EMEC Sectors Analysis and Luminosity study using the EMEC HV system

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⌘Outline

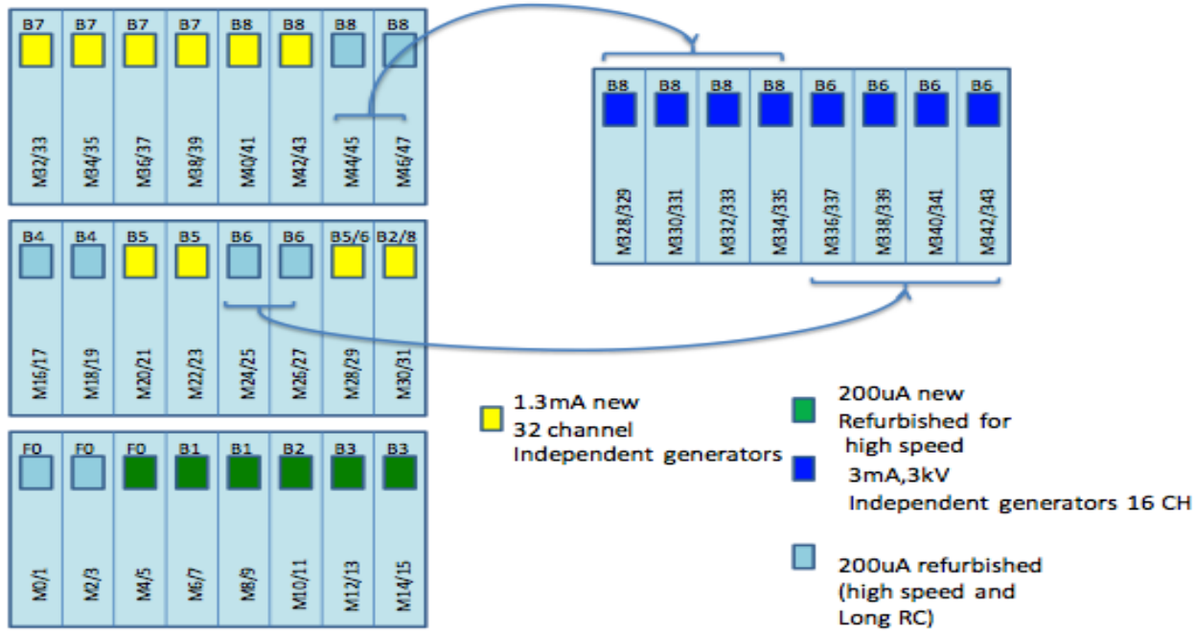
- ❖ **High-voltage channels selection**
- ❖ **Update in luminosity determination using EMEC HV current**
- ❖ **Comparison of 3 cross calibration methods**
  - ✧ *2-Parameter Fit of EMEC to BCM*
  - ✧ *Impact of EMEC Current Pedestal*
  - ✧ *1-Parameter Fit to EMEC Vs. BCM with direct Measurement of Current before collision*
- ❖ **EMEC Sectors Analysis**

⌘ High-voltage channels Selection/1

- The main feature of the EMEC is its variable gap size: the LAr gap increase when η decrease.
- In order to maintain a uniform response across the EMEC, the HV applied to the different η-sectors varies accordingly.
- The selection procedure was designed to identify issues that would affect the different EMEC sectors performance and ensure that only the best data will be used for luminosity determination .

❑ *New Modules insertion*

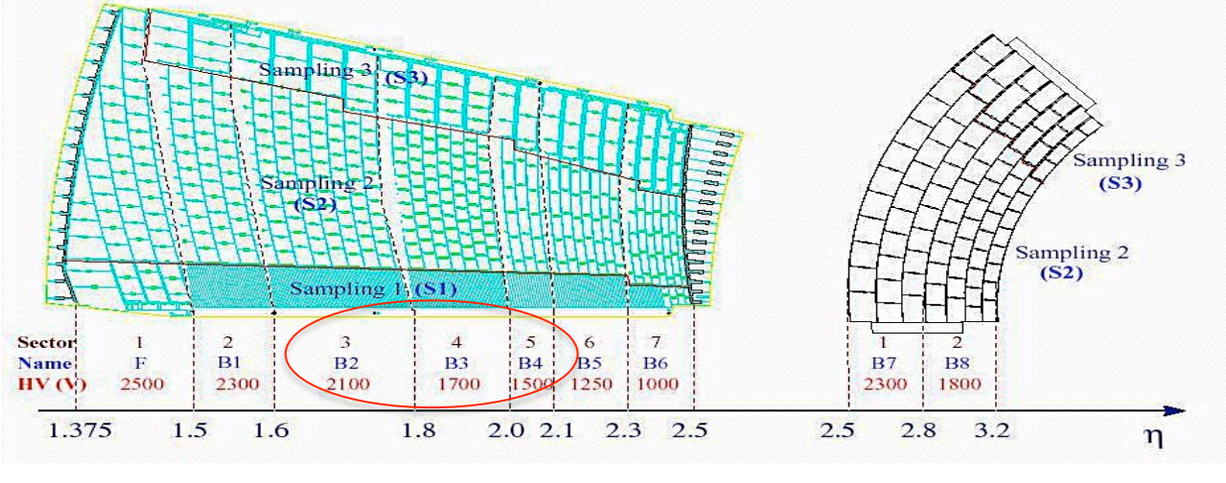
- Since 2010, the high-voltage experts decided to implement many features :
  - New philosophy 'auto-recovery mode' of HV trip management (new firmware : FW 4.34).
  - The EMEC sectors have been fed with HV modules with less sensitive to trips ('long RC').
  - New 32-channel HV modules equipped with independent HV generators are inserted to the sectors from B5 to B8.



❑ *Regular Change during 2012*

- The modules of sector F0 and B1 have known a regular change during 2012:
  - Many current noise studies in case of sector F0
  - Continuous problems in several channels of sector B1.

As result, we will ignore these sectors to retrain only the HV Lines of sectors B2, B3 and B4.



⌘ High-voltage channels Selection/2

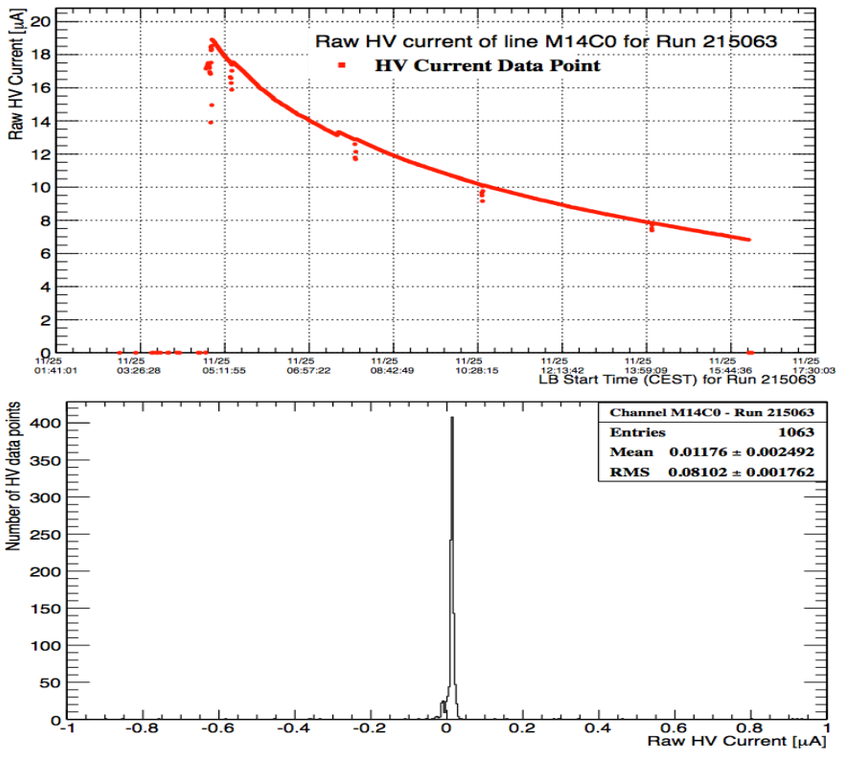
- The High-voltage lines selection has been performed through three different procedures to get a consistent picture of the HV current during each Run.

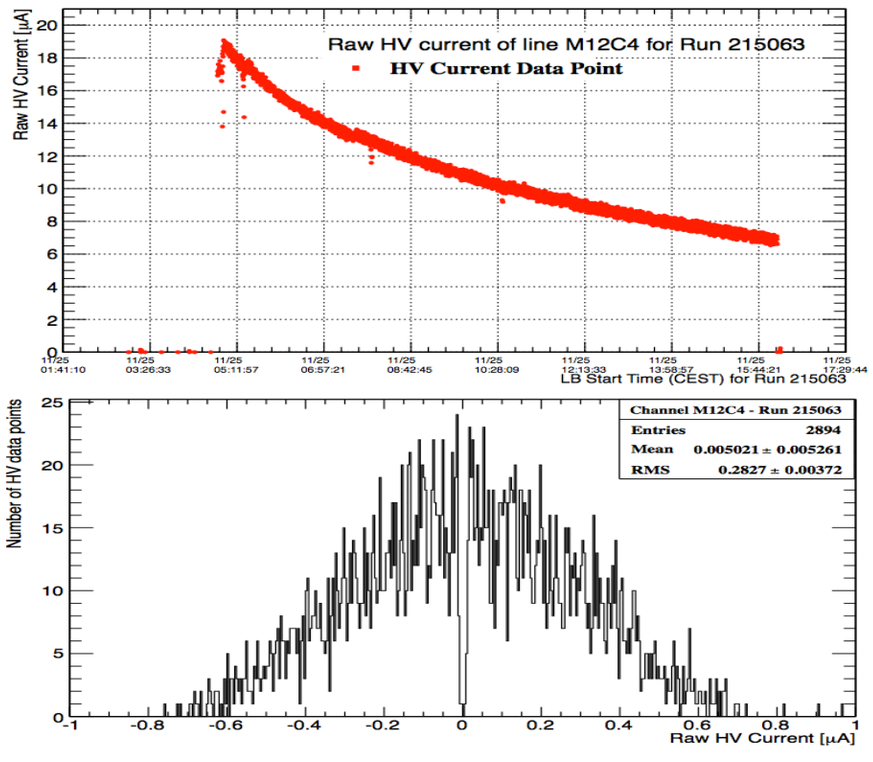
Selection Through number of electrodes

- Retain only channels with 24 electrodes or at least 23 electrodes.
  - ➔ **'M111C0'** was made by 12 electrodes, which imply a low current and an immediate rejection

HV lines with low current noise

- we viewed the root mean square of the distribution of the difference between two successive HV current data points.
  - ➔ **RMS > 0.12 µA** represent cases where the current is prone to bursts of noise, resulting in current fluctuations with time.





Deadbands for the readout current

- Given this insufficient number of current data point, the selection was performed through de 'Macro Luminosity Blocks (MacroLB ~ 10 minutes)'.
  - ➔ Channels with **at least 5 current data points Per Macro Luminosity blocks**.

⌘ High-voltage channels Selection/3

- The combination of these selection criteria bring down the total number of HV lines usable for luminosity determination to 94 out of 576 in EMEC-A and 102 out of 576 in EMEC-C. ➔ **~16% of EMEC-A & ~17% of EMEC-C.**

EMEC				High-Voltage Line (Channels)															
Detector	Sides	Sectors	Modules	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Electromagnetic End-Cap Calorimeter (EMEC)	EMEC-A	Sector B2	Mod.08					■	■						■				
			Mod.09												▪				
			Mod.10	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Mod.11		■														
		Sector B3	Mod.12			■	■	■	■	■	■	■	■				■	■	■
			Mod.13	■	■	■	■				■	■	■	■	■	■	■	■	■
			Mod.14																
			Mod.15																
		Sector B4	Mod.16	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Mod.17	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Mod.18	▪	▪	▪	▪											▪	▪
			Mod.19	▪	■	■		▪	■	■	■	■	■	■	■	■	■	▪	▪
	EMEC-C	Sector B2	Mod.108								■							■	
			Mod.109															■	
			Mod.110	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
			Mod.111	▪	■	■	■	■			■			■					
		Sector B3	Mod.112				■	■	■	■	■	■	■	■	■	■	■	■	■
			Mod.113															▪	
			Mod.114																
			Mod.115																
		Sector B4	Mod.116	▪	▪	▪	■	▪	■									■	■
			Mod.117	■	■	■	■	■	▪	■	▪	▪	■	■	■	■	■	■	■
			Mod.118	■	■	▪	■	■	■	■	■	■	▪	■	■	▪	■	■	■
			Mod.119	■	■	▪	■	■	▪	▪		▪	■			▪			

■ : Bad High-Voltage Line

□ : Good high-voltage line

▪ : Line with Low Number of data points by MacroLB

⌘ Update in luminosity determination

❑ We increase the Number of Runs to **278 Run** . We keep {After Selection} : **192 Good Run**

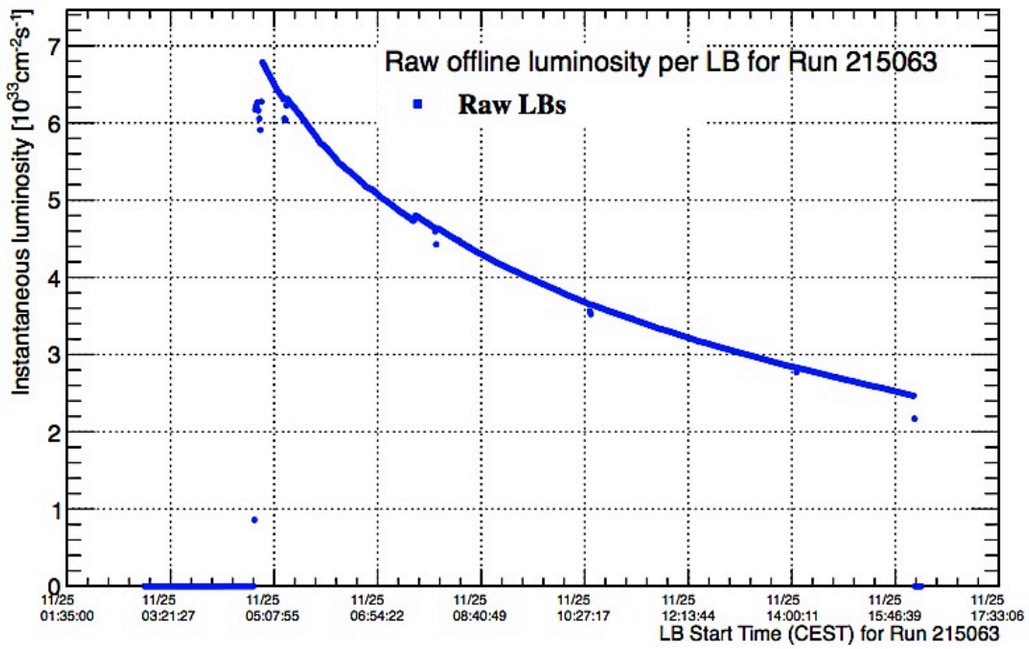
❑ *Good luminosity Blocks selection*

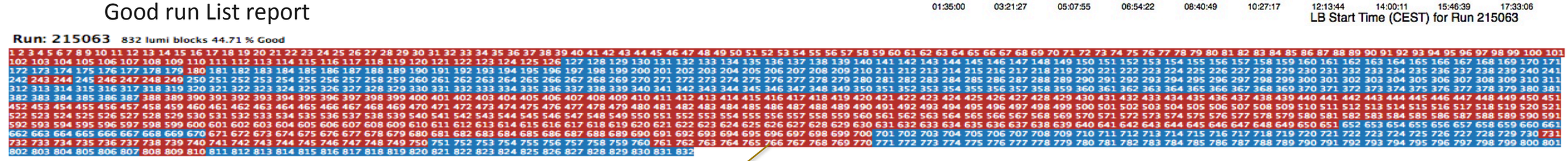
The Selection of Good LumiBlock is Based on 4 criteria, In case of **215063**:

- ✓ **Stable Beams :** Select only the period of stable beams.
- ✓ **Ready for Physics :** Select only the LB ready for physics.

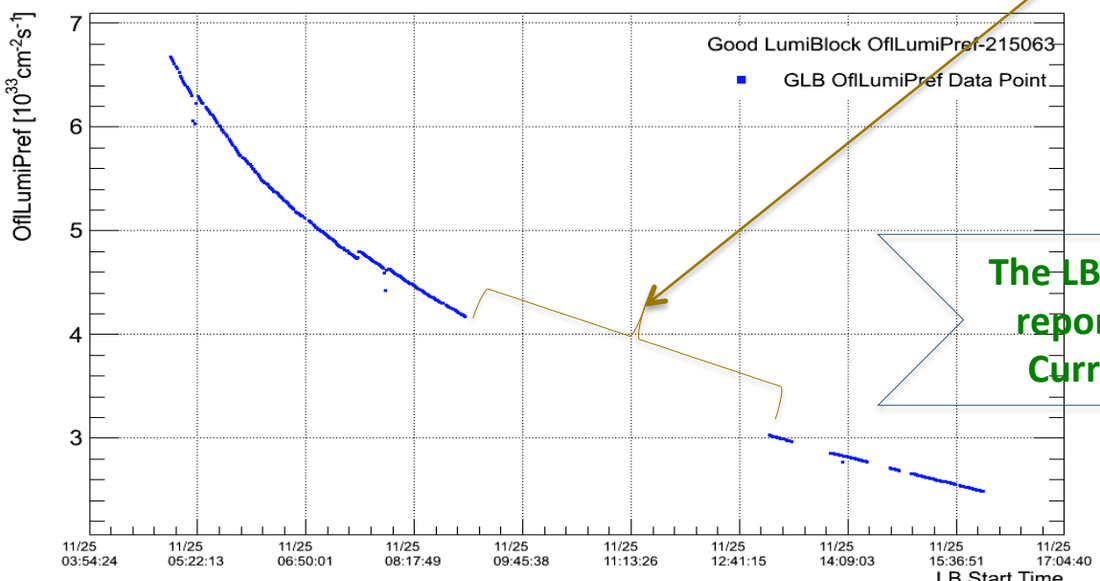
Run	Links	#LB	Start and endtime (local)	#Events	Ready for physics	LHC Fill	Stable beams
215063 Period: J7,J AllYear	DS, RS, BS, AMI, DQ, ELOG, DCS:SoR/EoR, OKS	848 (56 s)	Sun Nov 25 2012 02:54:51 – 16:13:40	18,807,156 (392.4 Hz)	LB 1–124: 0 LB 125–833: 1 LB 834–848: 0	LB 1– 21: 3320 LB 22– 24: 3321 LB 25–848: 3322	LB 1–120: FALSE LB 121–842: TRUE LB 843–848: FALSE

- ✓ **Long LB Duration :** Remove each short LB because that correspond to change of trigger conditions. **LB Duration > 59 s**
- ✓ **Good LB from GRL Report :** Remove each LB selected as bad LB in the Good run List report

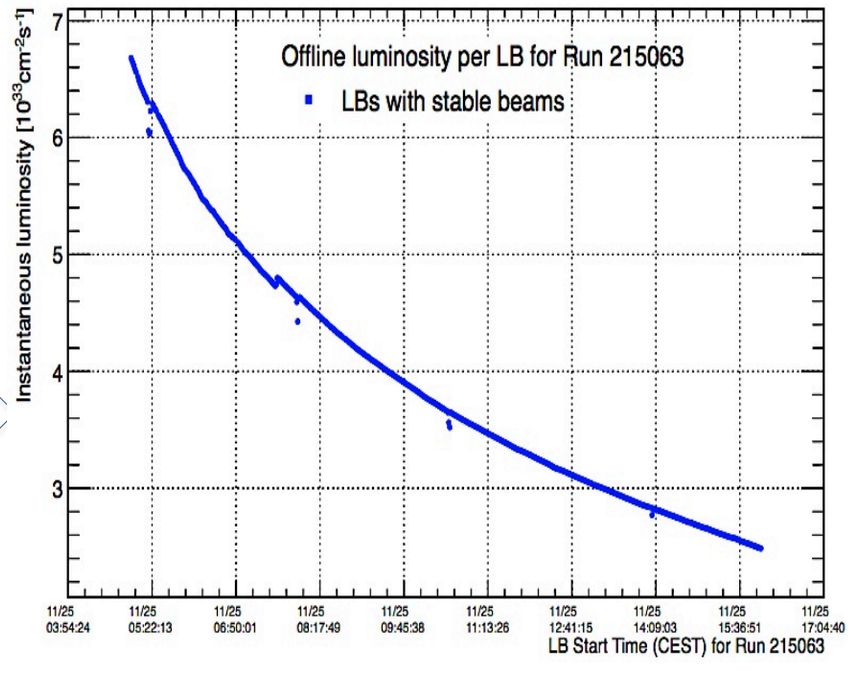




❑ *BCM Luminosity after LB selection*



The LB selected as Bad in the GRL report has no effect to The HV Current and BCM Luminosity

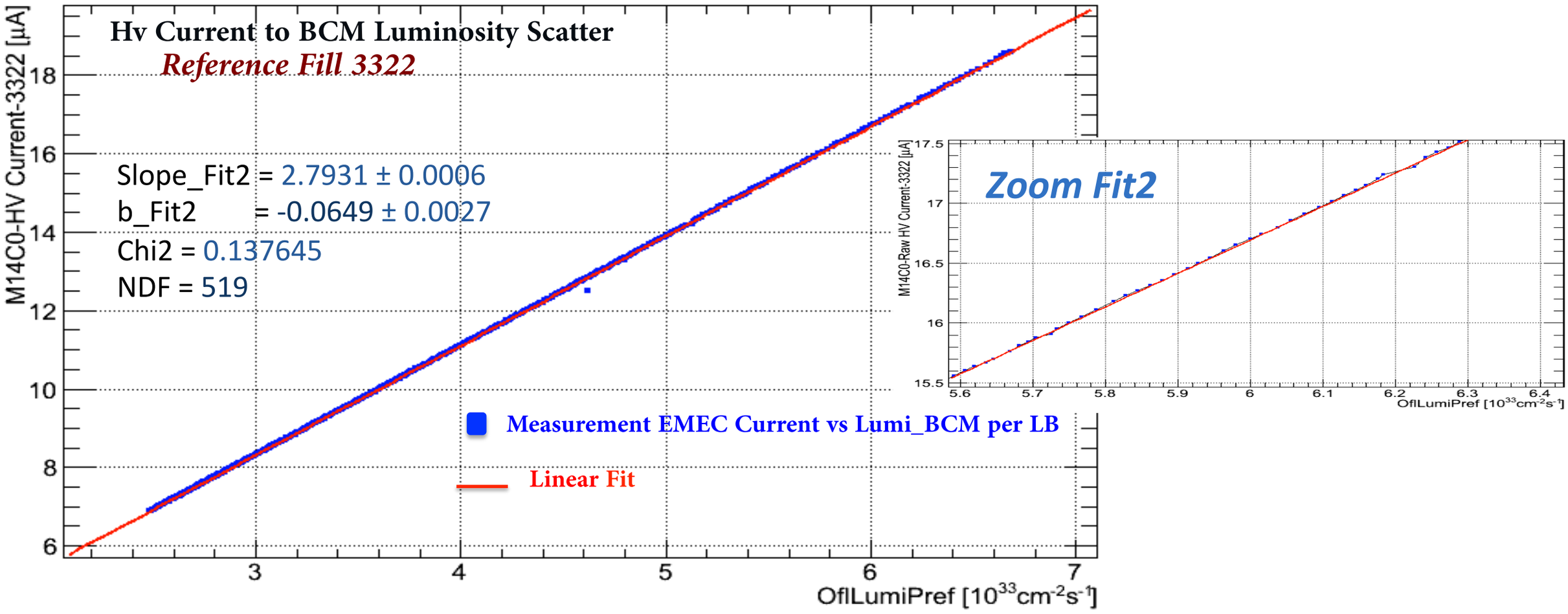


⌘ 2-Parameter Fit of EMEC To BCM (b_Fit2 , Slope_Fit2)

❑ *The Analysis Steps*

☛ For the reference Fill “3322”, Plot the **Scatter of HV Current and BCM Luminosity**.

☛ Apply a Linear **Fit** to this scatter then Get the **Fit parameters {Slope_Fit2 ; b_Fit2}**

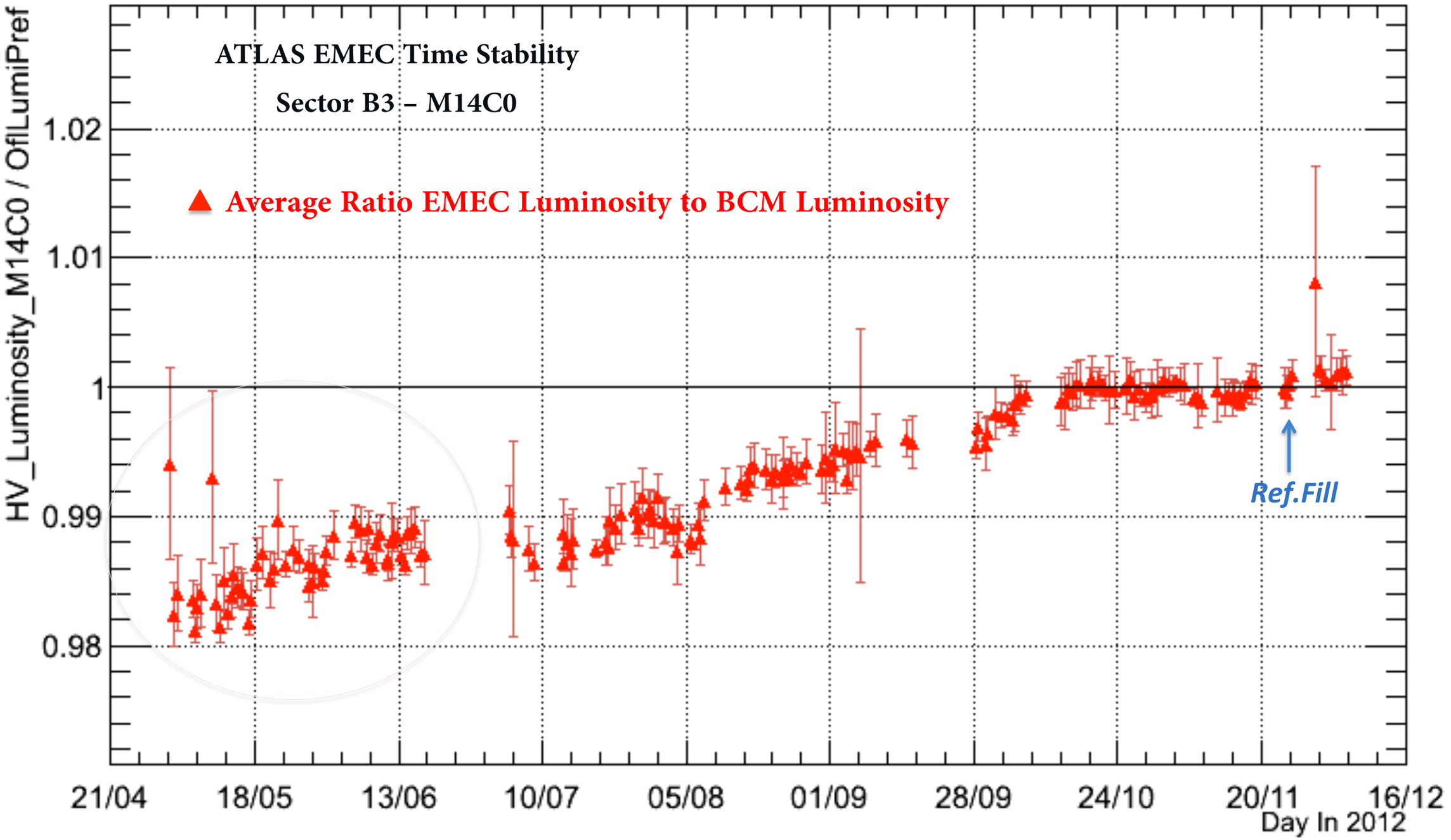


☛ Use this Fit parameters to Get the **EMEC Luminosity**

EMEC_Luminosity = [(1 / Slope_Fit2) * HvCurrent – (b_Fit2 / Slope_Fit2)]

☛ Plot the **Average Ratio** of EMEC HV Luminosity To BCM Luminosity [**EMEC Time stability**]

⌘ 2-Parameter Fit of EMEC To BCM (b_Fit2 , Slope_Fit2)



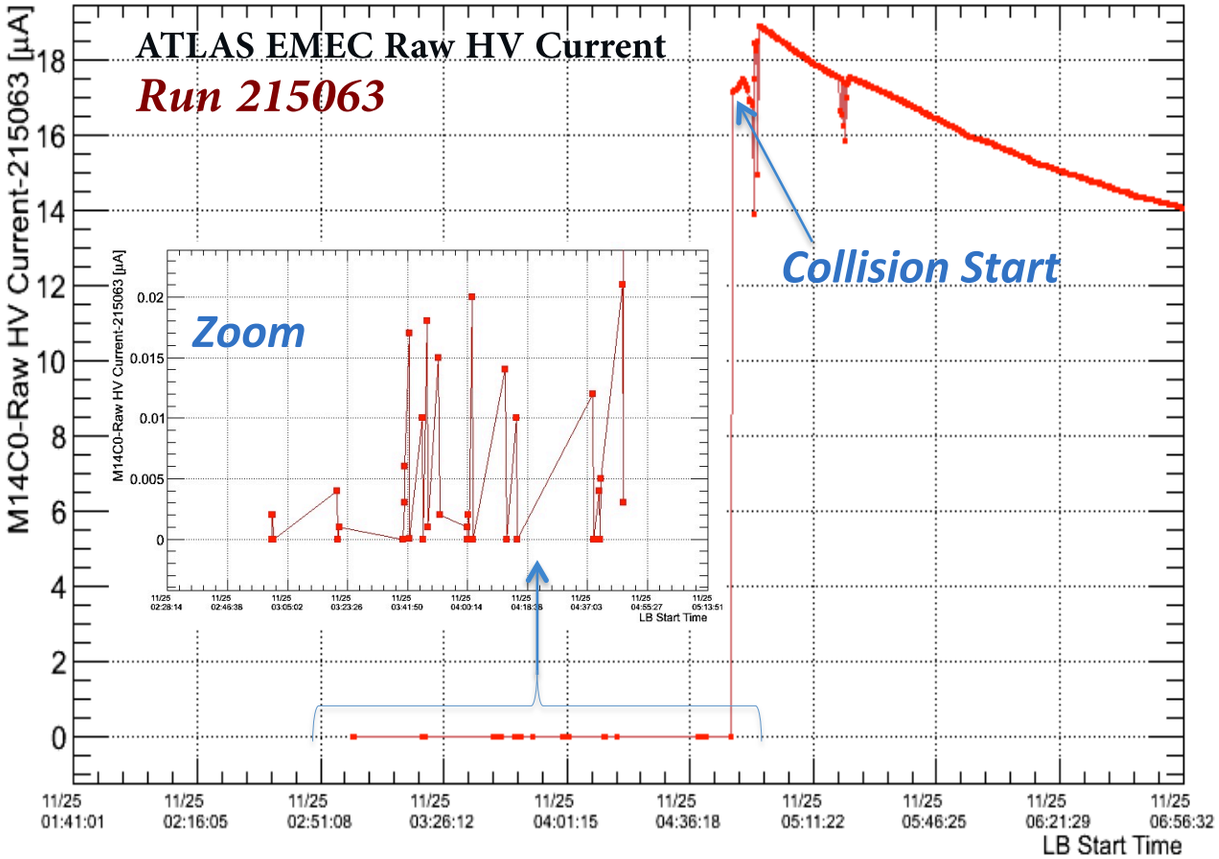
- **Slope_Fit2 =** 2.79319 (For the Ref. Fill**)** **b-Fit2 =** **-0.06493** (For the Ref. Fill)

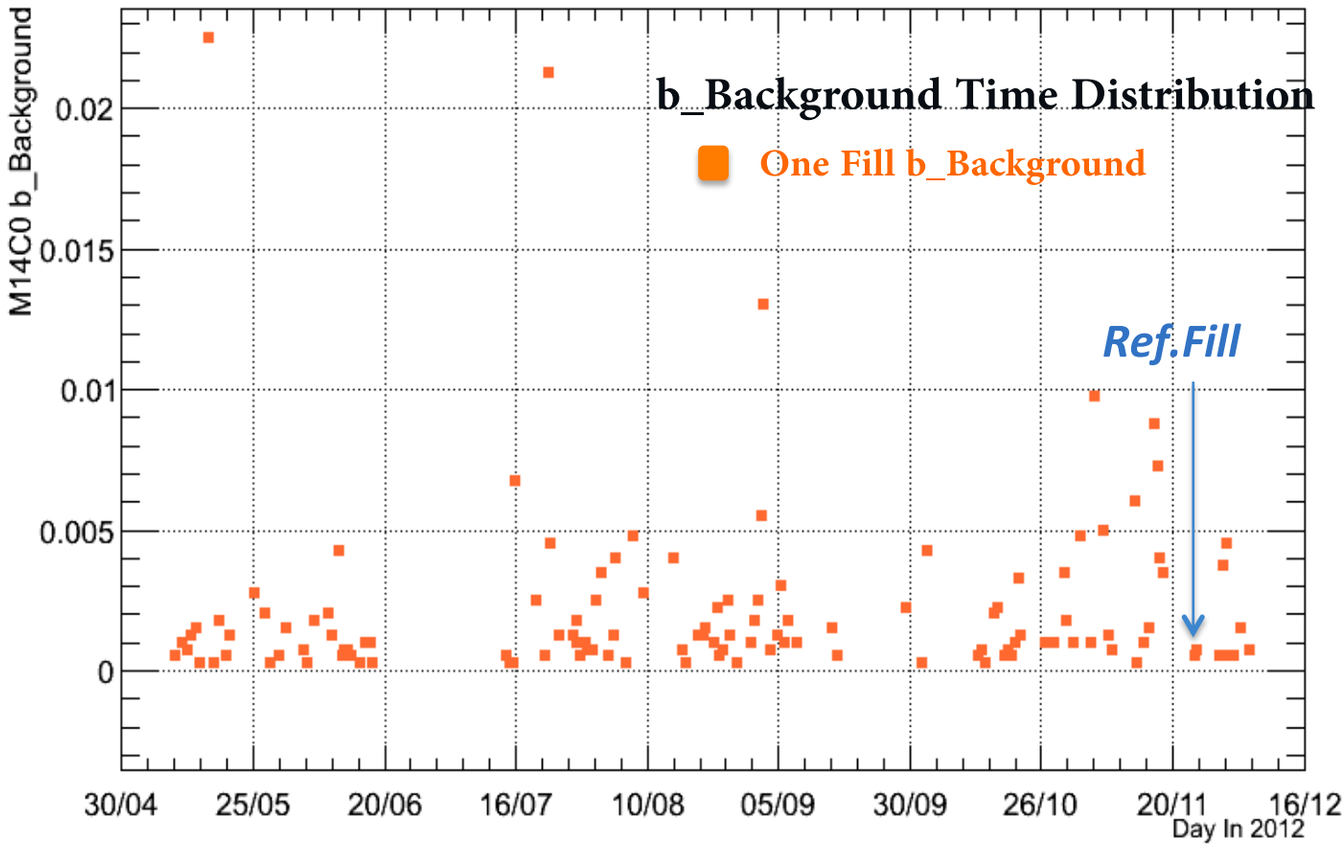
➔ **b-Fit2 correspond to ~0.5% of Average Current**

⌘ Impact of the EMEC Current Pedestal (b_Background , Slope_Fit2)

❑ *The Analysis Steps*

- ☛ For the reference Fill “3322”, Plot the **Scatter** of **HV Current** and **BCM Luminosity**.
- ☛ Apply the same Linear **Fit2** intercept by **b-Background**, then get the **Fit parameters {Slope_Fit2, b_Background}.**
- ☛ **{b_Background}** correspond to the Average of the sum of 3 entries before Collision for each Filll.



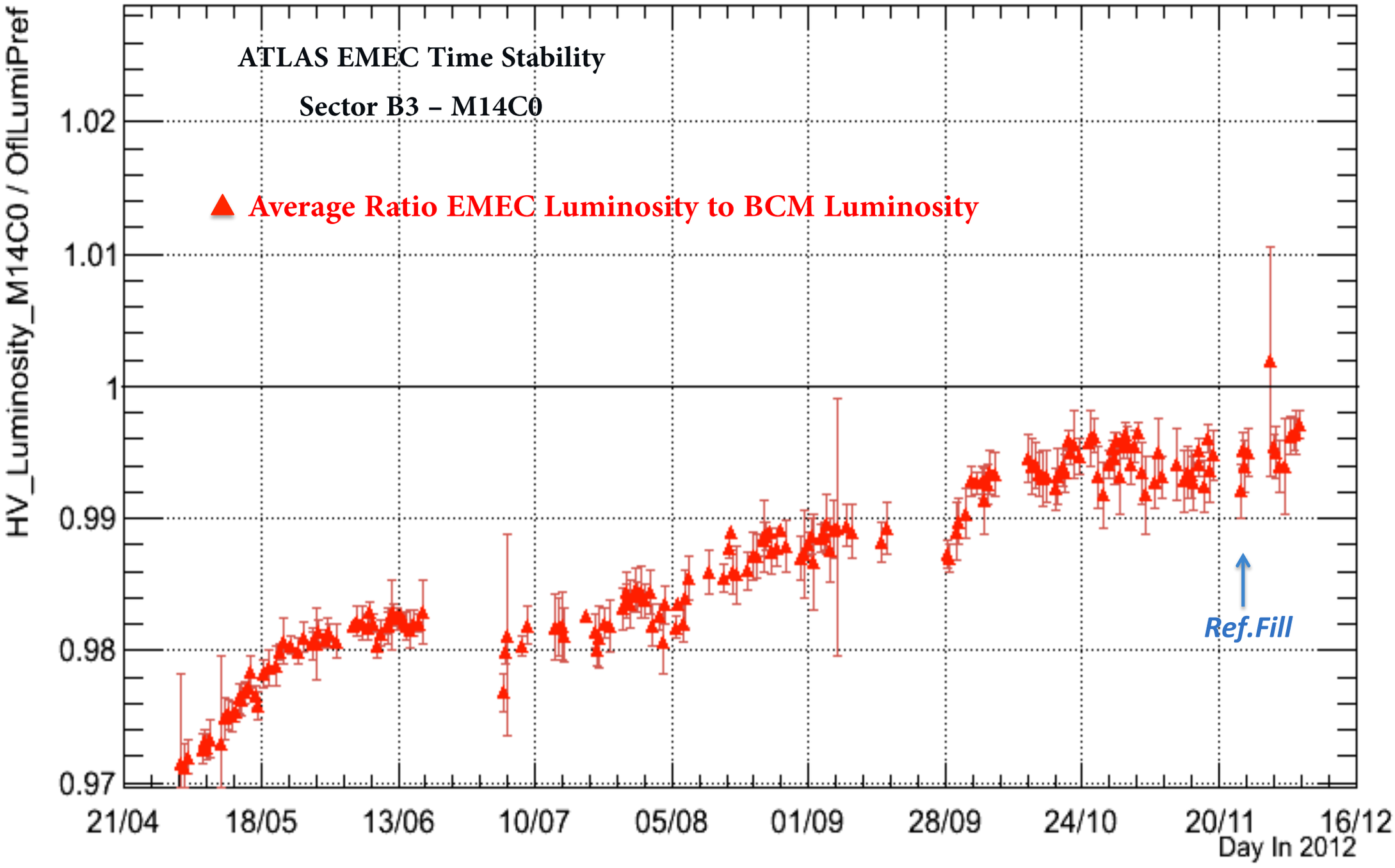


- ☛ Use this two parameters {Slope_Fit2 & b_Background} to Get the **EMEC Luminosity**

  EMEC_Luminosity = [(1 / Slope_Fit2) * HvCurrent – (b_Background / Slope_Fit2)]

- ☛ Plot the **Average Ratio** of EMEC Hv Luminosity To OflLumiPref [**EMEC Time stability**]

⌘ Impact of the EMEC Current Pedestal (b_Background , Slope_Fit2)



- **Slope_Fit2 = 2.79319** (For the Ref. Fill**)** **b_Background = 0.0005** (For Ref. Fill, But we get for each Fill a independent b_Background)

➔ **The EMEC Response decrease (by ~0.6%) due to the low b_Background**

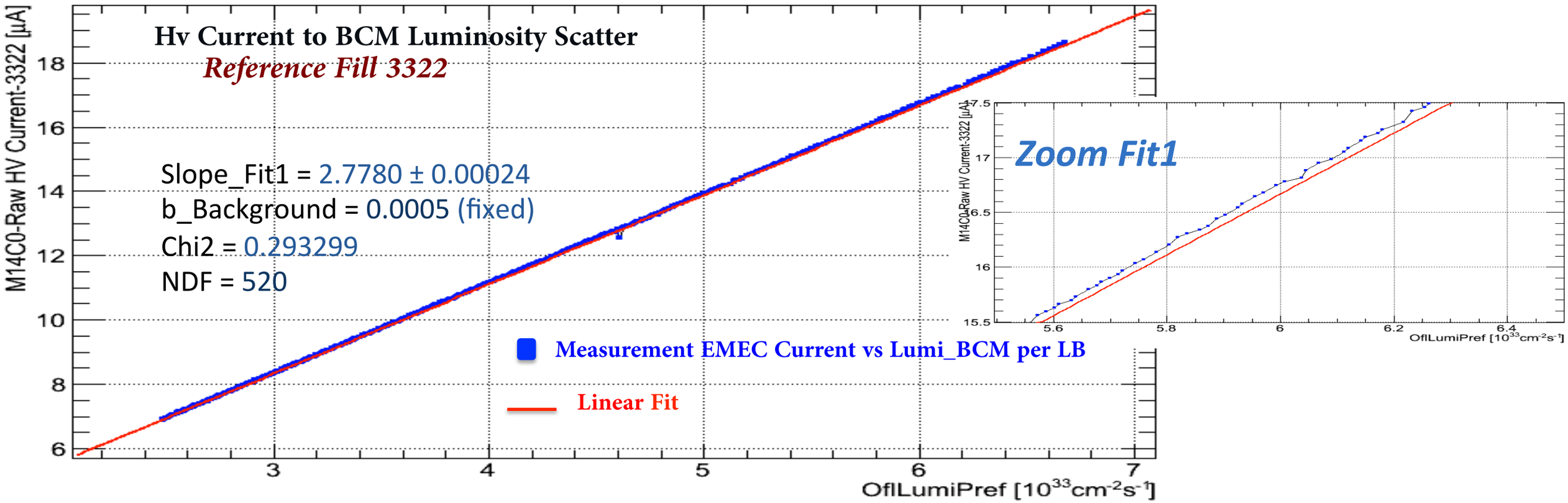
⌘ 1-Parameter Fit to EMEC vs BCM (b_Background , Slope_Fit1)

❑ The Analysis Steps

☛ For the Reference Fill '3322', Plot the **Scatter of HV Current and BCM Luminosity**.

☛ Apply a Linear **Fit** to this scatter using a new linear Function :

{ [Slope_Fit1]*x+[b_Background] } with a fixed b (b_background).



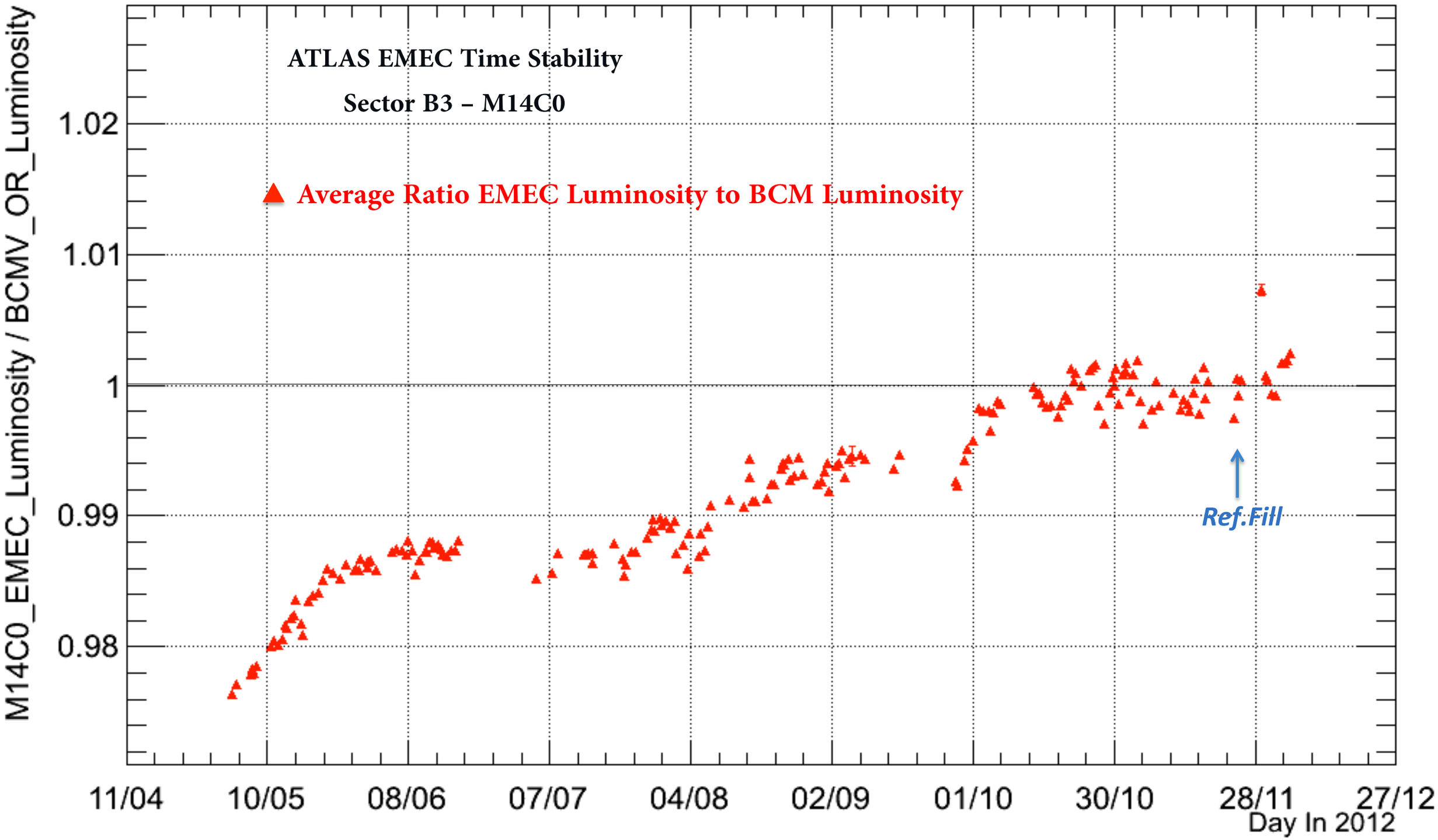
☛ Get the Average of the sum of 3 entries before Collision **{b_Background}** for each Fill.

☛ Use this two parameters {Slope_Fit1 & b_Background} to Get the **EMEC Luminosity**

EMEC_Luminosity = [(1 / slope_Fit) * HvCurrent – (b_Background / Slope_Fit1)]

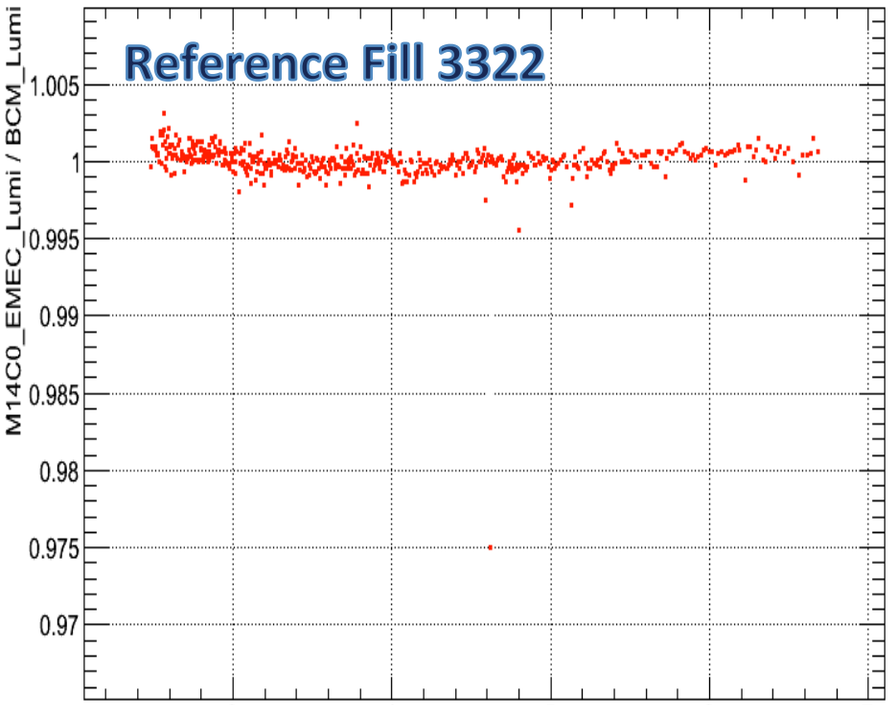
☛ Plot the **Average Ratio** of EMEC HV Luminosity To OflLumiPref [**EMEC Time stability**]

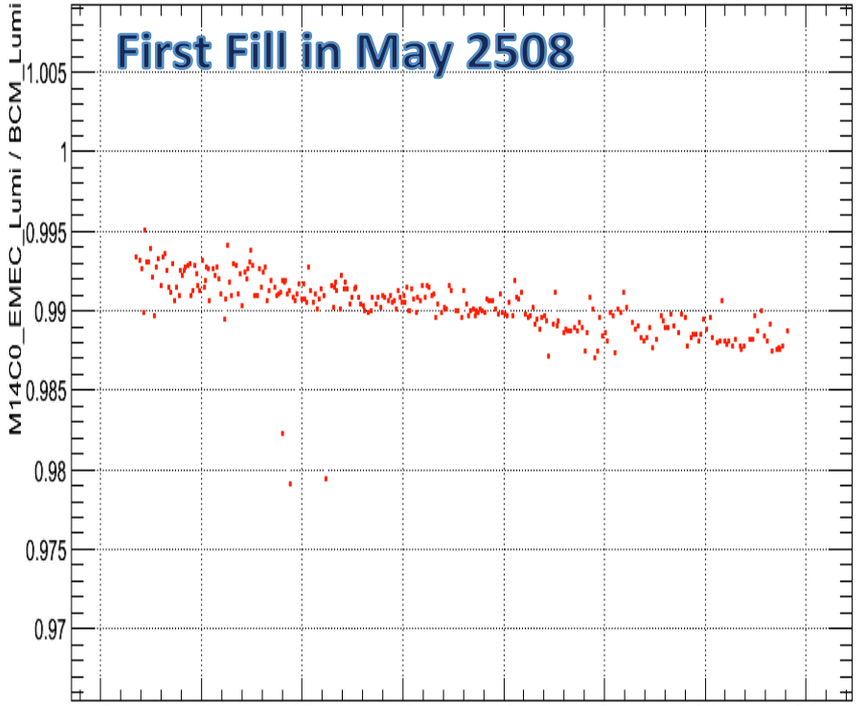
⌘ 1-Parameter Fit to EMEC vs BCM (b_Background , Slope_Fit1)

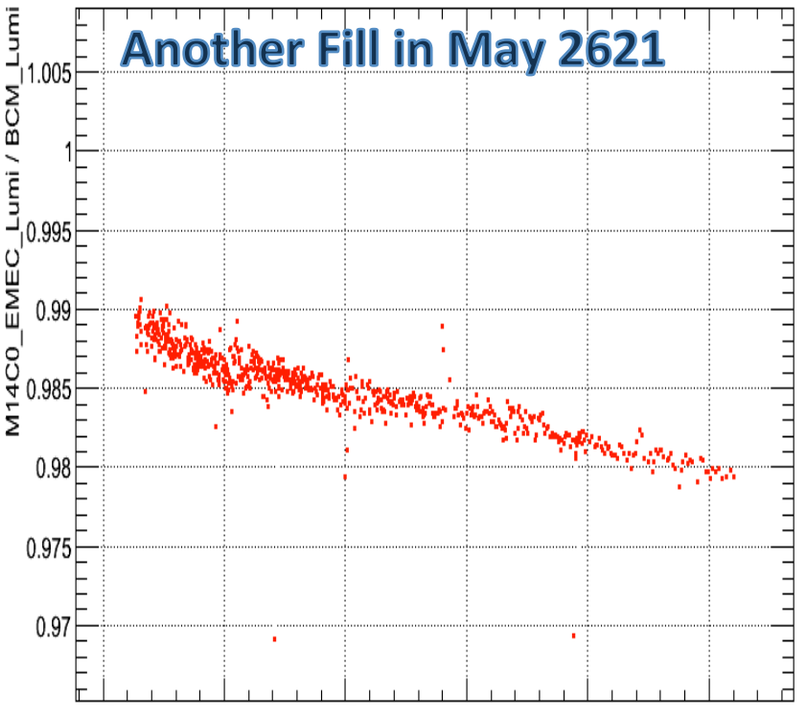


⌘ EMEC Ratio Luminosity To BCM Luminosity

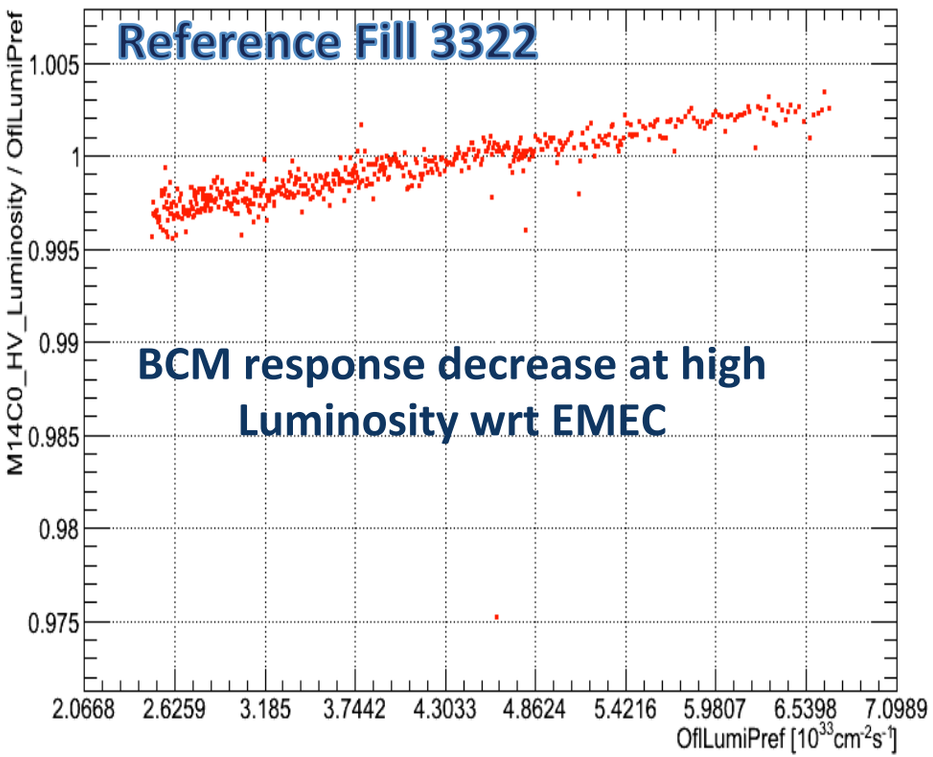
❑ 2-Parameter Slope_Fit2 & b_Fit2 :

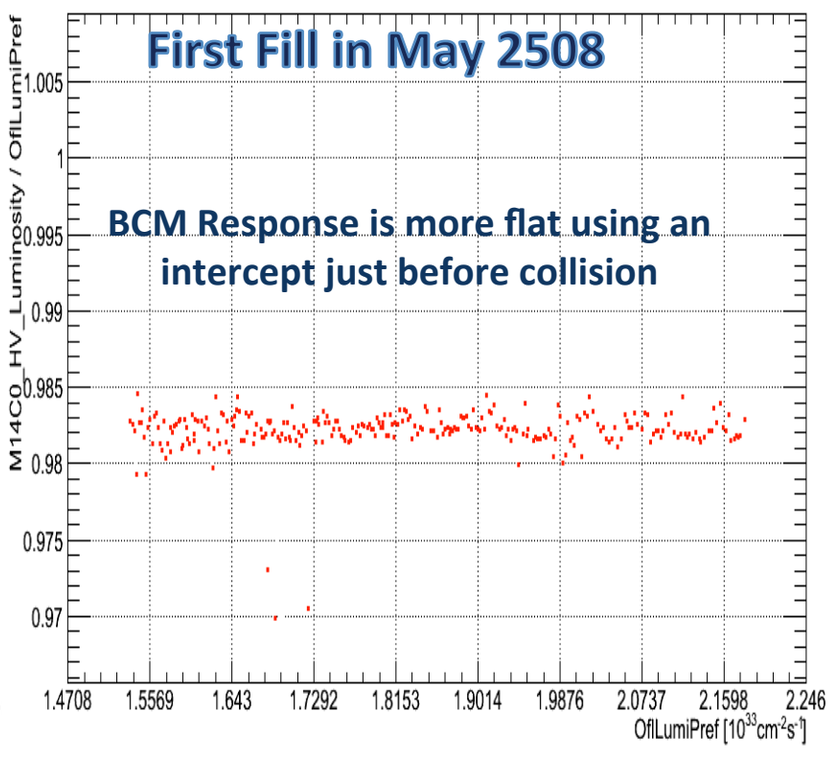


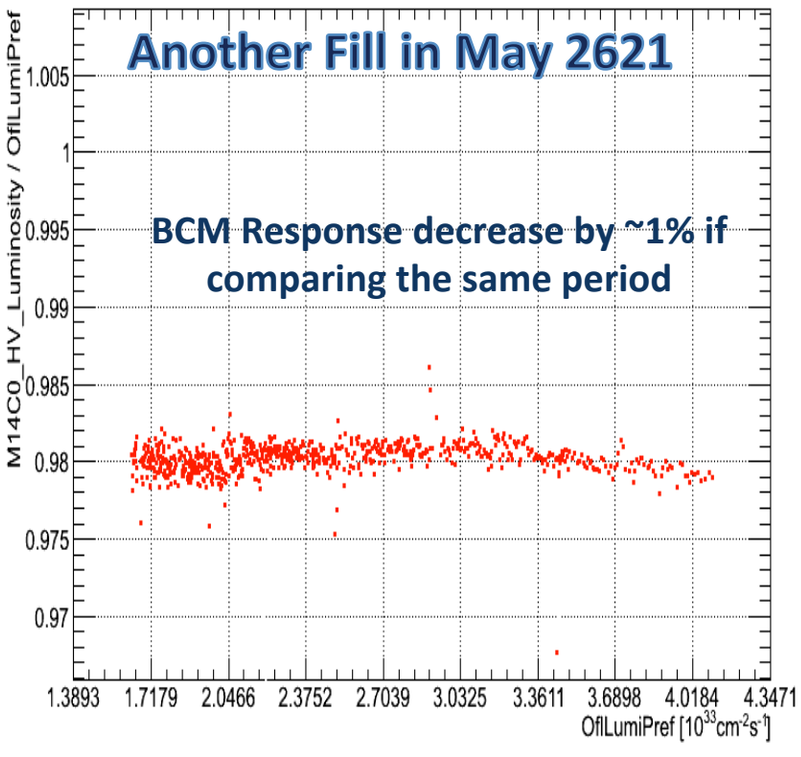




❑ 1-parameter : Only slope & Intercept measured before Collision :



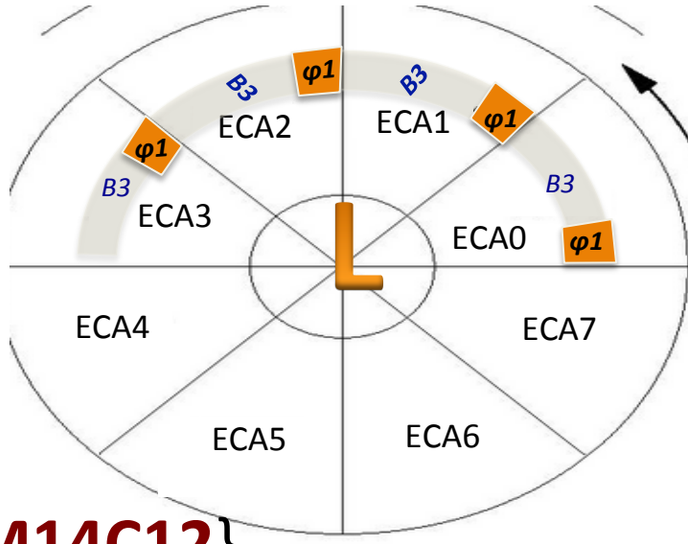


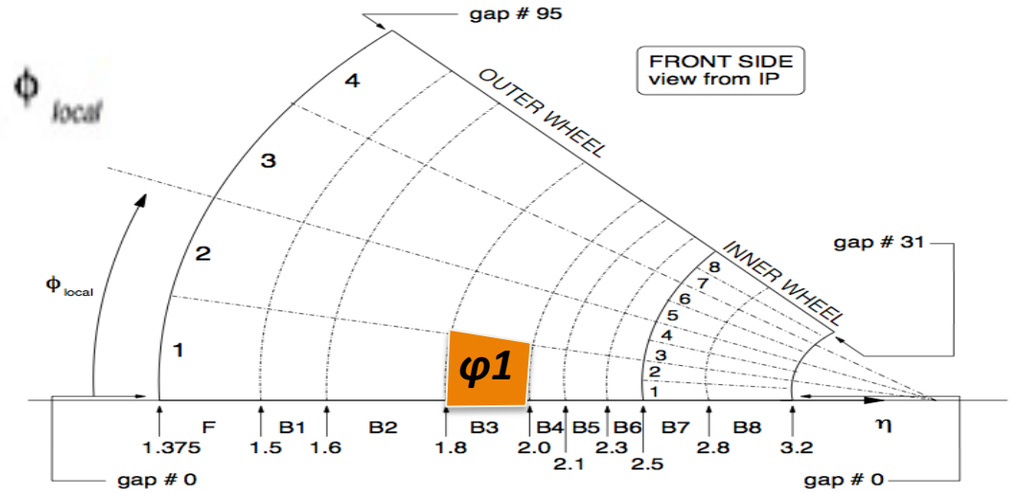


Detector	Detector Side	Detector Wheel	Eta Sector {η}	gap Voltage (H/L)	HV Module	Phi EMEC Sector {ϕ}	Phi HV Sector (Sub ϕ)			
							φ1	φ2	φ3	φ4
{EMEC} Electromagnetic End-Cap Calorimeter	EMEC-A	Outer Wheel	B3 (+1700 V)	Higher (H)	Mod.12	ECA0	Channel 0	~~Channel 1~~	~~Channel 2~~	Channel 3
						ECA1	Channel 4	~~Channel 5~~	~~Channel 6~~	~~Channel 7~~
						ECA2	~~Channel 8~~	~~Channel 9~~	Channel 10	Channel 11
						ECA3	Channel 12	~~Channel 13~~	~~Channel 14~~	~~Channel 15~~
					Mod.13	ECA4	~~Channel 0~~	~~Channel 1~~	~~Channel 2~~	~~Channel 3~~
						ECA5	Channel 4	Channel 5	Channel 6	~~Channel 7~~
						ECA6	~~Channel 8~~	~~Channel 9~~	~~Channel 10~~	~~Channel 11~~
						ECA7	~~Channel 12~~	~~Channel 13~~	~~Channel 14~~	~~Channel 15~~
			B3 (+1700 V)	Lower (L)	Mod.14	ECA0	Channel 0	Channel 1	Channel 2	Channel 3
						ECA1	Channel 4	Channel 5	Channel 6	Channel 7
						ECA2	Channel 8	Channel 9	Channel 10	Channel 11
						ECA3	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.15	ECA4	Channel 0	Channel 1	Channel 2	Channel 3
						ECA5	Channel 4	Channel 5	Channel 6	Channel 7
						ECA6	Channel 8	Channel 9	Channel 10	Channel 11
						ECA7	Channel 12	Channel 13	Channel 14	Channel 15
	EMEC-C	Outer Wheel	B3 (+1700 V)	Higher (H)	Mod.112	ECC0	Channel 0	Channel 1	Channel 2	Channel 3
						ECC1	Channel 4	Channel 5	Channel 6	Channel 7
						ECC2	Channel 8	Channel 9	Channel 10	Channel 11
						ECC3	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.113	ECC4	Channel 0	Channel 1	Channel 2	Channel 3
						ECC5	Channel 4	Channel 5	Channel 6	Channel 7
						ECC6	Channel 8	Channel 9	Channel 10	Channel 11
						ECC7	Channel 12	Channel 13	Channel 14	Channel 15
			B3 (+1700 V)	Lower (L)	Mod.114	ECC0	Channel 0	Channel 1	Channel 2	Channel 3
						ECC1	Channel 4	Channel 5	Channel 6	Channel 7
						ECC2	Channel 8	Channel 9	Channel 10	Channel 11
						ECC3	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.115	ECC4	Channel 0	Channel 1	Channel 2	Channel 3
						ECC5	Channel 4	Channel 5	Channel 6	Channel 7
						ECC6	Channel 8	Channel 9	Channel 10	Channel 11
						ECC7	Channel 12	Channel 13	Channel 14	Channel 15

Channels Combination 1 - HV Channels Average

- We will focus to Lowest gap of the EMEC-A Sector B3. We will select the HV Channels which provide the current to the Hv Sub Sector Phi1 in the 3 EMEC modules (ECA0-1-2-3)



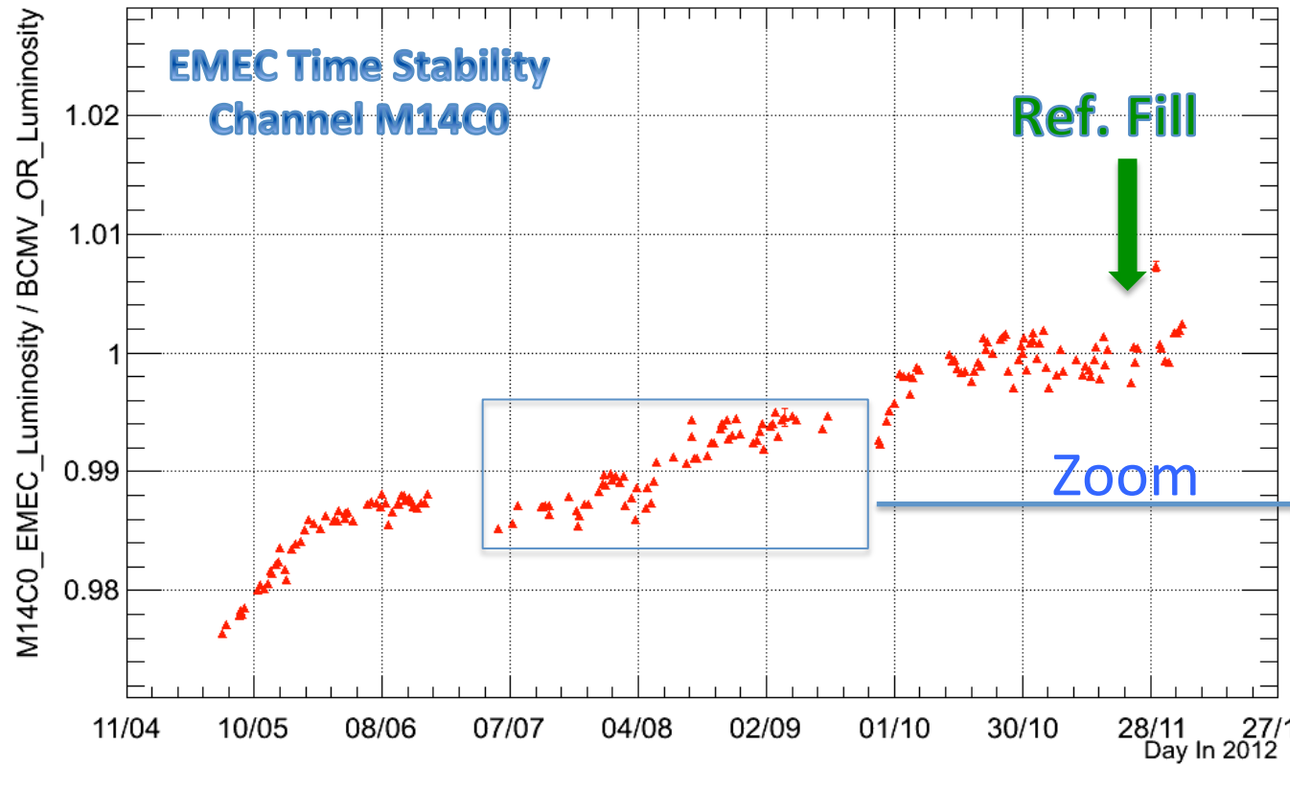


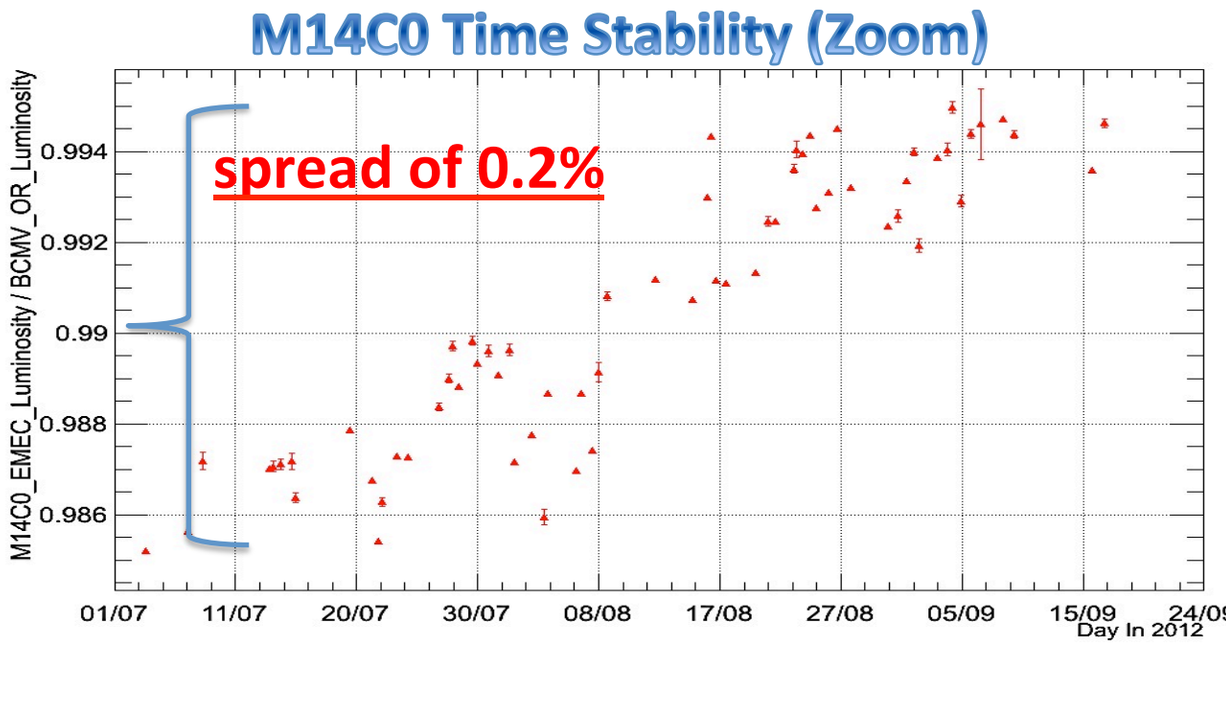
➔ {**M14C0-M14C4-M14C8-M14C12**}

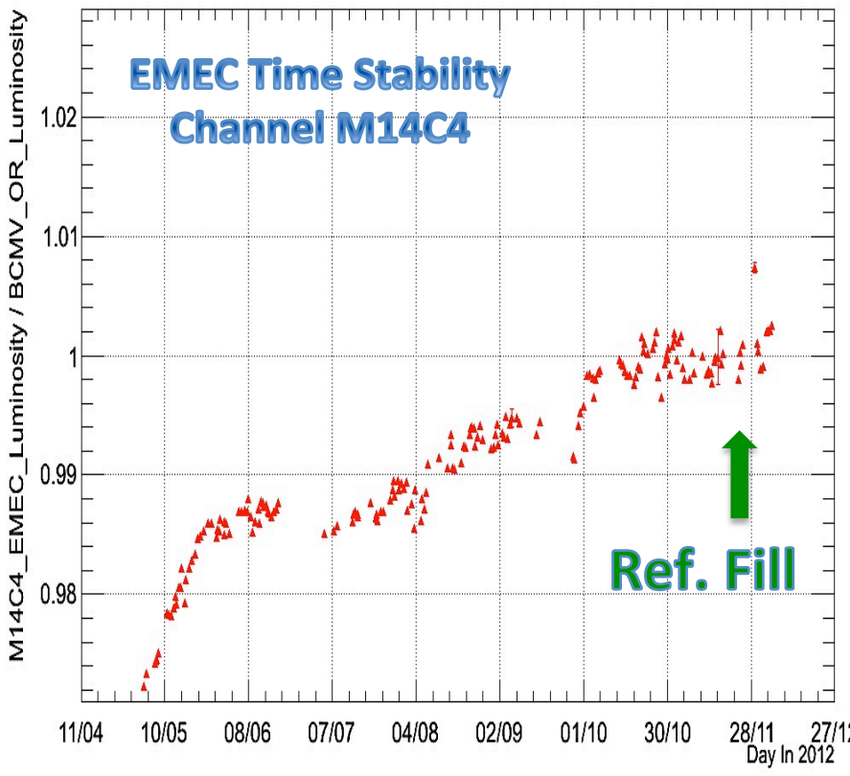
Detector	Detector Side	Detector Wheel	Eta Sector {η}	gap Voltage (H/L)	HV Module	Phi EMEC Sector {ϕ}	Phi HV Sector (Sub ϕ)			
							φ1	φ2	φ3	φ4
{EMEC} Electromagnetic End-Cap Calorimeter	EMEC-A	Outer Wheel	B3 (+1700 V)	Higher (H)	Mod.12		Channel 0	Channel 1	Channel 2	Channel 3
						ECA0	Channel 4	Channel 5	Channel 6	Channel 7
						ECA1	Channel 8	Channel 9	Channel 10	Channel 11
						ECA2	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.13	ECA3	Channel 0	Channel 1	Channel 2	Channel 3
						ECA4	Channel 4	Channel 5	Channel 6	Channel 7
						ECA5	Channel 8	Channel 9	Channel 10	Channel 11
						ECA6	Channel 12	Channel 13	Channel 14	Channel 15
			B3 (+1700 V)	Lower (L)	Mod.14	ECA7	Channel 0	Channel 1	Channel 2	Channel 3
						ECA0	Channel 4	Channel 5	Channel 6	Channel 7
						ECA1	Channel 8	Channel 9	Channel 10	Channel 11
						ECA2	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.15	ECA3	Channel 0	Channel 1	Channel 2	Channel 3
						ECA4	Channel 4	Channel 5	Channel 6	Channel 7
						ECA5	Channel 8	Channel 9	Channel 10	Channel 11
						ECA6	Channel 12	Channel 13	Channel 14	Channel 15

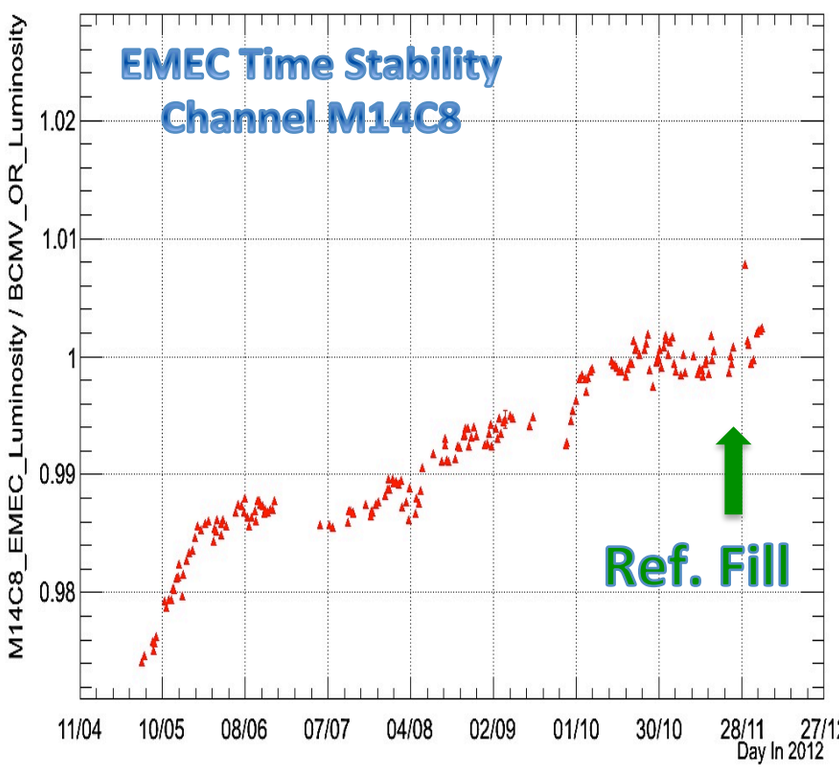
EMEC Time Stability {M14C0 – M14C4 – M14C8 – M14C12}

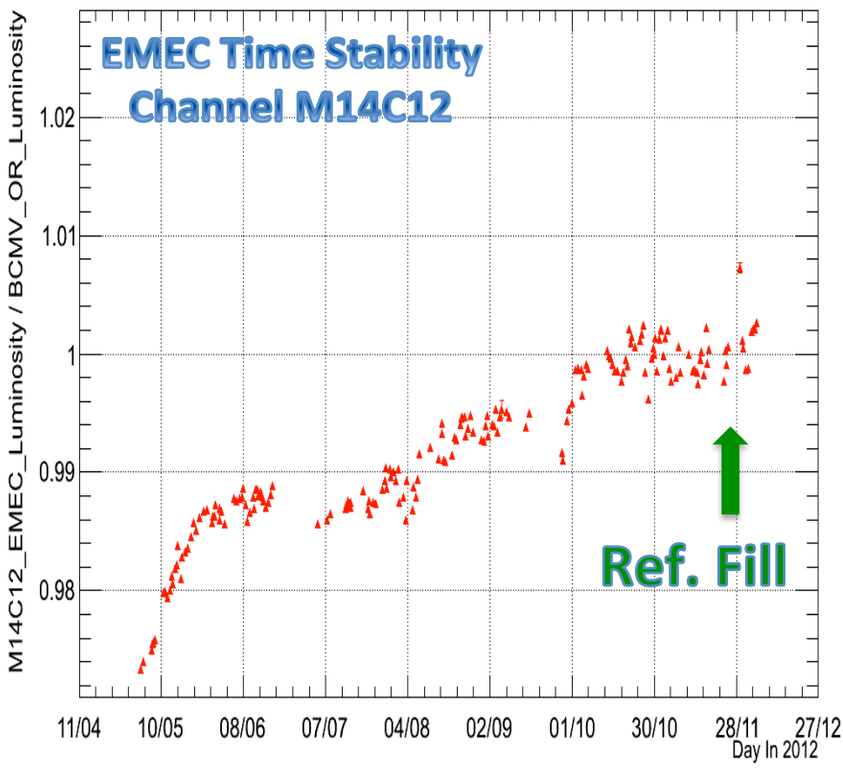
❑ We Plot the Average ratio EMEC Luminosity to BCM Luminosity for the 4 Channels selected





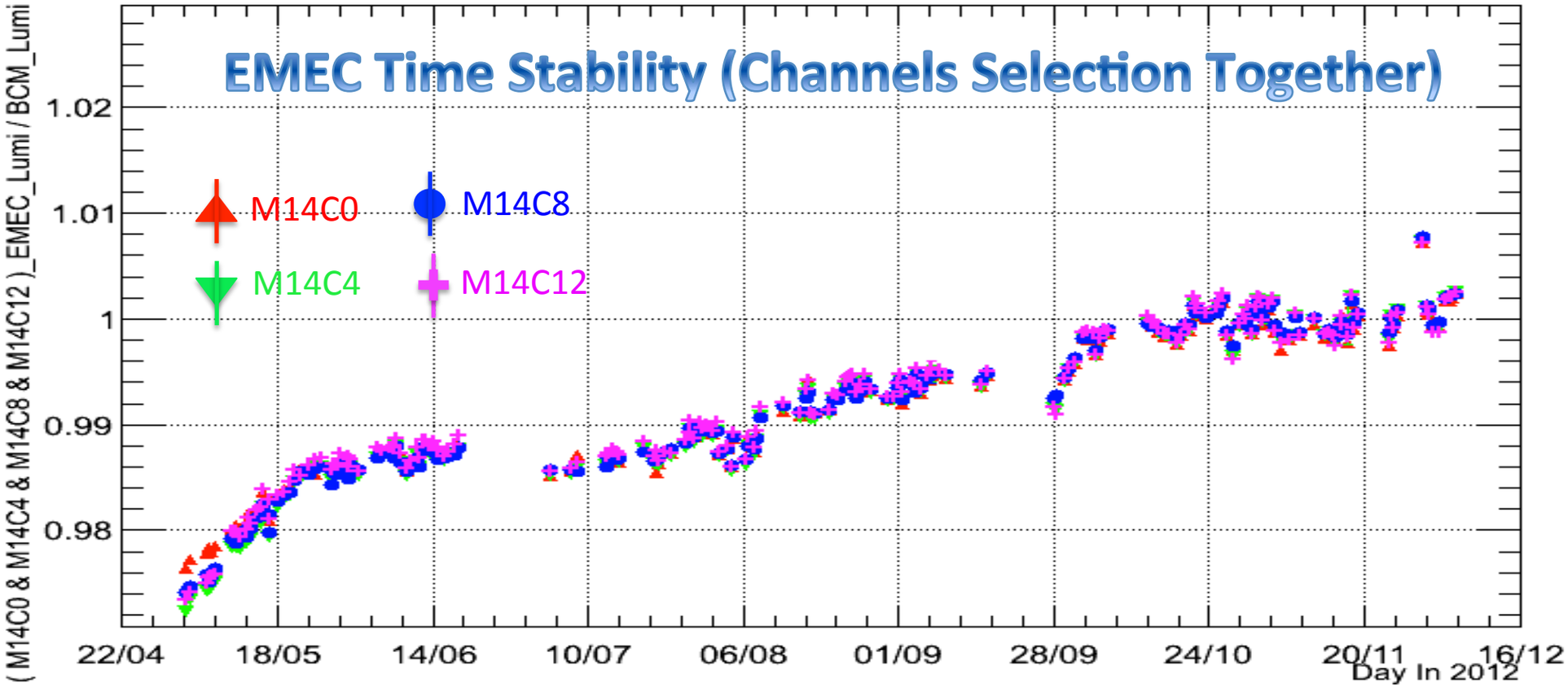




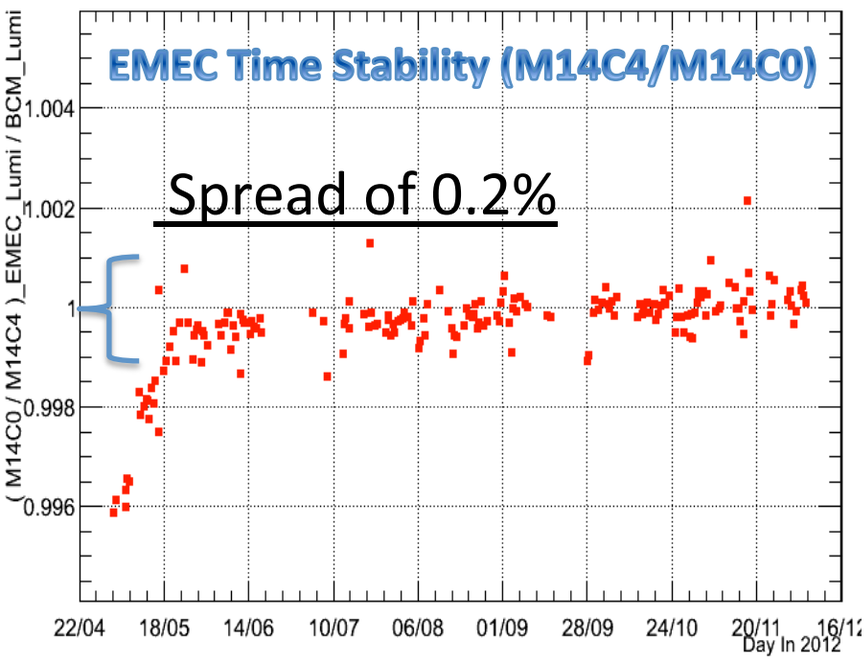


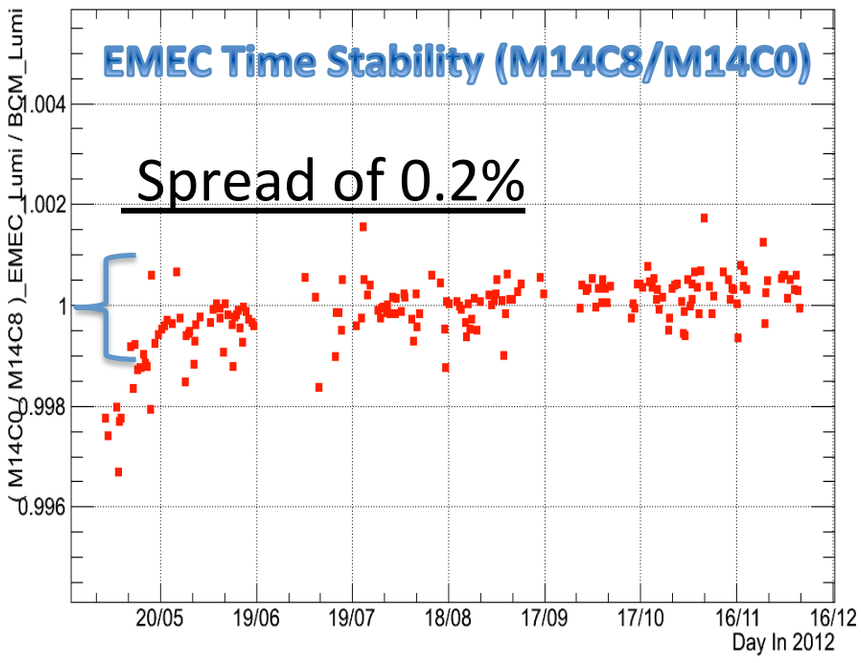
EMEC Time Stability {M14C0 – M14C4 – M14C8 – M14C12}

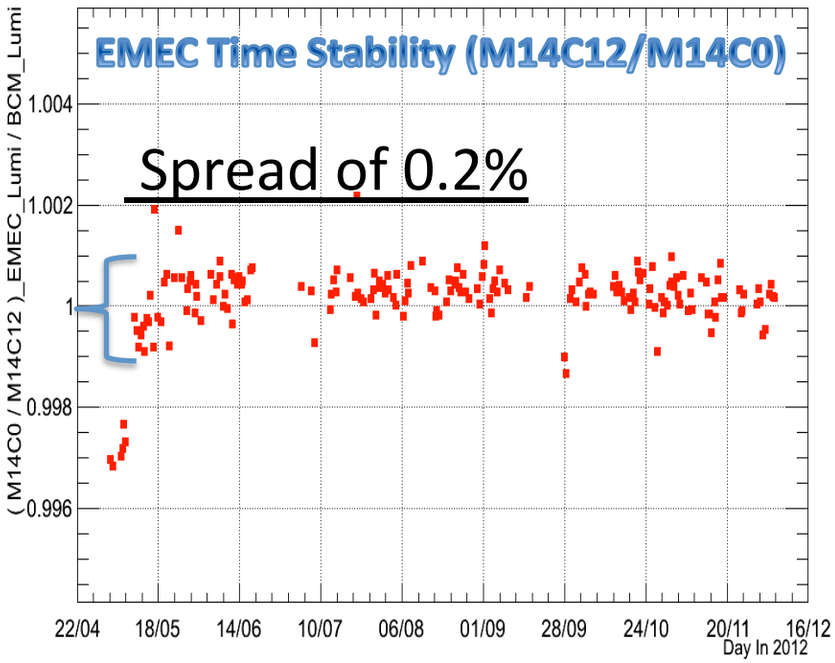
❑ The Average ratio EMEC Luminosity to BCM Luminosity for the 4 Selected Channels {Time Stability}



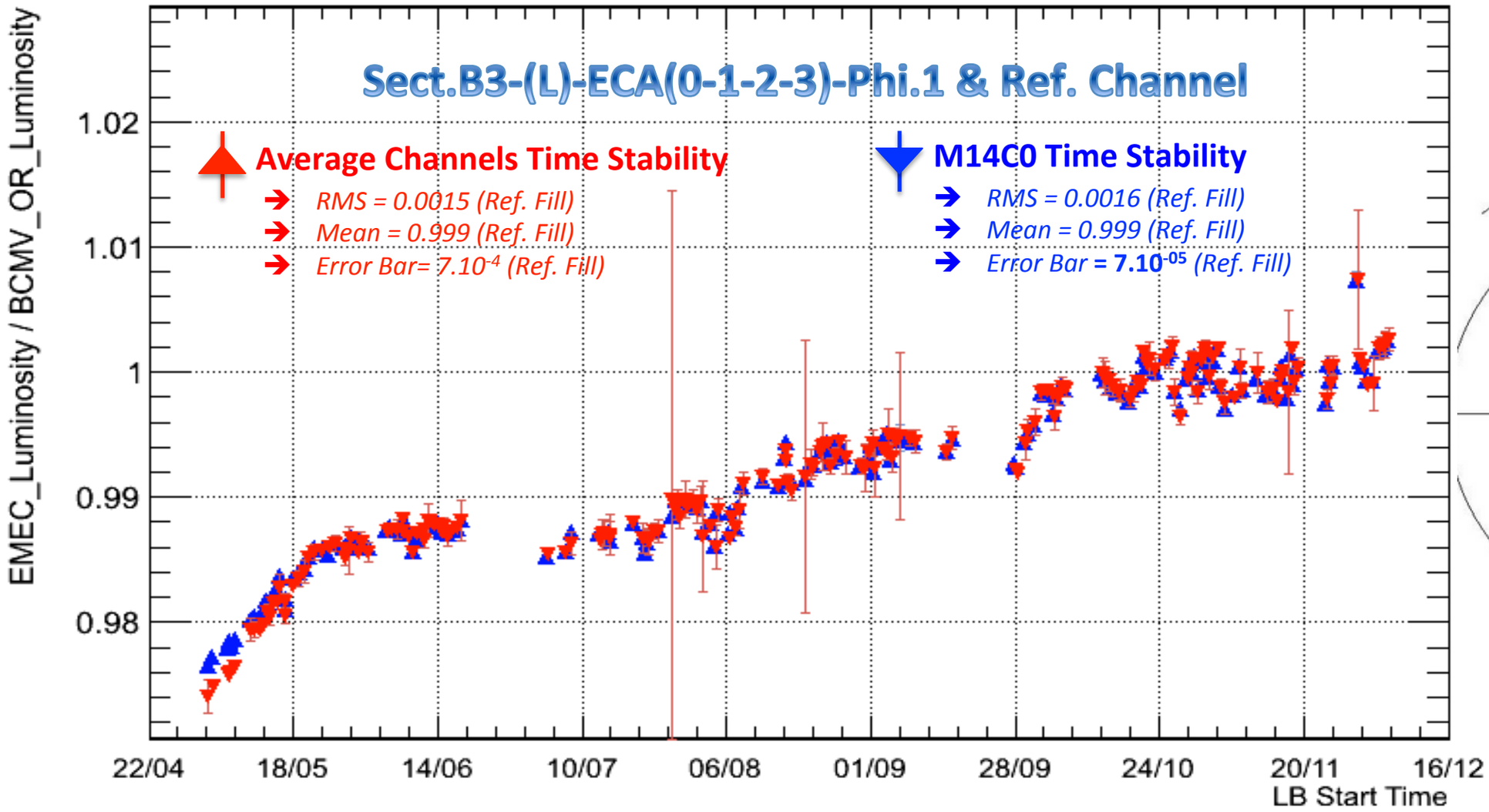
❑ The Ratio Time Stability of each Selected Channel to the reference Channel (M14C0)

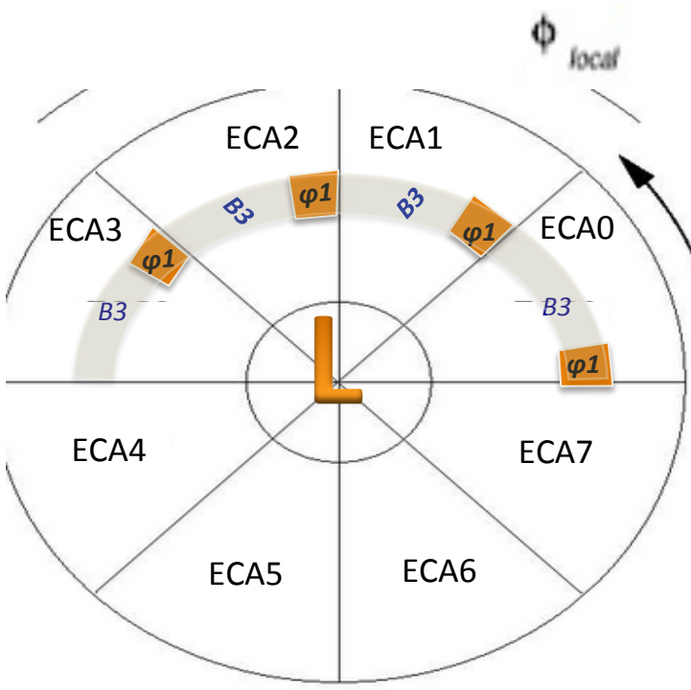


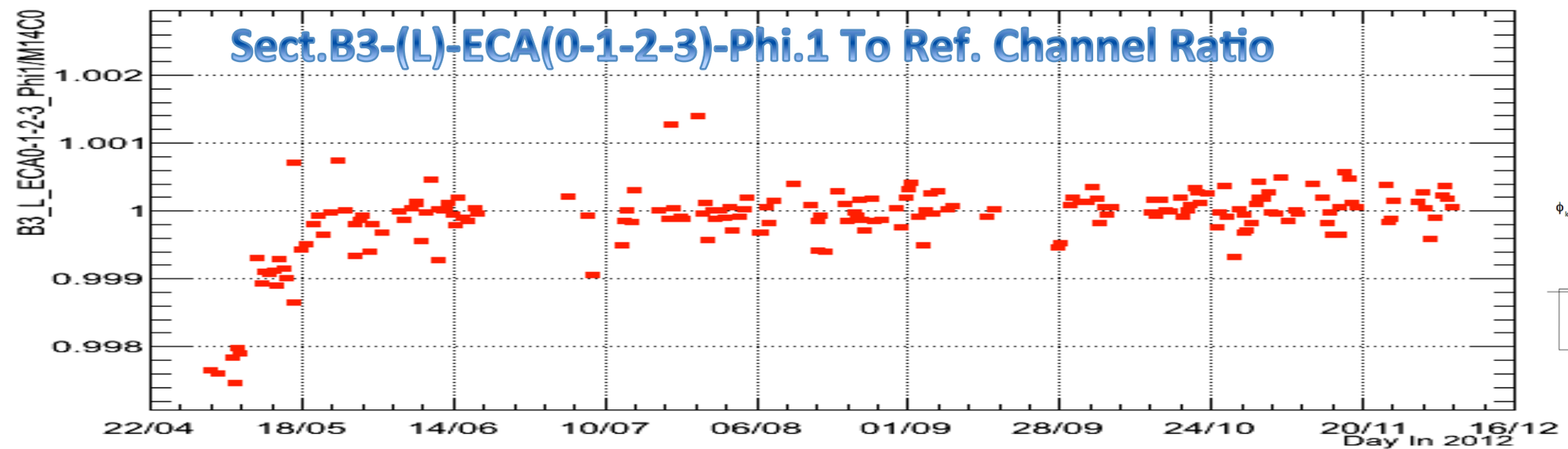


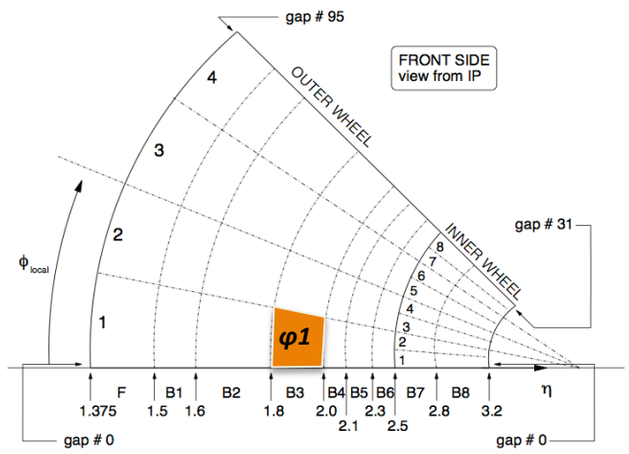


Sector B3- (L) - ECA(0-1-2-3) - Sub-Sector (*Phi1*)
Ref. Channel M14C0 to Average Channels Combination 1









Summary

- The ratio of single channel to the reference one gives a small spread of 0.2%, very close to the spread of every single channels, we deduce a negligible effect of BCM.

- Combining Channels in Highest gap gives an different EMEC effect than in Lowest gap. (Run 2) Comparing the both gap with combining a corresponding (Highest/Lowest) gap channels to verify if in lowest region we obtain an accurate results.

- Need more Good channels in each EMEC geometry to build an accurate idea about the efficiency of the channels combination (Run2).

- (In Backup) the same analysis using the average of Raw Hv Current for a different EMEC Geometry and then Determinate the EMEC Luminosity.

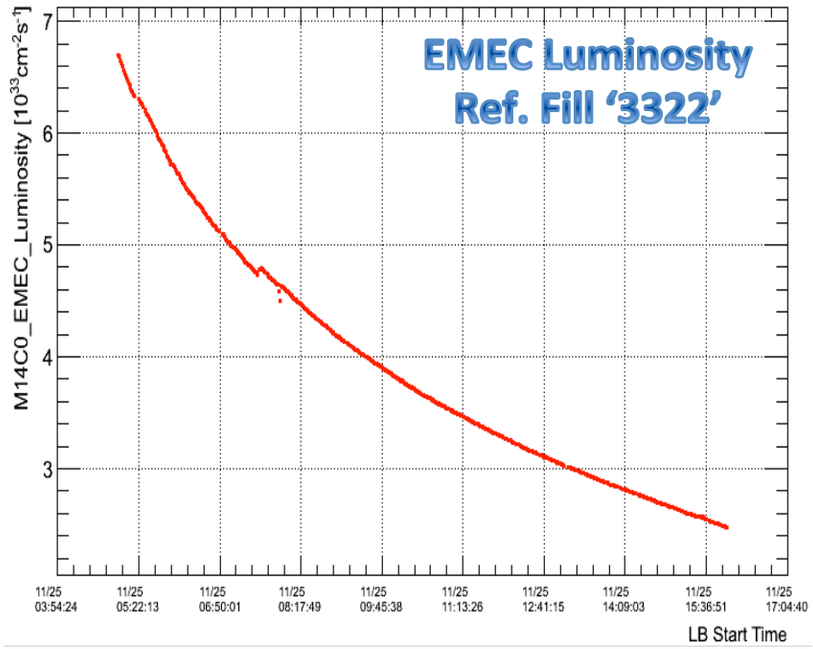
- **This analysis will be published in two (2) notes with the LAr group (writing by myself under submission) & the Luminosity Task force group.**

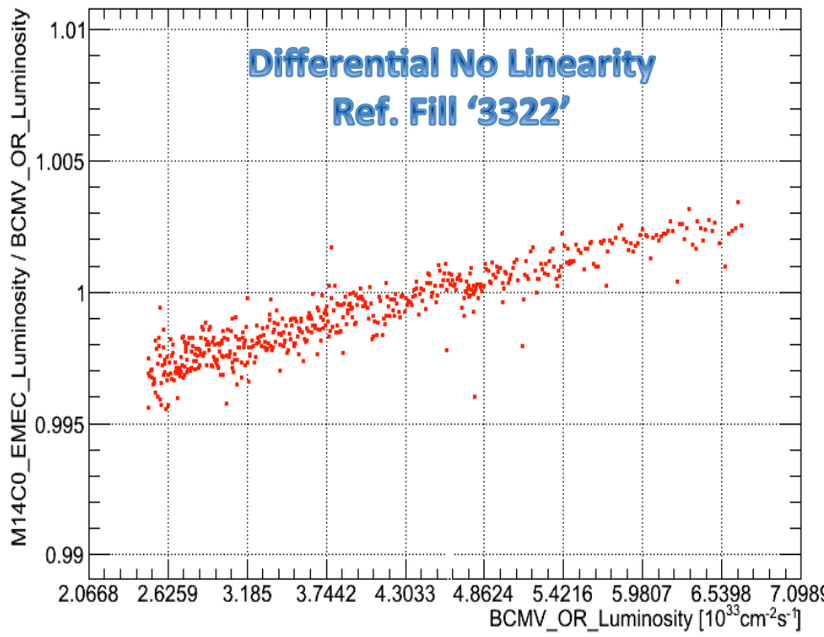
Backup

⌘ EMEC Luminosity Studies

- We calculate the EMEC Luminosity from a calibrated BCMV_OR Luminosity to HV Current with a direct measurement of Current before collision.

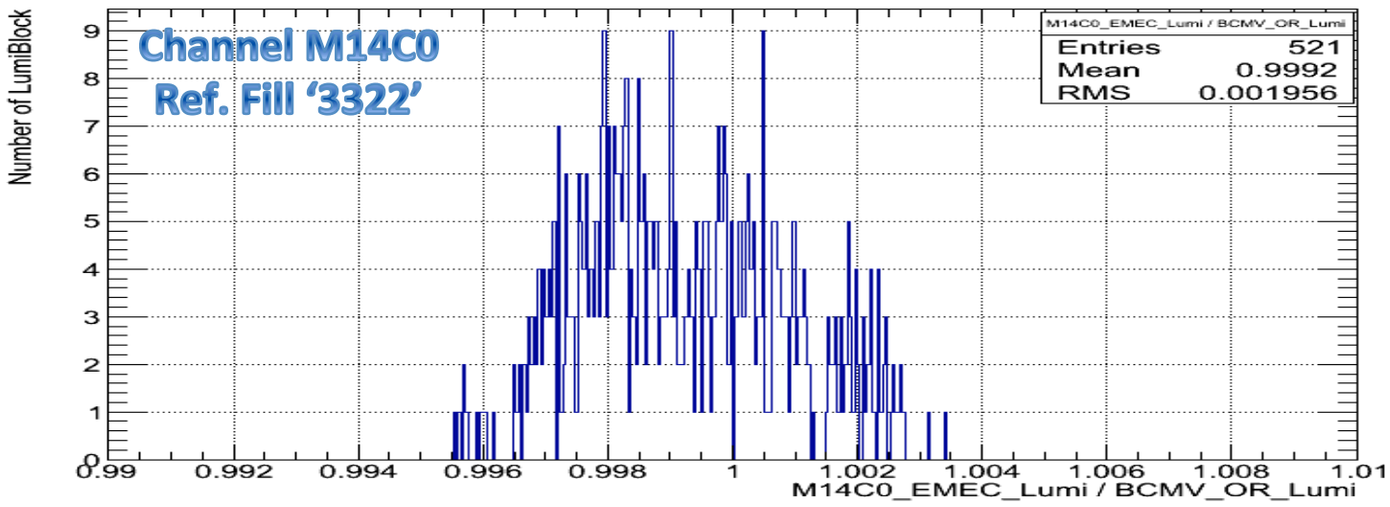
- The BCM Response decrease at High Luminosity wrt to EMEC.





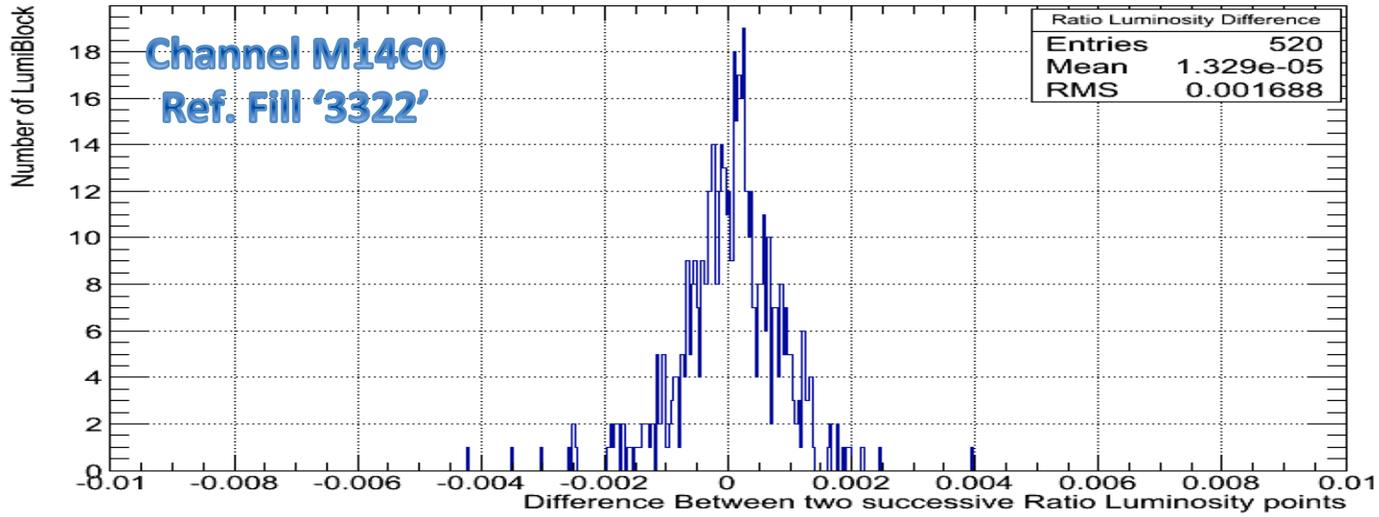
❑ Error bars (Original approach):

- We plot the ratio EMEC Luminosity to BCM Luminosity distribution with μ-dependence effect.
  - ➔ RMS = 0.0019
  - ➔ Mean = 0.999 (*For Time Stability*)
  - ➔ **Error = RMS/√(Nbr.LB) = 9 .10^{-05}**



❑ Error bars (Refined Approach):

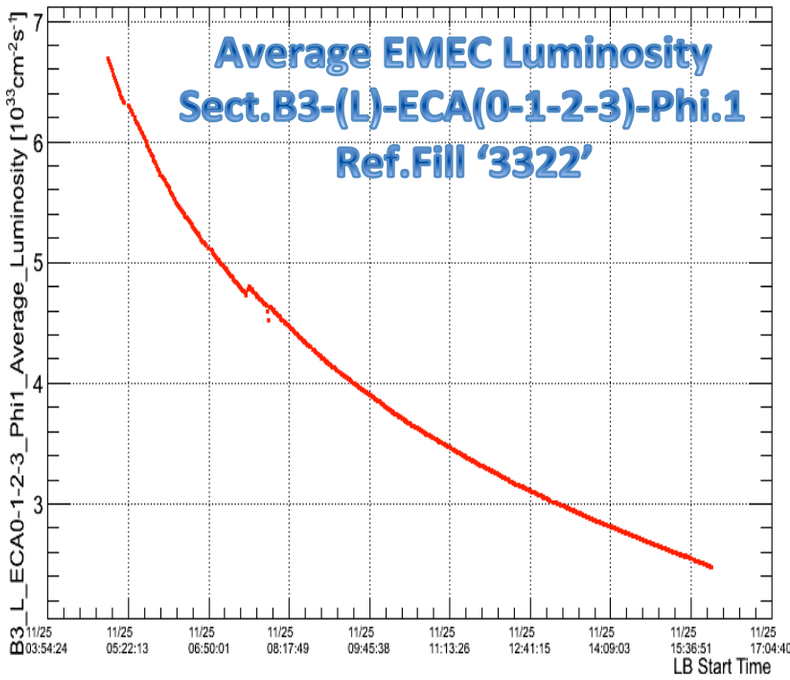
- We plot the distribution of the difference between two successive points from the ratio EMEC luminosity to BCM Luminosity.
- BCM Errors negligible ➔interne calculation
  - ➔ RMS = 0.0016
  - ➔ **Error = RMS/√(Nbr.LB) = 7.10^{-05}**

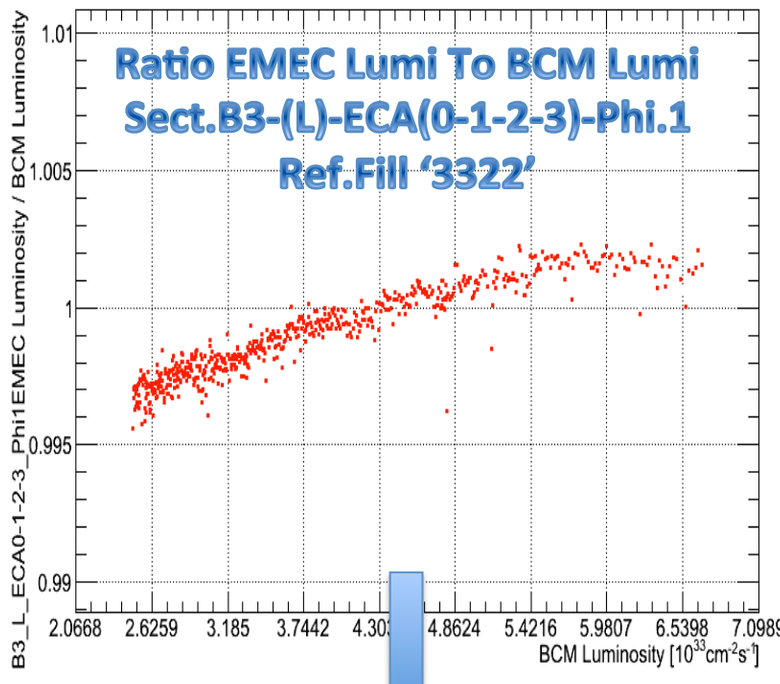


Sector B3- (L) - ECA(0-1-2-3) - Sub-Sector (*Phi1*) Average Channels Time Stability {M14C0 – M14C4 – M14C8 – M14C12}

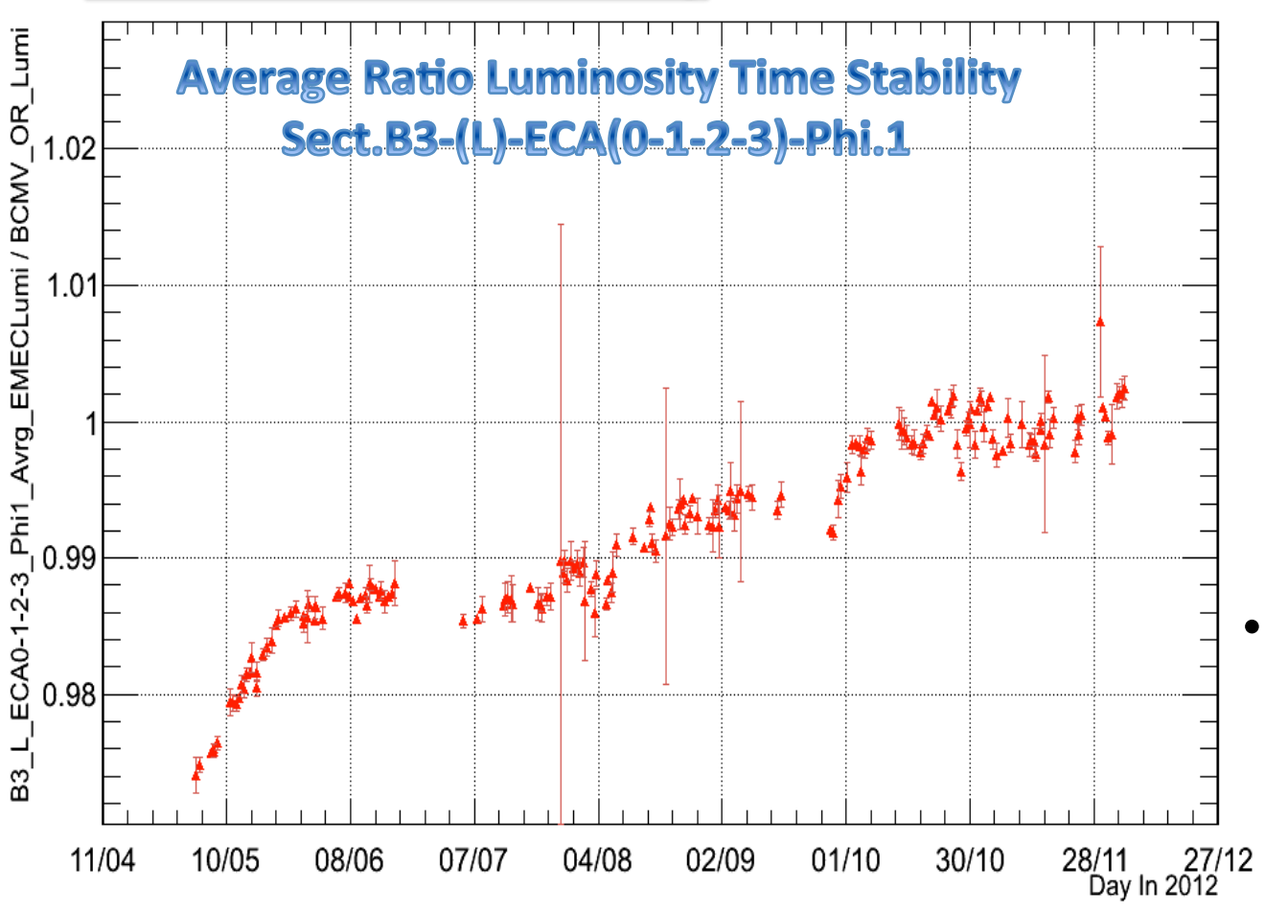
❑ The Average EMEC Luminosity

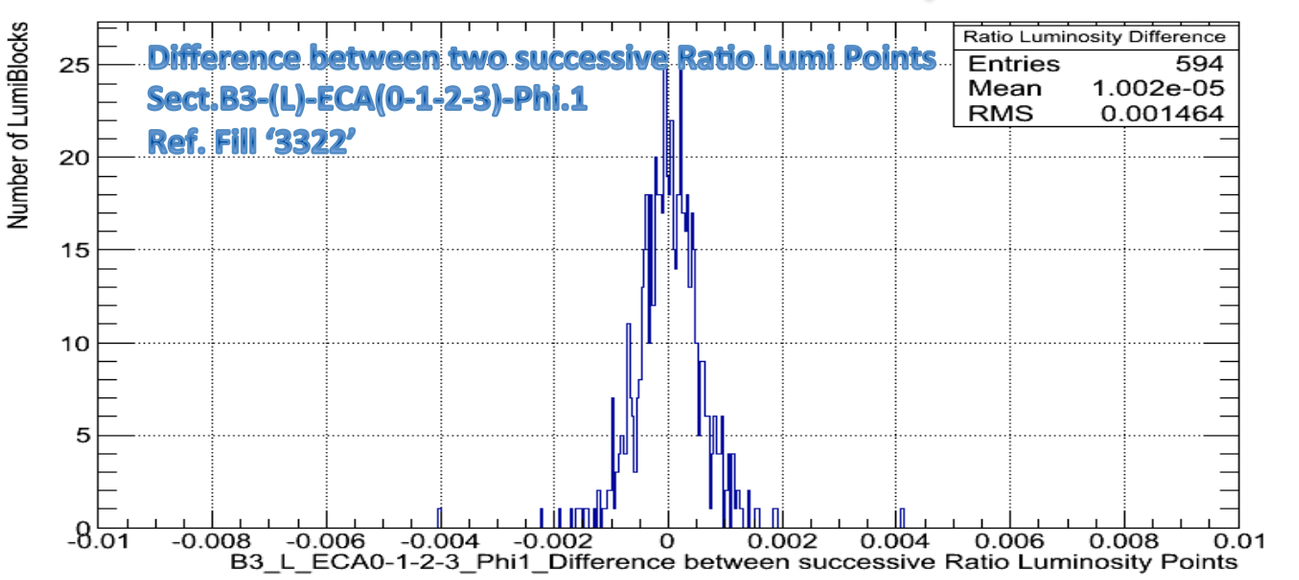
- We calculate the Average EMEC Luminosity from the average of each LB for the 4 channels selected.
- The Average Luminosity is calculating by LB following the number of Channels.
- BCM response decrease at High Luminosity wrt EMEC.





❑ The EMEC Time Stability





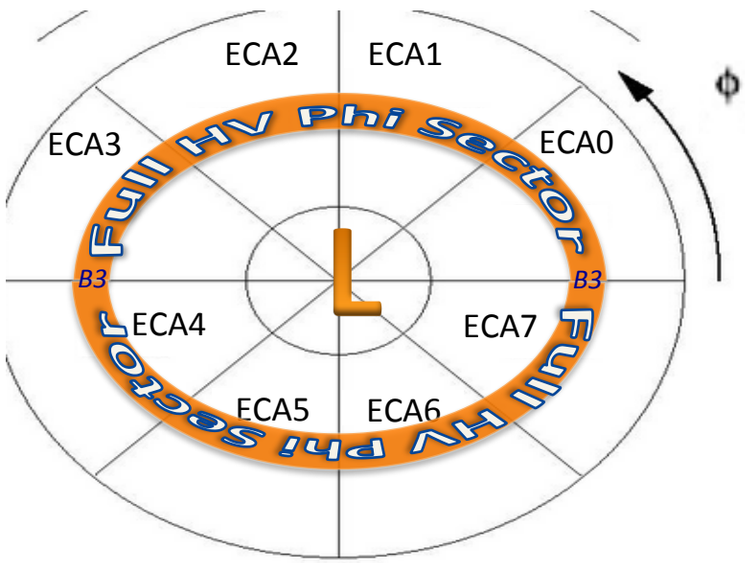
- The distribution of the difference between two successive points from the ratio EMEC lumi to BCM

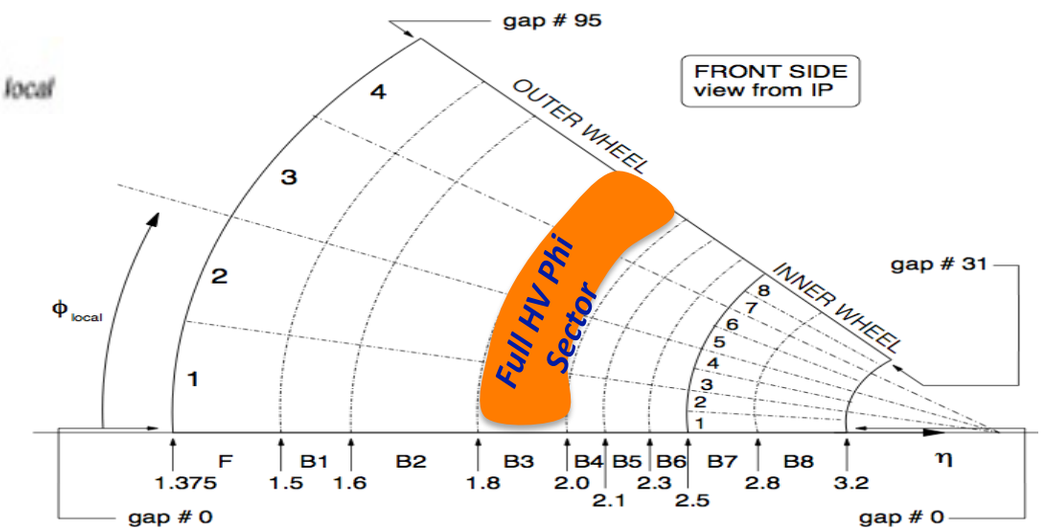
  ➔ RMS = 0.0015

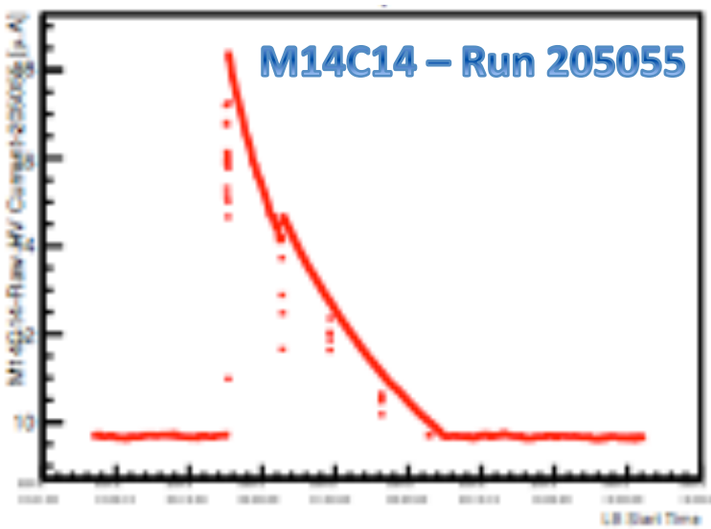
  ➔ **Error = RMS/√(Nbr.Channels) = 7.10^{-4}**

Channels Combination 2 - HV Channels Average

- We will focus to Lowest gap of EMEC-A Sector B3. We will select the HV Channels which provide current to the Full ECA Modules following the Full HV Sub sector ➔ {**Full Module 14 & Module 15**}

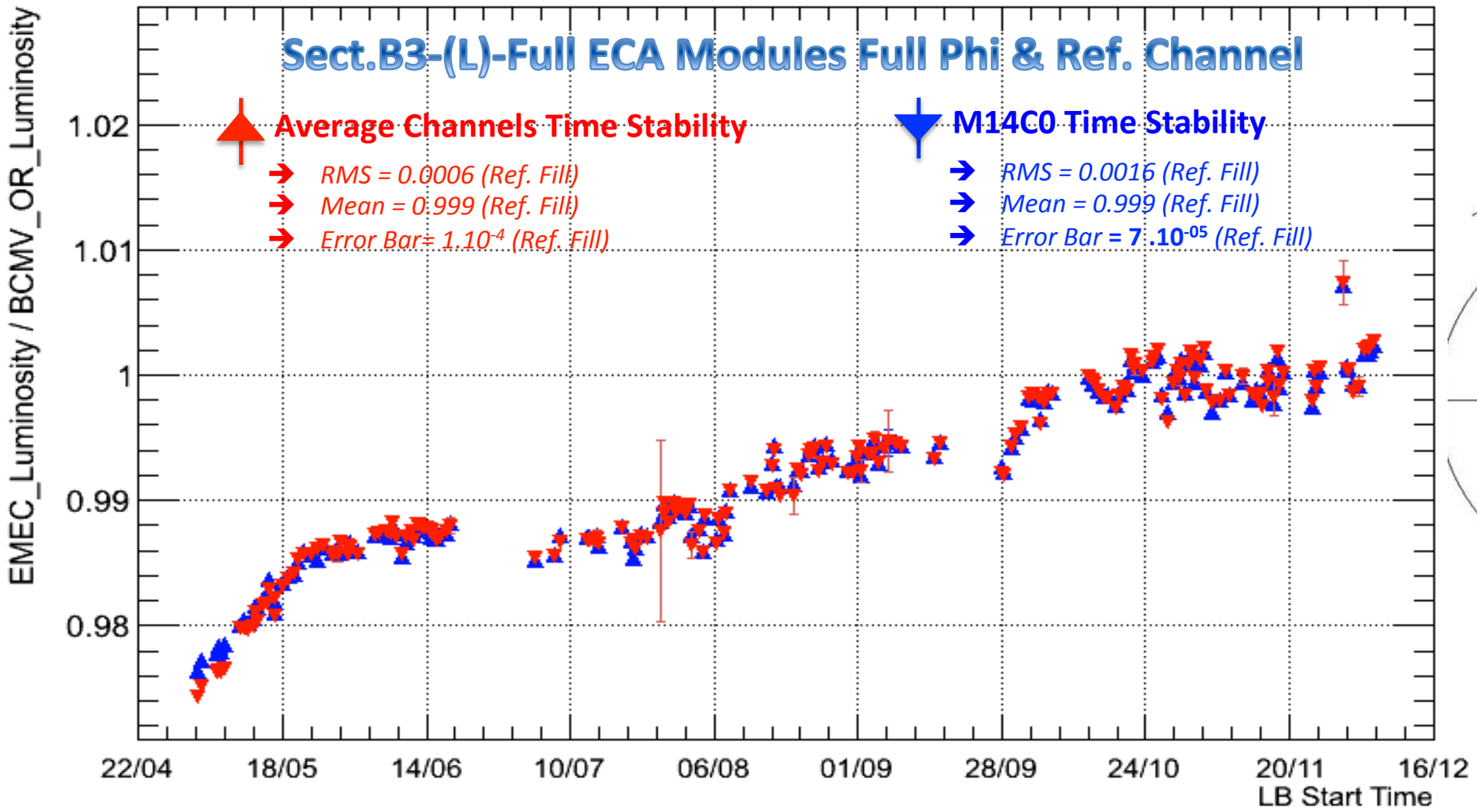


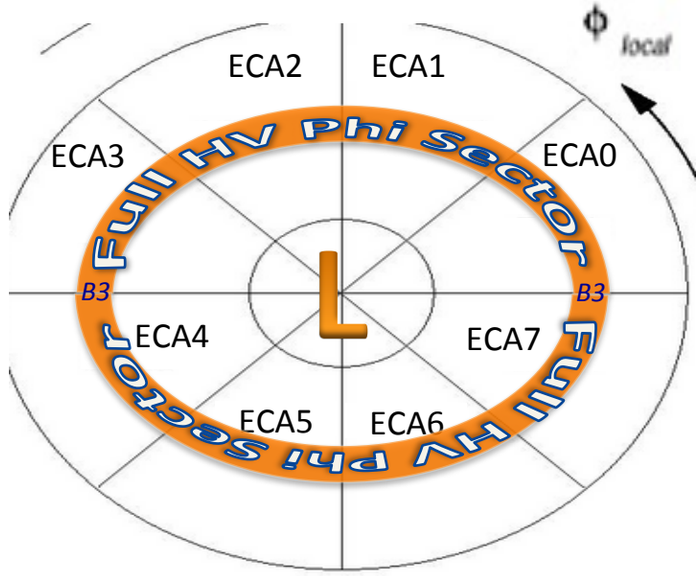


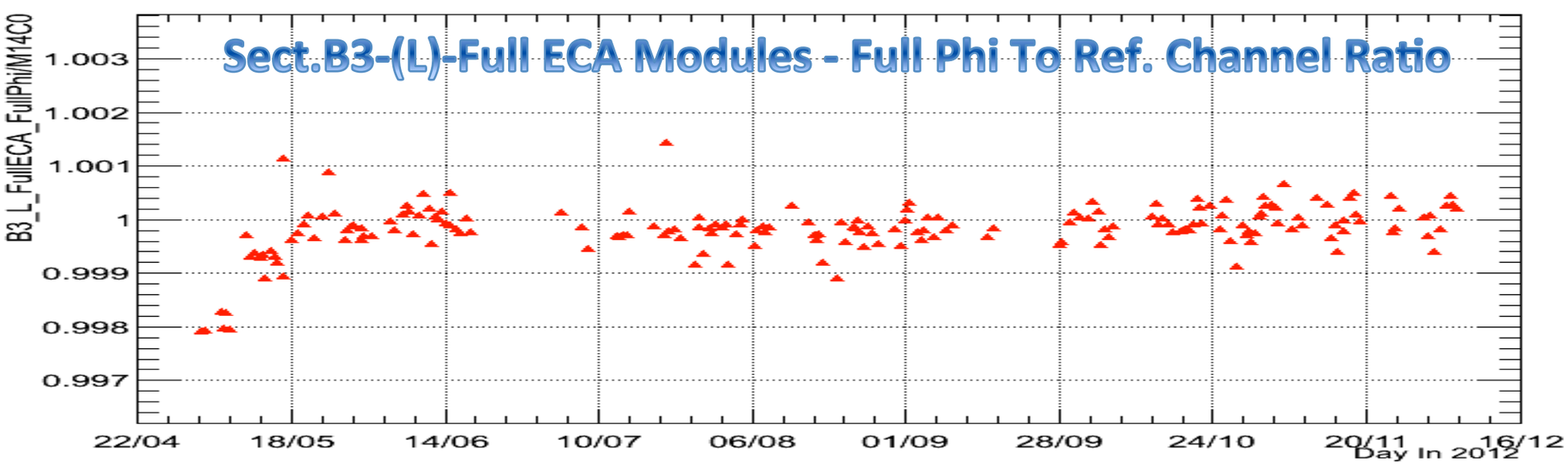


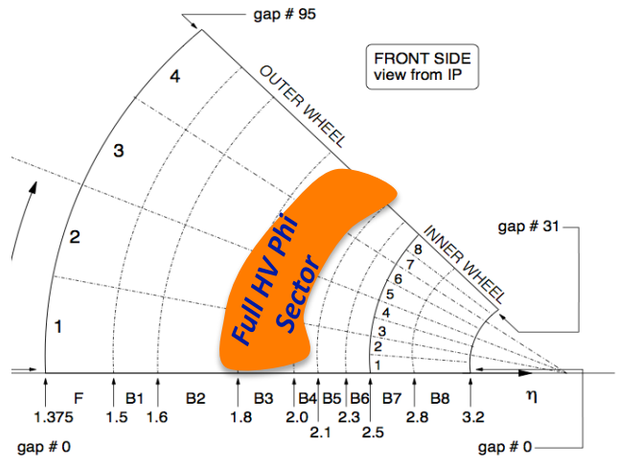
Detector	Detector Side	Detector Wheel	Eta Sector {η}	gap Voltage (H/L)	HV Module	Phi EMEC Sector {ϕ}	Phi HV Sector (Sub ϕ)			
							φ1	*φ2*	*φ3*	*φ4*
{EMEC} Electromagnetic End-Cap Calorimeter	EMEC-A	Outer Wheel	B3 (+1700 V)	Higher (H)	Mod.12	ECA0	Channel 0	Channel 1	Channel 2	Channel 3
						ECA1	Channel 4	Channel 5	Channel 6	Channel 7
						ECA2	Channel 8	Channel 9	Channel 10	Channel 11
						ECA3	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.13	ECA4	Channel 0	Channel 1	Channel 2	Channel 3
						ECA5	Channel 4	Channel 5	Channel 6	Channel 7
						ECA6	Channel 8	Channel 9	Channel 10	Channel 11
						ECA7	Channel 12	Channel 13	Channel 14	Channel 15
			B3 (+1700 V)	Lower (L)	Mod.14	ECA0	Channel 0	Channel 1	Channel 2	Channel 3
						ECA1	Channel 4	Channel 5	Channel 6	Channel 7
						ECA2	Channel 8	Channel 9	Channel 10	Channel 11
						ECA3	Channel 12	Channel 13	Channel 14 ✗	Channel 15
					Mod.15	ECA4	Channel 0	Channel 1	Channel 2	Channel 3
						ECA5	Channel 4	Channel 5	Channel 6	Channel 7
						ECA6	Channel 8	Channel 9	Channel 10	Channel 11
						ECA7	Channel 12	Channel 13	Channel 14	Channel 15

Sector B3- (L) – Full ECA Modules – Full Sub-Sectors *Phi*
Ref. Channel M14C0 to Average Channels Combination 2





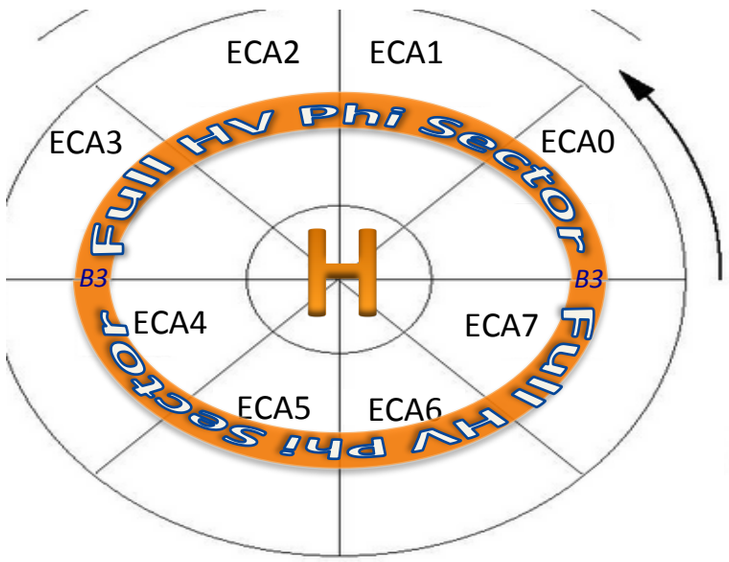


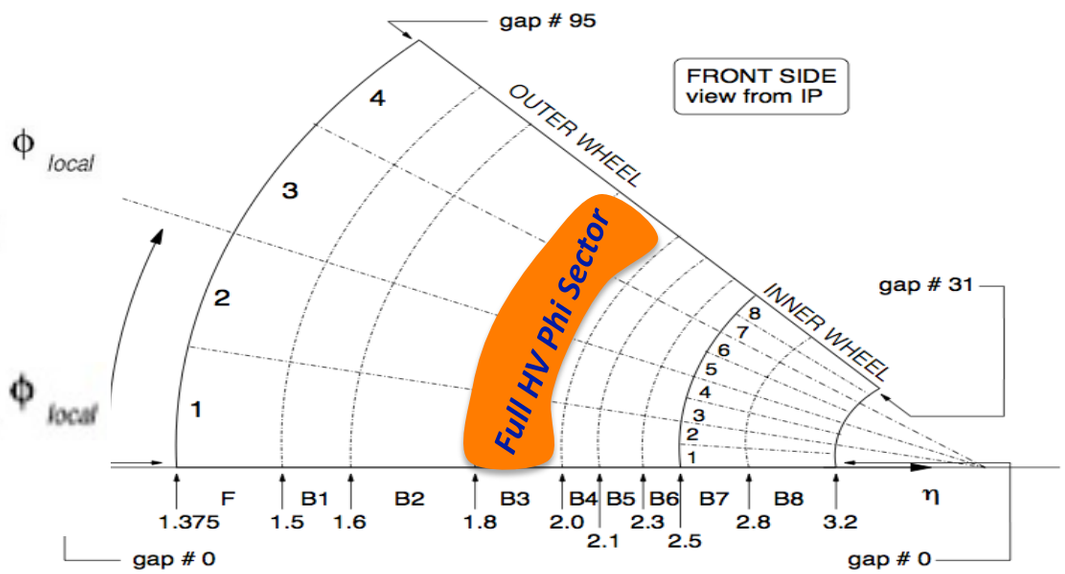


Channels Combination 3 - HV Channels Average

- We will focus to Highest gap of EMEC-A Sector B3. We will select the HV Channels which provide the current to the EMEC modules in Full ECA Modules following the Full HV Sub sector.

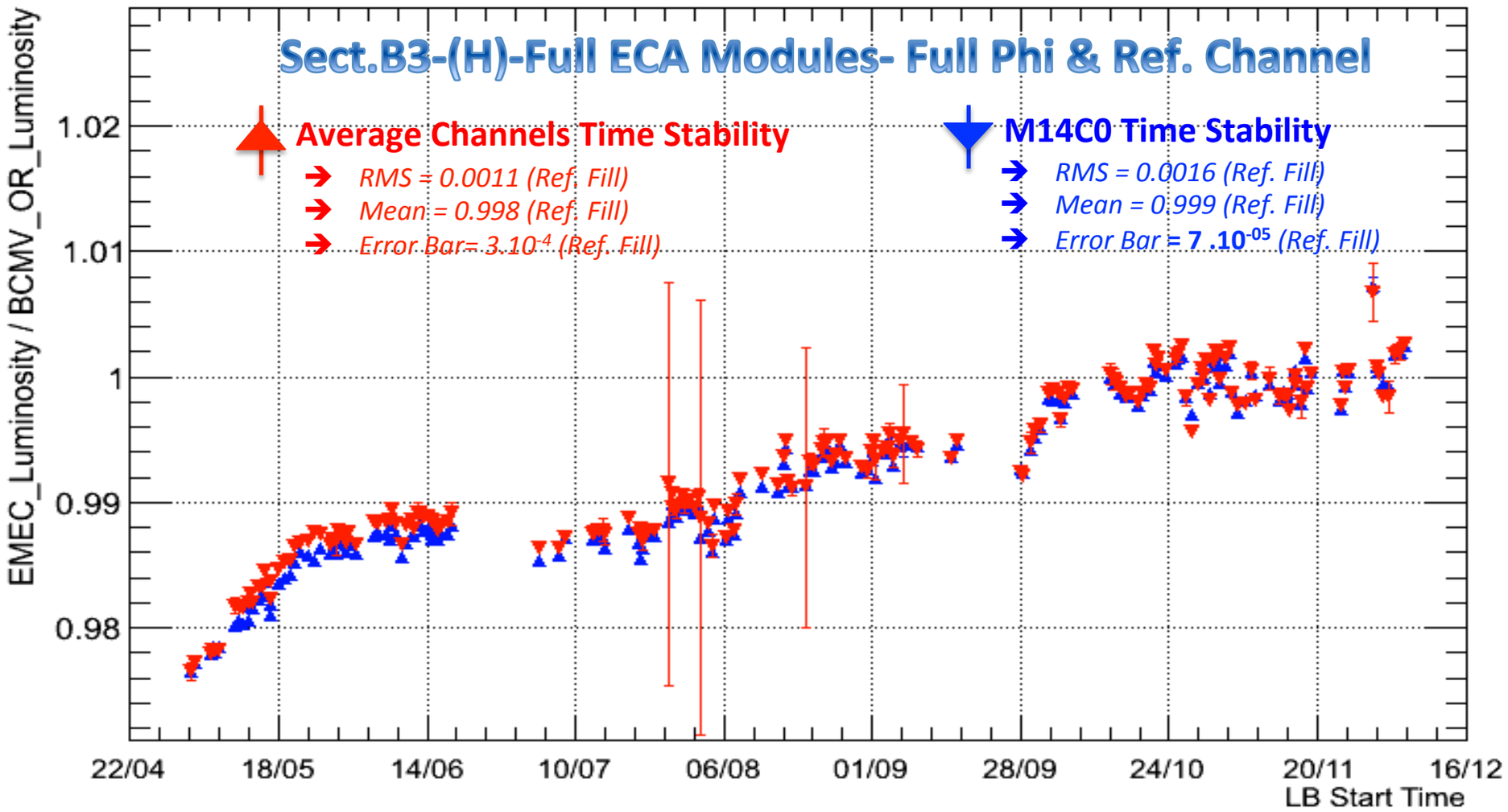
➔ {**Full Module 12 & Module 13**}

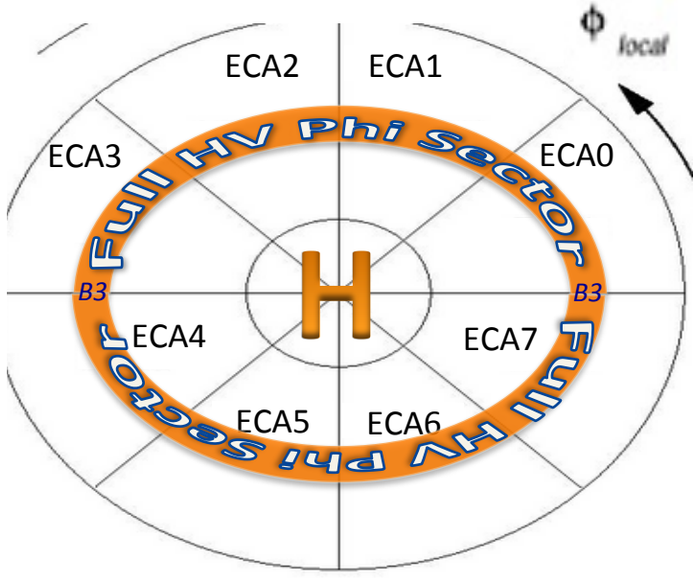


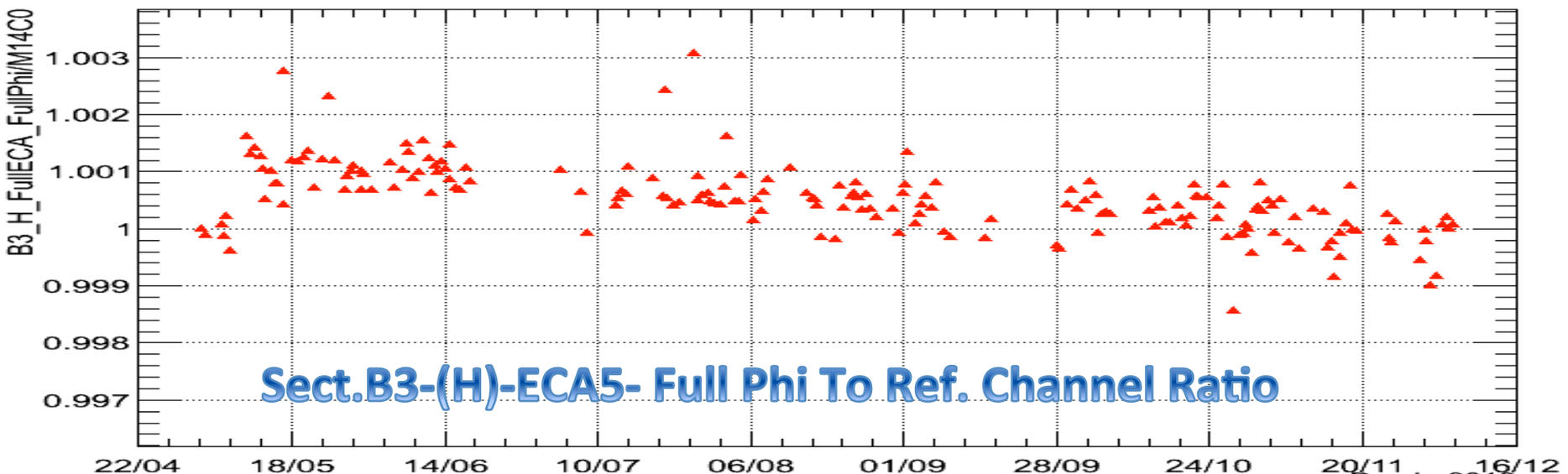


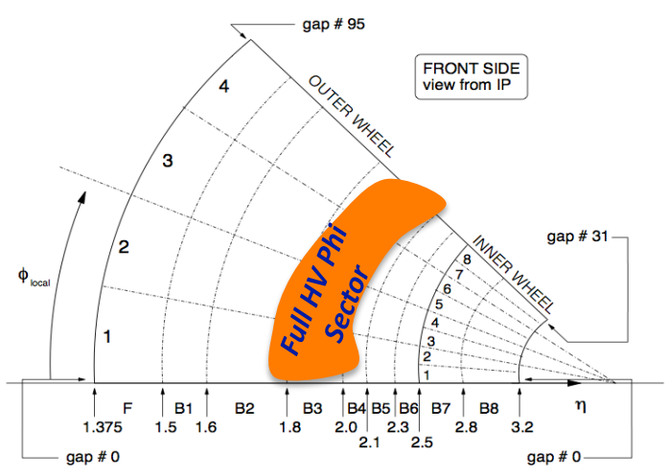
Detector	Detector Side	Detector Wheel	Eta Sector {η}	Line Voltage (H/L)	HV Module	Phi EMEC Sector {ϕ}	Phi HV Sector (Sub ϕ)			
							φ1	φ2	φ3	φ4
{EMEC} Electromagnetic End-Cap Calorimeter	EMEC-A	Outer Wheel	B3 (+1700 V)	Higher (H)	Mod.12	ECA0	Channel 0	Channel 1	Channel 2	Channel 3
						ECA1	Channel 4	Channel 5	Channel 6	Channel 7
						ECA2	Channel 8	Channel 9	Channel 10	Channel 11
						ECA3	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.13	ECA4	Channel 0	Channel 1	Channel 2	Channel 3
						ECA5	Channel 4	Channel 5	Channel 6	Channel 7
						ECA6	Channel 8	Channel 9	Channel 10	Channel 11
						ECA7	Channel 12	Channel 13	Channel 14	Channel 15
			B3 (+1700 V)	Lower (L)	Mod.14	ECA0	Channel 0	Channel 1	Channel 2	Channel 3
						ECA1	Channel 4	Channel 5	Channel 6	Channel 7
						ECA2	Channel 8	Channel 9	Channel 10	Channel 11
						ECA3	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.15	ECA4	Channel 0	Channel 1	Channel 2	Channel 3
						ECA5	Channel 4	Channel 5	Channel 6	Channel 7
						ECA6	Channel 8	Channel 9	Channel 10	Channel 11
						ECA7	Channel 12	Channel 13	Channel 14	Channel 15

Sector B3- (H) – Full ECA Modules – Full Sub-Sectors Phi Ref. Channel M14C0 to Average Channels Combination 3

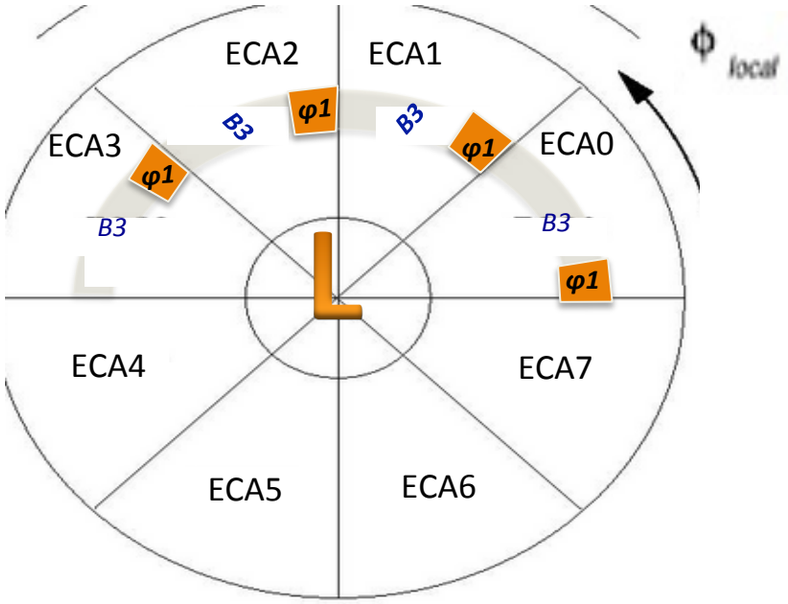


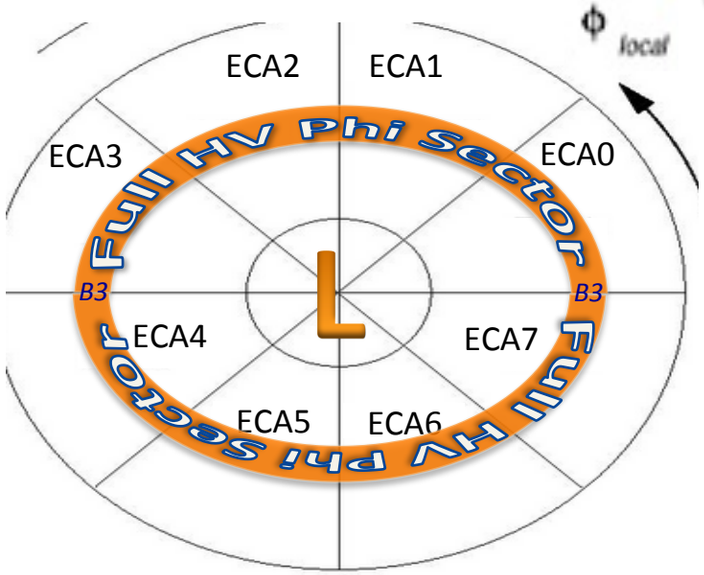


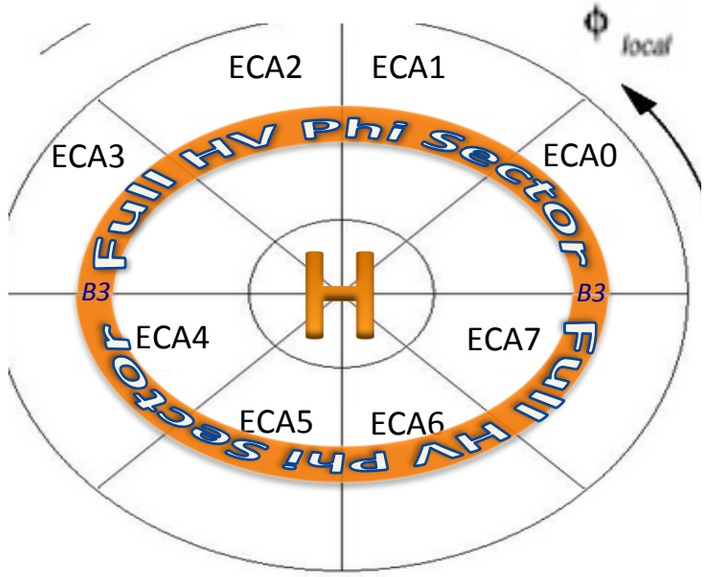


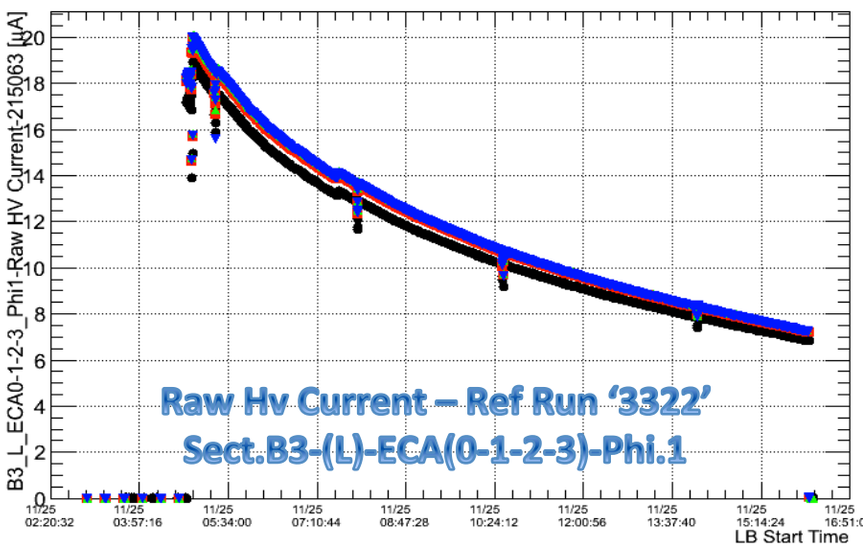


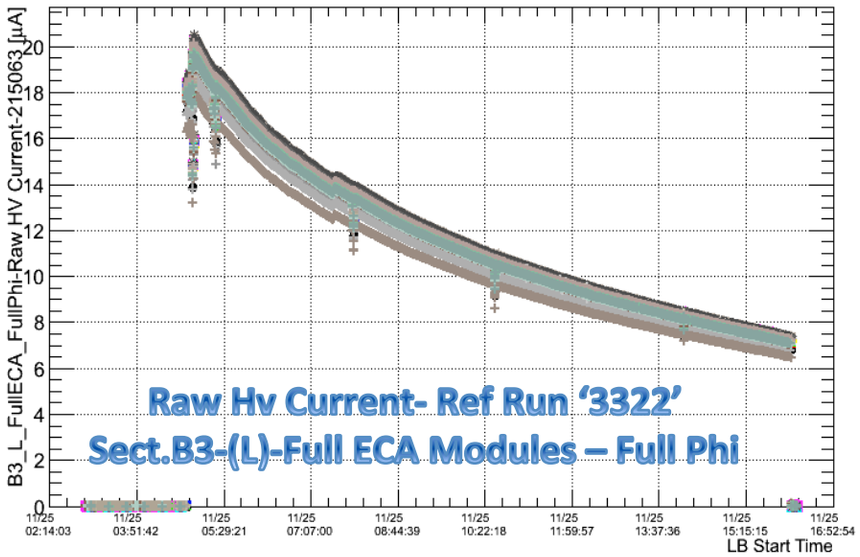
Channels selection Comparison

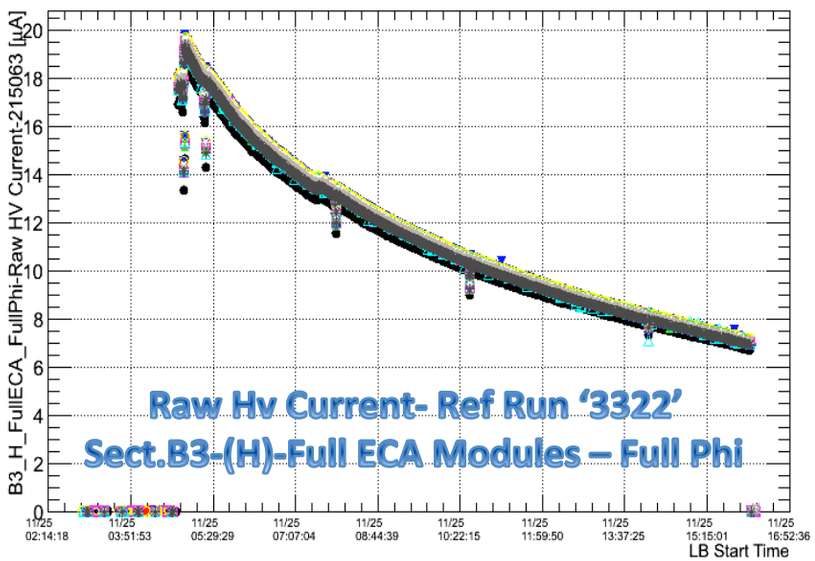


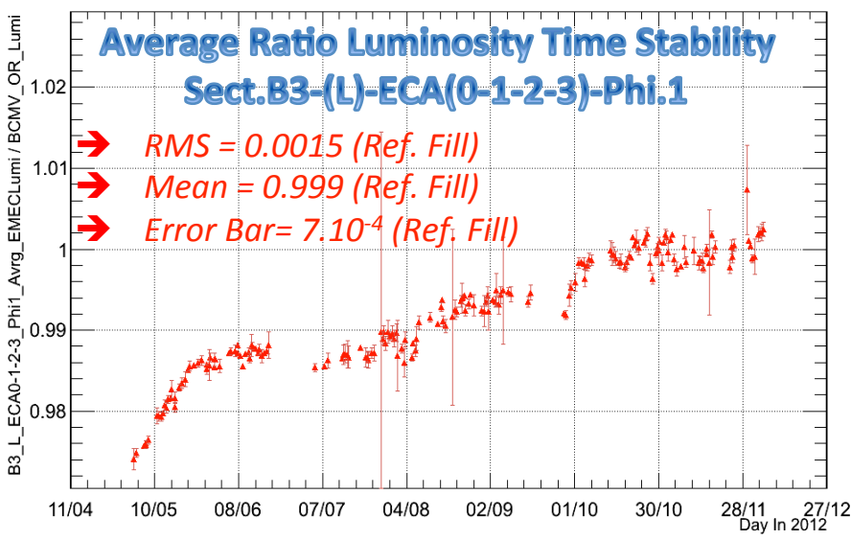


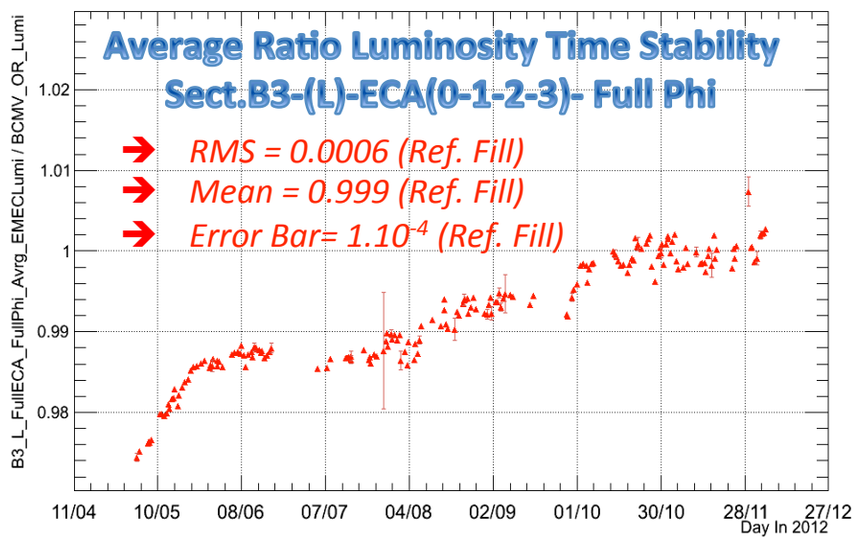


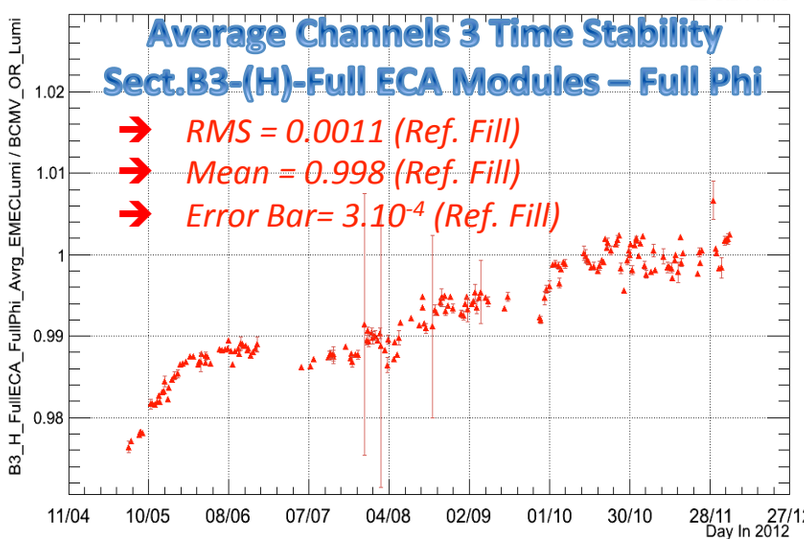




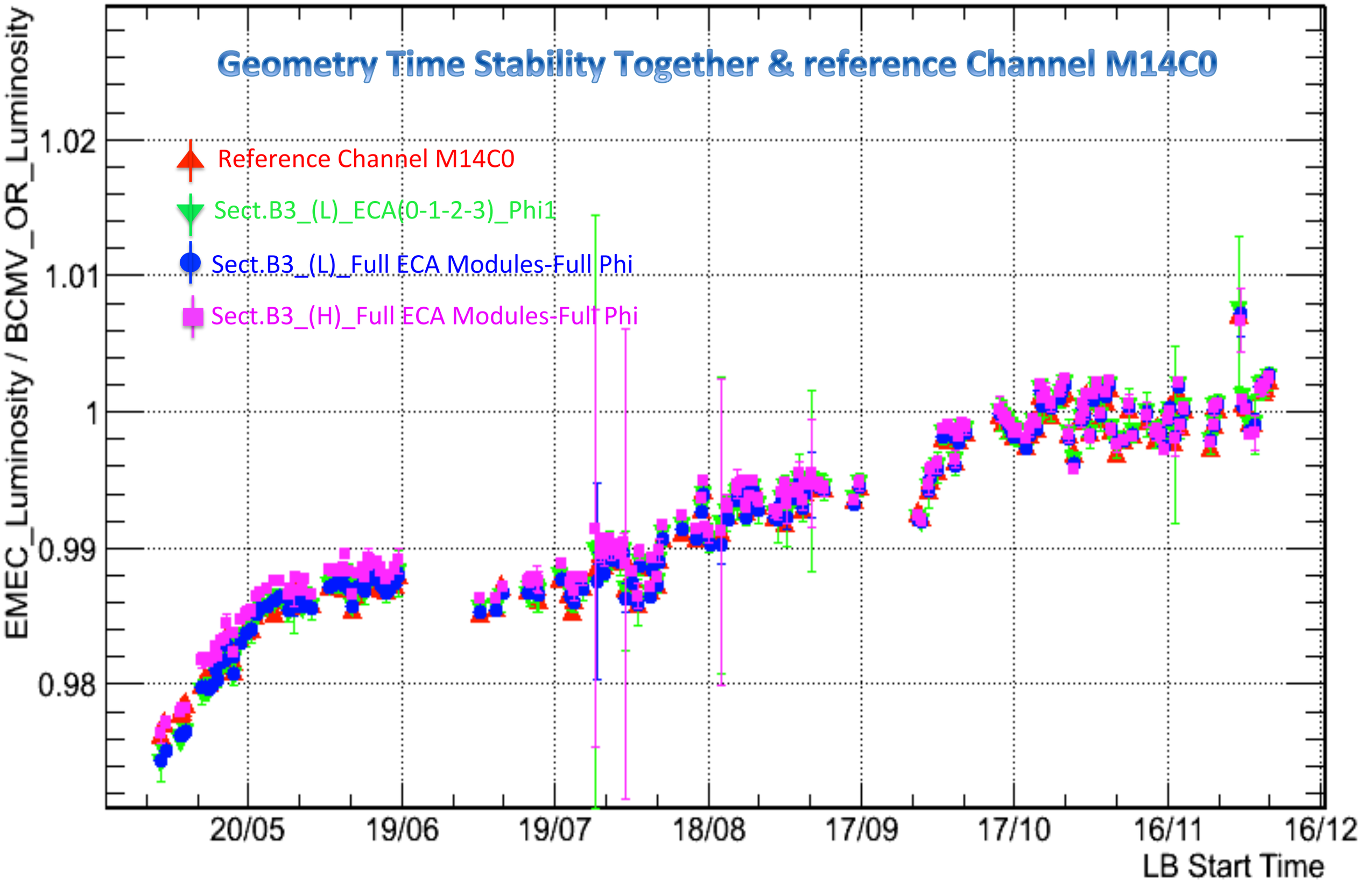






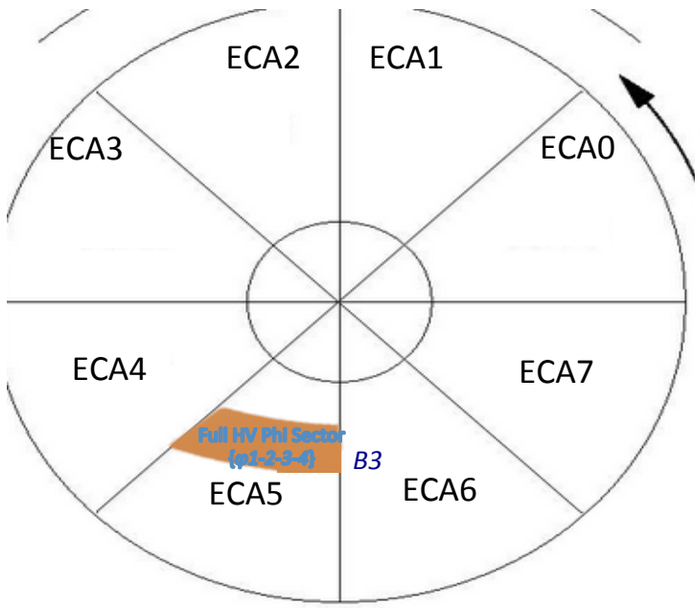


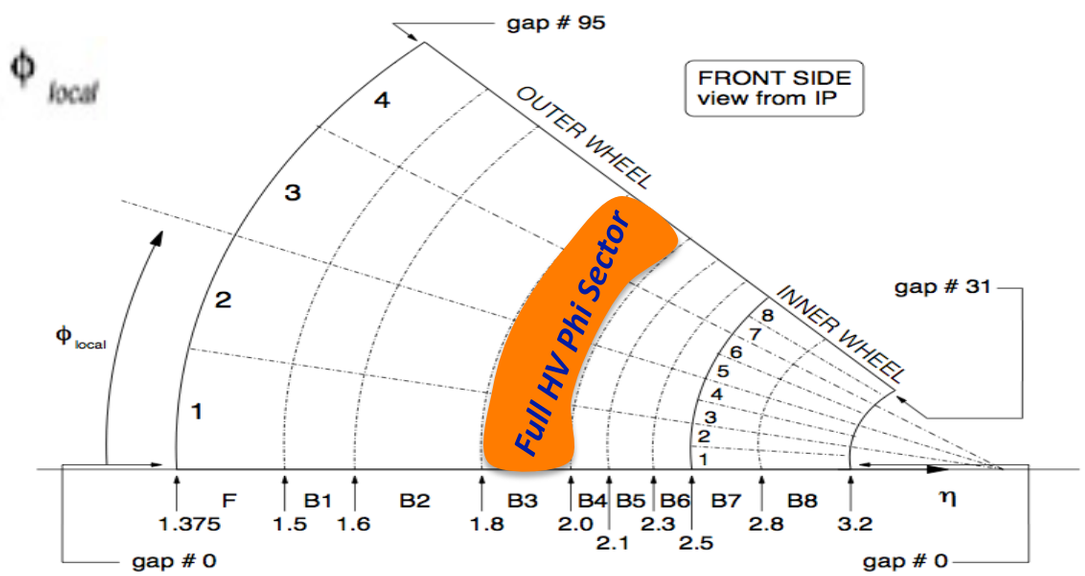
Channels selection Comparison



Channels Combination 4 - HV Channels Average

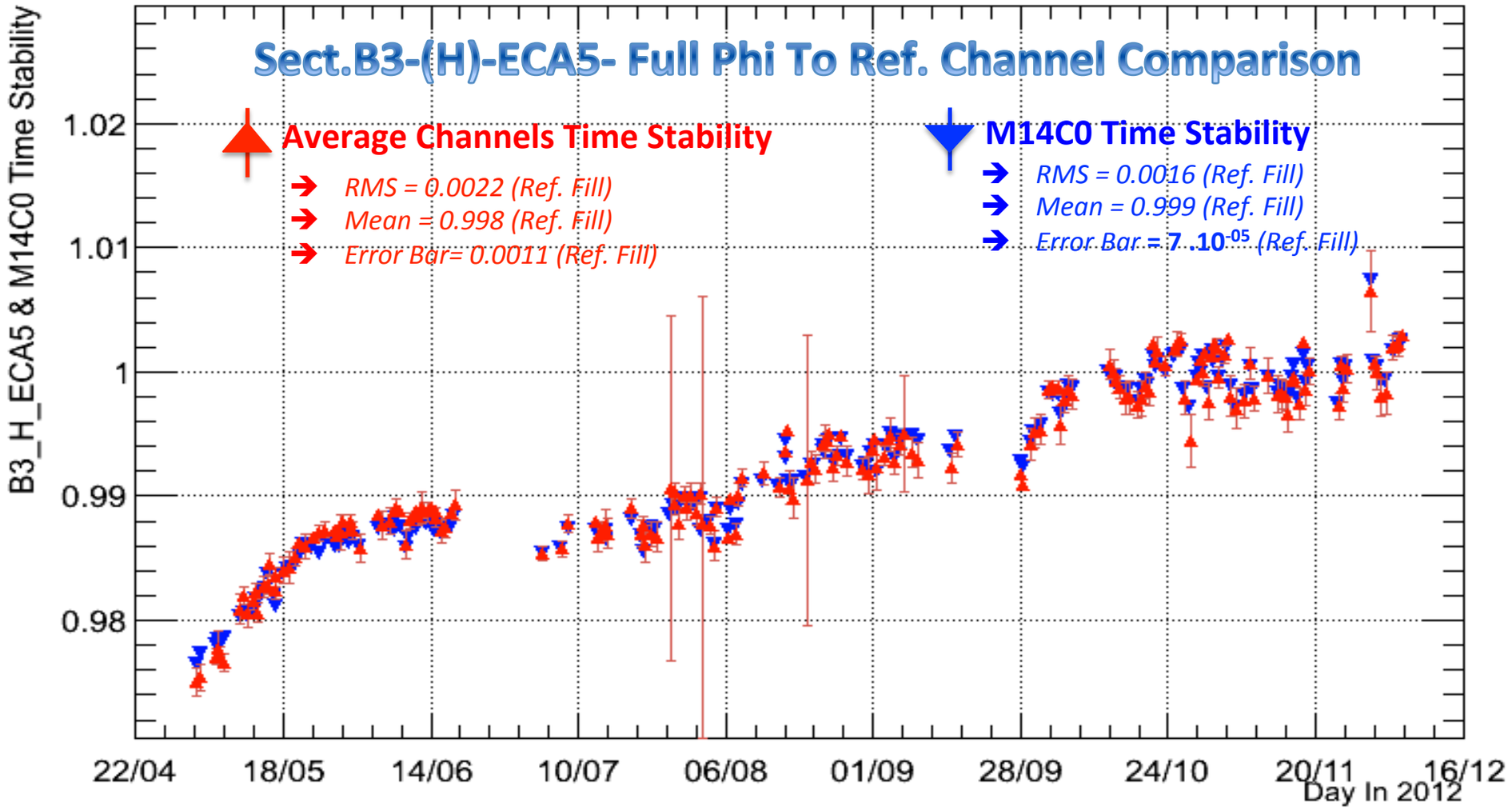
- We will focus to Highest gap of Sector B3 of the EMEC-A Side. We will select the HV Channels which provide the current to the EMEC module ECA5 following the Full HV Sub sector.
  ➔ {**M13C4-M13C5-M13C6-M13C7**}

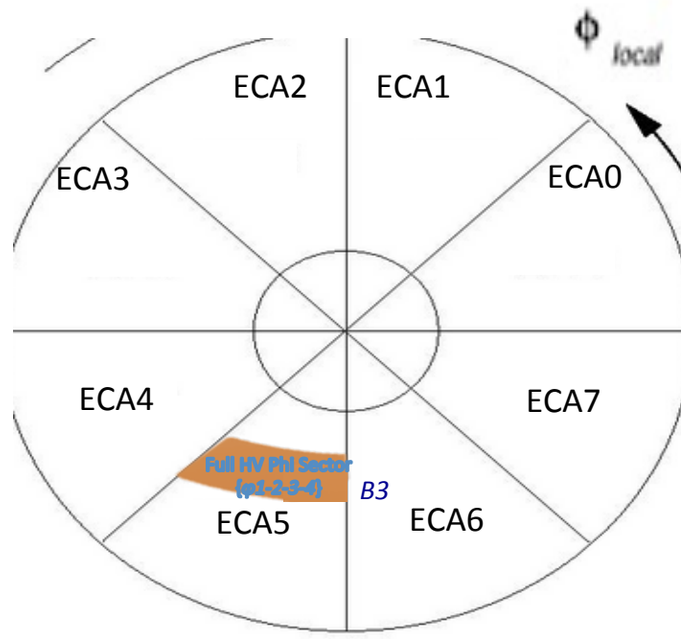


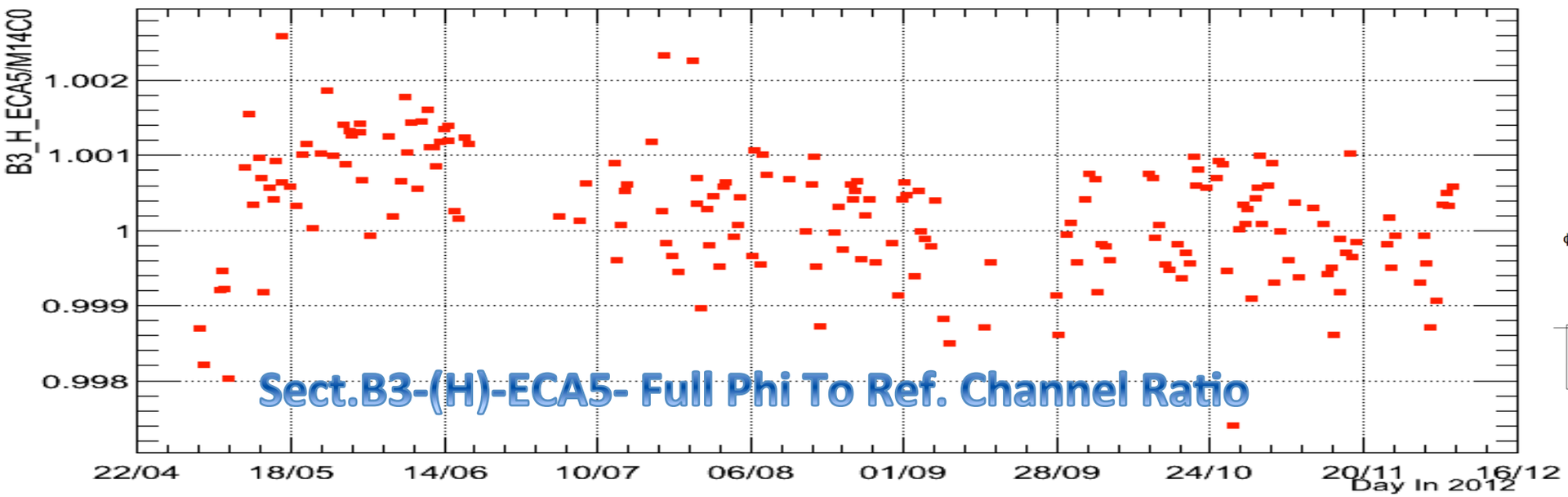


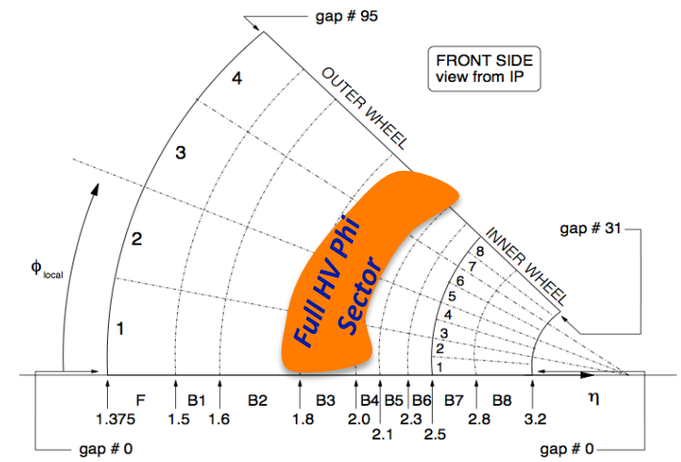
Detector	Detector Side	Detector Wheel	Eta Sector {η}	Line Voltage (H/L)	HV Module	Phi EMEC Sector {ϕ}	Phi HV Sector (Sub ϕ)			
							φ1	φ2	φ3	φ4
{EMEC} Electromagnetic End-Cap Calorimeter	EMEC-A	Outer Wheel	B3 (+1700 V)	Higher (H)	Mod.12	ECA0	Channel 0	Channel 1	Channel 2	Channel 3
						ECA1	Channel 4	Channel 5	Channel 6	Channel 7
						ECA2	Channel 8	Channel 9	Channel 10	Channel 11
						ECA3	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.13	ECA4	Channel 0	Channel 1	Channel 2	Channel 3
						ECA5	Channel 4	Channel 5	Channel 6	Channel 7
						ECA6	Channel 8	Channel 9	Channel 10	Channel 11
						ECA7	Channel 12	Channel 13	Channel 14	Channel 15
			B3 (+1700 V)	Lower (L)	Mod.14	ECA0	Channel 0	Channel 1	Channel 2	Channel 3
						ECA1	Channel 4	Channel 5	Channel 6	Channel 7
						ECA2	Channel 8	Channel 9	Channel 10	Channel 11
						ECA3	Channel 12	Channel 13	Channel 14	Channel 15
					Mod.15	ECA4	Channel 0	Channel 1	Channel 2	Channel 3
						ECA5	Channel 4	Channel 5	Channel 6	Channel 7
						ECA6	Channel 8	Channel 9	Channel 10	Channel 11
						ECA7	Channel 12	Channel 13	Channel 14	Channel 15

Sector B3- (H) - Sector (ECA5) – Full Sub-Sectors Phi Ref. Channel M14C0 to Average Channels 3 Comparison

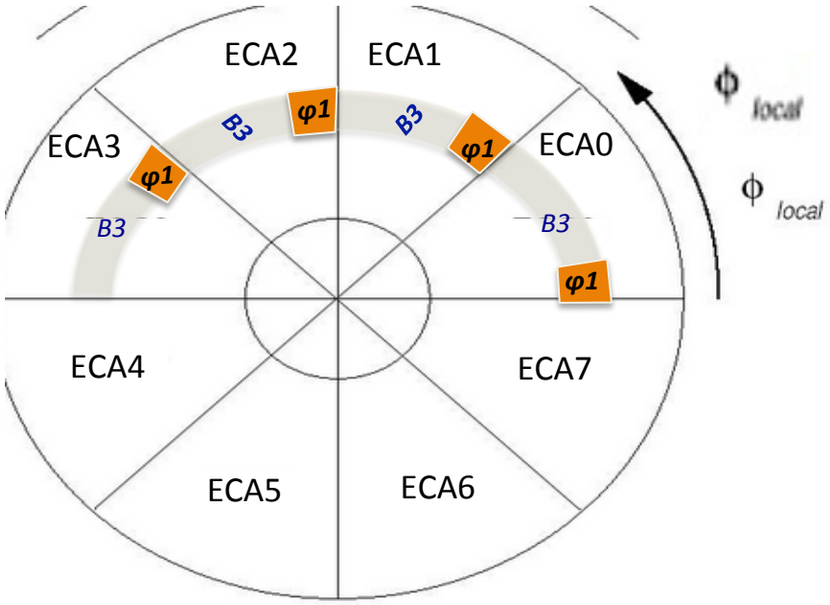


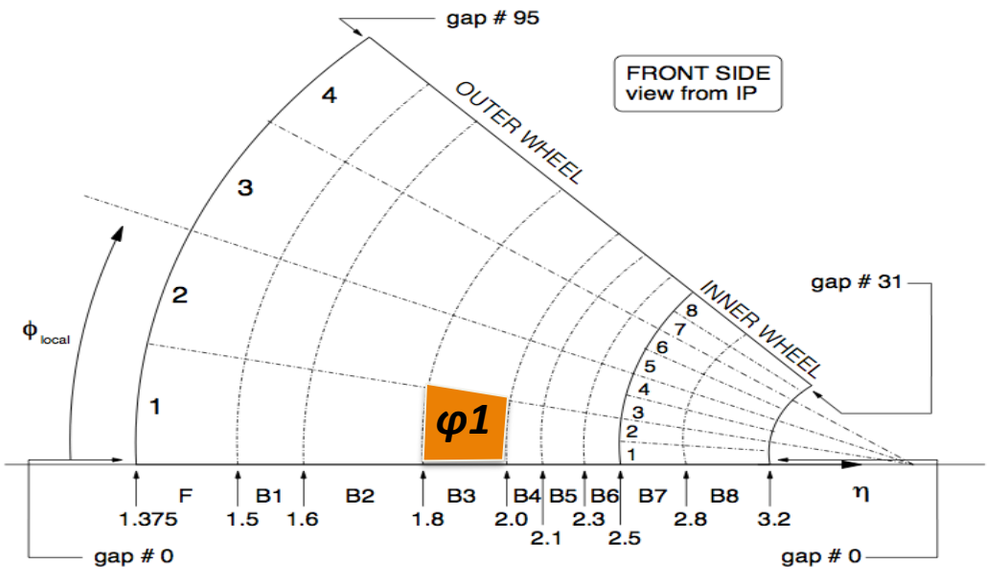


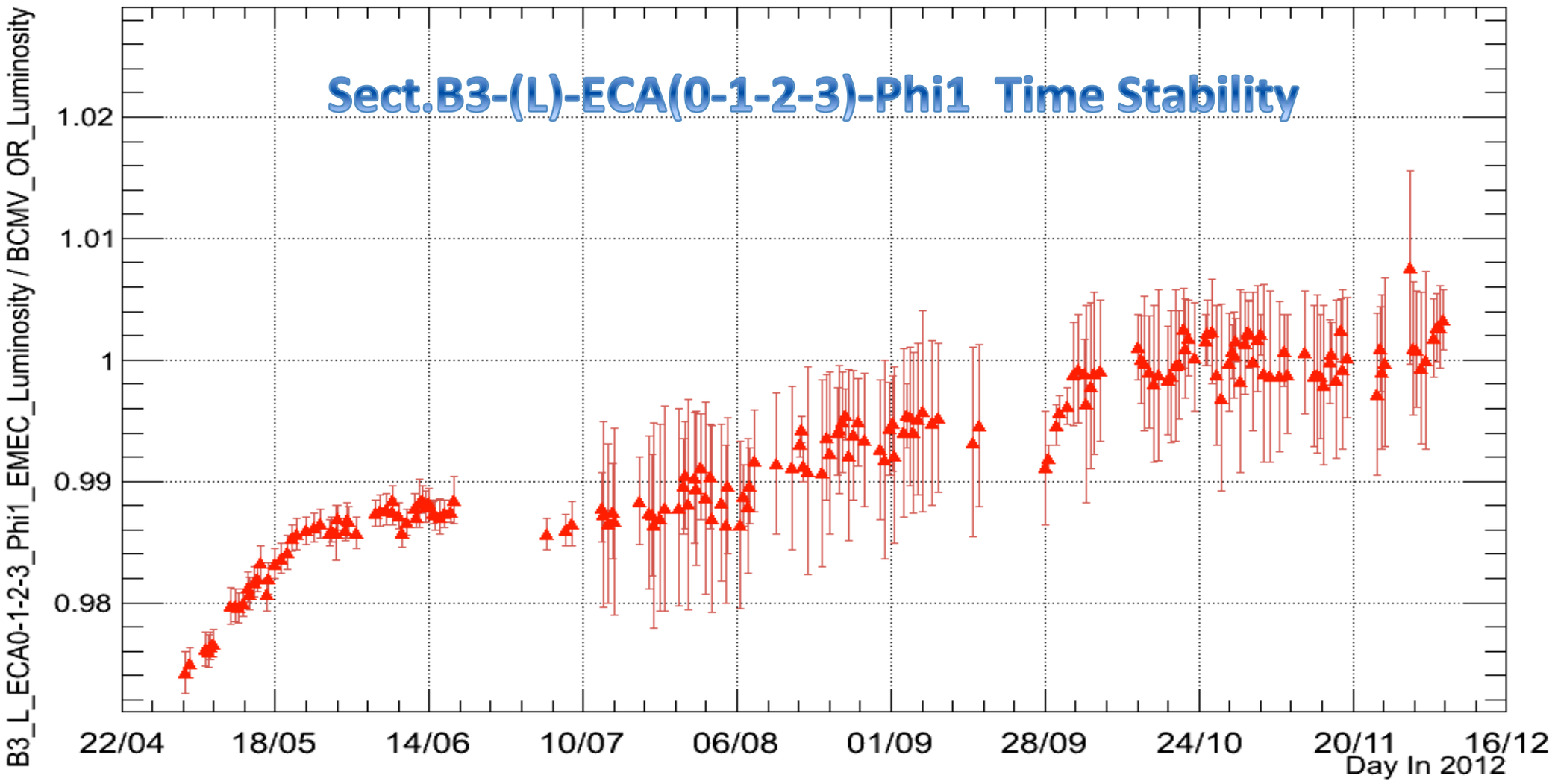




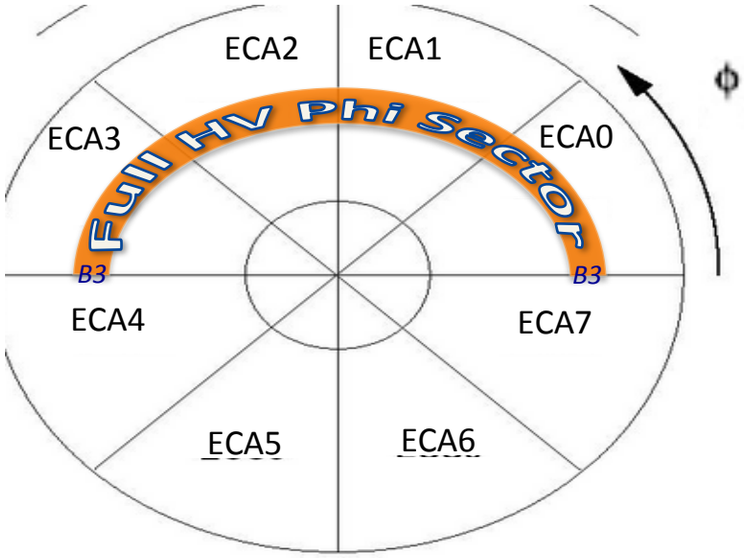
HV Current Average Analysis : Channels Combination 1

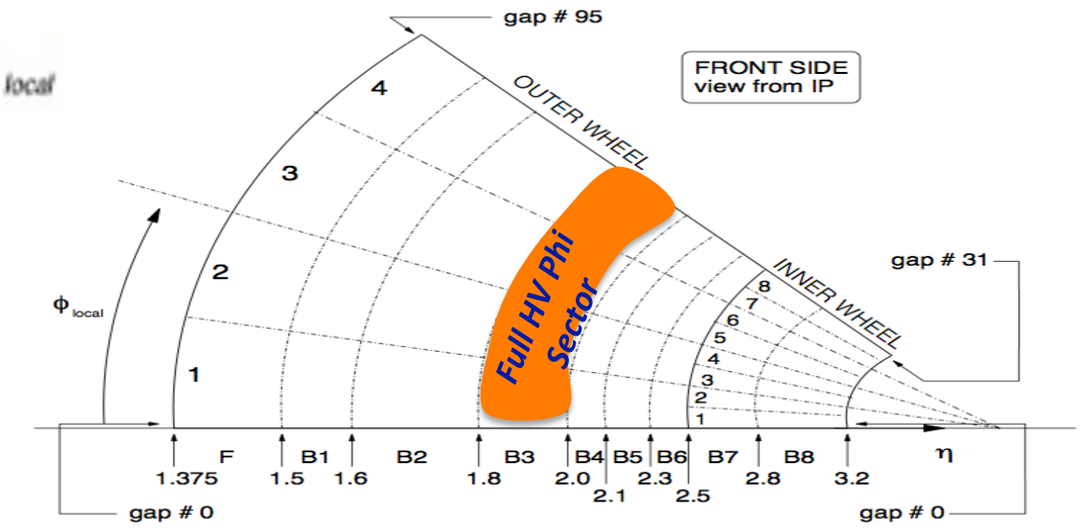


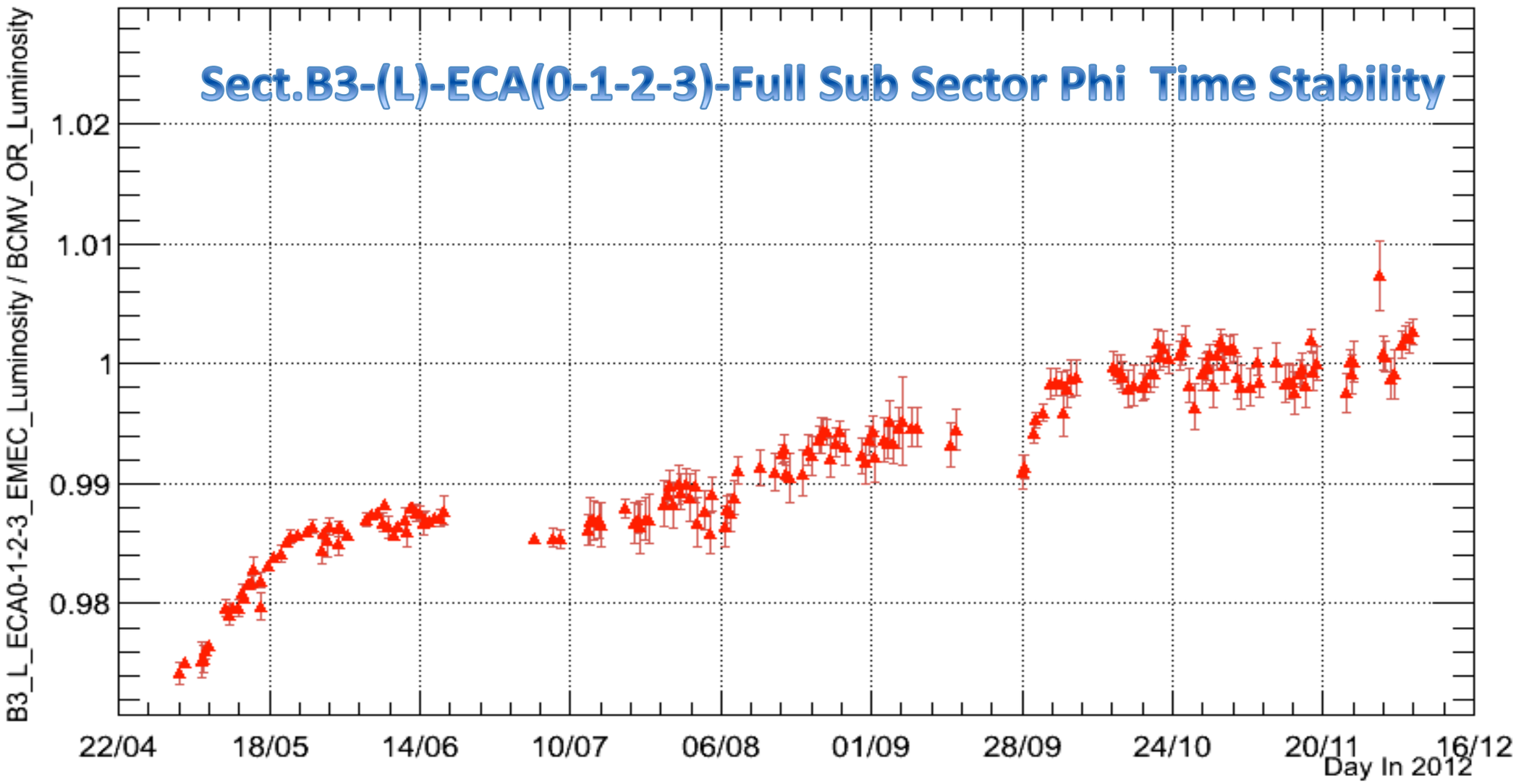




HV Current Average Analysis : Channels Combination 2







HV Current Average Analysis : Channels Combination 3