Riunione di Gruppo 1 - Napoli
19 Dicembre 2016

ATLAS Experiment Updates: Status and Plans

Elvira Rossi

ATLAS Napoli

Anagrafica 2016 (ATLAS + R&D Fase2) = 14.9 FTE
Anagrafica 2017 (ATLAS + R&D Fase2) = 15.7 FTE

- *Università 'Federico II':* **A. Aloisio, M. Alviggi, F. Ambrosino, V. Canale, G. Chiefari, M.Della Pietra, R. Giordano, P. Massarotti, L. Merola, G.Russo, G. Saracino**
- *INFN:* **G. Carlino, R. de Asmundis, A. Doria, V. Izzo, G. Sekhniaidze**

- *Università Parthenope*: **F. Conventi, E. Rossi, C. Di Donato**

- *Dottorandi e assegnisti:* **F. Cirotto, M. Lavorgna, A. Giannini, S. Perrella, A.Sanchez (fino ad Ottobre 2016)**
- *Laureandi 2016-2017:* **C. Calamita, M. Camerlingo, M. D'Errico, G. Di Luca, C. Grieco, N. Marino**

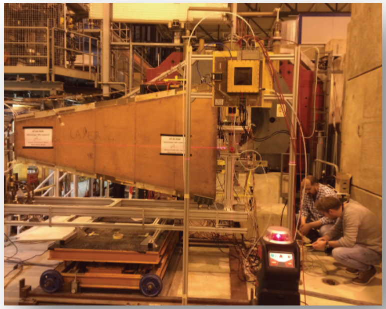
ATLAS Napoli: Attività del gruppo

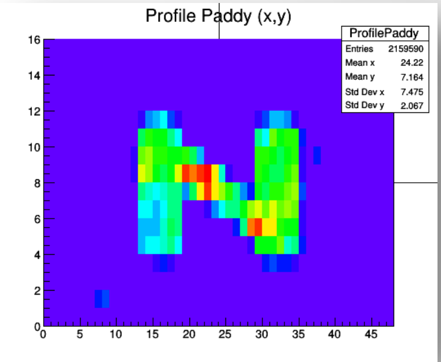
Muon Trigger:
- RPC detectors
- Trigger e DAQ
- Muon Tagger

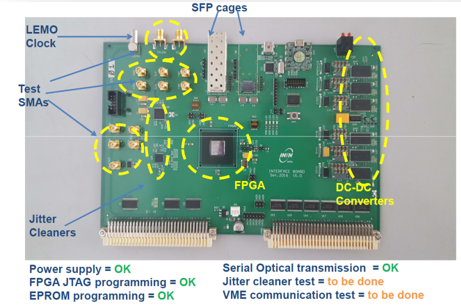
New Small Wheel: Micromegas detectors

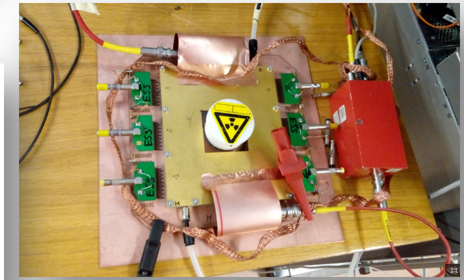
Fisica:
- BSM Diboson Resonaces Searches
- BSM e Esotica: ricerche BSM con (b)jet(s) e Missing E_T

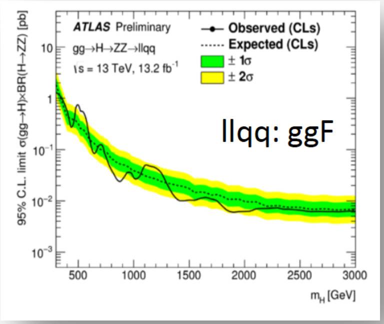
Computing
- Tier2

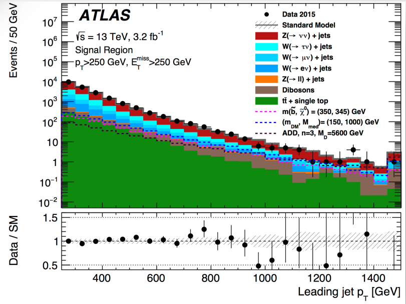












XII Workshop ATLAS-Italia: Fisica e Upgrade

XII Workshop ATLAS-Italia in Napoli November 2016

Great participation of the ATLAS Italian collaboration:

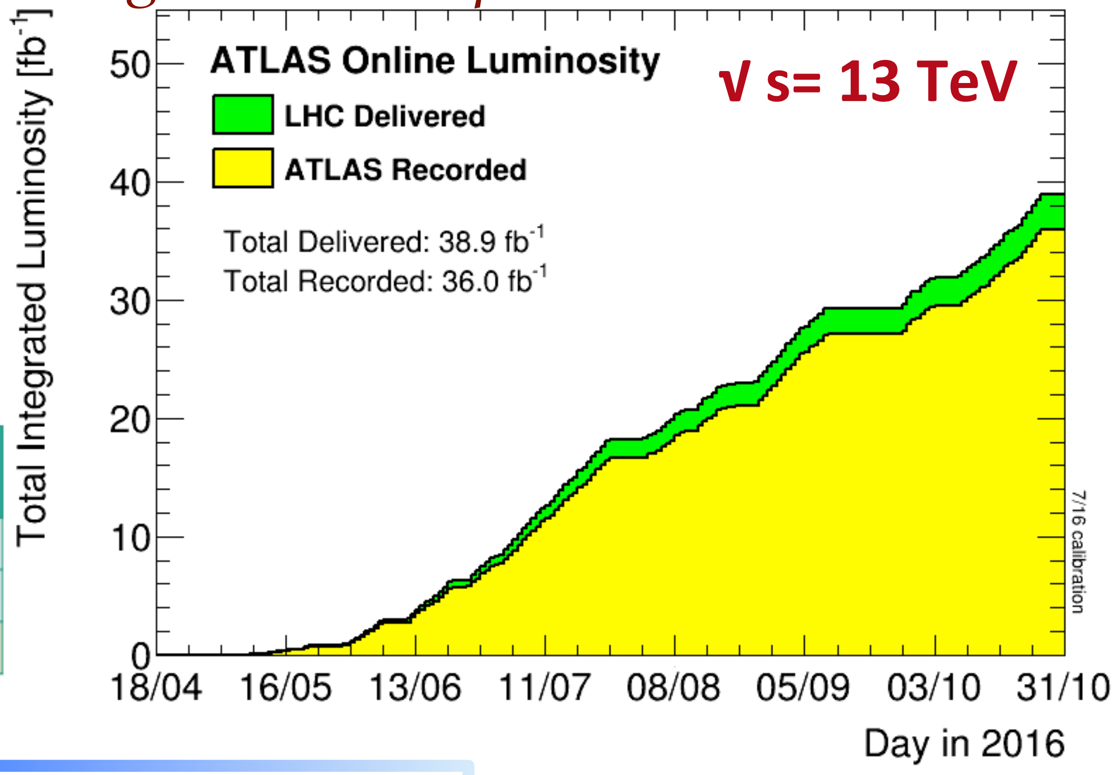
- **Interesting and new results**
- **Interesting and useful discussions**

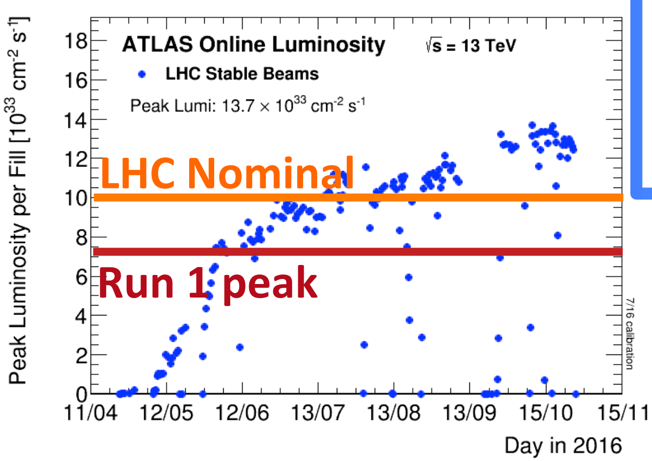
Exploring the unknown at LHC

..at unexplored energies with unprecedented rates

Using state-of-art tools:
- ✤ Detectors
- ✤ Triggers
- ✤ Computing
- ✤ Analysis techniques
- ✤ Theoretical calculations

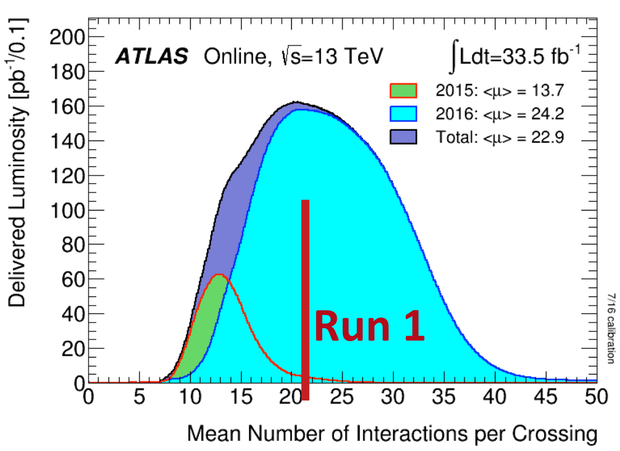
Year	Recorded Luminosity	Luminosity Good for Physics
2015	3.9 fb^{-1}	3.2 fb^{-1}
ICHEP 2016		13.2 fb^{-1}
2016	38.9 fb^{-1}	33 fb^{-1}





Highest instantaneous Luminosity reached 13.7 x$10^{33}$$cm^2s^{-1}$

Mean Interaction per BC:
- ✸ 2015: μ~13.7
- ✸ 2016: μ~24.2
- ✸ 2015+2016: μ~22.9



Trigger Operations

Team @ Napoli:

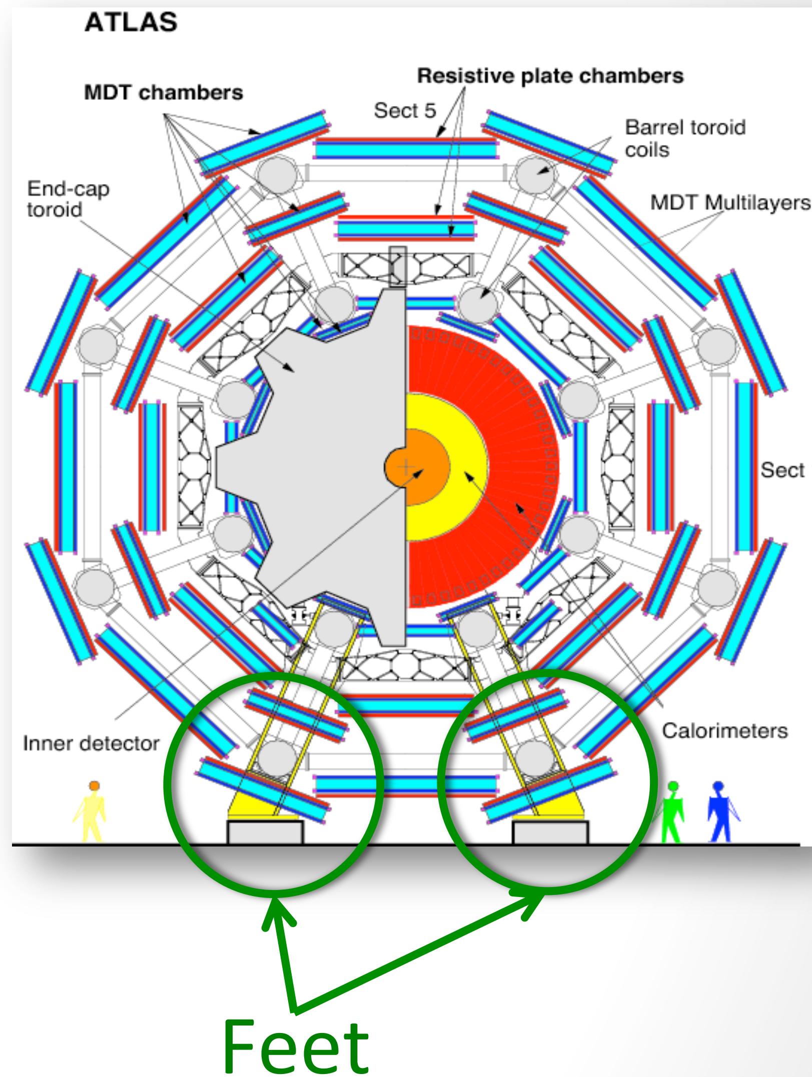
- **Muon Barrel Level1 Trigger Operations:** A. Aloisio, F. Conventi, M. Della Pietra, V. Izzo, S. Perrella, E. Rossi

ATLAS NAPOLI

Muon Barrel Level1 Trigger Operations

Operation activities in Napoli

- Maintenance of the ReadOut Driver (ROD) boards and of the Optical Links to read Trigger data Level 1 Muon Trigger Operation
- Trigger and DAQ RPC Maintenance: DAQ software updates for the Level 1 muon trigger to manage RODs and the Sector Logic (SL)
- Monitoring Online for the Data Quality
- Inclusion in the TDAQ system of the RPC in the "feet" and "elevator" region → 3% coverage recovered.
- L1 Muon Barrel Expert on-call shifts
- High Level Trigger Muon/Bphysics Expert on-call shifts



Analysis

Council Open Session - LHC Results: http://indico.cern.ch/event/595054/

ATLAS Public Results: https://twiki.cern.ch/twiki/bin/view/AtlasPublic

ATLAS NAPOLI

Team @ Napoli:

- **BSM Diboson Resonaces Searches:**
  F. Conventi, C. Calamita, A. Giannini, E. Rossi, A. Sanchez

- **BSM Searches with jet(s) e Missing E_T (mono-Jet):**
  F.Cirotto, F. Conventi, M. D'Errico, E. Rossi

- **BSM Searches with bjet(s) e Missing E_T (mono-bJet):**
  F.Cirotto, F. Conventi, M. Lavorgna, E. Rossi

2016: a challenging year

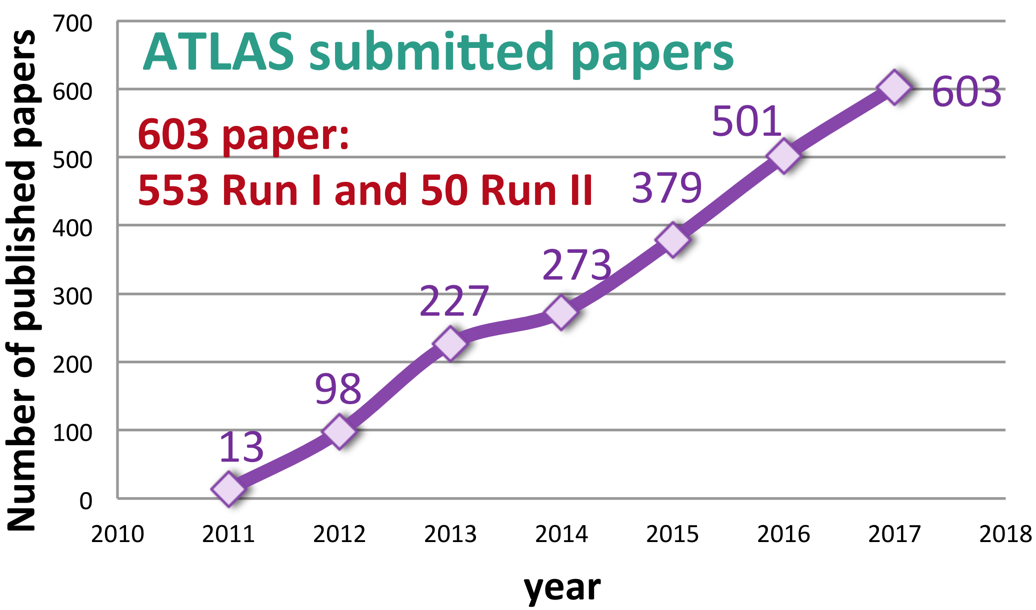
End of I period of Run2 at 13 TeV

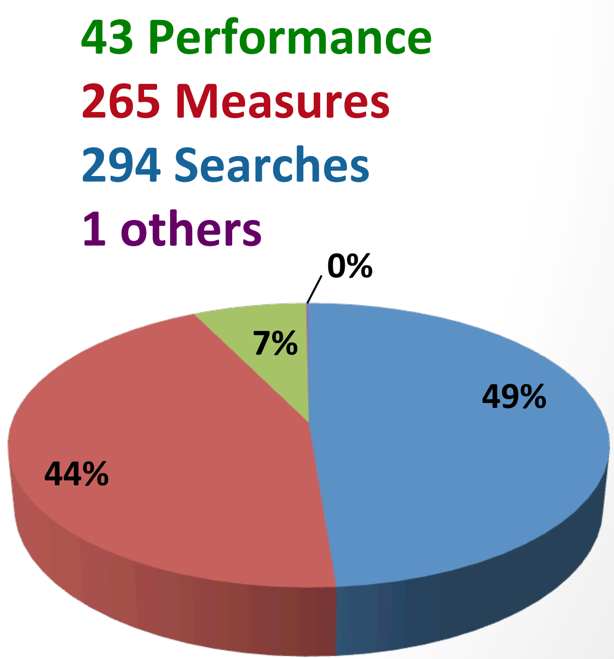
Run 2 Physics Objectives:

- Measure again SM processes at 13TeV
- Re-discover Higgs and study the rarest Higgs decays
- Search for NEW PHYSICS at 360˚
- Results will be critical for next machines

Upgrades

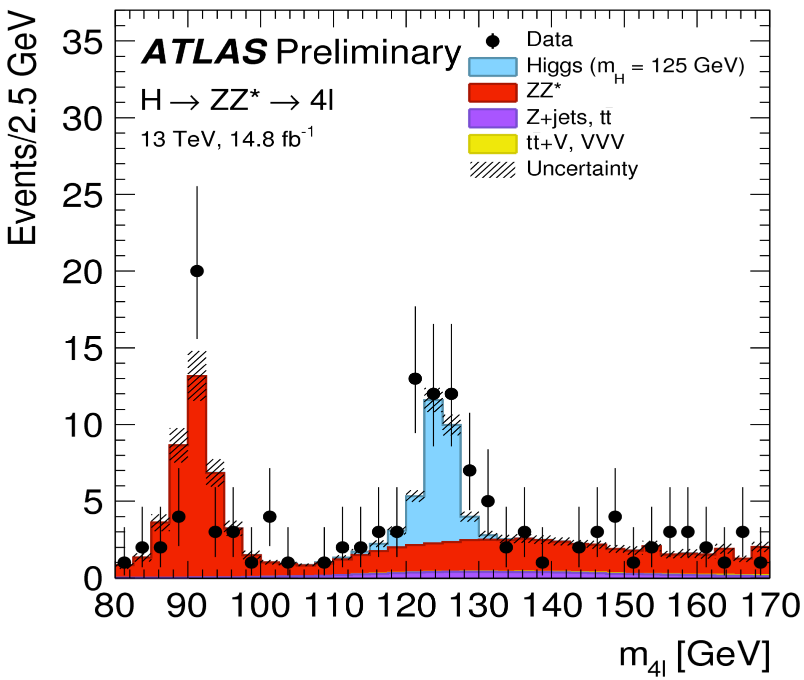
- Phase I
- R&D progresses for Phase II detectors: TDRs Phase II



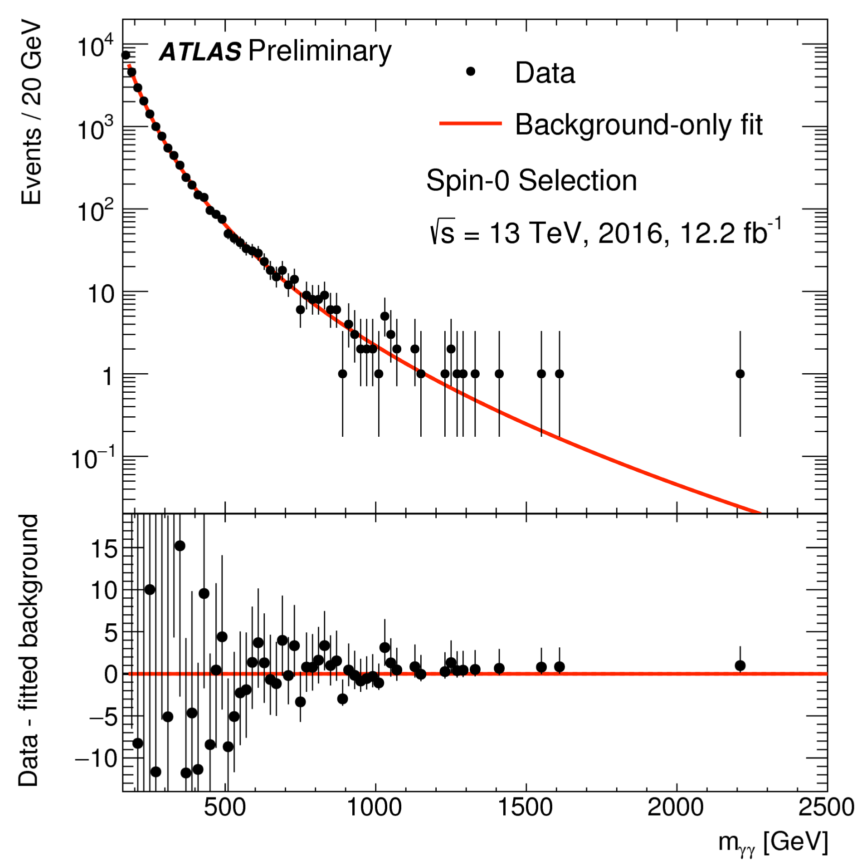


Higgs and Friends

H→ZZ->4leptons Rediscovery

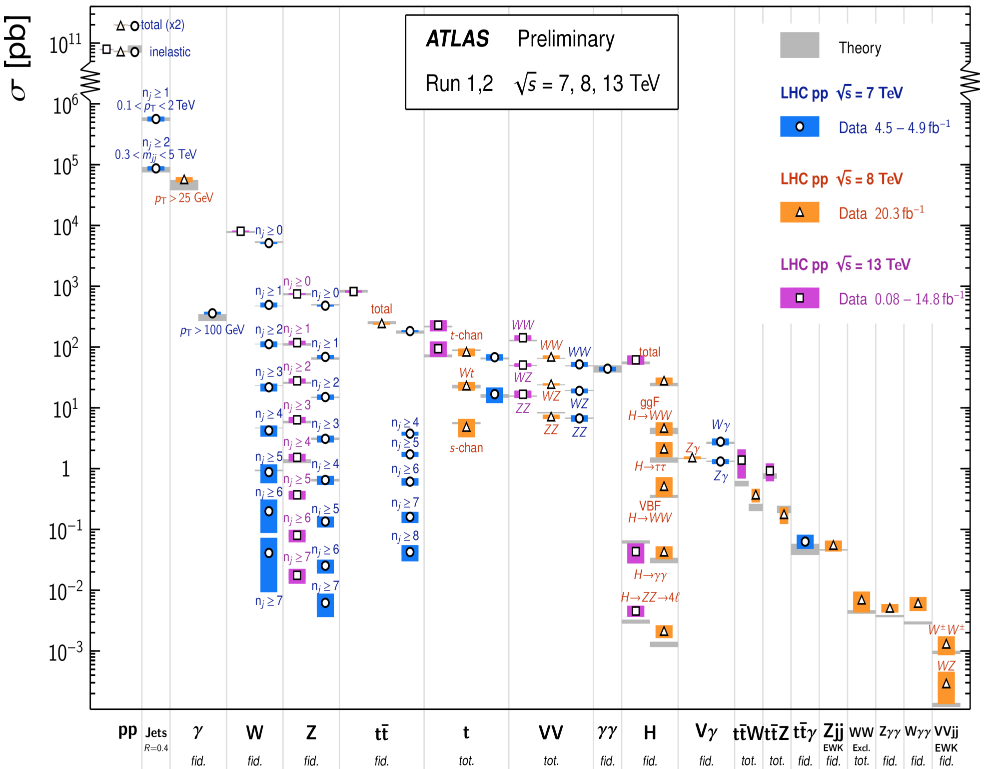


Rule out some hints from 2015

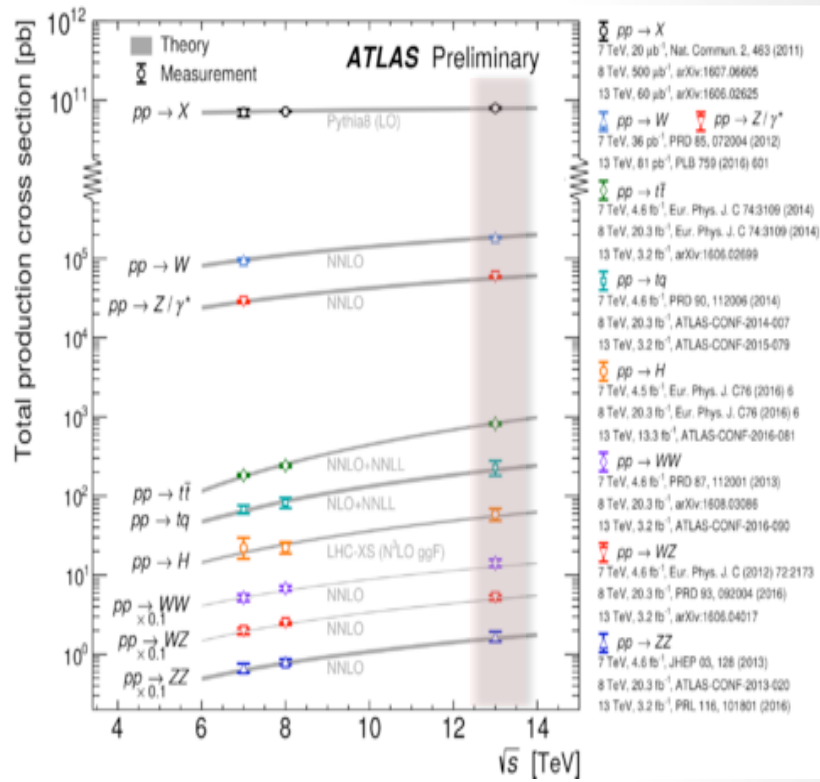


Standard Model Measurements

Production Cross Section Measurements



Total Cross Section Measurements



Run-I:

in blue: 7TeV data

In orange: 8TeV data

Run-II: in purple: 13 TeV data

In grey: Theory

Updated August 2016 for ICHEP

Waiting for new updates for Moriond 2017!!!

ATLAS Exotics searches

ATLAS Exotics Searches* - 95% CL Exclusion

Status: August 2016

ATLAS Preliminary

$\int \mathcal{L}\, dt = (3.2 - 20.3)\ \text{fb}^{-1}$ $\sqrt{s} = 8, 13$ TeV

	Model	ℓ, γ	Jets†	E_T^{miss}	$\int \mathcal{L}\, dt [\text{fb}^{-1}]$	Limit		Reference
Extra dimensions	ADD $G_{KK} + g/q$	–	≥ 1 j	Yes	3.2	M_D 6.58 TeV	$n = 2$	1604.07773
	ADD non-resonant $\ell\ell$	2 e, μ	–	–	20.3	M_S 4.7 TeV	$n = 3$ HLZ	1407.2410
	ADD QBH $\to \ell q$	1 e, μ	1 j	–	20.3	M_{th} 5.2 TeV	$n = 6$	1311.2006
	ADD QBH	–	2 j	–	15.7	M_{th} 8.7 TeV	$n = 6$	ATLAS-CONF-2016-069
	ADD BH high $\sum p_T$	≥ 1 e, μ	≥ 2 j	–	3.2	M_{th} 8.2 TeV	$n = 6$, $M_D = 3$ TeV, rot BH	1606.02265
	ADD BH multijet	–	≥ 3 j	–	3.6	M_{th} 9.55 TeV	$n = 6$, $M_D = 3$ TeV, rot BH	1512.02586
	RS1 $G_{KK} \to \ell\ell$	2 e, μ	–	–	20.3	G_{KK} mass 2.68 TeV	$k/\overline{M}_{Pl} = 0.1$	1405.4123
	RS1 $G_{KK} \to \gamma\gamma$	2 γ	–	–	3.2	G_{KK} mass 3.2 TeV	$k/\overline{M}_{Pl} = 0.1$	1606.03833
	Bulk RS $G_{KK} \to WW \to qq\ell\nu$	1 e, μ	1 J	Yes	13.2	G_{KK} mass 1.24 TeV	$k/\overline{M}_{Pl} = 1.0$	ATLAS-CONF-2016-062
	Bulk RS $G_{KK} \to HH \to bbbb$	–	4 b	–	13.3	G_{KK} mass 360-860 GeV	$k/\overline{M}_{Pl} = 1.0$	ATLAS-CONF-2016-049
	Bulk RS $g_{KK} \to tt$	1 e, μ	≥ 1 b, ≥ 1J/2j	Yes	20.3	g_{KK} mass 2.2 TeV	BR = 0.925	1505.07018
	2UED / RPP	1 e, μ	≥ 2 b, ≥ 4 j	Yes	3.2	KK mass 1.46 TeV	Tier (1,1), BR($A^{(1,1)} \to tt$) = 1	ATLAS-CONF-2016-013
Gauge bosons	SSM $Z' \to \ell\ell$	2 e, μ	–	–	13.3	Z' mass 4.05 TeV		ATLAS-CONF-2016-045
	SSM $Z' \to \tau\tau$	2 τ	–	–	19.5	Z' mass 2.02 TeV		1502.07177
	Leptophobic $Z' \to bb$	–	2 b	–	3.2	Z' mass 1.5 TeV		1603.08791
	SSM $W' \to \ell\nu$	1 e, μ	–	Yes	13.3	W' mass 4.74 TeV		ATLAS-CONF-2016-061
	HVT $W' \to WZ \to qq\nu\nu$ model A	0 e, μ	1 J	Yes	13.2	W' mass 2.4 TeV	$g_V = 1$	ATLAS-CONF-2016-082
	HVT $W' \to WZ \to qqqq$ model B	–	2 J	–	15.5	W' mass 3.0 TeV	$g_V = 3$	ATLAS-CONF-2016-055
	HVT $V' \to WH/ZH$ model B	multi-channel			3.2	V' mass 2.31 TeV	$g_V = 3$	1607.05621
	LRSM $W'_R \to tb$	1 e, μ	2 b, 0-1 j	Yes	20.3	W' mass 1.92 TeV		1410.4103
	LRSM $W'_R \to tb$	0 e, μ	≥ 1 b, 1 J	–	20.3	W' mass 1.76 TeV		1408.0886
CI	CI $qqqq$	–	2 j	–	15.7	Λ 19.9 TeV	$\eta_{LL} = -1$	ATLAS-CONF-2016-069
	CI $\ell\ell qq$	2 e, μ	–	–	3.2	Λ 25.2 TeV	$\eta_{LL} = -1$	1607.03669
	CI $uutt$	2(SS)/≥3 e, μ	≥1 b, ≥1 j	Yes	20.3	Λ 4.9 TeV	$\|C_{RR}\| = 1$	1504.04605
DM	Axial-vector mediator (Dirac DM)	0 e, μ	≥ 1 j	Yes	3.2	m_A 1.0 TeV	g_q=0.25, g_χ=1.0, $m(\chi) < 250$ GeV	1604.07773
	Axial-vector mediator (Dirac DM)	0 e, μ, 1 γ	1 j	Yes	3.2	m_A 710 GeV	g_q=0.25, g_χ=1.0, $m(\chi) < 150$ GeV	1604.01306
	$ZZ\chi\chi$ EFT (Dirac DM)	0 e, μ	1 J, ≤ 1 j	Yes	3.2	M_* 550 GeV	$m(\chi) < 150$ GeV	ATLAS-CONF-2015-080
LQ	Scalar LQ 1st gen	2 e	≥ 2 j	–	3.2	LQ mass 1.1 TeV	$\beta = 1$	1605.06035
	Scalar LQ 2nd gen	2 μ	≥ 2 j	–	3.2	LQ mass 1.05 TeV	$\beta = 1$	1605.06035
	Scalar LQ 3rd gen	1 e, μ	≥1 b, ≥3 j	Yes	20.3	LQ mass 640 GeV	$\beta = 0$	1508.04735
Heavy quarks	VLQ $TT \to Ht + X$	1 e, μ	≥ 2 b, ≥ 3 j	Yes	20.3	T mass 855 GeV	T in (T,B) doublet	1505.04306
	VLQ $YY \to Wb + X$	1 e, μ	≥ 1 b, ≥ 3 j	Yes	20.3	Y mass 770 GeV	Y in (B,Y) doublet	1505.04306
	VLQ $BB \to Hb + X$	1 e, μ	≥ 2 b, ≥ 3 j	Yes	20.3	B mass 735 GeV	isospin singlet	1505.04306
	VLQ $BB \to Zb + X$	2/≥3 e, μ	≥2/≥1 b	–	20.3	B mass 755 GeV	B in (B,Y) doublet	1409.5500
	VLQ $QQ \to WqWq$	1 e, μ	≥ 4 j	Yes	20.3	Q mass 690 GeV		1509.04261
	VLQ $T_{5/3}T_{5/3} \to WtWt$	2(SS)/≥3 e, μ	≥1 b, ≥1 j	Yes	3.2	$T_{5/3}$ mass 990 GeV		ATLAS-CONF-2016-032
Excited fermions	Excited quark $q^* \to q\gamma$	1 γ	1 j	–	3.2	q^* mass 4.4 TeV	only u^* and d^*, $\Lambda = m(q^*)$	1512.05910
	Excited quark $q^* \to qg$	–	2 j	–	15.7	q^* mass 5.6 TeV	only u^* and d^*, $\Lambda = m(q^*)$	ATLAS-CONF-2016-069
	Excited quark $b^* \to bg$	–	1 b, 1 j	–	8.8	b^* mass 2.3 TeV		ATLAS-CONF-2016-060
	Excited quark $b^* \to Wt$	1 or 2 e, μ	1 b, 2-0 j	Yes	20.3	b^* mass 1.5 TeV	$f_g = f_L = f_R = 1$	1510.02664
	Excited lepton ℓ^*	3 e, μ	–	–	20.3	ℓ^* mass 3.0 TeV	$\Lambda = 3.0$ TeV	1411.2921
	Excited lepton ν^*	3 e, μ, τ	–	–	20.3	ν^* mass 1.6 TeV	$\Lambda = 1.6$ TeV	1411.2921
Other	LSTC $a_T \to W\gamma$	1 e, μ, 1 γ	–	Yes	20.3	a_T mass 960 GeV		1407.8150
	LRSM Majorana ν	2 e, μ	2 j	–	20.3	N^0 mass 2.0 TeV	$m(W_R) = 2.4$ TeV, no mixing	1506.06020
	Higgs triplet $H^{\pm\pm} \to ee$	2 e (SS)	–	–	13.9	$H^{\pm\pm}$ mass 570 GeV	DY production, BR($H_L^{\pm\pm} \to ee$)=1	ATLAS-CONF-2016-051
	Higgs triplet $H^{\pm\pm} \to \ell\tau$	3 e, μ, τ	–	–	20.3	$H^{\pm\pm}$ mass 400 GeV	DY production, BR($H_L^{\pm\pm} \to \ell\tau$)=1	1411.2921
	Monotop (non-res prod)	1 e, μ	1 b	Yes	20.3	spin-1 invisible particle mass 657 GeV	$a_{\text{non-res}} = 0.2$	1410.5404
	Multi-charged particles	–	–	–	20.3	multi-charged particle mass 785 GeV	DY production, $\|q\| = 5e$	1504.04188
	Magnetic monopoles	–	–	–	7.0	monopole mass 1.34 TeV	DY production, $\|g\| = 1 g_D$, spin 1/2	1509.08059

$\sqrt{s}$ = 8 TeV $\sqrt{s}$ = 13 TeV

Mass scale [TeV]: 10^{-1}, 1, 10

1 TeV

*Only a selection of the available mass limits on new states or phenomena is shown. Lower bounds are specified only when explicitly not excluded.

†Small-radius (large-radius) jets are denoted by the letter j (J).

Di-boson Resonances and Neutral BSM Higgs searches

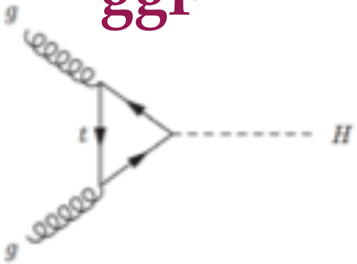
Di-boson searches VV, Vγ, VH, HH (V=W, Z)

- Predicted by many new physics models: HVT, W', Z', bulk RS graviton, 2HDM,…
- Valuable for SM physics, Vector Boson Scattering, and Three Gauge Coupling studies, HH will lead to the constraints of Higgs self-coupling
- If an excess is seen in one channel, measure the relative strengths in coupled channels —> e.g. Br(Zγ)/Br(γγ)
- understand the SU(2) structure of underlying theory

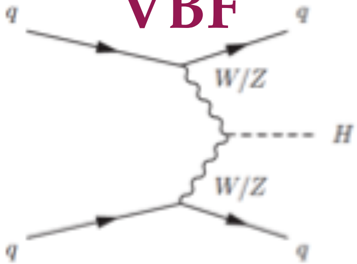
Di-boson Searches @ Napoli: X→ZV→llqq

Production mode:

ggF

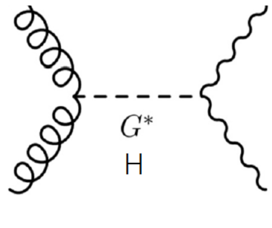


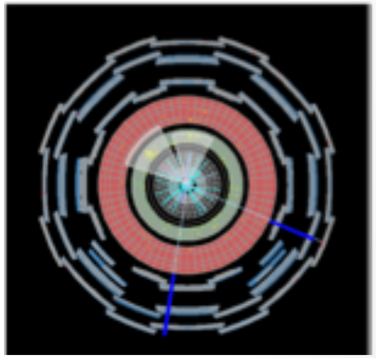
VBF



Decay modes:

ZV->ℓℓJ/ℓℓjj





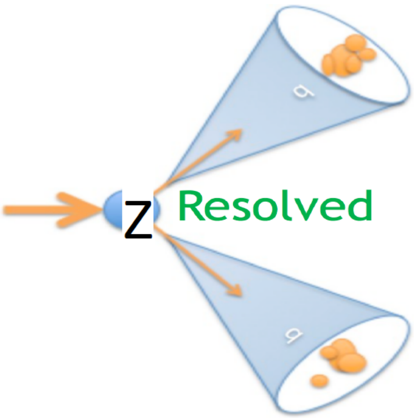
Search for a heavy resonance in the ZV → llqq decay channel in the diboson mass range **300 - 5000 GeV**. The results of the search are interpreted for: "Standard Model-like" Higgs boson (spin-0), Heavy Vector Triplet (spin-1), Randall-Sundrum graviton samples (spin-2)

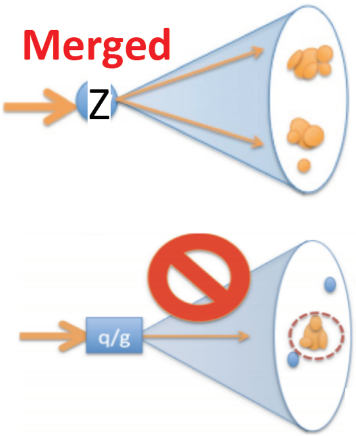
X→ZV→llqq

ATL-CONF-2016-082

llqq categorization:

- Merged large-R jet: high-purity and low-purity regions
- Resolved 2-jet: tagged (2b-jets) and untagged (<2 b-jets)
- Production mode categories: VBF and ggF
- llqq/vvqq Backgrounds: Z+Jets, W+Jets, Dibosons, top





Control regions:

- Z+jets: m_J (m_{jj}) mass sideband
- Top(llqq): eμ with ≥2 b−jets
- Top(ννqq): 1μ, b−jet(s), m_J near m_W
- W+jets: 1 μ, no b−jet, m_J mass sideband

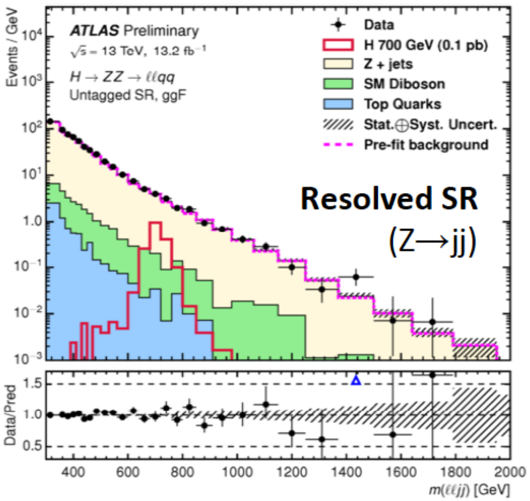
Leading systematics:

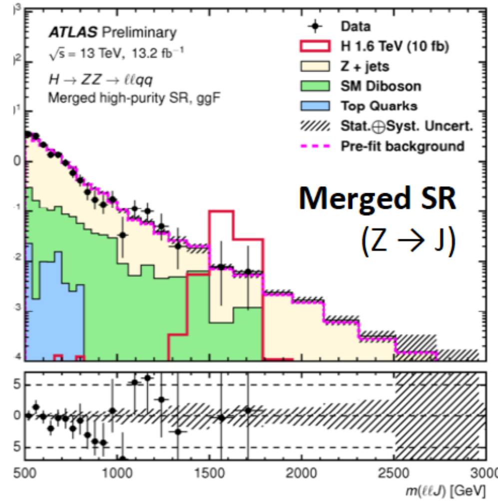
- Large-R jet energy scale / resolution
- Sub-structure variable
- Z+jets modeling

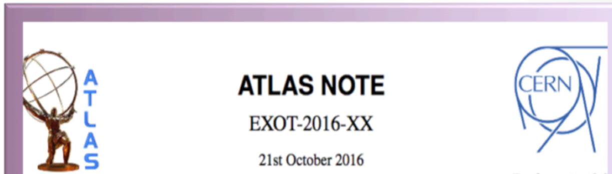
X→ZZ→llqq Results

ATL-CONF-2016-082

Resolution in m_{llJ} (m_{lljj}): 3-4%







ATLAS NOTE

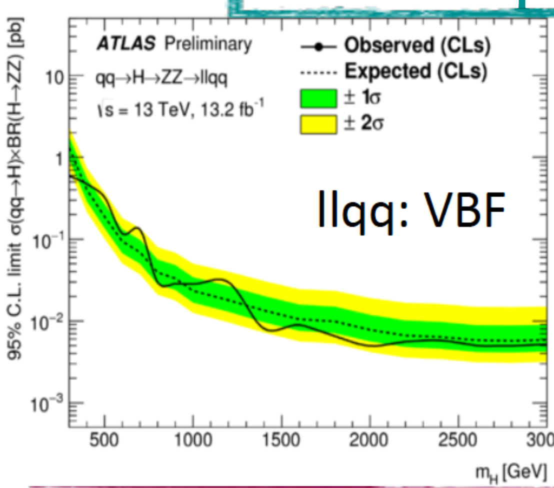
EXOT-2016-XX

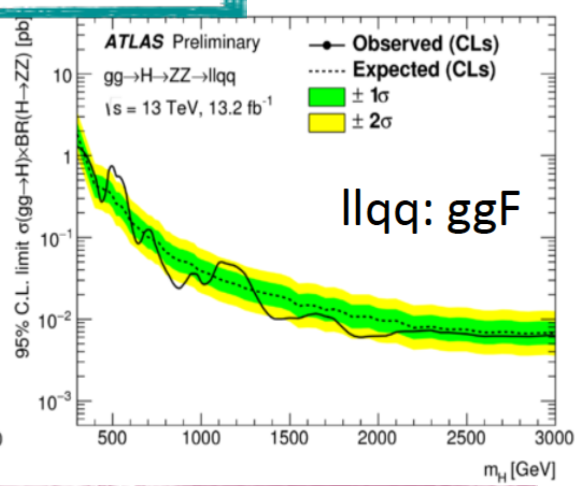
21st October 2016

Draft version 0.3

Search for diboson resonances in the ℓℓqq final state in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector

NWA Interpretation





Joint paper llqq/vvqq with the full 2015/2016 dataset in the Moriond timescale

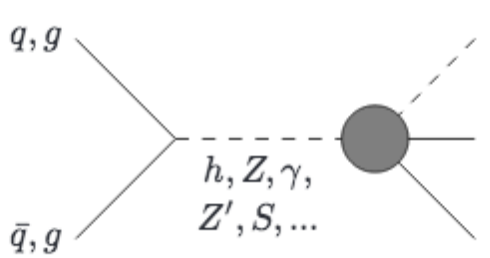
llqq editors:
F. Conventi, E. Rossi

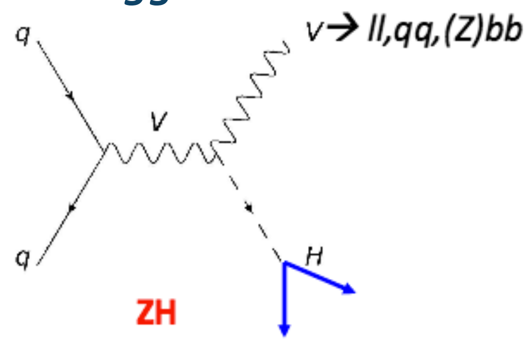
Results compatible with SM prediction

Searches with Jets and Missing energy in the final states

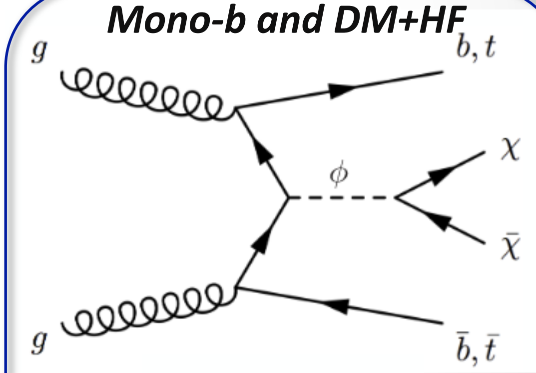
- Inclusive search for BSM models: **Invisible Higgs**, **DarkMatter**, **LargeExtraDimension**
- Basic selection: require at least 1 bjet + Missing Transverse Energy (MET) + veto leptons
- Backgrounds: Z(νν) + jets, tt, W(lν)+jets

mono-Higgs and Invisible Higgs

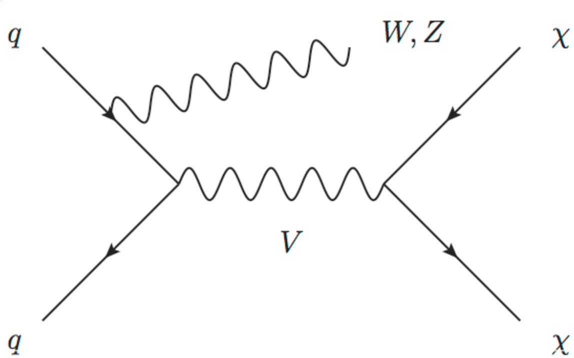


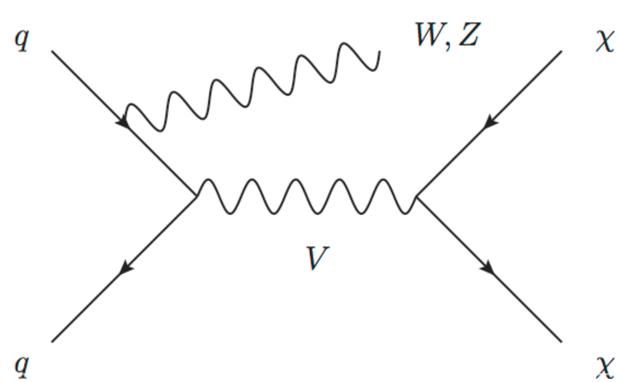


Mono-b and DM+HF

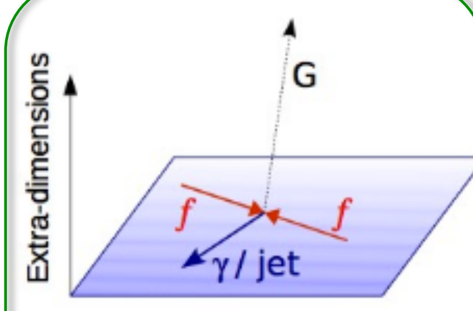


$$\phi = H/A$$



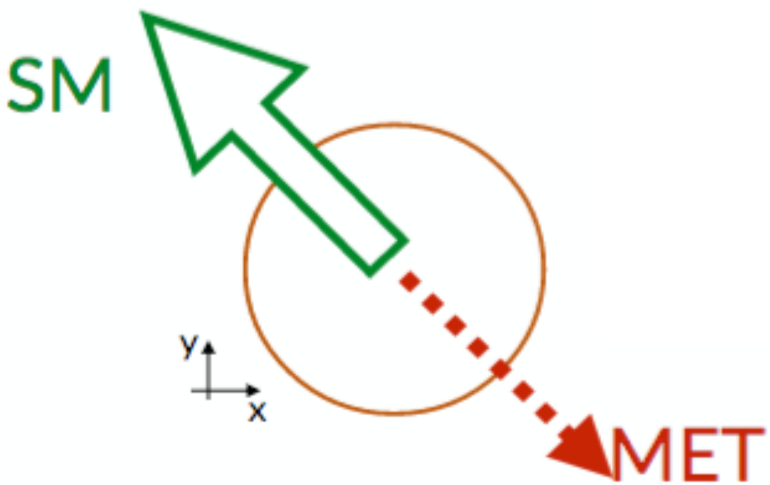


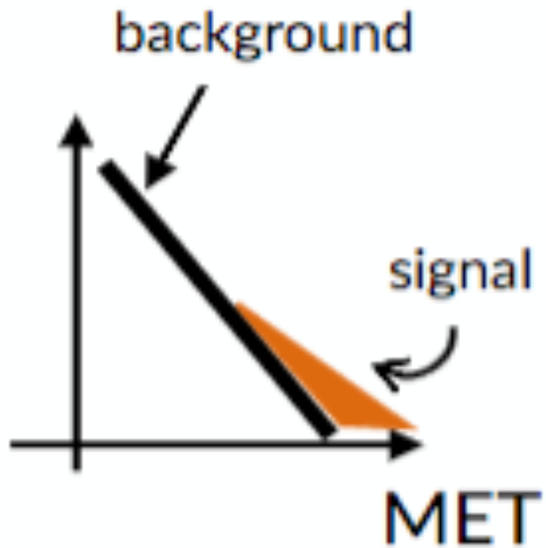
mono-WZ



Searches with Jets and Missing energy in the final states

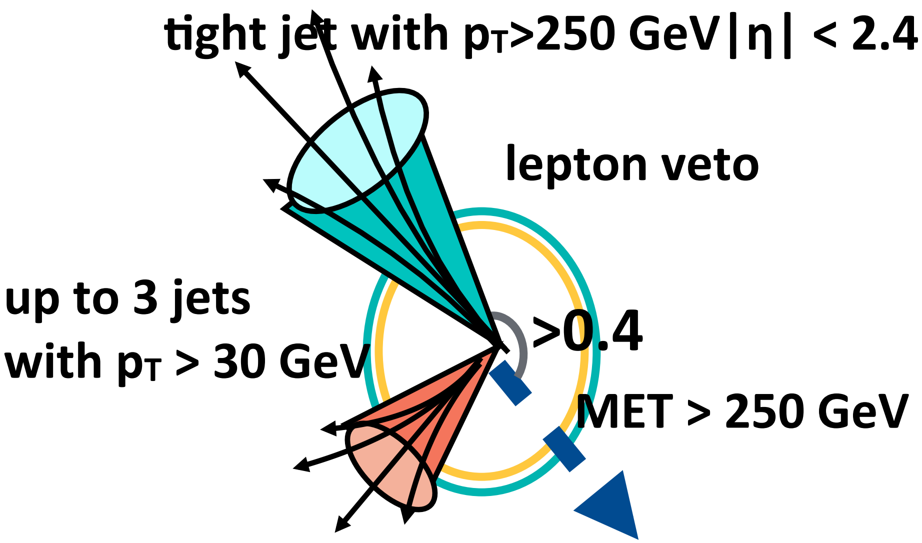
- Inclusive search for BSM models: **Invisible Higgs**, **DarkMatter**, **LargeExtraDimension**
- Basic selection: require at least 1 bjet + Missing Transverse Energy (MET) + veto leptons
- **Backgrounds:** Z(νν) + jets, tt, W(lν)+jets
- **Basic selection:** require at least 1 (b)jet + Missing Transverse Energy (MET) + veto leptons

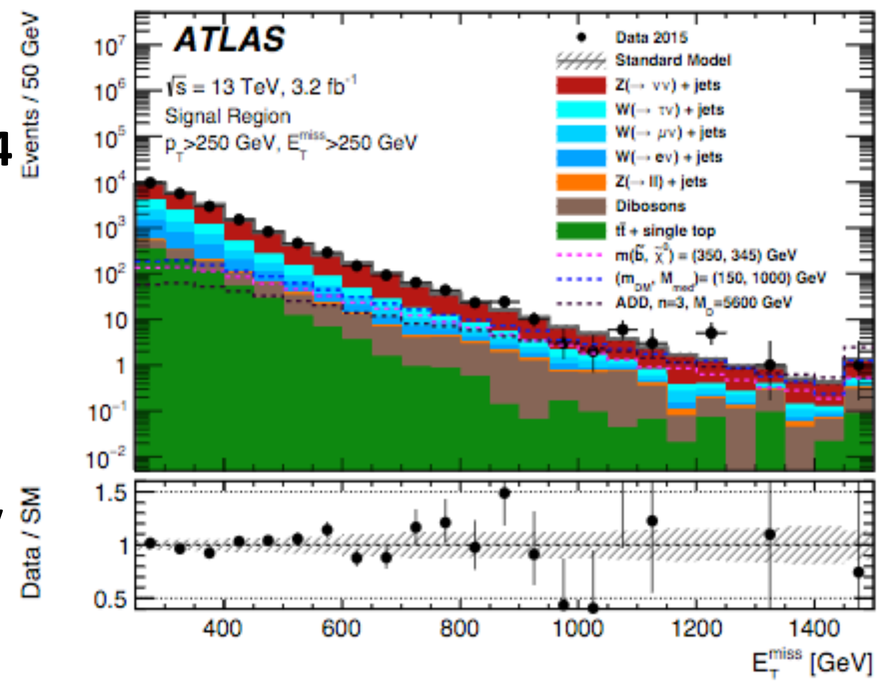




MonoJet Analysis

- Inclusive search for BSM models: **Invisible Higgs**, **DarkMatter**, **LargeExtraDimension**
- Basic selection: require at least 1 jet + Missing Transverse Energy (MET) + veto leptons
- Backgrounds: Z(νν) + jets, tt, W(lν)+jets





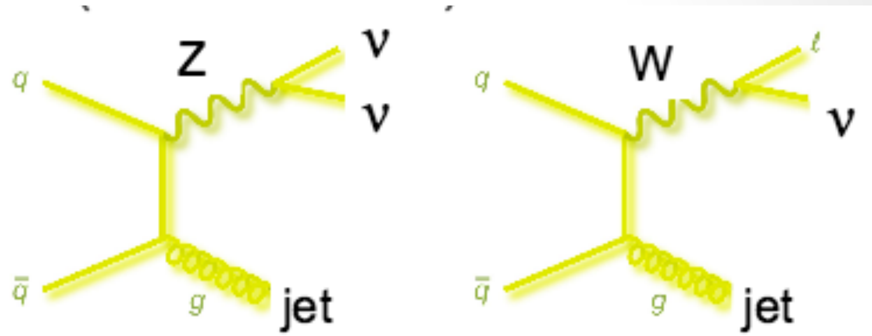
2015 data: no significant excess observed w.r.t. SM prediction

Paper with the full 2015/2016 dataset in preparation in the Moriond timescale

Big effort of Napoli's team in analysis and editing

Mono-bJet Analysis

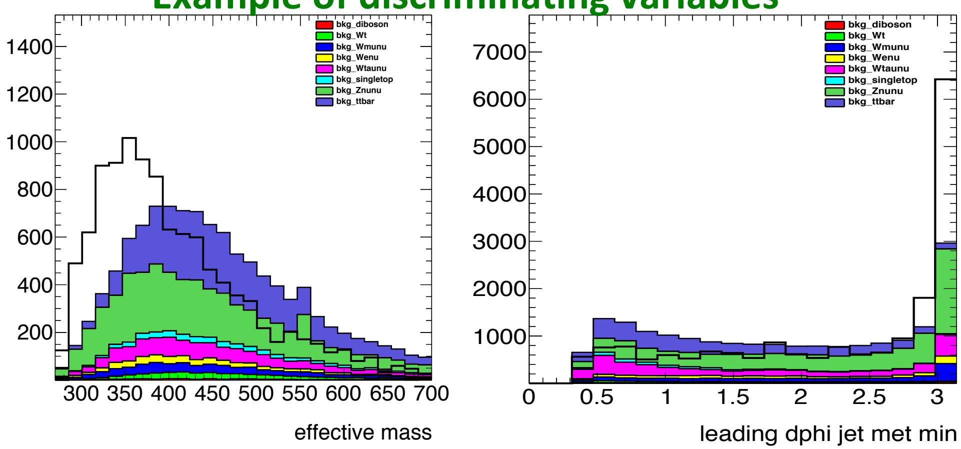
- Inclusive search for BSM models: **Invisible Higgs**, **DarkMatter**, **LargeExtraDimension**
- Basic selection: require at least 1 bjet + Missing Transverse Energy (MET) + veto leptons
- Backgrounds: Z(νν) + jets, tt, W(lν)+jets



Responsabilita' del gruppo di Napoli:

- **Ottimizzazione della selezione**
- **Stima del fondo Wjets and tt**
- **Interpretazione statistica**

Example of discriminating variables



Paper with the full 2015/2016 dataset in preparation in the Moriond timescale

Napoli's team main analyzers

Big effort also in editing

LHC Schedule

2009		LHC startup $\sqrt{s}$=900 GeV, Phase-0
2010–2012		**Run-I (2011-2012):** $\sqrt{s}$= 7 and 8 TeV, L=6x10^{33} cm^{-2}s^{-1}, bunch spacing 50ns, 75% of nominal luminosity → ~25fb^{-1}
2013–2014	LS 1	Long Shutdown 1 (LS1) → Go to design energy and nominal luminosity
2015–2018 (2016)		**Run-II (2015-2018):** $\sqrt{s}$= 13 and 14 TeV, L=10^{34} cm^{-2}s^{-1}, bunch spacing 25ns → ~75fb^{-1}
2019–2020	LS 2	LS2 → Injector + Upgrade to LHC Phase-1 to ultimate design luminosity
2021–2023		**Run-III (2020-2022):** $\sqrt{s}$=14 TeV, L=2x10^{34} cm^{-2}s^{-1}, bunch spacing 25ns → ~300fb^{-1}
2024	LS 3	LS3 → Upgrade to HL-LHC Phase-2 (ATLAS scoping document → CERN-LHCC-2015-020)
		Run-IV: $\sqrt{s}$=14 TeV, L=5x10^{34} cm^{-2}s^{-1} → ~3000fb^{-1}

Phase-0: LHC startup through Run-II

Phase-1: LS2 and Run-III

Phase-2: LS3 and Run-IV

Upgrades

Team @ Napoli:

Phase-1 Upgrades

- **New Muon Central Trigger Processor Interface (MuCTPI) Interface Board:** V. Izzo, R. Giordano, S. Perrella, G. Di Luca

- **New Small Wheel MicroMegas:** M. Alviggi, M. Camerlingo, V. Canale, R. De Asmundis, M. Della Pietra, C. Di Donato, C. Grieco, P. Massarotti, G. Sekhniaidze
- **New Small Wheel Electronics:** V. Izzo, S. Perrella, R. Giordano, N. Marino

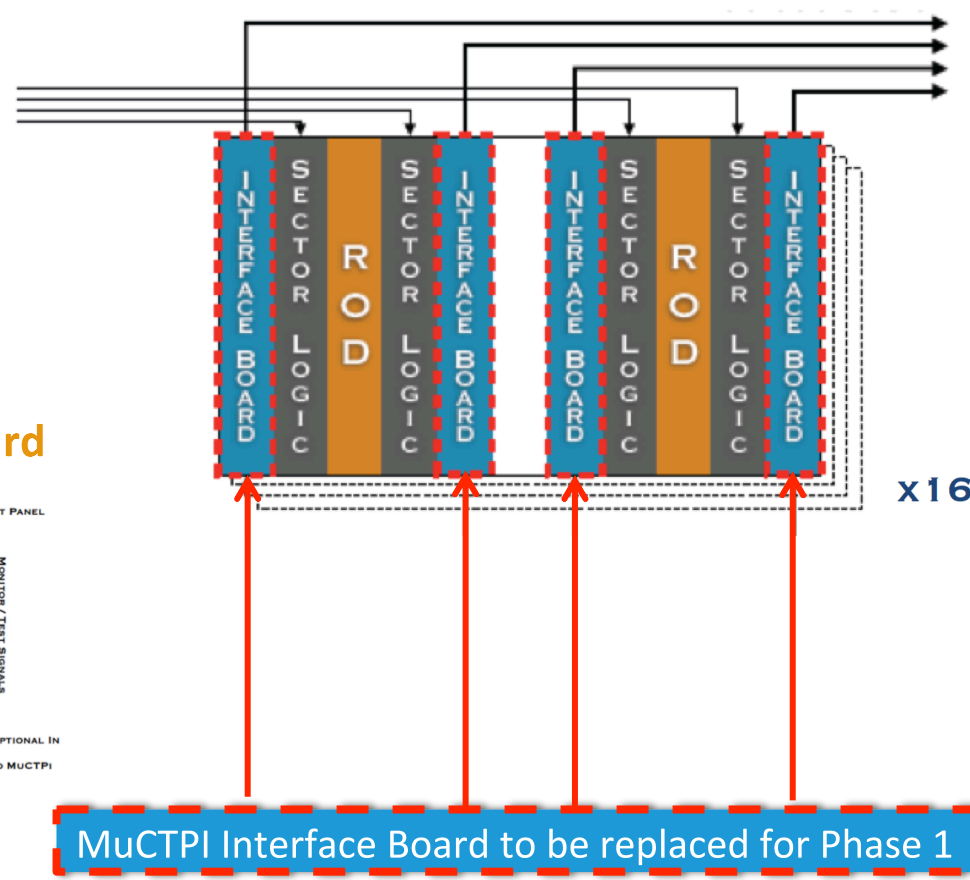
ATLAS NAPOLI

Phase-2 Upgrades

- **Muon Tagger:** M. Alviggi, M. Camerlingo, V. Canale, M. Della Pietra, C. Di Donato, C. Grieco, G. Sekhniaidze

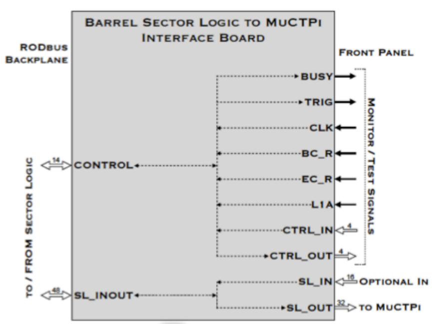
Phase1: New MuCTPI Interface Board

*INFN Napoli, Roma1, Roma2

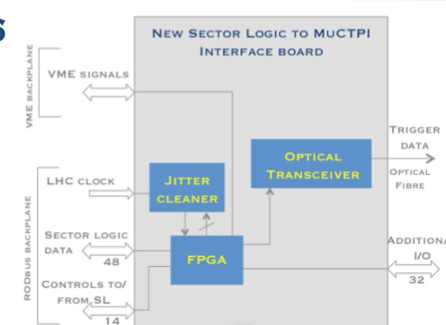


to Muon Central Trigger Processor Interface (MuCTPI)

Phase-0: actual board



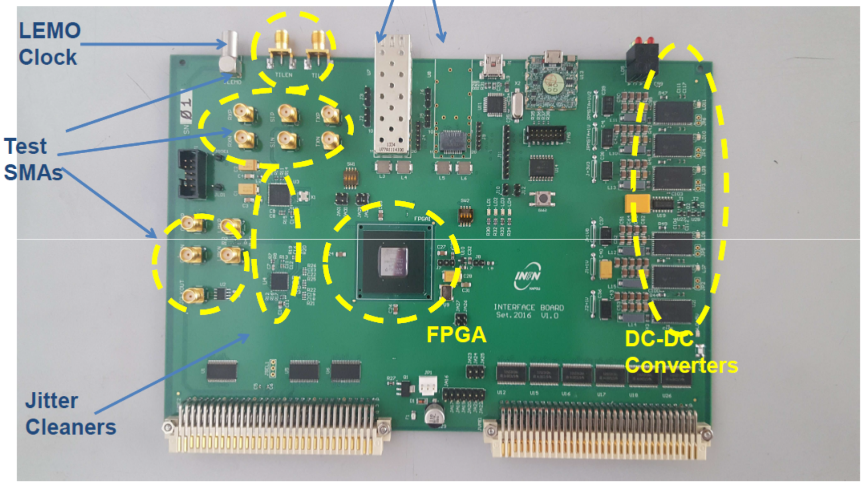
Phase-1: future board



- New Interface board equipped with a last-generation FPGA, allowing VME communication and serialization to MuCTPI via optical fibre
- Optical SFP+ transceiver, Data Rate: 6.4 Gb/s: 128 bit @ 40 MHz or 64bit @ 80MHz (Phase-0: 32 bit @ 40 MHz on copper cables)
- Serialization logic synchronous with 40 MHz LHC clock

Phase1: New MuCTPI Interface Board

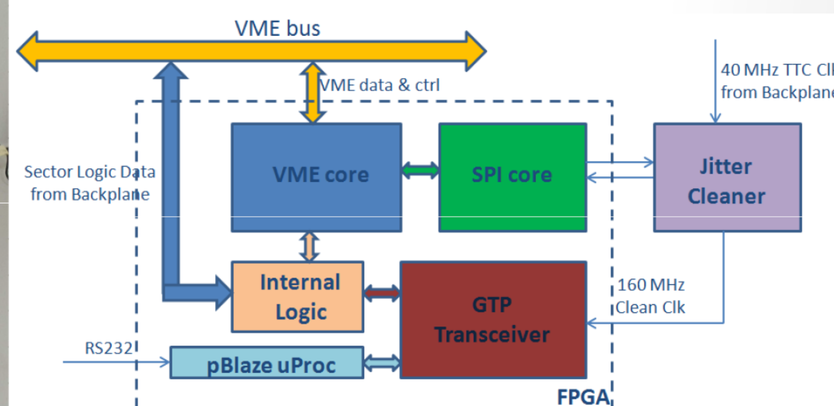
- **Interface board to MuCTPI @Napoli (V. Izzo, R. Giordano, S. Perrella, G. Di Luca):** development, production and test of the Interfaces boards to MuCTPI send data trough optical links from the Sector Logic (SL) in USA15 to Muon Central Trigger Processor (MuCTPI)



Power supply = OK
FPGA JTAG programming = OK
EPROM programming = OK

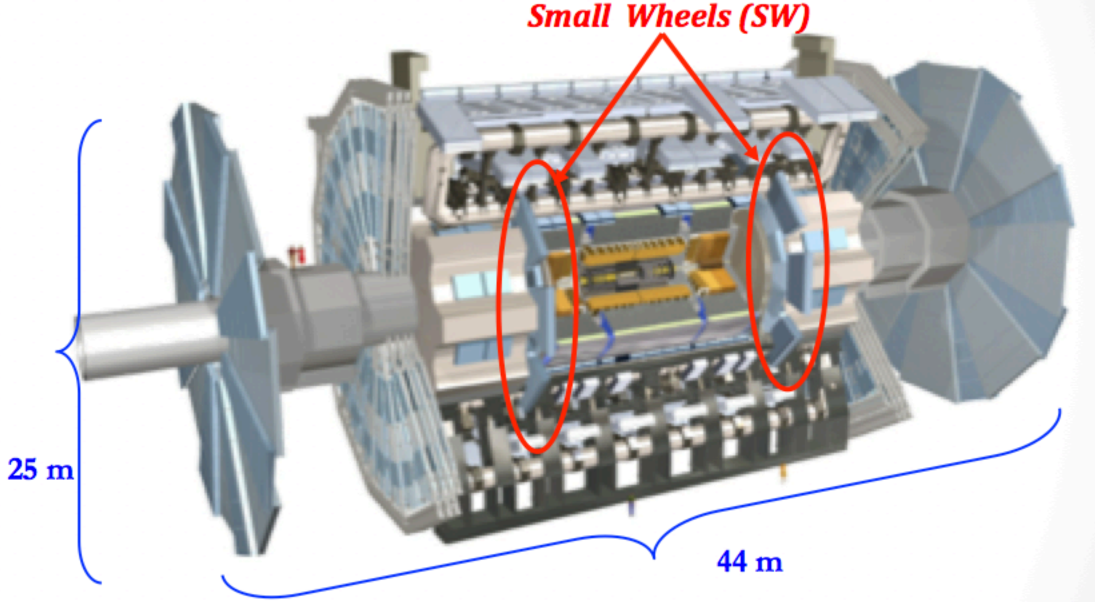
Serial Optical transmission = OK
Jitter cleaner test = to be done
VME communication test = to be done

Serial link tested on loopback, with IBERT @ 6.4 Gbps



Firmware development ongoing

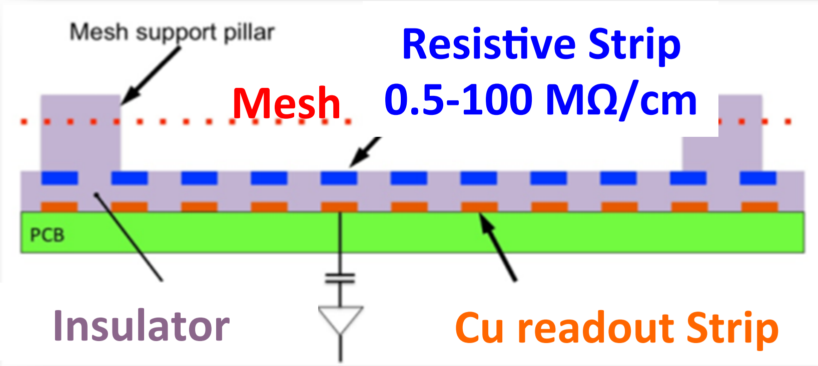
New Small Wheels



The New Small Wheel Upgrade with the replacement of the existing Small Wheels has the goal to address:

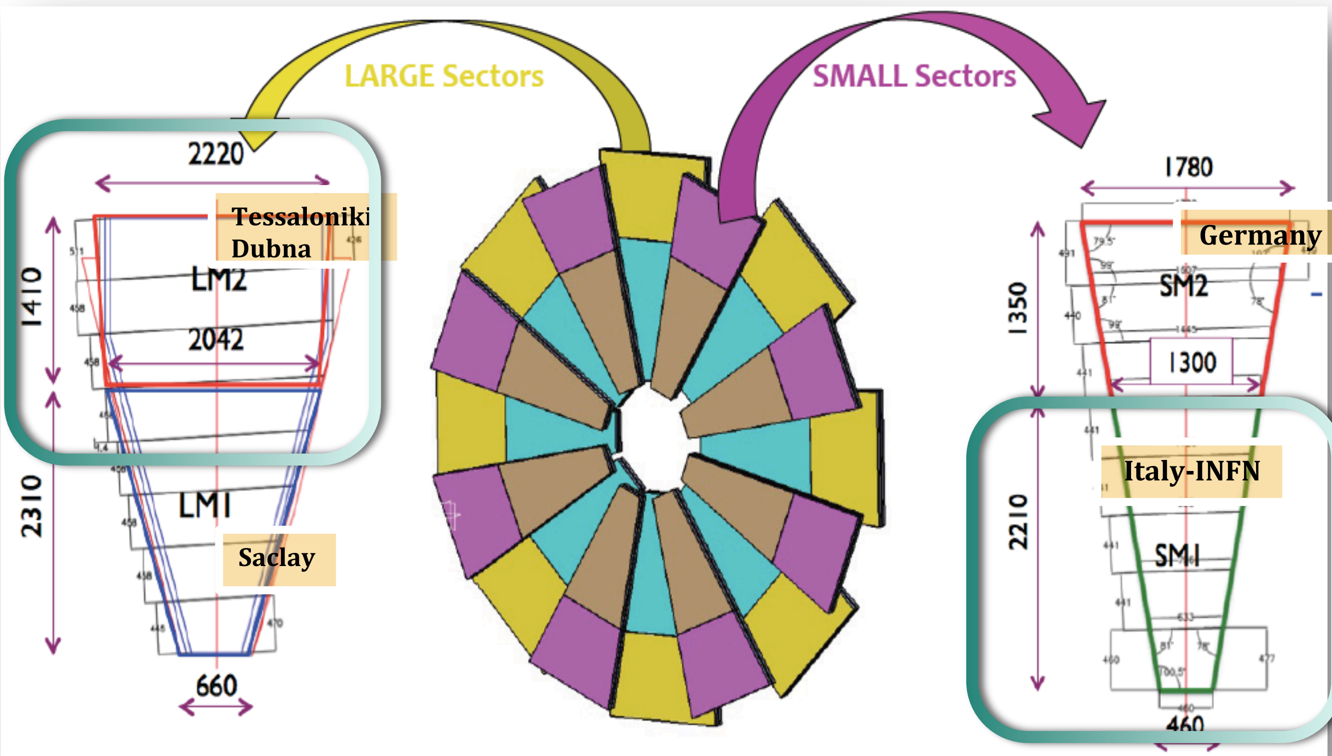
- The high fake track rate with the current setup
- Prohibitively high trigger Level 1 Muon rates if current p_T thresholds would be kept at luminosities as expected after LS2 and during the Phase-2 HL-LHC
- **Two detector technologies,** High redundancy, 16 active detection plane in total, technologies complement each other, both with trigger and tracking capabilities: **Micro-Mesh Gaseous detectors (MicroMegas)** and **small Thin Gap Chambers (sTGCs)**

Micro-Mesh Gaseous (MicroMegas) Chambers Construction



Micro-Mesh Gaseous (MicroMegas):

- 8 active layer with dimension up to 3 m^2
- Resistive Strips (to reduce sparks effect) +"floating mesh"



MicroMegas quadruplet construction type SM1 → Italy-INFN: Cosenza, Frascati, Lecce, Napoli, Pavia, Roma 1, Roma 3

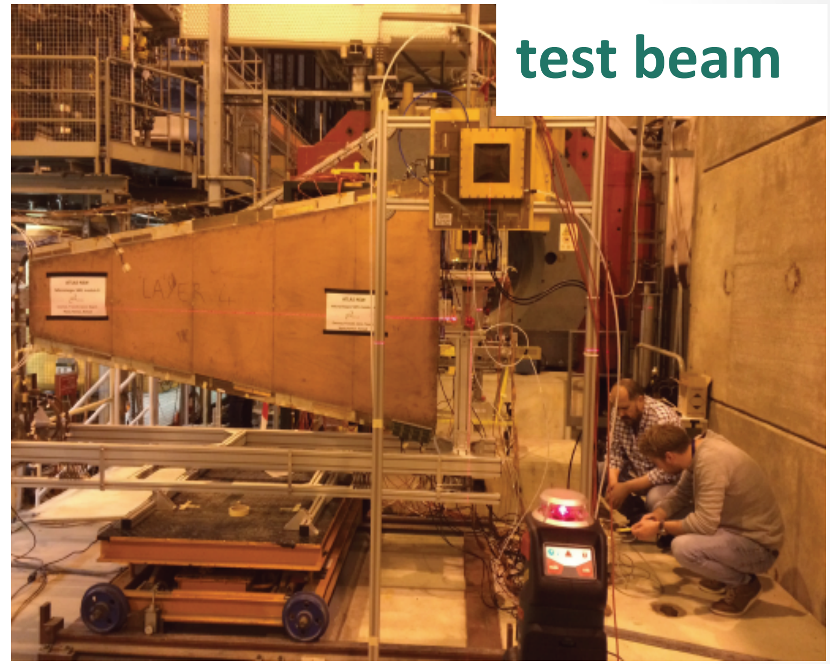
Napoli: Fabrication of tooling, Component Machining

SM1 Modulo0: Status and Plans

Realizzato a maggio 2016 e test beam a Giugno 2016

vista ‘frontale’ quadrupletto

test beam

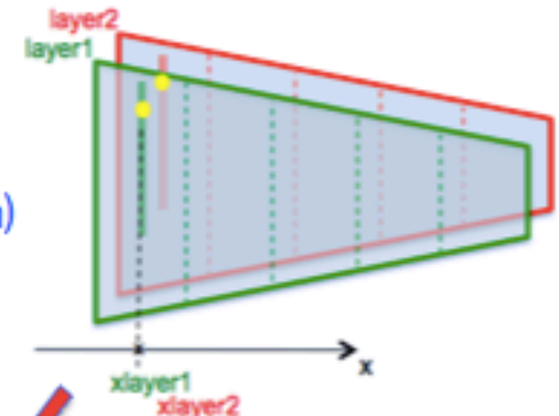


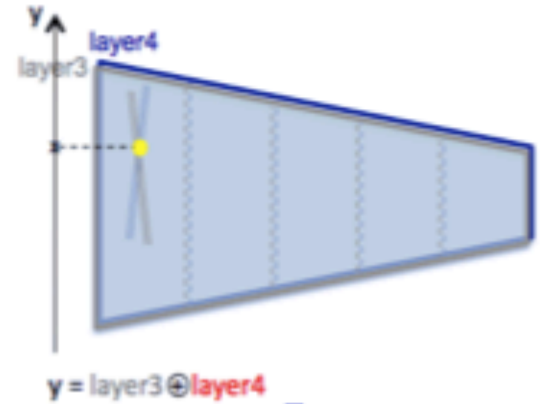
Next Steps:

- SM1 Mod0.5 a gennaio (preparazione pezzi e tooling con partecipazione OM e PM…)
- inizio produzione marzo 2017 (1 camera ogni 2/3 settimane)
- attualmente pronto anche il LM2 Mod0 realizzato al CERN

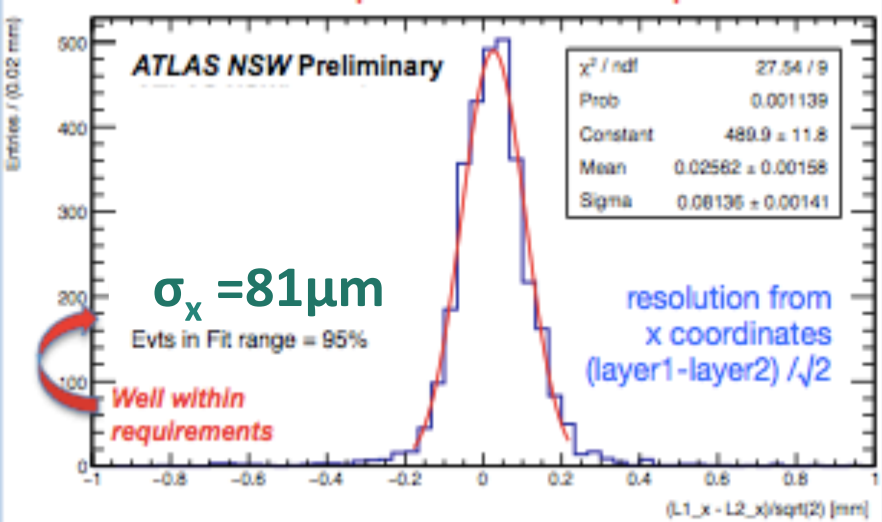
Test beam: Preliminary Results

- Perpendicular beam on PCB5 (PCB with longest strips)
- High Voltages:
  HV ampl = 570 V (E = 4.4×10^6 V/cm)
  HV drift = 300 V (E = 600 V/cm)
- Ar/CO_2 93/7 @ 20 l/h

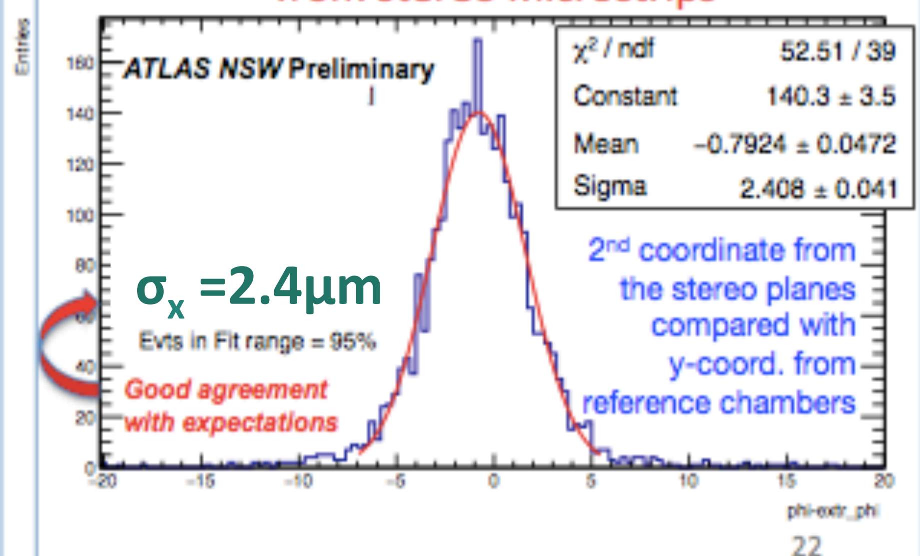




Resolution for the precision coordinate from parallel microstrips



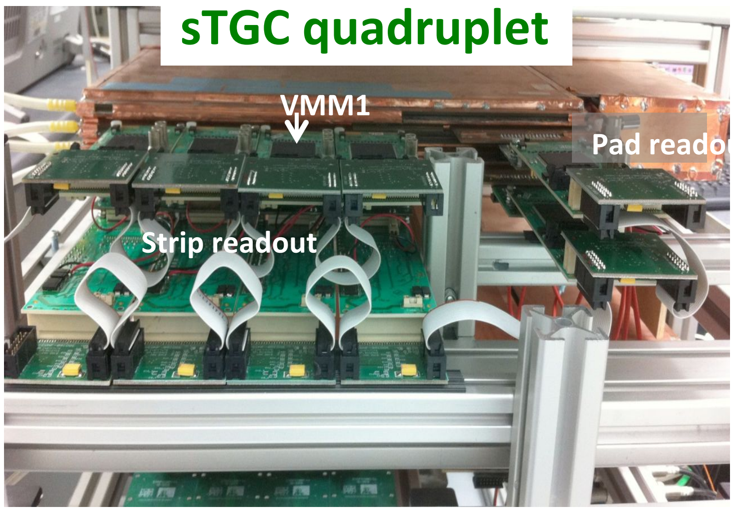
Resolution for the second coordinate from stereo microstrips



New Small Wheel: Electronics

NSW project involves detector construction and substantial electronics development:

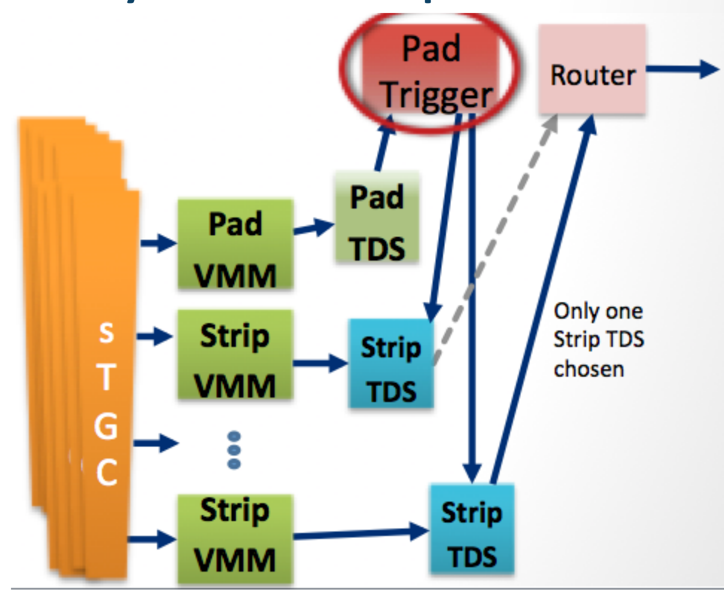
- New Frontend boards and VMM frontend chip, common to sTGC and MM
- Micromegas and sTGC trigger-on-detector electronics, off-detector processors ...
- **Napoli in collaboration with Roma1 is involved in the development of the sTGC PAD Trigger Board**



- **The PAD Trigger board is used to select the NSW regions having a hit, thus reducing the amount of data to be transferred Off-detector**
- **3/4 majority logic is required on both sTGC quadruplet.**
- **Strip-TDS sends only selected strip data to the routers.**

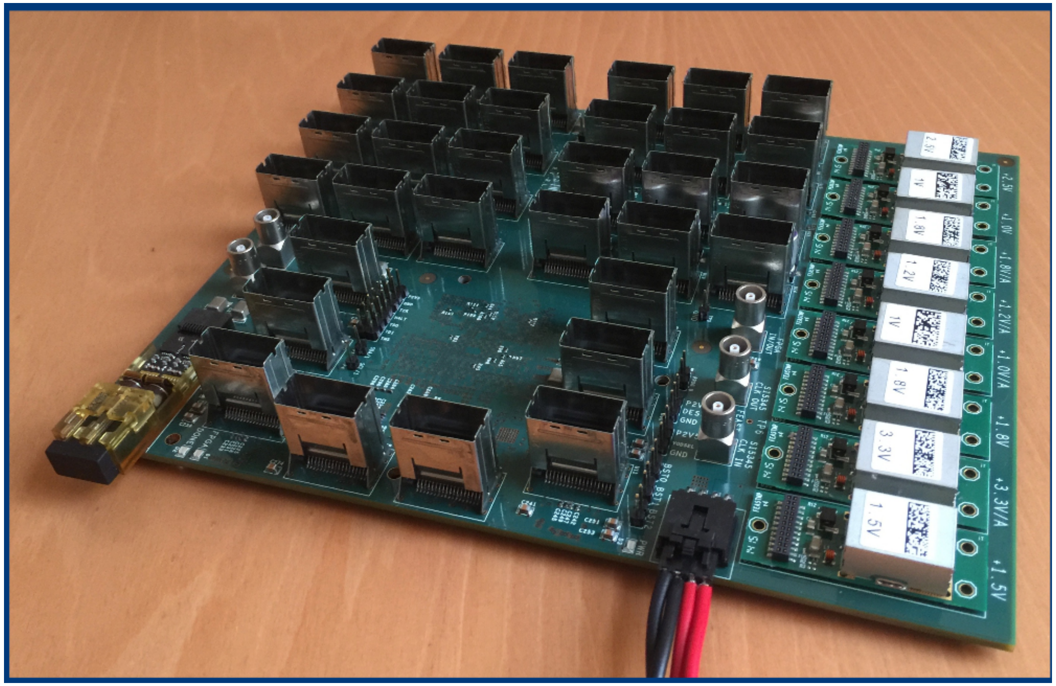
Activities in Napoli (V. Izzo, S. Perrella, R. Giordano, N. Marino):

- **Hardware and firmware development for the sTGC PAD Trigger Board**
- **Development of a fast serial link on FPGA for the DAQ MicroMegas and for the NSW Trigger**



New Small Wheel: Electronics

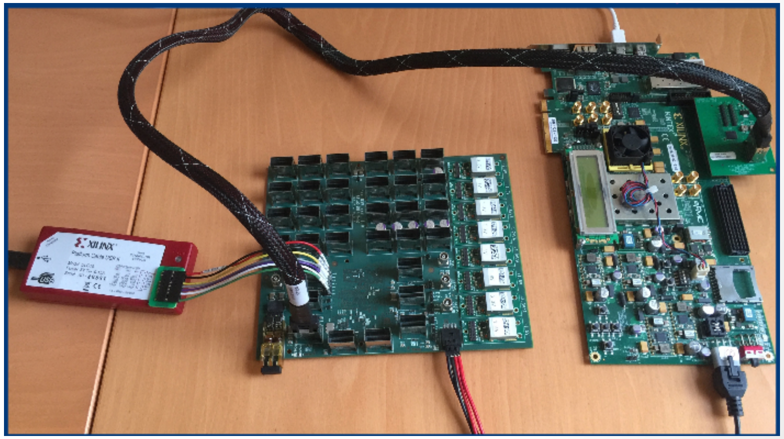
Prototype board designed in INFN Roma1 with essential contribution from Napoli



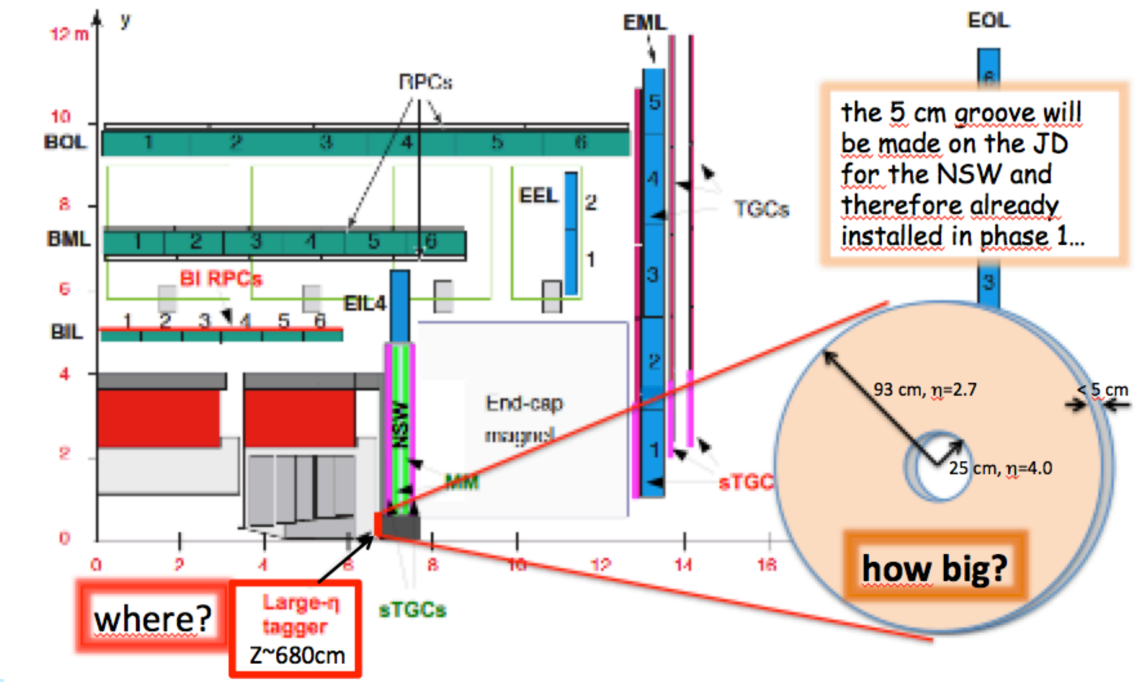
- Various integration tests in the NSW electronics chain foreseen in 2017

- Firmware being designed in early 2017

- Napoli is involved in the development of the high speed serial links for data transfer



Phase 2: Muon Tagger



why?
add muon identification capabilities for $2.7 < |\eta| < 4$, in conjunction with the coverage extension of the inner tracker

Detectors candidates:

focusing on Micro-Pattern Gaseous Detectors using the resistive anode technology developed for NSW MicroMegas

- Resistive micro-PIC (JAPAN)
- Micro Resistive Well (USTC)
- **MM with small pad readout (CERN, INFN)**

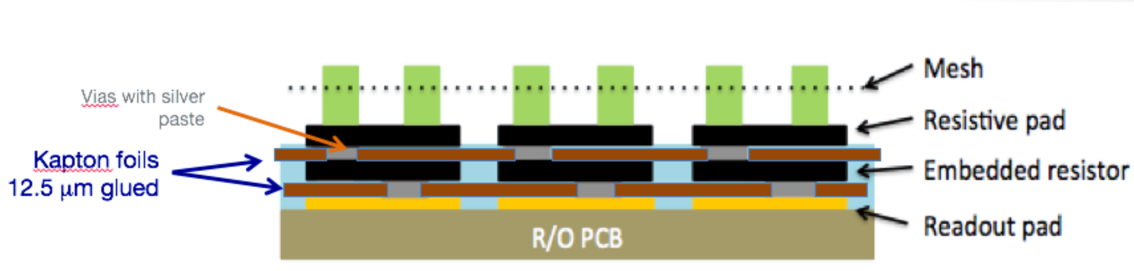
Requirements:

- Reconstruct a muon segment after the calorimeter: Matching with an ITK track (position, angle)
- **Operation at ~1-10 MHz/cm2 at R=25 cm**
- **Position resolution: few 100 mm**
- **Angle resolution ~ 10 mrad**
- **Requirements (greatly) relaxed at large R**

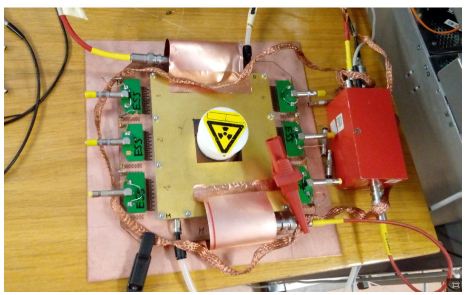
Detector R&D : Small Pads Resistive micromegas (CERN, INFN)

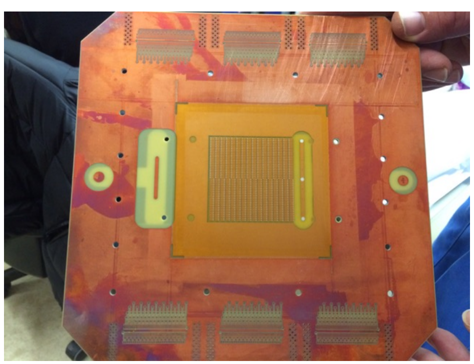
Prototypes built so far (Paddy1 and Paddy2): Matrix 48x16 – 1x3 mm^2 pads – 768 channels

"standard kapton insulating foils"
Tested without any problem of HV instabilities

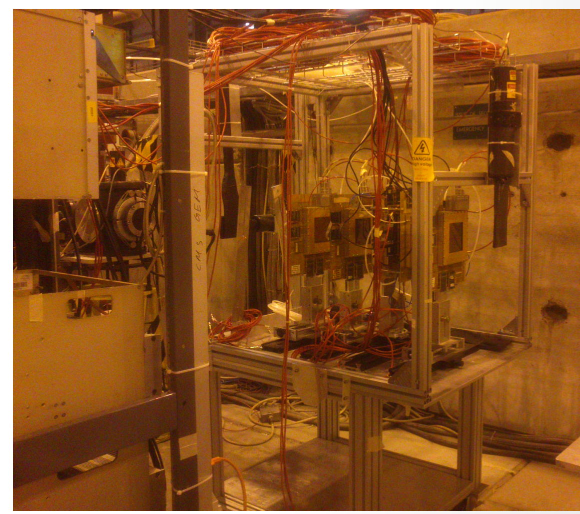


PROTOTYPES TESTED @ RD51 LAB AND H4 BEAM OCTOBER 2016





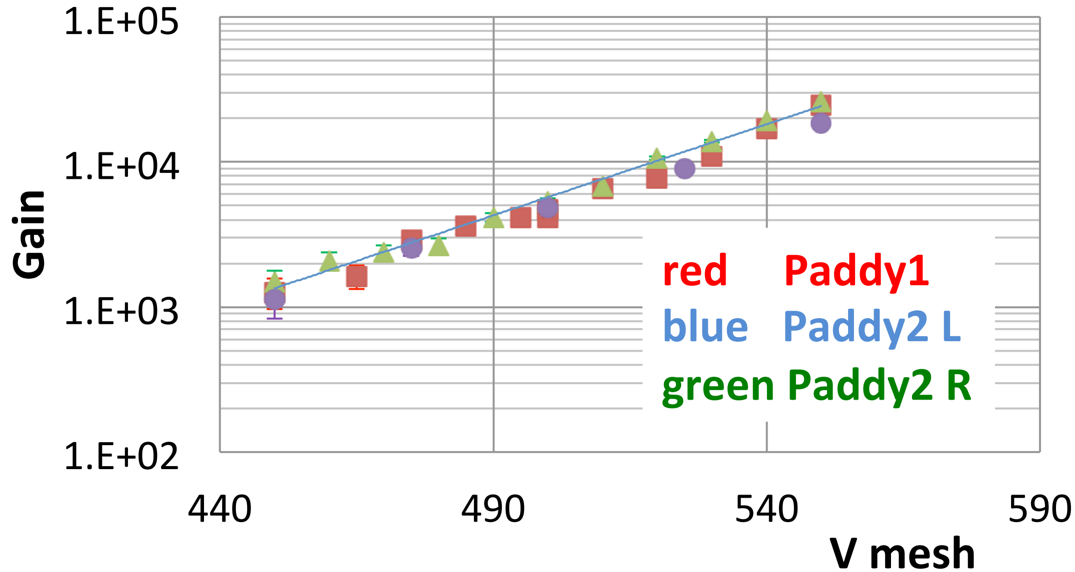
- High energy muons/pions beam
- Test Setup:
  - Small-pads MM
  - Two double readout (xy) small size bulk micromegas as reference
  - Ar/CO_2 93/7 pre-mixed gas; DAQ: SRS+APV25
- Efficiency Vs HV, Spatial resolution, Drift HV scan, Inclined tracks, Low/high intensity beam → rate capability

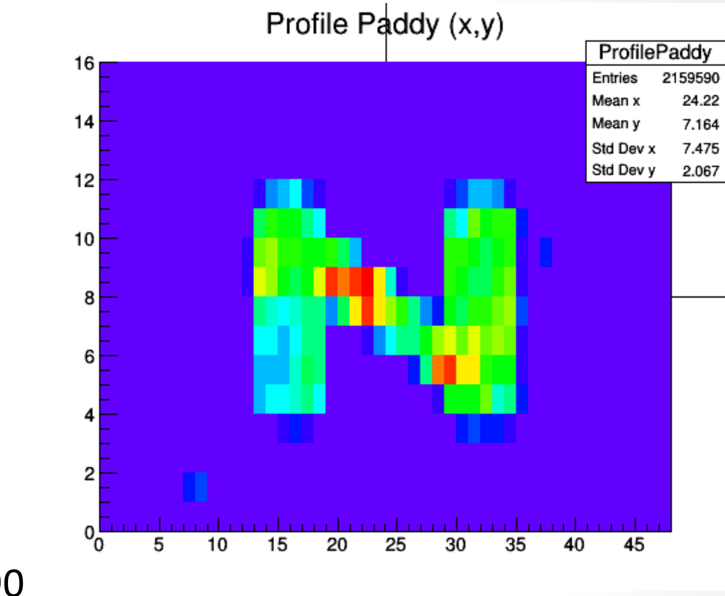


Some Results

Source Fe55: transparency, gain ,..
(compatible with bulk micromegas)

Pad MM with embedded resistors

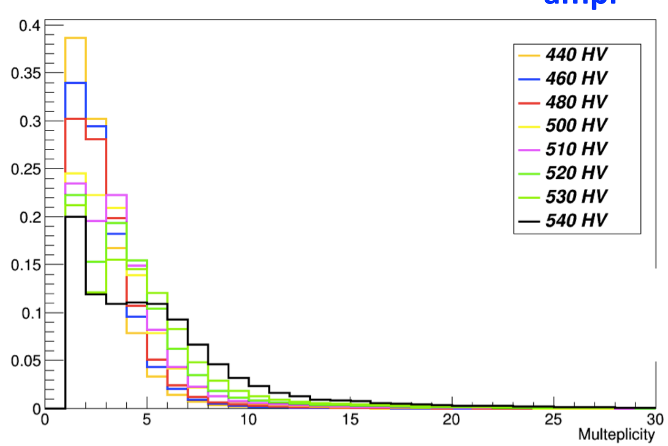




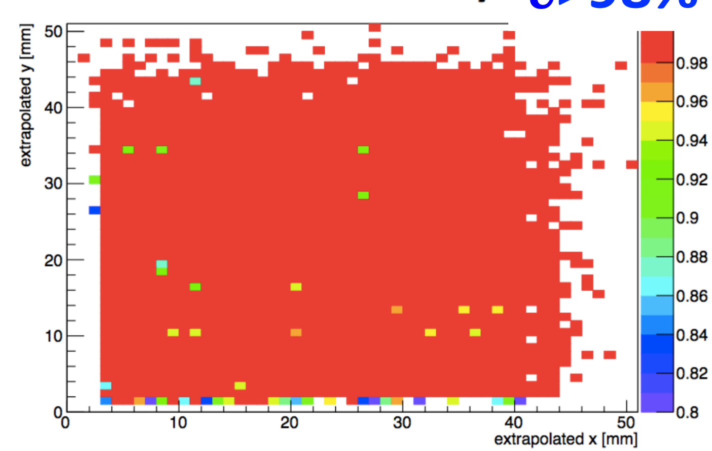
Test Beam (October)

Data analysis ONGOING

raw multiplicity vs V_{ampl}



Cluster efficiency ε>98%



E. Rossi

Il Tier2 di Napoli

- stato e attività -

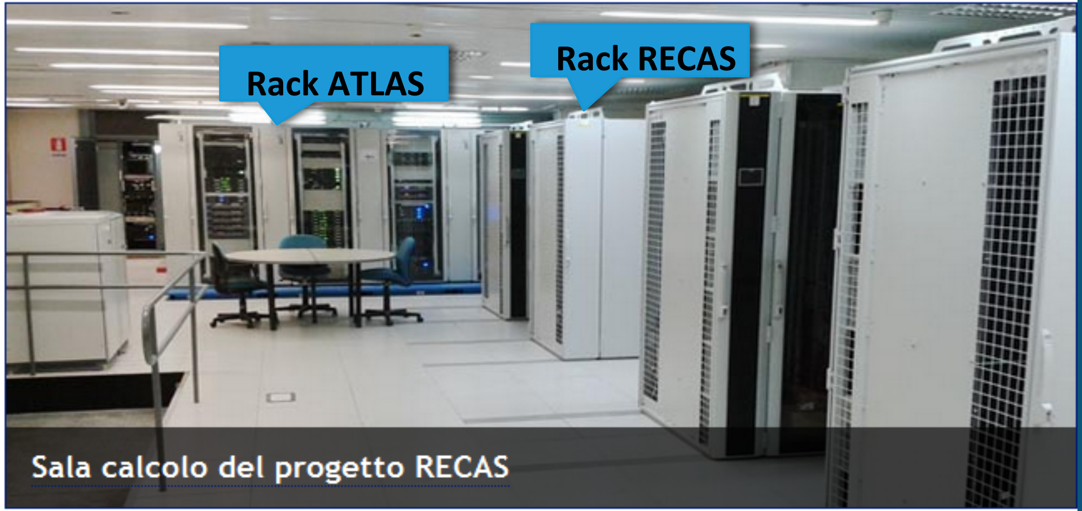
ATLAS NAPOLI

Team @ Napoli:

- **Tier2:** *G. Carlino, A. Doria, L. Merola, G. Russo, A. Sanchez*

Tier 2: Infrastruttura e risorse

L'infrastruttura (sistema di raffreddamento, gruppi di continuità, gruppo elettrogeno) utilizzata dal Tier2 di ATLAS a Napoli è integrata con quella realizzata per il progetto RECAS . E' utilizzata anche una parte dell'infrastruttura del precedente PON SCOPE.



Sala calcolo del progetto RECAS

In totale il Tier2 ha a disposizione 15 rack raffreddati , che contengono un totale di :

- **130 nodi di calcolo, ~ 2750 cores , ~ 3300 job slot**
- **~ 30 macchine di servizio**
- **~ 1.4 PB di spazio disco**

Aree di storage dedicate in base alle principali attività dei gruppi:

- **PHYS-HIGGS , TRIG-DAQ**

Attività specifiche a Napoli:

- **RPC e LVL1 Muon Trigger calibrazione e performance**

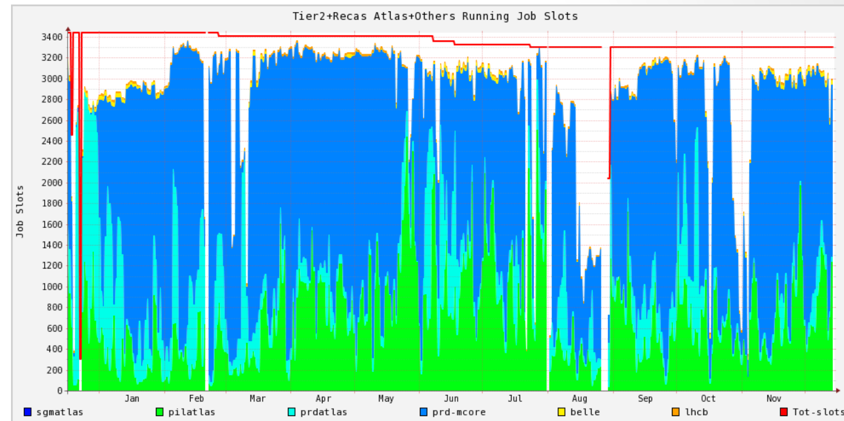
Uso delle risorse di calcolo per attività

- La maggior parte dei job di produzione di ATLAS girano su 8 cores
  - Simulazione (Geant4) e digitizzazione
  - Ricostruzione di dati reali e simulati

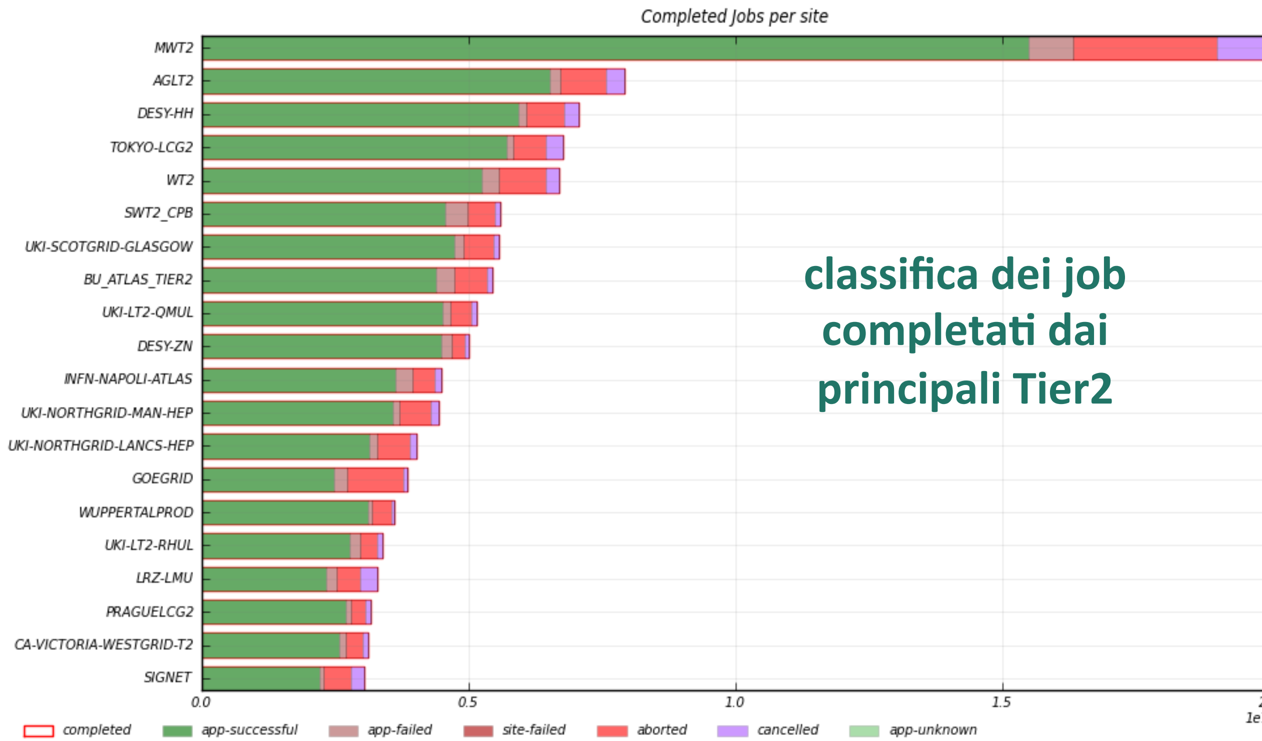
Rimangono per ora in single-core:
- Event generation
- User Analysis

- Una piccola frazione è riservata alla produzione
- di Belle

Se ci sono slot disponibili gira qualche job di LHCB



Alcuni "buchi" nel grafico sono dovuti a problemi legati all'infrastruttura (spegnimenti per black-out tipo 15 Agosto)



classifica dei job completati dai principali Tier2

Conclusions and Plans

- **Analysis:**
  - The ATLAS collaboration published **603** papers: all ATLAS public results are available https://twiki.cern.ch/twiki/bin/view/AtlasPublic/
  - Napoli Group very active in Diboson Resonance Searches
  - Napoli Group main analyzers for BSM Searches with (b)jet(s) and Missing E_T
- **Phase-1 Upgrades:** ATLAS detector and Trigger Upgrades ongoing
  - great effort from our team in particular for the New Small Wheel and MuCTPI interface board construction and design
- **Phase-2 Upgrades:** The project's development phase is very active and the changes will affect both the Detector and the Trigger system
  - Great involvement of our team for the Large η Muon tagger design and construction
- **Tier-2:** 3400 job running slot and ~ 1.4 PB disk capacity

Eagerly awaiting for updated results for Moriond 2017!

backup

ATLAS Upgrade for Phase-2

For Phase-2 to cope with ATLAS scopes and the very high luminosity many upgrade have been conceived. The project's development phase is very active and the changes will affect both the Detector and the Trigger system:

Trigger

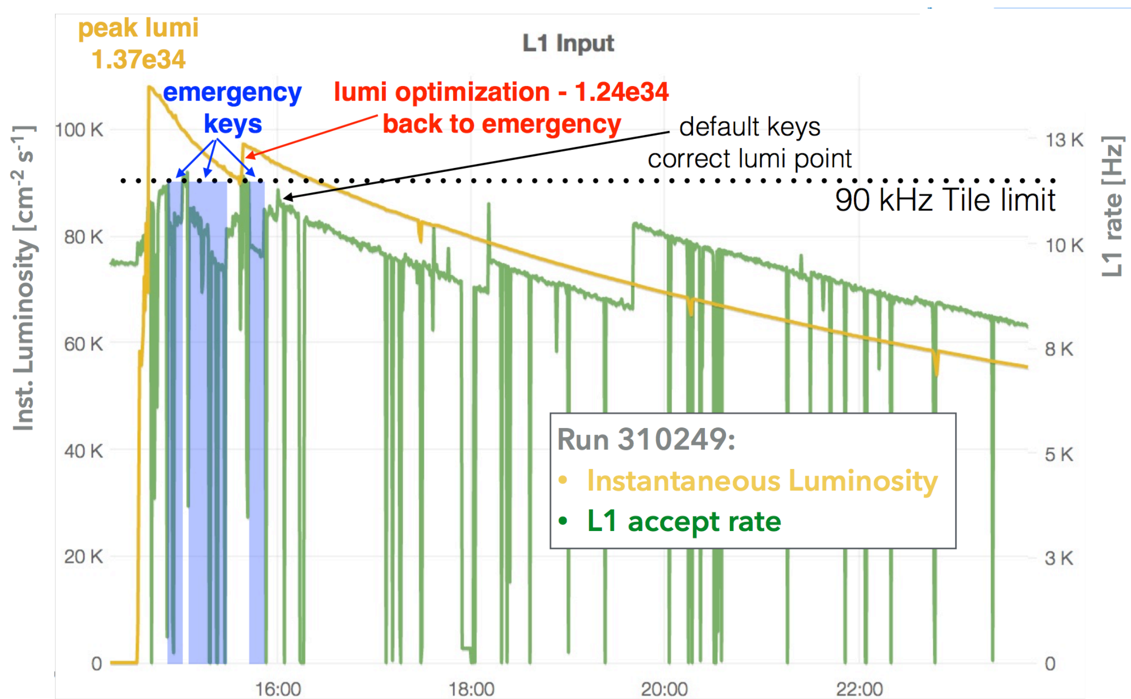
- New Trigger architecture: split the actual Level-1 in two sub trigger level → Level-0 and Level-1
- New detector readout
- Re-design of the Trigger Software
- **Great interest from INFN in many tasks and in particular in Level 1 Muon Barrel trigger (Roma1, Roma2, Napoli, Bologna) to higher the rate capability (from 100kHz to 500kHz) → electronic and trigger algorithms re-design**

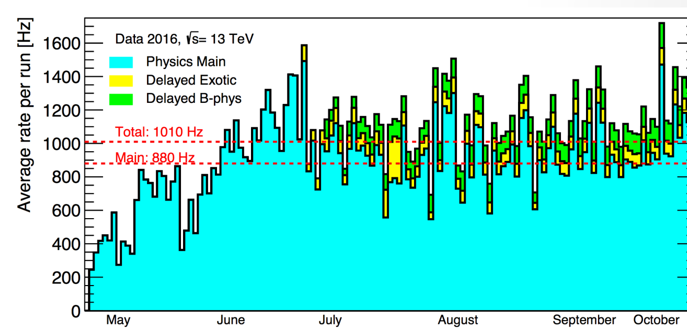
Detector

- **Muon Detector → great interest from INFN-Napoli** more details in the next slide
- **Calorimeters:**
  - **Lar:** new Front-end electronics (radiation damage and compatibility with the new trigger architecture) →**great interest from INFN (Milano)**
  - **TileCal:** New Read Out Electronics (radiation damage and compatibility with the new trigger architecture, increase of the Trigger informations) →**great interest from INFN (Pisa)**
- **Tracker:** the project is to replace the Inner Detector to cope with the high radiation damage and also to the very high occupancy, several possible scenario proposed (new detector with only pixel and silicon microstrip) →**great interest from INFN**

Trigger Operations in 2016

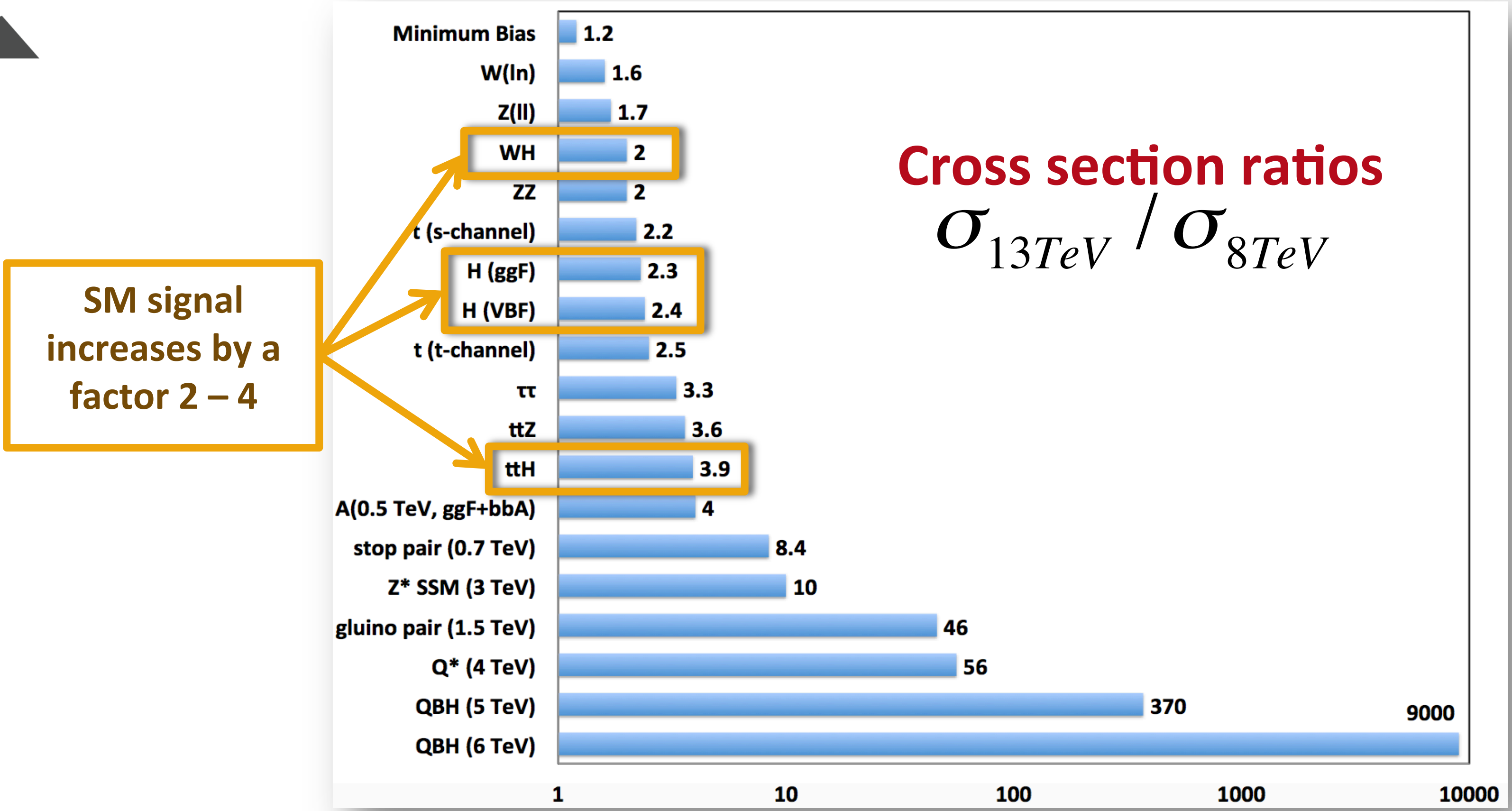
- Instantaneous luminosity develops over time
- **Menu evolution** covers the first aspect: Menu is defined up to a given peak luminosity and is valid for O(months)
- **Prescale evolution** covers the second aspect: within each run the lumi drops exponentially (*burn-off*) ➡ Prescales of some items can be relaxed over time
- menu carefully updated at lumi point to achieve **average output rate of Main stream ~1kHz**





Strategy developed (**Emergency prescales**) in order to guarantee L1 rate below 90 kHz (Tile limit) especially at the beginning of each run

Moving from 8 → 13 TeV



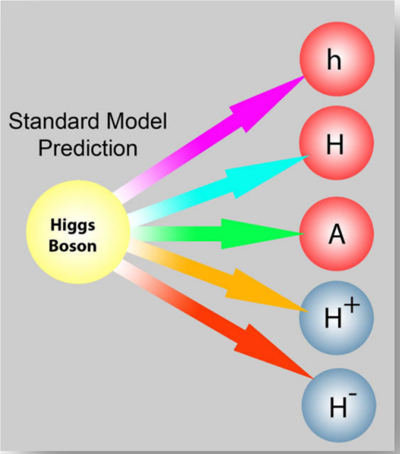
- ✧ Higgs signal increases by factor 2.3
- ✧ Background typically increases by factor 1.9 (3.3 for tt)
- ✧ Significance scales as S/√B → Sensitivity gain: 1.6
- ✧ Sensitivity scales with √L → √(25 fb^{-1}/ 10 fb^{-1}) = 1.6

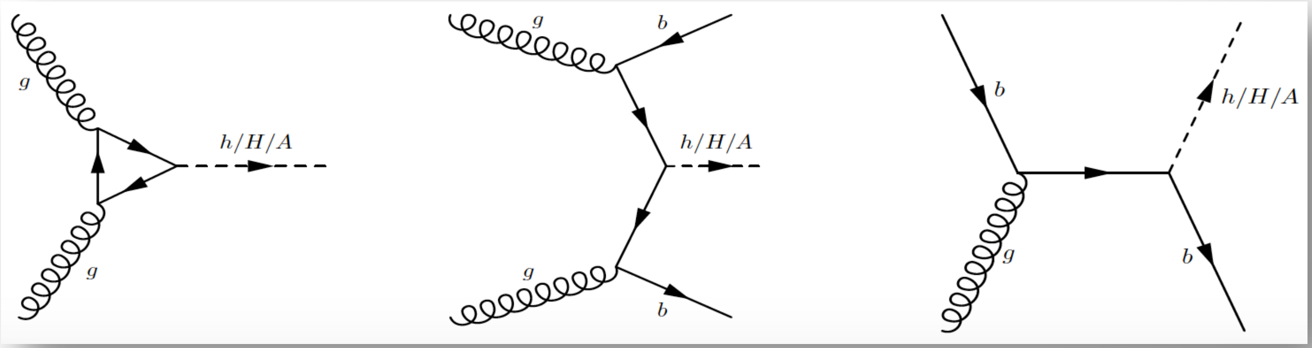
Di-boson Resonances and Neutral BSM Higgs searches

Di-boson searches VV, Vγ, VH, HH (V=W, Z)

- Predicted by many new physics models: HVT, W', Z', bulk RS graviton, 2HDM,…
- Valuable for SM physics, Vector Boson Scattering, and Three Gauge Coupling studies, HH will lead to the constraints of Higgs self-coupling
- If an excess is seen in one channel, measure the relative strengths in coupled channels —> e.g. Br(Zγ)/Br(γγ)
- understand the SU(2) structure of underlying theory

2 Higgs Doublet Models (2HDM) is one of the most promising model for SM extension predicting 5 physical bosons



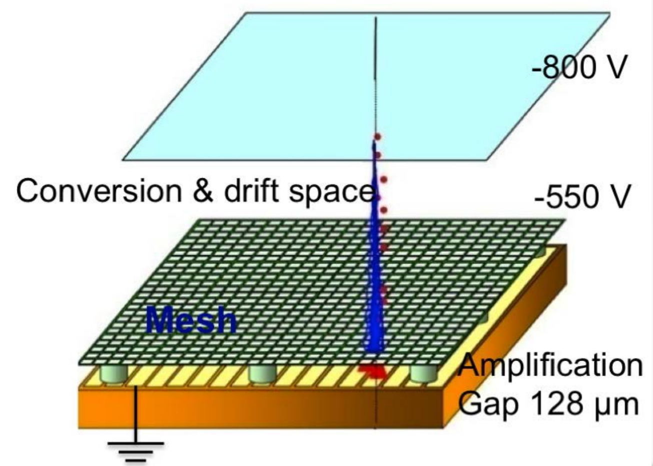


New Small Wheel Detectors

Two detector technologies, High redundancy, 16 active detection plane in total, technologies complement each other, both with trigger and tracking capabilities!

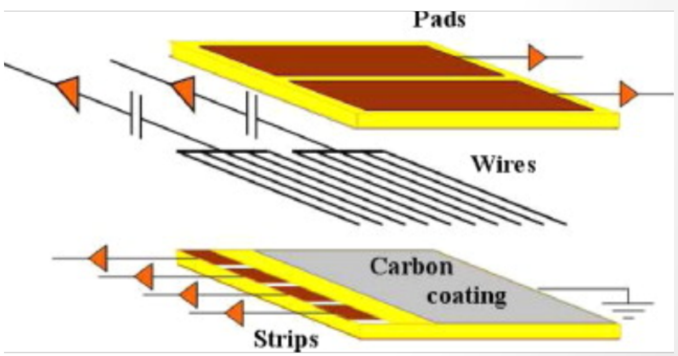
Micro-Mesh Gaseous detectors (MicroMegas) → primary precision tracker

- Space resolution < 100 μm independent of track incidence angle
- Good track separation due to small 0.5 mm readout granularity (strips)
- Excellent high rate capability due to small gas amplification region and small space charge effects



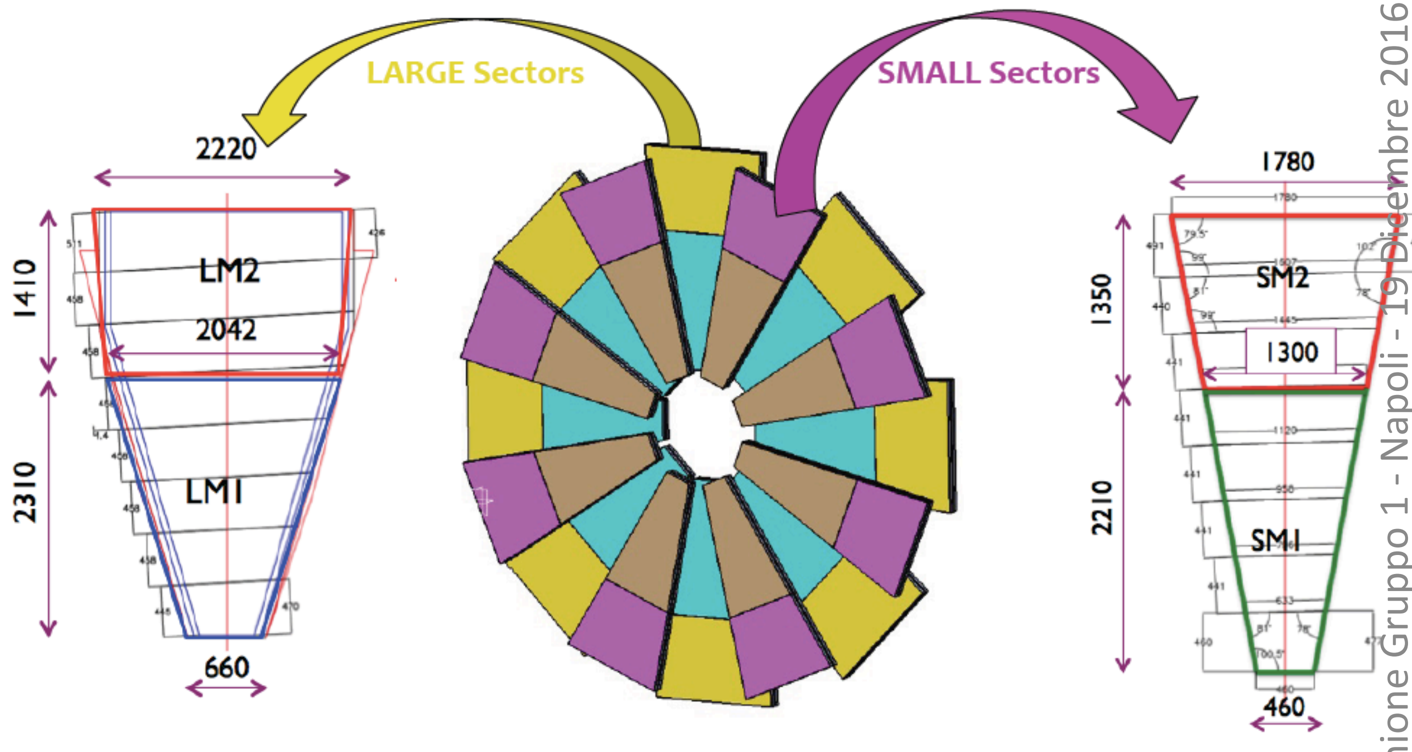
small Thin Gap Chambers (sTGCs) → primary trigger detector

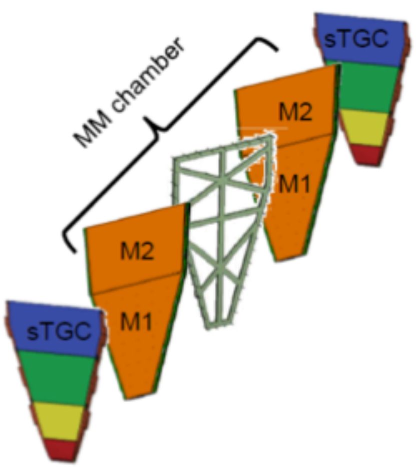
- Bunch ID with good timing resolution – additional suppression of fakes
- Good space resolution providing track vectors with < 1 mrad angular resolution
- Based on proven TGC technology, PAD electrodes instead of only strips as in current detector



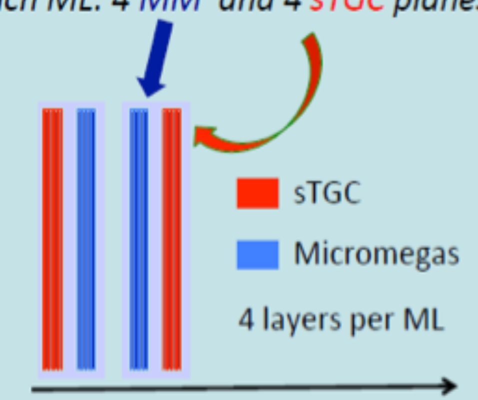
(a) a

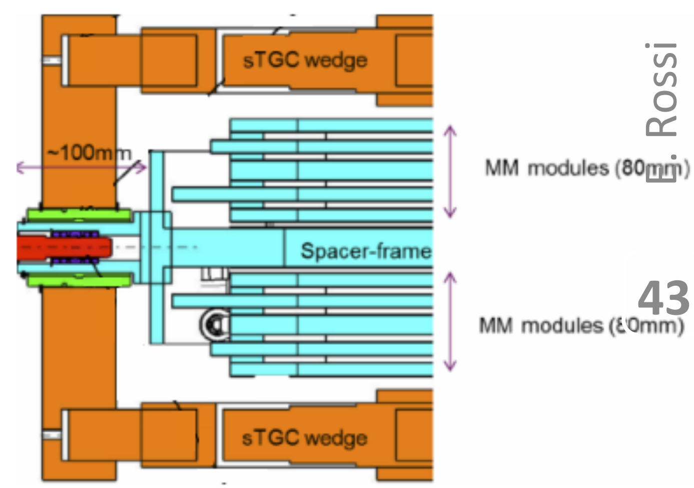
MM NSW





- *2 Multilayers per sector*
- *Each ML: 4 MM and 4 sTGC planes*





…in addition…

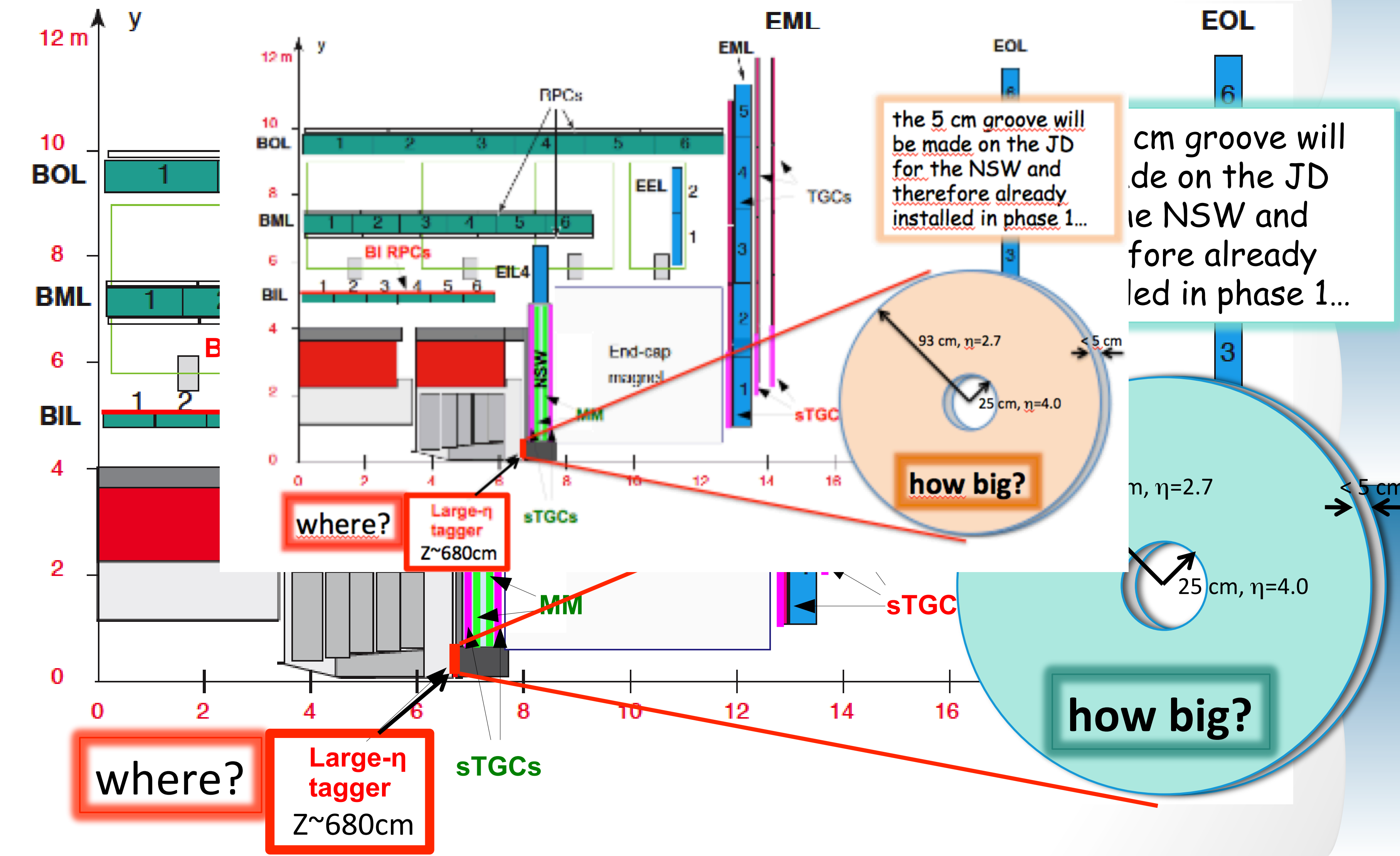
- front-end electronics
  - rad hard chips
  - high rate channels/chip (e.g. APV25, ATLAS SCT chip, …) and low power

- better evaluation of background (→ fake segments/tags)
  - ➢ **install small size detector in ATLAS** at the foreseen position for the large-eta Muon tagger → measure rates of neutrals and charged

- more simulation studies on performance
  - muon tagging performance
  - fake tags
  - ➢ number of detector layers

Phase 2: Muon Tagger

why?: add muon identification capabilities for 2.7 < |η| < 4, in conjunction with the coverage extension of the inner tracker



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Muon tagger requirements

Requirements:

- Reconstruct a muon segment after the calorimeter
- Matching with an ITK track (position, angle) determination of the muon p_T relies on Itk
- **Operation at ~1-10 MHz/cm2 at R=25 cm**
- **Position resolution: few 100 mm**
- **Angle resolution ~ 10 mrad**
- **Requirements (greatly) relaxed at large R**

Detectors :

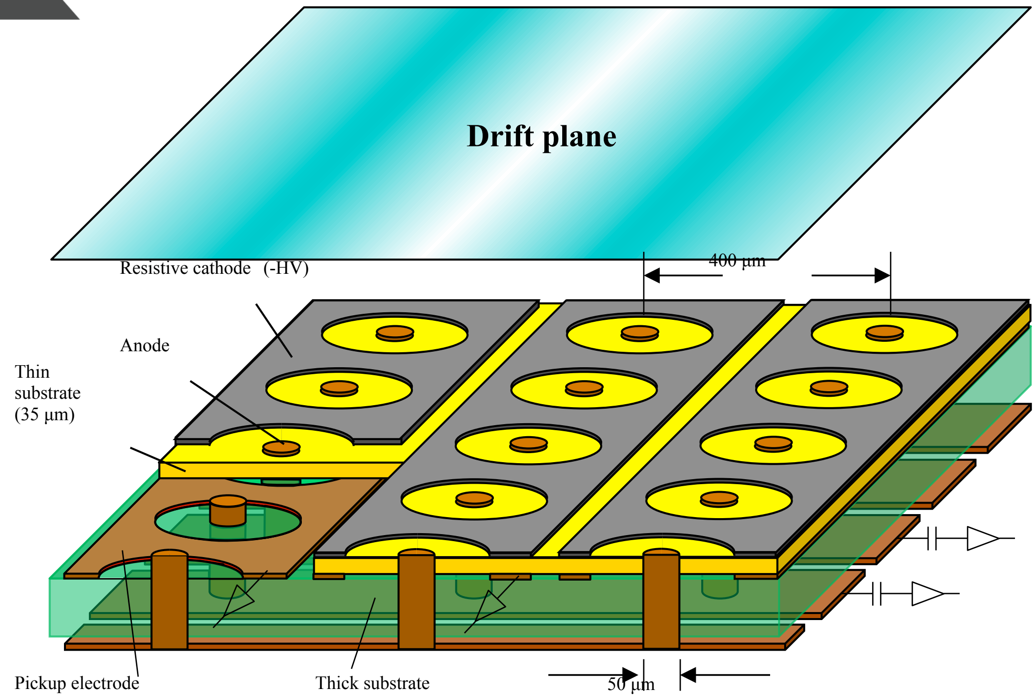
focusing on Micro-Pattern Gaseous Detectors using the resistive anode technology developed for NSW MicroMegas

(Si pixel detector satisfies the requirements, but too expensive…)

MPGD candidates:

- Resistive micro-PIC (JAPAN)
- Micro Resistive Well (USTC)
- **MM with small pad readout (CERN, INFN)**

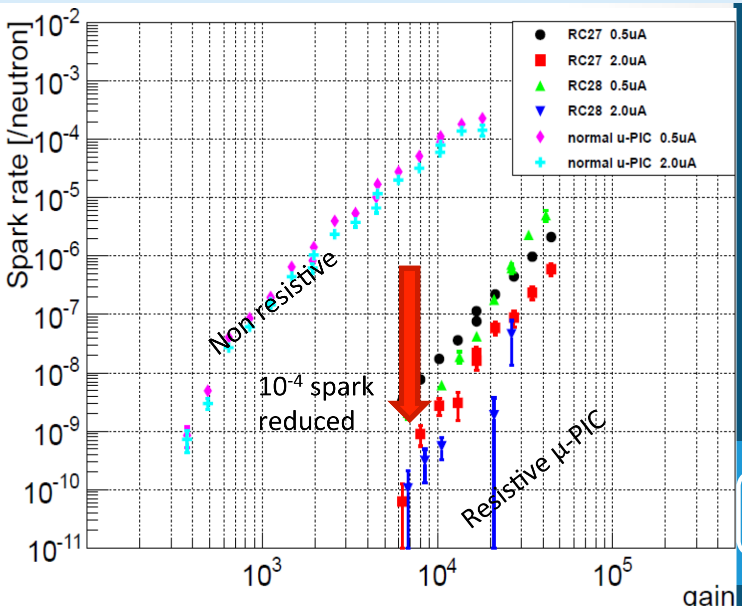
Resistive μ-PIC (Kobe Univ.)



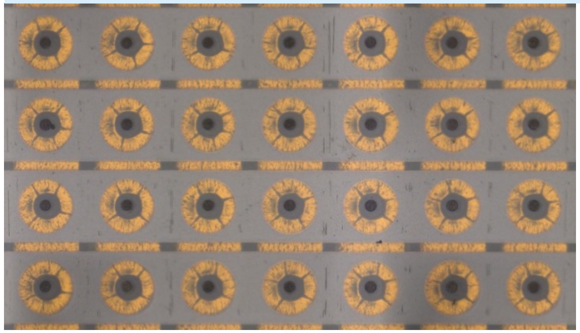
μ-PIC with resistive cathode

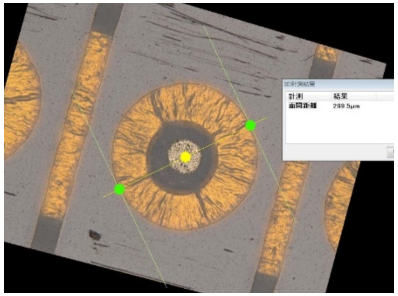
construction tecnique for large area yet too complicated....

Spark rate reduction using resistive μ-PIC for fast neutron



Resistive μ-PIC using sputtered carbon





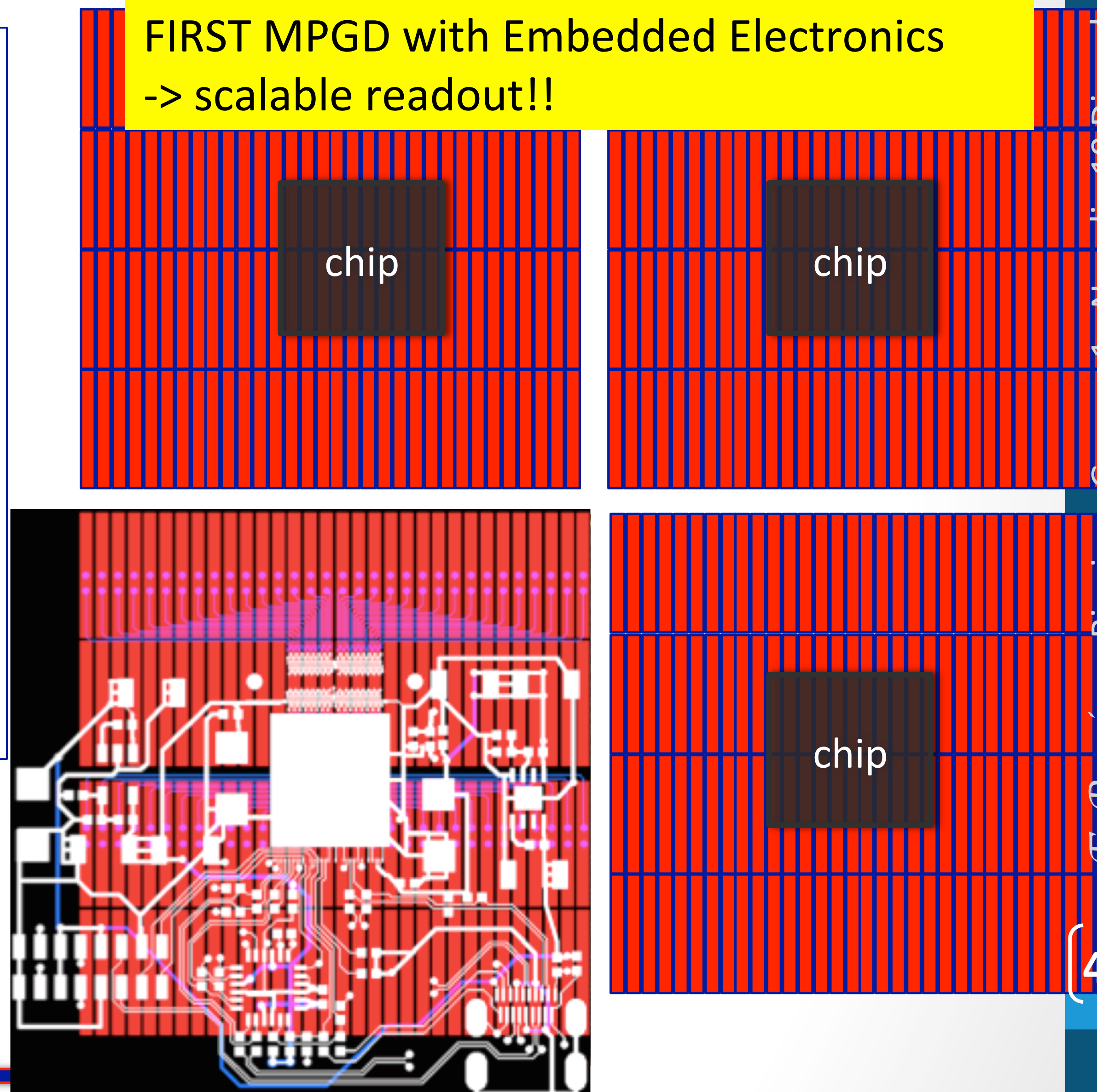
Embedded readout R&D: PADDY3

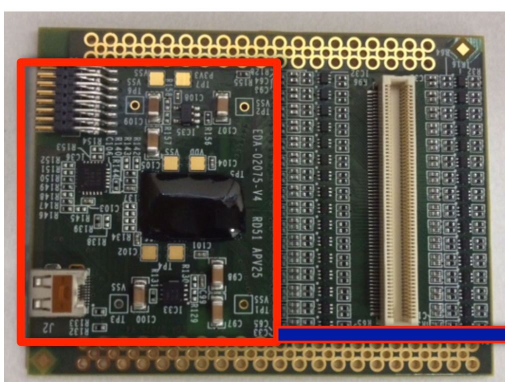
Divided in 4 regions
- 32x4 minipad each
- pad dimensions: 0.8 x 7.8 mm2
- pad pitches: x 1mm, y 8mm
- active area = 64x64 mm2 (4x (32x32)mm2)

Each region will be read out by a back wire bonded APV25 chip with its Front-end electronic reassembled on the detector board

→ 4 "master-like" APV hybrids (4 μHDMI connectors)

FIRST MPGD with Embedded Electronics
-> scalable readout!!

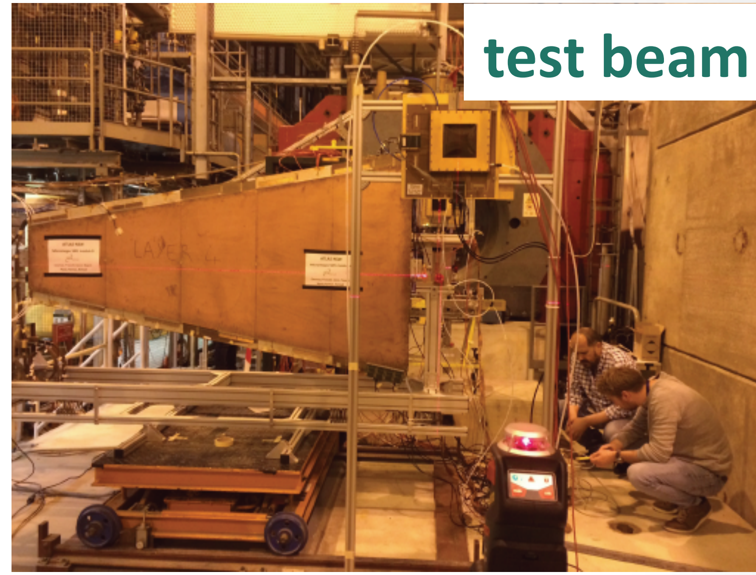


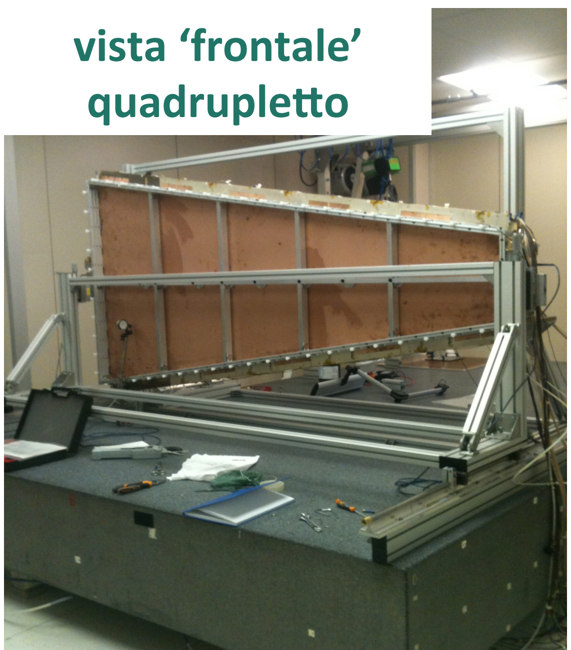

APV25 Hybrid by RD51

SM1 Modulo0: Status and Plans

Realizzato a maggio 2016 e test beam ad Ottobre


vista ‘laterale’ quadrupletto


test beam


vista ‘frontale’ quadrupletto

Next Steps:

- SM1 Mod0.5 a gennaio (preparazione pezzi e tooling con partecipazione OM e PM…)
- inizio produzione marzo 2017 (1 camera ogni 2/3 settimane)
- attualmente pronto anche il LM2 Mod0 realizzato al CERN