Summary of

Industrial session at Asian Linear Collider Workshop 2018

Co-Organized by

Kyushu University, KEK, AAA, INEUSTAR, E-JADE

29 May 2018 room 411

(including some inputs from LCWS2017 Industry session in Strasbourg)

To strengthen world-wide industrial collaboration for future linear colliders, we had industrial sessions in linear collider workshops, ECFA LC2016, Santander, LCWS2016 Morioka, and LCWS2017 Strasbourg. In addition, we had special opportunities at the workshop in Spanish embassy in Tokyo and the IEEE NSS/MIC conference in Strasbourg in 2016. The industrial session in ALCW2018 is a follow up of the successful session in Strasbourg 2017. The session consists of status of industry-academia collaboration in the US, Europe and Asia, an experience report from ITER, our neighbor, and activities of companies in the field of accelerator as well as detector science.

Session Conveners: Tohru Takahashi (Hiroshima University), Masanori Matsuoka (AAA)
Nuria Catalan Lasheras (CERN), Hugh Montgomery (Jefferson Lab),
Marc Winter (IPHC), Thomas Schoerner-Sadenius (DESY), Maxim Titov (CEA Saclay)

Recent Industry Events at the Linear Collider Workshops

ECFA LC2016 (Santander, Spain): Jun. 1, 2016

https://agenda.linearcollider.org/event/
ions/3895/#20160601

LCWS2016 (Mori

https://agenda.linearcollider.org/event/7371/sess
ions/4537/#20171025

LCWS2017 (Strasbourg, France): Dec. 6, 2016

https://agenda.linearcollider.org/event/7645/sess
ions/4537/#20171025

Goal of Industry Forums on Linear Colliders →
synergies between different industrial proponents have to be found and deepened,
which requires regular exchanges of information and points of view

Forum on Accelerator Technologies and
Instrumentation for the Future Large-Scale Facilities
(ILC/CLIC)

From Industry Session: 3 requirements

G. Taylor

1. **Physics Driver(s)**
   - *Precision Higgs is a clear driver for IL* … *CC(ee)*
   - *The high energy frontier - p*
2. **Technology**
   - *ILC SC*
   - … *further development*
   - … *I know nothing is easy!"*
   - … *for future pp collider needs considerable*
3. **Resources**
   - *Much Major HEP Capital Spending Complete by mid-2020's*
   - *(New Chinese funding for CEPC!)*

Very large (expensive) infrastructures in HEP have served as a driving force for various technologies evolutions ultimately changing the society:

The ILC/CLIC projects will boost and promote high-tech industry:

→ Advanced accelerator technologies for the society well-being

→ Importance of broadening international partnership to address social challenges using high-tech technologies

EU - Japan Industrial Cooperation

2016 IEEE NSS/MIC/RTSD in Strasbourg

アルザス・欧州日本学研究所（CEEJA)
Centre Européen d'Etudes Japonaises d'Alsace

アルザス・欧州日本学研究所(CEEJA)は2001年の設立以来、日本とアルザス間に築かれた強い絆を基に、以下の活動を行っています

1. ヨーロッパ市場への進出を見据えた日本企業への

2. 日本とアルザス間の文化・学術交流

3. ヨーロッパにおける 学研究の要として の役割

所は主にオ・ラン県、アルザス地方政 受けて運営しています。
ルーズ都市圏、コルマール市、キンツハイム市、東芝国際交流財団など、フランス、ヨーロッパ、日本に100以上の協力関連機関があります。

年間を通してヨーロッパにおける日本研究及び日本文化の紹介を数多く開催。
（国際シンポジウム、講義、研究会議、 版物、展覧会、コンサート、芝居、映画　など）

J. Goto

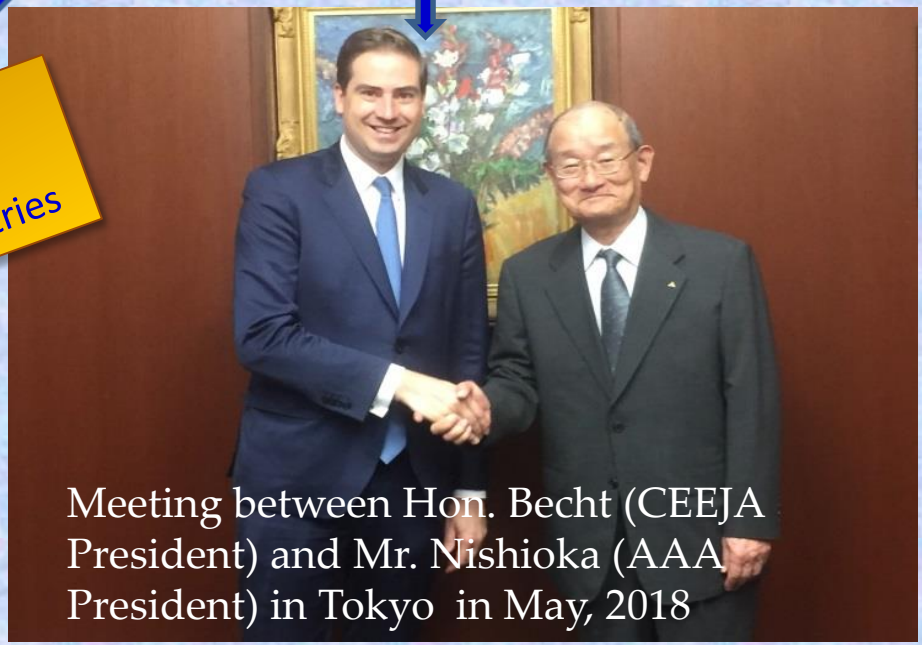
▼アルザス・欧州日本学研究所 による科学・文化イベント開催

40 years of France-Japan industrial cooperation

EU-Japan Center for Industrial Cooperation (offices in Brussels and Tokyo):
http://www.eu-japan.eu

The EU-Japan Centre i
Commission (D
Ministr y (METI) :

Special Event: "ILC - Industry – Innovation" is being planned in Brussels in 2018/2019 (tbc):
→ A New Challenge for Japanese and European Industries



Meeting between Hon. Becht (CEEJA President) and Mr. Nishioka (AAA President) in Tokyo in May, 2018

Promoting Large-Scale International Projects in Advanced Science and Technology

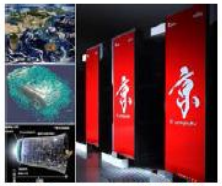
The cooperation between Europe and Japan has become ever more important in recent years. Advanced science and technology, in particular, is one of the maio[illegible]aborative avenues that lead to global peace and prosperity. Europe and Japa[illegible]easingly important roles in leading science and technology. Me[illegible]e Diet (parliament) hope to further enhance the cooperati[illegible]rts, in order to promote support for international co[illegible]t the government and the parliamentary le[illegible]

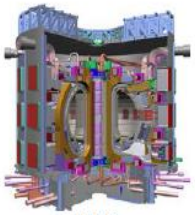
The following four i[illegible] and information T[illegible]echnological spin[illegible]e future projects are [illegible] Japan (see below). Japan [illegible]sion project and the LHC accelerator a[illegible]ollider (ILC), a future large-scale accelerator pr[illegible] its realization as an international project through coo[illegible]overnment, industry and the scientific community; Its core tech[illegible]g developed by Europe, USA, and Japan. Members of the Japanese Diet [illegible]deepen the dialogues with members of the parliament and governments in order to realize long-term support for large-scale international projects such as ITER, LHC, and ILC.*

Enhanced cooperation in energy, accelerators, space and information (e.g. ITER, LHC, ILC, …) → drivers of global innovation

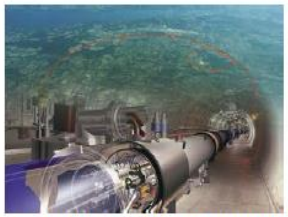

International Space Station (ISS)


Piz Daint / CSCS, Switzerland

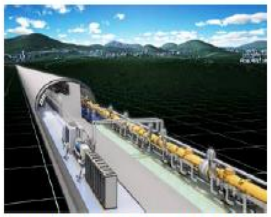

K Computer / RIKEN


ITER


MYRRHA Project
(Accelerator-Drive Subcritical Reactor)


Large Hadron Collider, CERN

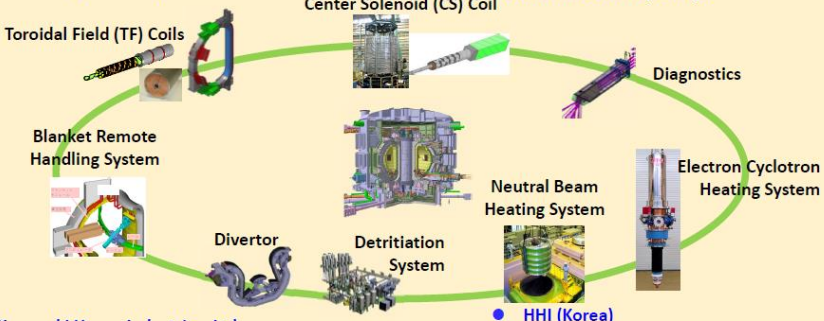

European XFEL, DESY


International Linear Collider (ILC)

Suppliers participating in procurements by Japan

QST

- Furukawa Electric Co., Ltd.
- Hitachi, Ltd
- Hitachi Metals, Ltd.
- Japan Super Conductor Technology, Inc.
- J-Power Systems Corporation
- Mitsubishi Heavy Industries
- NIPPON STEEL & SUMIKIN Engineering
- TOSHIBA Corporation
- Toshiba Electron Tubes & Devices Co., LTD.
- AT&M and TLWM (China):



- Kawasaki Heavy Industries, Ltd
- KYOCERA Corporation
- Metal Technology Co. Ltd.
- Mitsubishi Electric Corporation
- HHI (Korea)
- KIND (Germany)
- Industeel (France)
- FAV (Italy)
- Kiswire Advanced Technology (Korea)

M. Mori

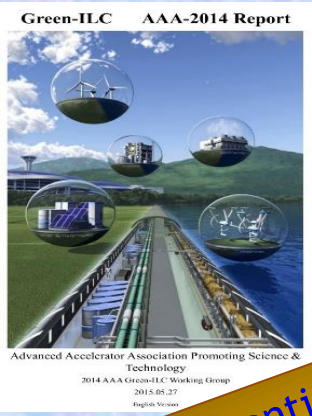
Next Generation of Particle Accelerators: Technologies for Industrial-Scale SRF Accelerators

Development of high intensity particle beams:

- Ordinary: electrons, protons, X-Ray
- Specific: positrons, neutrons, ions, …
- Large-scale infrastructures: power saving issues, renewable energies

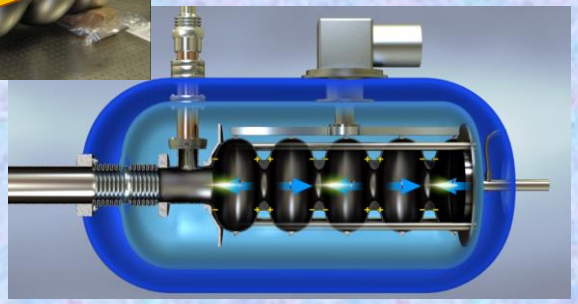
Develop new generation acceleration technics / structures:

- Super-conducting accelerating cavities
- Klystrons = energy sources
- Higher accelerating g… a)



Partic…

Potential to enable applications in waste-water treatment, border security, medical physics, compact light sources, material science - direct, positive impact on general public



…p particle transport systems:

- vacuum systems
- magnetic elements: dipoles, sextupoles, …

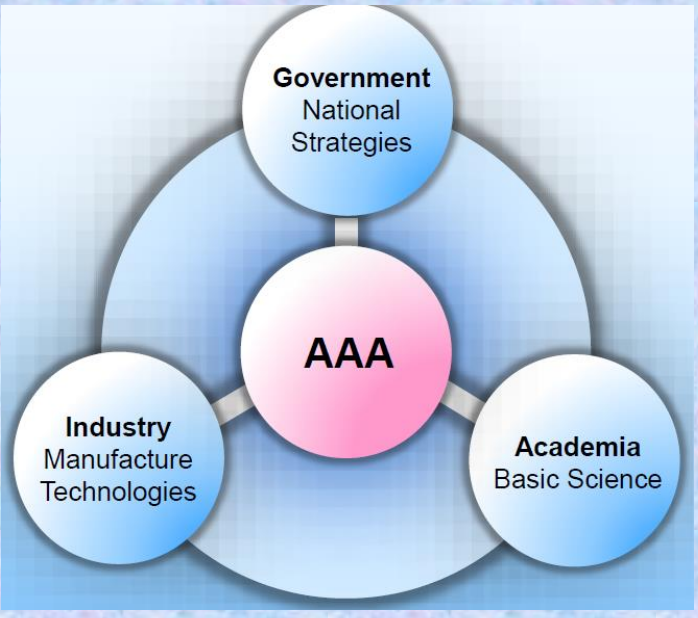
Develop particle beam focusing systems:

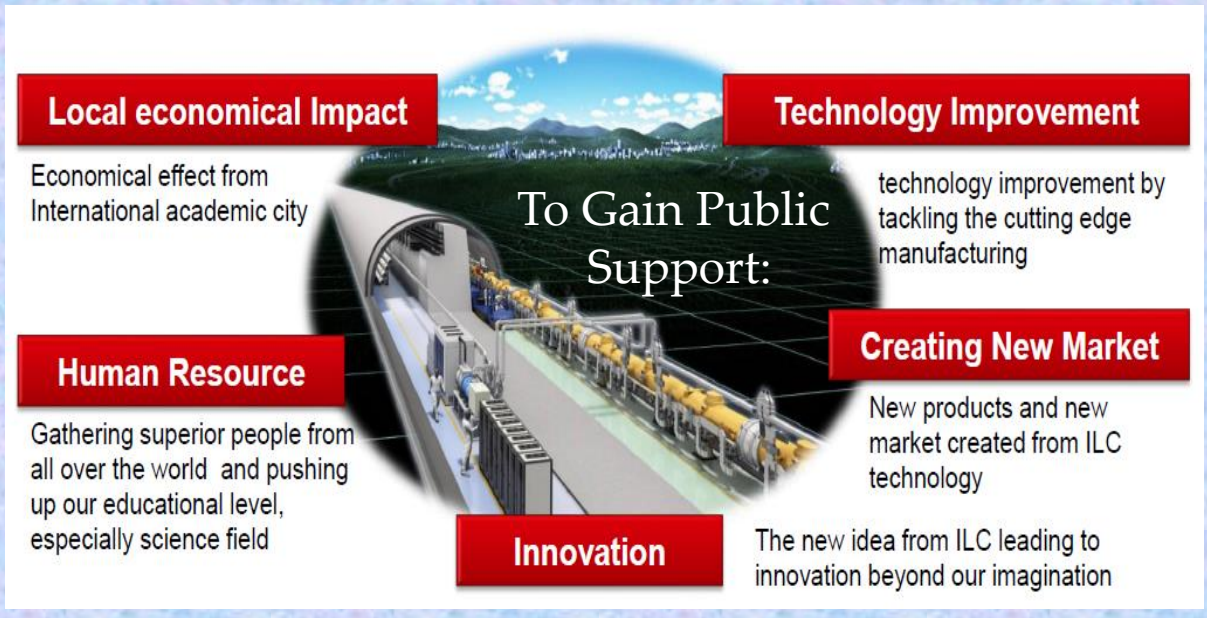
- SC quadruples
- Damping ring
- Nanometers-scale beams

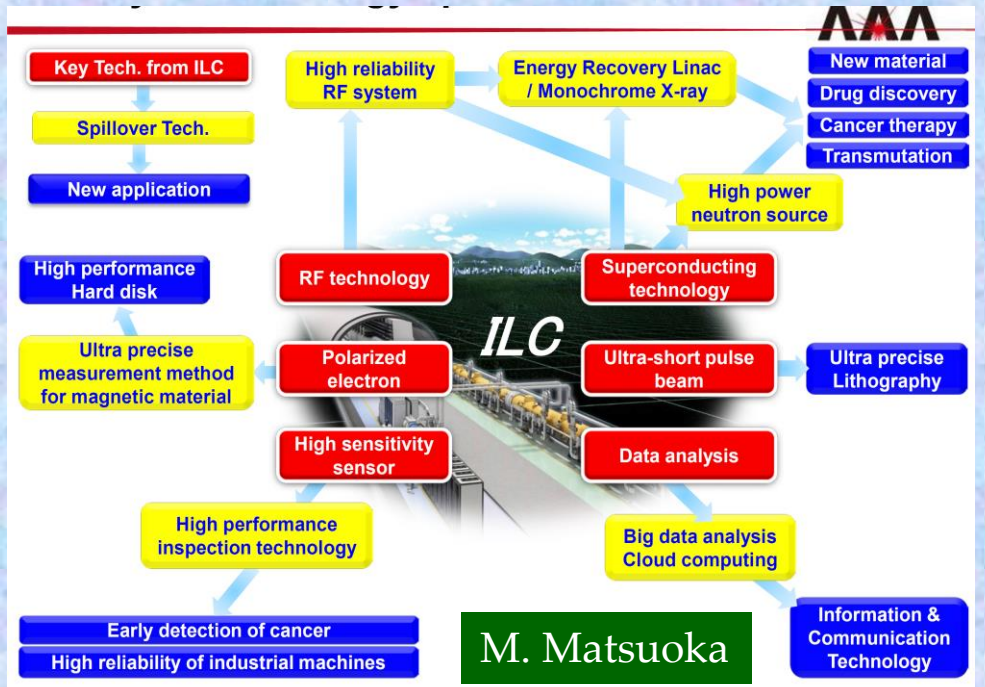
Develop beam control systems:

- non-destructive beam diagnosis
- fast high-precision feedback / correction

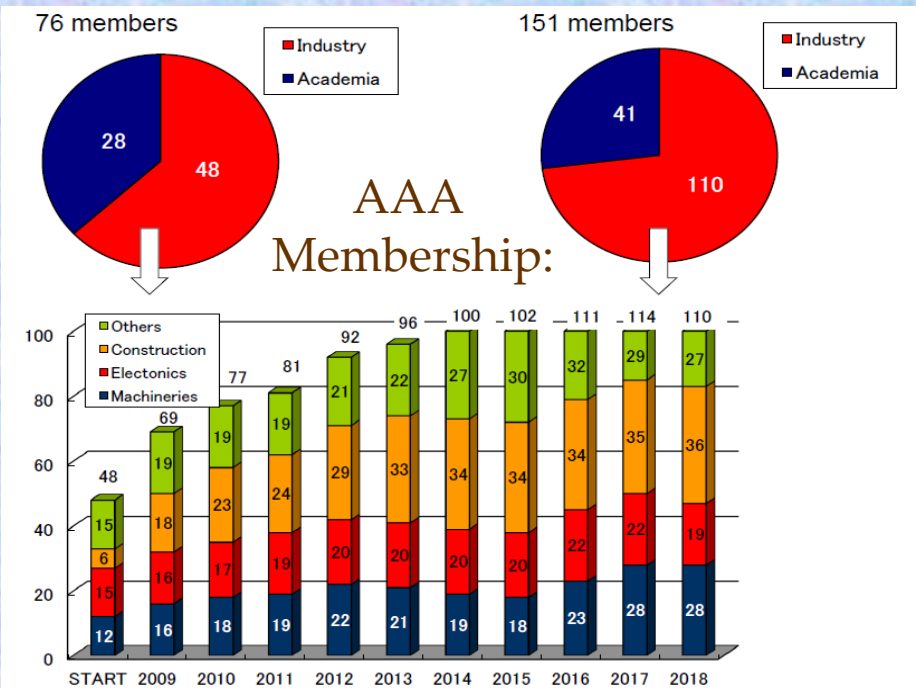
Academia – Industry Advanced Accelerator Association (AAA) in Japan



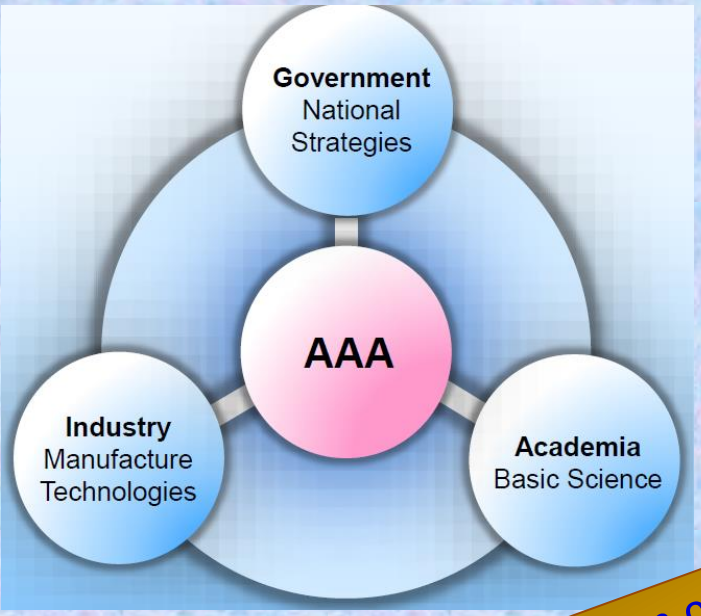




M. Matsuoka



Academia – Industry Advanced Accelerator Association (AAA) in Japan

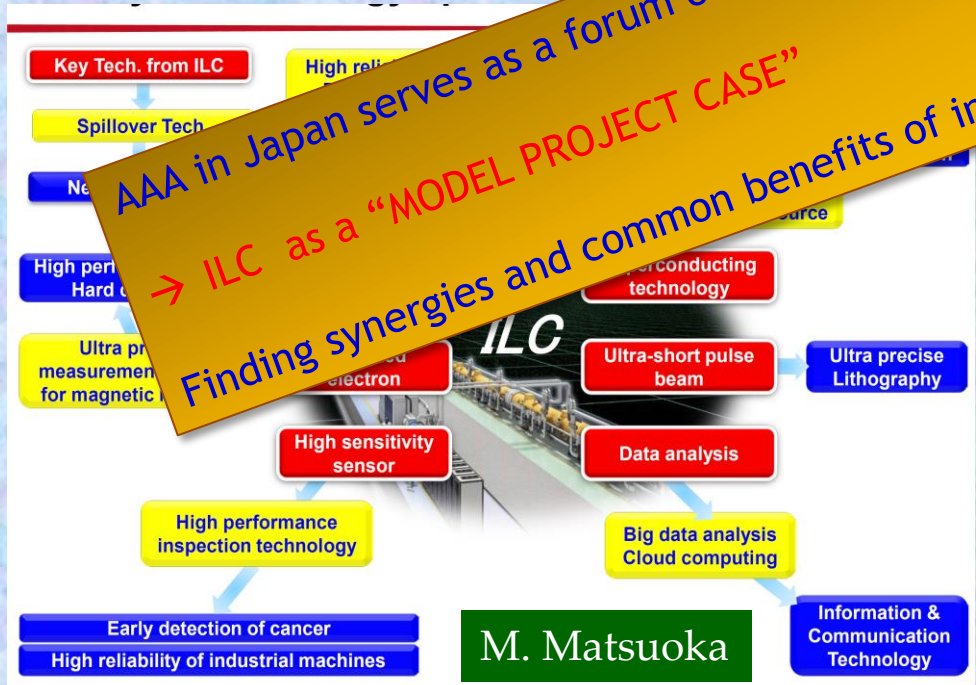


To Gain Public Support:

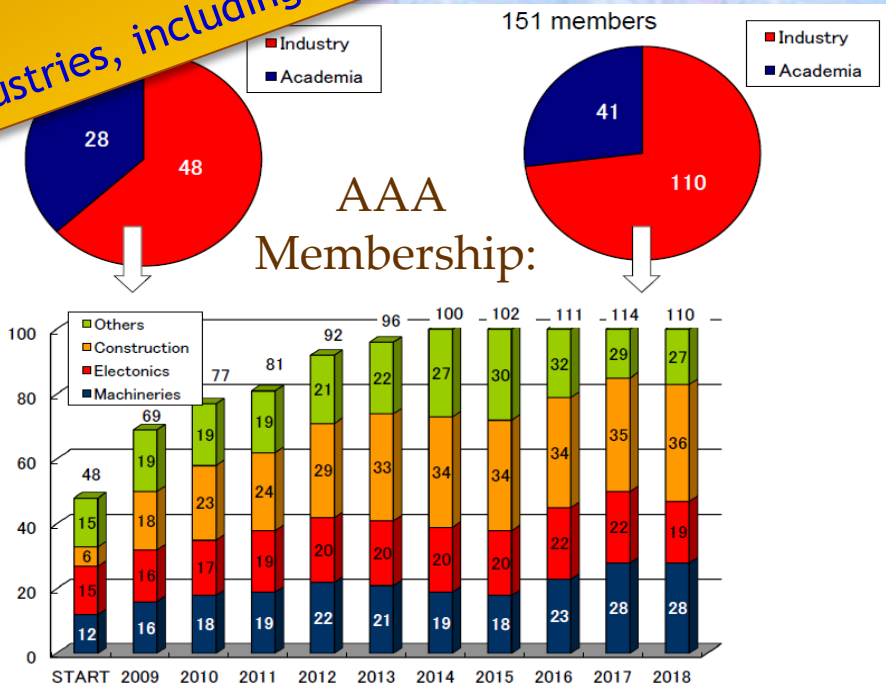
AAA in Japan serves as a forum on advanced accelerator R&D, IP and related areas

→ ILC as a "MODEL PROJECT CASE"

Finding synergies and common benefits of industries, including other research domains



M. Matsuoka



Symposiums on Advanced Accelerators with AAA Participation


M. Yoshioka


R. D. Heuer


A. Suzuki


M. Tsujii


S. Komamiya

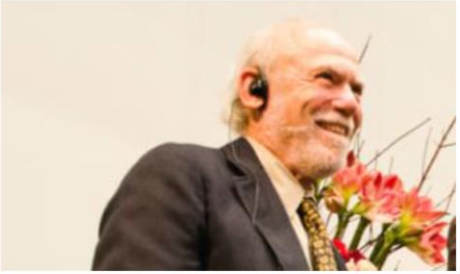

J. Kawaguchi


H. Yamamoto

M. Matsuoka


M. Ie


H. Murayama


B. Barish


D. P. Poneman


T. Masukawa

Academia – Industry Advanced Accelerator Association (AAA) in Japan

M. Matsuoka

Etemity Supreme Advisor:
The late Kaoru Yosano

Honorary Chair:
Masatoshi Koshiba
Nobel prize in Physics 2002

Supreme Advisor:
Takeo Kawamura
Senior Advisors:
Yoichi Tao
Junichi Nishiyama
Hiroya Masuda
Masao Ninomiya
Toshiyuki Sakamoto

Chair:
Takashi Nishioka
Vice Chair:
Atsuto Suzuki

General Meeting
Corporate Organizations
and Institutional Organizations

Board of Directors
Representative Director:Takashi Nishioka(MHI)
Director: Atsuto Suzuki(Iwate pref. University)
Director: Masanori Yamauchi (KEK)
Director: Yuzo Onishi (Kyoto Univ.)
Director: Mamoru Hatazawa (Toshiba)
Director: Hiroto Uozumi (Hitachi)
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Auditor: Sachio Komamiya (Univ. of Waseda)

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Secretary General:
Masanori Matsuoka

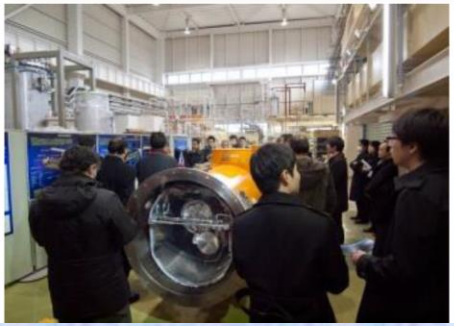
Technology Study Gr.
Leader: Hitoshi Hayano

Outreach Gr.
Leader: Hiroyuki Yoshizumi

CIVIL Gr
Leade

Recently, new group has been established
(by combining Civil and Large Project Study groups)

→ the "Project Promoting Group"
to promote the International Collaboration for ILC
(with Diet, Government, Academy & Industry)



Collaboration Between Different Agents of the Spanish Science (INESTAR – AAA)

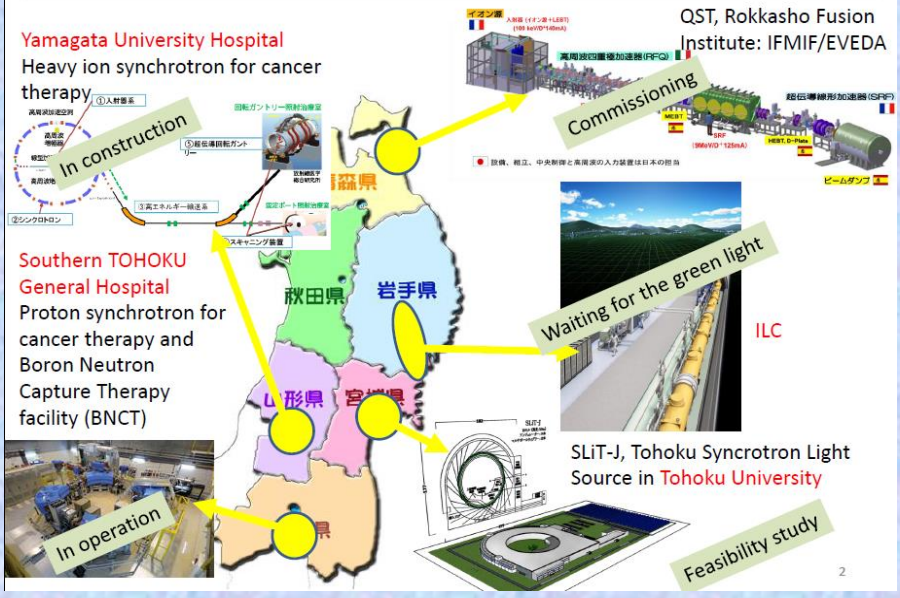
Collaboration Opportunities on Fusion and Accelerator Technologies and Projects, between Spanish and Japanese Organizations in 2016:

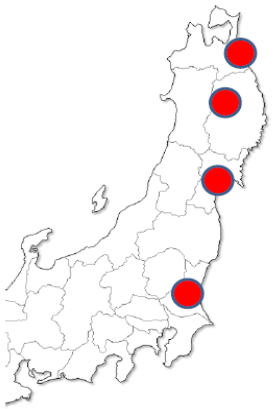
Workshop at Spanish Embassy in Tokyo (INEUSTAR – AAA)

INEUSTAR → Spanish Science Industry Association (private, no academia)

Tohoku Accelerator Production Cluster

Current accelerator projects in TOHOKU, where it was a blank area of accelerator

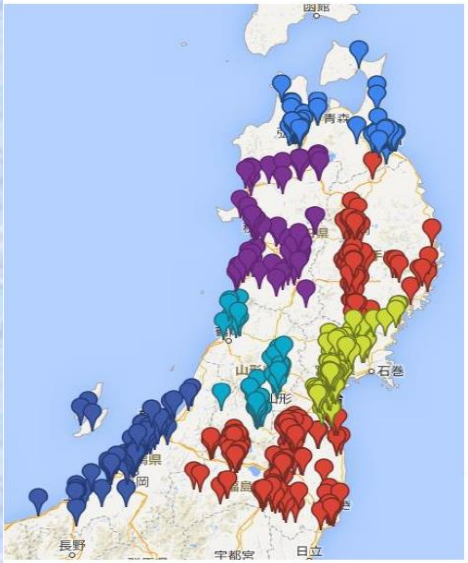




Cluster #1: Vertical Electro-polishing Equipment for Fabrication of Superconducting Cavities

- **MARUI GALVANIZING CO.,LTD.** (HQ in Hyogo Pref. & Aomori Branch): Plating business
- **Higashi Nihon Kiden-kaihatsu CO.,LTD.** (Iwate, Morioka): Various Control Panel for social infrastructures.
- **WING CO.,LTD.** (Iwate, Morioka): Plastic Processing business.
- **Iwate Prefecture**
- **Tohoku Economic Federation**
- **KEK**

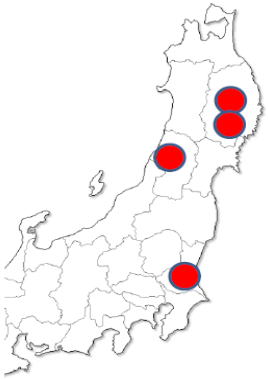
Main target:
Cost reduction by
- making compact EP facility
- minimizing necessary time to make EP



In TOHOKU, many large and small manufacturing industries (in total, more than 700) are located such as
- Automotive
- Aerospace
- Semiconductor
- Medical equipment
- Precision machinery
- Others

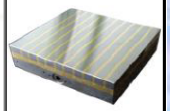
1st step of our effort
Among them, more than 110 companies want to enter the accelerator-related businesses and create **a loose alliance** in **General Incorporated Association, TOHOKU ECONOMIC FEDERATION**.

2nd step is to
organize the cluster in a few companies in order to expand their technical capacity.



Cluster #3: Tunable magnets for accelerators based on the permanent magnet technology

- **Suzuki Kikai Co., Ltd.,**
In Takizawa-city of Iwate prefecture
Precision machining, assembling, quality assurance



- **San-ai Seiki limited company**
In Oshu-city of Iwate prefecture
  - Various type of magnetic chuck
  - Good handling technology of permanent magnets

- **OHTSUKA INC.** in Tsukuba
Many experiences of precision machining of accelerator components for KEK
- **PREFACT** (Precision Factory)
Yamagata prefecture

- **Iwate prefecture**

M. Yoshioka

SppC related Technology Domestic Collaboration in China

"Applied High Temperature Superconductor Collaboration" was established in Oct. 2016.

- **Goal:**
  1) To increase the J_c of **IBS** by 10 times, reduce the cost to **20 Rmb/kAm @ 12T & 4.2K**;
  2) To reduce the cost of **ReBCO and Bi-2212** conductors to 20 Rmb/kAm @ 12T & 4.2K;
  3) Realization and Industrialization of iron-based magnet and SRF technology.
- **Working groups:** 1) **Fundamental science** investigation; 2) **IBS** conductor R&D; 3) **ReBCO** conductor R&D; 4) **Bi-2212** conductor R&D; 5) **performance** evaluation; 6) **Magnet and SRF** technology.
- **Collaboration meetings:** every 3 months, to report the progress and discuss plan for next months.

J. Gao

CEPC Industrial Promotion Consortium (CIPC) in China

1) Superconduting materials (for cavity and for magnets)
2) Superconductiong cavities
3) Cryomodules
4) Cryogenics
5) Klystrons
6) Vacuum technologies
7) Electronics
8) SRF
[illegible] Engineering
[illegible] Precise machinary.....

→ start as the Industrial Consortium with a possibility to transform to "Academy-Industry organization" in China with "CEPC as a Model Project Case" (?)

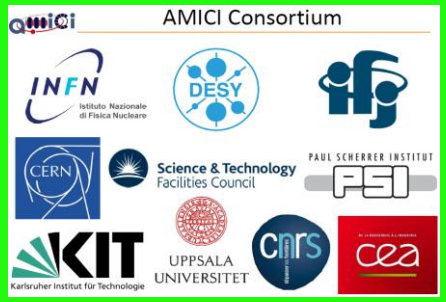
Established in Nov. 7 , 2017

More than 50 companies joined in first phase of CIPC,
and more will join later....

J. Gao

Technology Promotion Consortiums & Industrial Clusters @ LC Industry Forums

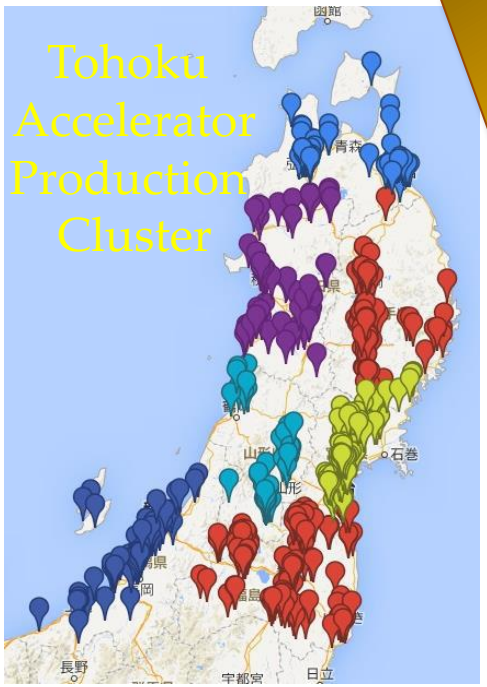
AMICI



PIGES (France):

EU H2020:

Consolidate links and enlarge international cooperation between academia and industrial players involved in accelerator science for future large scale infrastructures → as a seed for more global Industrial consortiums (?)



("ILC as the model case")

Advanced Accelerator Association Promoting Science & Technology

Linear Collider Industry Forums

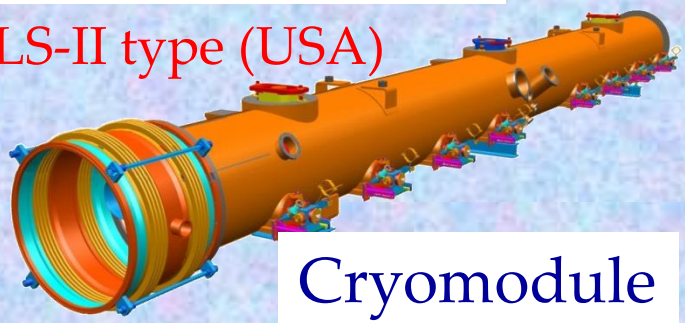
ineustar

Asociación Española de la Industria de la Ciencia

Global Superconducting RF Linac Technology

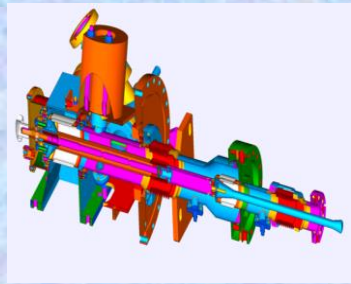
Cryomodule based on European XFEL (DESY) / LCLS-II type (USA)

RF Cavity



Cryomodule

Power Coupler



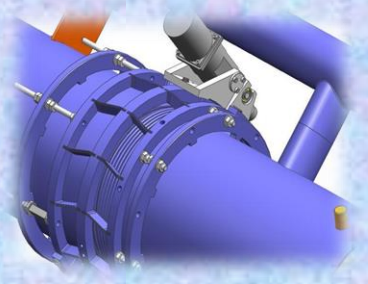
Talks @ LCWS2017 / Strasbourg:

- RF Cavities → Talks by EZ, RI
- XFEL Village in CEA → ALSYOM
- Couplers → THALES

SCRF Linac Technology

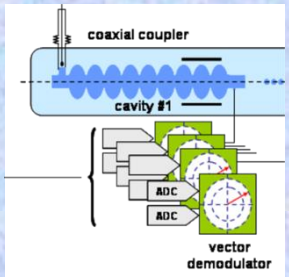
ilc GDE

Frequency Tuner



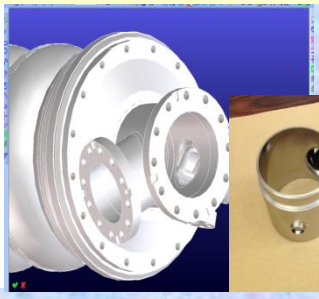
Acknowledging the efforts of the TESLA Technology Collaboration

LLRF



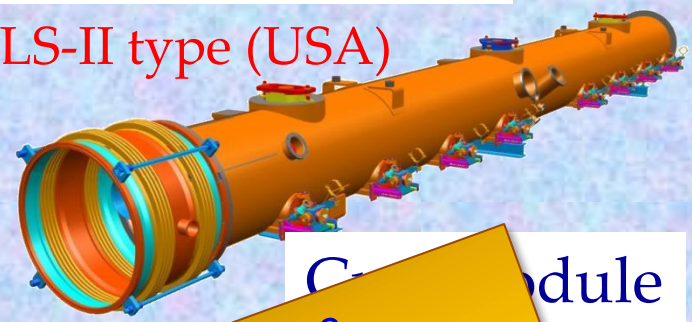
RF power

HOMs (higher order modes) coupler



Global Superconducting RF Linac Technology

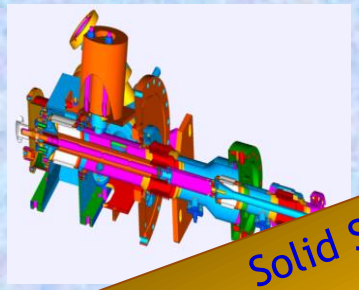
Cryomodule based on European XFEL (DESY) / LCLS-II type (USA)



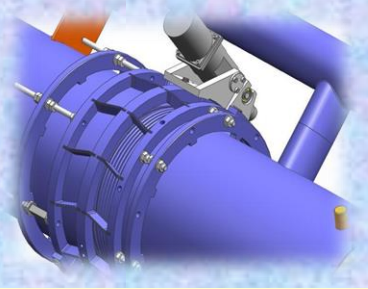
RF Cavity

Cryomodule

Power Coupler



Frequency Tuner



Talks @ LCWS2017 / Strasbourg:

- RF Cavities → Talks
- XFEL Villa
- Co

Solid SRF technological base for the ILC on a global scale is now in place

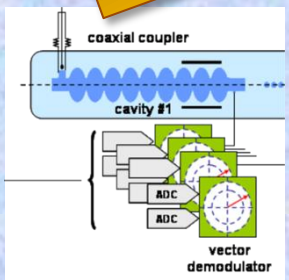
→ promote development of 1.3 GHz cavities, expertize and infrastructure in all 3 regions

TRIUMF, Canada
FNAL, ANL
SLAC
BARC, RRCAT India

Linac Technology

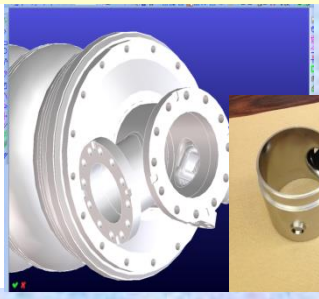
ilc GDE

Acknowledging the efforts of the TESLA Technology Collaboration



RF power

HOMs (higher order modes) coupler



ILC-SRF Technology: Accelerators and Expertize Worldwide

Largest deployment of this technology to date
- 100 cryomodules
- 800 cavities
- 17.5 GeV (pulsed)

FNAL/ANL

SLAC

Cornell

JLab

LAL/Saclay

DESY

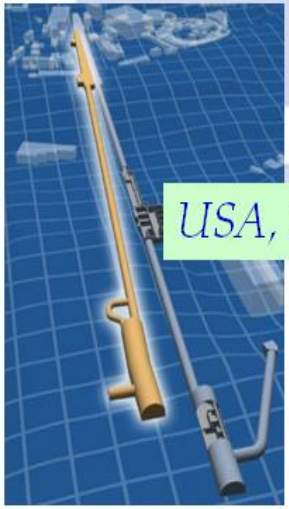
INFN

ILC Kitakami proposed site

KEK-ILC Lab Hub

IHEP KEK

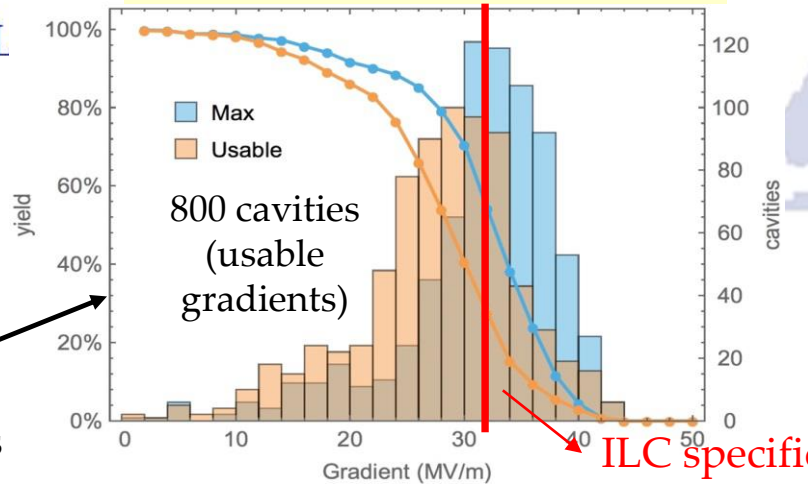
Asia, PAPS@IHEP CFF/STF@KEK



USA, LCLS-II

US infrastructure @ LCL
- 35 cryomodules
- 280 cavities
- 4 GeV (CW)

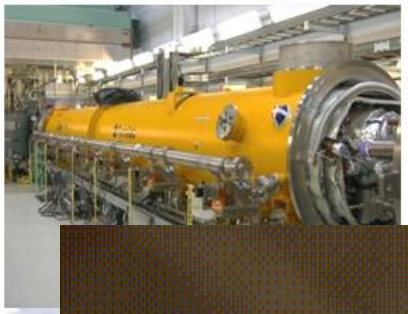
EXFEL SRF Cavity Gradients:



A "10% prototype" of the ILC: Industrialised cavity & cryomodule production up to ILC specifications

ILC specifications

XFEL@ DESY: an Ultimate "Integrated System Test" for the ILC



European XFEL

Largest deployment of this technology to date
- 100 cryomodules
- 800 cavities
- 17.5 GeV (pulsed)

Kitakami
posed site

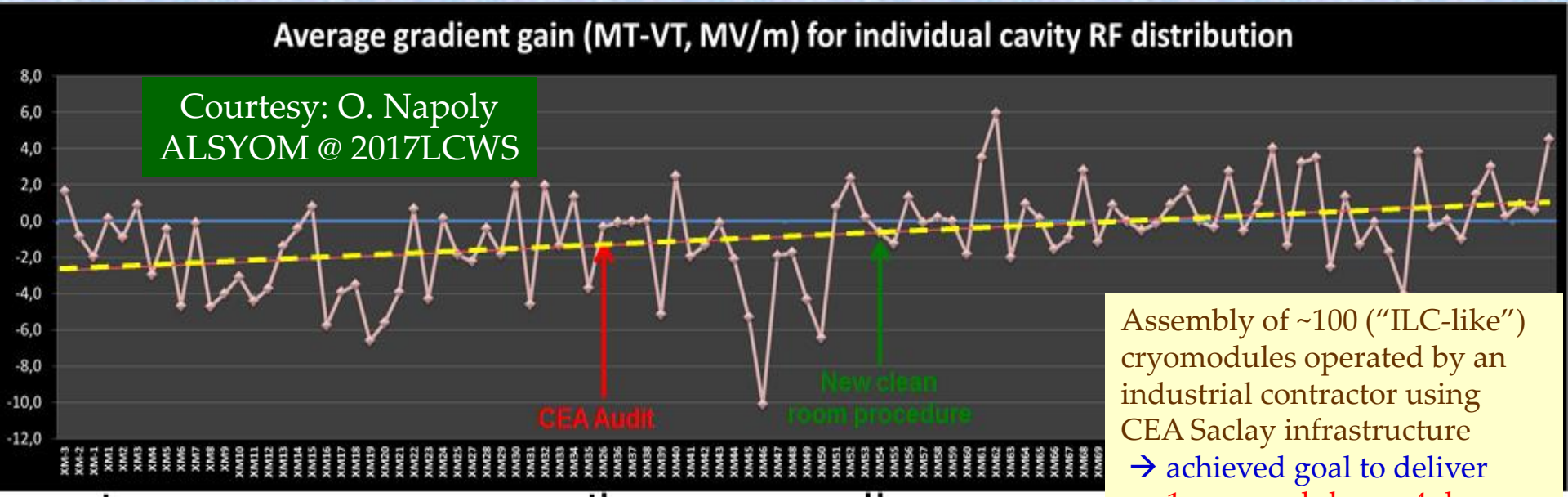
KEK-ILC
Lab Hub

Asia,
PS@IHEP
/STF@KEK

Gradient (MV/m)

ILC specifications

XFEL Gradient Performance: Cryomodule vs Cavity



Assembly of ~100 ("ILC-like") cryomodules operated by an industrial contractor using CEA Saclay infrastructure
→ achieved goal to deliver 1 cryomodule per 4 days

1st sample of 34 series CM
ΔE_{op} = -2.1 MV/m

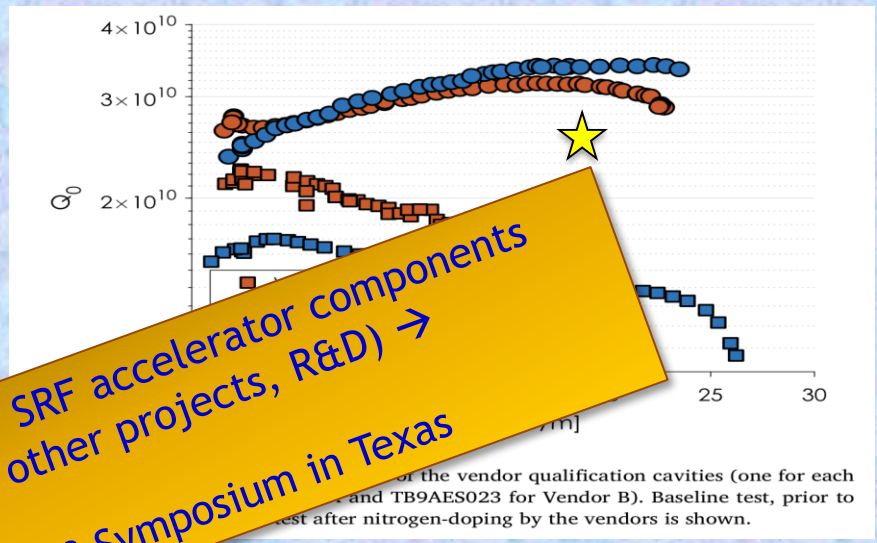
2nd sample of 19 series CM
ΔE_{op} = -1.7 (-0.9) MV/m

last 47 series CM
ΔE_{op} =+0.5 MV/m

Degradation mitigated through critical efforts during the 100 European XFEL cryomodule assembly. No-degradation achieved.

Industry-Research Institution Collaboration in the United States

Technology transfer of nitrogen doping treatment to cavity vendors for LCLS-II



Number of highly skilled US-vendors for SRF accelerator components (e.g. contributing to LCLS-II and other projects, R&D) →

invite them to the next LCWS2018 Symposium in Texas

Production of LC ½ at JLab, ½ at Fermilab (300 cavities)

S. Posen

Process includes vertical test qualification, string assembly, cold mass, vacuum vessel, cryomodule testing

Potential technical contribution to ILC 250GeV construction from China
(Just possibilities and hope, personal point of view)

Parameters	Value
C.M. Energy	250 GeV
Peak luminosity	1.35 x10^{34} $cm^{-2}s^{-1}$
Beam Rep. rate	5 Hz
Pulse duration	0.73 ms
Average current	5.8 mA (in pulse)
Av. field gradient	31.5 MV/m +/-20% Q_0 = 1E10
# 9-cell cavity	8012 (x 1.1)
# cryomodule	928
# Klystron	~200

Higgs factory (250GeV)

300 cryomodules (cold mass) or more? realistic

1 company in China - experience with "cold mass" assembly

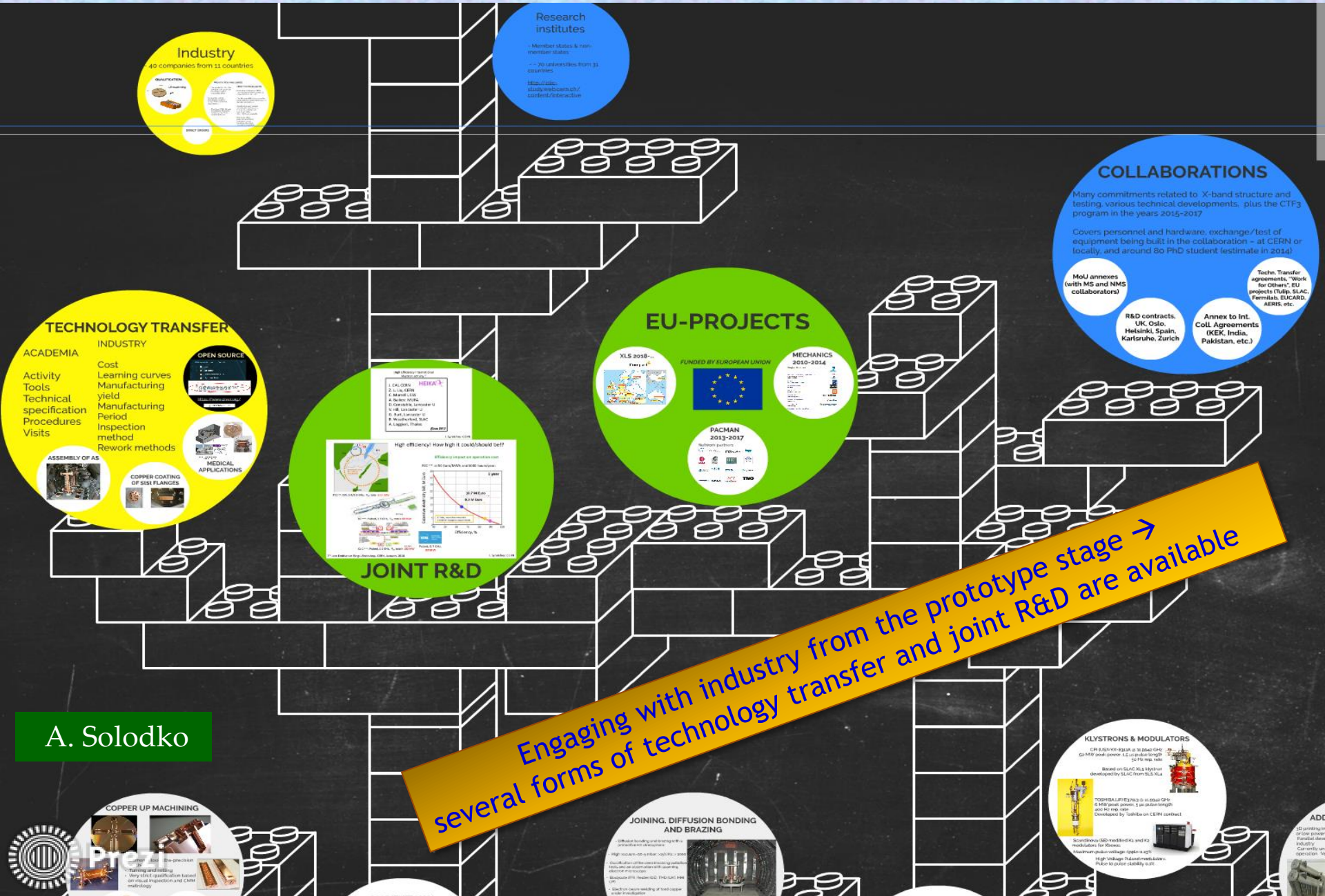
Three cavity production centers: 800-1000 cavities in total (ideal maximum case, needs great efforts…)

3 companies in China

Damping ring magnets
Components like vacuum Chamber, etc
~1/3 or more?

J. Gao

Experience of Industry-Academia Cooperation in CLIC



Examples of Industrial Developments for CLIC

S. Stapnes ALCW2018
N. Catalan Lasheras, LCWS2017

Bodycote (FR)
Reuter (DE)
TMD (UK)

SWISSto12 (CH)
3T RPD (UK)
Concept Laser (DE)
INITIAL (FR)
Protoshop (DE)

VDL (NL)
LT-Ultra (DE)
Yvon Boyer (FR)
DMP (ES)
Morikawa (JP)
KERN (DE))

Thermocompact (FR)
BACMI (FR)
Multivalent (NL)

CINEL (IT)
VDL (NL)
BACMI (FR)
CECOM(IT)
Reuter (DE)
Nihon (JP)
COMEB (IT)
Viztrotech (KR)

Thales (FR)
CPI(US)
Toshiba (JP)

Scandinova (SE)
Jema (ES)
Picatron (CH)

Compact Linear Collider

General Overview: RF- Componets

Next phase:

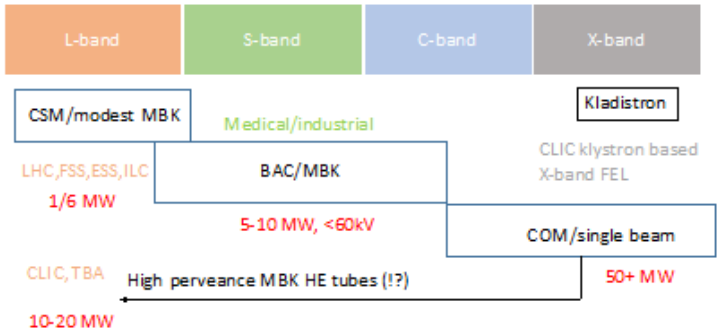
- Qualified companies, technical and commercial documentation, reliable costs (i.e. not first prototype), ideally (small) part of larger market

New Ideas on Klystron Efficiency: INITIAL study

S. Stapnes

Now addressing improved efficiencies for all possible f-ranges and power requirements - relevant for any machine

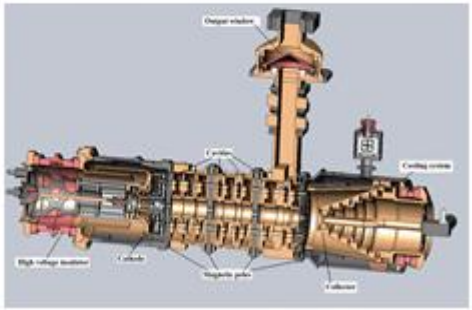
The choice of bunching technology may drive the applicable frequency range and multi-beam options (cost/performance):



Commercial Prototype of High Efficiency S-band Pulsed BAC MBK

Igor Guzilov[1], Roman Egorov[1], Gerard Mcmonagle[2], Igor Syratchev[2], Ben Woolley[2]
[1]JSC "Vacuum device's basic technologies", Moscow, 117342, Vvedenskogo str., 3, k1
RUSSIAN FEDERATION,
[2]CERN, CH-1211, Geneva 23, Switzerland

"To minimise the development risks and fabrication cost of the first BAC MBK prototype, we have decided to facilitate a retrofit design of an existing klystron; MBK KIU-147. It has been in production in Russia (FSUE "Toriy") for almost 15 years and operates at 60 kV, 290 A with **42% RF power production efficiency**."



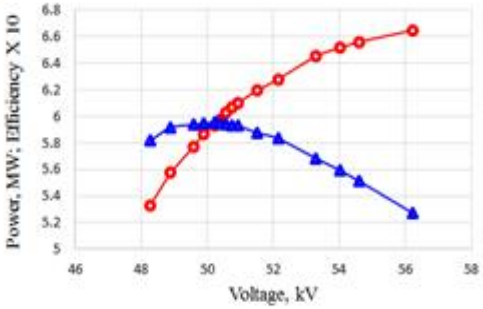


Figure 5: The efficiency (triangular) and RF power production (circle) in saturation at 3.003 GHz as functions of high voltage.

Existing and Planned X-band Infrastructure in Collaboration with CERN

Eindhoven	Compact Compton source - 100 MeV	6 MW	Design and procurement
CERN	CLEAR - 50 MeV (from Xbox-1)	50 MW	Design and preparation
Frascati	XFEL, injector to plasma - 1 GeV	4(8)x50 MW	CDR
Collaboration	CompactLight - 6 GeV		Design study
CERN	LDMX - 3.5 GeV	24x50 MW	Proposal under discussion
Groningen	1.4 GEV XFEL Accelerator - 1.4 GeV		NL roadmap
CERN	CLIC - 380 GeV	5000x50 MW	CDR

CERN	XBox-1	50 MW, 12 GHz	Operational (later to CLEAR)
	Xbox-2	50 MW, 12 GHz	Operational
	XBox-3	4x6 MW, 12 GHz	Operational
KEK	NEXTEF	2x50 MW	Operational
Tsinghua	Later energy upgrade for Compton	50 MW, 12 GHz	Commissioning
Trieste	CTF	45 MW, 3 GHz	Operati
Valencia		2x10 MW	
Frascati			
Shanghai			
Melbourne, ALS			Proposal submission
SLAC			Operational (I think)

Trieste	Linearizer for Fermi	50 MW	Operational
PSI	Linearizer for SwissFEL	50 MW	Operational
	Deflector for SwissFEL	50 MW	Design and procurement
DESY	Deflector for FLASHforward	6 MW	Design and procurement
	Deflector for FLASH2	6 MW	Design and procurement
	Deflector for Sinbad	tbd	Planning
SINAP	Linearizer for soft X-ray FEL	6 MW	Operational
	Deflectors for soft X-ray FEL	2x50 MW	Procurement
Daresbury	Linearizer	6 MW	Design and procurement
Tsinghua	Li	6 MW	Planning
			Operational
		50 MW	Operational

There is a growing interest on the use of high gradient X-band technology outside HEP domain

S. Stapnes, ALCW2018

Beyond being a collaboration for CLIC, many groups have their own X-band facilities and components (see overview)

Left: EU Design Study for X-Band FELs 2018-2020: http://compact-light.web.cern.ch

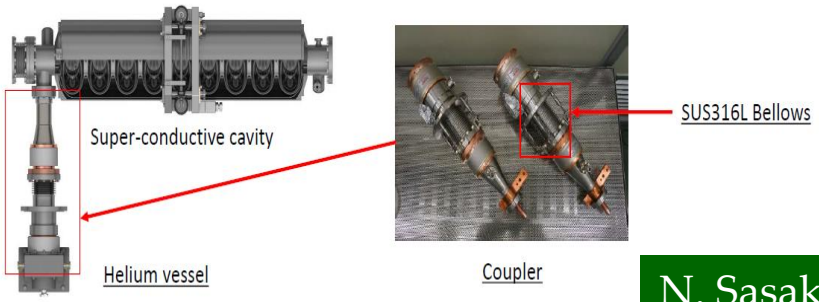
In the CLIC preparation phase:
Take advantage of the widespread use of electron linacs, and rapidly increasing use of X-band → make technology available to other research institutes and companies

ALCW2018: Industrial Company Presentations

Akita Chemical Industries: Development of copper plating solution suitable for couplers

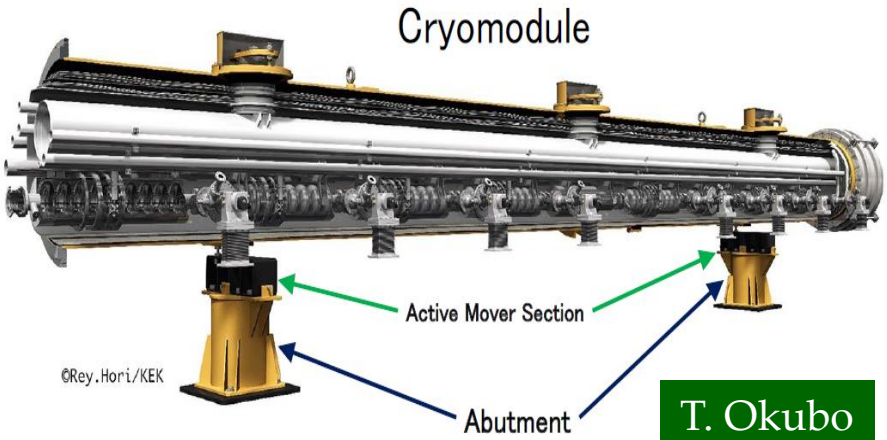
The inside of input couplers is copper-plated to reduce loss of high frequency.

These couplers are used under sever conditions and thus require stabilized plating quality.



N. Sasaki

IWATE IRON: Consideration of precision adjustment abutment of ILC cryomodule



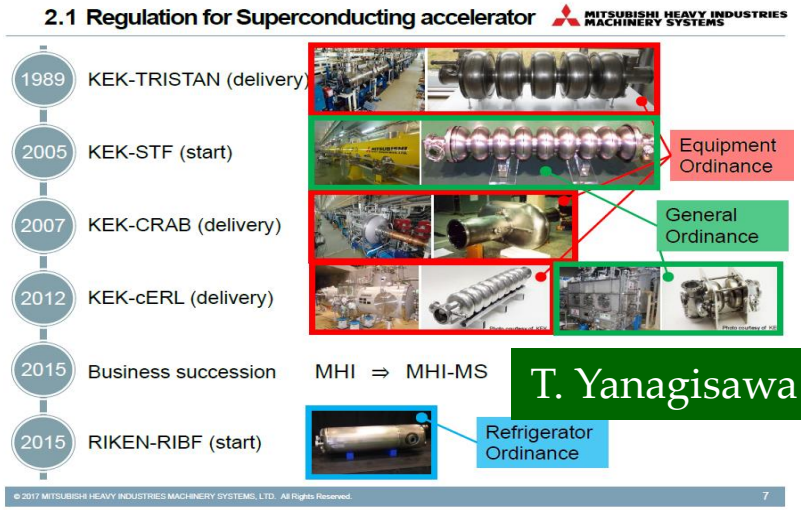
T. Okubo

Scandinova: High stability technology for Klystron modulators

O. Yushiro

Magnetron Series				Klystron Series					PG-SERIES	E-SERIES
M050-i	M100 M100D	M100-i M100D-i	M200 M200D	K100	K200	K300	K400	K500	PG200	E100-i
Integrated	Single and Dual	Integrated Single and Dual	Single and Dual	-	-	-	-	-	-	Integrated
0,2-2,0 MW	1-3,1 MW	1-3,1 MW	2,5-5 MW	3-10 MW	7-35 MW	25-50 MW	30-60 MW	50-100 MW	0-36 MW (Generator peak power)	0-30 kW (Modulator peak power)

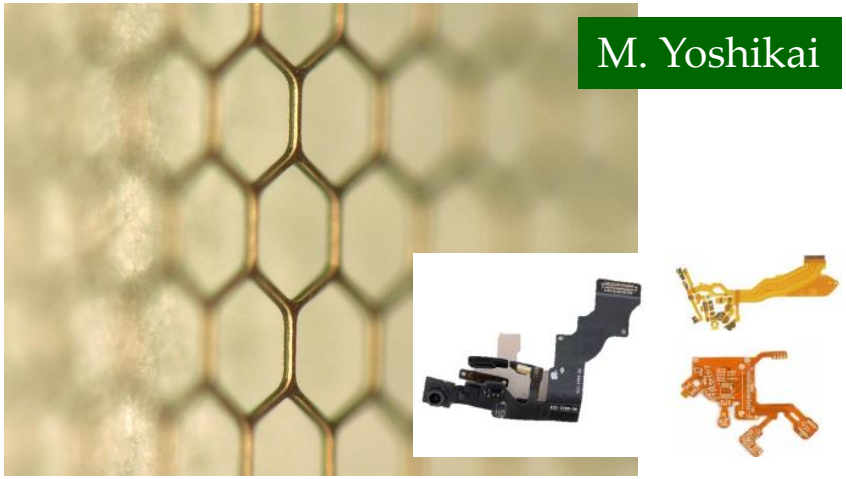
MHI-MS: New standards for the high pressure gas safety act for ILC is needed



T. Yanagisawa

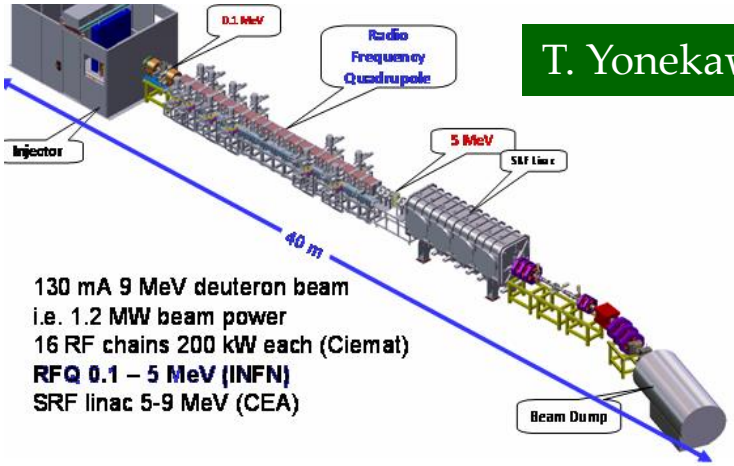
ALCW2018: Industrial Company Presentations

FUJIKURA: Development of GEM Gating Foils Using Flexible Circuit Production Technique



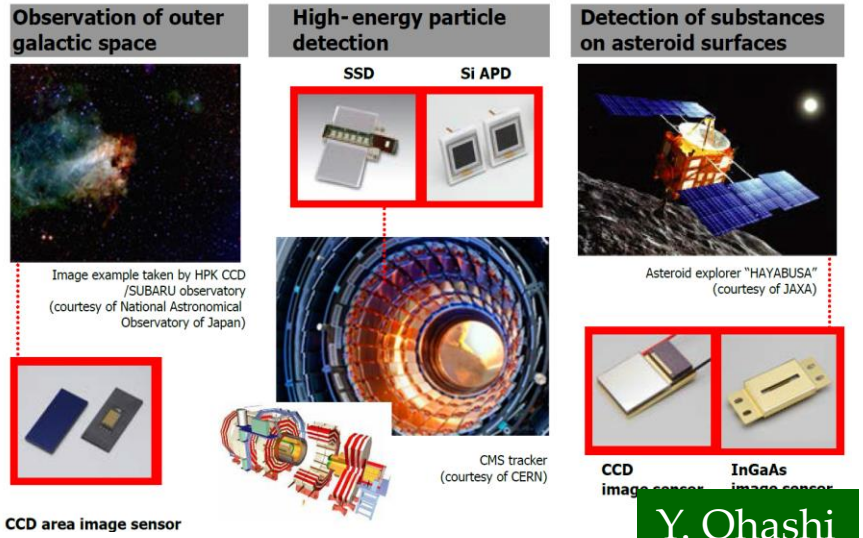
M. Yoshikai

SEVEN SOLUTIONS: RF Time and Distribution; RF-cavities Control / Tune Systems



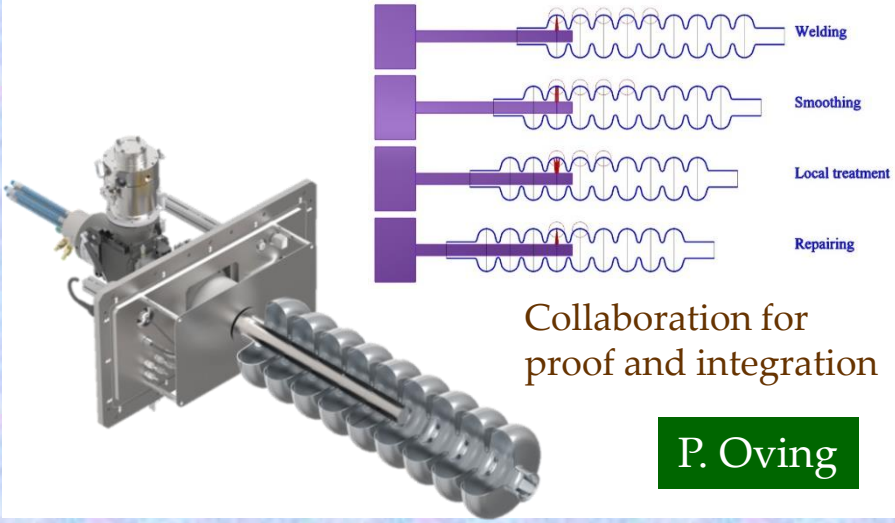
T. Yonekawa

HAMAMATSU: Silicon Detectors for HEP



Y. Ohashi

TECHMETA: Inside Cavity Welding of Equatorial Weld



Collaboration for proof and integration

P. Oving

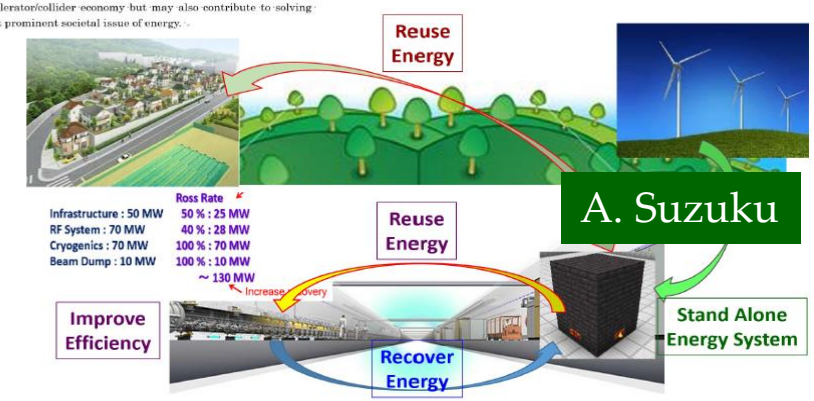
Future Direction for Industry – Academia Collaboration

Request for ICFA Panel of Sustainable Accelerator/Collider

(2013 or 2014 ?)

1. Context.
- Energy consumption and related running cost are major issues for many on-going and future accelerator/collider projects ranging from medical and industrial equipment to the highest energy or most intense research machines.
- The feasibility of HEP future infrastructures is strongly depending on the efficient implementation, both at the design and operation level, of energy saving/recovery/recycling schemes as well as on the injection of sustainable energies in the energy mix.
- Any progress done in the framework of flagship projects whose electrical consumption come close to large cities not only will impact the accelerator/collider economy but may also contribute to solving the most prominent societal issue of energy.

GREEN ILC



A. Suzuku

Waste heat energy recovery and its off-line transportation

Transportation of heat energy using "HAS-Clay" by container truck

Principle of "HAS-Clay"

➔ Sintered nano-scale compound of
Hydroxy Aluminum Silicate + Amorphous Aluminum Silicate

➔ Phase transition of H_2O (Vaper ⇔ Water) + Chemisorption

➔ HAS-Clay: "Adsorbent" developed by the National Institute of Advanced Industrial Science and Technology (AIST)

- Specific gravity 1.2
- Adsorbed moisture content 0.37kg/kg
- Volume filling rate 50%
- Heat storage density **580 MJ/m³**

➔ 12 times of energy of natural gas (45 MJ/ m³)

M. Yoshioka

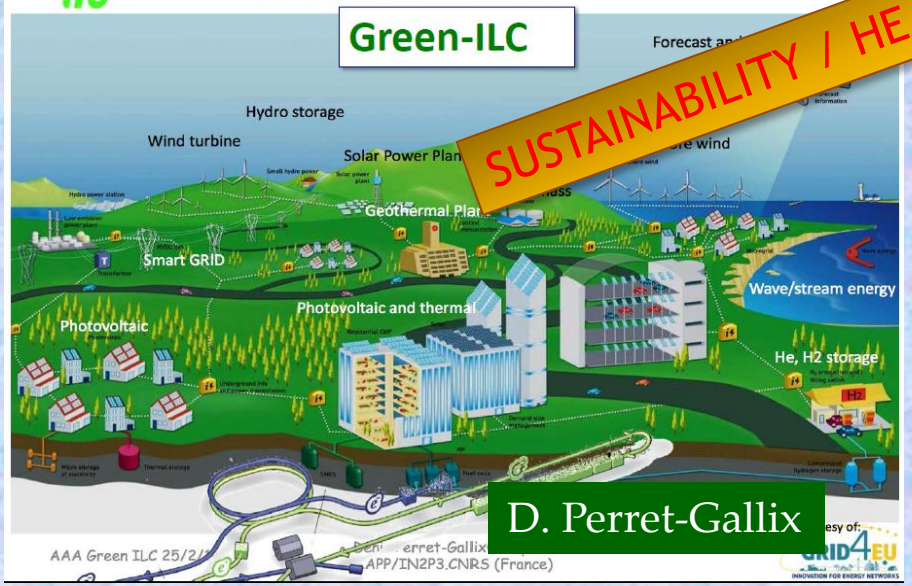
Energy recovery from waist heat of factory, incineration plant, generation, sola...

Heat utilization business: Greenhouse agriculture, wood and biomass drying, heat supply business for community and etc.

SUSTAINABILITY / HEAT - ENERGY RECOVERY

ILC center futuristic view

Green-ILC



D. Perret-Gallix

...process with NaCl water (salt water), instead of HF mixture.

ID :TUPB097 SRF2017

R&D of Electro-Polishing (EP) process with HF-free neutral electrolyte by Bipolar-Pulse (BP) method.

J. Taguchi [1], K. Ishida [1], Y. Mochida [1], T Nakajima [1], M. Kunieda [2], S. Kakudo [2], H. Hayano [3], T. Saeki [3]

[1] NOMURA PLATING CO., LTD , Nishiyodogawa, Osaka Japan [2] The University of Tokyo , Tokyo, Japan [3] KEK / The Graduate University for Advanced Studies, Tukuba, Ibaraki Japan

Abstract

Currently the Electro-Polishing (EP) process of Superconducting Radio-Frequency (SRF) accelerating cavity is performed with the electrolyte that is the mixture of hydrofluoric and sulfuric acids. However, the ...

Conventional EP method

(1)Solution : H_2SO_4(60%)/HF(40%)
- Very dangerous
  - Severe burn on skin
  - Toxic gas(HF, H_2S , SO_2)
- High cost
- By-product of Sulfar
  - Performance degradation

$2H_2S + SO_2 \rightarrow 2H_2O + 3S$

(2)DC voltage with Nb anode and Al cathode

Bipolar(BP)-EP with neutral electrolyte

(1) Neutral electrolyte
- Safer
- Low coat
- No by-product

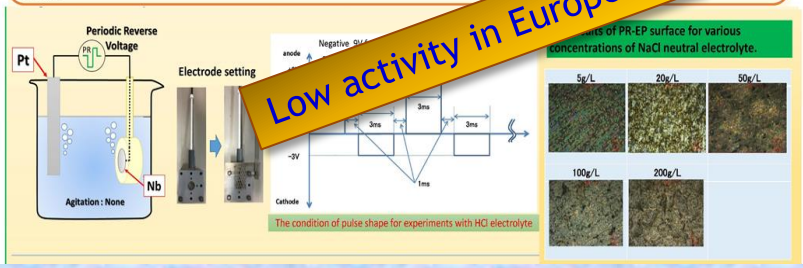
(2)Periodic Reverse (PR) voltage

Studies on BP-EP process with neutral electrolyte

(1) The selection of the anion in neutral electrolyte for the electro-polishing process of Nb
(2) Study on the ...
(3) Study ... electrolyte.

Collaboration of Nomura plating (industry) and KEK. Sample test seems OK.

T. Saeki



Low activity in Europe

Backup Slides

Institute of Electrical and Electronics Engineers

2012 IEEE NSS/MIC/RTSD Anaheim, California

27 October - 3 November 2012

The Wonder of Science

2012 IEEE NSS/MIC/RTSD

Special Linear Collider Event
29-30 October 2012

As part of the NSS Symposium, a special Linear Collider (LC) event is organized, which will include presentations on:

- **International Linear Collider (ILC) and the Compact Linear Collider (CLIC) accelerator**
- **Detector concepts**
- **Impact of LC technologies for industrial applications**
- **Forum discussion about LC perspectives**

In a view of the current and future large-scale, the IEEE NSS/MIC Symposium is the natural place to address:

- The role of particle physics and technology for medical physics and society well-being
- The importance of broadening international partnership to address social challenges using high-tech technologies

More information: w
Contact: nss2012@d

clic ilc IEEE NUCLEAR & PLASMA SCIENCES SOCIETY

Linear-collider technologies for all

CERN Courier article, March 2013:
http://cerncourier.com/cws/article/cern/52358

A special event at the 2012 IEEE Nuclear Science Symposium provided a broader stage to discuss technological developments for a future linear collider.

...ructure made from the ...disc of a CLIC accelerating ...(image credit: DESY.)

The LHC at CERN is a prime example of worldwide collaboration to build a large instrument and pursue frontier science. The discovery there of a particle consistent with the long-sought Higgs boson points to future directions both for the LHC and more bre... particle physics. Now, the international commu... machines to complement the LHC and ... physics, including the favoured ... collider (LC). Two m... national L... lab...

...ologies for ...m on LC perspec- ...ndustry and laboratory-based ...unity to discuss LC progress with the ...rumentation community at large, and to justify ...ments in technology required for future particle accelera- ...tors and detectors. Representatives of the US Funding Agencies were also invited to attend.

CERN's director-general, Rolf Heuer, introduced the event before Steinar Stapnes, CLIC project leader, and Barry Barish, director of the ILC's Global Design Effort (GDE), reviewed the two projects. The ILC concept is based on superconducting radio-frequency (SRF) cavities, with a nominal accelerating field of 31.5 MV/m, to provide e^+e^- collisions at sub-tera-electron-volt energies in the centre-of-mass. The CLIC studies focus on an option for a multi-tera-electron-volt machine using a novel ...beam acceleration scheme, with normal-conducting accelerating structures operating at fields as high as 100 MV/m. In this approach, two beams run parallel to each other: the main beam, to be accelerated; and a drive beam, to provide the RF power for the accelerating structures.

Both studies have reached important milestones. The *CLIC Conceptual Design Report* was released in 2012, with three volumes for physics, detectors and accelerators. The project's goals for the coming years are well defined, the key challenges being related to system specifications and performance studies for accelerator parts and detectors, technology developments with industry and implementation studies. The aim is to present an implementation plan by 2016, when LHC results at full design energy should become available.

The ILC GDE took a major step towards the final technical design when a draft of the four-volume *Technical Design Report* (TDR) was presented to the ILC Steering Committee on 15 December 2012 in Tokyo. This describes the successful establishment of ▷