

An aerial photograph of a circular particle accelerator facility, overlaid with a complex diagram. The diagram features several concentric paths in light blue and red. A purple path with a grey sphere and a blue path with a grey sphere are also shown. Two green squares are placed on the paths, and a grey cylindrical component is visible on the right side. The background shows a landscape with trees and some buildings.

# Precision Phenomenology for nucleon Femtography

**Matteo Cerutti**

EIC User Group Award for the Best Graduate Student



**Università degli Studi di Pavia**  
**Dipartimento di Fisica**

Corso di Laurea in Fisica

**Bachelor degree**

**Spettroscopia degli adroni e proprietà  
di simmetria dell'interazione forte**



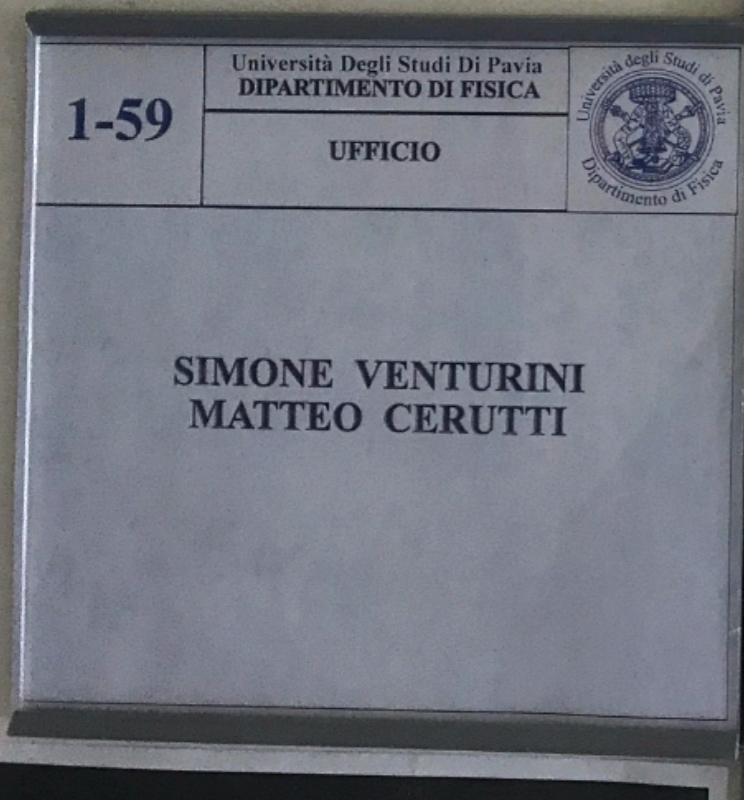
**UNIVERSITÀ DEGLI STUDI DI PAVIA**  
**DIPARTIMENTO DI FISICA**

CORSO DI LAUREA MAGISTRALE IN SCIENZE FISICHE

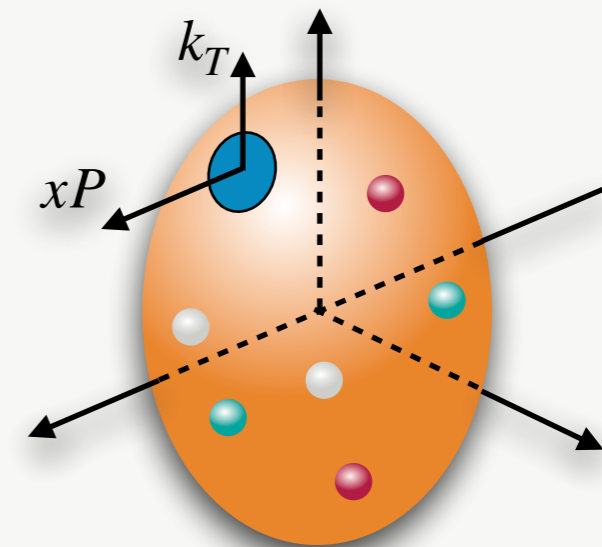
**Master degree**

**UNIVERSALITY OF FRAGMENTATION  
FUNCTIONS IN NON COLLINEAR  
HADRONIZATION PROCESSES**

**Matteo Cerutti**



# Transverse-Momentum Distributions (TMDs)



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## Extraction of pion transverse momentum distributions from Drell-Yan data

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## Unpolarized transverse momentum distributions from a global fit of Drell-Yan and semi-inclusive deep-inelastic scattering data

### The MAP Collaboration<sup>1</sup>

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Giuseppe Bozzi<sup>4,e,f</sup>, Matteo Cerutti<sup>1,a,b</sup>, Fulvio Piacenza<sup>a</sup>, Marco Radici<sup>2,b</sup>  
and Andrea Signori<sup>1,a,b,2</sup>

Matteo Cerutti

# MAP Collaboration

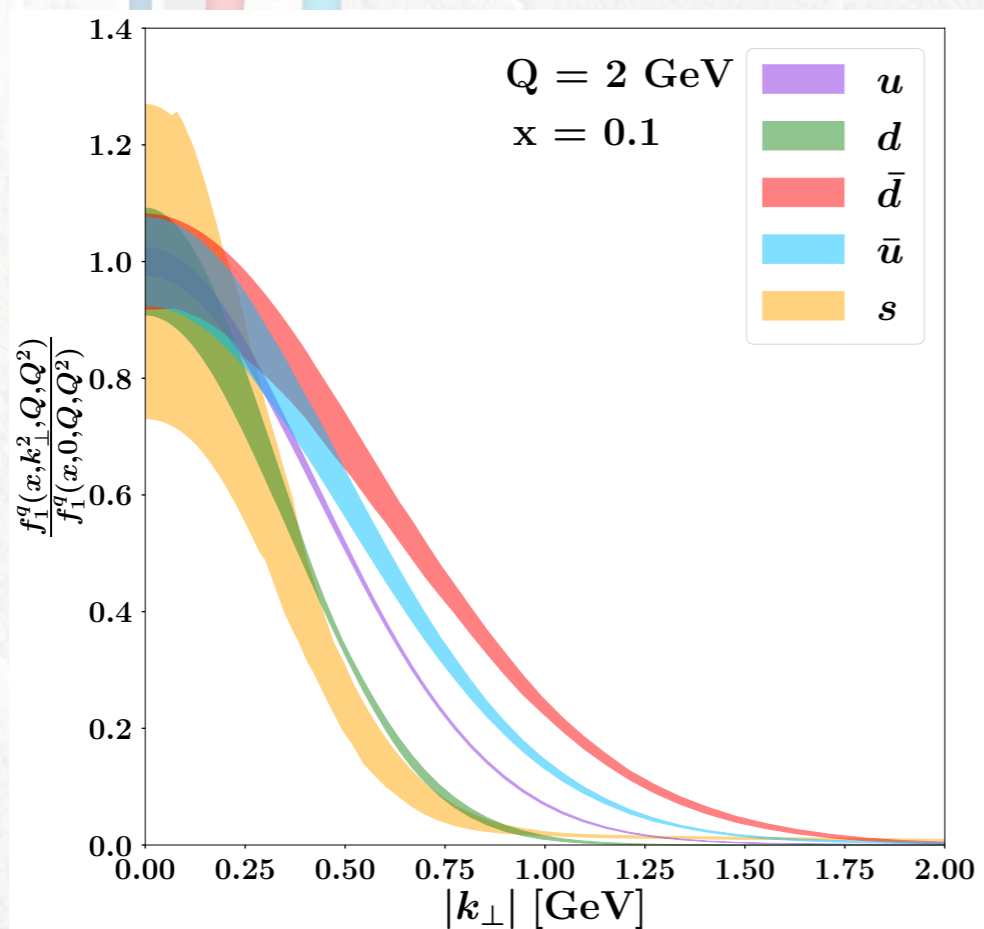


**Matteo Cerutti**

# Present

## State-of-the-art

extraction of unpolarized TMDs  
with FLAVOR DEPENDENCE



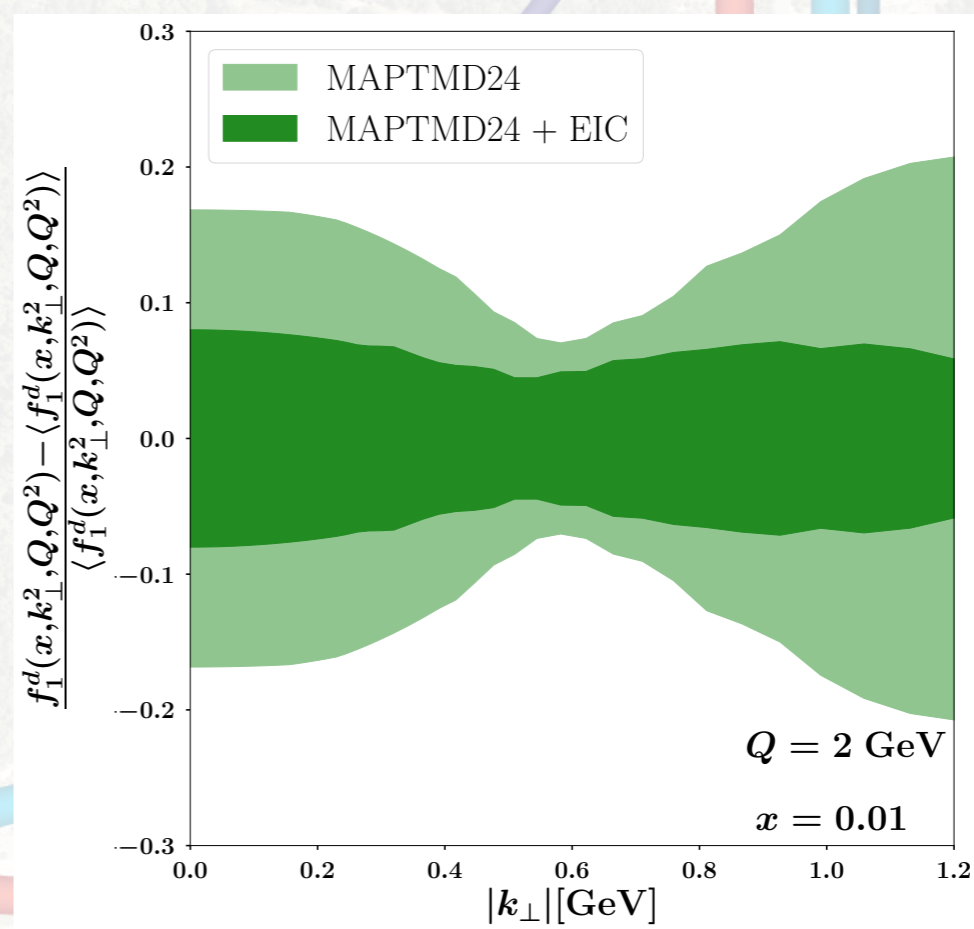
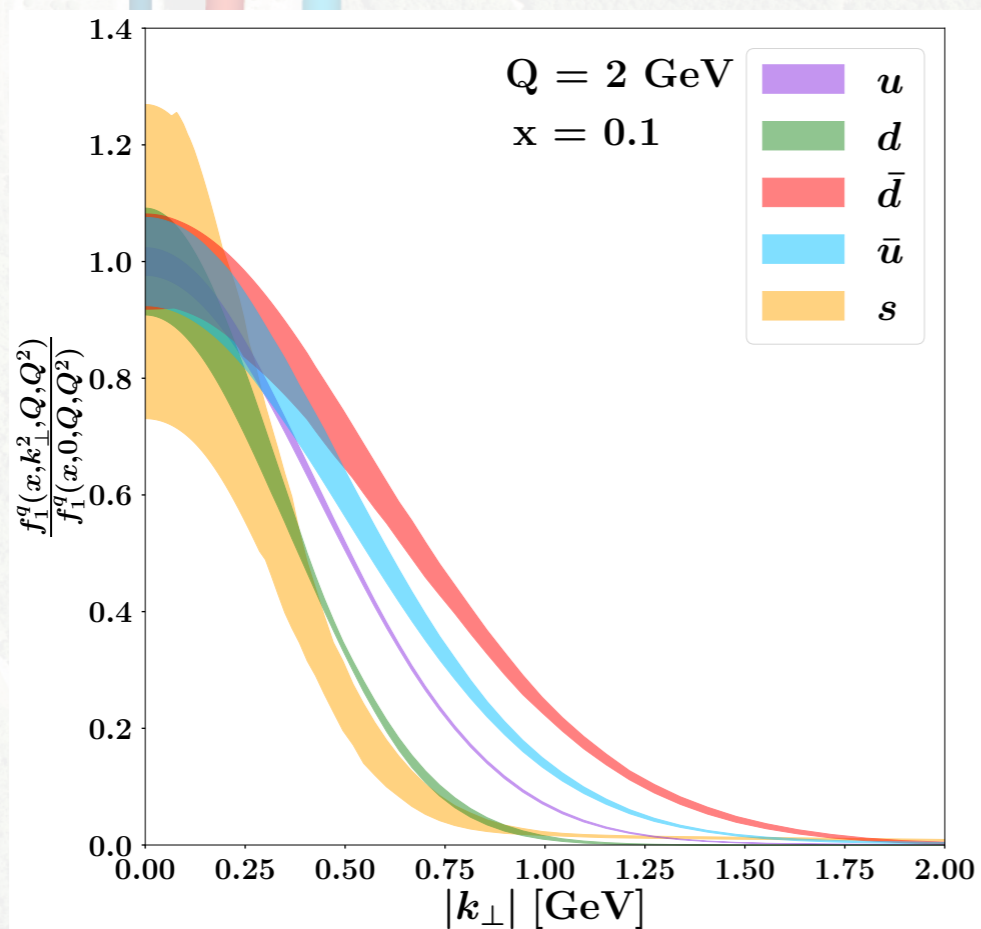
**Present**

**Future**

**State-of-the-art**

**Bright!!!**

extraction of unpolarized TMDs  
with FLAVOR DEPENDENCE



TEO	SIMO	$0.3 + \frac{0.7}{Q}$	E537	$6 \leq Q \leq 6.5$ (1) $6.5 \leq Q \leq 7$ (2)	1.48 (146 m <sup>2</sup> points)	$0.35 + \frac{0.3}{Q}$		1.55 (137 m <sup>2</sup> points)
3	3	$0.3 + \frac{0.6}{Q}$		∅	1.54 (138 m <sup>2</sup> points)	$0.25 + \frac{0.4}{Q}$	∅	1.63 (129 m <sup>2</sup> points)
	3	$0.3 + \frac{0.5}{Q}$		∅	1.61 (131 m <sup>2</sup> points)	$0.3 + \frac{0.7}{Q}$ (0.38 for neg. pred)	∅	1.49 (144 m <sup>2</sup> points)
	2	$0.3 + \frac{0.65}{Q}$	E537	$6 \leq Q \leq 6.5$	1.51 (143 m <sup>2</sup> points)	$0.3 + \frac{0.6}{Q}$		1.495
	1							

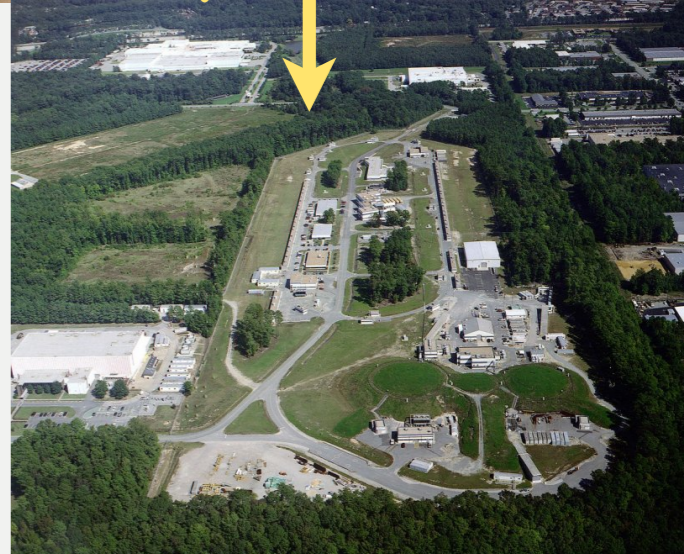
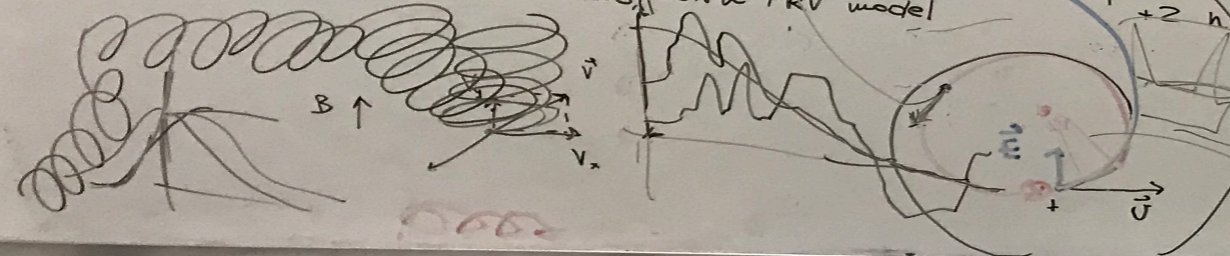
MISCELLANEA

- 8 1 Hadron-in-Jet (Unp. + Collins?)
- 4 1 Di-hadron FF
- 2 2 → relation DIFF and TMDFF
- 2 3 → calculation of NLO contribution
- 1 4 → implementation in Mont Blanc
- 40 27 → global fit

$-4 \leq Q \leq 5$	$0.3 + \frac{0.7}{Q}$	2	1.37 (115)
	$0.3 + \frac{0.6}{Q}$	1	1.41 (121)
	$0.3 + \frac{0.55}{Q}$	∅	1.42 (100)

- Extensive study of Normalization  $0 < \tilde{\alpha} < 1$  prefactors (3 different cases)
- Jet Correlator
- Freezing of  $\alpha_s$
- extraction of gluon unp. TMD with NP
- implementation of all the machinery in NP to fit Pion TMDs with PRV model

$\alpha = 1 + \tilde{\alpha}$   
 $H_{\text{Pion}}^{\text{up}} = 1300$  counts  
 $H_{\text{Pion}}^{\text{down}} = 500$  counts  
 $N_{H_3}^{\uparrow} = 5500$   
 $N_{H_3}^{\downarrow} = 4700$  | 54  
 $A_{NH_3} = \frac{1-b}{1+b} = \frac{200}{10200} = \frac{3}{17} A_H \Rightarrow A_H = \frac{4}{0.915}$   
 $X = 0.1$   
 $\begin{matrix} p \rightarrow \pi^+ + p \rightarrow \pi^+ \\ h \rightarrow \pi^+ + h \rightarrow \pi^+ \end{matrix}$   
 $\begin{matrix} 2 p \rightarrow \pi^+ \\ + 2 h \rightarrow \pi^+ \end{matrix}$   
 $\begin{matrix} \pi^+ \text{ te} \\ \pi^+ \text{ te} \\ \text{Lü e f} \\ \text{Lü c e} \end{matrix}$



Thank you!!!