جامعة محمد الخامس بالرباط
Université Mohammed V de Rabat

University Mohammed V in Rabat

Request to join ePIC Collaboration

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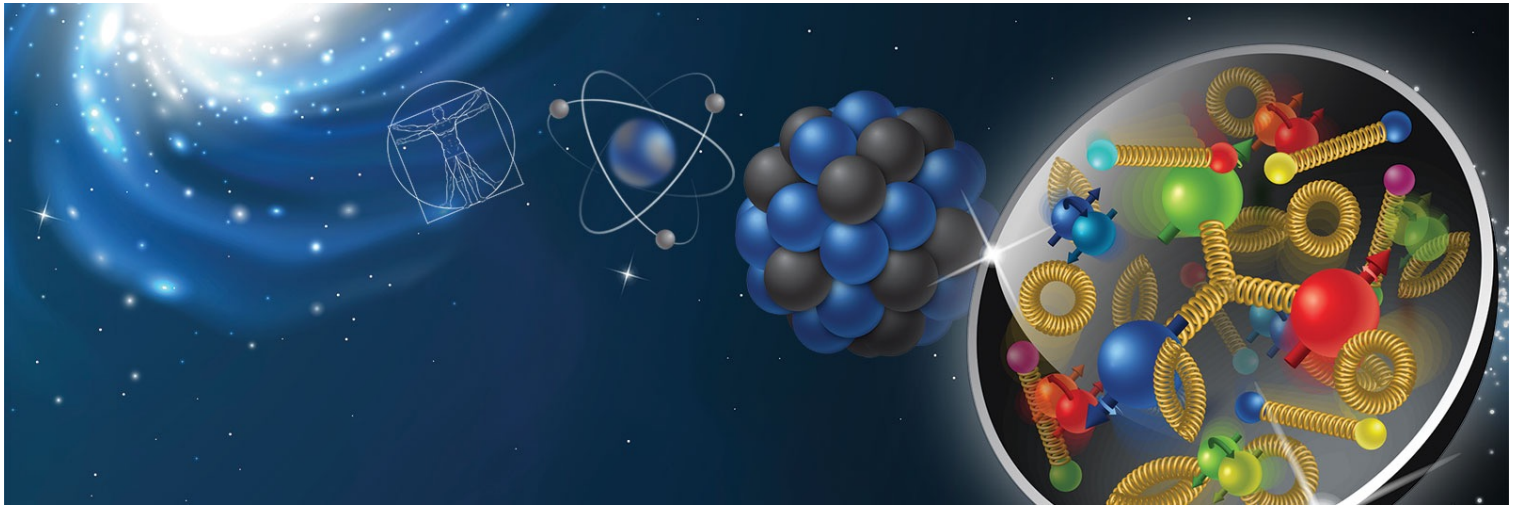
12 January 2024

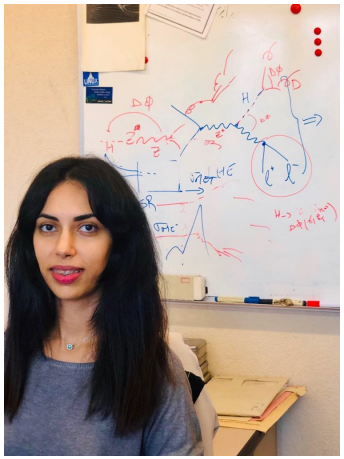


Outline

- Rabat activities with : ATLAS, ANTARES and KM3NeT.

- Plans for the ePIC

Group

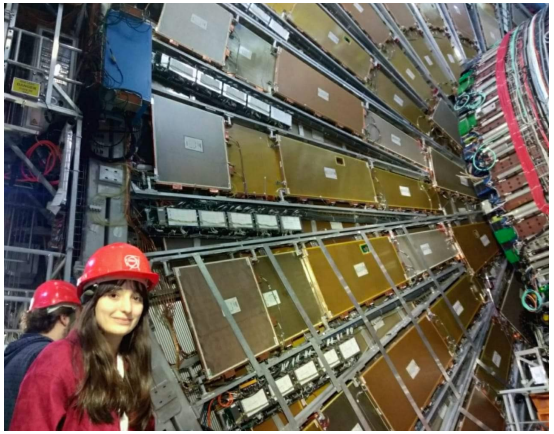


Hassnae EL Jarrari

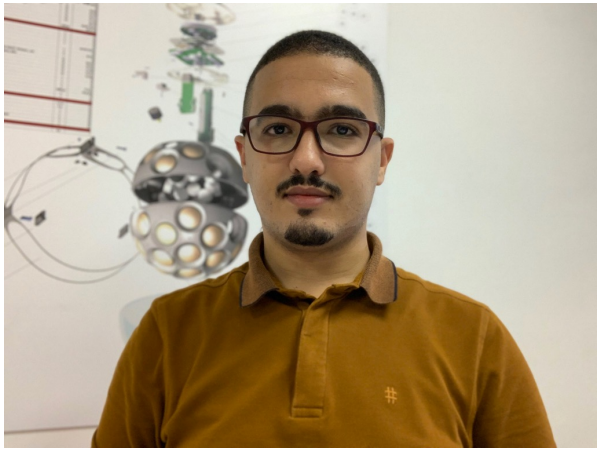
Mustafa Chaoui

Malak Tamlihat

Jihad Boumaaza

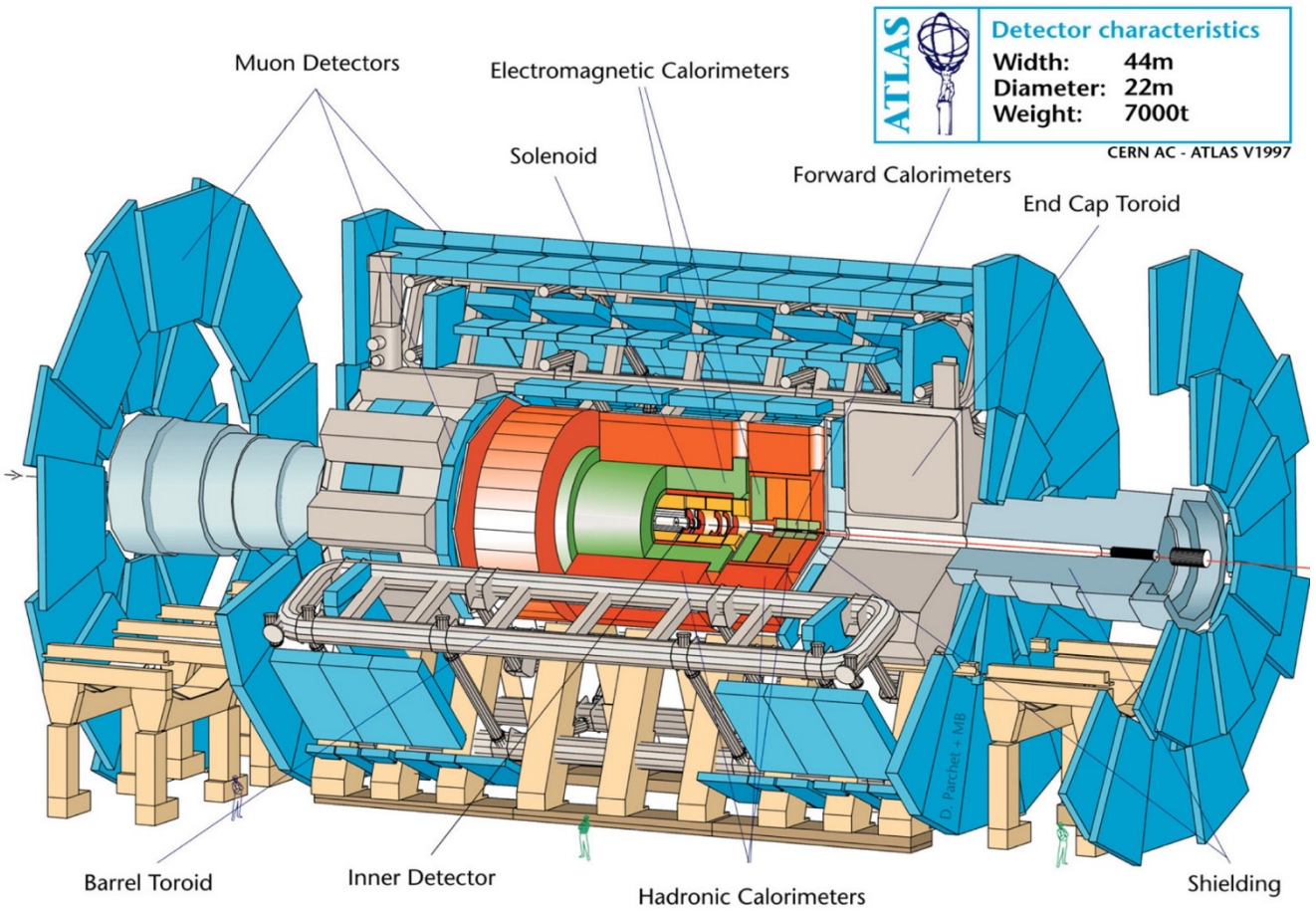


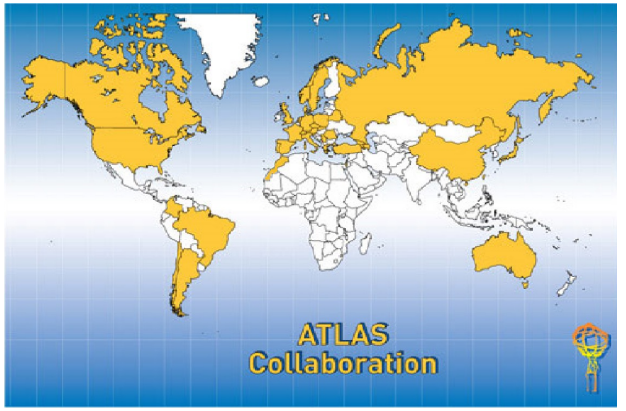
Meriem Bendahman



Ahmed Eddymaoui

ATLAS



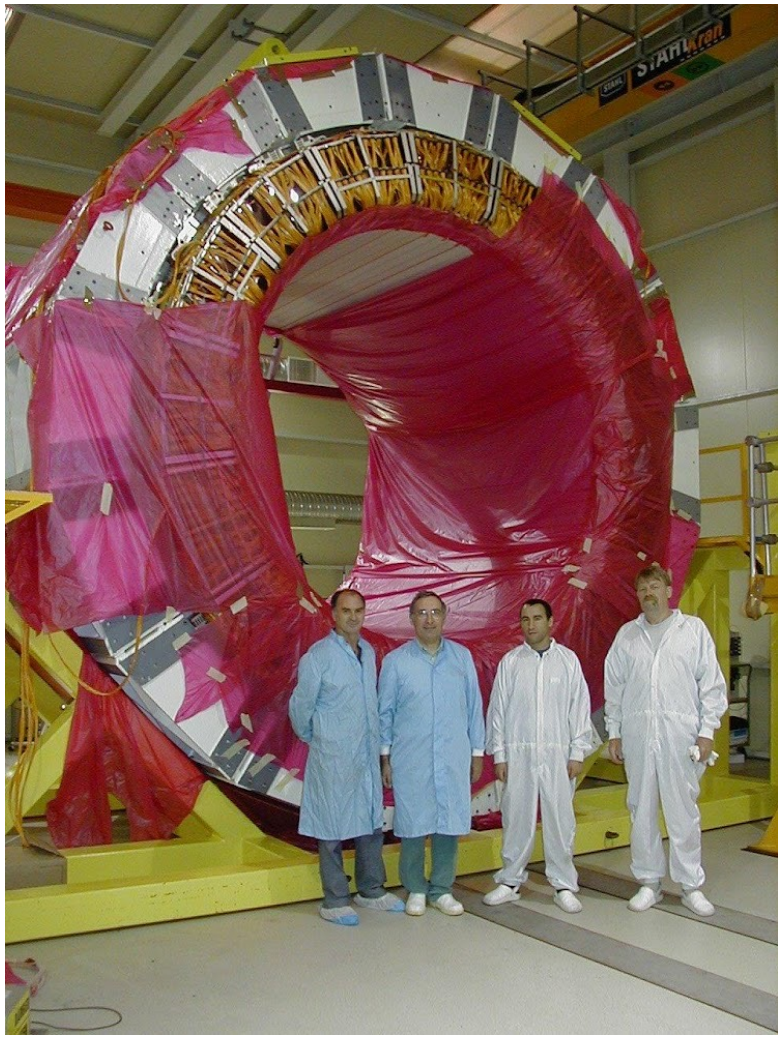


181 Institutions

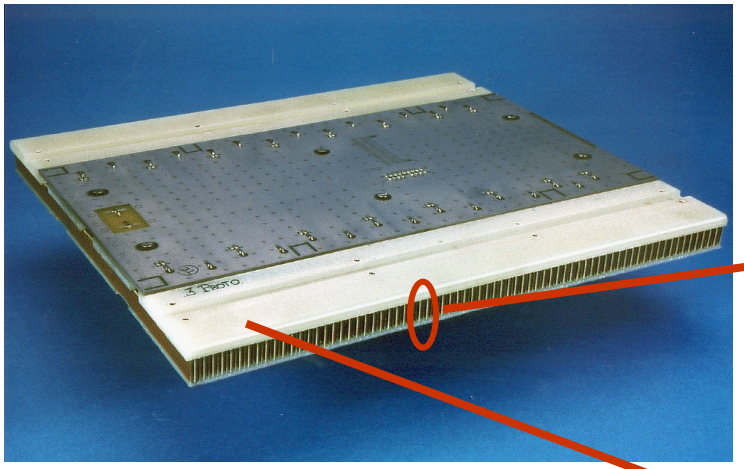
3000 Scintific authors, 1200 PhD students

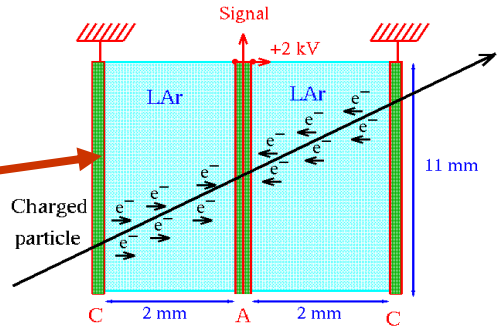
41 Countries

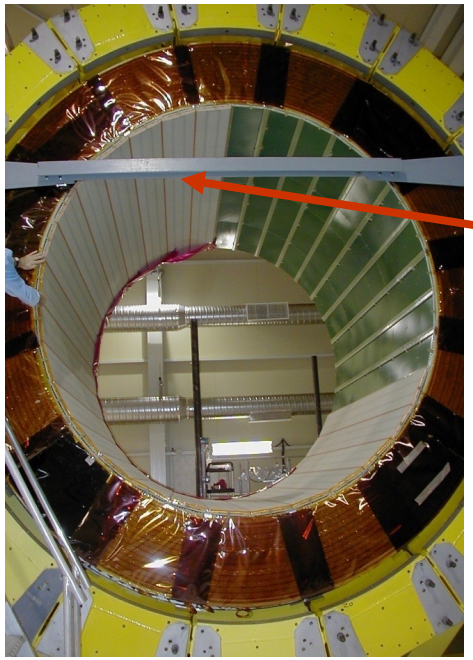
ATLAS (Presampler)

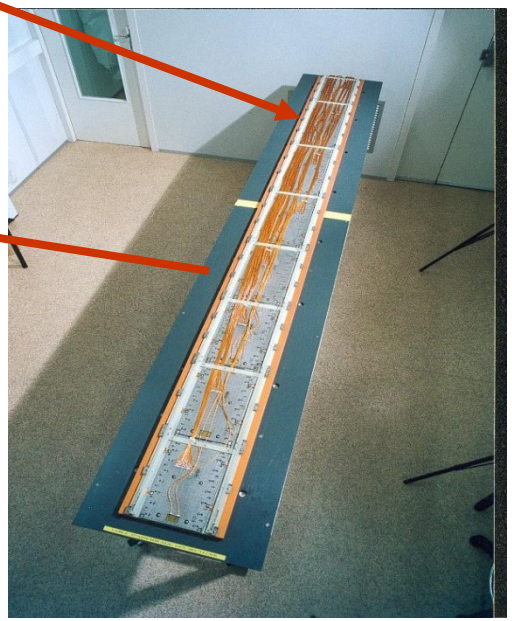


1 wheel of 32 sectors



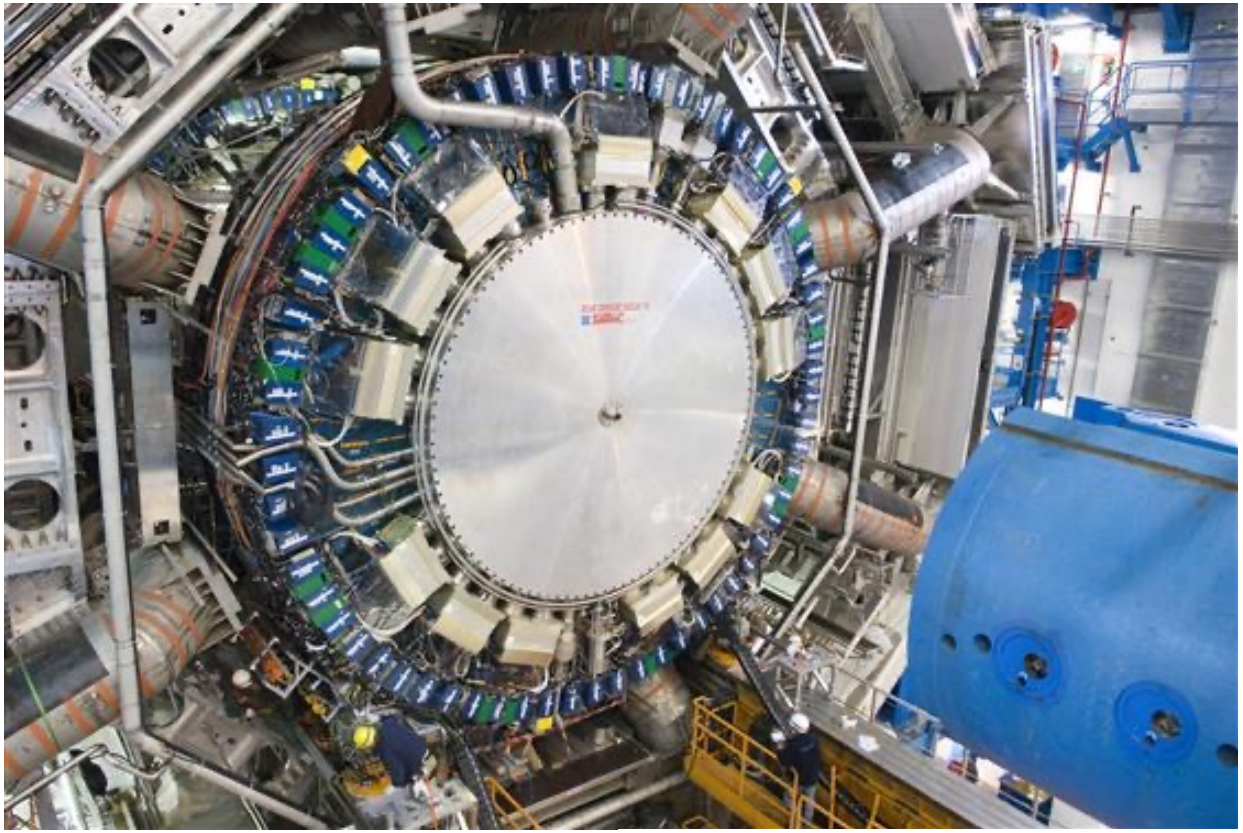






Presampler sector

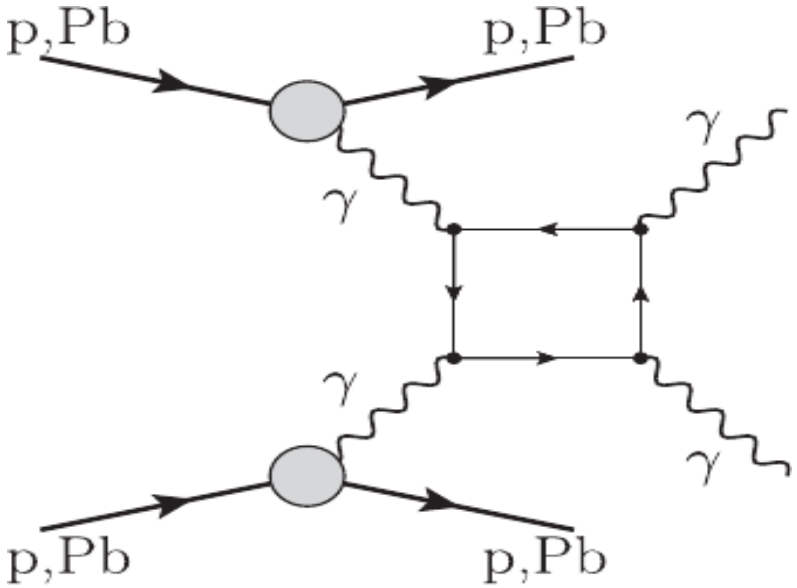
ATLAS (Tile Calorimeter)

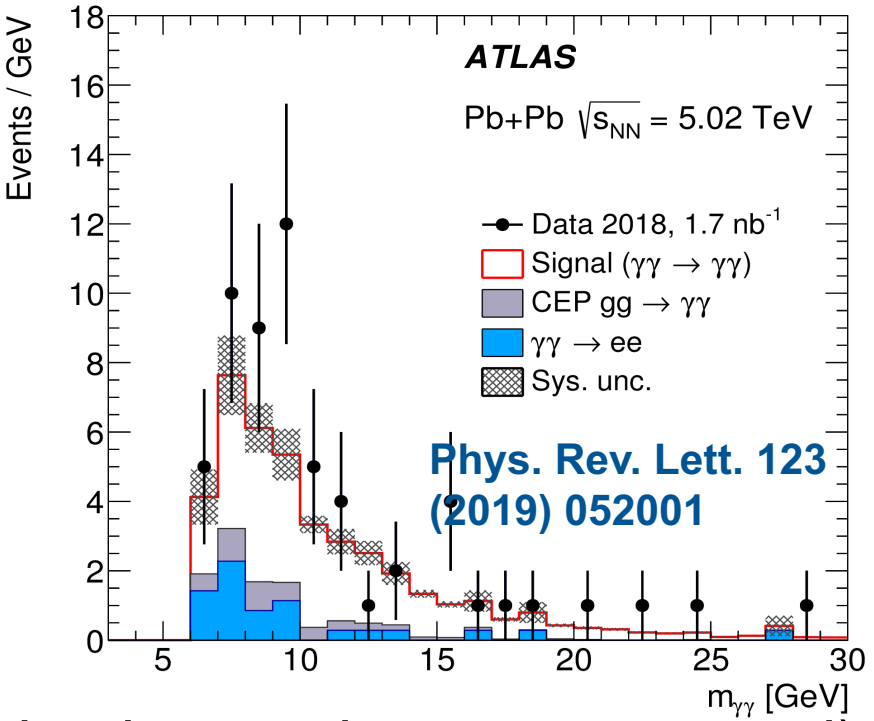


Detector operation, HV-DCS
DCS, PVSS-II, SCADA, ETM

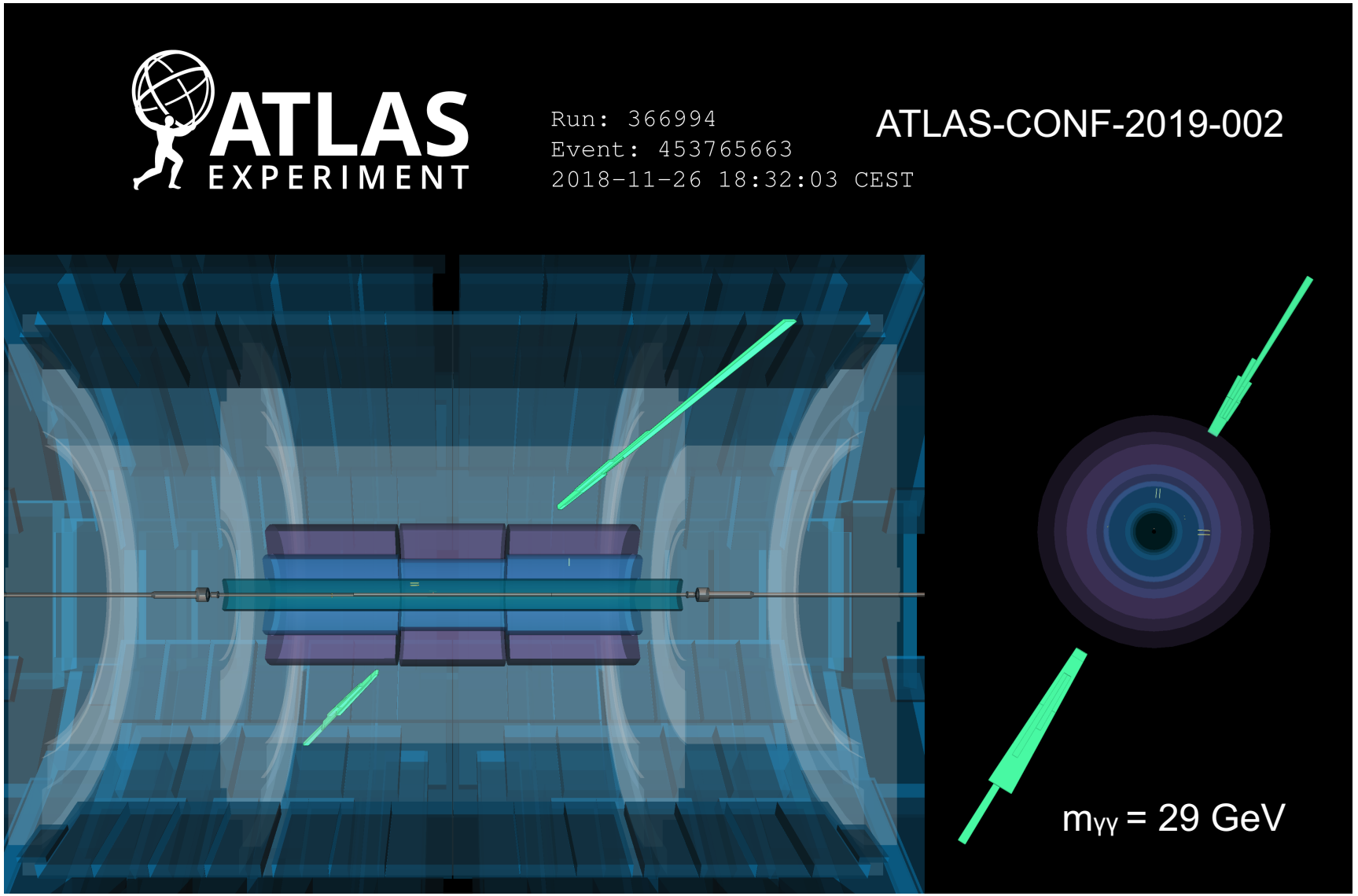
PVSS II by ETM

Heavy Ions : LyBLy scattering

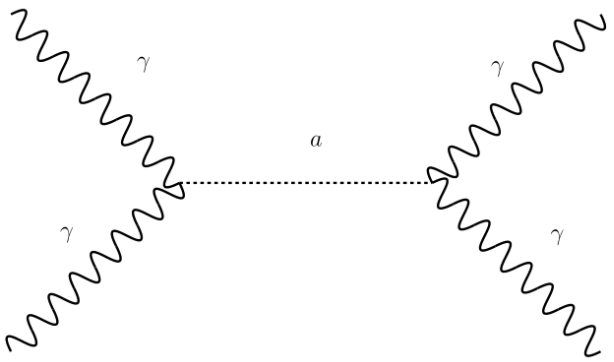




- **59** events observed (where **12 ± 3** background events expected)
- Observed signal significance over the background only hypothesis is of **8.2σ**
- Updated cross-section: **σ = 78 ±13 (stat) ±8 (sys) nb**
- SM predictions: **51 ±5 nb** Phys. Rev. C 93 (2016) 044907
  50 ±5 nb Eur. Phys. J. C 79 (2019) 39

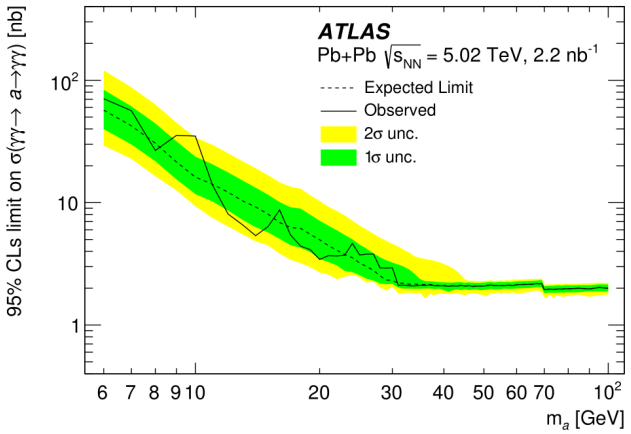

ATLAS
EXPERIMENT
Run: 366994
Event: 453765663
2018-11-26 18:32:03 CEST
ATLAS-CONF-2019-002
$m_{\gamma\gamma}$ = 29 GeV

Search for ALPs in UPC Pb+Pb collisions

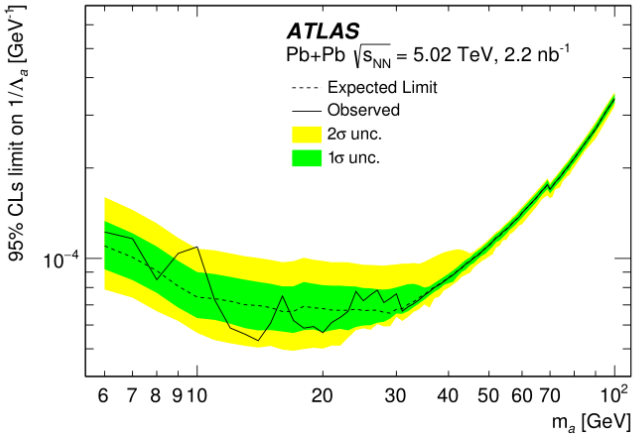


Same event topolgy as light-by-light
Data : 2015+2018 heavy ions (UPC)
MC Signal : Starlight generator
Backgrounds : same as light-by-ight + light-by-light

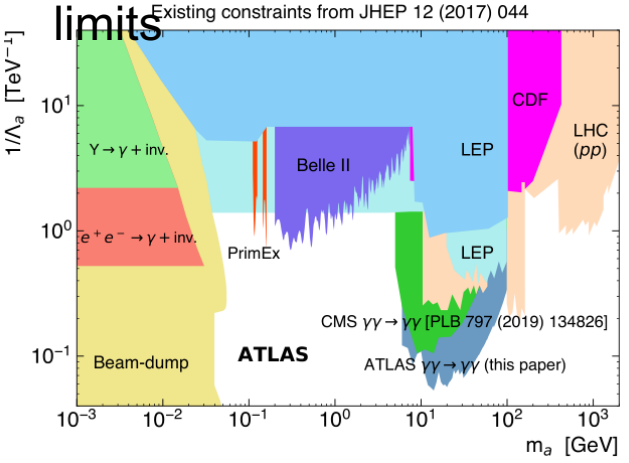
Limit on cross section



Limit on coupling



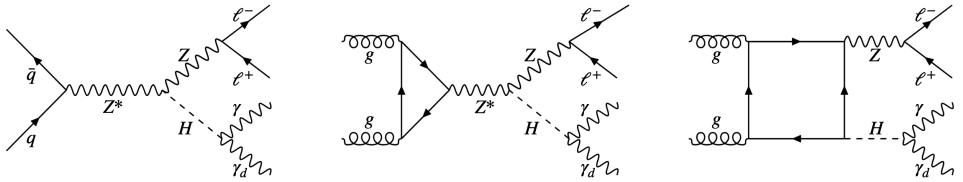
Compilation of exculsion limits



arXiv:2008.05355

Search for dark photons in ZH mode

- This is a search for a Higgs boson decaying into a photon and a dark photon (missing transverse momentum).
- Considering the (qq, gg) ZH production mode, benefitting from a clean final state $(Z \to l^+l^-)$ to search for $H \to \gamma\gamma_d$ within a dark photon mass range of $0 \to 40$ GeV



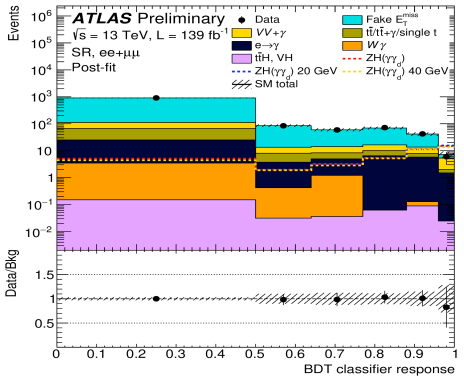
SIGNAL REGION OPTIMISATION

Two same flavour, opposite sign, medium ID and loose isolated leptons, with leading $p_T > 27$ GeV, sub-leading $p_T > 20$ GeV
Veto events with additional lepton(s) with loose ID and $p_T > 10$ GeV
76 GeV $< m_{\ell\ell} <$ 116 GeV
Only one tight ID, tight isolated photon with $E_T^\gamma > 25$ GeV
$E_T^{miss} > 60$ GeV with $\Delta\phi(\vec{E}_T^{miss}, \vec{p}_T^{\ell\ell\gamma}) > 2.4$ rad
$m_{\ell\ell\gamma} > 100$ GeV
$N_{jet} \leq 2$, with $p_T^{jet} > 30$ GeV, $\lvert\eta\rvert < 4.5$
Veto events with b-jet(s)

BACKGROUND ESTIMATION

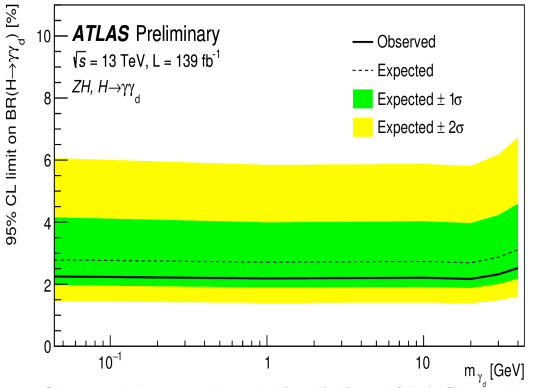
- **Fake E_T^{miss}:** $Z\gamma + jets$, $Z + jets$ ⇒ **Data-driven ABCD**
- **$e \to \gamma$ fake:** VV, VVV ⇒ **Data-driven fake rate and probe-electron CR**
- ***top*:** MC, with 20% systematic uncertainty from the ***top* VR** (>=1 b-tag).
- $VV\gamma$: MC normalised to data in the $VV\gamma$ **CR** (enhanced in $WZ\gamma$ $(3\ \mu + 1\gamma)$).
- $W\gamma$, *Higgs*: pure MC.

RESULTS AND INTERPRETATION



Post fit distribution of the BDT classifier response

No excess is observed with respect to the Standard Model predictions

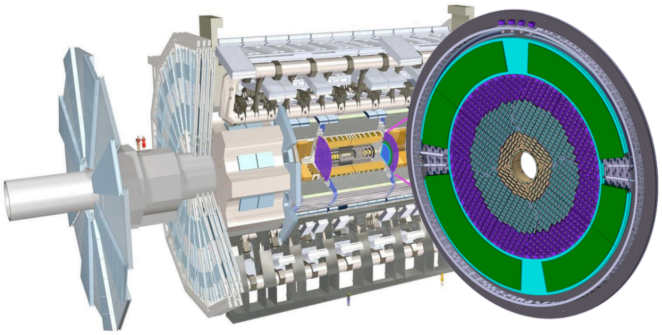


Observed (expected) exclusion limits at 95% CL on the BR(H → $\gamma\gamma_d$) as a function of the dark photon mass: [2.19-2.52]% ([2.71-3.11]%).

Observed (expected) LHC Limits on BR(H → $\gamma\gamma_d$) for massless dark photons :

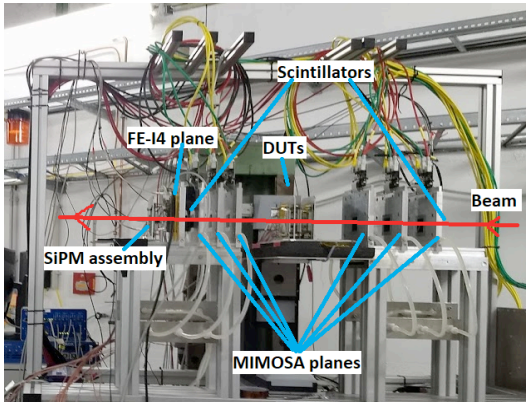
Production	ZH	VBF
ATLAS	**2.3 (2.8)%**	1.8 (1.7)%
CMS	4.6 (3.6)%	3.5 (2.8)%

High Granularity Timing Detector

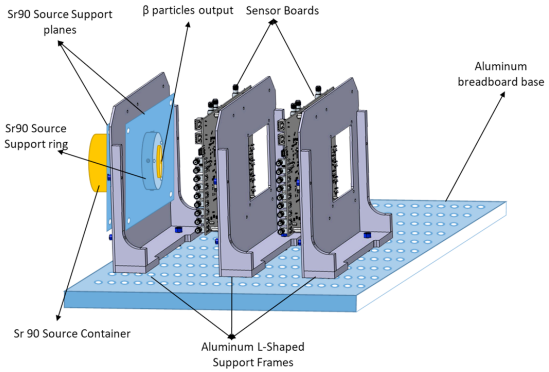


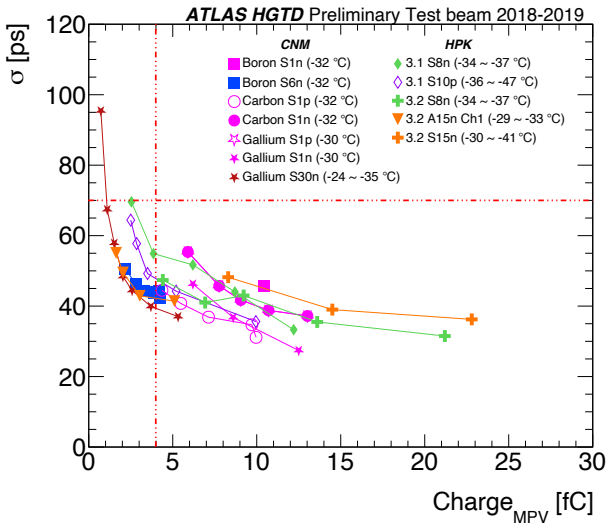
- HGTD is expected to start data taking in 2028 and will be the first large-scale application of LGAD technology to highly reduce pileup in the forward region of the ATLAS detector during the HL-LHC physics program.
- LGADs and their readout ALTIROCs are optimised to reach a $\sigma_t < 50$ ps per track up to the end of the lifetime.
- Measurements of LGAD sensors from laboratory and test beams have shown promising results.

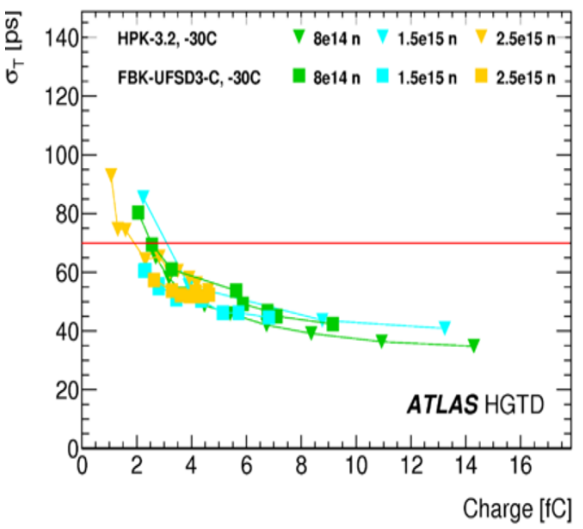
TestBeam



Laboratory



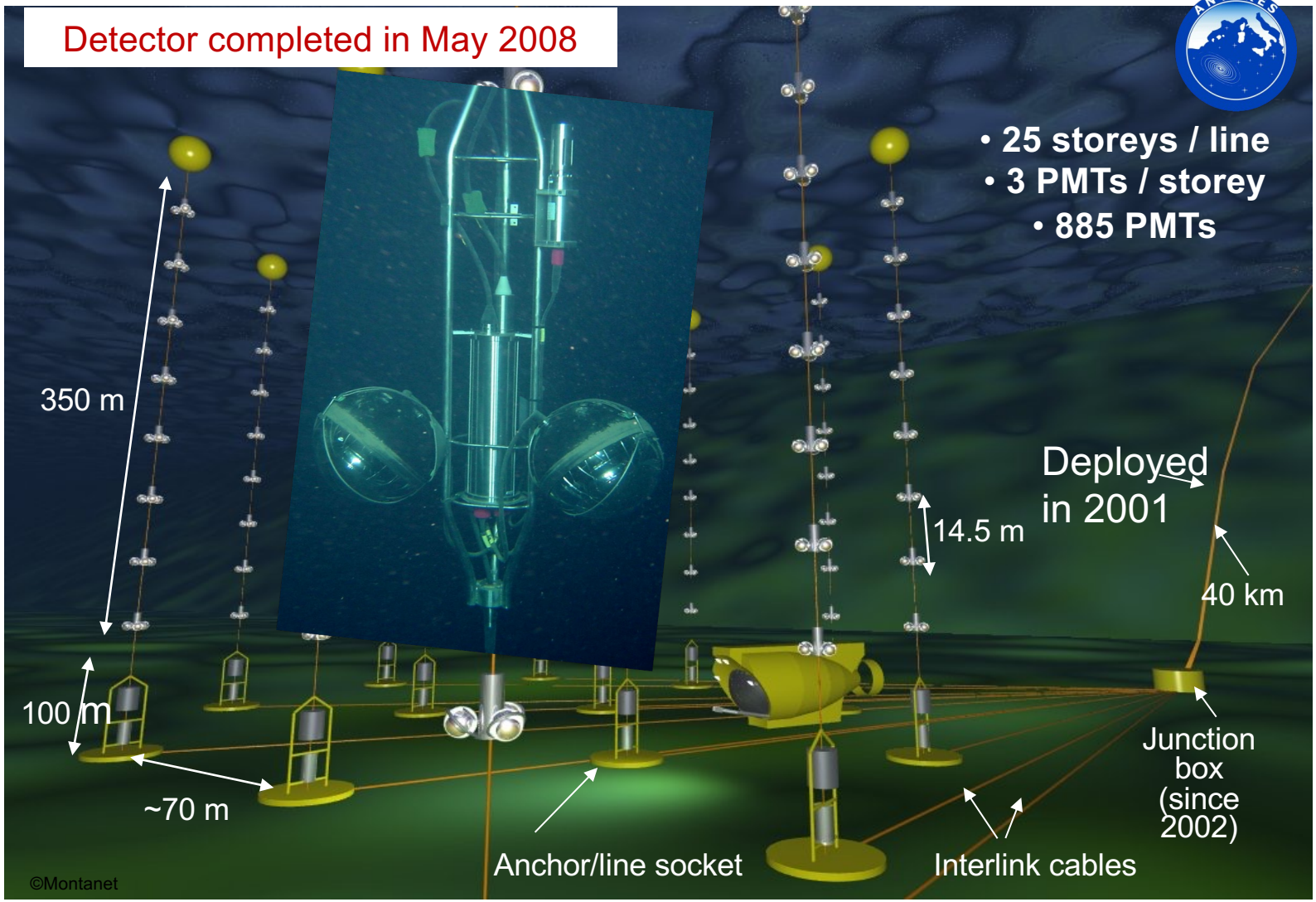




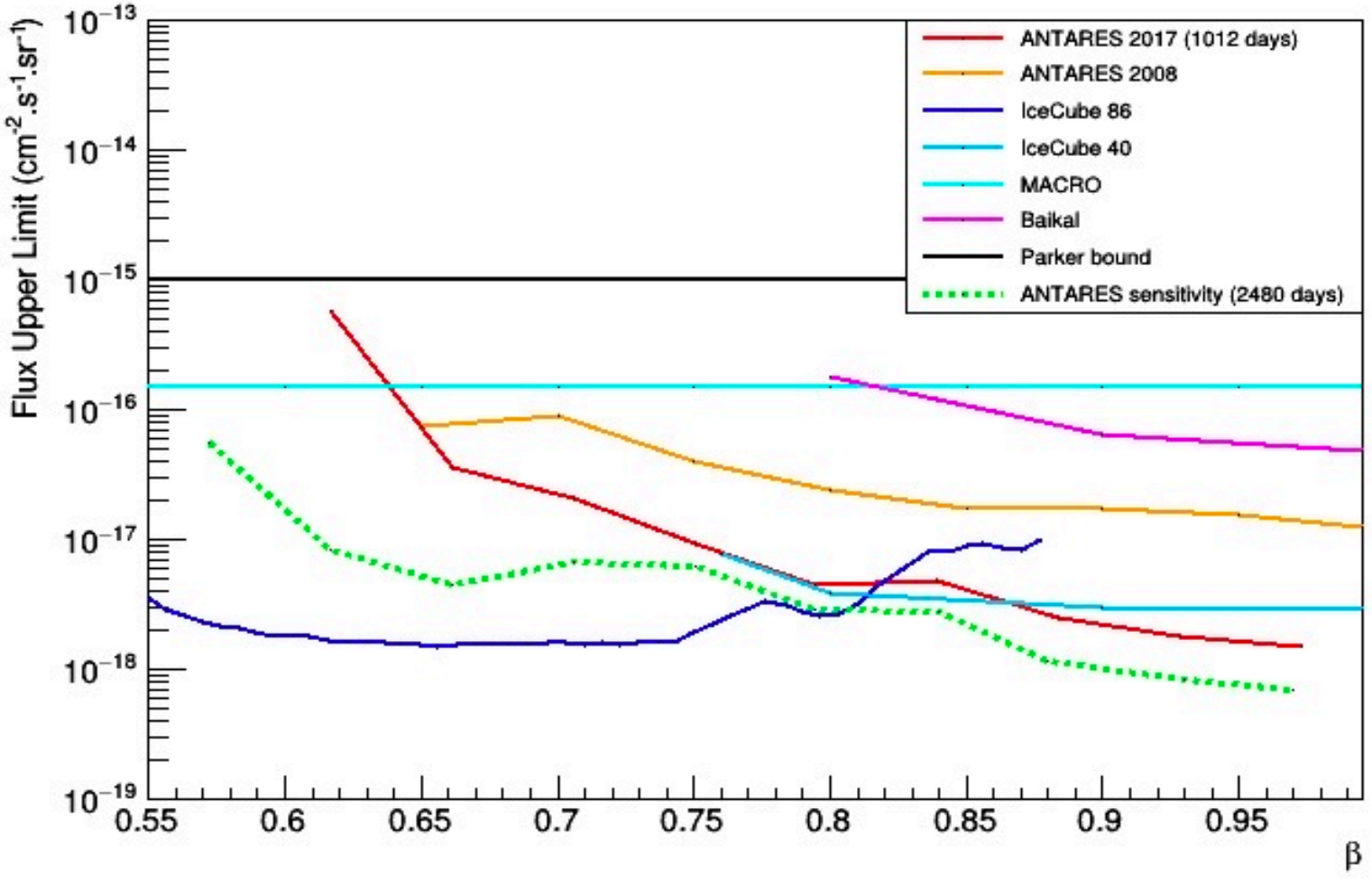
Exotic Physics with ANTARES

Morocco joined the collaboration in 2011, represented by Mohammed I University in Oujda. Mohammed V University in Rabat, Cadi Ayyad University of Marrakesh and the National Center of Energy, Sciences and Nuclear Techniques CNESTEN.

ANTARES Telescope



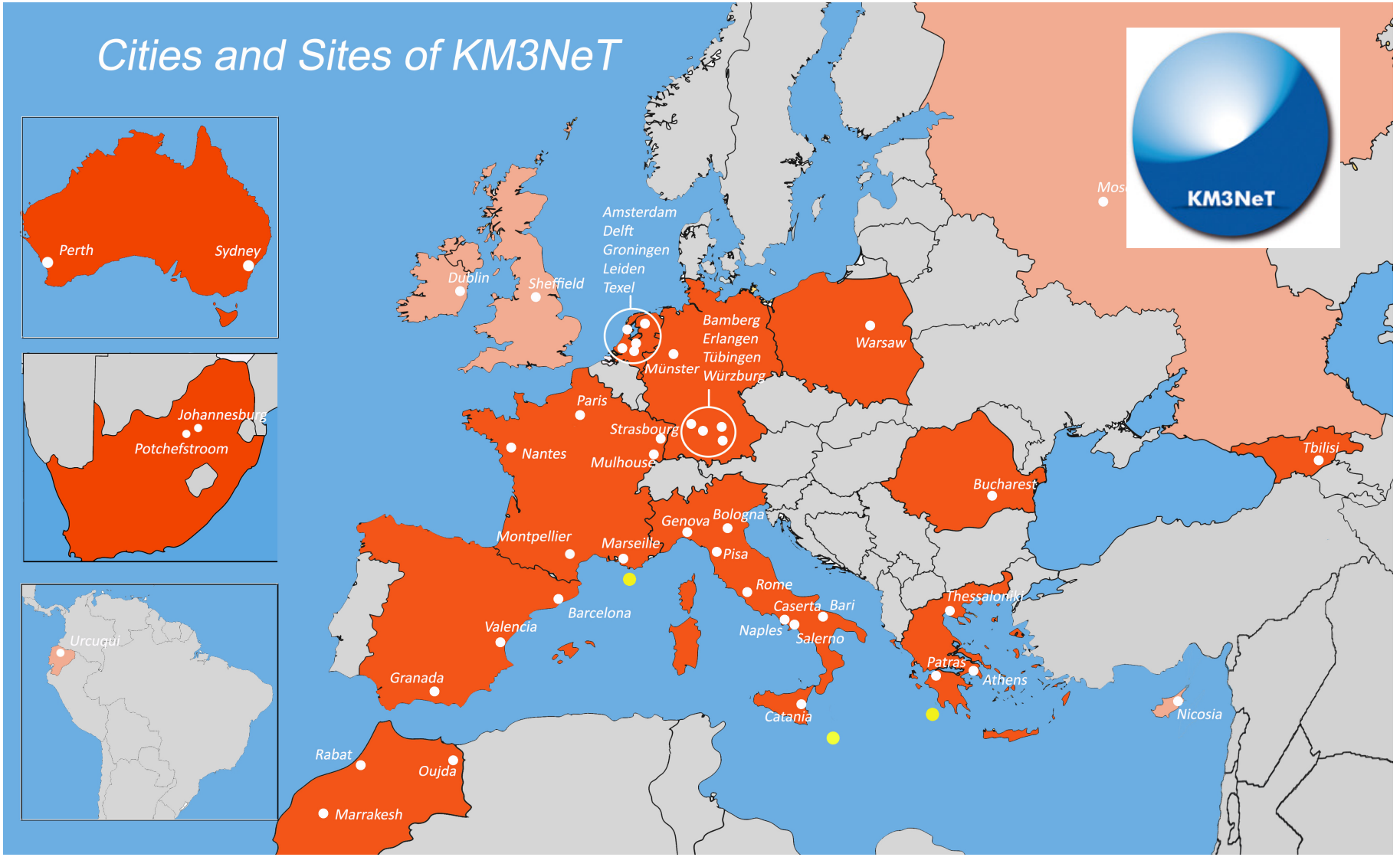
Search for Magnetic Monopoles



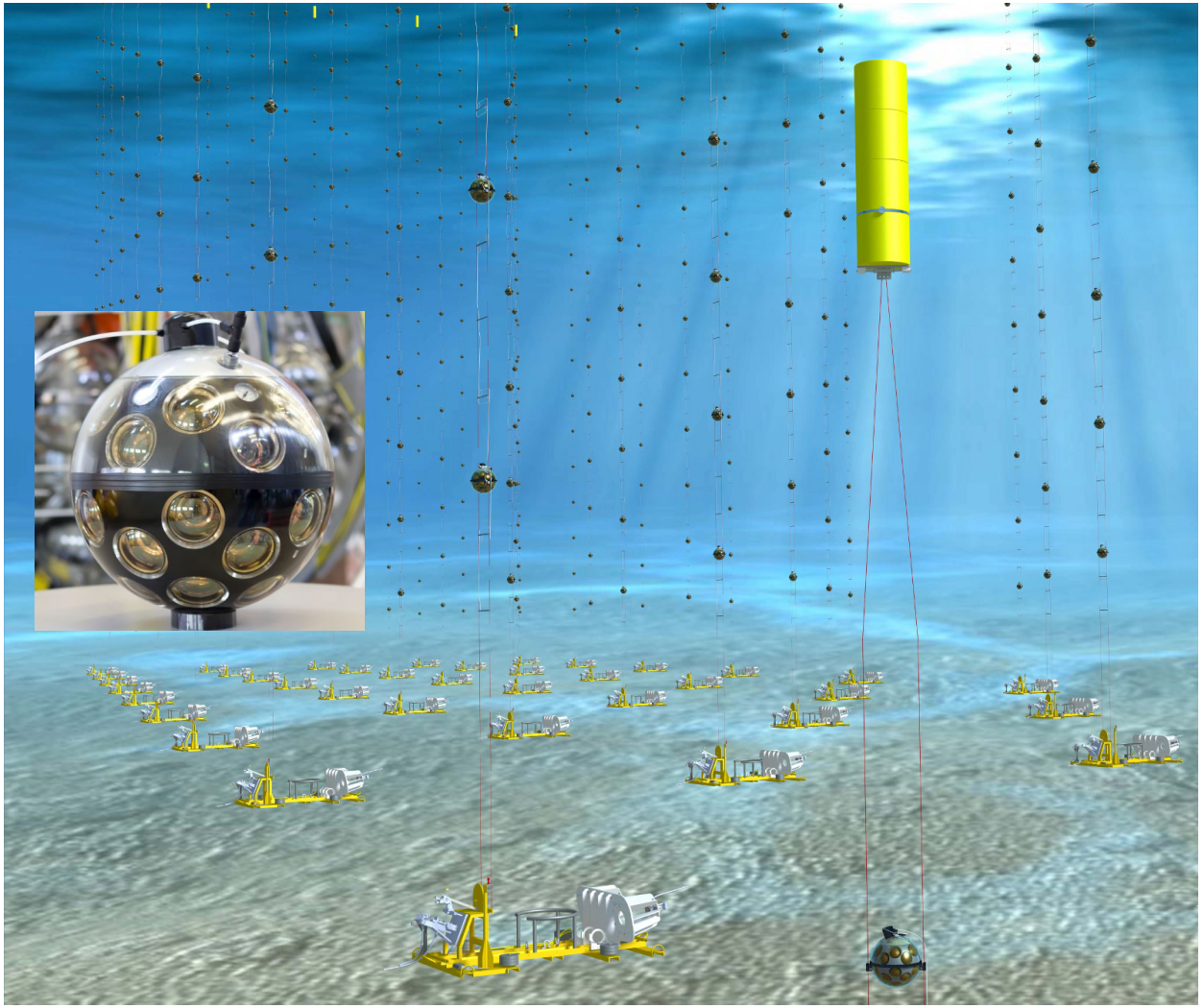
NEUTRINO 2020

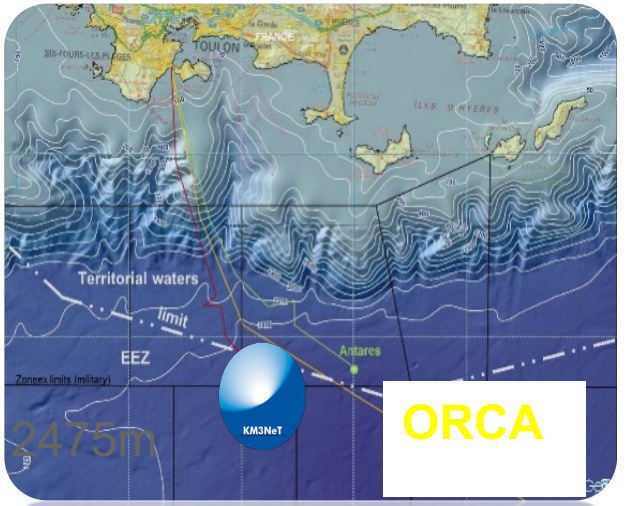
JHEP 07 (2017) 54
JHEA 34 (2022) 1-8

KM3NeT


Cities and Sites of KM3NeT
KM3NeT
Perth
Sydney
Johannesburg
Potchefstroom
Urcuqui
Amsterdam
Delft
Groningen
Leiden
Texel
Dublin
Sheffield
Münster
Bamberg
Erlangen
Tübingen
Würzburg
Warsaw
Paris
Strasbourg
Nantes
Mulhouse
Bucharest
Tbilisi
Genova
Bologna
Montpellier
Marseille
Pisa
Rome
Caserta
Bari
Naples
Salerno
Barcelona
Valencia
Granada
Thessaloniki
Patras
Athens
Catania
Nicosia
Rabat
Oujda
Marrakesh

KM3NeT




Territorial waters
limit
EEZ
Antares
KM3NeT
2475m
ORCA


KM3NeT
3400m
ARCA

KM3NeT

- 31 PMTs in one sphere
- 3 x cathode area wrt ANTARES OM
- Single photon counting
- Directional information
- Inspiring design for IceCube-Gen 2

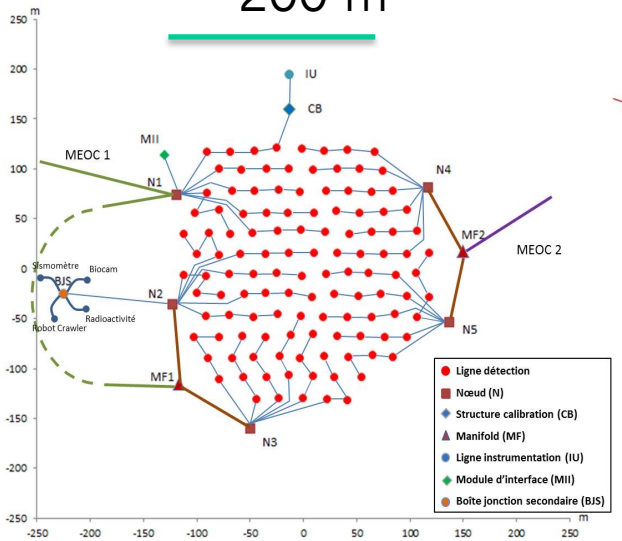
KM3NeT ARCA/ORCA

Astrophysics/**O**scillation **R**esearch
with **C**osmics in the **A**byss

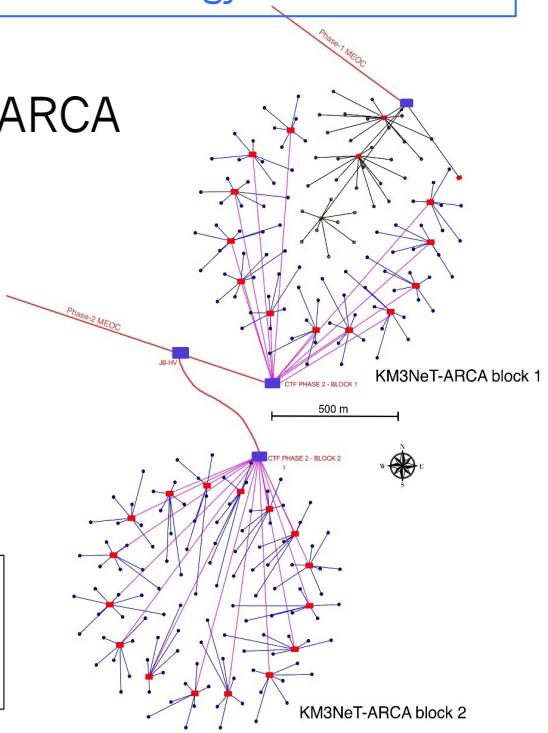
ARCA: 3.5km depth, 100km from Capo Passero (Sicily)
Focus: Cosmic Neutrino Sources
large, sparse grid -> high energy
ORCA: 2.5 km depth, 40km from Toulon (France)
Focus: Atmospheric neutrino oscillations
small, dense grid -> low energy

ORCA

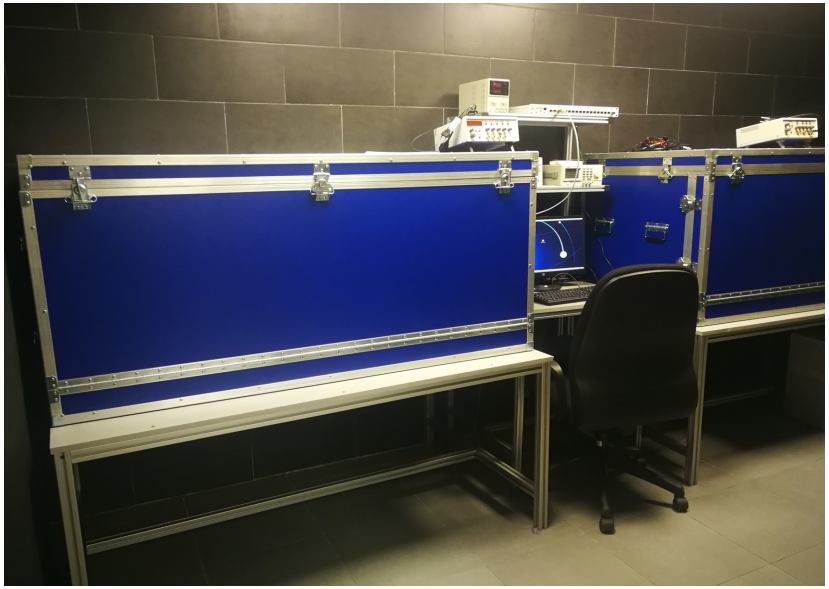
200 m



ARCA



National DOM integration site in Rabat



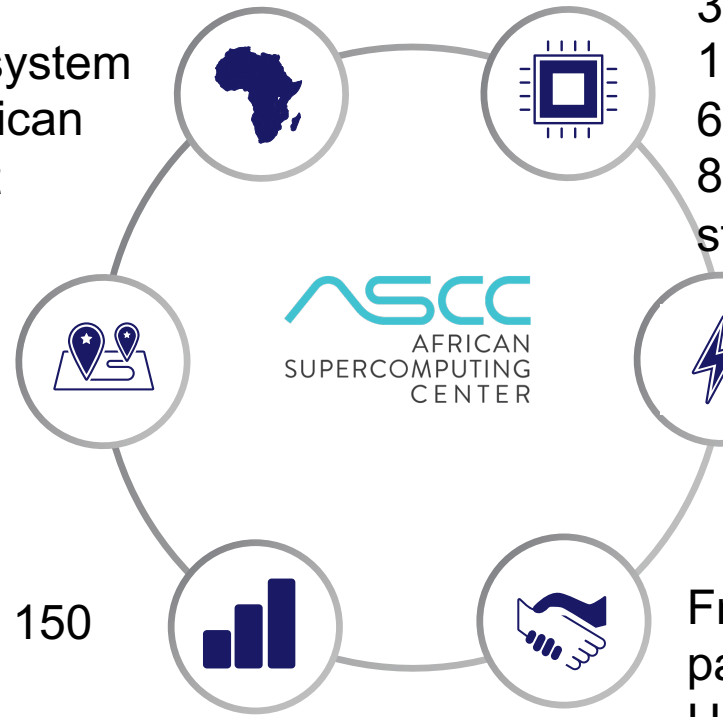
National DOM integration site in Rabat

Plans with ePIC at EIC

- Contribute to the **AC-LGAD-TOF** tasks force : tests of sensors, integration, DAQ,…
- PID and Tracking **Performace study.**
- **Exotic Physics** : ALP, LyBLy.

African SuperComputing Center

ASCC



Largest system in the African continent

3.15 PF of performance
1300+ servers
67000+ CPU cores
8000 TB of combined storage

Regional Academic Research Hub

About 650KW of electrical power at full capacity

In the TOP 150 systems worldwide (#147)

Fruit of a partenership with the University of Cambridge

ASCC: What is the vision?

Provide a world-class capability in advanced computing

- Support Data-Driven initiatives and research projects
- Attract talent and researchers to universities in the region
- Increase the competitiveness of research and innovation in the region

Set the pace for Innovation using Data Analytics

- Create a Data Analytics community (National and Regional levels)
- Accelerate AI/ML initiatives

Regional Academic Research Hub

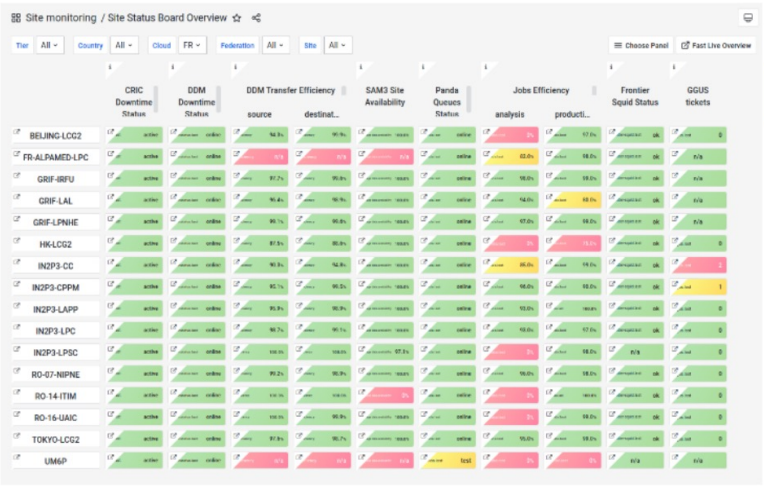
- Create a hub between the industrial and academic worlds
- Exchange ideas, create synergies and collaboration opportunities

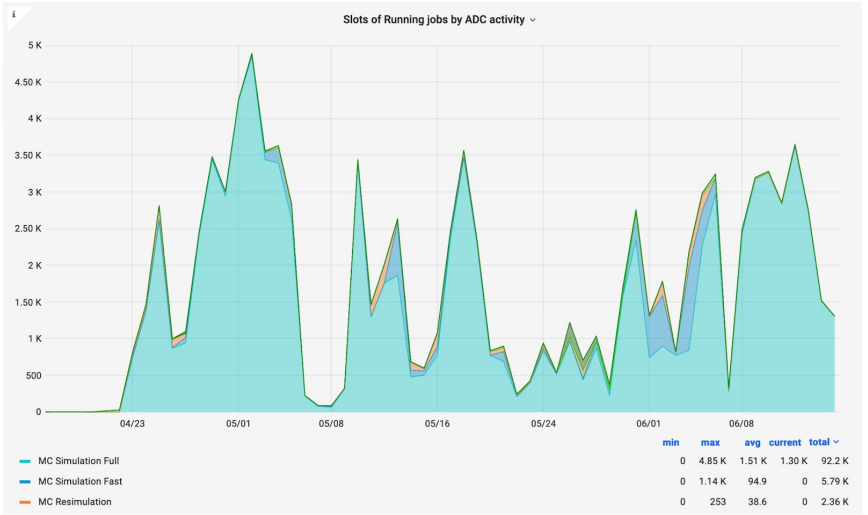
National ATLAS Tier2

FR-cloud

FR-cloud groups Tier 1 and several Tier 2 and Tier 3 sites for operational issues

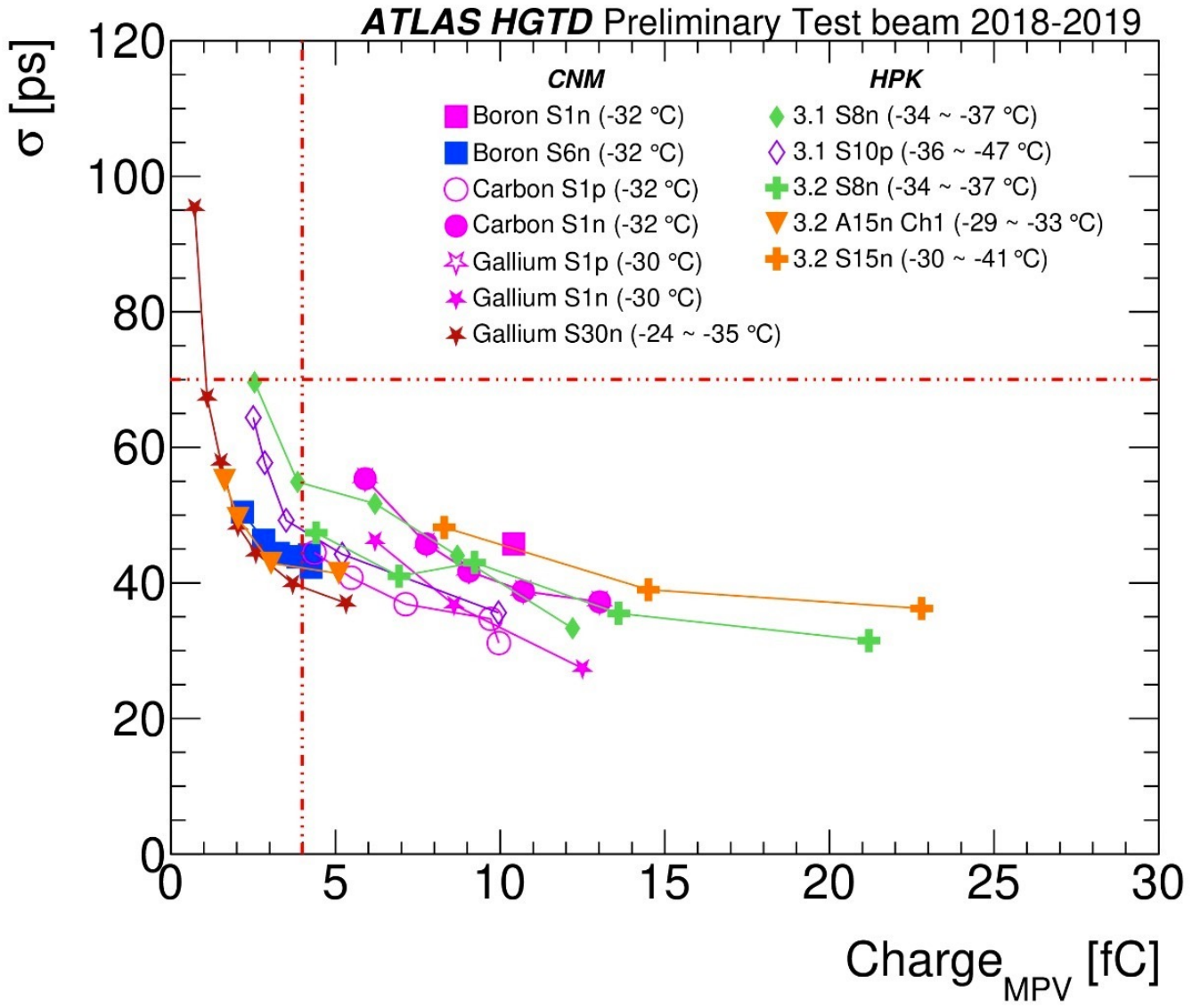
- countries : China, France, Japan, Morocco, Romania
- Tier 1 site : IN2P3-CC
- Tier 2 sites : BEIJING-LCG2, GRIF-IRFU, GRIF-LAL, GRIF-LPNHE, HK-LCG2, IN2P3-CPPM, IN2P3-LAPP, IN2P3-LPC, IN2P3-LPSC, RO-07-NIPNE, RO-14-ITIM, RO-16-UAIC, TOKYO-LCG2, UM6P



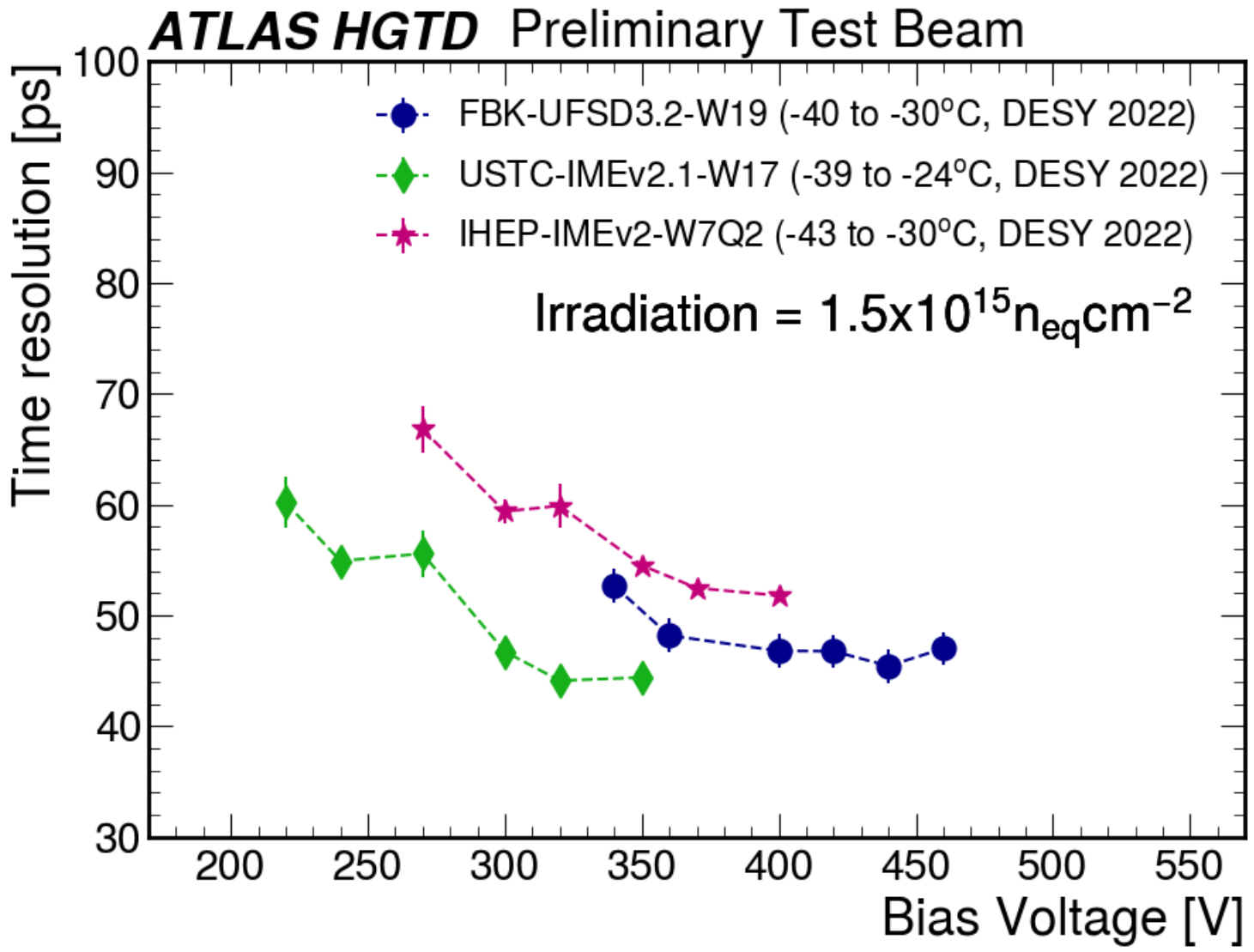


Welcome to the T2 site of University Mohammed VI Polytechnique (UM6P),
Ben Guerir, Morocco
https://ascc.um6p.ma/
https://atlas-cric.cern.ch/core/experimentsite/detail/UM6P/

ATLAS upgrade (HGTD)



ATLAS upgrade (HGTD)



Packaging and SMT Lines (Cleanrooms Class 1000 and 10000)