IFIC INSTITUT DE FÍSICA CORPUSCULAR
EXCELENCIA SEVERO OCHOA
CSIC
Universitat de València

Física Experimental



Resumen Actividades - 2016

Física Experimental

Antes que nada…



- ✔ Este año hemos cambiado de representante del departamento experimental.

Antes que nada…

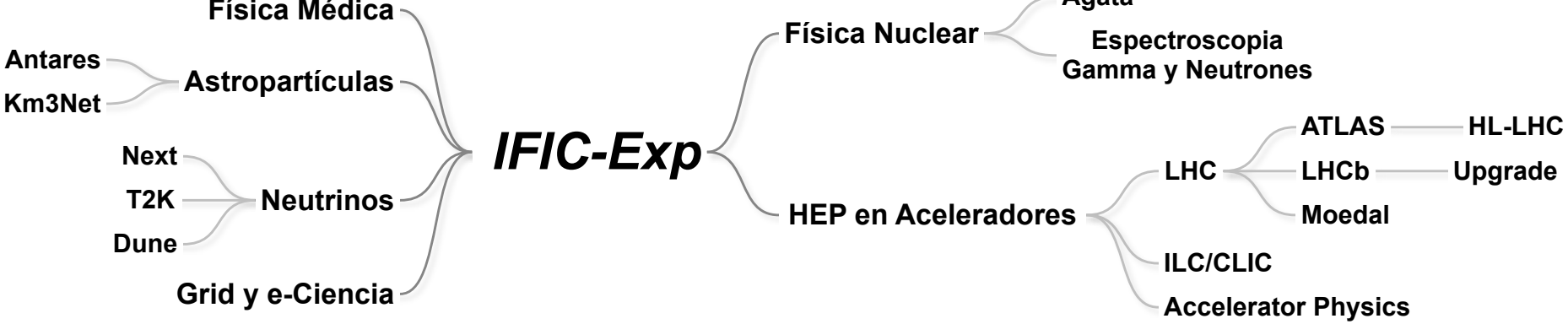


- ✔ Este año hemos cambiado de representante del departamento experimental.

Gracias Berta por la labor realizada durante estos últimos años.

IFIC Experimental



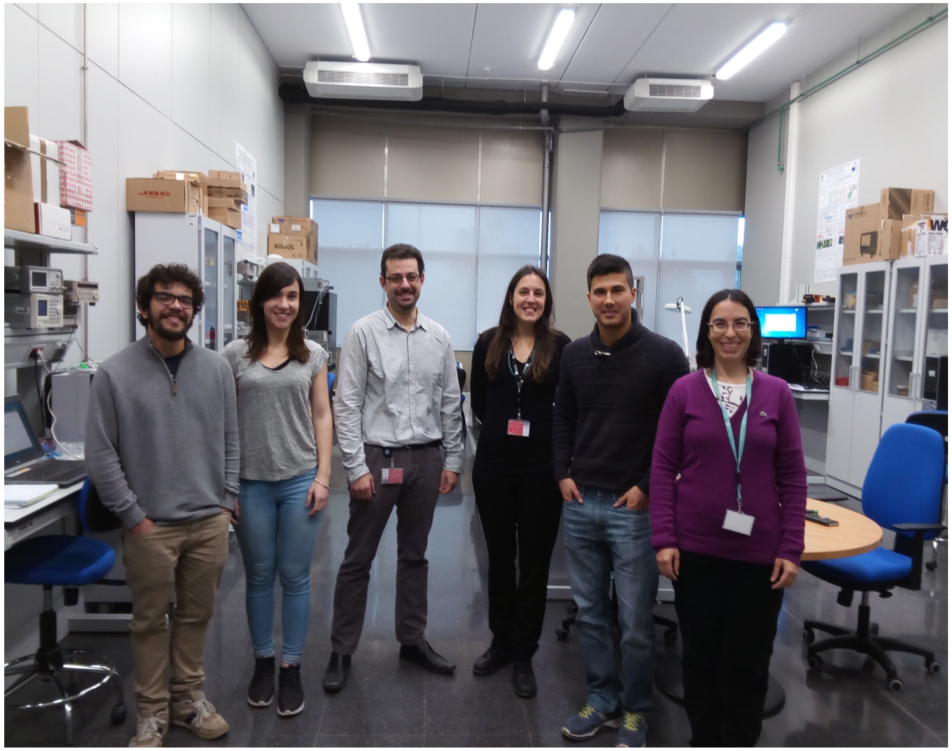


Física Médica – Grupo IRIS

Image **R**econstruction, **I**nstrumentation & **S**imulation in medical applications

IRIS	Dr. Gabriela Llosá (RyC) Dr. Josep F. Oliver (TSI, UV) Dr. Ana Ros (Postdoc S8A) John Barrio, phd And Etxebeste, phd Enrique Muñoz, phd UV

Colaboradores IFIC	Prof. Jose Bernabeu Dr. Carlos Lacasta Eng. Carles Solaz



http://ific.uv.es/iris

IFIMED

Image **R**econstruction, **I**nstrumentation & **S**imulation in medical applications

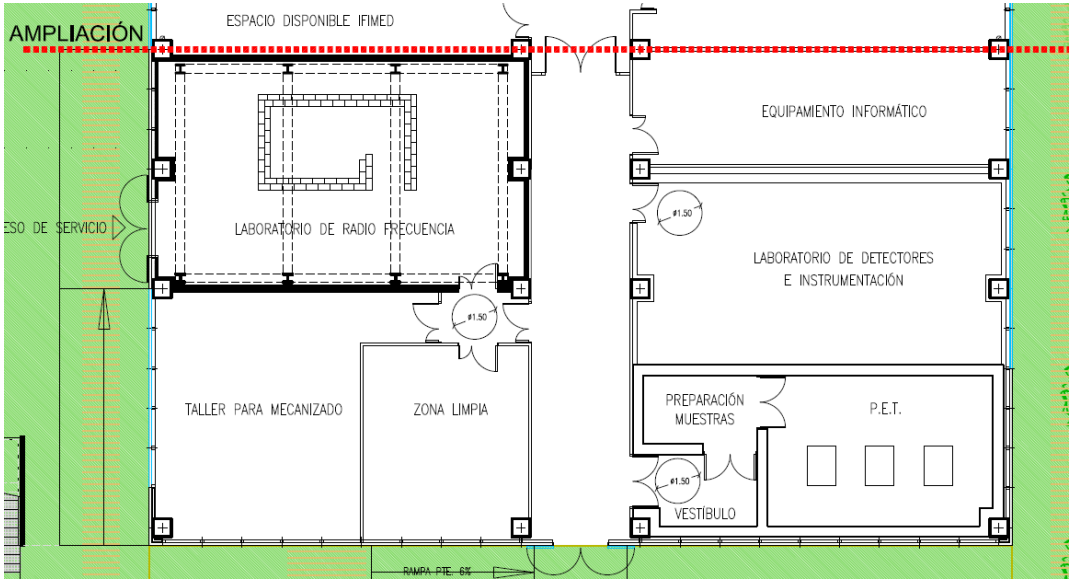
Mudanza al edificio IFIMED terminada

1) Puesta en funcionamiento del edificio:

   Prevención riesgos laborales
   Licencia Instalaciones radioactivas

2) Puesta en marcha de laboratorios de instrumentación y Micro PET/CT





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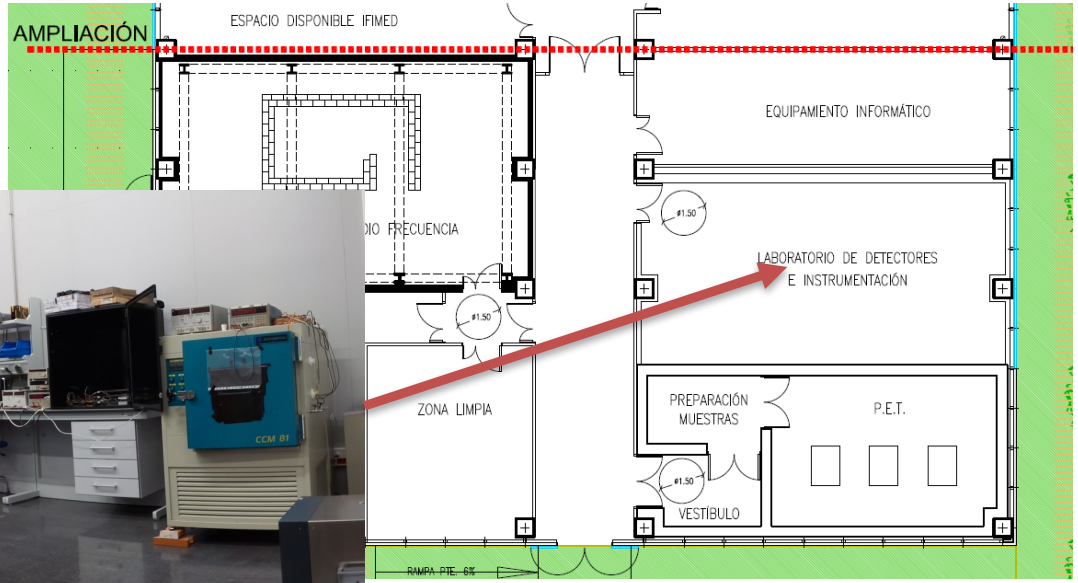
Instrumentation Lab.





IFIMED

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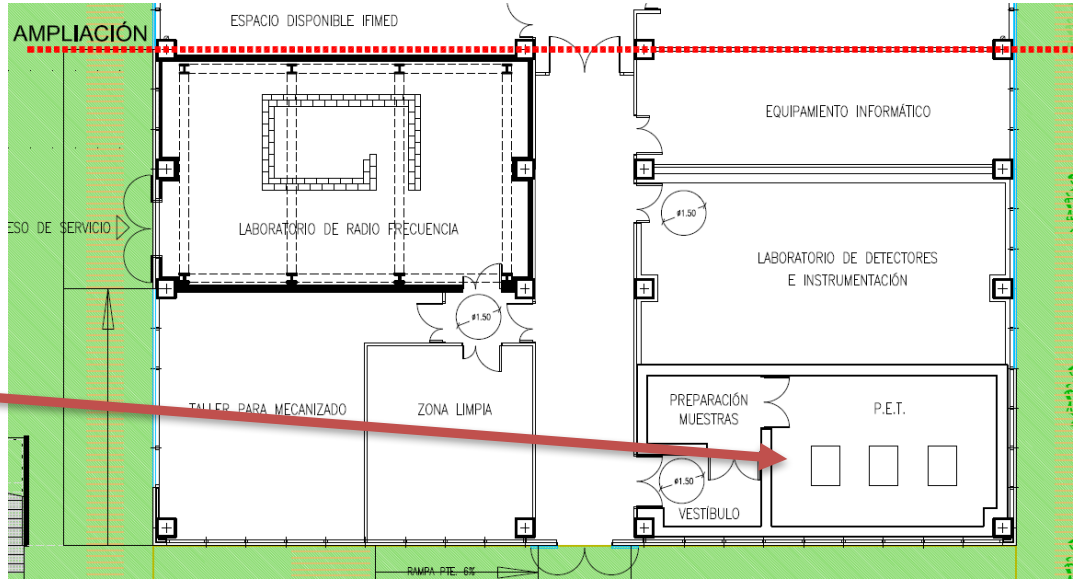
Micro PET/CT





Main research lines

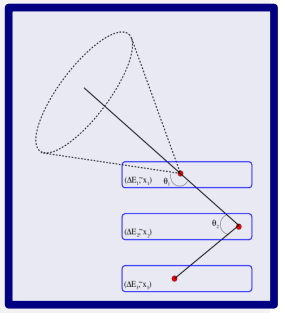
Compton Telescope:
Hadrontherapy monitorization

Three $LaBr_3$ + SiPM planes

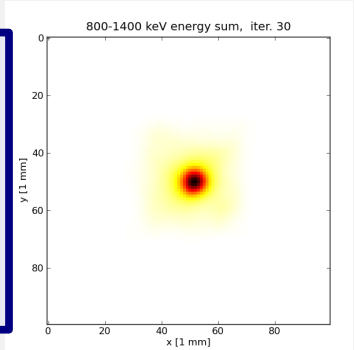
Beam test at Dresden HDZ 3MV Tandetron:

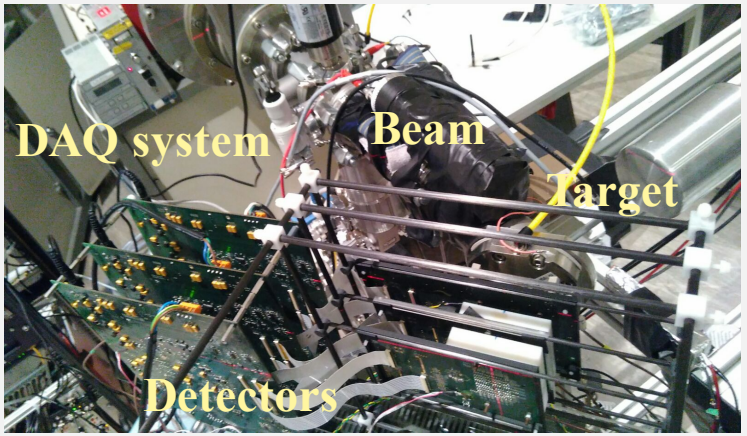
proton-capture resonance reaction $^{15}N(p,\alpha\,\gamma_{4.439})^{12}C$ -> 4 MeV gammas

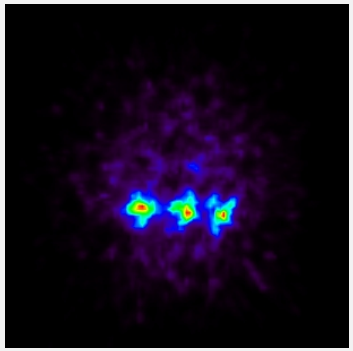
Simulacion y optimización



Reconstrucción de imágenes

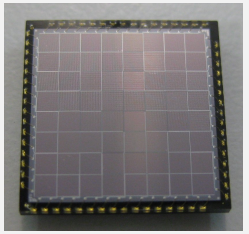


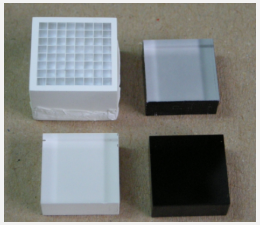




PETETE:
Small Animal PET

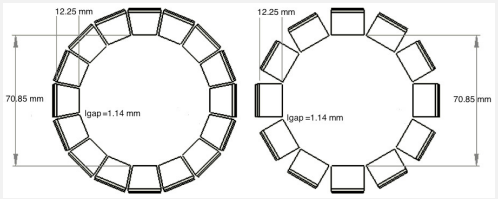
Second prototype with continuous LYS crystals + SiPM

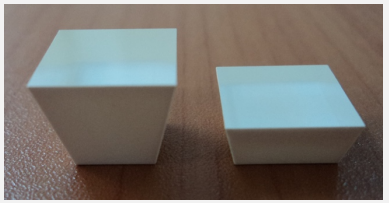




Construction of a full ring

Simulations to estimate performance





Publicaciones 2016

1. *Experimental evaluation of the resolution improvement provided by a silicon PET probe.* K. Brzeziński, J.F. Oliver, J. Gillam, M. Rafecas, A. Studen, M. Grkovski, H. Kagan, S. Smith, G. Llosá, C. Lacasta**. Journal of Instrumentation, 2016, volume 11.**
2. *Modelling Random Coincidences in Positron Emission Tomography by Using Singles and Prompts: a Comparison Study.* Josep F Oliver, M. Rafecas. **PLoS ONE., 2016, 11(9).**
3. *Performance of MACACO Compton Telescope for Ion-Beam Therapy Monitoring: first test with proton beams.* Solevi, Paola; Muñoz, Enrique; Solaz, Carles; Trovato, Marco; Dendooven, Peter; Gillam, John; Lacasta, Carlos; Oliver, Josep; Rafecas, Magdalena; Torres-Espallardo, Irene; Llosá, Gabriela. **Phys. Med. Biol., 2016, volume 61, num 14, 5149-5165**
4. *3D position determination in monolithic crystals coupled to SiPMs for PET.* Ane Etxebeste, John Barrio, Enrique Muñoz, Josep F Oliver, Carles Solaz and Gabriela Llosá. **Phys. Med. Biol.,61 (2016), 3914–3934.**
5. *The SAFIR experiment: Concept, status and perspectives.* R Becker, A Buck, C Casella, G Dissertori, J Fischer, A Howard, M Ito, P Khateri, W Lustermann, Josep F. Oliver, U Röser, G Warnock, B Weber. **Nucl. Inst. Meth. A, 2016.**
6. *First Images of a Three-layer Compton Telescope prototype for Treatment Monitoring in hadron Therapy.* Gabriela Llosá, Marco Trovato, John Barrio, Ane Etxebeste, Enrique Muñoz, Carlos Lacasta, Josep F. Oliver, Magdalena Rafecas, Carles Solaz and Paola Solevi. **Front. Oncol., 2016, volume 6: 14**

Antares – KM3NeT

STAFF	Juan Jose Hernández Rey (Prof. CSIC) Juan Zúñiga (Prof. T. UV) Ramón Cases (Prof. T. UV)
TENURE	Juan de Dios Zornoza (RyC)
POSTDOC	Alexis Coleiro (S8A)
STUDENTS	Javier Barrios (Atracció de Talent) Christoph Tönnis (Grisolía) Moritz Lodze (Grisolía) Giulia Illuminati (FPI-S8A) *Antonio Sanchez (Prometeo) *Faye Havelock (Erasmus Imp. Coll.) *Tamara de Ara (S8A-iniciación)
ENGINEERS	Diego Real (Contratado Proyecto) David Calvo (PTA) *Daniel Hernández (Gerónimo Forteza)

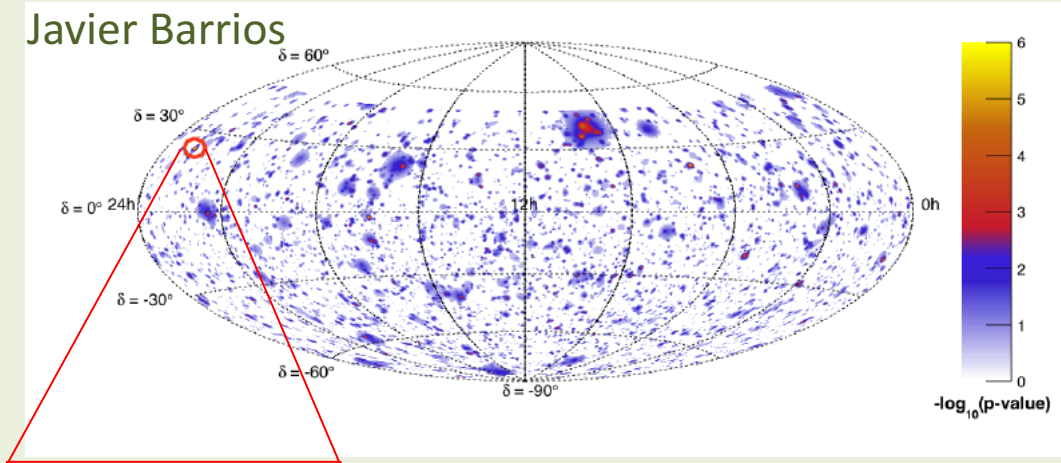


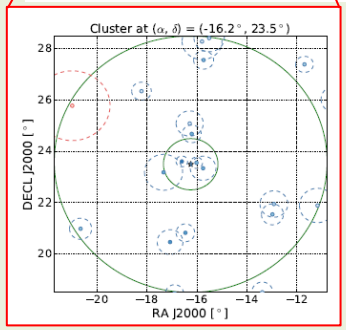
*Left the group during 2016

Selected Results: Point Sources

First **all-flavour** search (tracks *and cascades*).
Data from 2007 to 2015

Javier Barrios





Most significant cluster:
$(\alpha, \delta)=(-16.25^{o}, -23.50^{o})$
P-value=5.9% → 1.9σ

No statistically significant excess

Agustín Sánchez Losa's PhD thesis was **awarded** with the **Global Neutrino Network Prize,** sponsored by **APPEC**



GNN
The Global Neutrino Network

Selected Results: Dark Matter

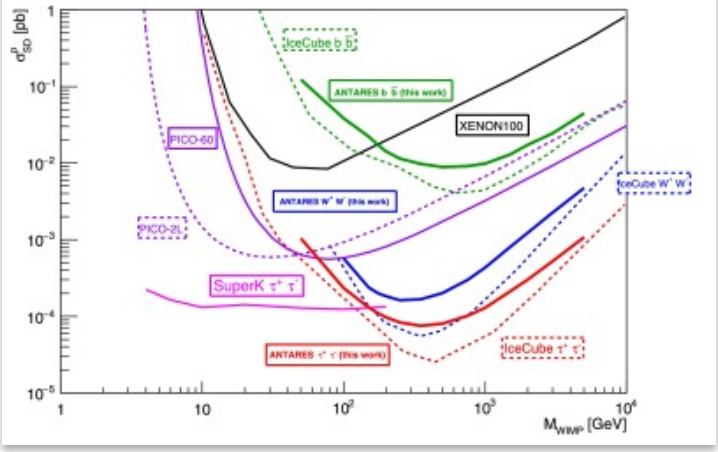
New DM limits for the Sun and GC (Christoph Tönnis)

Sun

Neutrino telescopes are the **best tool** for probing **spin dependent** cross section.

A signal from the **Sun** would be a **smoking-gun** .

Sun: JCAP 5 (2016) 016



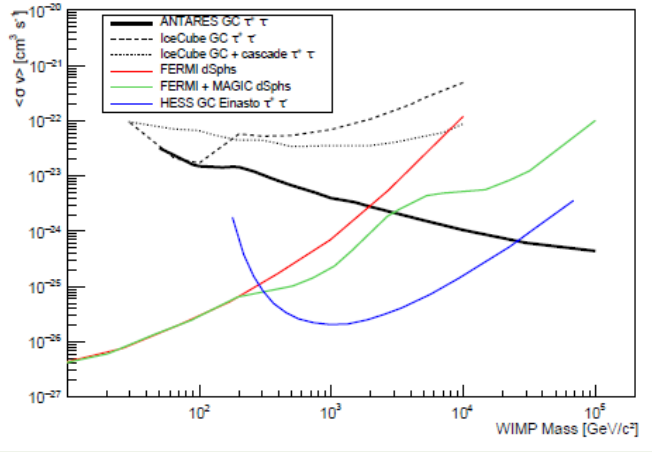
Our old paper (IFIC made) on the subject (2013) has 66 cites on HEP-INSPIRES! ("**well known paper**")

Juande Zornoza is the **Dark matter and Exotic Physics Coordinator**

Galactic Centre

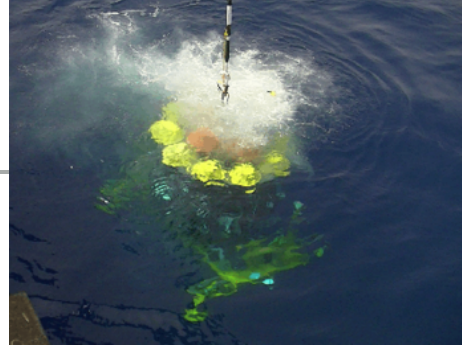
For the **Galactic Centre**, **ANTARES** has the **best limits** for masses above ~30 TeV (and better than IceCube for all masses)

GC: arXiv: 1612.04595



KM3NeT





Detector deployment

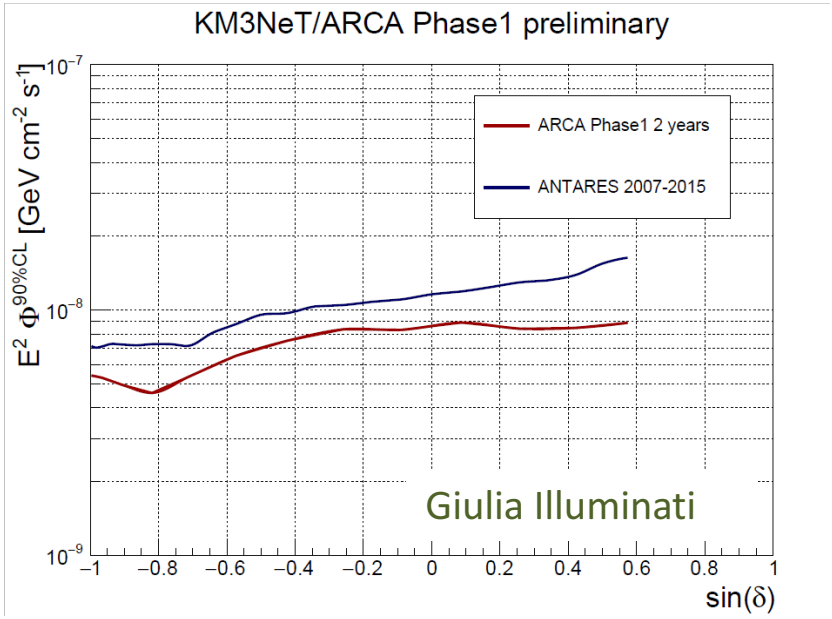
Two lines in operation

Successful data taking

Next lines to be deployed soon

Phase I (31 lines) to be completed in about **1½ years**

In just **two years** of Phase I, better limits than all data of ANTARES up to now



At IFIC's labs.:

Phase 1: Readout (TDCs) firmware produced

Phase 2: Main board designed

Diego Real KM3NeT electronics coordination

A remainder about Phase 2:

1. ORCA (115 lines, 5.8 Mton, France, **neutrino mass hierarchy and dark matter**.
2. ARCA (230 lines, 1 km^3, Italy, **neutrino astrophysics.**

ESFRI ROADMAP

Mandate by the European Commission

*"Its **scientific case** is evaluated 'very high' and its **maturity** 'high'"*



KM3NeT 2.0 included in the **ESFRI** Roadmap for scientific infrastructures on pan-European interest

Only three new infrastructures in **Physics** and Engineering in 2016: KM3NeT 2.0, CTA, EST

Strong **political support from at least two countries is now a must**; physics case is a necessary but not sufficient condition anymore

The Spanish FPA Committee for infrastructures (**CIFPA**) has given a **positive report** (with input from outside evaluators)

H2020

Funding from the H2020 program (InfraDev-2016-2017)

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR RESEARCH & INNOVATION
Directorate B - Open Innovation and Open Science
RTD.B.4.

Having completed the evaluation, we are pleased to inform you that your proposal has **passed this phase** and that the Commission would now like to start **grant preparation**.

LETTER OF INTENT

Letter of Intent for Phase 2 published in J.Phys.Nucl. Part. Phys. 43 (2016)

Letter of intent for KM3NeT 2.0

S Adrián-Martínez[1], M Ageron[2], F Aharonian[3], S Aiello[4], A Albert[5], F Ameli[6], E Anassontzis[7], M Andre[8],

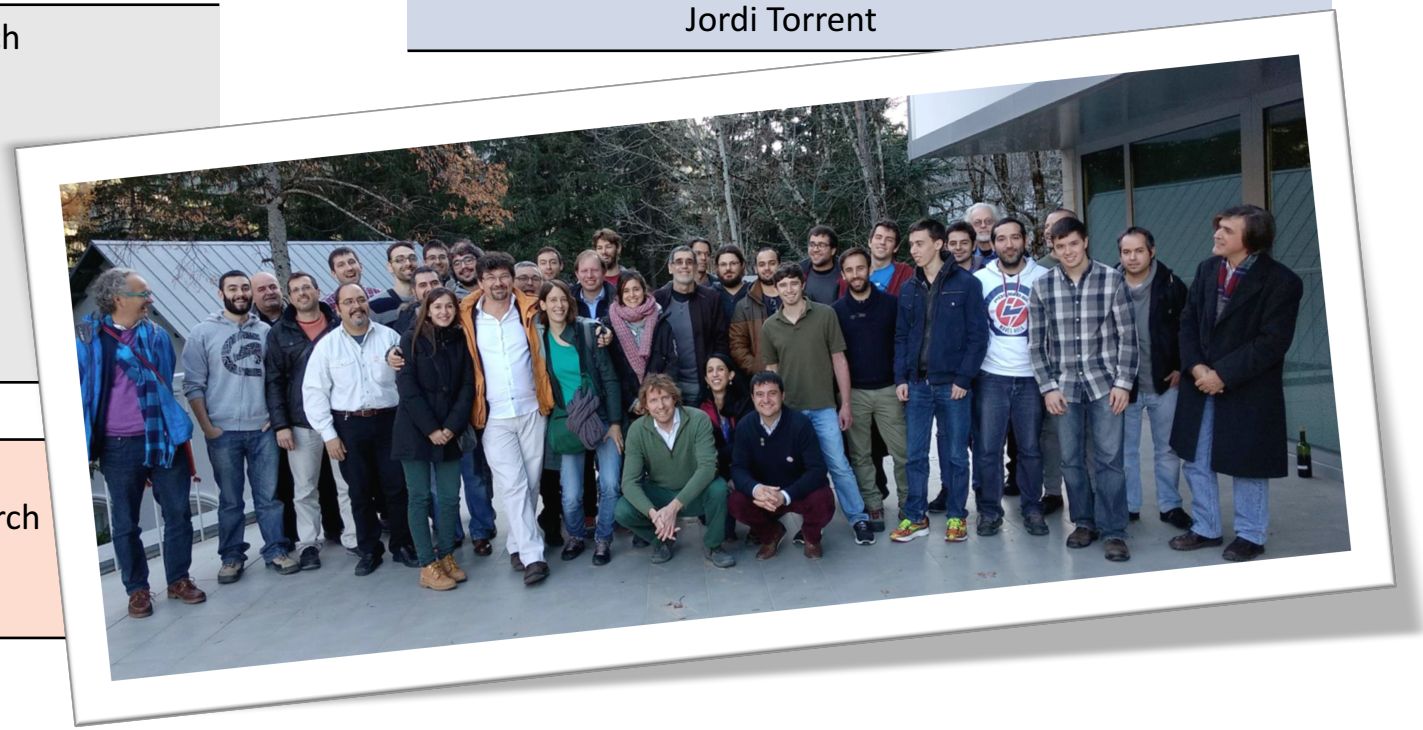
Selected conferences



- ✔ “KM3NeT: status and perspectives” J. Barrios-Martí, TeV Particle Astrophysics, Geneva, 2016
- ✔ “Dark matter searches with neutrino telescopes”, J.J. Hernández-Rey, Dark Matter 2016, Cantabria, 2016
- ✔ “Results on dark matter searches with the ANTARES neutrino telescope”, J.D. Zornoza, Neutrino 2016, London 2016
- ✔ “The indirect search for dark matter with the ANTARES neutrino neutrino telescope”, C. Toennis, RICAP, Rome, 2016
- ✔ “Upgrade of the Central Logic Board for the Phase-2 of the KM3NeT Neutrino Telescope”, D. Calvo, D. Real, F. Carrió, IEEE Real Time Conference, Padova, 2016

The Group

SENIOR	Anselmo Cervera José Díaz **Juan Jose Gómez Cadenas** Pau Novella **Michel Sorel** Nadia Yahlali
PhD STUDENTS	Jose Maria Benlloch Ryan Felkai Javier Muñoz Miquel Nebot Brais Palmeiro Javier Perez Luis Serra Ander Simón
POSTDOCS	Paola Ferrario Neus Lopez March Andrew Laing Josh Renner
ENGINEERS & TECHNITIANS	Vicente Álvarez Sara Cárcel Jose Vicente Carrion Alberto Martínez Jose Manuel Monserrate Marc Querol Javier Rodríguez Jordi Torrent



The Experiment

- ✔ Search for the neutrinoless double beta decay of Xe-136 at the Laboratorio Subterraneo de Canfranc (LSC)
  - ➔ Neutrino identity (Majorana vs Dirac)
  - ➔ Neutrino absolute mass
  - ➔ Lepton number violation



(2010-2014)
Demonstration of detector concept



(2015-2018)
Test underground and radio-pure operations, background



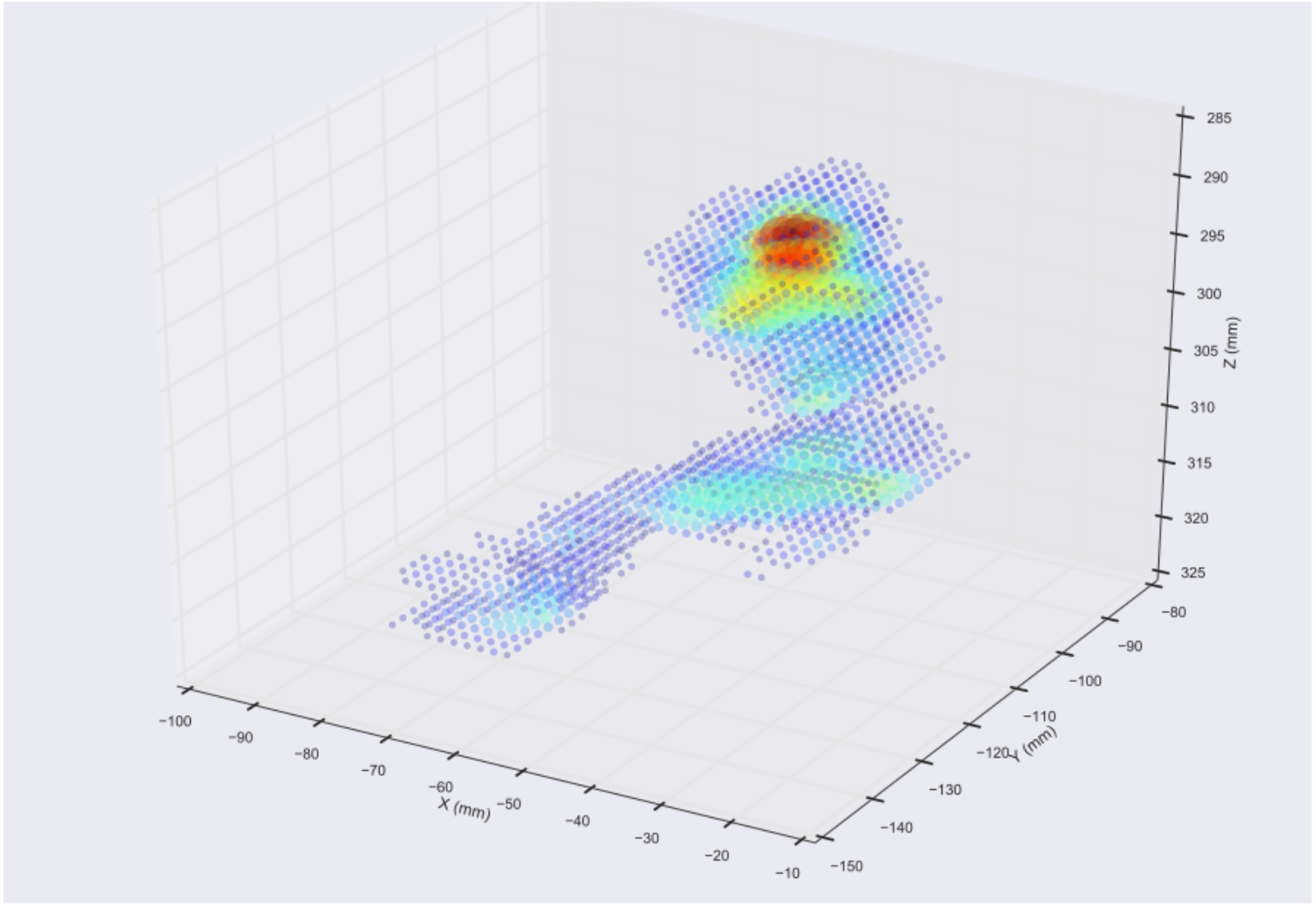
(2018-2020)
Neutrinoless double beta decay searches

Highlights 2016

NEW operations with Xenon started at the LSC



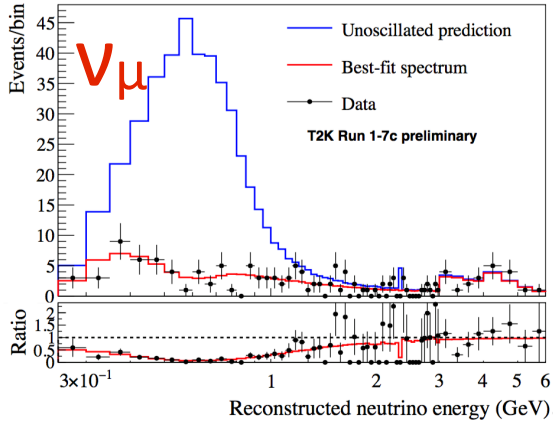
First Look at NEW data: single electron from ^{22}Na calibration source

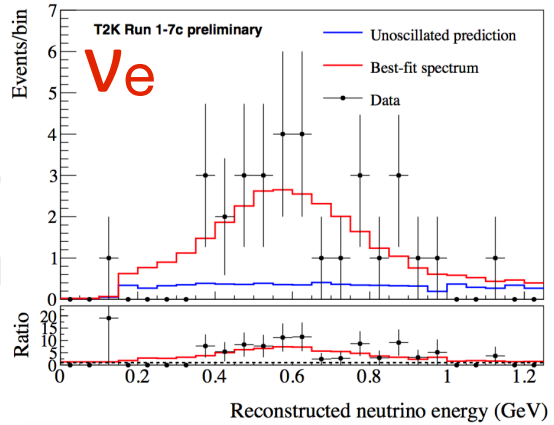


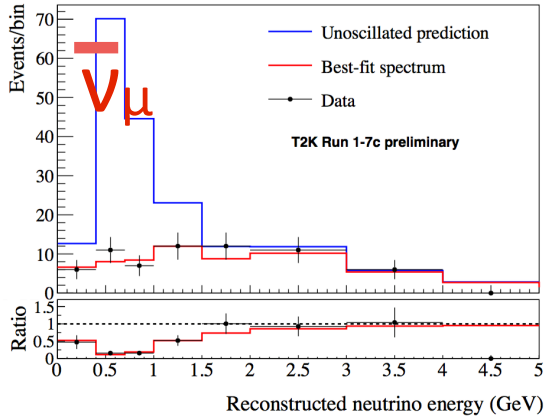
Primer análisis combinado ν anti-ν

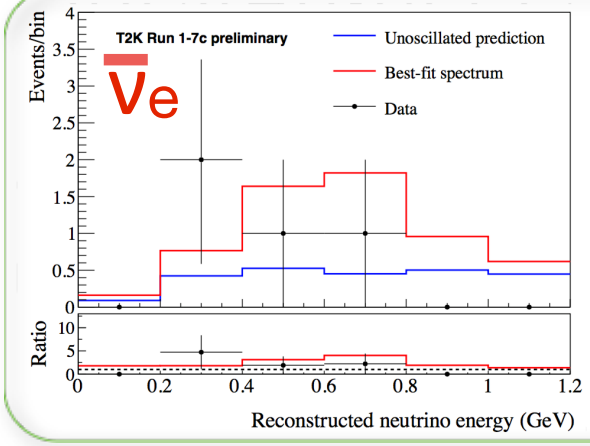
T2K/DUNE	Anselmo Cervera (CT) Michel Sorel (CT) Pau Novella (RyC) Alexander Izmaylov (JdC)

déficit de ν_μ ——— **exceso de ν_e**









Neutrinos: 7.48 10^{20} POT

Antineutrinos: 7.47 10^{20} POT

Hacia la aparición de anti-ν_e's

A estás alturas deberíamos observar más anti-ν_e's

Quizás una indicación de δ_{CP}

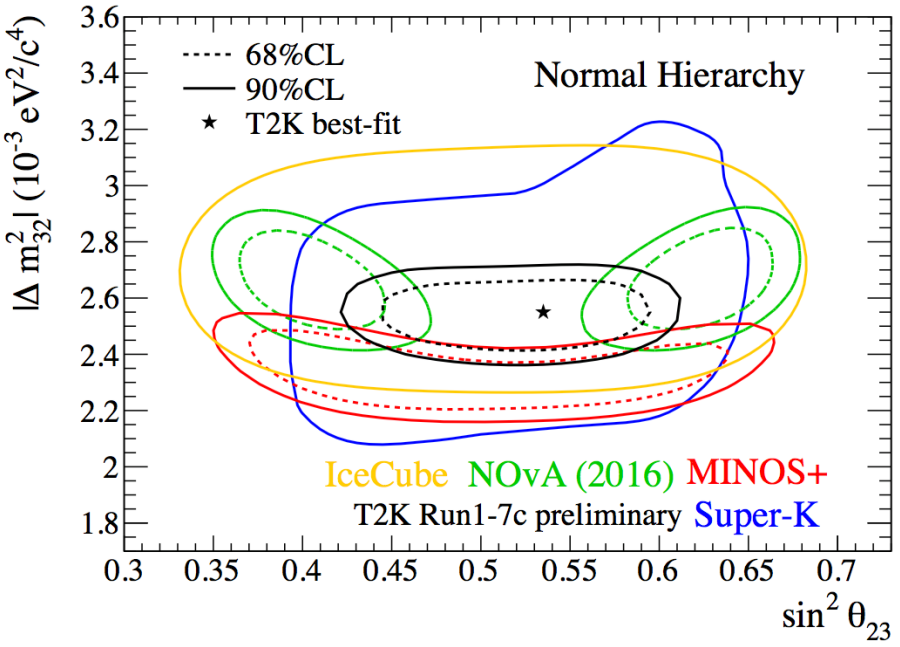
Poniendolo todo junto en un ajuste…

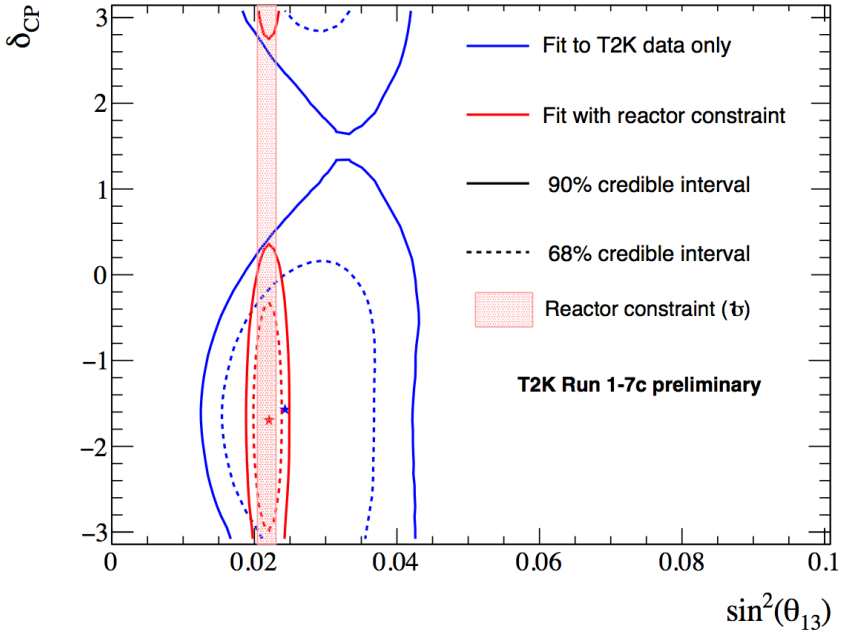
Mejor medida de Δm^2_{23} y θ_{23}

Interesante tensión con NOvA, posible indicación de θ_{23} no máximo (≠45º)

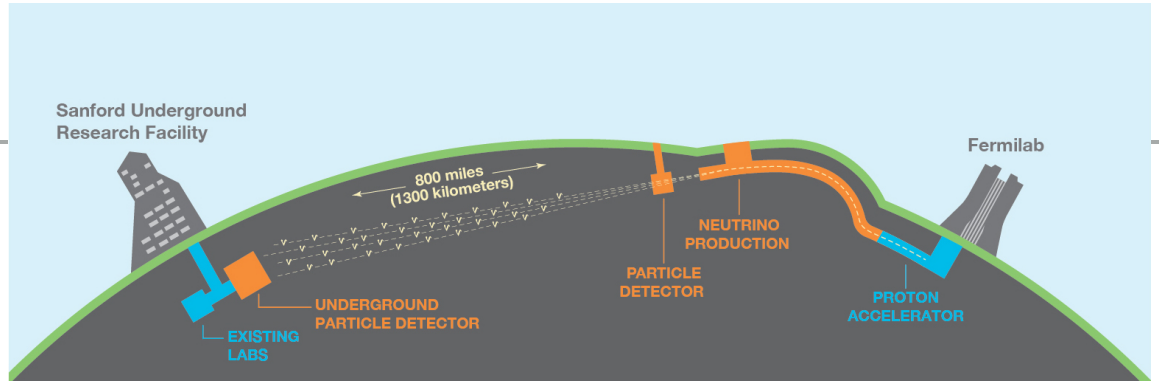
δ_{CP} = -π/2 y jerarquía normal (Δm^2_{23}>0) preferido por los datos

Por primera vez T2K puede decir algo sobre δ_{CP} sin ayuda de los reactores





Also tests of CPV: results with neutrinos and antineutrinos consistent



DUNE
DEEP UNDERGROUND
NEUTRINO EXPERIMENT

4 TPCs de **Argón líquido** de **10 kton** cada una, a 1.7 km de profundidad, expuestas a un haz de **neutrinos múonicos** desde **Fermilab**

Principal objetivo es el descubrimiento de **violación de CP** (δ_{CP})
Toma de datos en ~2026

"CD-3a approval" en 2016: 300 M$ para construcción civil

ProtoDUNE en el CERN

Prototipo de LAr TPC con un volumen activo de 6x6x6 m^3

Test-beam en 2019

Nuestra contribución

- **Coordinación Proton Decay WG**
- **Coordinación del "slow control" en ProtoDUNE**
- **Elaboración de la framework de Analysis en DUNE y ProtoDUNE**
- **Varios análisis en ProtoDUNE**

Espectroscopia Gamma y de Neutrones

GROUP	Dr. Berta Rubio (Prof.) Dr. Jose Luis Taín (Inv. Cient) Dr. Alejandro Algora (Cient. Tit.) Dr. Cesar Domingo (RyC) Dr. Sonja Orrigo (Postdoc) Dr. Anabel Morales (Postdoc) Dr. Luis Caballero (Postdoc) Ion Ladarescu (Ing. Cont.) Jorge Agramunt (Ing. Cont.) Ana Montaner (Est. doc.) Victor Guadilla (Est. doc.) Alvaro Tolosa (Est. doc.) Pablo Gramaje (Est. doc.)



Collaborators	Prof. William Gelletly (Prof.) Dr. Enrique Nácher (Tit. Sup.) Ebhelixes Valencia (Est. doc.) Dr. Dolores Jordan (Postdoc) Dr. Ariel Tarifeño (Postdoc) Dr. Ela Ganiouglu (Prof.)

Espectroscopia Gamma y de Neutrones

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Financiación durante el 2016:

FPA: FPA2014-52823-C2-1-P
IP Alejandro Algora

ERC-grant: 681740 (started this year) !!!
IP Cesar Domingo

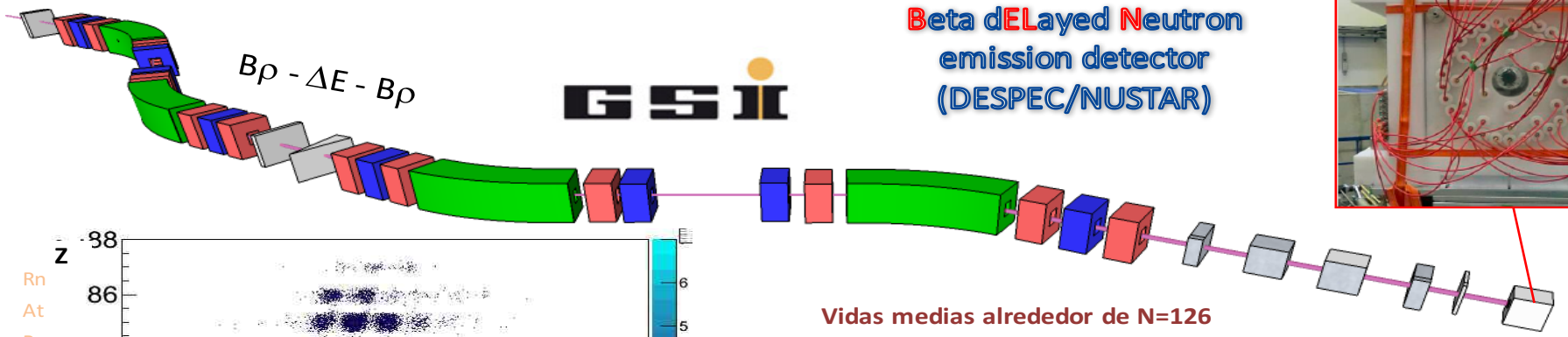
Proyecto de Colaboración con ENRESA
IP Cesar Domingo, Berta Rubio

Colaboraciones:

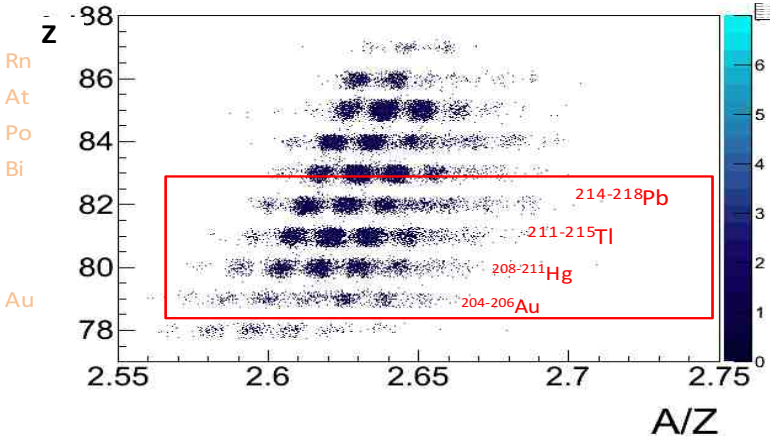
GSI (Alemania), RCNP(Japon), RIKEN (Japon), GANIL (Francia), Univ. Surrey (UK), Univ. Jyväskylä (Finlandia), Subatech (Francia), MTA ATOMKI (Hungría), CIEMAT (España), UPC (España), etc.

1st measurement of β-delayed n emitting isotopes beyond N=126

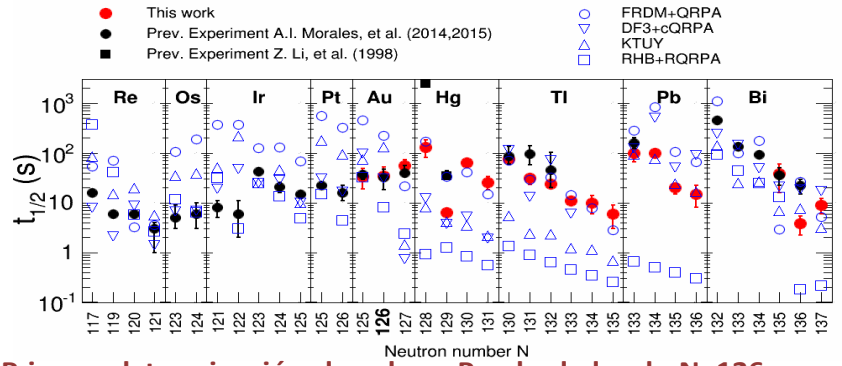
^{238}U, 1 GeV/u, 2x10^9 pps



BELEN30
Beta dELayed Neutron emission detector (DESPEC/NUSTAR)



Vidas medias alrededor de N=126



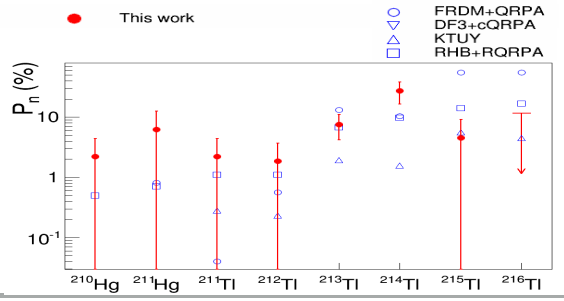
PRL 117, 012501 (2016) PHYSICAL REVIEW LETTERS week ending 1 JULY 2016

First Measurement of Several β-Delayed Neutron Emitting Isotopes Beyond $N = 126$

R. Caballero-Folch,[1,2] C. Domingo-Pardo,[3,*] J. Agramunt,[3] A. Algora,[3,4] F. Ameil,[5] A. Arcones,[5] Y. Ayyad,[6] J. Benlliure,[6] I. N. Borzov,[7,8] M. Bowry,[9] F. Calviño,[1] D. Cano-Ott,[10] G. Cortés,[1] T. Davinson,[11] I. Dillmann,[2,5,12] A. Estrade,[5,13] A. Evdokimov,[5,12] T. Faestermann,[14] F. Farinon,[5] D. Galaviz,[15] A. R. García,[10] H. Geissel,[5,12] W. Gelletly,[9] R. Gernhäuser,[14] M. B. Gómez-Hornillos,[1] C. Guerrero,[16,17] M. Heil,[5] C. Hinke,[14] R. Knöbel,[5] I. Kojouharov,[5] J. Kurcewicz,[5] N. Kurz,[5] Yu. A. Litvinov,[5] L. Maier,[14] J. Marganiec,[18] T. Marketin,[19] M. Marta,[5,12] T. Martínez,[10] G. Martínez-Pinedo,[5,20] F. Montes,[21,22] I. Mukha,[5] D. R. Napoli,[23] C. Nociforo,[5] C. Paradela,[6] S. Pietri,[5] Zs. Podolyák,[9] A. Prochazka,[5] S. Rice,[9] A. Riego,[1] B. Rubio,[3] H. Schaffner,[5] Ch. Scheidenberger,[5,12] K. Smith,[5,21,22,24,25] E. Sokol,[26] K. Steiger,[14] B. Sun,[5] J. L. Taín,[3] M. Takechi,[5] D. Testov,[26,27] H. Weick,[5] E. Wilson,[9] J. S. Winfield,[5] R. Wood,[9] P. Woods,[11] and A. Yeremin[26]

+ PhD Thesis: R. Caballero-Folch (UPC-Barcelona), 2015, Phys. Rev. C in prep.

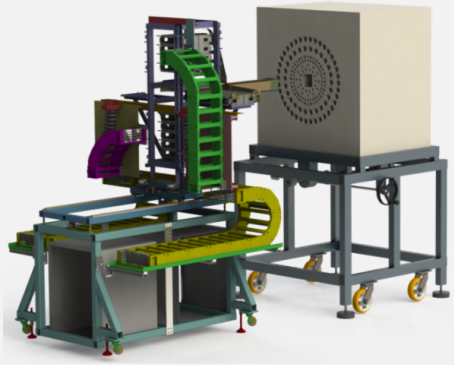
Primera determinación de valores Pn alrededor de N=126



BRIKEN Commissioning

ß-delayed neutrons at RIKEN (BRIKEN)
Mayor sistema de detectores de ^{3}He
Instalación haces radioactivos RIKEN de Japón.
Gran peso de grupos españoles e IFIC en particular.

Portavoz de la colaboración: **Cesar Domingo**
Desarrollo sist. adquisición: **Jorge Agramunt**



Este año se ha realizado el comisioning del detector con papel fundamental del IFIC (Tain, Agramunt, Tolosa).



Cinco propuestas de experimento con 28 días de haz en total, de las cuales tres tienen portavoces españoles del IFIC.

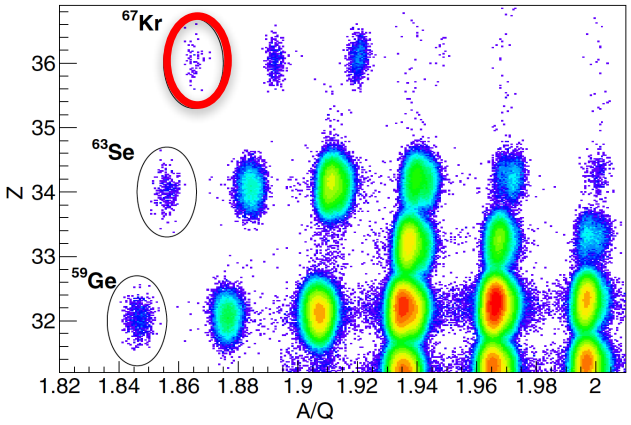
Región 78Ni (NP1412-RIBF127R1)
Spokespersons: Rykaczewski, **Tain**, Grzywacz, Dillman

Región 110~125 (NP1512-RIBF139)
Spokespersons: Nishimura, **Algora**

Region A~165 (NP1612-RIBF148)
Spokespersons: Kiss, **Morales**, Tarifeño, Estrade

Estudio de Núcleos exóticos en RIKEN y GANIL

Descubrimiento de la radioactividad de dos protones en el nucleo mas pesado (^{67}Kr)

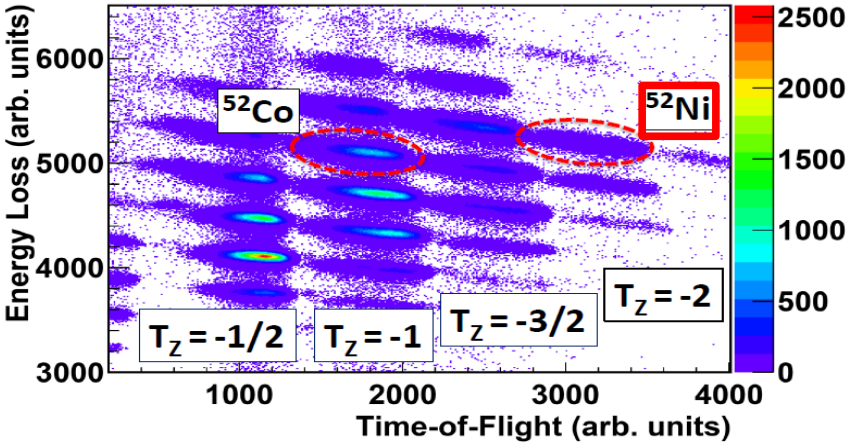


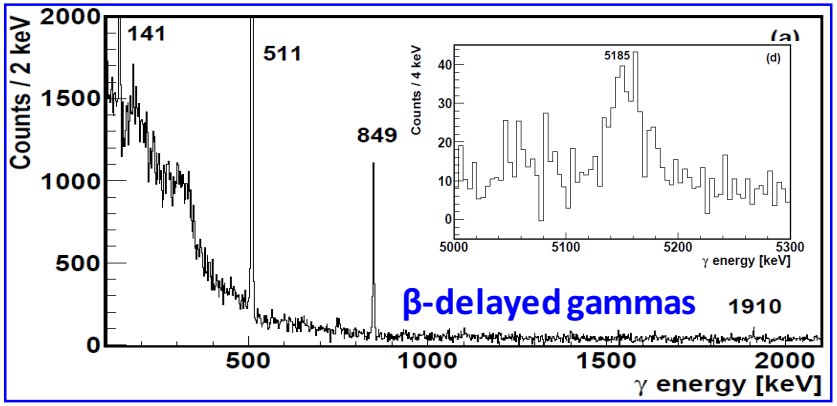
PRL 117, 162501 (2016) PHYSICAL REVIEW LETTERS week ending 14 OCTOBER 2016

Two-Proton Radioactivity of ^{67}Kr

T. Goigoux,[1] P. Ascher,[1] B. Blank,[1] M. Gerbaux,[1] J. Giovinazzo,[1] S. Grévy,[1] T. Kurtukian Nieto,[1] C. Magron,[1] P. Doornenbal,[2] G. G. Kiss,[2] S. Nishimura,[2] P.-A. Söderström,[2] V. H. Phong,[2] J. Wu,[2] D. S. Ahn,[2] N. Fukuda,[2] N. Inabe,[2] T. Kubo,[2] S. Kubono,[2] H. Sakurai,[2,3] Y. Shimizu,[2] T. Sumikama,[2] H. Suzuki,[2] H. Takeda,[2] J. Agramunt,[4] A. Algora,[4,5] V. Guadilla,[4] A. Montaner-Piza,[4] A. I. Morales,[4] S. E. A. Orrigo,[4] B. Rubio,[4] Y. Fujita,[6,7] M. Tanaka,[6] W. Gelletly,[4,8] P. Aguilera,[9] F. Molina,[9] F. Diel,[10] D. Lubos,[11] G. de Angelis,[12] D. Napoli,[12] C. Borcea,[13] A. Boso,[14] R. B. Cakirli,[15] E. Ganioglu,[15] J. Chiba,[16] D. Nishimura,[16] H. Oikawa,[16] Y. Takei,[16] S. Yagi,[16] K. Wimmer,[3] G. de France,[17] S. Go,[18] and B. A. Brown[19]

Primera observación de la desintegración beta del isómero 2^+ del ^{52}Co (Tz=-1)

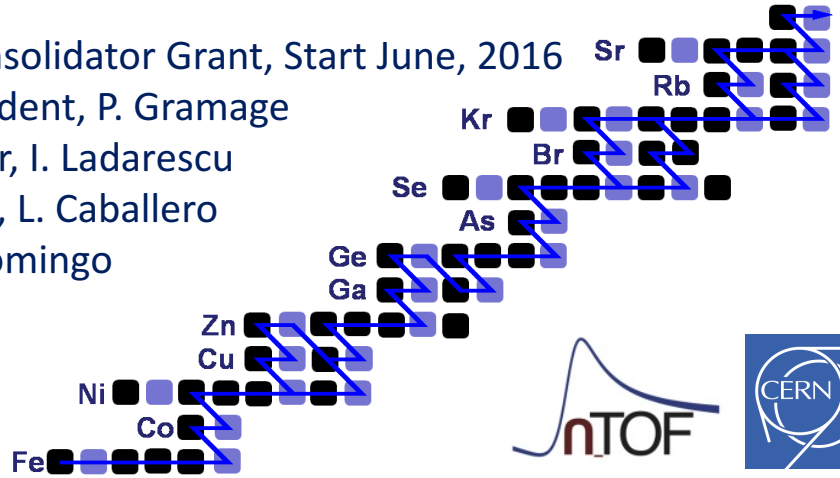




S.E.A. Orrigo et al., PRC 94, 044315 (2016)

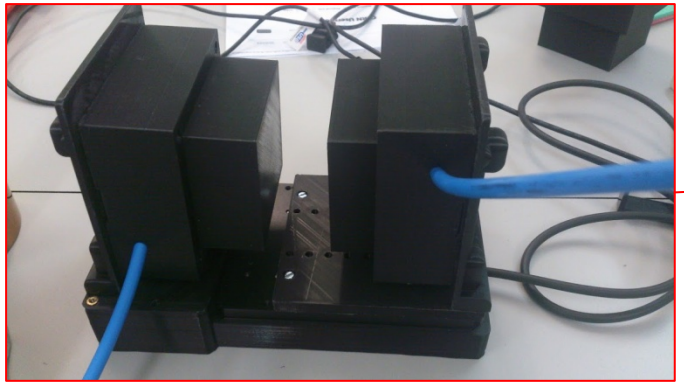


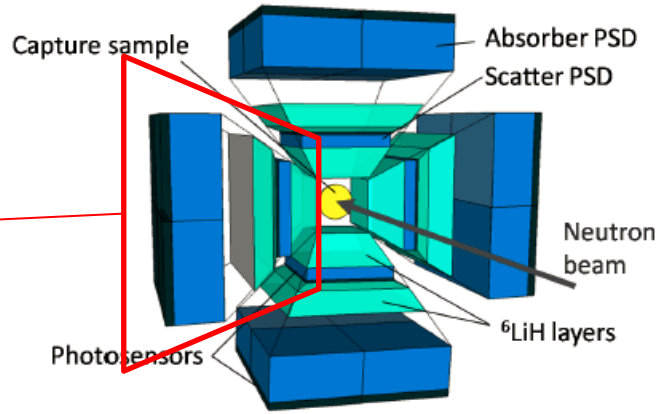
- ERC Consolidator Grant, Start June, 2016
- PhD Student, P. Gramage
- Engineer, I. Ladarescu
- Postdoc, L. Caballero
- PI, C. Domingo



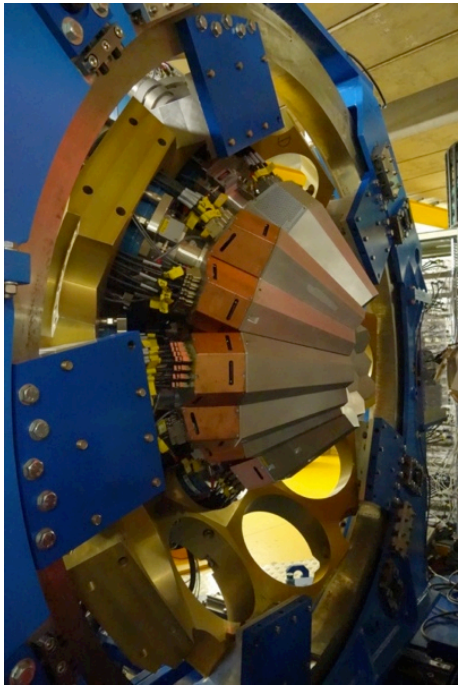
nTOF CERN

1st i-TED module prototype





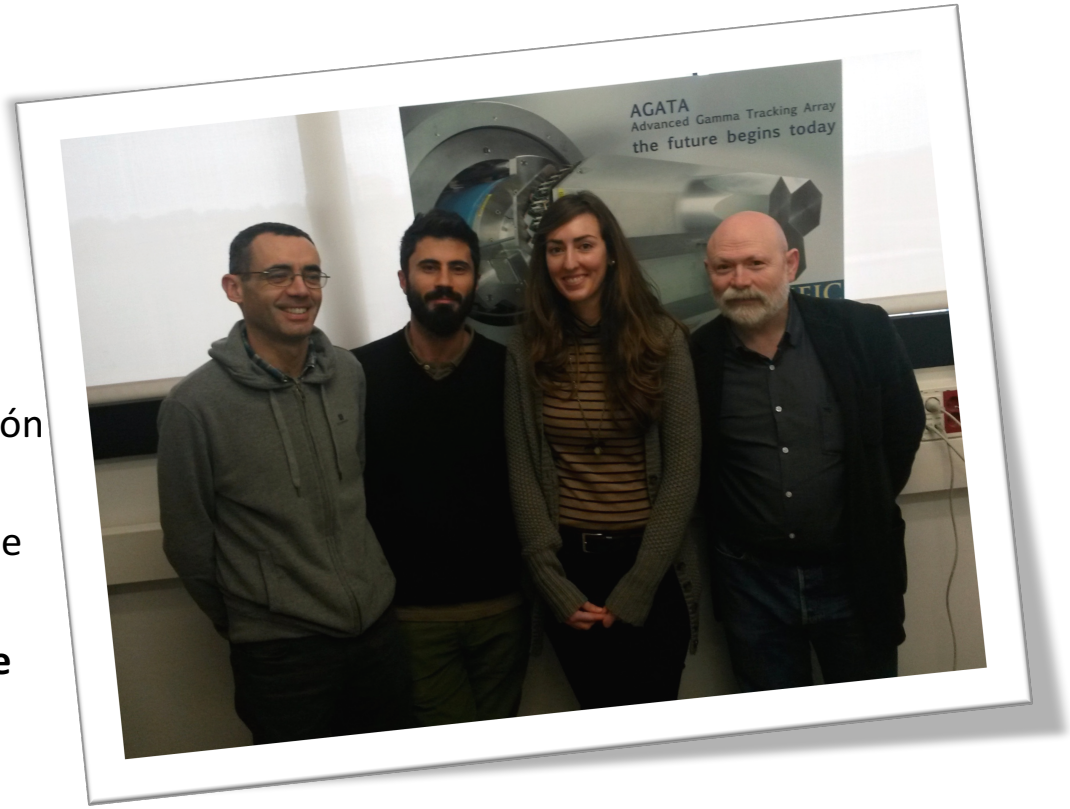
AGATA





Nuevo Digitalizador de AGATA

AGATA	A. Gadea C. Domingo-Pardo R. Aliaga T. Hüyük R.M. Rerez-Vidal



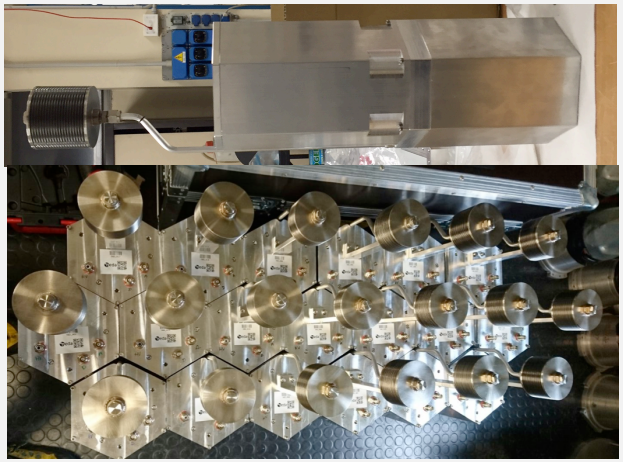
Mejoras en AGATA (35 detectores) con contribución del grupo y de los **servicios de mecánica del IFIC.**

Participación en el segundo año de la campaña de AGATA en GANIL.

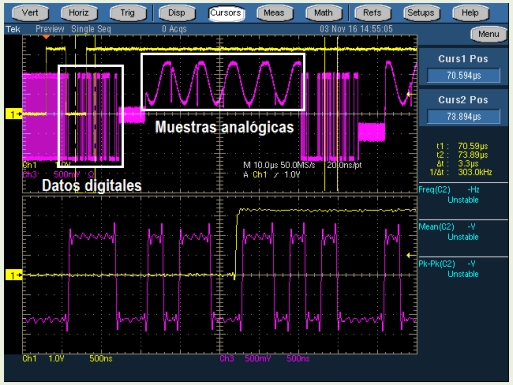
Análisis de datos en GRID. **Soporte del servicio de Informática del IFIC**

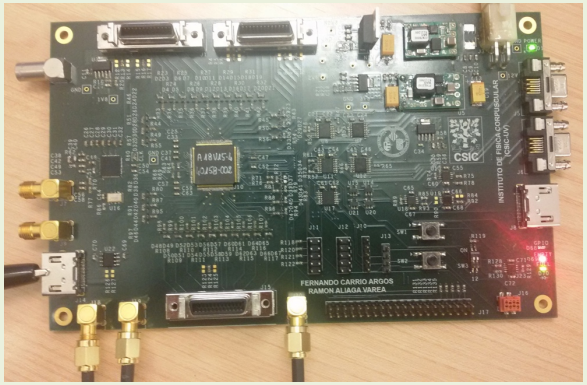
Producción científica en 2016:
2 PRL, 8 PRC, 1 NIMA, 3EPJA...

AGATA



Integración del detector de Neutrones NEDA para AGATA (IFIC - ETSE UV)





Test del primer prototipo de un buffer analógico integrado ASIC para las medidas de AGATA con detectores de partículas ligeras.
IFIC – I3M UP – ETSE UV
Servicio de Electrónica del IFIC

Accelerator R&D, IFIC

RESEARCH ACTIVITIES

Collimation systems studies for Circular Colliders (LHC) and Future Linear Colliders (CLIC and ILC)

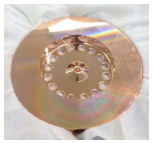
Optics Design and Beam Instrumentation studies for the Beam Delivery System of Future Linear Colliders

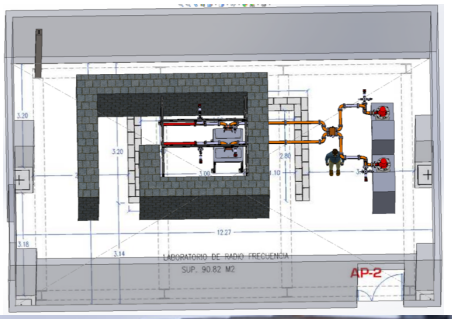
- **Design and Construction of Beam Instrumentation:**
- **Optical Transition Radiation Monitors for ATF-ATF2**
- **Beam Position Tuning for Hadrontherapy Facilities**
- **Stripline Kickers for CLIC Damping and pre-Damping Rings**
- **Beam Position Monitors studies for the Drive Beam of CTF3 (KE2022/TE IFIC-CSIC)**

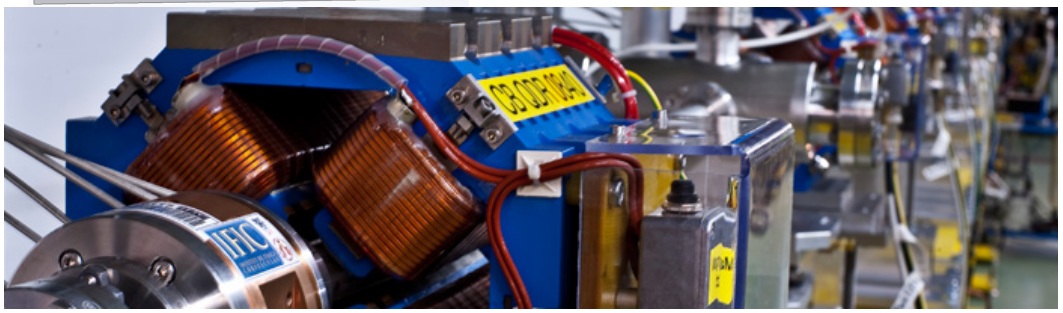
LHC Consolidation Work (KE2023/TE IFIC-CSIC)

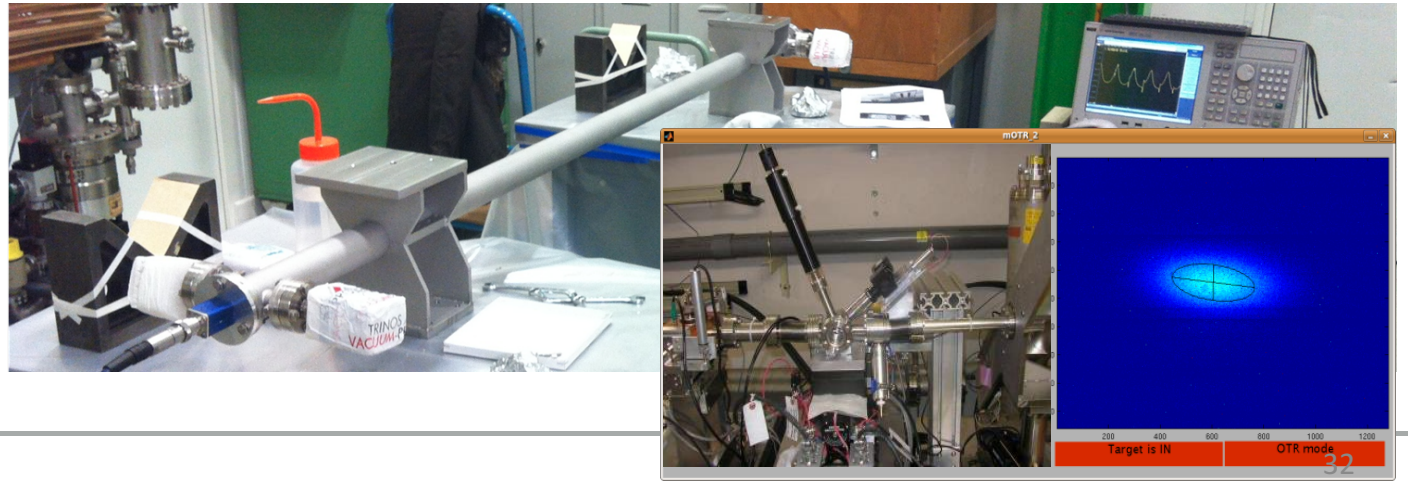
Cyclinacs for Hadrontherary applications and High-Gradient RF structures (KE2638/BE IFIC-CSIC

COLLABORATORS









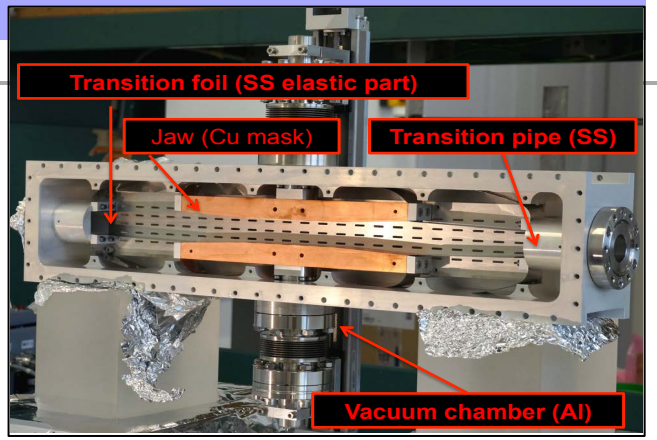
PEOPLE

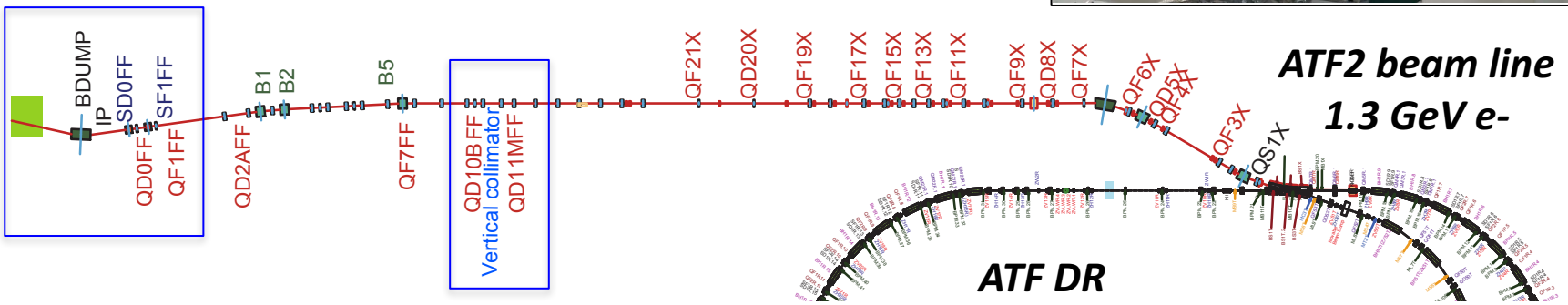
Dr. Angeles Faus-Golfe (CSIC-CNRS researcher)
Dr. Daniel Esprante Pereira (Electronical engineering)
César Blanch Gutiérrez (Mechanical engineering)
Theodoros Argyropuolos (Postdoc researcher)
Núria Fuster Martínez (PhD Student UV)
Jorge Giner Navarro (PhD Doctoral student CERN)
Natalia Galindo Muñoz (PACMAN PhD student)
Anna Vnuchenko (Oma PhD student)

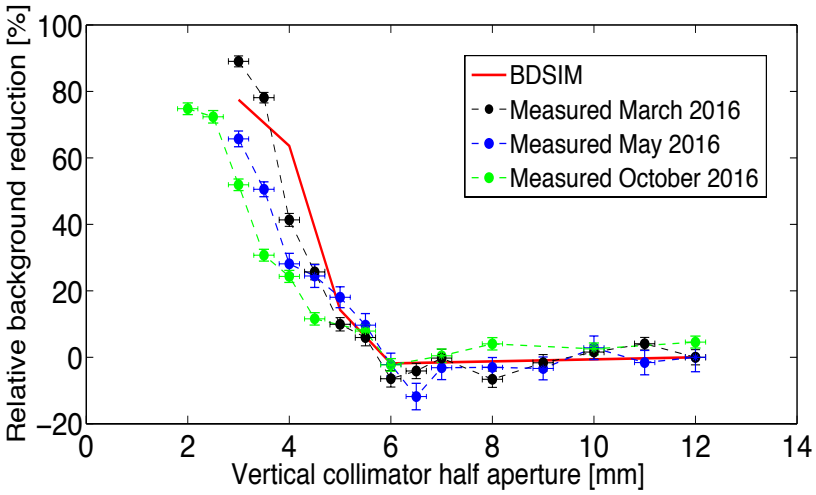
http://gap.ific.uv.es/

ATF2 (KEK) Beam Halo Collimation System 2016 Runs

- **A vertical collimation system was installed in March 2016**
- The **efficiency** of the vertical collimator in reducing **the background photons at the Post-IP has been demonstrated** under different beam conditions in different beam runs





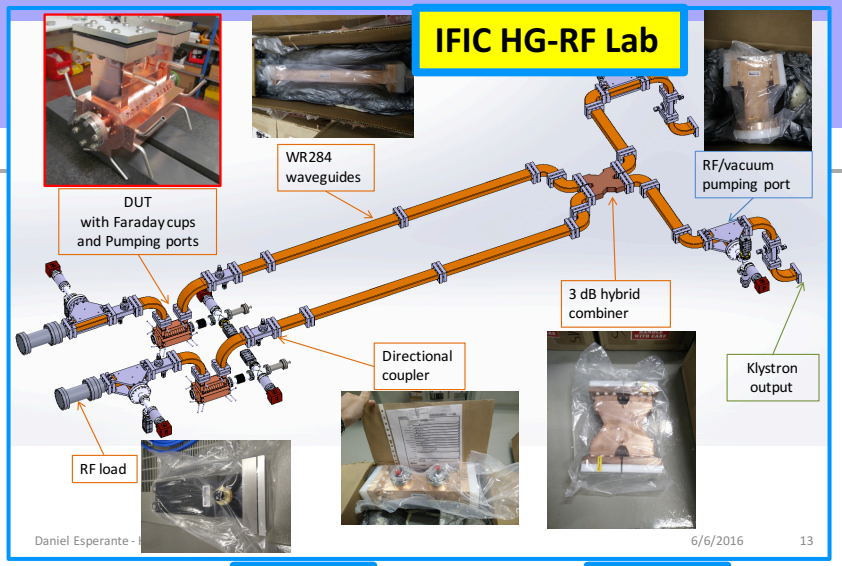


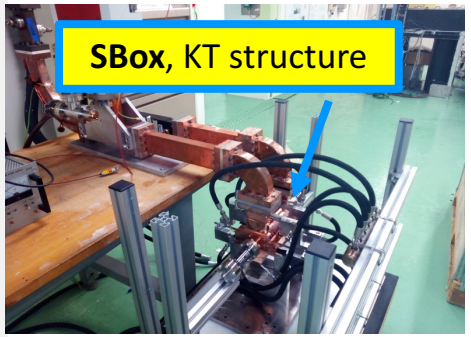
Publicaciones y charlas

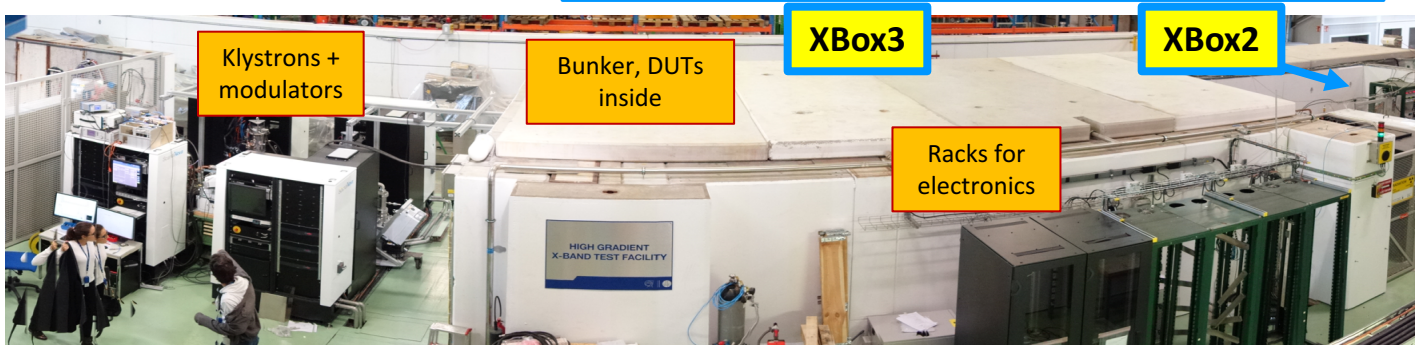
- N. Fuster- Martínez, A. Faus-Golfe, et al.. ***Commissioning and first performance studies of a single vertical beam halo collimation system at ATF2***. Proceedings IPAC16, Busan, South Korea.
- N. Fuster- Martínez, A. Faus-Golfe, A. Latina, J. Snuverink ***Geometrical wakefield study of a rectangular collimator for ATF2***. ATF2-01-16 report http://atf.kek.jp/collab/ap/library/internal-reports/show_internal_report.php) CLIC-note-1069, ATF-16-01
- N. Fuster- Martínez, A. Faus-Golfe, et al. ***Performance and wakefield studies of a single vertical beam halo collimation system at ATF2***. Proceedings IBIC16, Barcelona, Spain.
- **LCWS 2016**, Linear Collider Workshop, Morioka, Japón. **ATF2 Beam Halo Collimation System Background and Wakefield Measurements in 2016 Runs**. Oral.

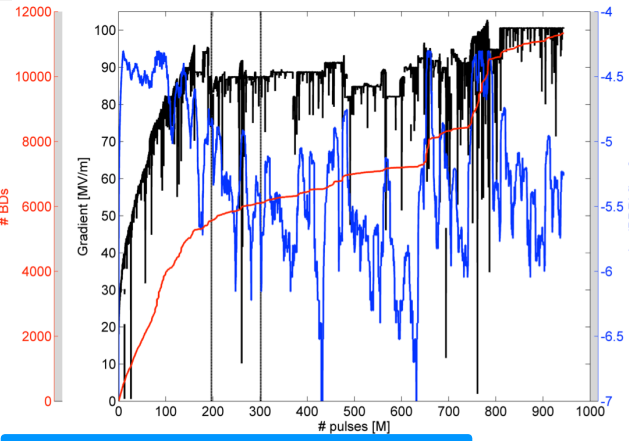
IFIC RF lab and CERN XBox systems

- **Valencia RF lab construction**
  - Waveguides, vacuum and some equipment tests
  - Cooling system and main power new installation
- **Xbox systems at CERN**
  - XBox1 and XBox2 operation and data analysis
  - XBox3 construction and commissioning
  - SBox construction, commissioning and first data (KT structure)







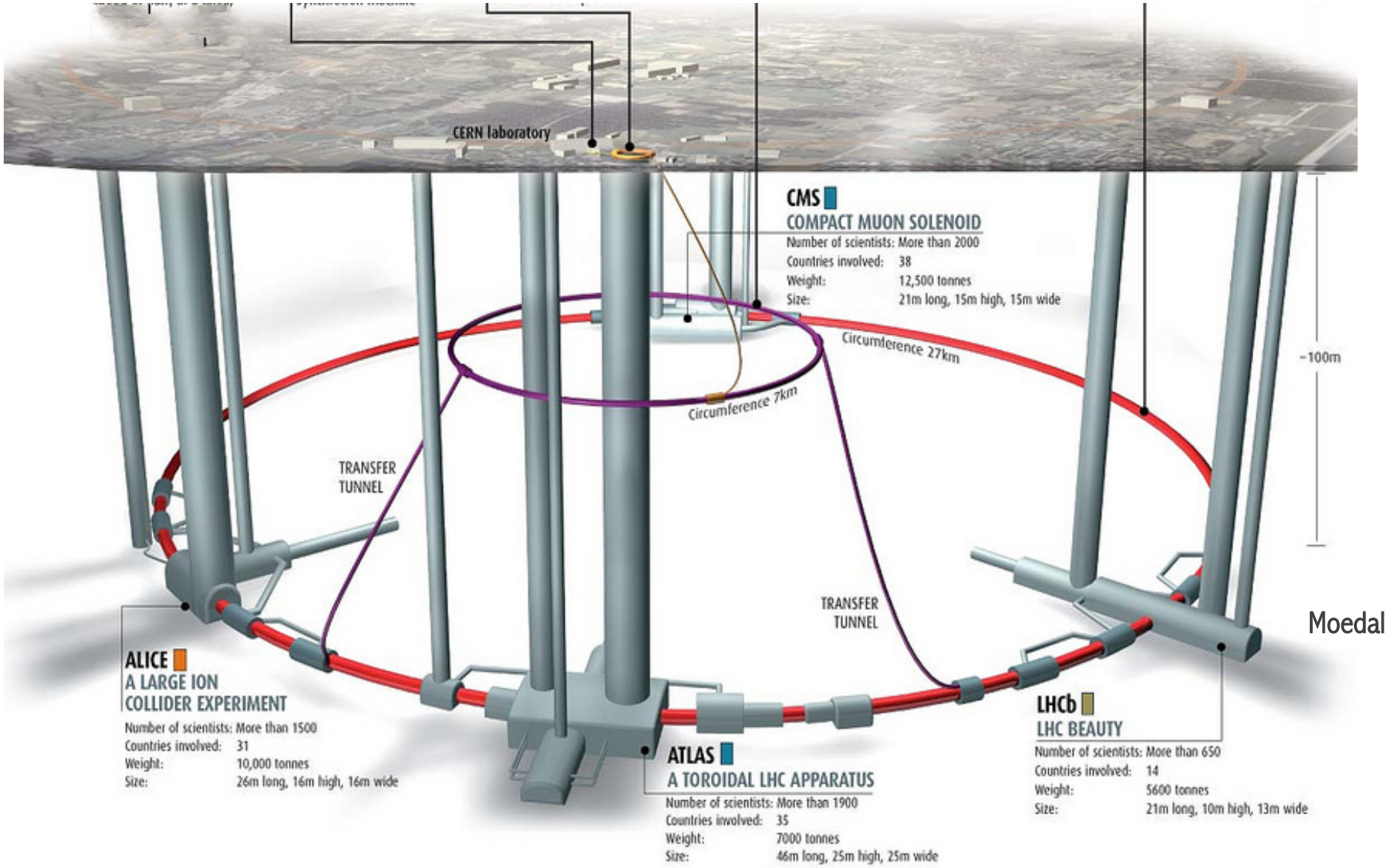


XBox2, T24openstructure

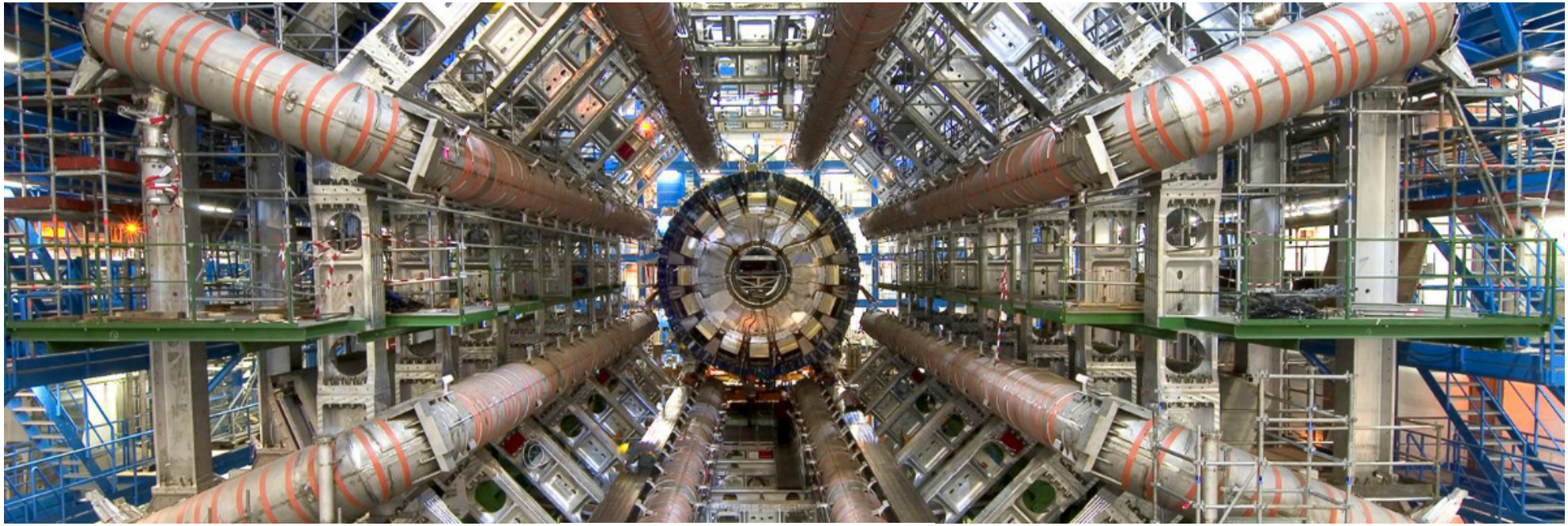
Publicaciones y charlas:

- N. Catalan Lasheras et al. *Commissioning of XBox3: A very high capacity X-band RF test stand.* Proc. LINAC16, Michigan.
- S. Benedetti et al. *Fabrication and high gradient testing of a novel S-band backward Travelling Wave accelerating structure for proton therapy linacs. Proc.* LINAC16.
- *N. Catalan Lasheras et al.* Fabrication and high-gradient testing of an accelerating structure made from milled halves. LINAC16.
- F. Tecker, T. Argyropoulos et al. *Beam-Loading Effect on the Breakdown Rate in High-Gradient Accelerating Structures*. Proc. IPAC16, Busan, Korea.
- G McMonagle et al. *Construction and commissioning Xbox3: a very high capacity X-band test stand.* Proc. 2016 IEEE IPMHVC Power Modulator Conf., San Francisco, California.
- D. Belohrad, D. Esperante et al., *Upgrade of the LHC bunch by bunch intensity measurement acquisition system,* Proc. IBIC 2016, Barcelona, Spain, Sep 2016.
- 3 charlas de D. Esperante, J. Giner, T. Argyropoulos en **HG2016** High-Gradient workshop, Argonne, Chicago. 1 charla J. Giner en **CLIC Workshop 2016**.
- Quirante, T. Argyropoulos, J. Giner-Navarro, D. Gamba, J. Tagg, E. Senes. Beam-loading effect on breakdown rate in high-gradient accelerating structures. Proceedings IPAC16 (Busan, Korea), May 2016.
- S. Benedetti, T. Argyropoulos, N. Catalan Lasheras, A. Degiovanni, M. Garlasché, J. Giner Navarro, A. Grudiev, G. Mcmonagle, A. Solodko, R. Wegner, B. Woolley, W. Wuensch. Fabrication and testing of a novel S-band backward travelling wave accelerating structure for proton therapy linacs. Proceedings LINAC2016 (East Lansing, USA), September 201
- G. McMonagle, N.Catalan Lasheras, C. Eymin, S. Rey, A. Solodko, I. Syratchev, B. Woolley, W. Wuensch, J. Giner Navarro, D. Esperante Pereira, T. Argyropoulos, J. Tagg. Construction and commissioning Xbox3: a very high capacity X-band test stand. Proceedings 2016 IEEE Power Modulator and High Voltage Conference (Los Angeles, USA), 2016.
- N. Catalan Lasheras, C. Eymin, G. McMonagle, S. Rey, I. Syratchev, B. Woolley, W.Wuensch, J. Giner Navarro, D. Esperante Pereira, T. Argyropoulos, M. Volpi and J. Tagg. Commissioning of Xbox3: a very high capacity X-band RF test stand. Proceedings LINAC2016 (East Lansing, USA), September 2016.
- N. Catalan Lasheras, A. Grudiev, G. Mcmonagle, I. Syrachev, B. Woolley, W. Wuensch, H. Zha, G. Bowden, V. Dolgashev, A. Haase, T. Argyropoulos, J. Giner Navarro, D. Esperante Pereira, R. Rajamaki, X. Stragier, P.J. Giansiracusa, T.G. Lucas and M. Volpi. Fabrication and high-gradient testing of an accelerating structure made from milled halves. Proceedings LINAC2016 (East Lansing, USA), September 2016.
- A. Degiovanni, U. Amaldi, S. Benedetti, M. Garlasché, J. Giner-Navarro, P. Magagnin, G. McMonagle, I. Syratchev, W. Wuensch. Design and high power measurements of a 3 GHz Rotary Joint for medical applications. To be published: Technical Report CLIC-Note-1071, CER
- D. Belohrad, D. Esperante Pereira, J. Kral, S. B. Pedersen, Upgrade of the LHC bunch by bunch intensity measuremente acquisition system, Conference proceedings 2016 International Beam Instrumentation Conference IBIC 2016, Barcelona, Spain, Sep 2016.

The Large Hadron Collider… and beyond



ATLAS - 2016

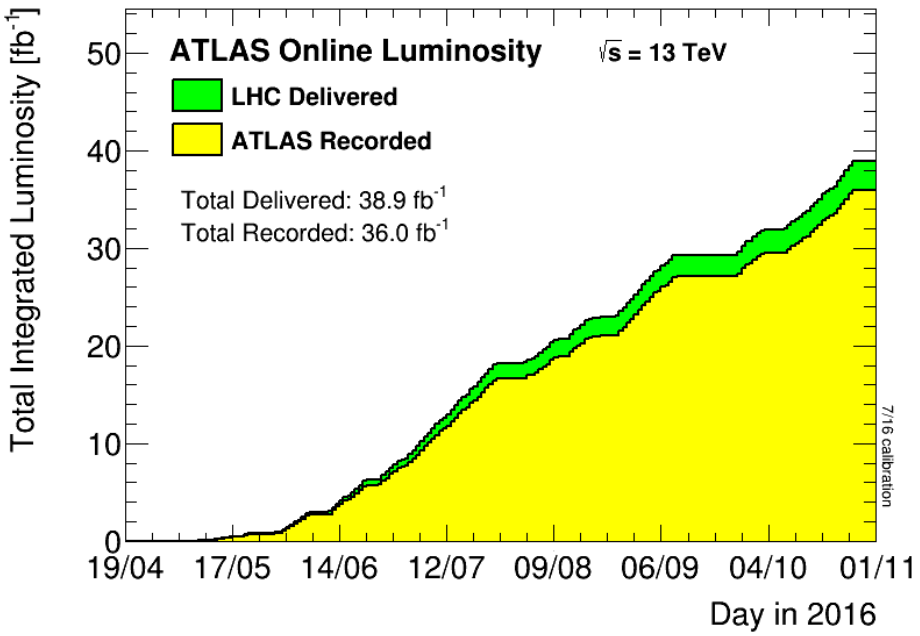


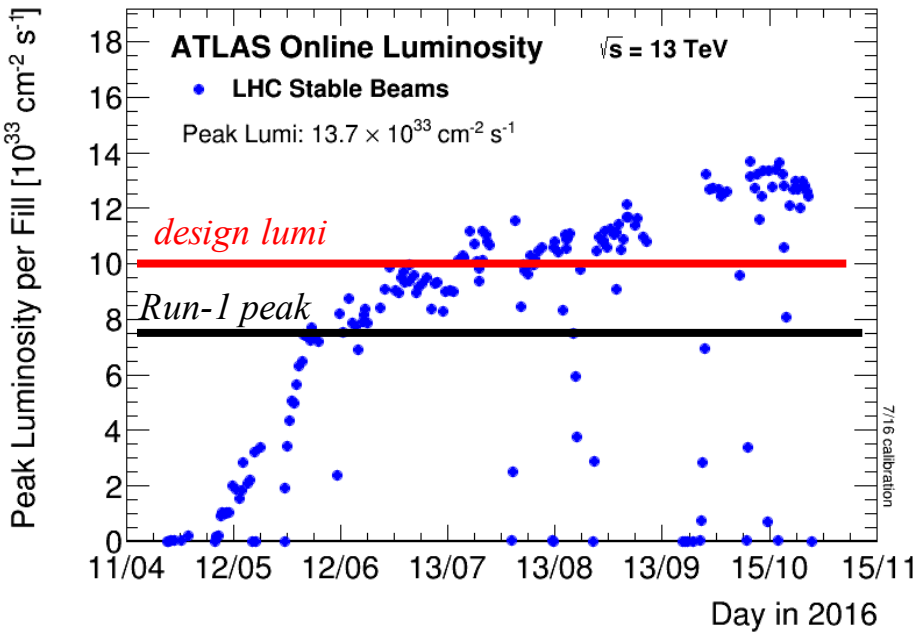
IFIC@ATLAS

- **Coordinated project**
  - **SCT**
  - **TileCal**
  - **Future Colliders**
- **Grid**

ATLAS - 2016

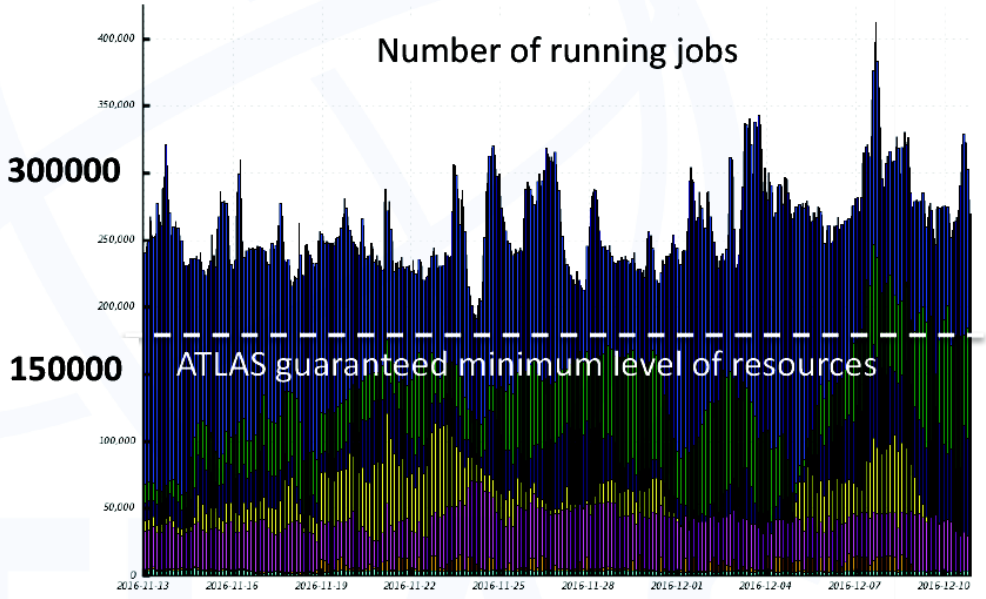
- ✔ 2016 has been a production year for LHC
  ATLAS performance in 2016 was excellent
  - ➔ Doubled Run-1 luminosity, well beyond LHC design !!
  - ➔ More data collected in 2016 than in all previous years together
    - ↳> 96% working channels
    - ↳> 93% of the data collected usable for physics analysis





ATLAS Computing

- ✔ Worldwide GRID computing resources are crucial
  - ➔ Higher luminosity and data-taking rate were a challenge for the computing infrastructure as well
  - ➔ ATLAS relies on the capability to produce large MC simulation and process the data rapidly to present the best possible results.



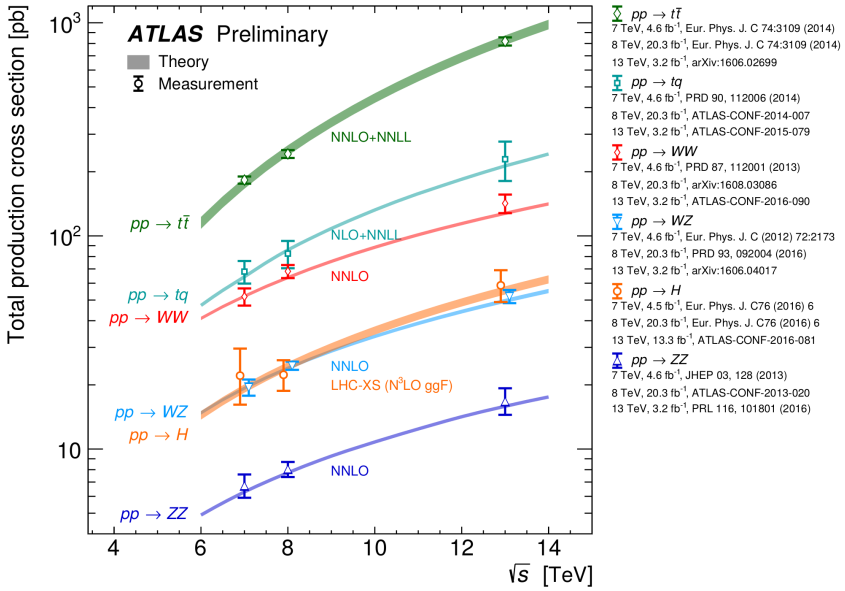
ATLAS Physics

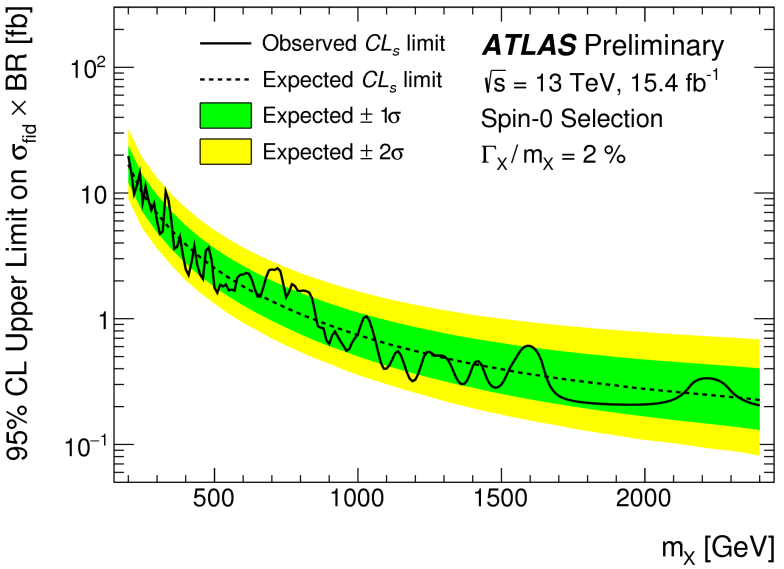
Huge number of measurements and searches updated for ICHEP.

Good performance of the LHC allowed to improve many analyses

Unfortunately 2016 data didn't confirm some of the suggestive indications that started to appear in 2015

Searches and 13 TeV measurements are now wrapping-up 2015+2016 results for Winter conferences, but published in 2016 as many papers with Run1 data as Run2.





Computación GRID & e-Ciencia

MIEMBROS

Personal Permanente:

A. Fernández Casani	:	Titulado Superior Informática- CSIC
S. González de la Hoz	:	Profesor Titular – UVEG
J. F. Salt Cairols,	:	Profesor Investigación - CSIC
J. Sánchez Martínez	:	Titulado Superior Informática- CSIC

PostDoc:

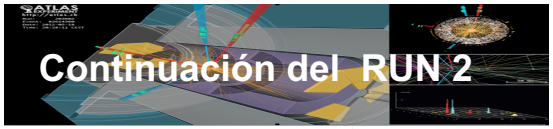
E. Fullana Torregrosa:	Postdoc 'Severo Ochoa'

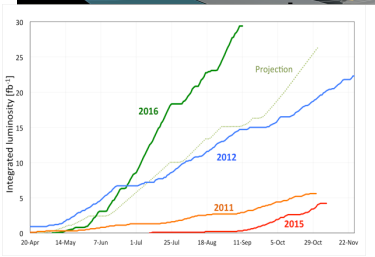
Personal Contratado ó Vinculado:

J. Lozano Bahilo	Contratado Proyecto, CSIC
F. Fassi	Doctora Vinculada. Profesora Física Universidad de Rabat
C. García Montoro	Técnico Apoyo Ministerio
V. Sánchez Martínez:	Contrato 3 meses Proyecto (Marzo-Junio 2016) . Tesis Doctoral defendida en 2016
M. Kaci :	Contrato Proyecto, CSIC (finalización en Octubre 2016)

Colaboradores externos/ Colaboradores Visitantes:

G. Amorós Vicente:	Técnico Especialista en la AEMET (Agencia Española de Meteorología)
Miguel Villaplana	Postdoc en INFN-Milán

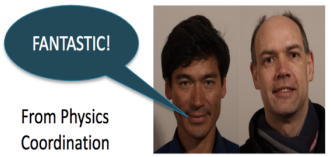




Luminosidad Integrada

Infraestructura del ATLAS Tier-2 :

Cada año nuestro Tier-2 tiene que suministrar:
-Los recursos de computing y almacenamiento de datos comprometidos (5% del total de todos los T2 de ATLAS)
-Financiado por el Plan Nacional de AA EE.



Comment from Francesco Forti (LHCC chair) after the ATLAS presentation

"I am always impressed about how quickly you can produce results after you take the data. Are your results produced directly by the Online system?"

Computación GRID & e-Ciencia

Nuevo proyecto FPA aprobado y concedido:

"Towards a genuine TIER-2 Spanish Federation of ATLAS to face the challenge of the management and processing of the Big Data of the LHC"

Evolución recursos del Tier-2

T2-ES	2006	2007	2008	2009	2010	2011	2012	2013	2014	201	2016	017
CPU(HS06)	92	243	1750	5390	10308	13900	13300	18000	20600	2610	30000	875
DISK(TB)	14	63	387	656	1107	1880	2350	2550	2800	325	3900	875

FAX: - Federated Data Storage System

Expert System:

User Support

Cloud Computing

Distributed Analysis: se apoya en 'derivation framework' para los análisis

DAST: coordinación de grupo de expertos para el análisis distribuido para las dos zonas europea y de US

Análisis de Física en Resonancias ttbar (Exotics)

Nuevo Data Flow de ATLAS

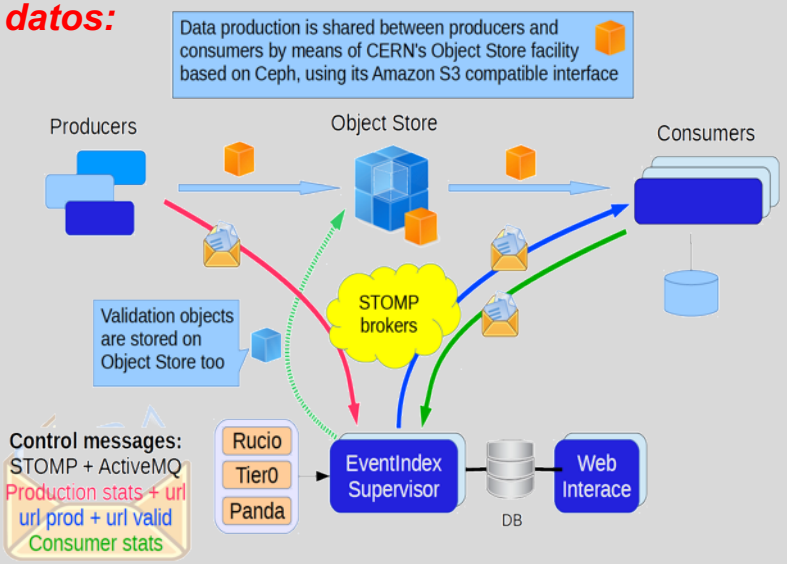
EventIndex

Desarrollo y despliegue de un catálogo de sucesos con una gran cantidad de datos – Real Data and Monte Carlo- para todas las etapas de procesados

Objetivo: obtener una mejores prestaciones en el proceso de análisis

Alta implicación del grupo del IFIC

2016: Implementación del nuevo Flujo de datos:



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Alta implicación del grupo del IFIC

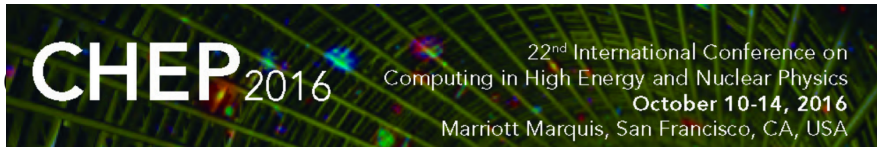
2016: Implementación del nuevo Flujo de datos:

EVENT INDEX WORKSHOPS:

18-20 Mayo en IFIC (Valencia)

7-9 Noviembre en U. Génova &INFN

GRID & e-Ciencia: Conferencias



-(C) 'ATLAS EventIndex general and monitoring infrastructure", A. Fernández, D. Barberis, A. Favareto, C. Garcia-Montoro, S. González de la Hoz, J. Hrivnac, F. Prokoshin, J. Salt, J. Sánchez, R. Toebbike.
-(C) 'How to keep the GRID full and working with ATLAS production and physics jobs", A. Pacheco Pages, F. Barreiro Megino, F. Fassi, A. Filipcic, A. Di Girolamo, S. González de la Hoz, I. Glushkov, T. Maeno, R. Walker
-Farida Fassi: convener del Track 7 de la CHEP'16 'Middleware, Monitoring and Accounting
http://chep2016.org/node/11



-(C) 'ATLAS EventIndex Data Collection Supervisor and Web Interface', C. García Montoro, A. Fernández Casani, J. Sánchez (on behalf of ATLAS Collaboration)

Nota: (C) : contribución presentación

IFIC / Tier-2 ATLAS España: un centro de Referencia y de acuerdos/proyectos colaborativos

- Proyecto Event Index: I + D en Computing con otros centros de ámbito internacional.

- Ayuda I-COOP B (CSIC) COOPB 20247
" Launching a Platfor of GRID Computing in Morocco to meet the New Challenges of Physics Researches ". Instituciones: IFIC . Universidad Mohammed V –Rabat (Marruecos).
CONCEDIDA Período: 2017-2018

Organización de Workshops (para 2017)

- Semana Software & Computing ATLAS: 12-16 de Junio de 2017 a realizar en IFIC (Valencia).

ATLAS - TileCal

"CONTRIBUCIONES AL CALORIMETRO HADRONICO TILECAL Y AL PROGRAMA DE FISICA DEL EXPERIMENTO ATLAS DEL LHC",

FPA2015-65652-C4-2-R, 2016-2018

PI: Luca Fiorini, Co-PI: Juan Valls



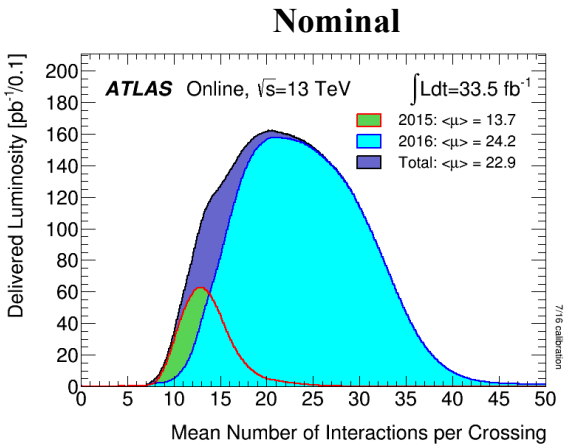
PHYSICISTS	J. A. Valls (Staff, CSIC) A. Ferrer (Professor, UV) E. Higón (Professor, UV) V. Castillo (Professor, UV) L. Fiorini (Researcher, UV) A. Bailey (S8A postdoc, CSIC)
PhD STUDENTS	D. Álvarez L. Cerdá S. Rodriguez
ENGINEERS & STUDENTS	A. Valero (Staff, CSIC) P. Zuccarello (Post-doc, UV) F. Carrió (Contract, UV) Ignacio Asensi (student, UV) Francisco García (sudent, UV)

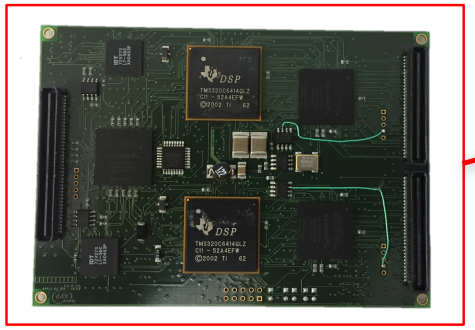
ATLAS-TileCal Operations

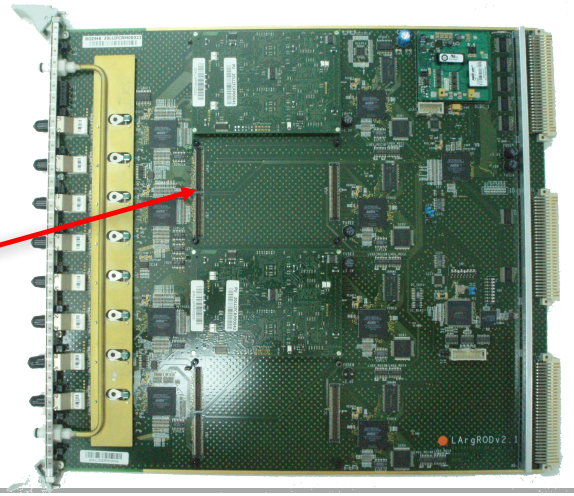
IFIC is resposible of the TileCal Read Out Drivers (ROD), a key component of the DAQ.

Increase of LHC peak luminosity → higher trigger rate (higher than nominal 90 kHz).

1. Need to optimize the existing DSP code
2. Prepare for an upgrade of the system, during 2017 shutdown, to cope with up to 100 kHz.
    1. This is responsibility of IFIC.







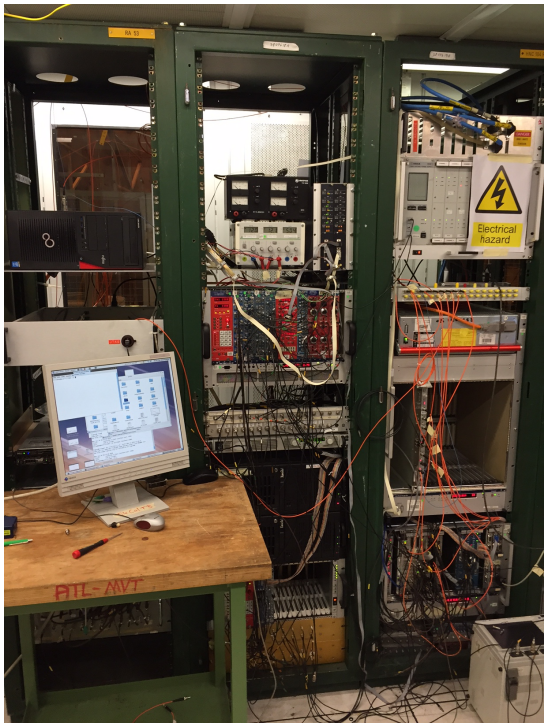


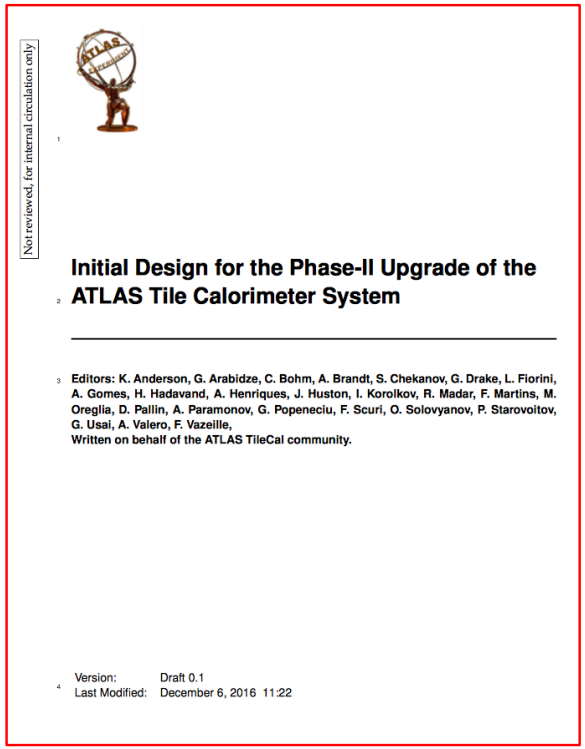
HL-LHC TileCal Upgrade

TileCal-IFIC responsible of the design of the Trigger Preprocessor (TilePPr) DAQ software, firmware.

Two beam tests during 2016 to validate the design in two prototypes.

TileCal **Initial Design Review (IDR)** released in Dec. 2016.

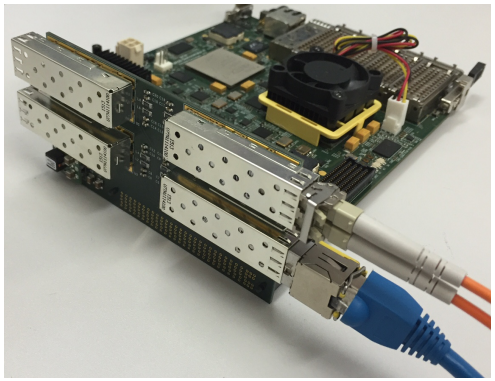


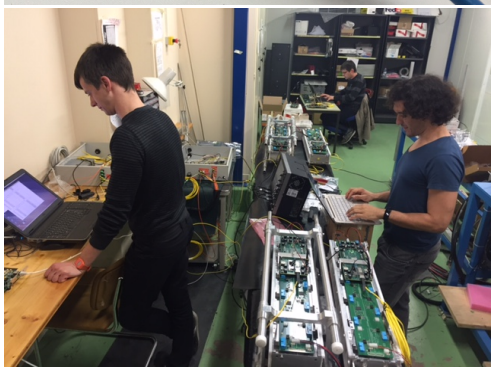

Not reviewed, for internal circulation only

Initial Design for the Phase-II Upgrade of the ATLAS Tile Calorimeter System

Editors: K. Anderson, G. Arabidze, C. Bohm, A. Brandt, S. Chekanov, G. Drake, L. Fiorini, A. Gomes, H. Hadavand, A. Henriques, J. Huston, I. Korolkov, R. Madar, F. Martins, M. Oreglia, D. Pallin, A. Paramonov, G. Popeneciu, F. Scuri, O. Solovyanov, P. Starovoitov, G. Usai, A. Valero, F. Vazeille,
Written on behalf of the ATLAS TileCal community.

Version: Draft 0.1
Last Modified: December 6, 2016 11:22



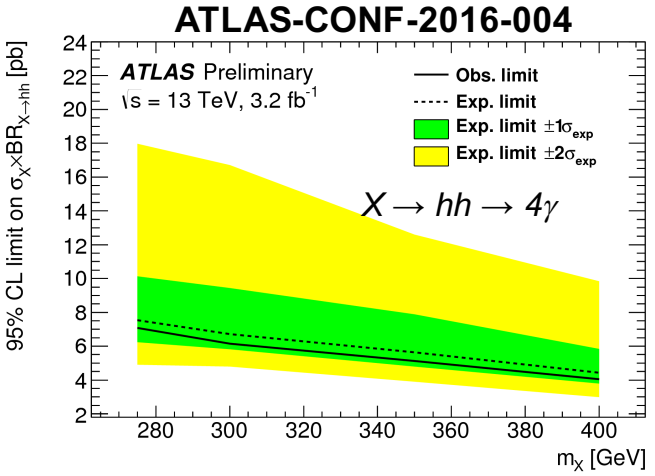


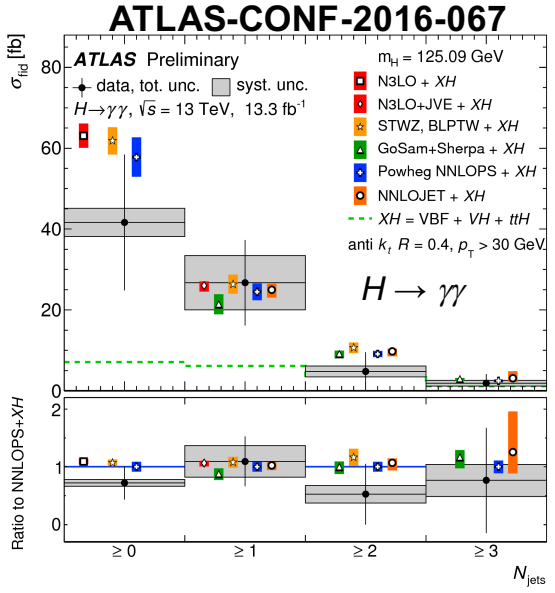


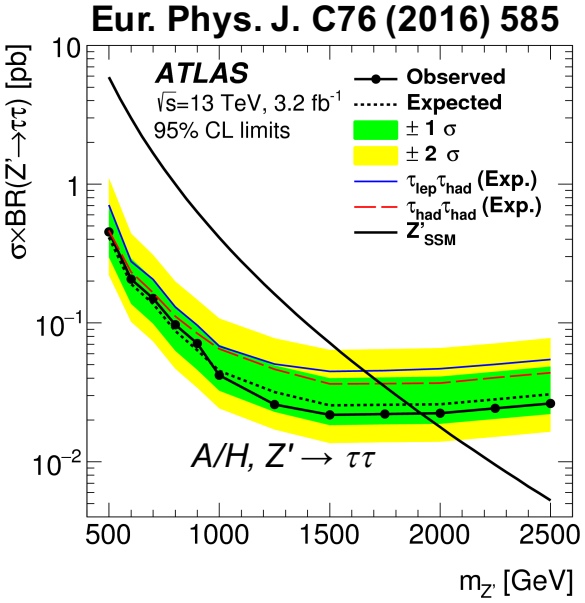
TileCal – ATLAS physics

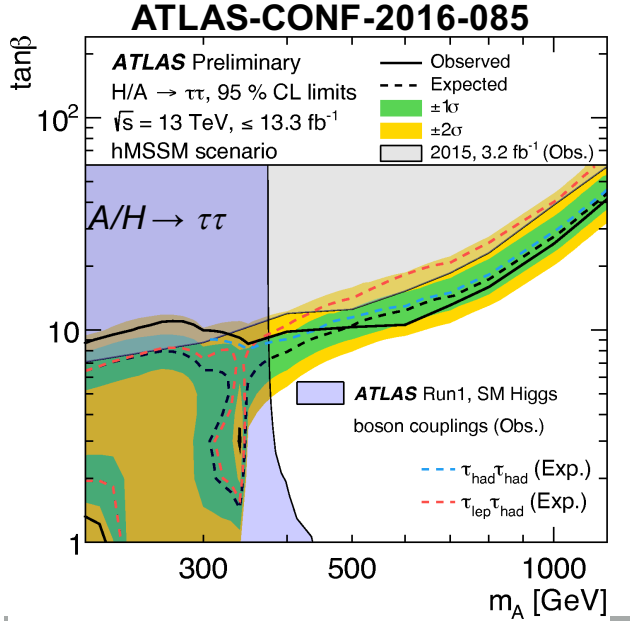
The most exciting results presented at Moriond and ICHEP:

1. 13 TeV data allowed to extend extend greatly the reach of high mass searches and measured Higgs cross-section @ 13 TeV
2. Contributed to the extension of the reach of heavy Higgs and new physics coupling to the Higgs sector.
3. Measured differential and fiducial cross-section in the H → ɣɣ final state
4. Unfortunately new physics not found yet!







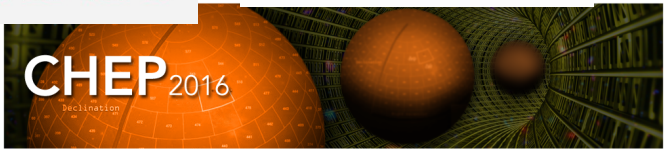


Conferences in 2016













Conferences & Workshops in 2016:

- 4 Talks
- 5 Poster
- 3 Workshops
- 1 PhD School

ATLAS Responsibilities 2016:

- ATLAS Tau Working Group convener (L. Fiorini)
- ATLAS TileCal Upgrade Coordinator (A. Valero)
- ATLAS TileCal Signal Reconstruction Coordinator (A. Valero)
- ATLAS TileCal speaker committee (L. Fiorini)
- ATLAS TileCal Dreputy Run Coordinator (L. Cerdá)
- ATLAS TileCal Data Quality Leader (D. Álvarez)

ATLAS & Future Colliders

STAFF	J. Fuster E. Ros M. Vos
STUDENTS POSTDOCS ENGINEERS	E. Fullana (Postdoc-S8a- 50% GRID) M.A. Villarejo (engineer) M. Boronat (PhD AIDA) I. Garcia (PhD AIDA) P. Gomis (PhD Generalitat) M. Perelló (PhD FPI) D. Melini (PhD. HiggsTools) J. Aparici (PhD- 50% GRID)



Individual presentations at International Conferences, Physics Schools, invited seminars: 18
Organization of International Conferences and Workshops: 6
Publications (ATLAS+ILC+CLIC): 167
Scientific management, committees and coordination:

- Session convener: 4 (MV);
- C11-IUPAP (Particles and Fields) chair (JF 2014-2017);
- Chair of the ECFA linear collider study for detector and physics (JF renewed 2017-2019).
- IFAE+DESY-PRC scientific committees (JF)
- OECD GSF activity on sustainability of Research Infrastructures (JF)
- DEPFET Linear Collider representative (MV)

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PROJECTS	**FPA2015-65652-C4-3-R** Contribution to the operation and data analysis of ATLAS. R&D for future colliders and associated physics studies, 2016-2018
	AIDA2020 EU FP8 Horizon 2020, 2015-2019, Advanced European Infrastructures for Detectors at Accelerators, 2015-2019
	HiggsTools-ITN, grant agreement No 316704}, EU Marie Curie project 2013-2016, FP7-PEOPLE-2012-ITN
	E-JADE, H2020-MSCA-RISE-2014, No. 645479, Europe-Japan Accelerator Development Exchange Programme, 2015-2018

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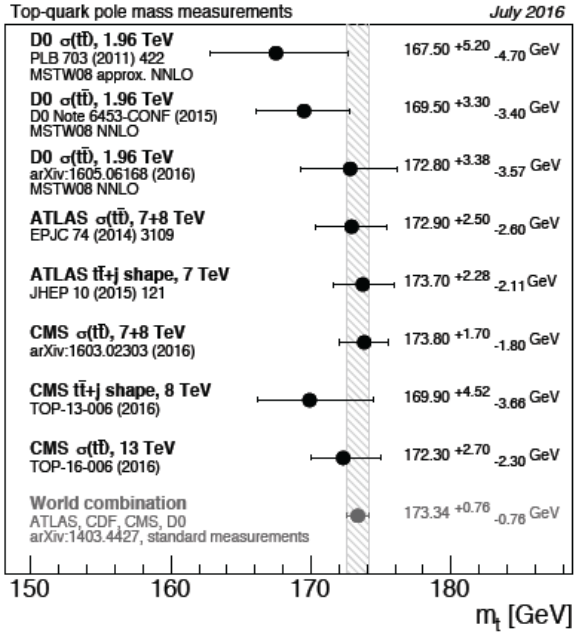
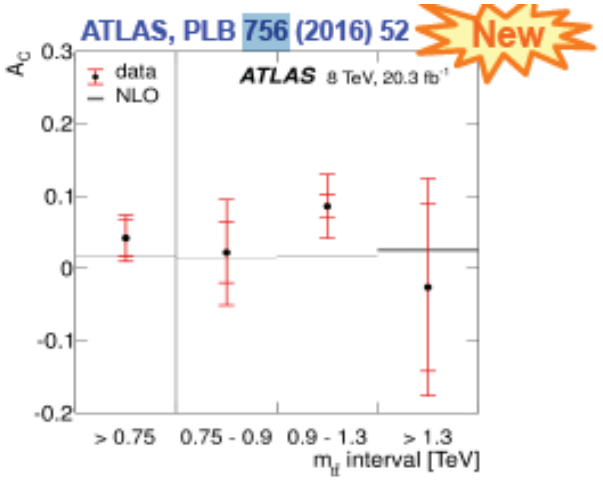
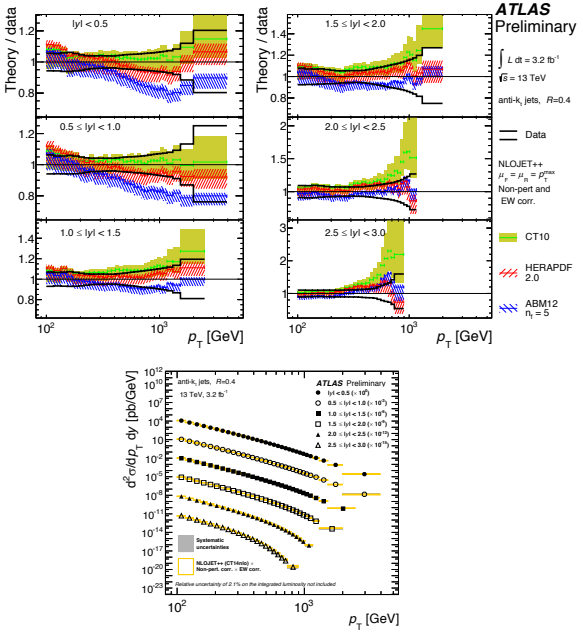
Top & Jets physics @ ATLAS



Top-quark pole mass from tt+1jet events, EPJC73 (2013) 2438
ATLAS 7 TeV result: m = 173.7 ± 2.3 GeV, JHEP 1510 (2015) 121
On-going work: D. Melini+J. Fuster



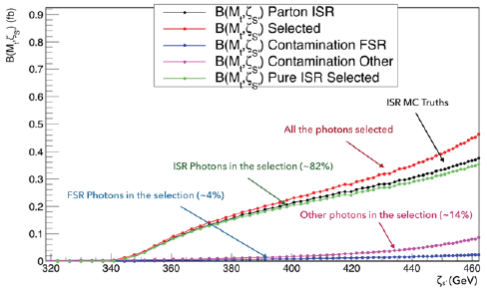
Charge asymmetry in boosted tt production, ATLAS-CONF-2015-048, PLB756 (2016) 52-71
First measurement in highly boosted regime
On-going work: J. Aparici+M. Vos



Multi-jet production
On-going work: E. Fullana

Top & Jet Physics @ FLC

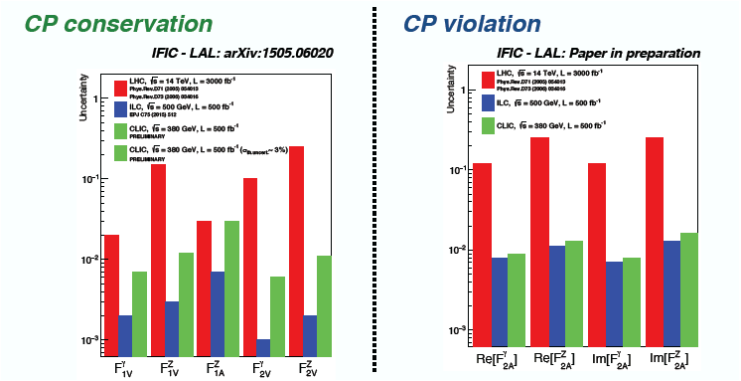
s = 500 GeV	ISR case		FSR case	
Integrated Luminosity	m_t (GeV)	Δm_t (MeV)	m_t (GeV)	Δm_t (MeV)
500 fb^{-1}	173.158	155	173.153	130
1000 fb^{-1}	173.140	103	173.127	92
2600 fb^{-1}	173.133	61	173.114	57

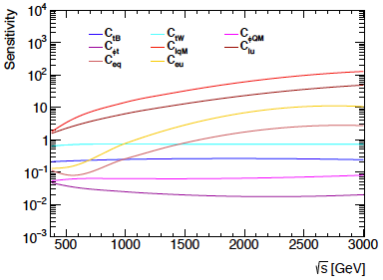


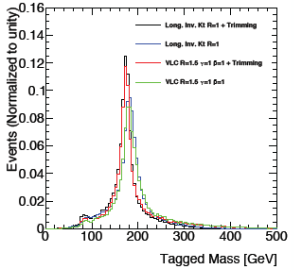
Top-quark mass determinations at LC (ILC+CLIC) in the continuum

On-going work: M. Boronat+P. Gomís+J. Fuster

In collaboration with A. Hoang and V. Mateu







Study of top anomalous coupling at LC (ILC+CLIC)

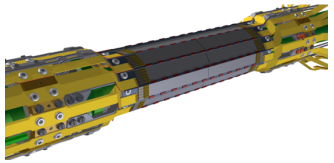
On-going work: I. García+ M. Perelló+E. Ros+M. Vos

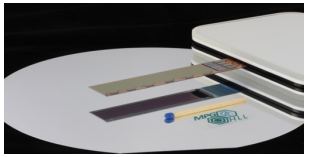
Detector R&D for future linear colliders

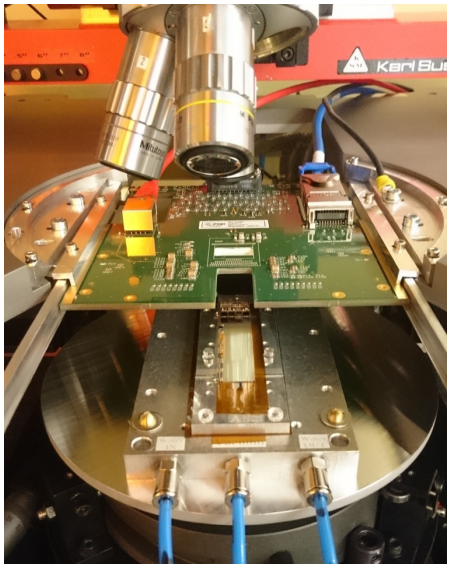
DEPFET







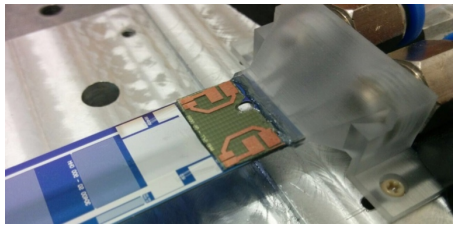


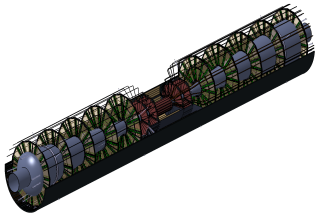


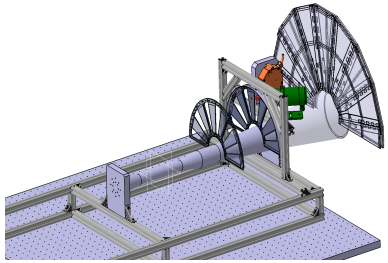
DEPFET chosen technology as the innermost vertex pixel detector of the Belle II and also a strong candidate as a pixel technology to the detector concepts of the future linear collider.

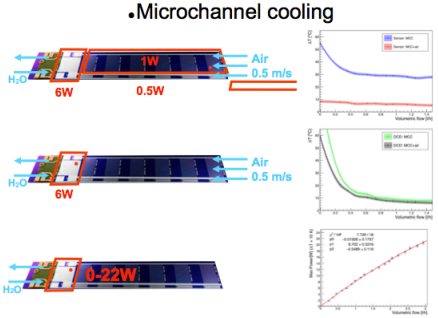
IFIC (M. Boronat, P. Gomís, M.A. Villarejo, J. Fuster. M. Vos)

- Design and production of a needle card to perform the first test over the full assembled modules.
- Development a set of test to perform the quality control check.
- DEPFET Representative at LC







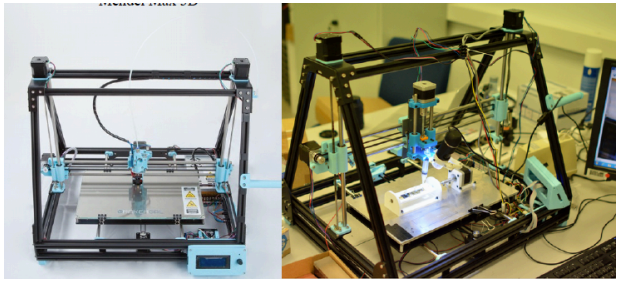


AIDA2020 - infrastructure for detector R&D.

IFIC (I. García, M. Perelló, M.A. Villarejo, M. Vos)

- Sensor cooled via integrated micro-channels
- WP9/MCC work package package
- Forward tracker design
- Thermo-mechanical studies

Collaboration: IFCA, INTA, MPG-HLL, U. Bonn



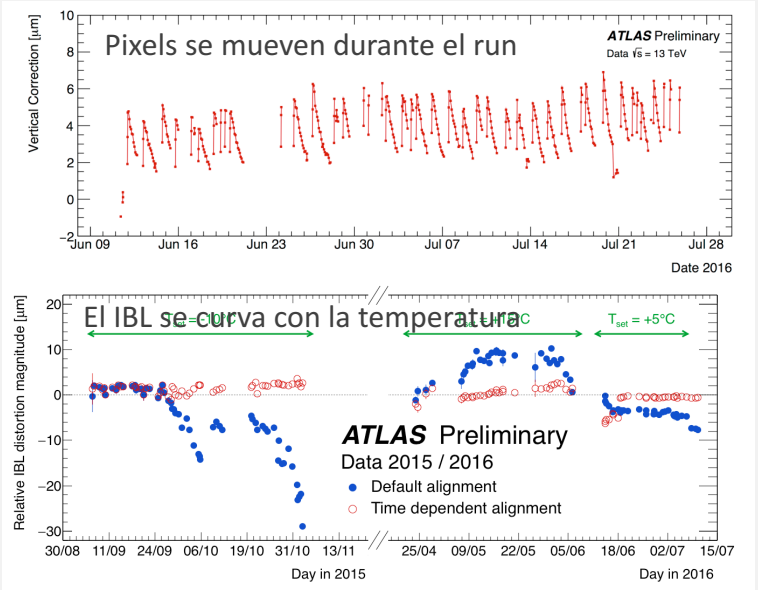
ATLAS-SCT-ITk

SENIORS	C. García (Prof. CSIC) C. Lacasta (Inv. CSIC) S. Martí (Inv. CSIC) V. Mitsou (C.T. CSIC) S. Cabrera (CT CSIC) MJ Costa (CT CSIC) JE Garcia (RyC CSIC) J. Mamuzic (postdoc)
STUDENTS	J. Jiménez (phd) L. Barranco (phd) D. Rodriguez (phd) U. Soldevila (phd) S. Pedraza (phd) O. Estrada (phd)
ENG:	J. Bernabeu (TS CSIC) J. Sanchez (TS CSIC) JV Civera (T CSIC) M Villarejo (TS UV) F. González (T UV) A. Platero (T proy.) C. Solaz (TS proy.) P. Leon



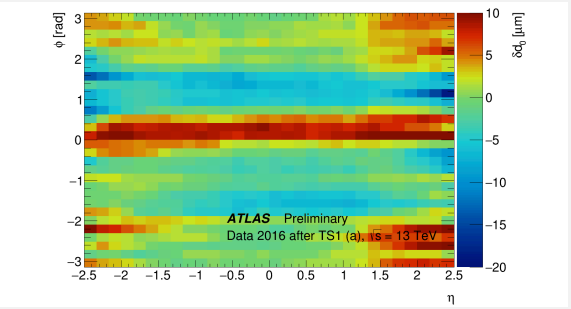
Alineamiento del detector de Trazas

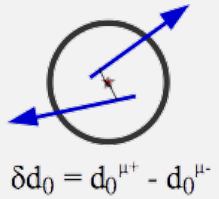
Alineamiento de estructuras grandes cada 20 minutos. Constantes lista en <24 horas para poder procesar los datos



Off-line: se realinea todo el detector (desde las grandes estructuras hasta cada módulo/tubo individual). **Total > 700,000 grados de libertad**

Hemos implementado este año la evaluación de la sistemática con sucesos Z y J/ψ→ μ+μ-



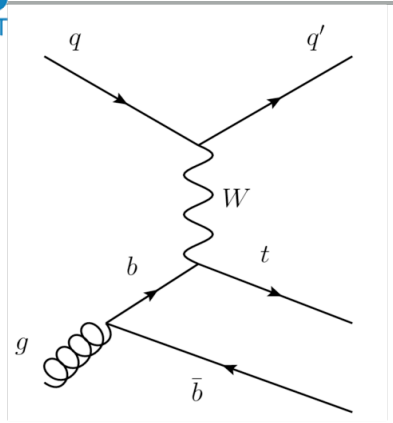


Ya está listo el realineado completo de los datos de 2016 para los análisis de Moriond

Presentaciones en conferencias (en nombre de ATLAS):

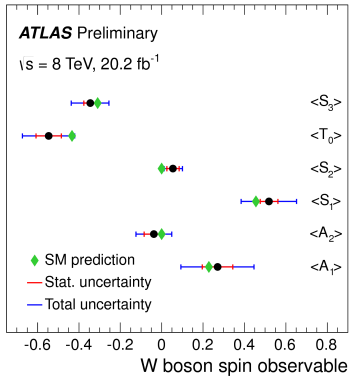
1. J. Jimenez. *Novel time-dependent alignment of the ATLAS Inner Detector in the LHC Run*. **PIXEL 2016**)
2. S. Martí. Alignment of ATLAS inner tracke. **LCWS2016**

Física del top



- The structure of the Wtb vertex has been probed at both production and decay using t-channel top events.
- First measurement of all W spin observables (proposed by Aguilar-Saavedra and Bernabeu Phys. Rev. D 93 (2016) 011301).
- Best measurement of top quark polarisation.
- All measurements in agreement with SM predictions.
- Best limits on complex phase of anomalous couplings (sensitive to CP violation effects in the top sector) set.

W spin observables



Top Polarisation

$$\alpha_\ell P = 0.96 \pm 0.05\ (\text{stat.}) \pm 0.10\ (\text{syst.}) = 0.96 \pm 0.12,$$
$$P(F_R + F_L) = 0.26 \pm 0.08\ (\text{stat.}) \pm 0.14\ (\text{syst.}) = 0.26 \pm 0.16.$$

Constraints on top anomalous couplings

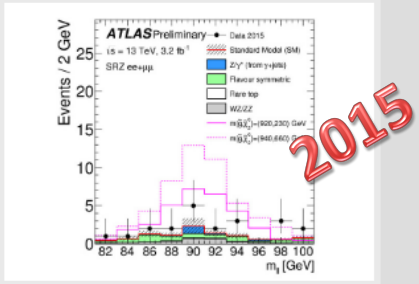
$$\text{Im}\, g_R \in [-0.17,\ 0.06] \text{ at the 95\% confidence level}$$

All results presented @ Top2016 Conference for the first time (**ATLAS-CONF-2016-097**).
Will be reflected in PhD Thesis L. Barranco, J. Jiménez, S. Pedraza. Final paper in latest steps of ATLAS review.

- Contributions to conferences related Top Physics (on behalf of ATLAS) : **ICNFP2016** (MJ Costa), **LHCDaysSplit2016**, **DubnaSchool2016** (JE Garcia), **Top2016** (J Jimenez).
- Organization of the **5th ATLAS single top-quark workshop** (Valencia, 12-14th December.

Searches for Supersymmetry

Development of generic code for **global** **p-value** calculation of observed "bumps"

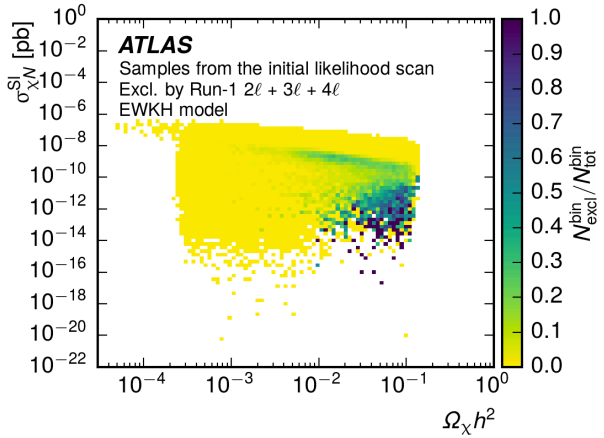


Too many Z bosons?

The LHC is about to yield its first 2016 collisions, and the past campaigns have provided enticing results. A search for supersymmetry has spotted a mild excess of Z bosons with missing energy both in Run 1 and Run 2, and the 2016 data are expected to either confirm or erase it. A team at IFIC is involved in this search and is getting prepared to analyse the new data as soon as they are out. More.

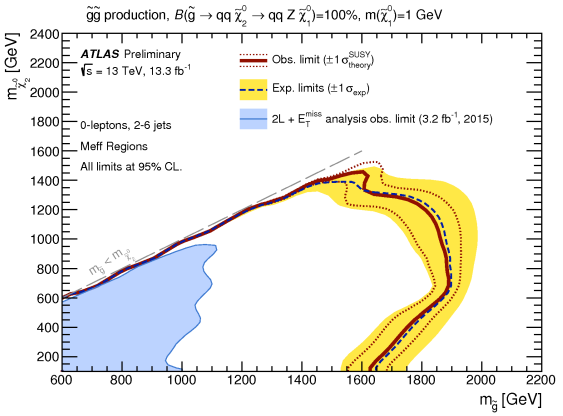
1 2 3 4

Dark matter in pMSSM – electroweak production channels



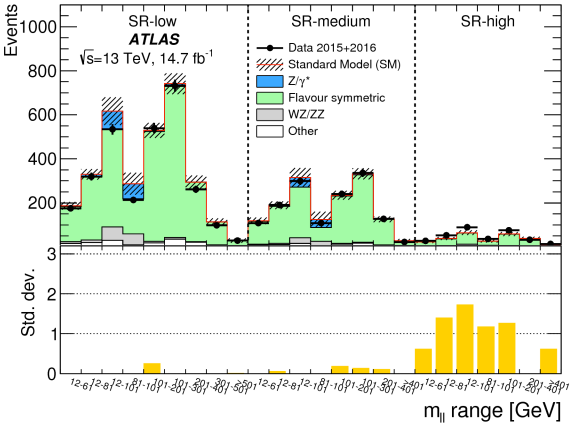
JHEP 1609 (2016) 175

0 lepton + 2-6 jets + MET



ATLAS-CONF-2016-078

2 lepton + jets + MET: Z mass & "edge" analysis

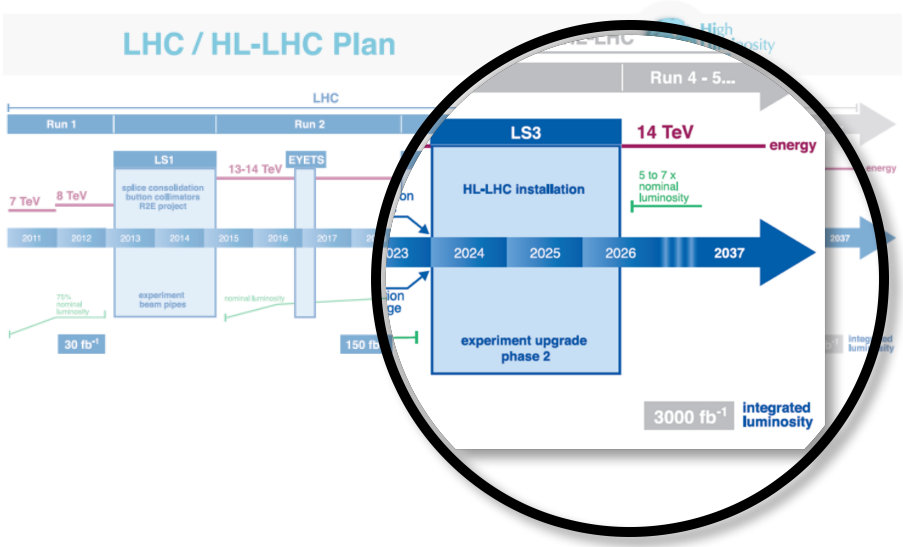


ATLAS-CONF-2016-098
arXiv:1611.05791

J. Mamuzic, V.A. Mzitsou, R. Rui de Austri *(Short Term Associate)*

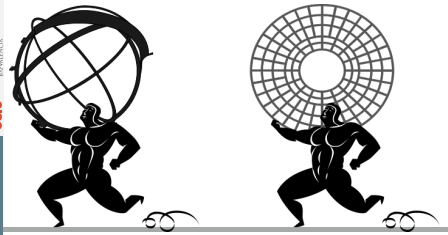
Talks in **Corfu2016, CPAN2016**

ITK – ATLAS Tracker for the HL-LHC



TDR ready: next step MoU signature and start of procurement.

Production starts in 2 years !!!



Not reviewed, for internal circulation only

ATL-COM-UPGRADE-2016-040

Technical Design Report for the ATLAS ITk Strip Detector

The ATLAS Collaboration

16th December 2016

This is the first of two Technical Design Report documents that describe the upgrade of the central tracking system for the ATLAS experiment for the operation at the High Luminosity LHC (HL-LHC) starting in the middle of 2026. At this time the LHC will have been upgraded to reach a peak instantaneous luminosity of 7.5×10^{34} cm^{-2}s^{-1}, which corresponds to approximately 200 inelastic proton-proton collisions per beam crossing. The new Inner Tracker (ITk) will be operational for more than ten years, during which ATLAS aims to accumulate a total data set of 3,000 fb^{-1}. Meeting these requirements presents a unique challenge for the design of an all-silicon tracking system that consists of a pixel detector at small radius close to the beam line and a large-area strip tracking detector surrounding it. This document presents in detail the requirements of the new tracker, its layout and expected performance including the results of several benchmark physics studies at the highest numbers of collisions per beam crossing. The design, construction and expected performance of the large-area silicon-strip tracker are set out in detail. These include the results of measurements of prototype modules and associated support structures and the plans for their mass production. A short description is given of the state of the development of the pixel tracker, which will be presented in detail in the second Technical Design Report document one year from now. This document will also describe the management of the project, its schedule and major milestones. The costs of the new tracker and the collaboration that plans to build it are also presented.

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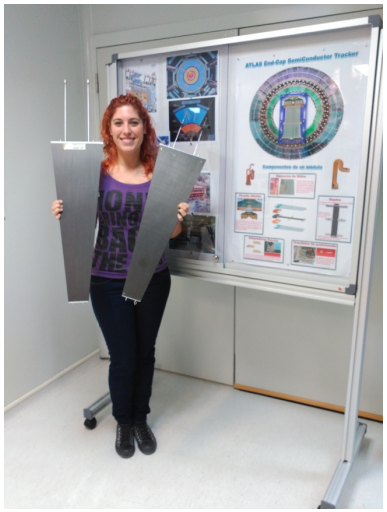
ITK – Módulo y pétalo

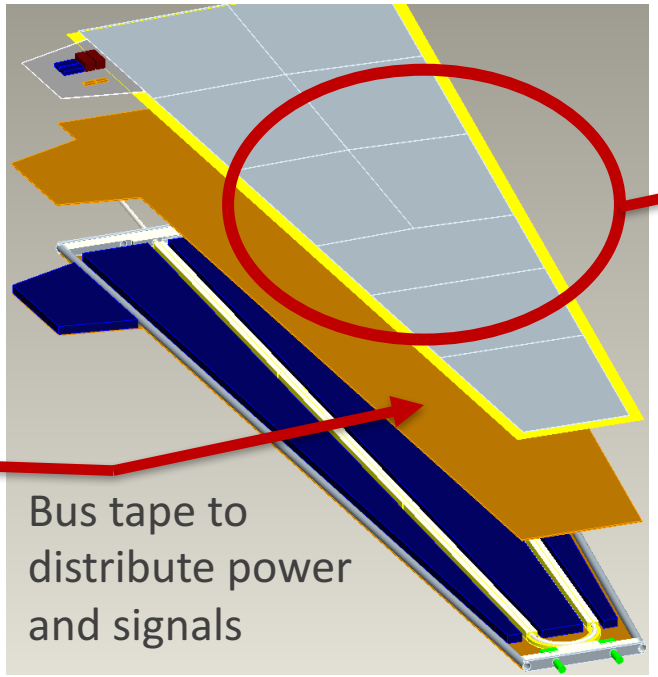


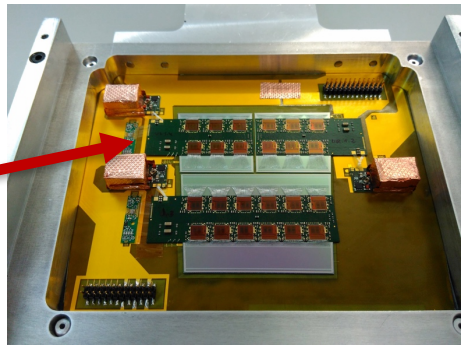
Sensors are glued in local supports (**Petals**). This is the building block of the system. A carbon fiber sandwich with integrated cooling and electronics.

Double sided object with **18 sensors**, 70cm height, 10-20cm width

IFIC

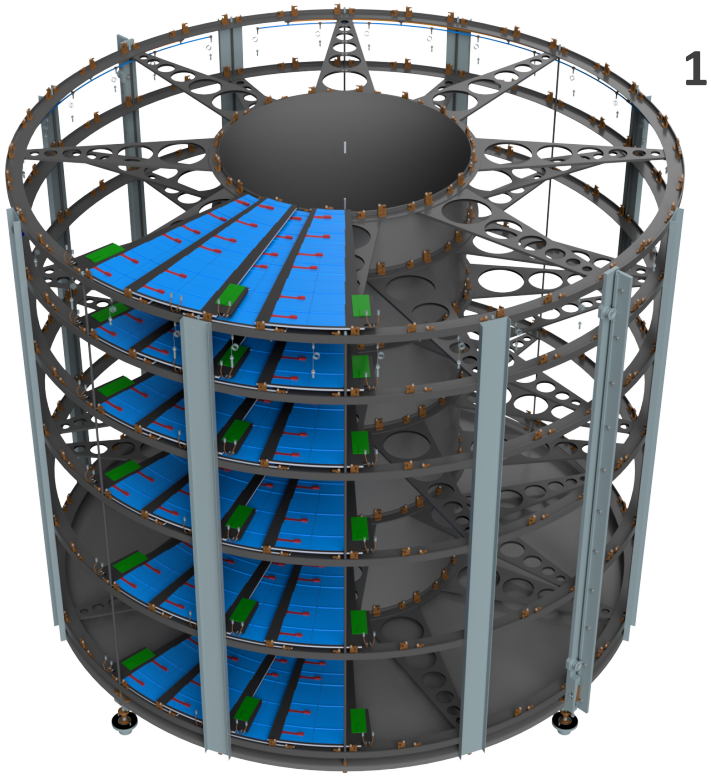






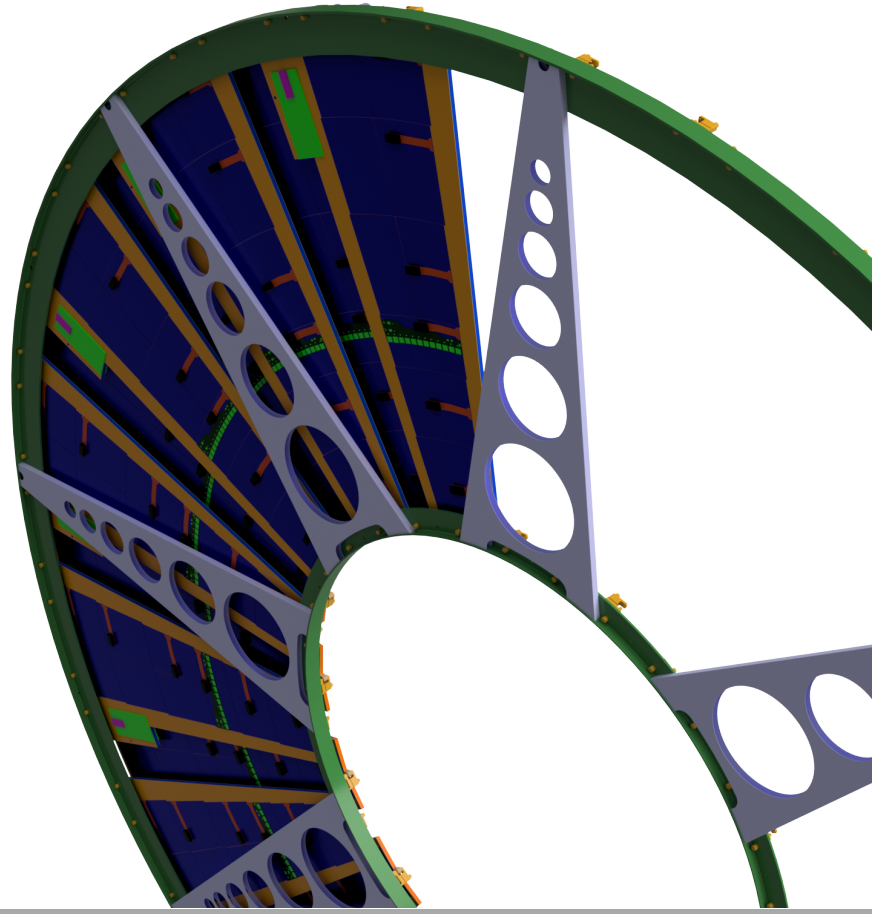
Petalet

Global support and Integration

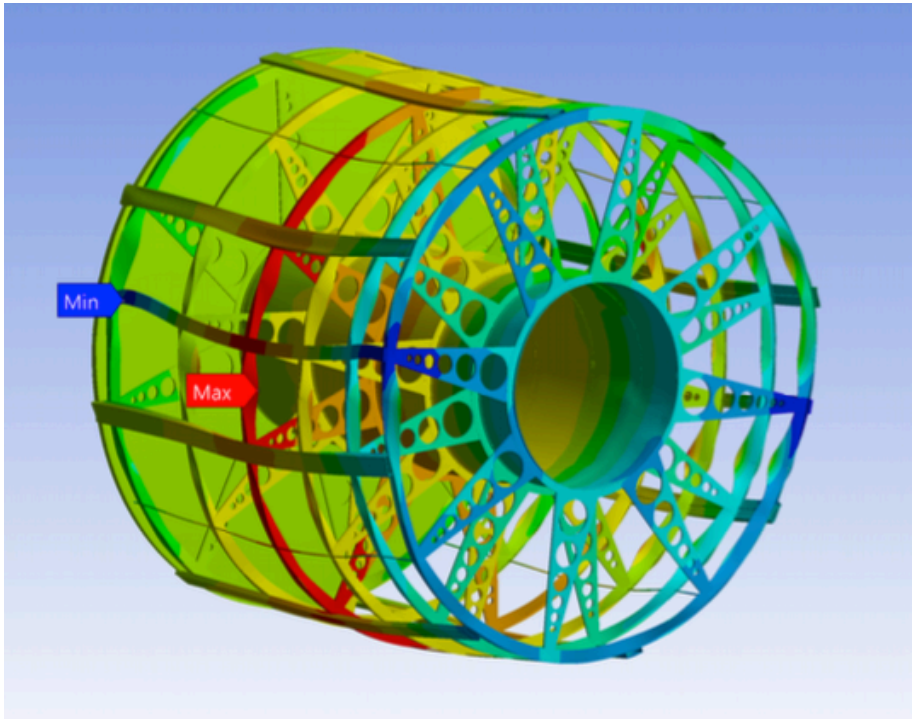


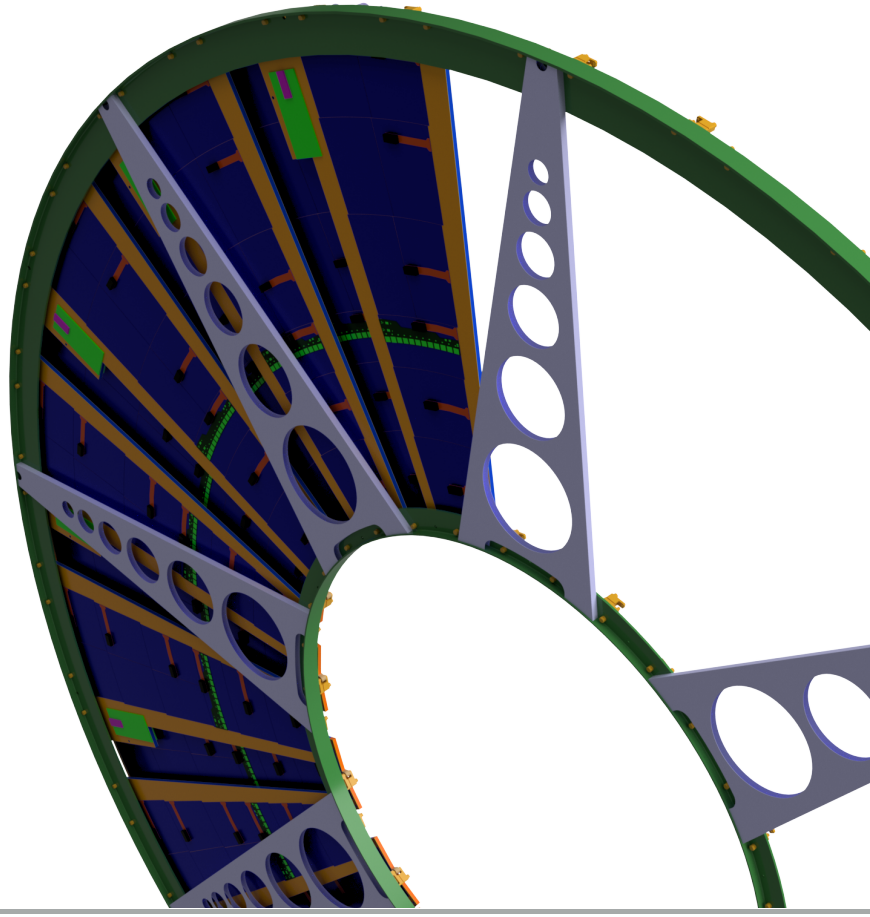
1.60 x 2 m

Design of the global support structure and petal fixation to the structure.



Global support and Integration

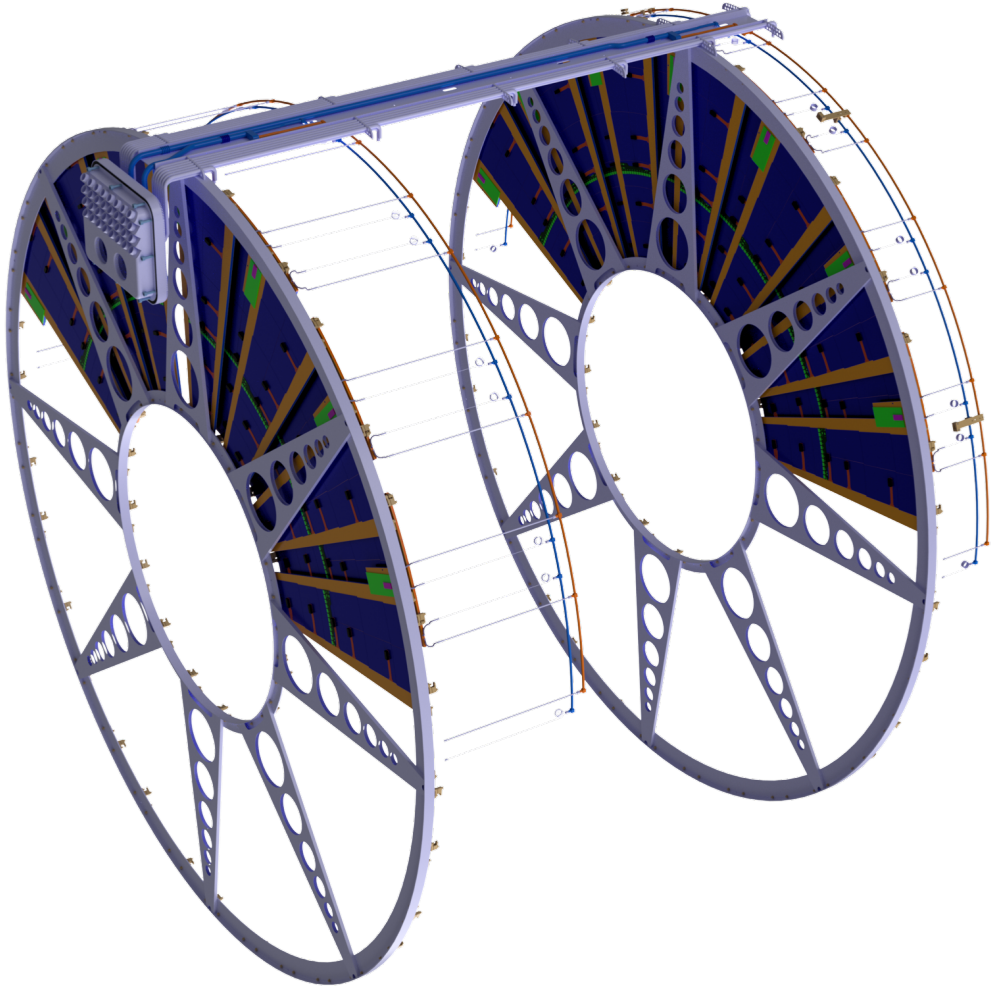




Design of the global support structure and petal fixation to the structure.

Finite Element Analysis to optimize the structural stability of the system.

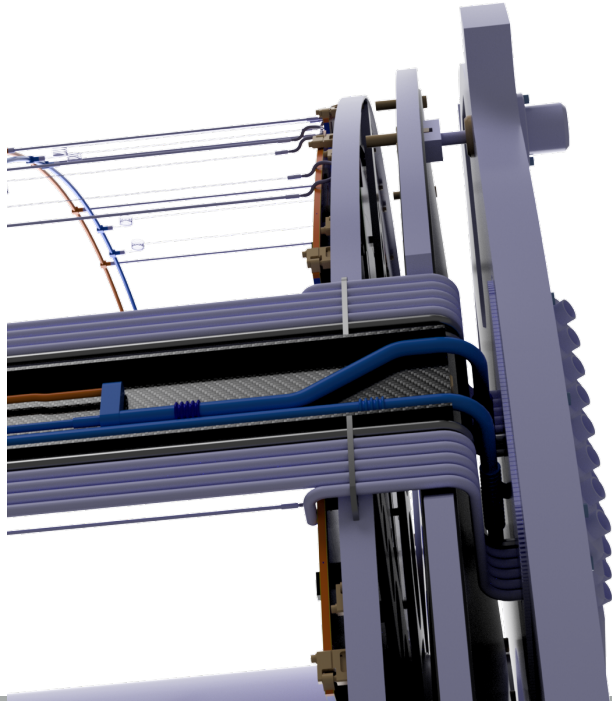
Global support and Integration



Design of the service module bringing power, control signals and cooling to the petals.

Cooling manifolding.

Service patch panel in the structural bulkhead to connect to services beyond the ITk volume



IFIC INSTITUT DE FÍSICA CORPUSCULAR

EXCELENCIA SEVERO OCHOA

VALENCIA 12-16 Sept. 2016

ATLAS ITk week Valencia

12-16 September 2016

Valencia

Europe/Zurich timezone

235 participants

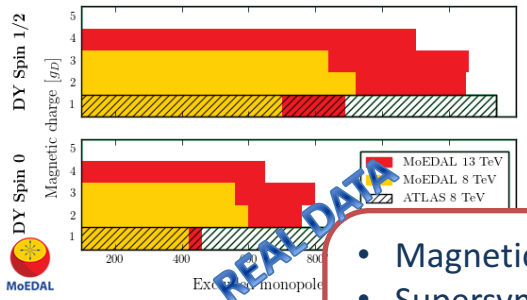
Search...



MoEDAL: Highly ionising particles at LHC

MoEDAL is unlike any other LHC experiment:

- mostly **passive detectors**; no trigger; no readout
- largest deployment of **Nuclear Track Detectors** at a collider
- first time **trapping detectors** deployed as a detector



- Magnetic monopoles, dyons
- Supersymmetry: sleptons, R-hadrons
- Long-lived Higgs H^{++}
- Black-hole remnants
- Quirks, Q-balls, ….



IFIC Valencia Team

✔J. Bernabeu, J. Mamuzic, V.A. Mitsou (leader), C. García, R. Ruiz de Austri, V. Vento, O. Vives

✔Sensitivity on stable electrically-charged particles, e.g. SUSY

✔Simulation of monopole production via photon fusion

✔Monopolium phenomenology

✔V.A. Mitsou: Chair of Collaboration Board

- PROMETEO II/2013-017 – LHC & Cosmology
- FPA2015-65652-C4-1-R – ATLAS ID
- Group M&O funded by *Generalitat Valenciana*



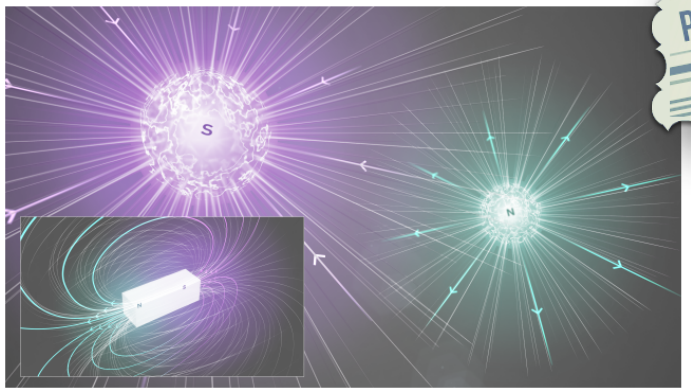
MoEDAL: Highly ionising particles at LHC

MoEDAL

The LHC MoEDAL experiment publishes its first paper on its search for magnetic monopoles

10 Aug 2016

PRESS RELEASE



Magnetic monopoles and dipoles (Image: CERN)

Geneva, 10 August 2016. In a paper published by the journal JHEP today, the MoEDAL experiment at CERN[1] narrows the window of where to search for a hypothetical particle, the magnetic monopole. Over the last decades, experiments have been trying to find evidence for magnetic monopoles at accelerators, including at CERN's Large Hadron Collider. Such particles were first predicted by physicist Paul Dirac in the 1930s but have never been observed so far.

"Today MoEDAL celebrates the release of its first physics result and joins the other LHC experiments at the discovery frontier," says Spokesperson of the MoEDAL experiment, James Pinfold.

Just as electricity comes with two charges, positive and negative, so magnetism comes with two poles, North and

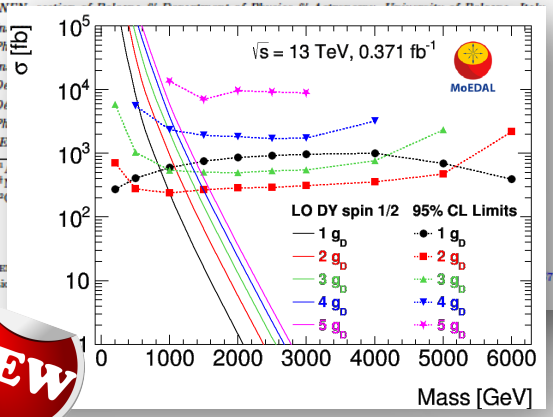
JHEP PUBLISHED FOR SISSA BY SPRINGER
RECEIVED: April 22, 2016
ACCEPTED: July 15, 2016
PUBLISHED: August 10, 2016

Search for magnetic monopoles with the MoEDAL prototype trapping detector in 8 TeV proton-proton collisions at the LHC

The MoEDAL collaboration

B. Acharya,[a,b] J. Alexandre,[a] K. Bendtz,[v,1] P. Benes,[k] J. Bernabéu,[c] M. Campbell,[da] S. Cecchini,[w] J. Chwastowski,[f] A. Chatterjee,[i] M. de Montigny,[g] D. Derendarz,[f] A. De Roeck,[da] J. R. Ellis,[a,db] M. Fairbairn,[a] D. Felea,[h] M. Frank,[ta] D. Frekers,[j] C. Garcia,[c] G. Giacomelli,[e,†] D. Haşegan,[ta] M. Kalliokoski,[dc] A. Katre,[t] D.-W. Kim,[m] M. G. L. King,[c] K. Kinoshita,[n] D.H. Lacarrère,[da] S. C. Lee,[m] C. Leroy,[db] A. Lionti,[t] A. Margiotta,[e] N. Mauri,[w] N. E. Mavromatos,[a] P. Mermod,[t,2] D. Milstead,[v,1] V. A. Mitsou,[c] R. Orava,[o] B. Parker,[y] L. Pasqualini,[e] L. Patrizii,[w] G. E. Păvălaş,[h] J. L. Pinfold,[g] M. Platkevič,[k] V. Popa,[h] M. Pozzato,[w] S. Pospisil,[k] A. Rajantie,[p] Z. Sahnoun,[w,4] M. Sakellariadou,[a] S. Sarkar,[a] G. Semenoff,[r] G. Sirri,[w] K. Sliwa,[s] R. Soluk,[g] M. Spurio,[e] Y. N. Srivastava,[t] R. Staszewski,[f] M. Suk,[k] J. Swain,[t] M. Tenti,[z] V. Togo,[w] M. Trzebinski,[f] J. A. Tuszyński,[y] V. Vento,[c] O. Vives,[c] Z. Vykydal,[k] T. Whyntie,[y,z] A. Widom,[t] G. Willems[j] and J. H. Yoon[u]

[a] *Theoretical Particle Physics & Cosmology Group, Physics Dept., King's College London, U.K.*
[b] *International Centre for Theoretical Physics, Trieste, Italy*
[c] *IFIC, Universitat de València — CSIC, Valencia, Spain*
[da] *Experimental Physics Department, CERN, Geneva, Switzerland*
[db] *Theoretical Physics Department, CERN, Geneva, Switzerland*
[dc] *Beams Department, CERN, Geneva, Switzerland*



NEW

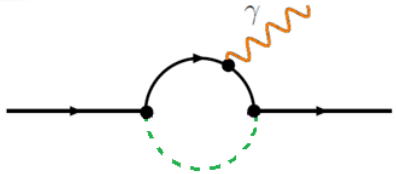
- **MoEDAL Collab, JHEP 08 (2016) 067**
- Epele, Fanchiotti, García Canal, Mitsou, Vento, arXiv:1607.05592
- MoEDAL Collab, arXiv:1611.06817 [hep-ex]
- + Invited talks by V Mitsou in **Discrete2016**, ICNFP2016, **Corfu2016, HEP2016**

LHCb



+ a new Postdoc (L. Henry, starting in January)
+ a new PhD (F. Cornet)

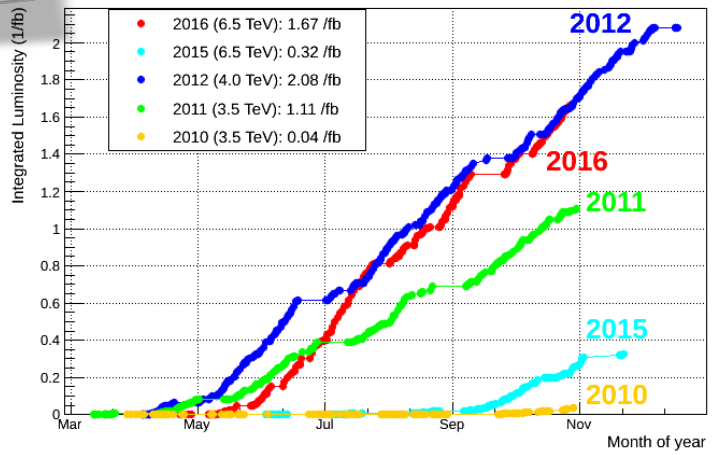
GVPROMETEOII/2014/049
FPA2015-68318-R



Scientific goals

Indirect searches for new physics through precision measurements **Particles created *off-shell***
Evidence in quantum effects (loops) *(BR's, asymmetries…)*

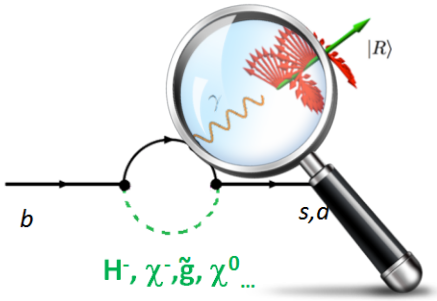
Excellent data taking performance in 2016!



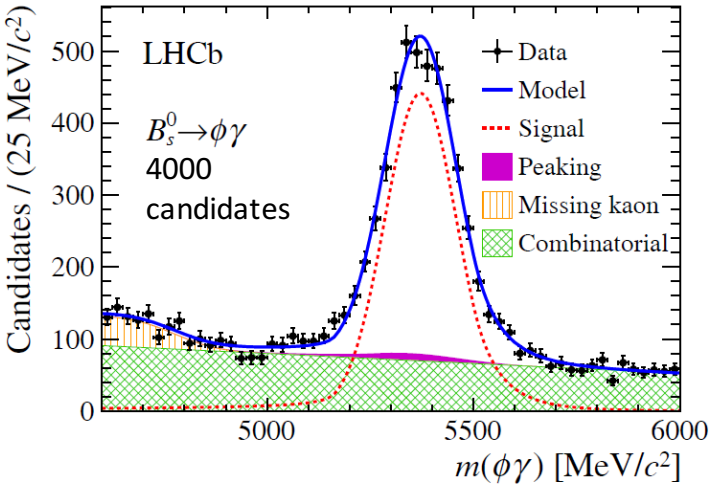
LHCb - Exp

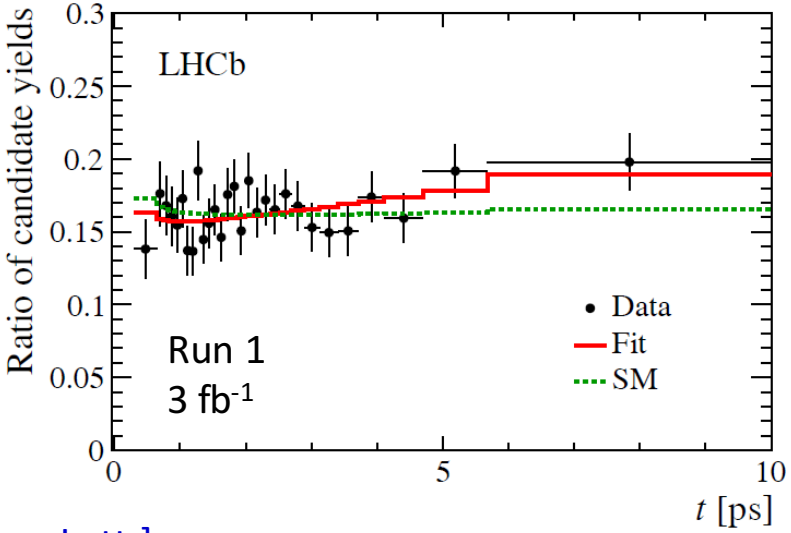
Contributions to Physics

- First time-dependent analysis of a radiative B_s decays
  → Access to the photon polarization



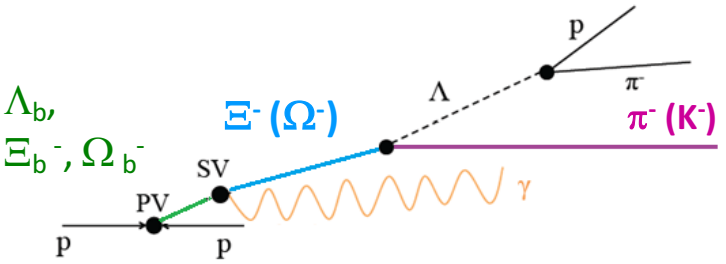
CERN Physics Highlight at ICHEP 2016 !





[arXiv:1609.02032v1, accepted by Phys. Rev. Lett.]

- VLC Task-force in b-baryon decays:
  photon polarization, spin physics…

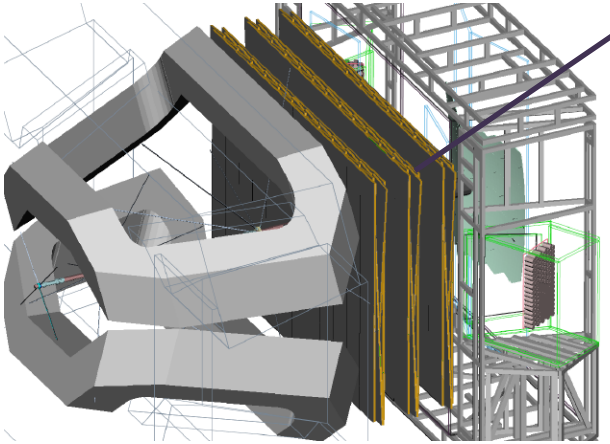


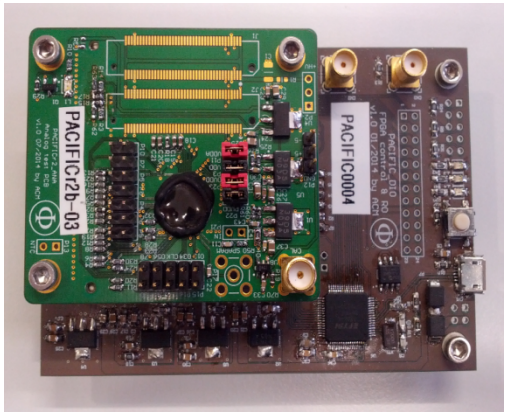
LHCb - Upgrade

Contribution to the central tracker (SCiFi): **FE ASIC PACIFIC**

SCintillating Fibres:







IFIC contributions:

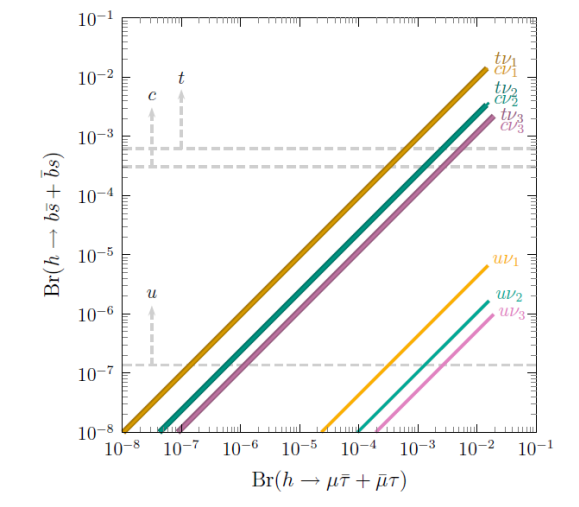
- *Design of the digital control (I2C) and drivers for PACIFIC v4.*
- Test and characterization of PACIFIC (v3).
- *Engineering Design Review* (EDR)
- Compact Setup with all detector elements

(in collaboration with ICC-UB, LPC-UBP and PIH-RKU)

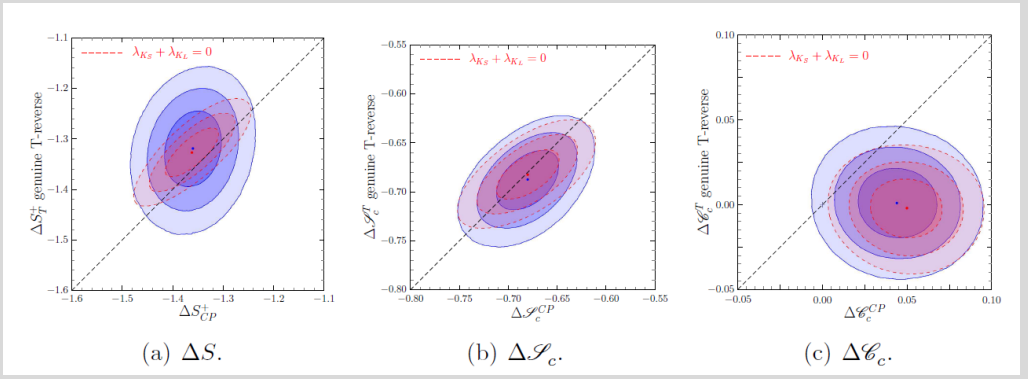
José



LHCb - Theory



"Flavour Changing Higgs Couplings in a Class of Two Higgs Doublet Models". F.J. Botella, M. Nebot, et al arXiv:1508.05101 [hep-ph]. Eur.Phys.J. C76 (2016) no.3, 161

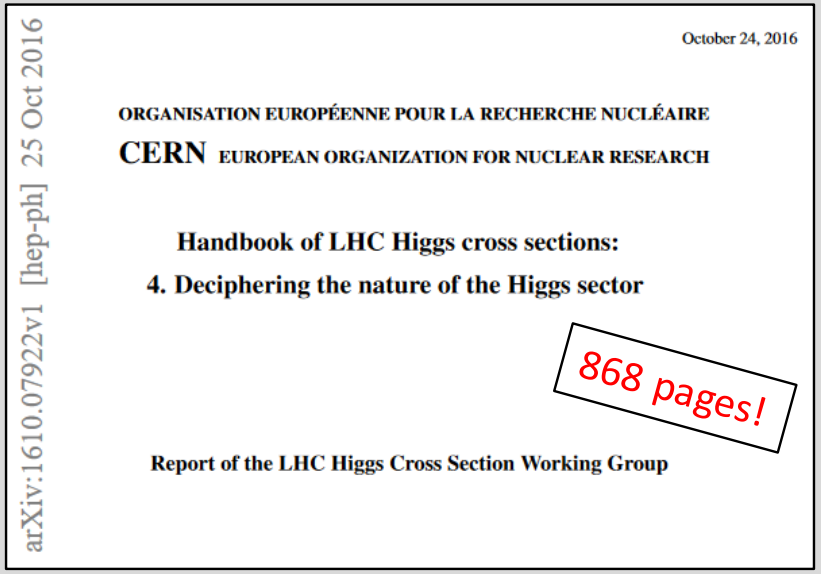


(a) ΔS. (b) $\Delta \mathscr{I}_c$. (c) $\Delta \mathscr{C}_c$.

"Genuine T, CP, CPT asymmetry parameters for the entangled B_{d} system". J. Bernabéu, F.J. Botella, M.Nebot. arXiv:1605.03925 [hep-ph]. JHEP 1606 (2016) 100

"What if the Masses of the First Two Quark Families are not Generated by the Standard Higgs?". F.J. Botella et al. arXiv:1602.08011 [hep-ph]

"Vector-like Quarks at the Origin of Light Quark Masses and Mixing". F. J. Botella, M. Nebot, et al. arXiv:1610.03018 [hep-ph].



LHCb @IFIC

Publications in 2016 (LHCb based mainly on Run1 data):

BaBar publications: 11

LHCb publications: 50 → **Much more expected for 2017 with Run2!**

Theo. papers: 5, including a **Handbook of LHC Higgs Cross Sections**

Master thesis: 1 LHCb Master thesis (Joan Ruiz Vidal)

Conferences: 5 talks at international conferences (1 talk at ICHEP 2016, Chicago)

PhD thesis: **First LHCb-IFIC PhD thesis** (Pablo Ruiz Valls)

Responsabilities:

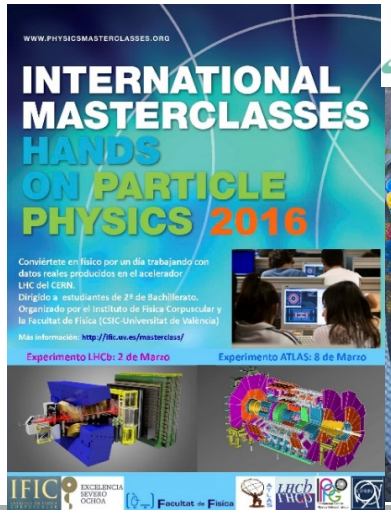
Convener of the Radiative Decays group at LHCb (A. Oyanguren)

Member of the LHCb Speaker Bureau (F. Martínez)

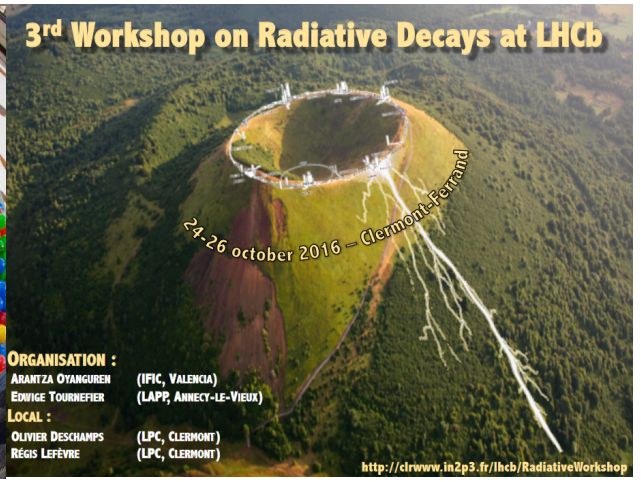
Member of the Heavy Flavour Averaging Group (HFAG) (A. Oyanguren)

Coordination of the Spanish Flavour Physics Network (REFIS) (A. Oyanguren)

Workshops & Outreach:







Felices Fiestas !!



