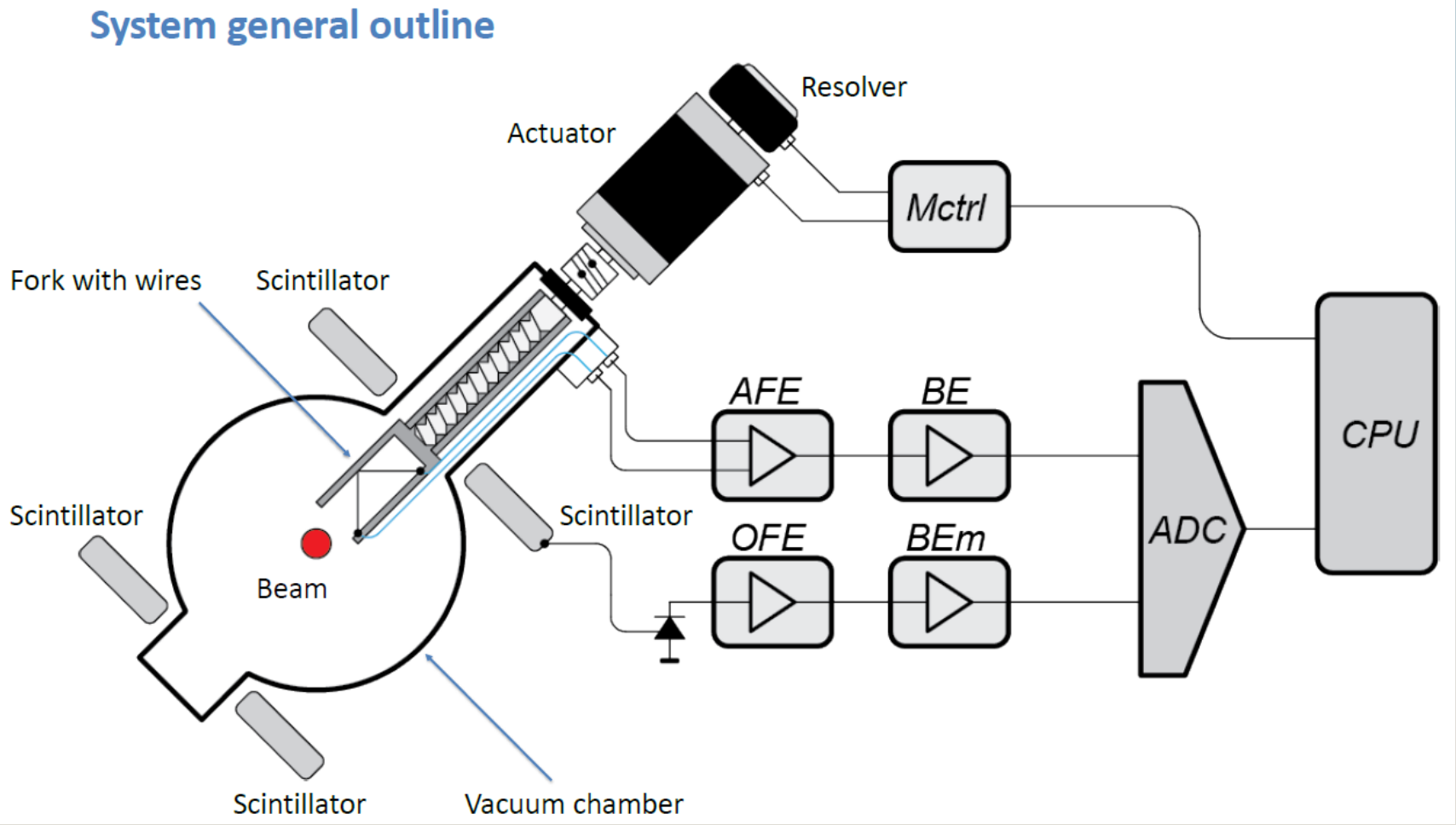
The Partner is responsible to integrate for ESS Accelerator Division, the COTS parts of the system, based on COTS products of ESS ERIC choice, indicated in the following:

i. The digitizer card according to ESS ERIC specifications;
ii. The electronic crate;
iii. The motion controller, according to ESS ERIC specifications;
iv. The EPICS integration, the control software and engineering screen.

AFE 11 + 2 spares=13 AFE;
OFE: 5 + 1 spare= 6 OFE;
3 OFE for fast WS
13 BE and 9 BEmod

ESS IKC WS ACQUISITION SYSTEM

DELIVERIES – 2



ESS IKC WS ACQUISITION SYSTEM

4 DELIVERIES - 3

✓	**Analog Front End (AFE)**	**13x**	delivered and tested at ESS
✓	**Back-End (BE)**	**13x**	delivered and tested at ESS
✓	**Optical Front End (OFE),**	**9x**	running, done by end of 2019
80% Done	**Modified Back End (BE_{mod})**	**6x**	running, done by end of 2019
✓	**EPICS IOC & ENG PANEL**		delivered and tested at ESS

Still due:

- 80% Done Certification documents (Certificate *of Conformity)* ….
- 80% Done **TRR, SAR-1** and **SAR-2** >>> next week, *IKC DIAG FORUM*…

There are *extra BONUS* deliveries, as well *(free of charge)*:

- ✓ *Software-assisted* ***Factory Acceptance Test procedure*** delivered and tested at ESS
- ✓ Wire current emulator
- ✓ Cable tester
- ✓ OFE optical tester

HOW DID WE ADDRESSED QUALITY RELATED ISSUES …

Global Quality of the supply to ESS

3 main areas involved:

- **Technical:** Design, Manufacturing, Communication and Documentation
- **Administrative:** Contract, Procedures, Meetings and Control
- **Human:** good relationship, to get used to work together

our "JOB" at ESS will be completed with the in-situ test phase

- Not only "***Design for delivery***", but rather "***Design to Install***"
- To participate to the Installation and Commissioning

But, overall, our IKC to ESS WS system has been heavily driven by:

- **Experience**

HOW DID WE ADDRESSED QUALITY RELATED ISSUES …

Technical: Design, Communication, Manufacturing and Documentation (!!!)

- **Agreement on the specifications** documents
  - at first with B. Chemyol
  - then, with C. Derrez and T. Shea
- Establishing **efficient technical communication channels**, while keeping paperwork overhead moderate…
  - regular skype tel-cos (on a 2-week basis) with minutes, from March '16 to August '18
  - regular participation to the IKC DIAG FORUMs
- Always "fight for" **test with beam,** before releasing production phase:
  - CERN (2017, AFE+BE)
  - Julich (2019, OFE)
- Applying **ST internal good design rules**, tested in several successful and reliable implemented designs (over 25+ years)
- Manufacturing: either with **pre-qualified suppliers** or **internal senior staff, 100% daily control**

HOW DID WE ADDRESSED QUALITY RELATED ISSUES …

Administrative: Contract, Procedures, Meetings and Control

- Implementing the ESS IKC framework:
  PDRs, CDRs, SARs, TRRs, FATs , SATs , TACs etc etc
- To run all foreseen Meetings
- To prepare all foreseen documentation

Human: Relationship and work together

- Establishing good personal relationship with ESS Colleagues and other IKCs (ESS Bilbao)
- Strengthen the "distributed" Team by regular teamwork
- Get used to work together to solve issues… to get the work done
- **Vertical Integration** sessions (2 held: in Lund and Bilbao)
- To implement a "positive criticism": point out any, at least curious, situation or solution

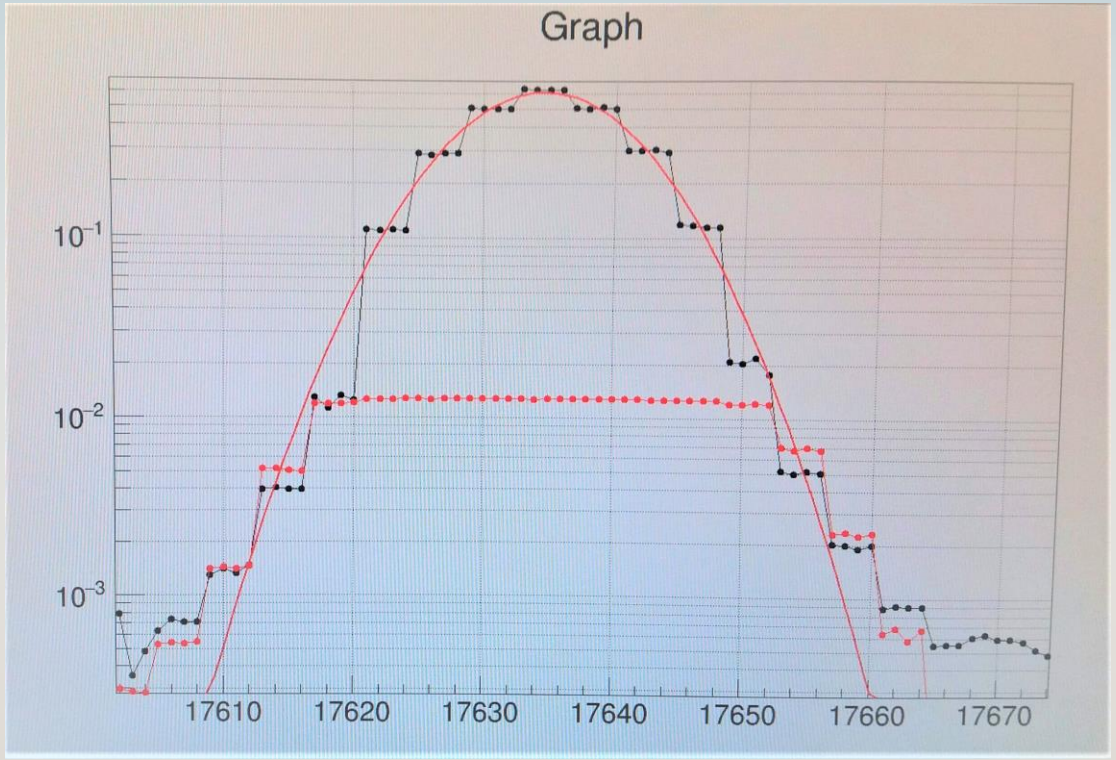
MAIN RESULTS …1
THE OPTICAL FRONT END

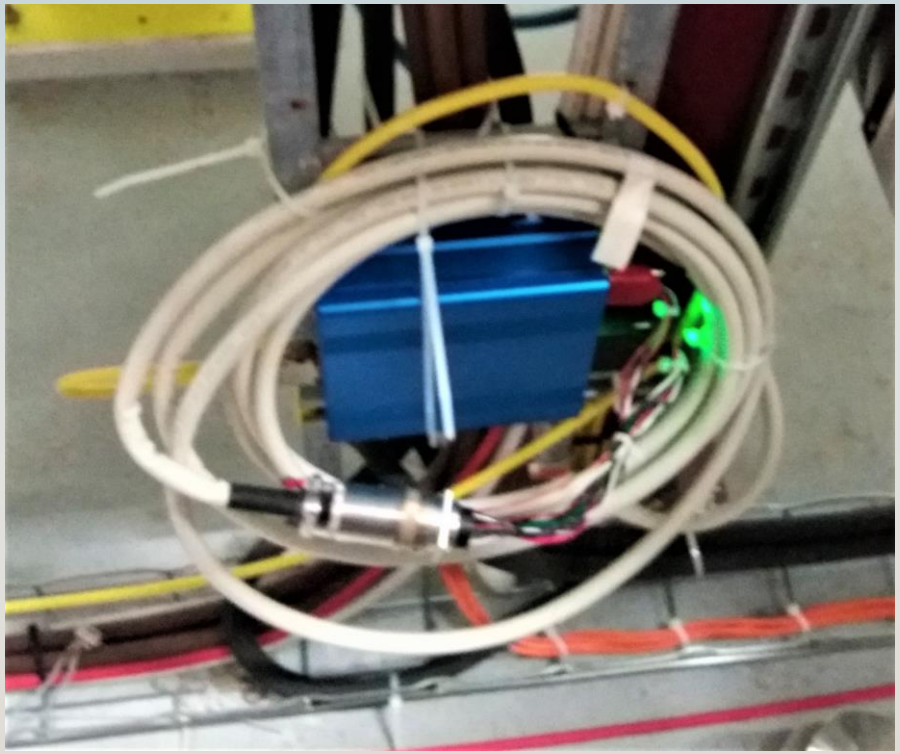
The **Optical Front End** represents one of the outstanding results of this IKC

(by Sandi Grulja)

MAIN RESULTS …2
BEAM PROFILE RECONSTRUCTION, AT CERN – OCT&NOV 2017

By installing and testing the **Analog Front End** and **Back End,** connected to a CERN wire scanner on LINAC 4 at CERN, we were able to double check the HW prototype operation in a **real ion accelerator environment** **(credits to Raffaele De Monte)**





MAIN RESULTS …3
THE EPICS SOFTWARE-ASSISTED ACCEPTANCE PROCEDURE

In order to rapidly and reliably test all (100% quality assurance) delivered HW modules, an EPICS procedure has been written such that it both excites the AFE inputs and read back the Back End outputs. Obviously, it generates a written report (**credits to Stefano Cleva**)

Elettra Sincrotrone Trieste — Test App - 2 — EUROPEAN SPALLATION SOURCE

BE-AFEtest-undef 2018-11-16 22:28:56

Calibration Table:

#	current	units	Vscope	units	VpulserMax	units	VpulserMin	units	RefLevelHiGain	units	RefLevelLoGain	units
1	10	nA	1.245	V	1.255	V	1.1	V	0.0	V	0.0	V
2	30	nA	1.27	V	1.285	V	1.1	V	0.003697	V	0.0	V
3	50	nA	1.28	V	1.295	V	1.1	V	0.003954	V	0.0	V
4	100	nA	1.31	V	1.322	V	1.1	V	0.005818	V	0.0	V
5	300	nA	1.336	V	1.346	V	1.1	V	0.009588	V	0.0	V
6	500	nA	1.348	V	1.36	V	1.1	V	0.013277	V	0.0	V
7	1	uA	1.37	V	1.383	V	1.1	V	0.022346	V	0.0	V
8	3	uA	1.42	V	1.45	V	1.1	V	0.075673	V	0.0	V
9	5	uA	1.45	V	1.48	V	1.1	V	0.111941	V	0.000477	V
10	10	uA	1.51	V	1.56	V	1.1	V	0.231239	V	0.001994	V
11	30	uA	1.695	V	1.8	V	1.1	V	0.664866	V	0.007636	V
12	50	uA	1.865	V	2.035	V	1.1	V	0.854769	V	0.04413	V
13	100	uA	2.26	V	2.6	V	1.1	V	0.85774	V	0.183188	V
14	300	uA	4.01	V	5.0	V	1.1	V	0.857473	V	0.563845	V

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Agilent Technologies,33220A,MY44020530,2.02-2.02-22-2

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PIC-BE: 0:+0:255:0x122:1:R:3249:A02

BE id: undef

AFE id: undef

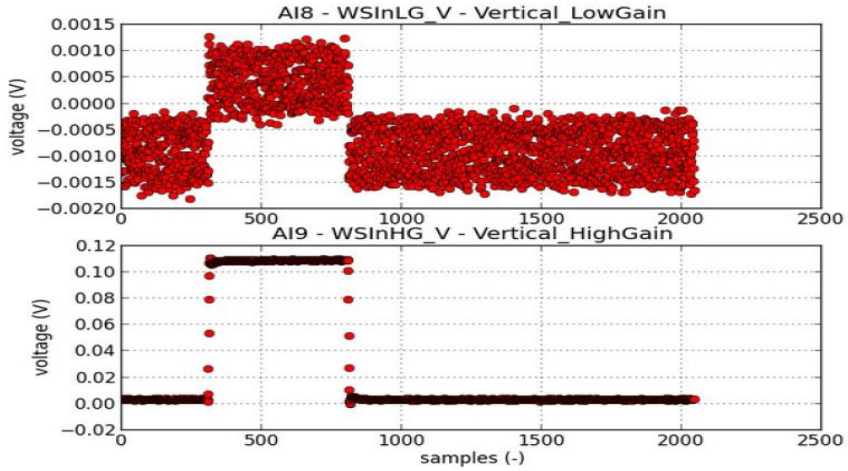
****

SetRampStep - SetGenerator: 300 uA -- 5.0 V -- 1.1 V

SetRampStep - GetGenerator: 300 uA -- 5.0 V -- 1.1 V

file:///C:/Users/mario
TINGS/2019%2010%
08%2015_43_32.htm..

Elettra Sincrotrone Trieste — Test App - 3



AI8 mean(ROI): 0.000424 V -- ROIlo: 500 -- ROIhi: 700

AI8 st.dev.(ROI): 0.000403 V -- ROIlo: 500 -- ROIhi: 700

AI8 mean(BKG): -0.000931 V -- BKGlo: 1400 -- BKGhi: 1800

AI8 st.dev.(BKG): 0.000392 V -- BKGlo: 1400 -- BKGhi: 1800

AI8 mean(ROI - BKG): 0.001355 V

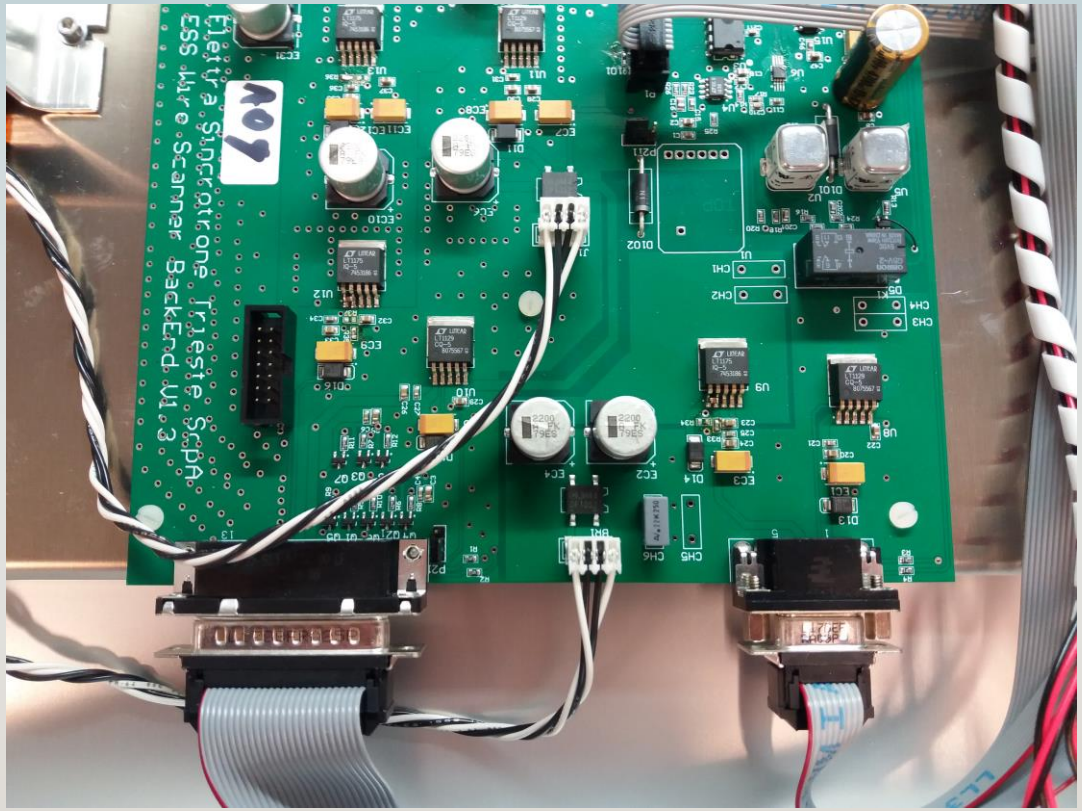
AI8 st.dev.(ROI - BKG): 0.000011 V

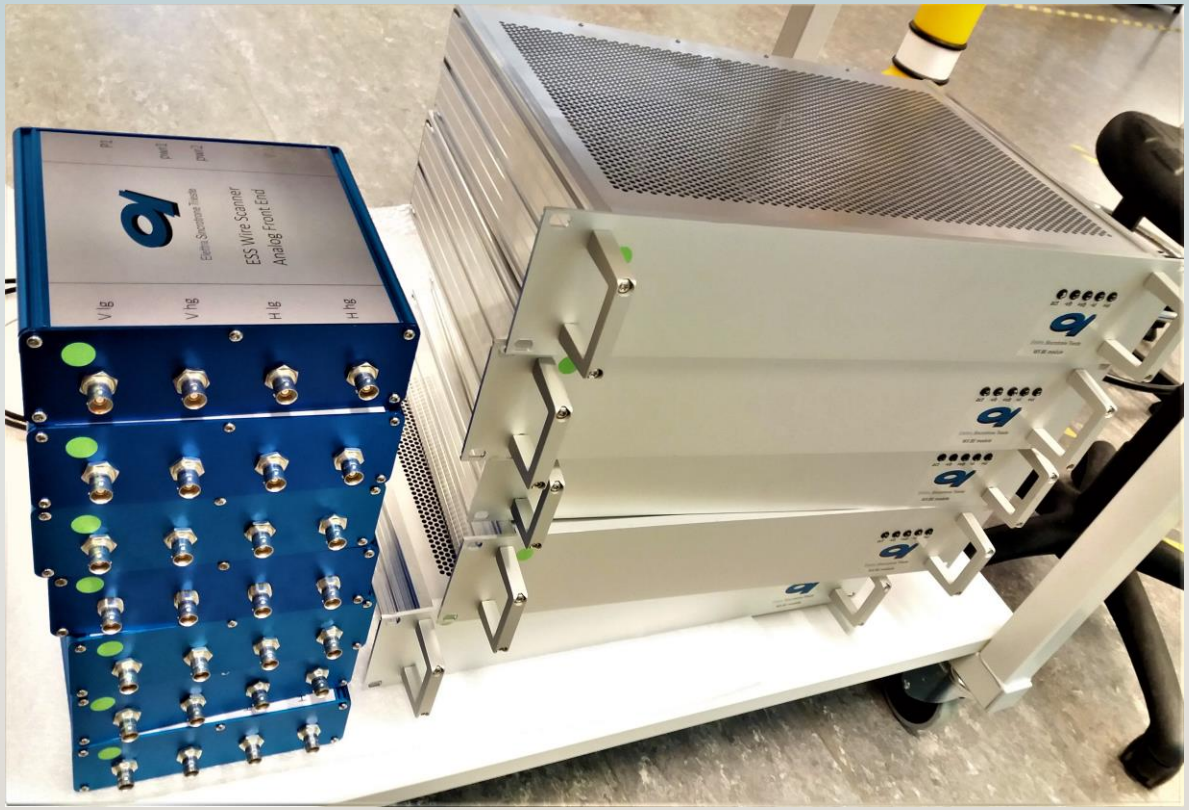
Elettra Sincrotrone Trieste

MAIN RESULTS … 4
AFE + BE (10+3) SITE ACCEPTANCE TEST

EUROPEAN SPALLATION SOURCE

This year, in JUNE, we have completed the **Site Acceptance Test** (SAT) for the **Analog Front End**s and associated **Back Ends**, teaming and training **ESS Staff (C. Derrez)**.

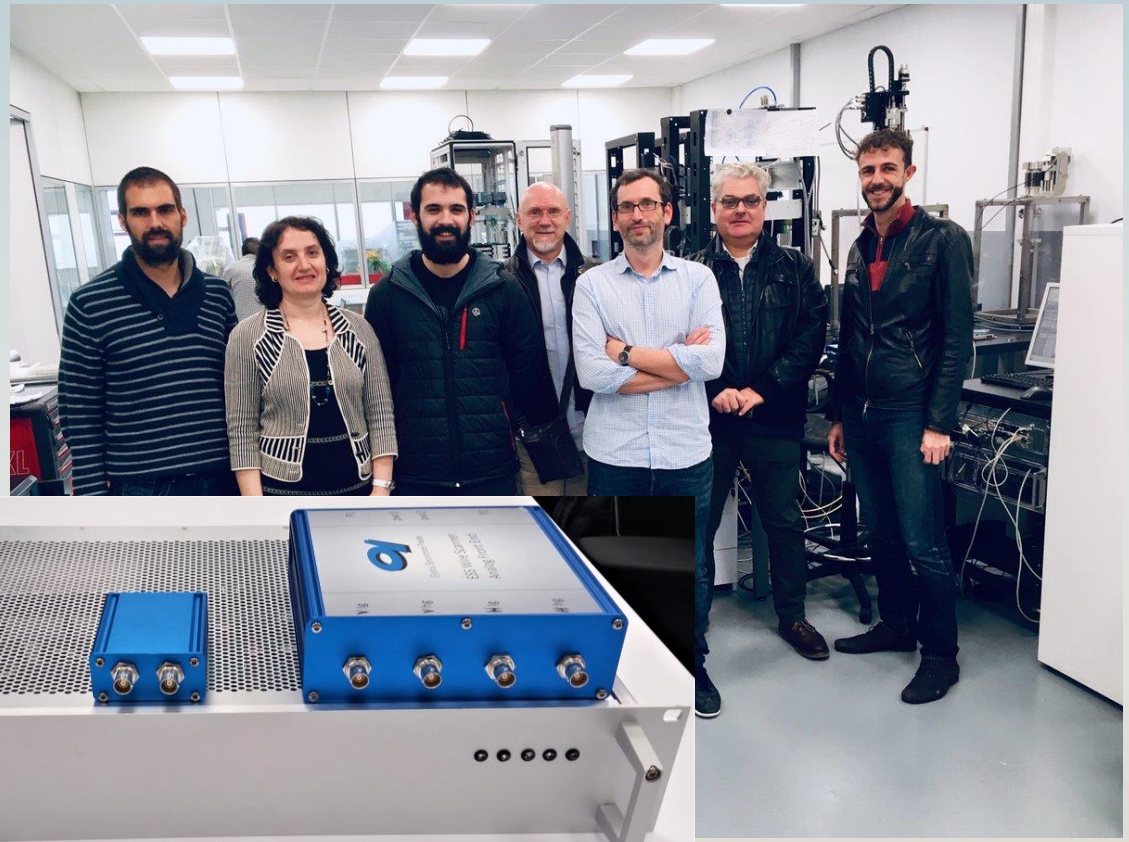




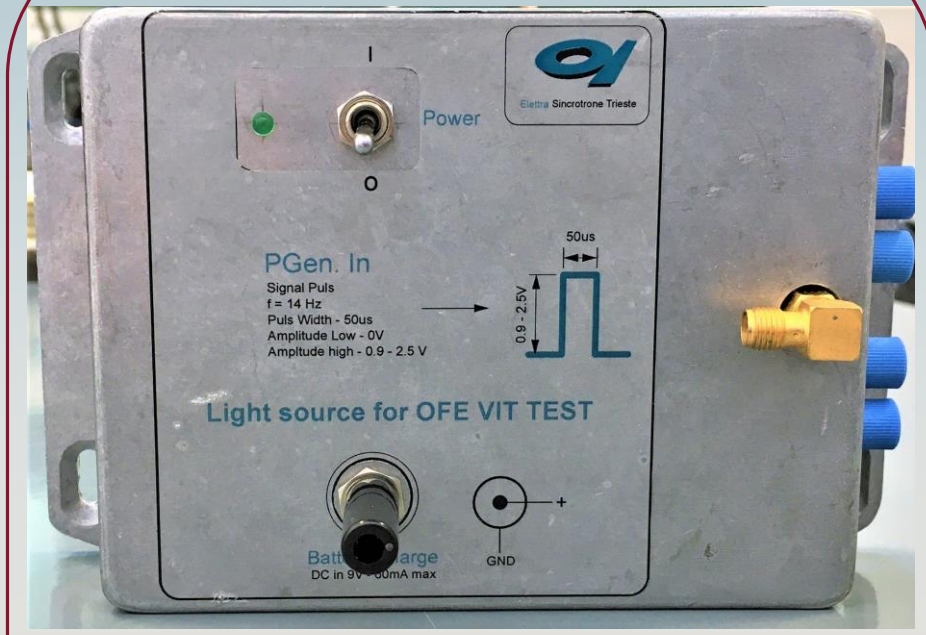
TETRA-LAB TEAM… WORKING TOGETHER

TEST @ PARTNER LAB, CERN, OCT-NOV 2017

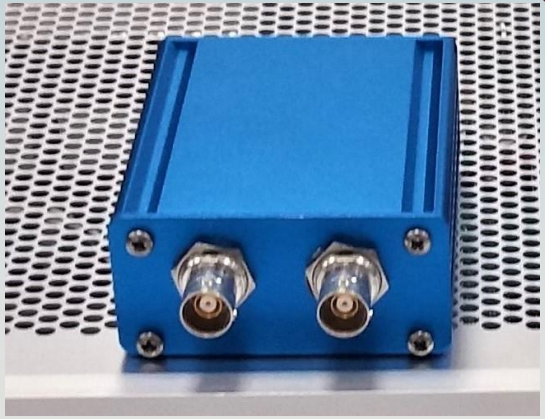
VERTICAL INTEGRATION TEST @ ESS-Bilbao, NOV 2018



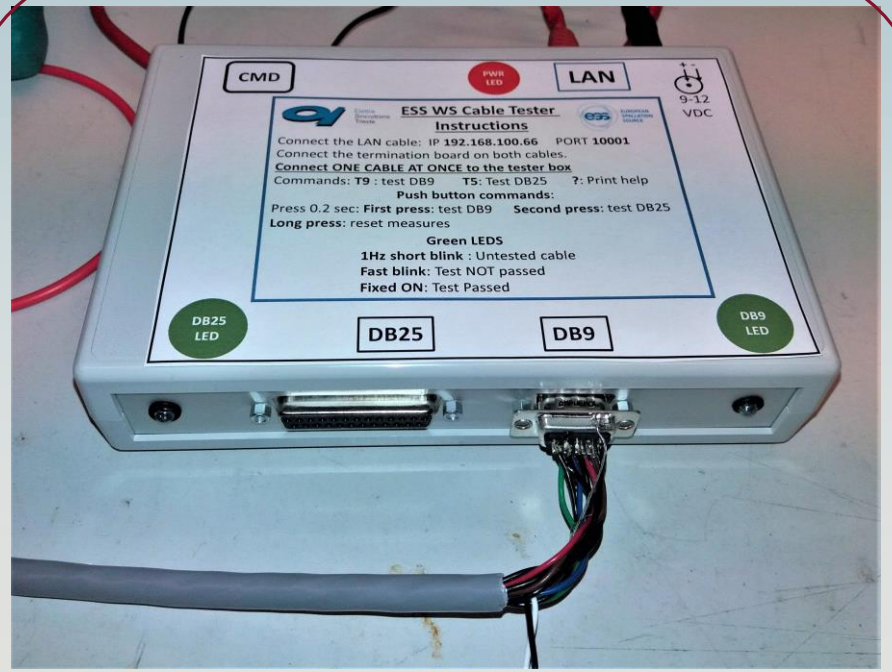
SOME BY-PRODUCTS …



Equalized OFE optical tester



AFE balanced wire current generator



Automatic long run cable tester

Thank you for your attention