

Futuri acceleratori: attività nella sezione INFN-Bari



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e LPC-FNAL Batavia

per il gruppo RD_FA



Bari
11 Luglio 2018

Organizzazione

➤ **Diverse aree di interesse ed attività:**

- Misure di precisione per acceleratori e^+e^- (FCC-ee, CepC)
- Misure di precisione per acceleratori pp (FCC-hh) e SppC
- Misure per electron ion collider (EIC)
- Prospettive di scoperta di nuova fisica
- Generatori MC, simulazione del rivelatore
- Infrastruttura di calcolo per simulazione ed analisi

➤ **Sono coinvolti fisici teorici e sperimentali**

➤ **Contributi per CDR per CepC/FCC (2018) e per EU Strategy (2018)** **(attività strettamente legata agli studi di CMS per Run2 e HL-LHC)**

➤ **Anagrafica Bari 2017/2018:**

- Nicola De Filippis (ric. poliba: 10%)
- Marcello Abbrescia (prof. ass., uniba): 10%
- Antonio Valentini (prof. ass., uniba): 50%, Grazia Cicala (ric. CNR): 30%
- Pier Verwilligen (ric. INFN): 10%

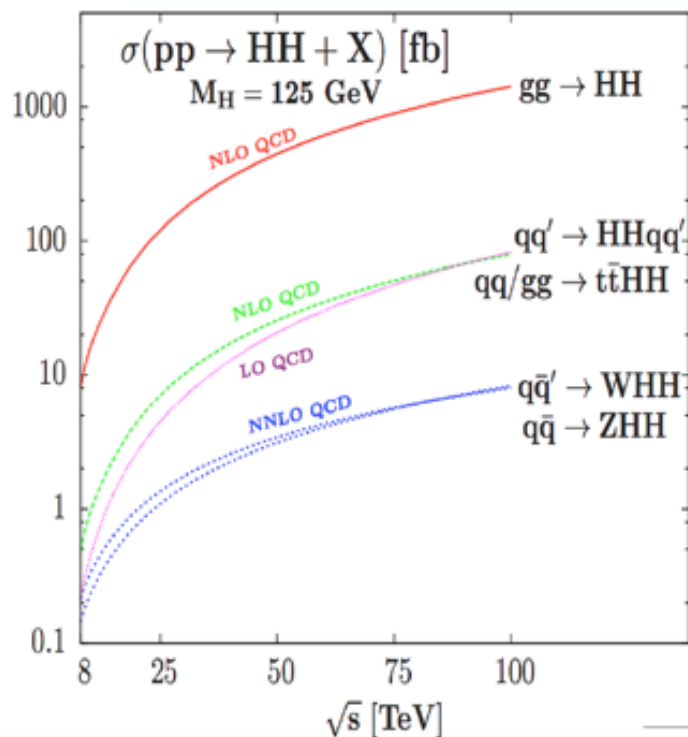
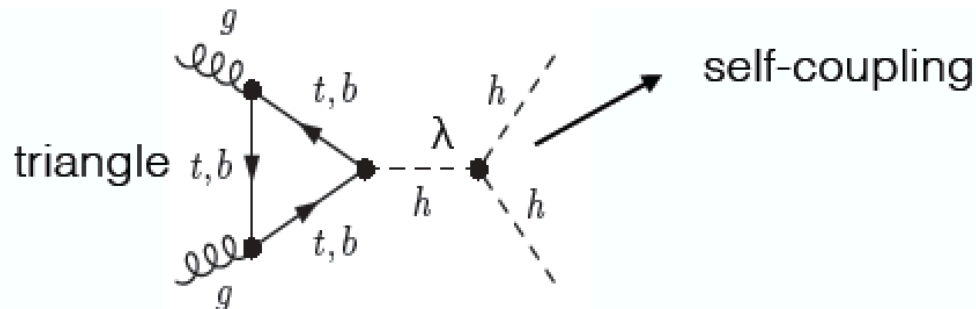
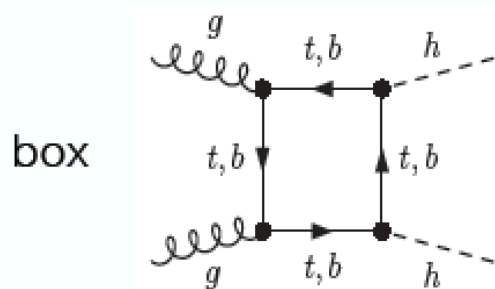
➤ **Fondi RD_FA per missioni confluiti su INFN Pisa**

Attività nel 2018:

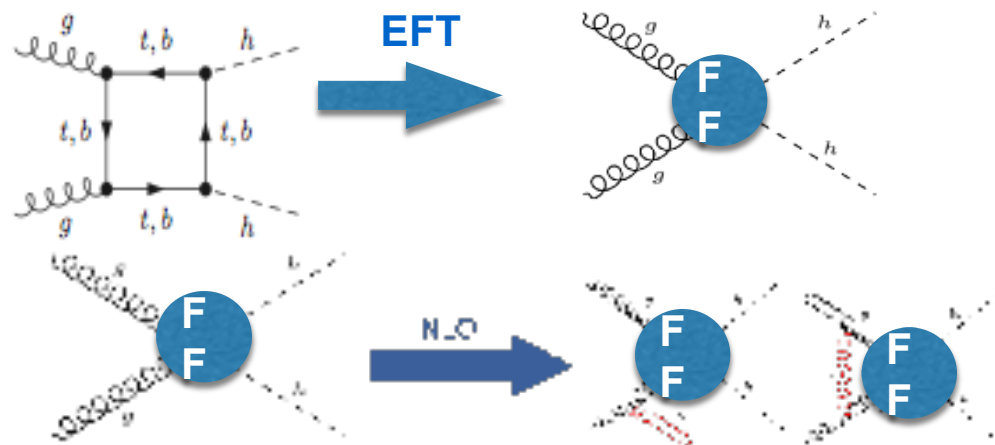
Fisica

Studi per FCC-hh/SppC: fisica

Produzione di-Higgs per studiare l'accoppiamento triplo di H e non solo:

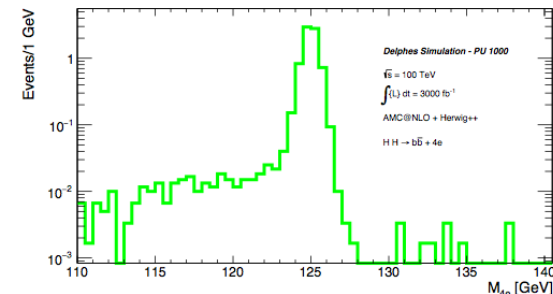
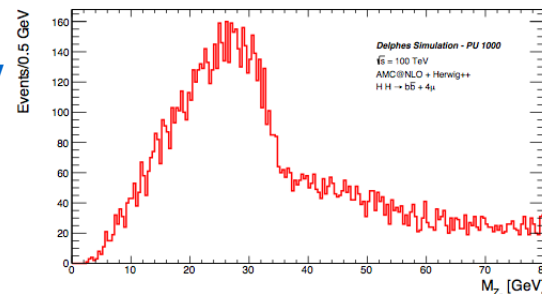
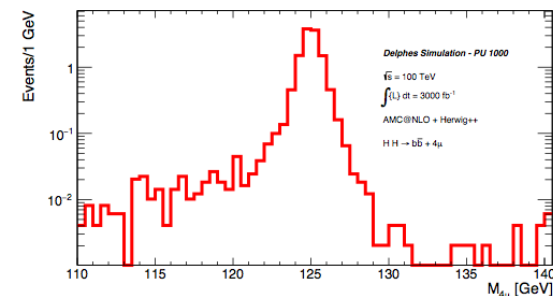
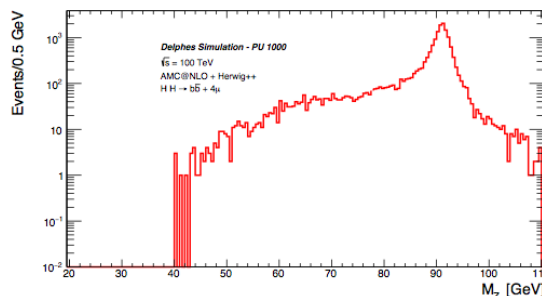


- Modo di produzione dominante: **fusione di gluoni**
- Segnale simulato con Madgraph5_aMC@NLO
- “NLO reweighting” del p_T del sistema HH con correzione legata alla massa finita del top implementata attraverso dei “Form Factor”, *R. Frederix et al., Phys. Lett. B732 (2014) 142*



Studi per FCC-hh/SppC: $HH \rightarrow ZZbb \rightarrow 4lbb$

- ≥ 4 muoni con $p_T > 5$ GeV, $|\eta| < 4.0$
- ≥ 4 elettroni con $p_T > 7$ GeV, $|\eta| < 4.0$
- selezione Z_1 : coppia l^+l^- con massa più vicina alla massa della Z nominale: $40 \text{ GeV} < m_{Z1} < 120 \text{ GeV}$
- selezione Z_2 : seconda coppia l^+l^- $12 \text{ GeV} < m_{Z2} < 120 \text{ GeV}$
- tra i 4 leptoni selezionati: almeno uno con $p_T > 20$ GeV ed uno con $p_T > 10$ GeV
- soppressione risonanze QCD: $m(l^+l^-) > 4 \text{ GeV}$
- $120 < m_{4l} < 130 \text{ GeV}$
- almeno 2 b-jets con $p_T > 30 \text{ GeV}$



- 4l permette di ricostruire la massa dell'Higgs con precisione
- Il b-tagging è un importante ingrediente dell'analisi

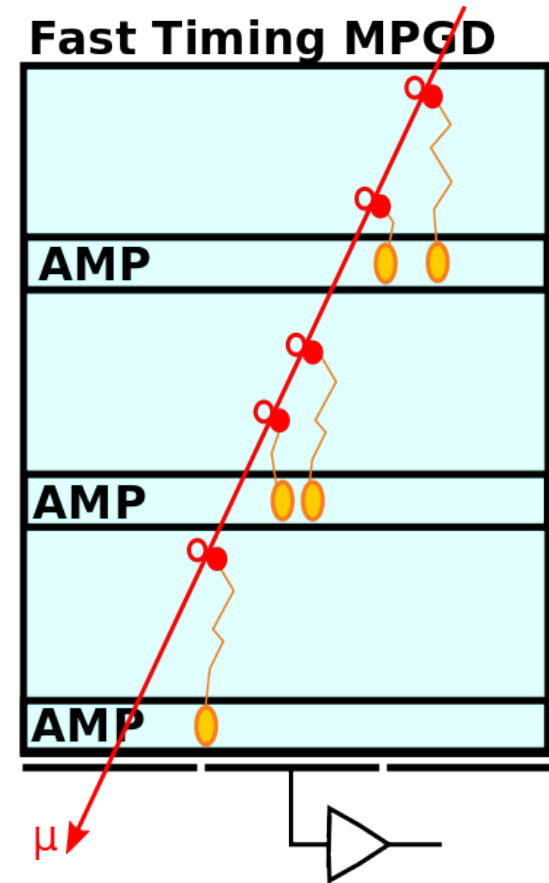
L=3 ab⁻¹	$\sigma \cdot L \cdot \text{Br}(hh \rightarrow ZZbb \rightarrow 4lbb)$	no b-jet req.	with b-jet	ϵ (no b-jet)	ϵ (b-jet)
4μ	161	61	12,1	38%	7,4%
4e	161	40	7,7	25%	4,8%
Tot	322	101	20	31%	6,2%

Analisi presentata a LHCP 2018 e finalizzata per il CDR per FCC

Attività nel 2018: Rivelatore

Development of Fast Timing MPGD - status

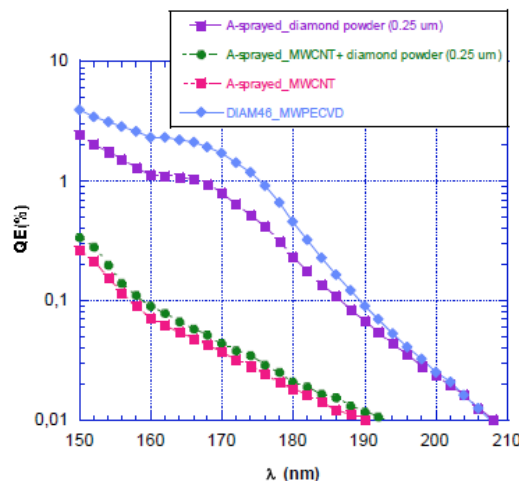
- MPGD-FaTimA (Fast Timing Applications) was funded 2016-2017 in [CSN-V](#) and has ~2.0 FTE
- In 2018 Piet put 0.1 FTE in RD-FA to have additional funds for the detector: idea was to ask 3kEUR for additional detector planes → unfortunately no support
- FTM electronics tested fall 2017; FTM detector constructed Spring 2018.
- Detector & Electronics tested: detector seems to work fine (however we cannot quantify the gain with the current setup → Grant 20kEUR) however electronics suffer from problems of internal power supply in chip → 2 x lower gain; 20ns time jitter;
- Delays in detector construction & problems with electronics did not justify request for detector extension (yet).
- Activities will continue in new [CSN-V](#) experiment dedicated to R&D of the FTM. Collaboration Bari-Lecce-Pavia



Fotocatodi a nanodiamante – A. Valentini

New photocathode based on NanoDiamond (ND) particles: the planned activity consists in initial studies to understand the compatibility of this innovative photocathode material with the operation in gaseous detectors. So far, the only photoconverter compatible with large-size, operative gaseous detector is CsI.

The use of CsI in gaseous detector suffers of some **intrinsic limitations**: ageing, causing a severe decrease of the quantum efficiency after a collected charge of the order of some mC/cm² and long recovery time (about 1 day) after an occasional discharge in the detector. CsI is chemically fragile: if exposed, even for short time, to atmospheres with water vapour the molecule is broken and therefore the QE is lost



Achievements of 2018:

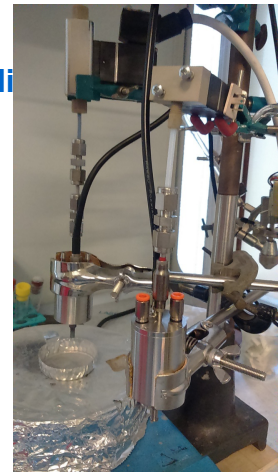
- comparison the quantum efficiency of photocathode samples in vacuum and in different gaseous atmospheres;
- realization of a photon detector prototype with a photocathode using as substrate a THGEM and to characterize it;
- made a preliminary ageing study measuring the QE before and after collecting defined amount of charge at the photocathode itself.

The **ND powder** is hydrogenized before the cathode coating, the spray procedure by an ultrasonic atomizer used to form the photocathode does not require temperatures exceeding 120 degrees C. **This is compatible with gaseous detector components**

Preliminary tests of mechanical attachment of the photocathode and ageing due to exposure to air indicate that this photocathode material is **robust**.

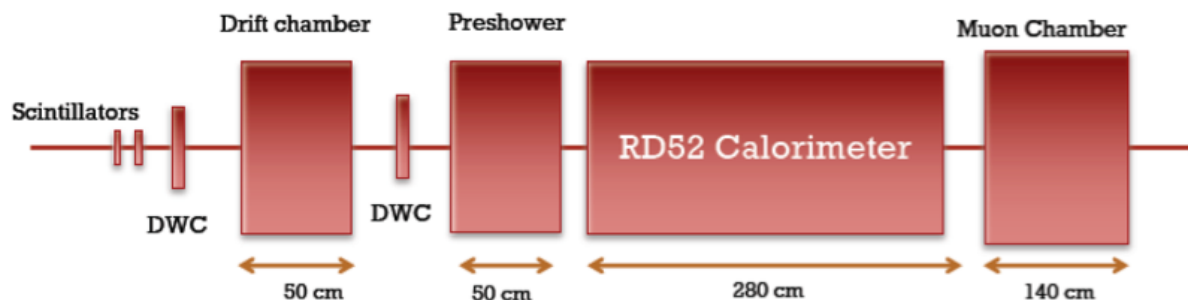
CRESCITA degli
STRATI di
DIAMANTE

**Activities will
continue in
new CSN-V
experiment**



Test beam 2018 al CERN: area H8

September 5-12



■ Measurements:

- Particle Identification with:
 - Drift Chamber Prototype (p, π , k) using dE/dx VS cluster counting
 - Preshower + Dual Readout Calorimeters (e, π , μ)
 - μ RWell (e, μ)
- Preshower optimization studies
- Tracking qualification
- Small calorimeter module with SiPM readout qualification
- RD52 calorimeter with longitudinally displaced fibers qualification

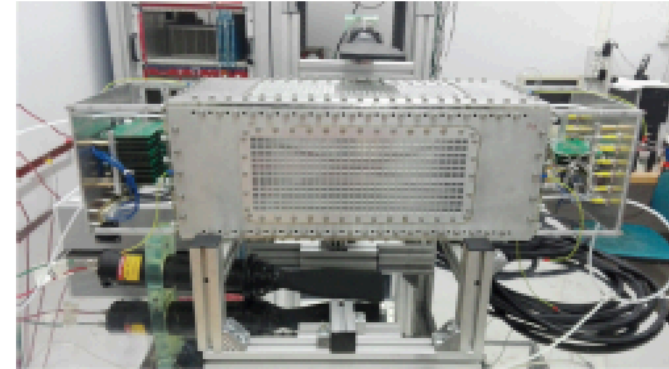
Partecipazione di Bari al testbeam:

- A. Taliercio dal 2 and 13 settembre
- N. De Filippis dal 7 al 11 settembre

I nostri interessi: Camera a deriva

■ Detector

- 12 layers X 12 cells = 144 channels
- $1 \times 1 \text{ cm}^2$ drift cells instrumented with MEG2 front-end
 - DRS4 8 channels
 - LeCroy 12-bit ADC 16 channels (under discussion)
 - 96 channels readout with Discriminator + TDC
 - 24 channel: not equipped



Rivelatore costruito e testato a INFN Lecce
→ contiamo di partecipare alla analisi dei
dati del testbeam ed allo sviluppo di
software per il tracking

I nostri interessi: Camere a μ

■ Geometry

- Preshower: (detector + support) $35 \times 50 \times 50 \text{ cm}^3$ (xyz)
- Muon chamber: (detector + support) $35 \times 50 \times 100 \text{ cm}^3$ (xyz)

■ Detector

■ Preshower

- 2 layers of Gem (2 points xy)
- Different absorber layers (0 – 2 X₀) (4 points?)
- Detector planes $10 \times 10 \text{ cm}^2$

■ Muon chamber

- 2 layers of Gem (2 points xy)
- 2 layers of muR-Well (2 points xy)

Contiamo di partecipare alla analisi dei dati raccolti con le muR-Well (misure di risoluzione spaziale, etc..)

Piani per attività nel 2019

Far partire uno studio sulla polarizzazione del tau per FCC-ee / CepC (next slide) → pubblicazione

Consolidare attività di analisi dati su camere a deriva di intesa con INFN-Lecce.

Partecipazione a test beam 2019 ed analisi dati

Studi su rivelatori per muoni di intesa con INFN-Bologna/Frascati

Studi per FCC-ee: fisica per 2019

tau polarization plays a central role at FCC-ee

- Separate measurements of A_e and A_τ from

$$P_\tau(\cos\theta) = \frac{A_{pol}(1 + \cos^2\theta) + \frac{8}{3}A_{pol}^{FB}\cos\theta}{(1 + \cos^2\theta) + \frac{8}{3}A_{FB}\cos\theta}$$

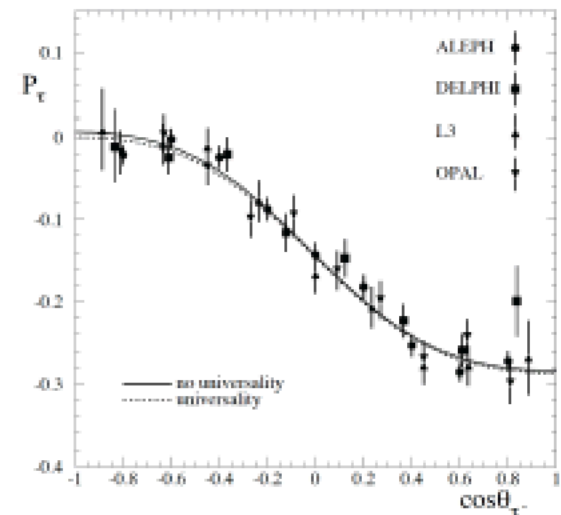
At FCC-ee

- very high statistics: improved knowledge of tau parameters (e.g. branching fraction, tau decay modeling) with FCC-ee data
- use best decay channels (e.g. $\tau \rightarrow \rho \nu_\tau$ decay **very clean**), note that detector performance for photons / π^0 very relevant

→ **measure $\sin^2\theta_{\text{eff}}$ with $6.6 \cdot 10^{-6}$ precision**

$$A_{pol} = \frac{\sigma_{F,R} + \sigma_{B,R} - \sigma_{F,L} - \sigma_{B,L}}{\sigma_{tot}} = -A_f$$
$$A_{pol}^{FB} = \frac{\sigma_{F,R} - \sigma_{B,R} - \sigma_{F,L} + \sigma_{B,L}}{\sigma_{tot}} = -\frac{3}{4}A_e$$

Measured P_τ vs $\cos\theta_\tau$.



Anagrafica e Richieste finanziarie per 2019

- Persone
 - N. De Filippis - 10%
 - M. Abbrescia - 10%
 - R. Aly - 10%
 - A. Talierno - 10%
- **MI: meeting/workshop** (in particolare quello in Cina a Novembre)
e testbeam 2019
 - N. De Filippis: 2k euro per attività WP1 e WP7
 - M. Abbrescia: 2k euro per attività WP7
 - R Aly: 2k euro per attività WP1 e WP7

Futuro di medio termine: attivazione attività di sviluppo e test rivelatore a Bari → strumentazione e utilizzo camera pulita