

# Point of view from CEA



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Third JCL

(Journées Collisionneur Linéaire)

LPSC Grenoble, December 1<sup>st</sup>, 2014

# Outline

- ILC and IRFU until today
  - Accelerator
  - Detector & physics
- Perspectives
  - Global
  - Local

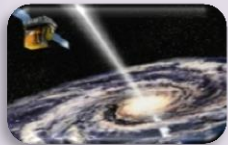
# ILC and IRFU until today

# History

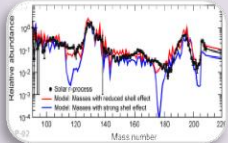
- Constant involvement of **IRFU** in the path leading to the current **ILC** project:
  - 1997 TESLA conceptual design report
  - 2001 TESLA / XFEL
  - 2005 Global Design Effort
  - 2012 Linear Collider Collaboration
  
- **ILC project in Japan**

# IRFU

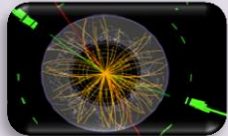
## Institute of Research into the Fundamental laws of Universe



**SAP:** Astrophysics  
Space technologies



**SPhN:** Nuclear Physics

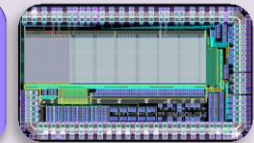


**SPP:** Particle Physics

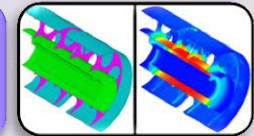
**SACM:** Accelerators,  
Supra. Magnets



**SEDI:** Detectors,  
electronic, computing



**SIS:** Systems engineering



- **SPP:** M. Besançon, P. Colas, S. Ganjour, C. Royon, M. Titov, (*retired: P. Lutz*).
- **SEDI:** D. Attié, D. Calvet, X. Coppolani, I. Giomataris, A. Le Coguie, I. Mandjavidze, ...
- **SACM:** F. Kircher, O. Napoly .

# **ILC and IRFU until today: accelerator**

# Superconducting cavities

- Superconducting RF technology, based on bulk Niobium, is used for most of the linear accelerators since 2000.
- Motivated by the XFEL developments, accelerating gradients of 30 MV/m can be produced reliably.



*704 MHz cavity developed at Ifu within the EUCARD2 program (similar to ESS high beta):*

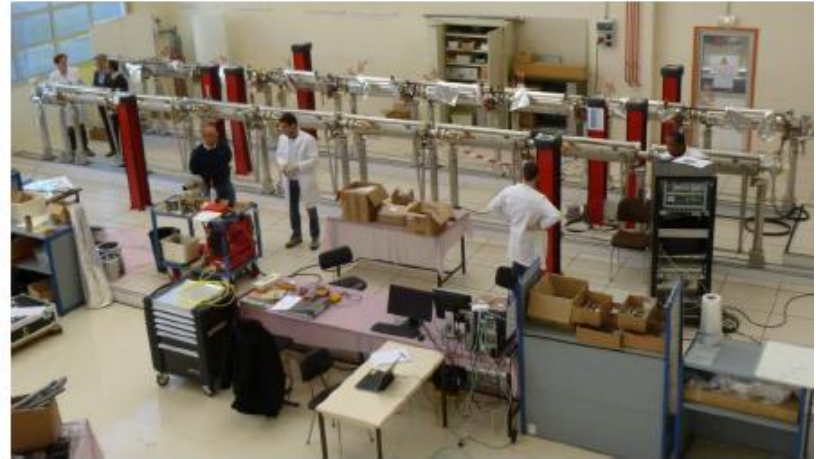
- 1. after welding*
- 2. during vertical electropolishing process*



# XFEL cryomodule assembly



XM-1 cavity string in IS04 Clean Room (final leak test)



String dressing (tuners, magnetic shield, welding...)



Vacuum vessel assembly





# XFEL

- Largest deployment of SRF technology to date.
- Role of IRFU:
  - Cavity string and module assembly.
  - Cold beam position monitors.
- Commissioning with beam: 2<sup>nd</sup> half 2015.
- Ultimate “integrated systems test” for ILC.

# **ILC and IRFU until today: detector & physics**

# R&D detector

- R&D on:
  - mainly **TPC with micromegas readout**.
    - also R&D on pixel technology.
  - **vertex detector with MAPs** (Monolithic Active Pixels)
    - later pursued for LHC upgrade.
- Partial funding by European programs:
  - EUDET (2006-2010)
  - AIDA (2010-2015)
- Link with **RD51** (M. Titov spokesperson).
  - Micro Pattern Gaseous Detectors.
- In the context of **LC-TPC** collaboration.

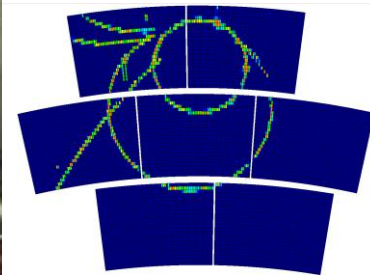
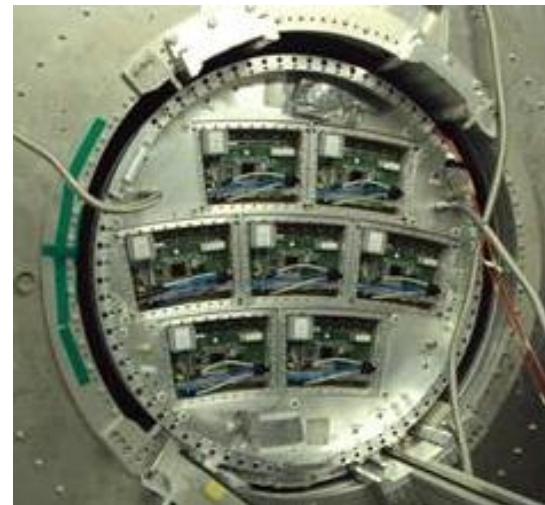
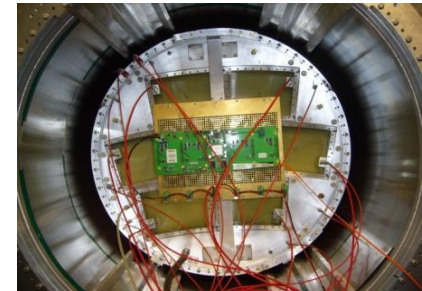
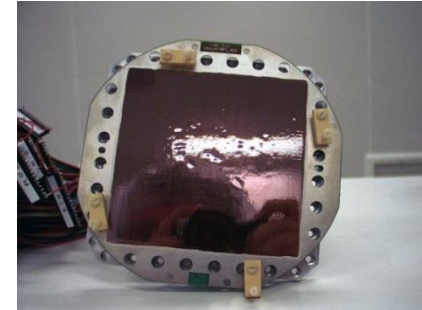
# R&D TPC

**2002-2005** : feasibility study, 1000 channel TPC in Saclay.

**2005-2007**: beam tests at KEK, with and without resistive foil.

**2008-2011**: large prototype, 1 module at a time tested at DESY.

**2012-2013**: 6-7 modules covering the TPC.

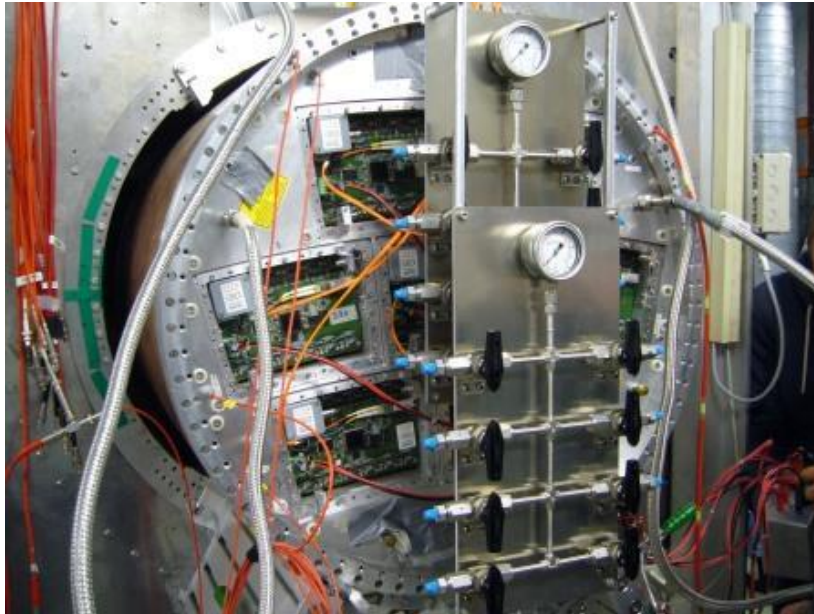


# R&D TPC

- Brought **proof of principle**.
- **Resistive anode** technique to improve spatial resolution.
- Now concentrating on an engineered design:
  - Integration.
  - Understanding edge effects.
  - Cooling.
- 3 theses:
  - W. Wang 2013.
  - A. Chau 2014.
  - D.S. Bhattacharya 2016.

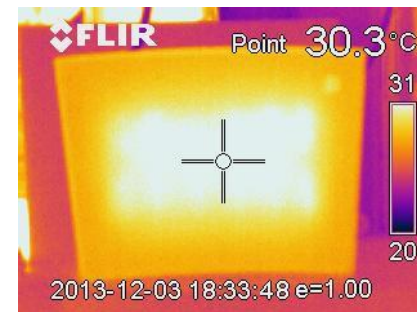
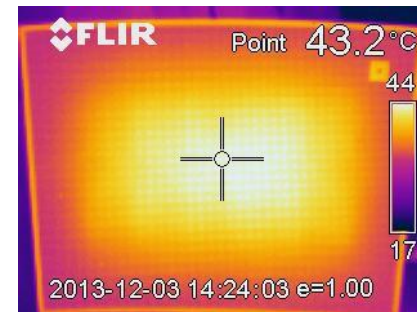
# Diphase CO<sub>2</sub> cooling

- Principle: CO<sub>2</sub> has a much lower viscosity and a much larger latent heat than all usual refrigerants. The two phases (liquid and gas) can co-exist at room temperature.
- Tests with 1 module were performed at Nikhef in December 2013, and tests with 7 modules at DESY in February 2014.



Dec. 1, 2014

Georges Vasseur, 3rd JCL



# Scientific life in Saclay

- 2<sup>nd</sup> JCL in November 2013.
- Software week.
  - Reconstruction and analysis.
- Physics case ILC club.
  - Dark matter.
  - Higgs coupling.
  - Extra dimensions.



# Collaborations

- Linear Collider Collaboration
  - Executive board members:
    - O. Napoly (accelerator expert)
    - M. Titov (liaison for detector R&D)
- ILD proto-collaboration
  - ILD DOI signed by IRFU.

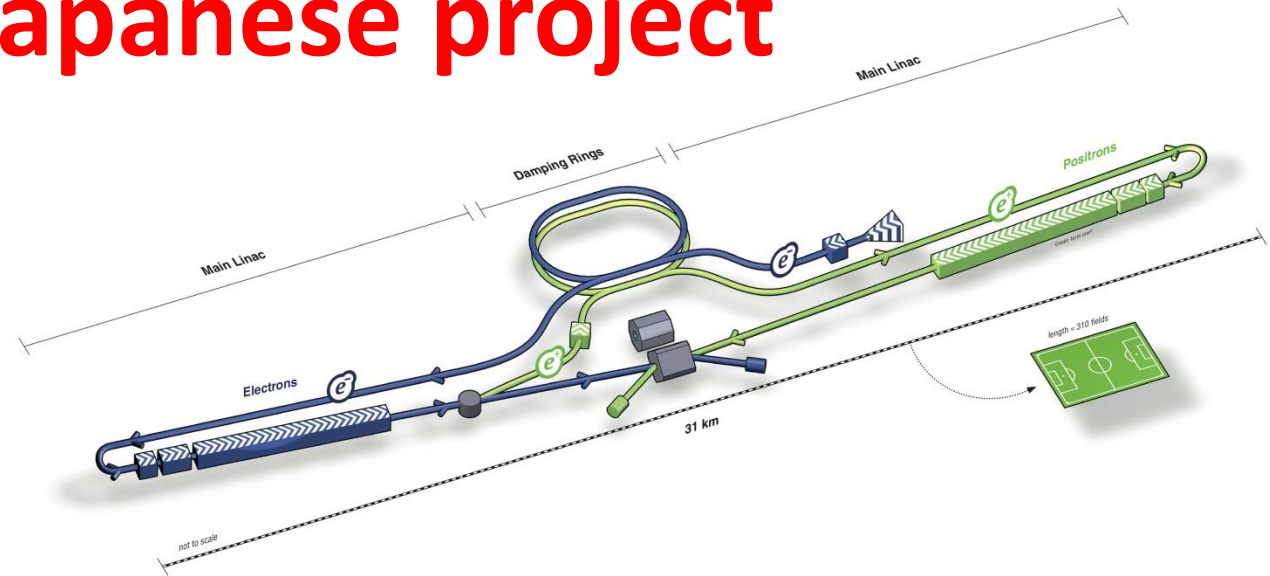


# Perspectives (global)

# Physics case

- Physics case for an  $e^+e^-$  collider well established.
- **Precision physics** post-LHC in the context of the recent discovery of the 125 GeV Higgs boson.
- Test Standard Model.
  - Higgs physics.
  - Top physics.
  - W mass.
- Look for **physics beyond SM**.
  - Dark matter, ...

# Japanese project



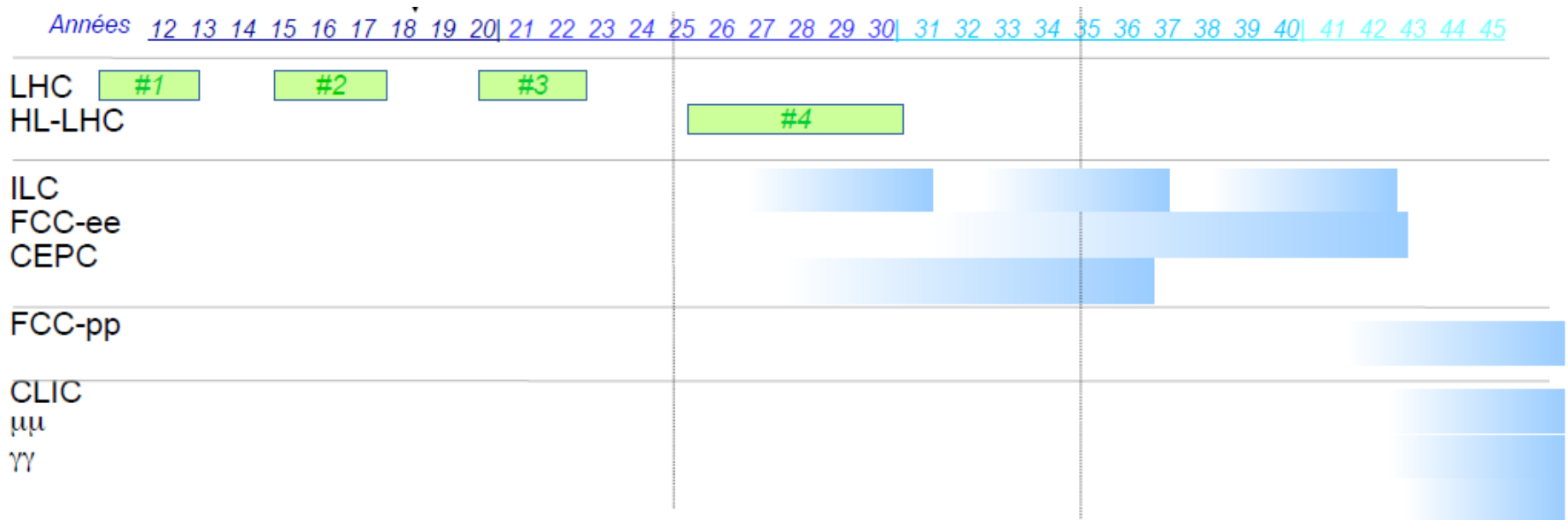
- Two detectors: **ILD** and **SiD**.
- No decision from Japanese government yet.
  - International cost sharing.
- US: P5 for a reopening of R&D funding.

# European strategy

- Adopted in 2013.
- High-priority large-scale scientific activities:
  - 1) exploitation of the full potential of the LHC, including the high luminosity upgrade.
  - 2) design studies for accelerator projects.
  - 3) ILC : « *Europe look forward to a proposal from Japan to discuss a possible participation* ».
  - 4) future long-baseline neutrino experiments.
- Next revision foreseen around 2018,
  - Knowing what has been found at LHC - 13 TeV.

# Future collider projects

- New collider projects launched in 2014:
  - FCC at Cern.
  - CEPC in China.
- Beyond physics and technology, the choice will depend on financial and political arguments.



# Perspectives (local)

# Ingredients

- **SPP scientific council (CSTS)** meeting on June 6<sup>th</sup>, 2014 on:
  - ILC (previously in June 2007)
  - FCC
  - RD51 (previously in December 2008)
- **SPP prospective day** on October 1<sup>st</sup>, 2014.
  - Goal : evolution of SPP within 10 years.
  - Document prepared by the internal member of CSTS.
  - One day of presentations and discussion.

# SPP today

- Collider (40/27) D0, ATLAS, CMS  
LHC upgrade  
ILC, FCC
- Neutrino (9/4) T2K, WA105, LBNO  
Double-Chooz, Nucifer, Cesox  
Antares
- Dark matter (3/2) Edelweiss
- $\gamma$  astronomy (4/1) HESS, CTA
- Cosmology (9/6) SNLS, Planck,  
BAO (BOSS, eBOSS, Desi)
- Antimatter (4/3) GBAR
- Instrumentation (3/2) CALIPSO



# SPP evolution

- Most physicists to join experiments on future colliders are physicists currently on LHC.
- Transition speed will depend whether or not new physics is found at LHC at 13 TeV.
- **Links with FCC:**
  - SPP hosts groups both in ILC and FCC.
  - Recommendations from CSTS:
    - Keep involved in both projects.
    - Common work on R&D and physics studies.

# Funding

- Continue **R&D work** for ILC in the next few years.
  - Support from IRFU.
  - Subvention and external funding (Europe, ANR, ...)
- If positive **decision to build the ILC**, need additional funding:
  - apply to TGIR (together with IN2P3).
    - As for LHC upgrade and CTA, already in the pipeline.

# Conclusion

- Involvement of IRFU in ILC program since more than twenty years:
  - Accelerator.
  - Detector (micromegas TPC).
  - Physics preparation.
- Looking forward for the decision on ILC in the next few years.