

RD_FA - Trieste

S. Dalla Torre, S. Levorato

*STEFANO e' in viaggio:
si scusa per la sua assenza*

RD_FA - A new activity started in CSN I in year 2017

Collaboration structure

- PI: Franco Bedeschi
- INFN groups:
 - Pisa, Padova, Roma I, Bari, Bologna, Lecce, Perugia, Ferrara, Roma III, **Trieste**, Catania, Firenze, Genova, Lab. Naz. di Frascati, Milano, Milano Bicocca, Napoli, Pavia, Torino



Nuove macchine per RD_FA



❖ **Giappone:**

- ILC

❖ **CERN:**

- CLIC, FCC-ee, FCC-hh

❖ **Cina:**

- CepC, SppC

❖ **USA:**

- EIC

❖ **???:**

- Muon Collider

❖ **Linear e+e-:**

- CLIC, ILC

❖ **Circular e+e-:**

- CepC, FCC-ee

❖ **Circular pp:**

- SppC, FCC-hh

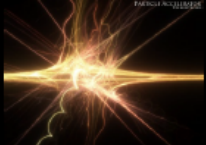
❖ **Circular electron ion:**

- EIC

❖ **Muon collider:**

- Proton/gamma/**positron** production

CSN1, Roma, Febbraio 2017 F. Bedeschi, INFN-Pisa



Work Packages



❖ **Attività' suddivisa in vari work packages:**

- WP 1: Fisica e simulazione
- WP 2: Machine Detector Interface
- WP 3: Pixel detectors
- WP 4: RICH e TPC con MPGD (principalmente a EIC)
- WP 5: Ultralight Drift Chamber
- WP 6: Silicon Microstrip Tracking
- WP 7: MPGD per Muon systems
- WP8: Muon Collider R&D
- (WP 9: Dual Readout calorimetry)

CSN1, Roma, Febbraio 2017 9 **F. Bedeschi, INFN-Pisa**

RD_FA @ TRIESTE

- A. Bressan
- M. Cobal
- S. Dalla Torre
- S. Dasgupta
- S. Levorato
- A. Martin
- F. Tassarotto

ATTIVITA'

- Organizzazione EICUG, luglio 2017
- R&D
- Contributi allo sviluppo del caso di fisica (MC)

EICUG2017

CONTRIBUTION IN BUILDING UP THE COMMUNITY

- previous EICUG meetings
 - June 2014, Stony Brook
 - January 2016, Berkley
 - July 2016, Argonne

- *initiative for the dissemination and the enlargement of the community
in Italy and Europe*

the JULY 2017 meeting of the EICUG will be host at INFN – Trieste
Trieste (Italy), 18-22 July 2017



<http://eicug2017.ts.infn.it/>

Organized by A. Bressan and S. Dalla Torre, S. Levorato
with the support of the Trieste COMPASS group

	workshop	EICUG meeting			
	18-Jul Tuesday	19-Jul Wednesday	20-Jul Thursday	21-Jul Friday	22-Jul Saturday
morning	workshop	opening session	plenary session	parallel sessions	closing session
afternoon	workshop	plenary session	plenary session	parallel sessions	
				institutional meetings	
evening	registration / welcome party	social banquet			

- **Accelerator workshop** - Fulvia Pilat, Ferdinand Willeke

PARALLEL SESSIONS

- **New Technologies** (detectors) - K. Gnanvo, S. Procureur
- **Nucleon and Nuclear structure and hadronization** - G. Schnell, H. Matevosyan
- **Phenomenology and new observables** - Z. Kang, C. Lorce'
- **3D nucleon and nucleus structure** - B. Pasquini, A. Martin
- **Collective effects in nucleons and nuclei** - M. Ruspa, Y. Hatta

INVITED TALKS - Physics

- *Progress from LHC in the physics domain of interest for EIC* (E. Scapparone)
- *UPC and nucleon and nuclear structure* (T. Lappi)
- *3D imaging* (A. Bacchetta)
- *Nucleon structure and dynamics from lattice QCD* (G. Koutsou)
- *The origin of the mass* (C. Roberts)
- *Saturation at small x* (R. Venugopalan)

INVITED TALKS - Detectors

- *TPC review and perspectives for EIC* (T. Hemmik)
- *MAPS developments and perspectives for EIC* (P. Camerini)
- *PID developments and perspectives for EIC* (speaker to be confirmed)
- *MPGDs for high energy applications* (M. Titov)

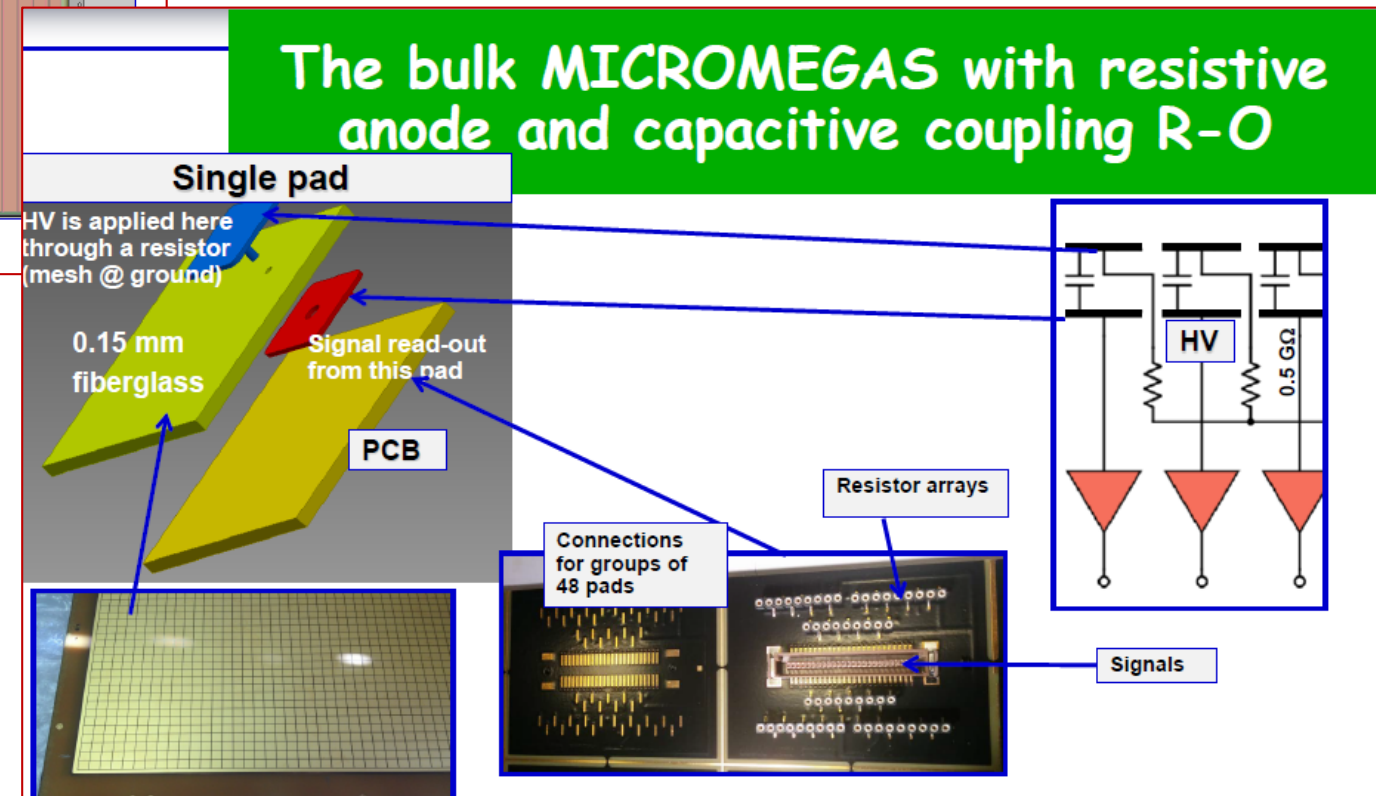
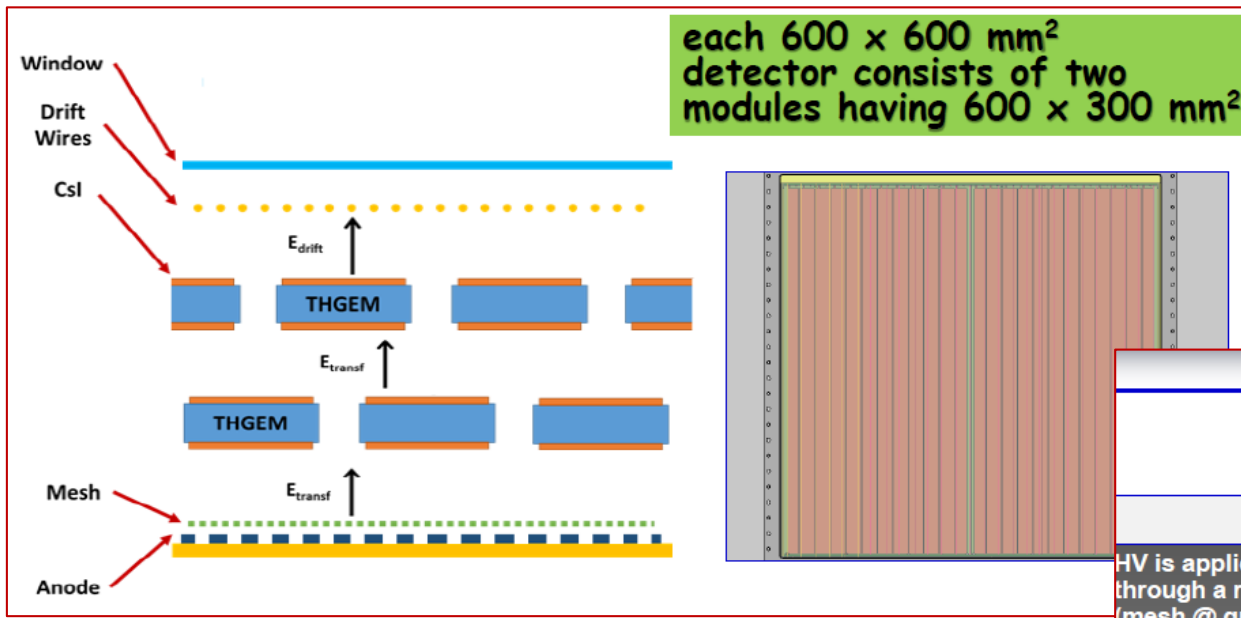
HARDWARE, R&D

R&D for EXPERIMENTS @ EIC

Two strategic sectors for experimental set-ups at EIC matching our expertise and with open issues:

- **HIGH-p: h-PID in the range $6 < p < 60$ GeV/c**
 - Radiator: gas is mandatory
 - Collider implementation: short (~ 1 m) radiator length
 - Two attempts, so far, both requiring deeper exploration
 - High pressure, studied for ALICE upgrade VHMPID
 - Towards the very far UV with window-less approach (prototype tested at Fermilab)
 - In both approaches [gaseous photon detectors](#) are mandatory
- **The next TPC generation for high rate operation requires ungated TPCs**
 - How?
 - By Ion BackFlow (IBF) suppression in [MPGDs](#)
 - IBF suppression recipes deteriorate dE/dx resolution ...
 - Parameter tension $\rightarrow$ appropriate compromise needed

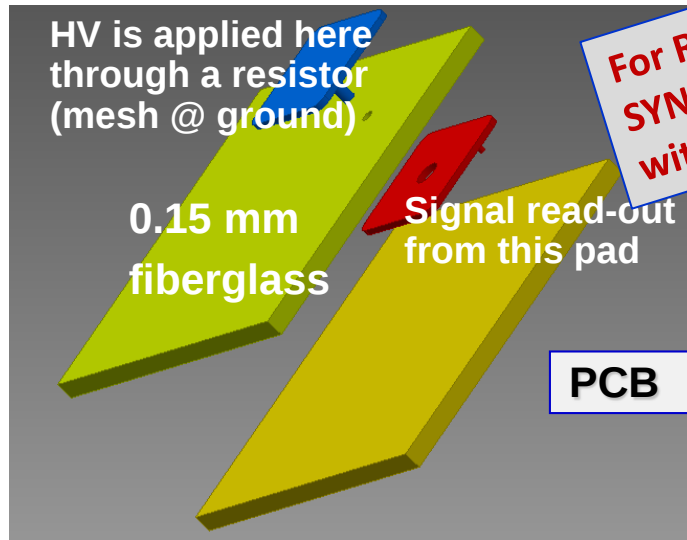
The novel photon detectors by MPGD technologies



A SUMMARY OF THE R&D PROGRAMME

resistive MM
with **small**
pad size
 $O(10 \text{ mm}^2)$

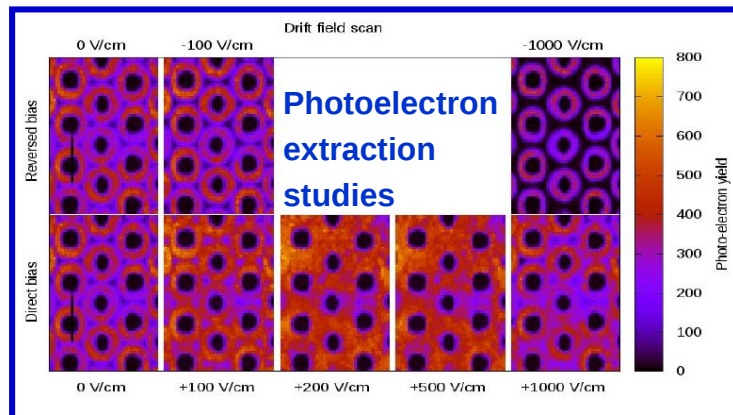
ALREADY
ON GOING



For RICH, also
SYNERGIC
with TPC

Further reduction of the **Ion**
BackFlow (IBF) rate:
presently $\sim 5\%$

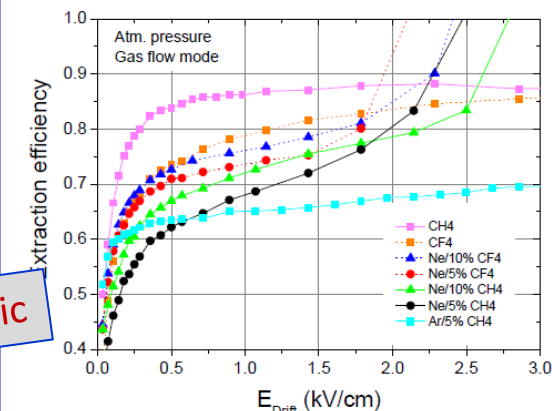
GEM vs THGEM as photocathodes



RICH specific

Issues related to hybrid MPGD-based PDs operated in **C-F** atmosphere:

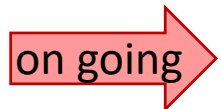
- photoelectron extraction
- Detector gain
- ageing



C. D. R. Azevedo et al., 2010 *JINST* 5 P01002

PLANNING (as presented in CSN I)

- Planning over 3 years
- 4 R&D items illustrated in the previous slide



on going

		2017				2018				2019			
TASK no	TASK	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter
1	resistive MM by discrete elements with miniaturized pad size												
2	comparison of THGEM vs GEM photocathodes												
3	enhancement of the IFB suppression in hybrid MPGDs												
4	operation of hybrid MPGDs (THGEMs + MM) in fluorocarbon-rich gas mixtures												

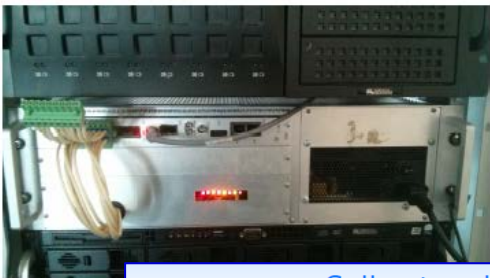
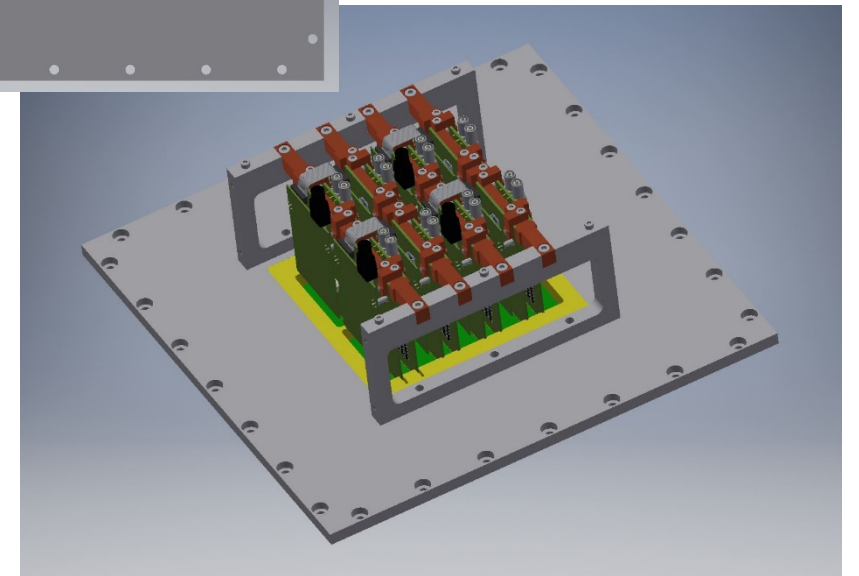
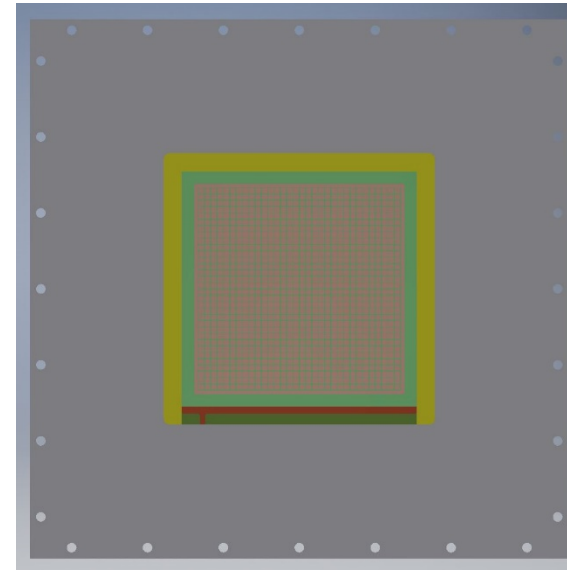
Resistive MM with miniaturized pad-size

$8 \times 8 \text{ mm}^2 \rightarrow 3 \times 3 \text{ mm}^2$

Prototype active area : $10 \times 10 \text{ cm}^2$

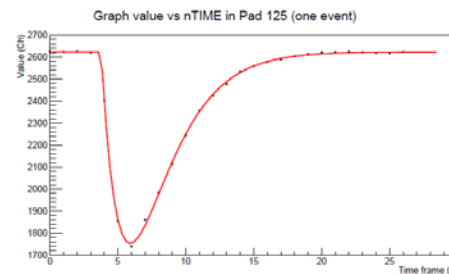
Designed to be expandable: FE card and resistor cards cover the same area of the pads (grouped by 128 channels)

- Design well advanced
- In parallel, prepare for the prototype read-out:
 - By the **SRS** (Scalable Read-out System), FE: **APV25**
 - Development of the DAQ software and test with an existing prototype
 - Stage: M. Baruzzo



Collecting data with 1 APV

From 100 hz maximum up to 6 khz only using the right settings.



S. Dalla Torre, S. Levorato

A VERY RECENT NEW OPTION FOR THE R&D

CsI, the only standard photoconverter compatible with gaseous atmospheres, has problematic issues, main ones:

- It does **not** tolerate **exposure to air** (water vapour, oxygen)
- **Ageing** by ion bombardment

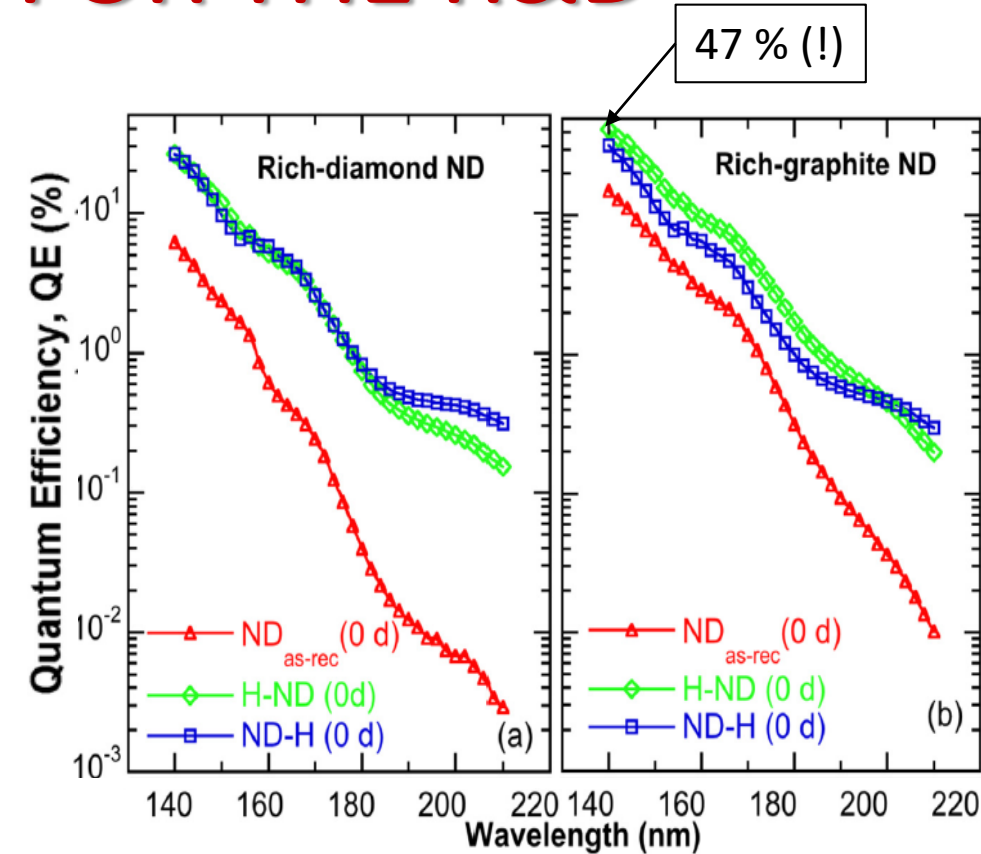
From Antonio Valentini – Sezione INFN di Bari (2016)

- Italian patent application n. 102015000053374
- **Photocatodes: diamon film obtained with Spray Technique** making use of NC powder
 - Spray technique: **$T \sim 120^\circ$** (instead of $\sim 800^\circ$ as in standard techniques)

Coupling of ND photoconverter and MPGDs?

an exiting perspective with several open questions

- **Radiation hardness ?**
- **Ageing ?**
- **Compatibility and performance with gas atmospheres ?**



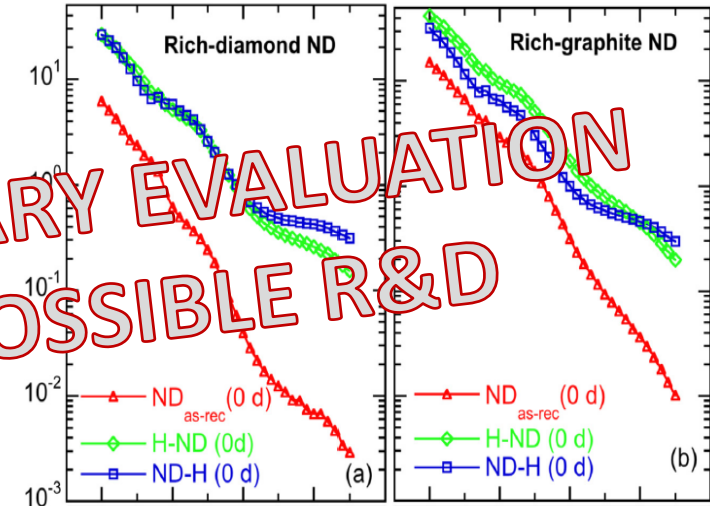
L.Velardi, A.Valentini, G.Cicala al.,
Diamond & Related Materials 76 (2017) 1

PRELIMINARY EVALUATION
OF A POSSIBLE R&D

A VERY RECENT NEW OPTION FOR THE R&D

*If this novel R&D is started →
items 2,3,4 postponed to start
this strategic R&D in 2018
(decision within a few days)*

PRELIMINARY EVALUATION
OF A POSSIBLE R&D



on going

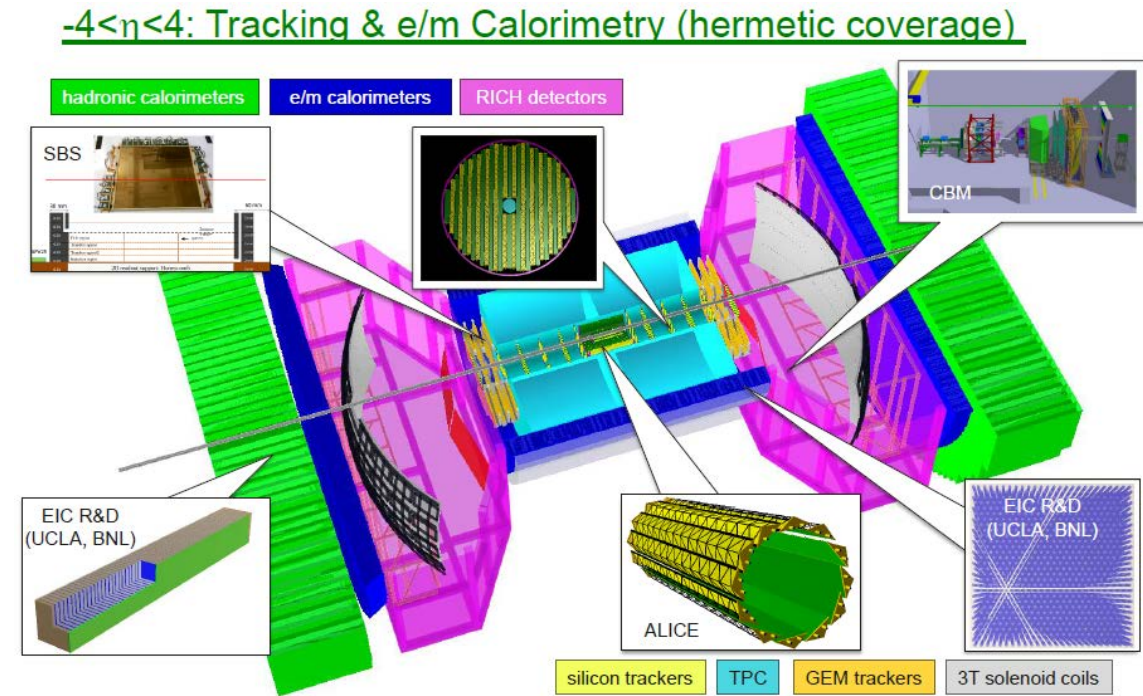
NC photocathodes
in gas

TASK no	TASK	2017				2018				2019			
		1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter
1	resistive MM by discrete elements with miniaturized pad size												
2	comparison of THGEM vs GEM photocathodes												
3	enhancement of the IFB suppression in hybrid MPGDs												
4	operation of hybrid MPGDs (THGEMs + MM) in fluorocarbon-rich gas mixtures												

PHYSICS

CONTEXT: EIC WISHES FOR THE EXPERIMENTS

- Reach in kinematic variables
- Reliable electron identification
- Good hadron PID
- High spatial resolution of primary vertex
- Low material budget
- The more close to 4π acceptance the better
- Luminosity and polarization measurement
- Close-to-beam-line acceptance add-on detectors to register
 - recoil protons
 - low Q^2 electrons
 - neutrons in hadron beam direction



GOAL: IMPROVE THE PHYSICS EVENT GENERATORS

Starting point: the experience gained within COMPASS

- Event Generators

- from good, old Lepto to Pythia 6
- Synergies with the EIC plans: bringing ℓN in Pythia 8

- Radiative Correction tools

- Radgen
- Djangoh/HERACLES

- GEANT for the experimental setup simulation

- Moreover we plan to use the comparison with the COMPASS data to validate the new tools under development

GOAL: IMPROVE THE PHYSICS EVENT GENERATORS

Present activities for EIC:

- Insert spin effects into the Monte Carlo event generators:
- Account for radiative effects at Monte Carlo level
- Run EIC ROOT to give inputs for hardware design
 - software runs on the RACF @ BNL (RHIC and ATLAS Computing Facility) where the EIC group has its own nodes: a Trieste account available
- RICH dedicated simulations

Recursive Monte-Carlo
for polarized quark j

Albi Kerbizi
University of Trieste, INFN

Spin 2016, Champaign
26 September 2016

SUPPORT FOR R&D AND PHYSICS STUDIES

SUPPORT STATUS

- R&D

- In 2016 application to the programme Generic Detector R&D for an Electron Ion Collider
 - We have joint the eRD6 Consortium
 - GRANT received for consumables, travelling, a postdoc
- For 2017 request within the INFN-HEP program RD_FA
 - Support received for consumables (**13 k€**) and travelling

- Physics studies

- In 2016 application to the programme Generic Detector R&D for an Electron Ion Collider within the project eRD20
 - The project has received support
- For 2017 request within the INFN-HEP program RD-FA
 - Support received for travelling