Improving the tracking of the COMPASS Large-Angle Spectrometer for polarized Drell-Yan measurements

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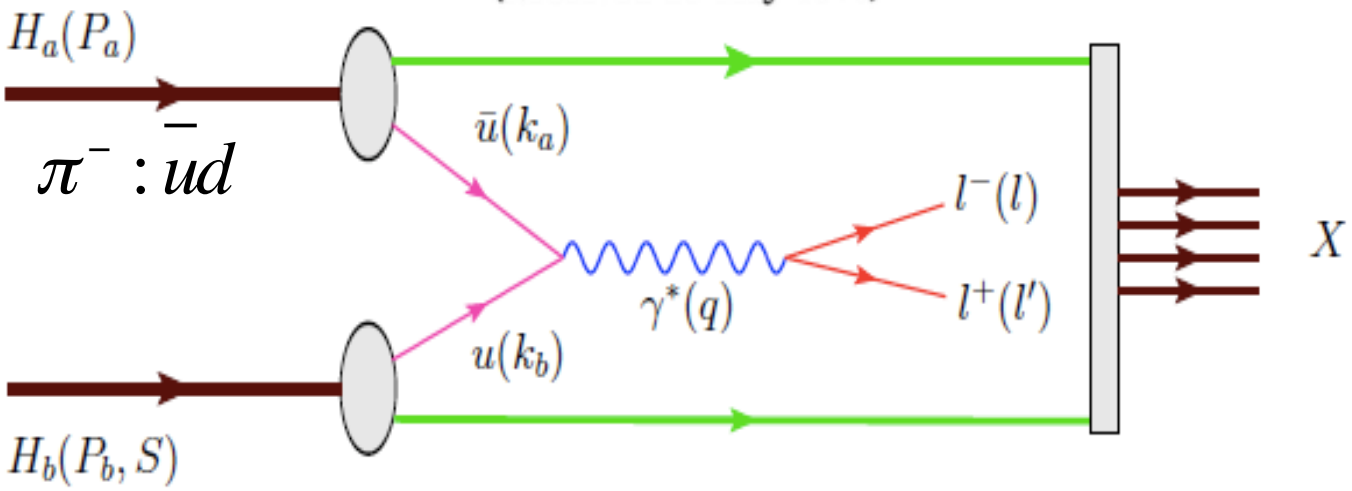
The Drell-Yan process

MASSIVE LEPTON-PAIR PRODUCTION IN HADRON-HADRON COLLISIONS AT HIGH ENERGIES*

Sidney D. Drell and Tung-Mow Yan
Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305
(Received 25 May 1970)



Polarized *proton: uud*

Study of two Transverse Momentum Dependent PDFs:

Complementary

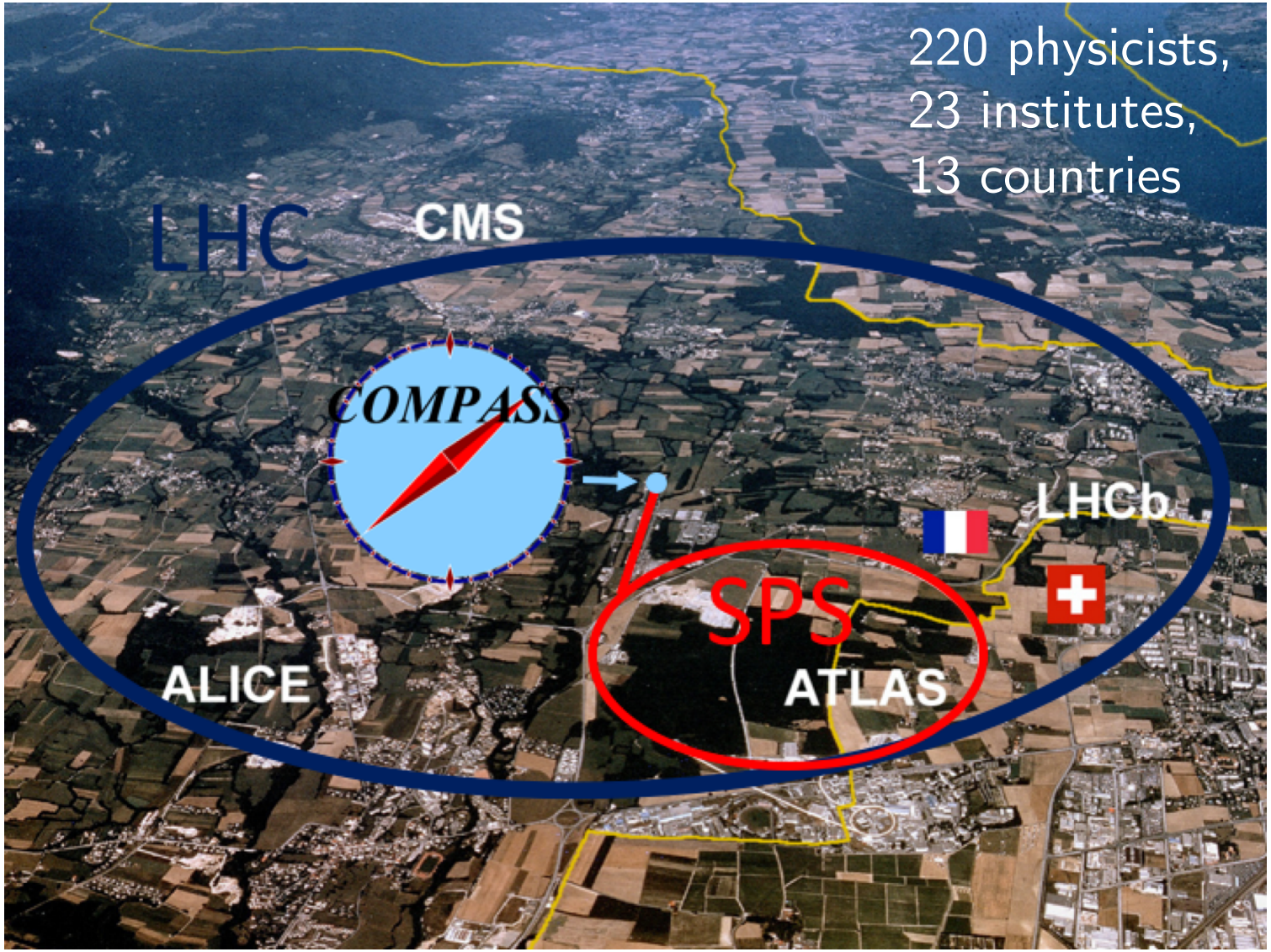
Drell-Yan ⟺ **Semi-Inclusive Deep-Inelastic Scattering (SIDIS).**

Simple process — Hadron Fragmentation

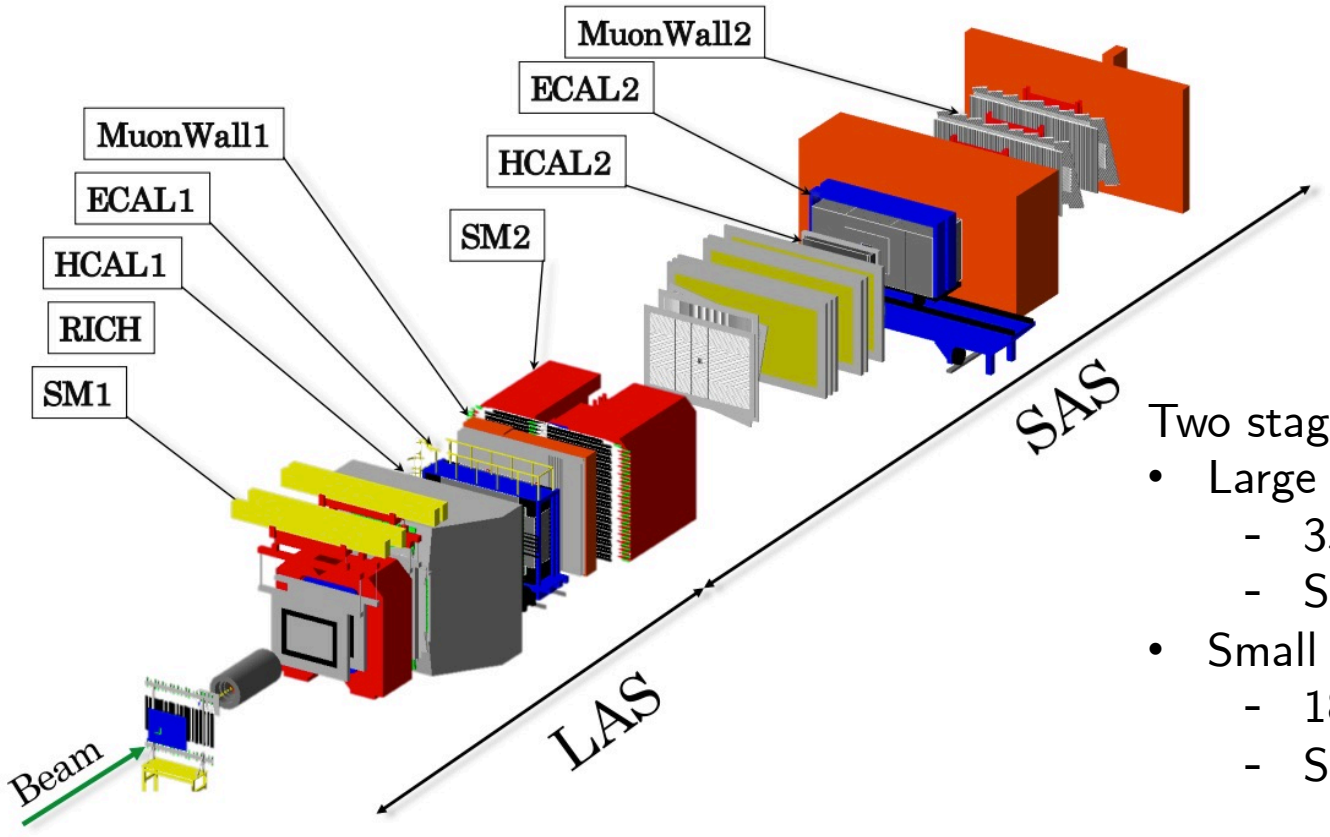
- $f_{1T}^{\perp}$: the Sivers function, which required a transversely polarized target
- $h_1^{\perp}$: the Boer-Mulders function

▶ low cross-section, therefore we need to run at the highest luminosity possible.

The **C**ommon **M**uon **P**roton **A**pparatus for **S**tructure and **S**pectroscopy Experiment



The COMPASS Spectrometer



Length of the Spectrometer: 60 m

Two stages spectrometer:

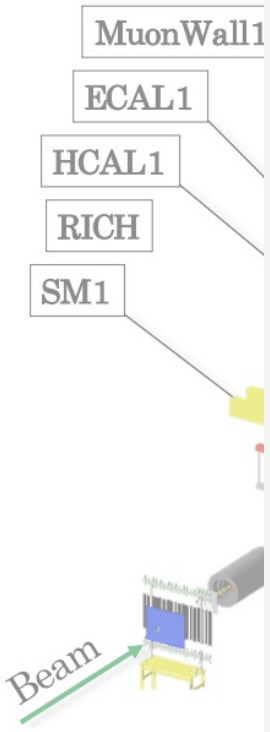
- Large Angle Spectrometer (LAS)
  - 35 mrad $<\Theta<$ 180 mrad
  - SM1 magnet (1 T.m)
- Small Angle Spectrometer (SAS)
  - 18 mrad $<\Theta<$ 35 mrad
  - SM2 magnet (4.4 T.m)

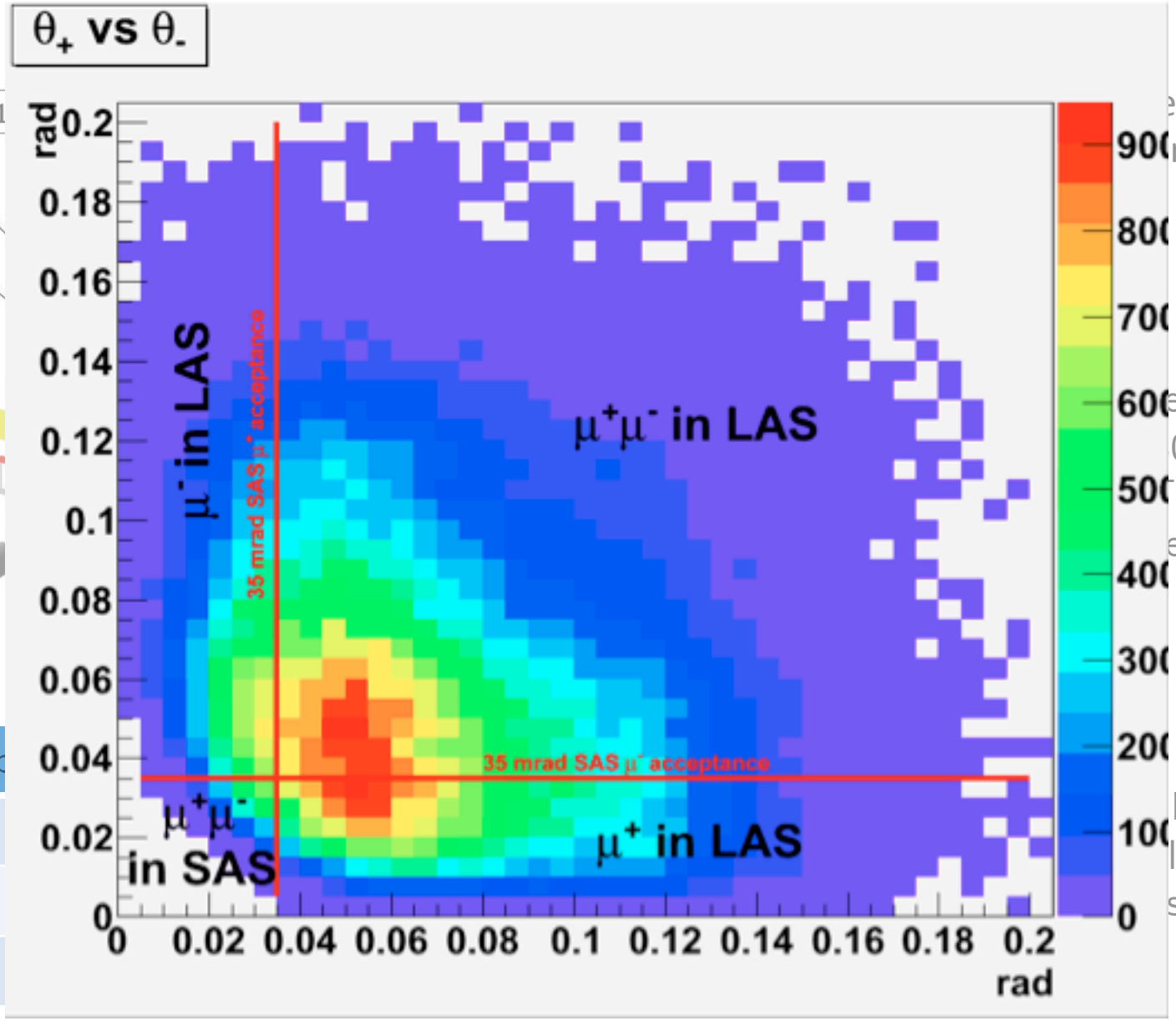
Beam Type	Details
μ^+/μ^-	160/200 GeV
h^+	190 GeV, p/π/K 75/24/1%
h^-	190 GeV, π/K/p 97/2/1%

Polarized Target:

- Polarized protons (NH_3) with Dynamic Nuclear Polarization
- Longitudinal & Transverse Polarization
- ~ 80-90 %

The COMPASS Spectrometer





Beam Typ
μ^+/μ^-
h^+
h^-

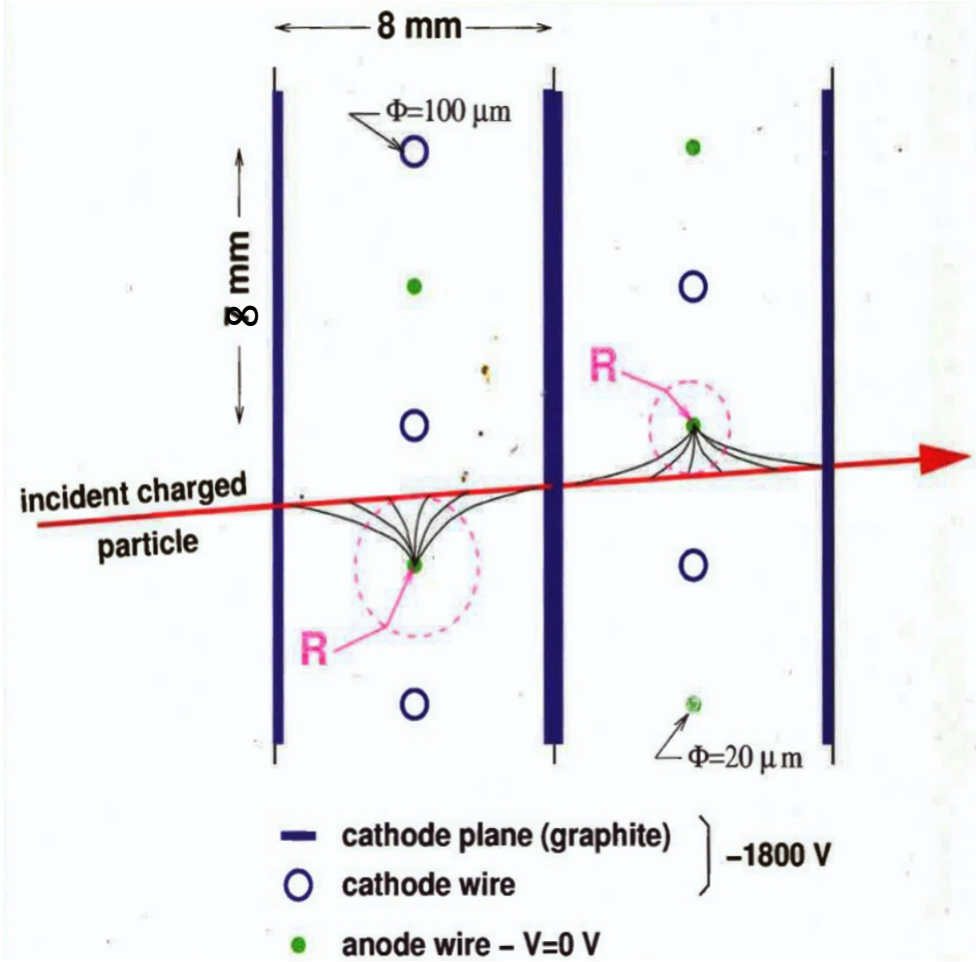
r: 60 m

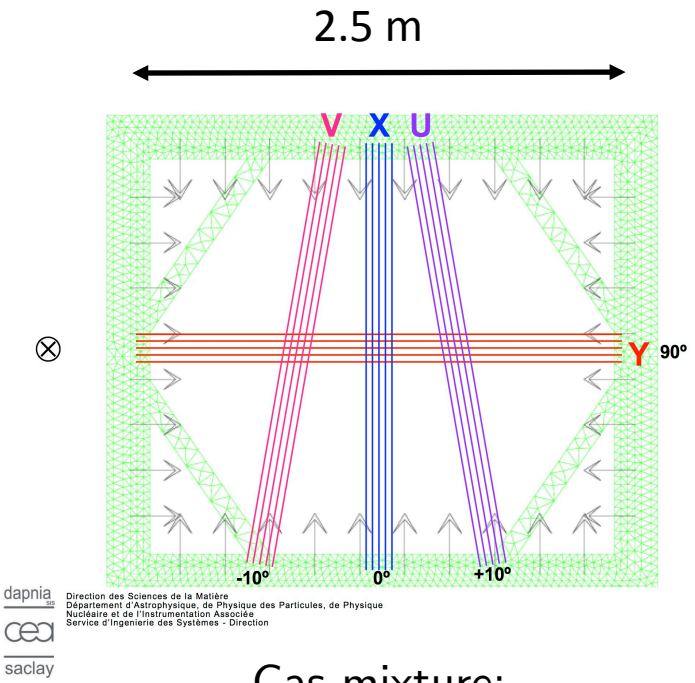
eter (LAS)
0 mrad
.m)
eter (SAS)
mrad
T.m)

H_3) with
larization
sverse

The COMPASS Spectrometer

Large Area Planar Drift Chambers



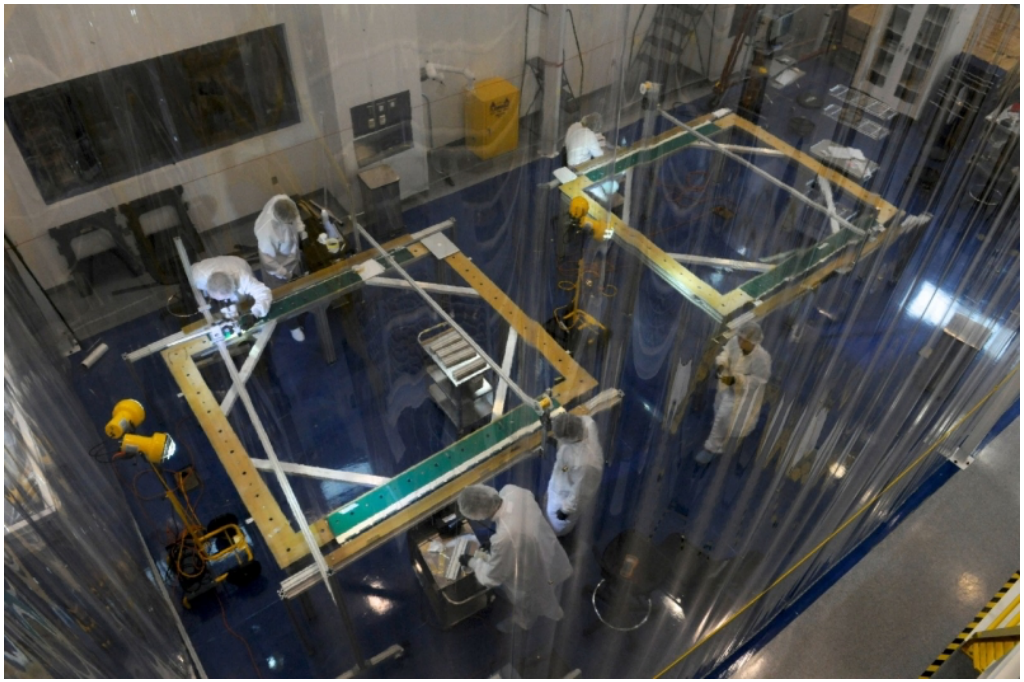


Gas mixture:
$Ar/C_2H_6/CF_4$
45%/45%/10%

N_{pe}/cm: 102

2503 sense wires
2511 field wires

DC05 - Construction at ODU



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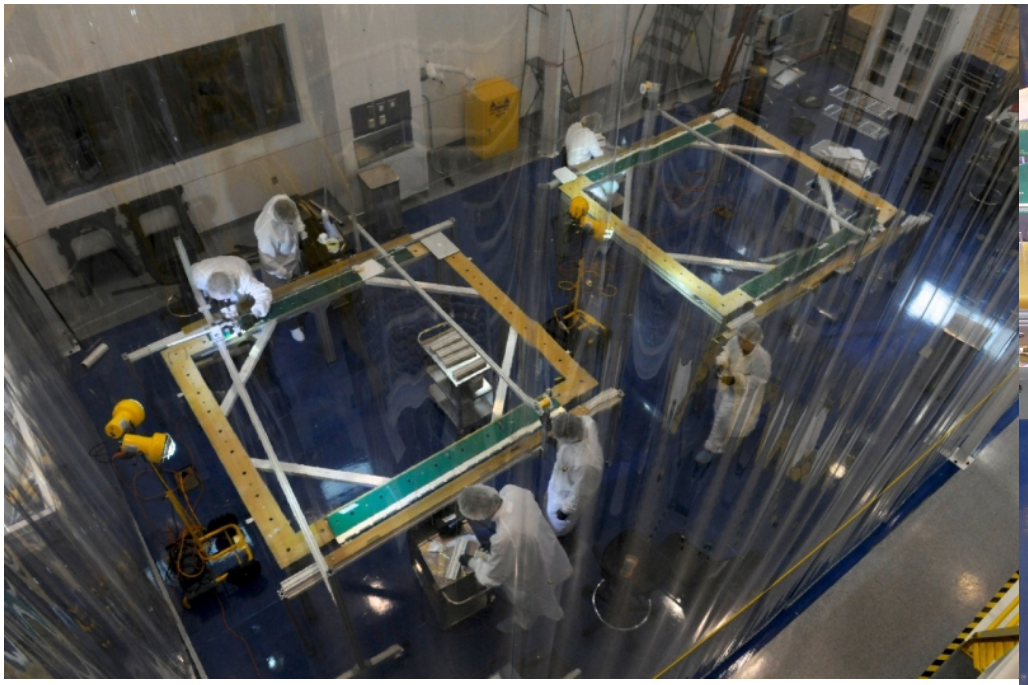

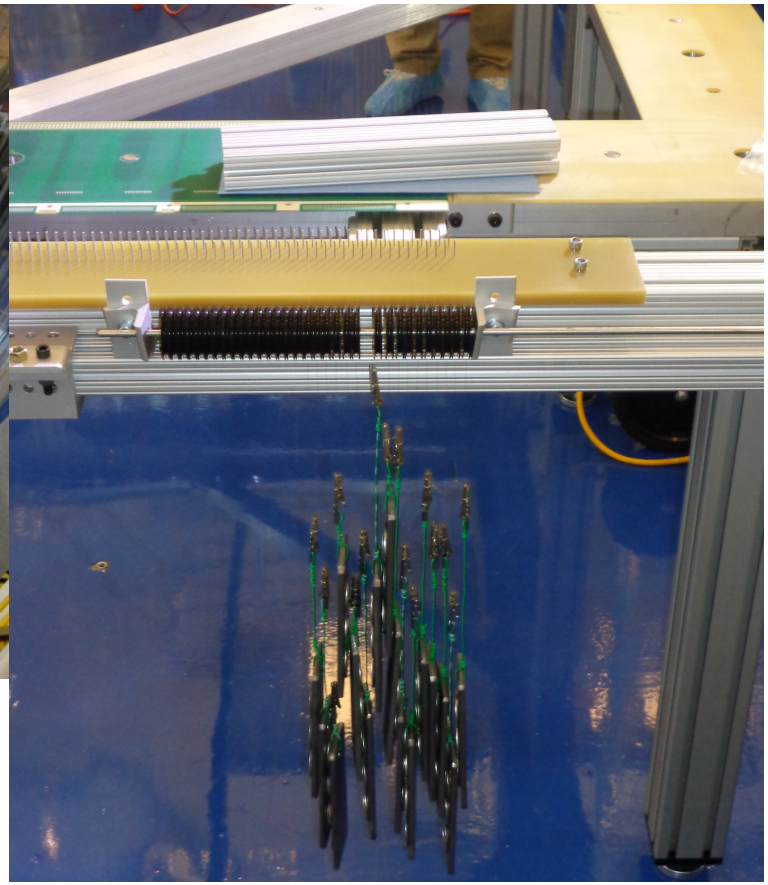

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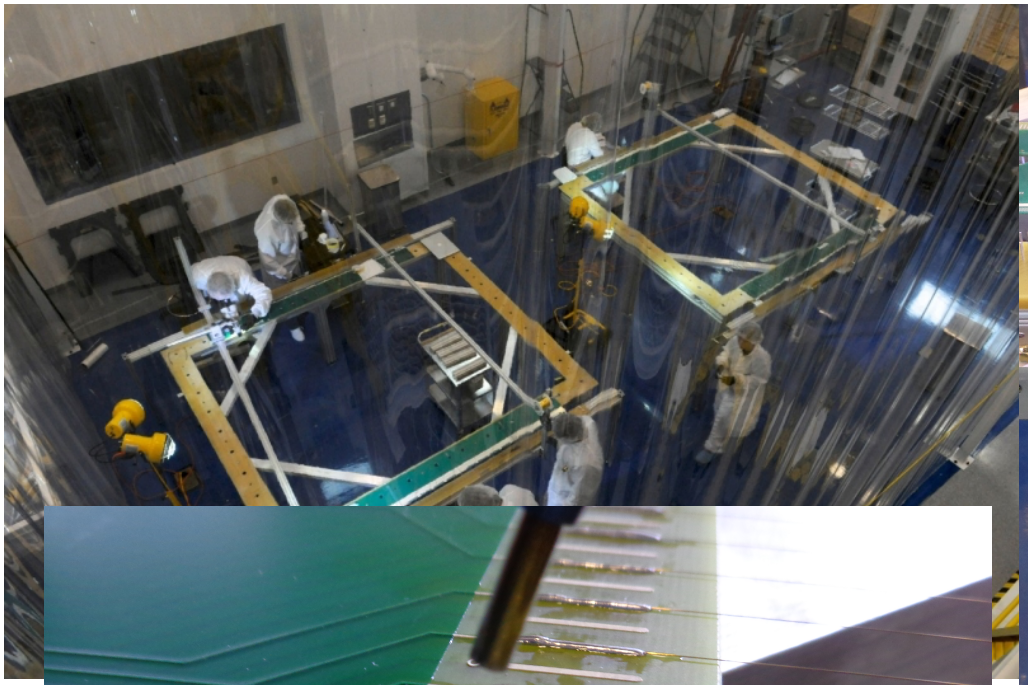
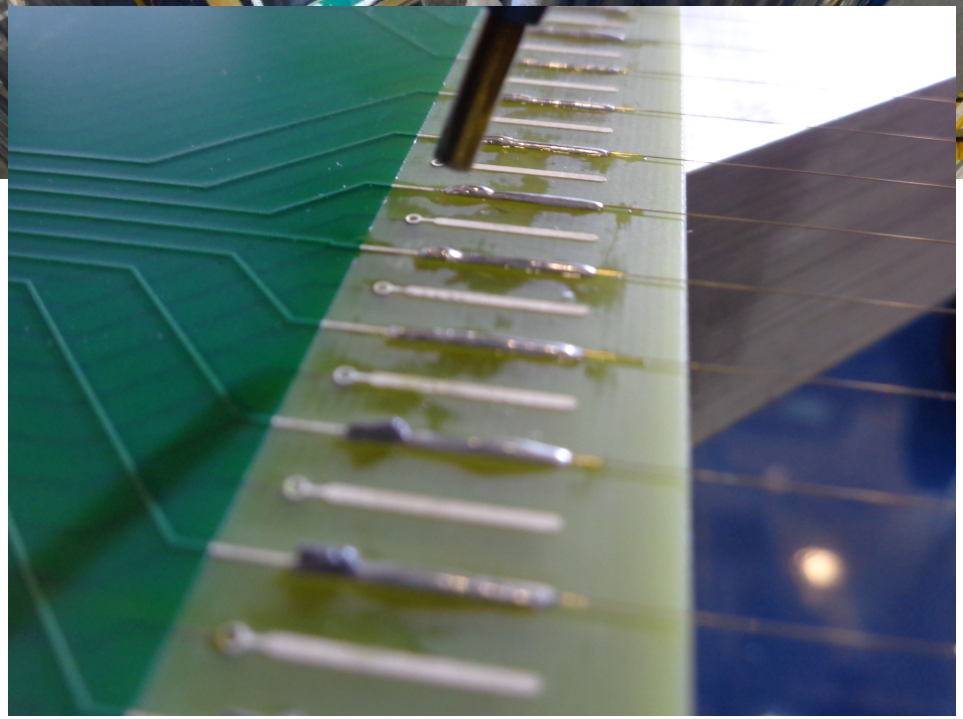
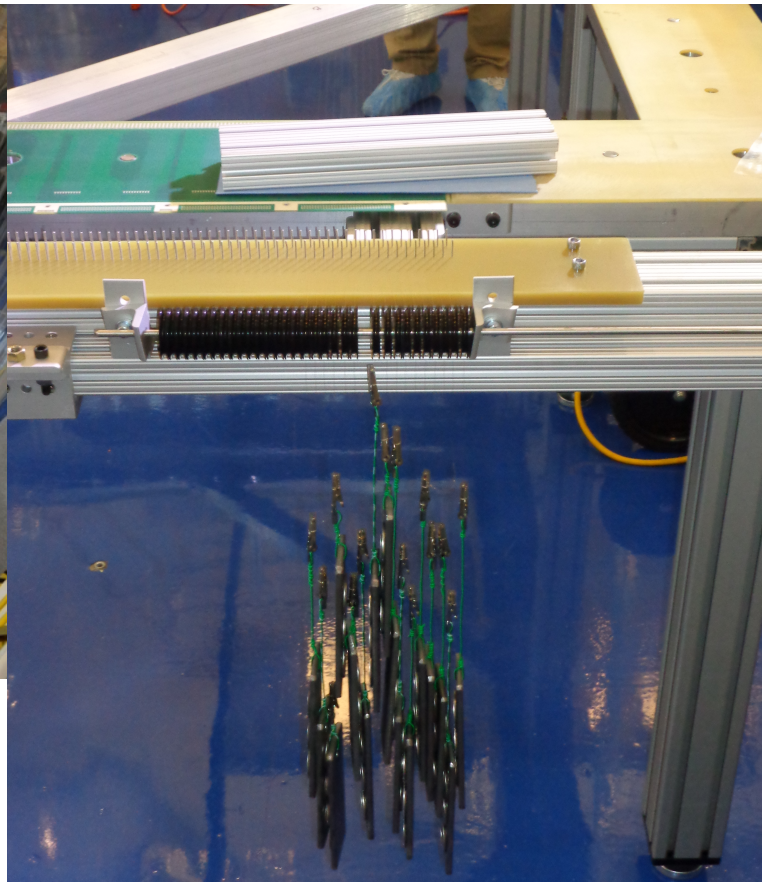
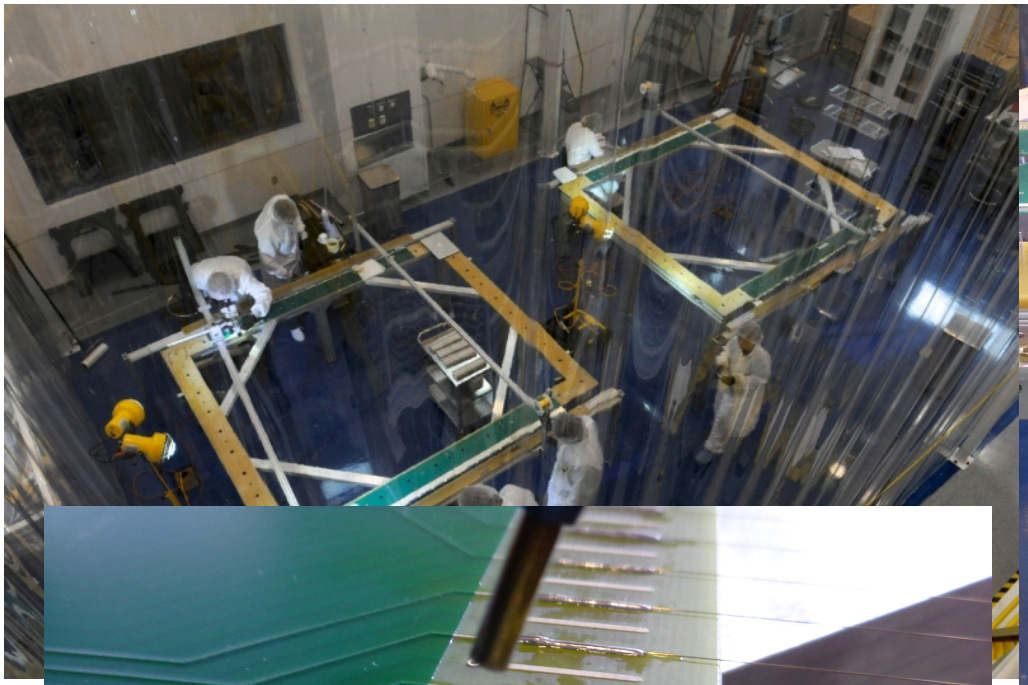
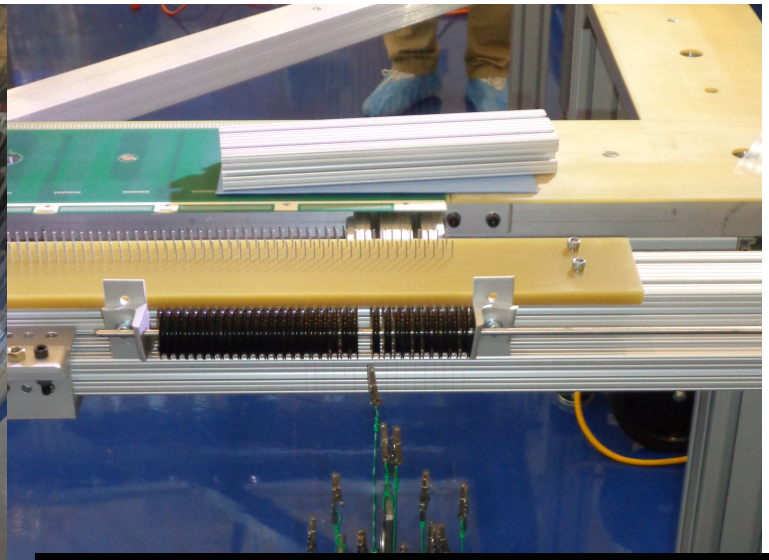


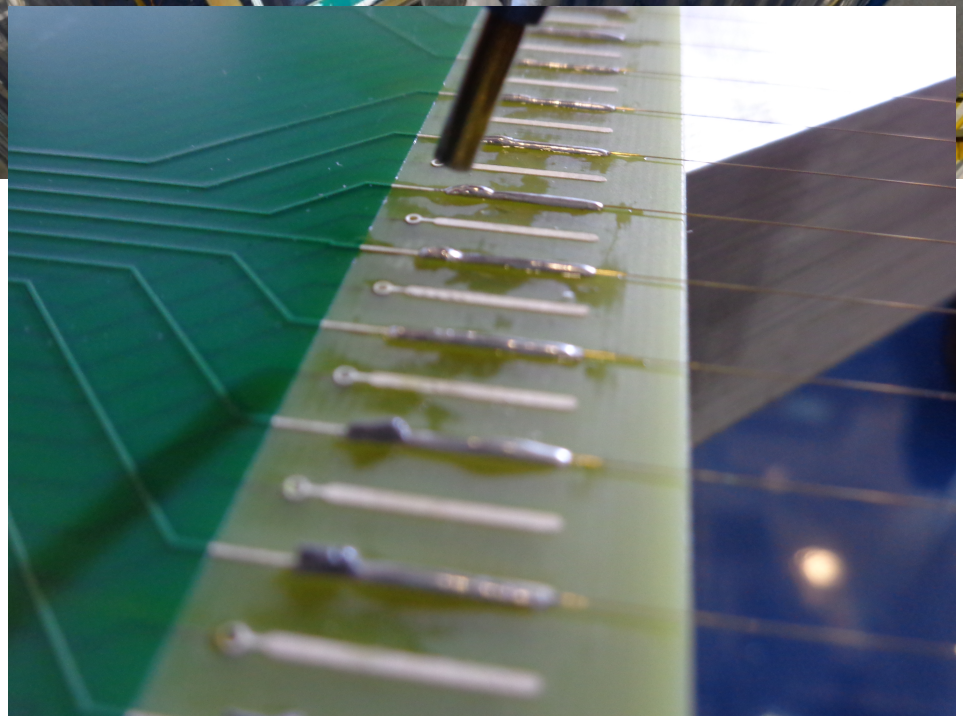


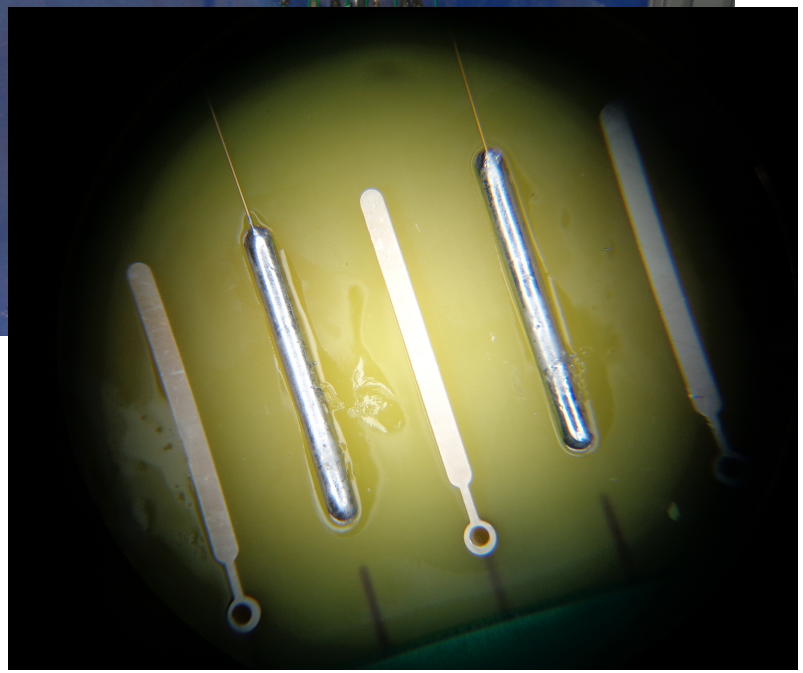


DC05 - Construction at ODU









DC05 - Installation & Commissioning

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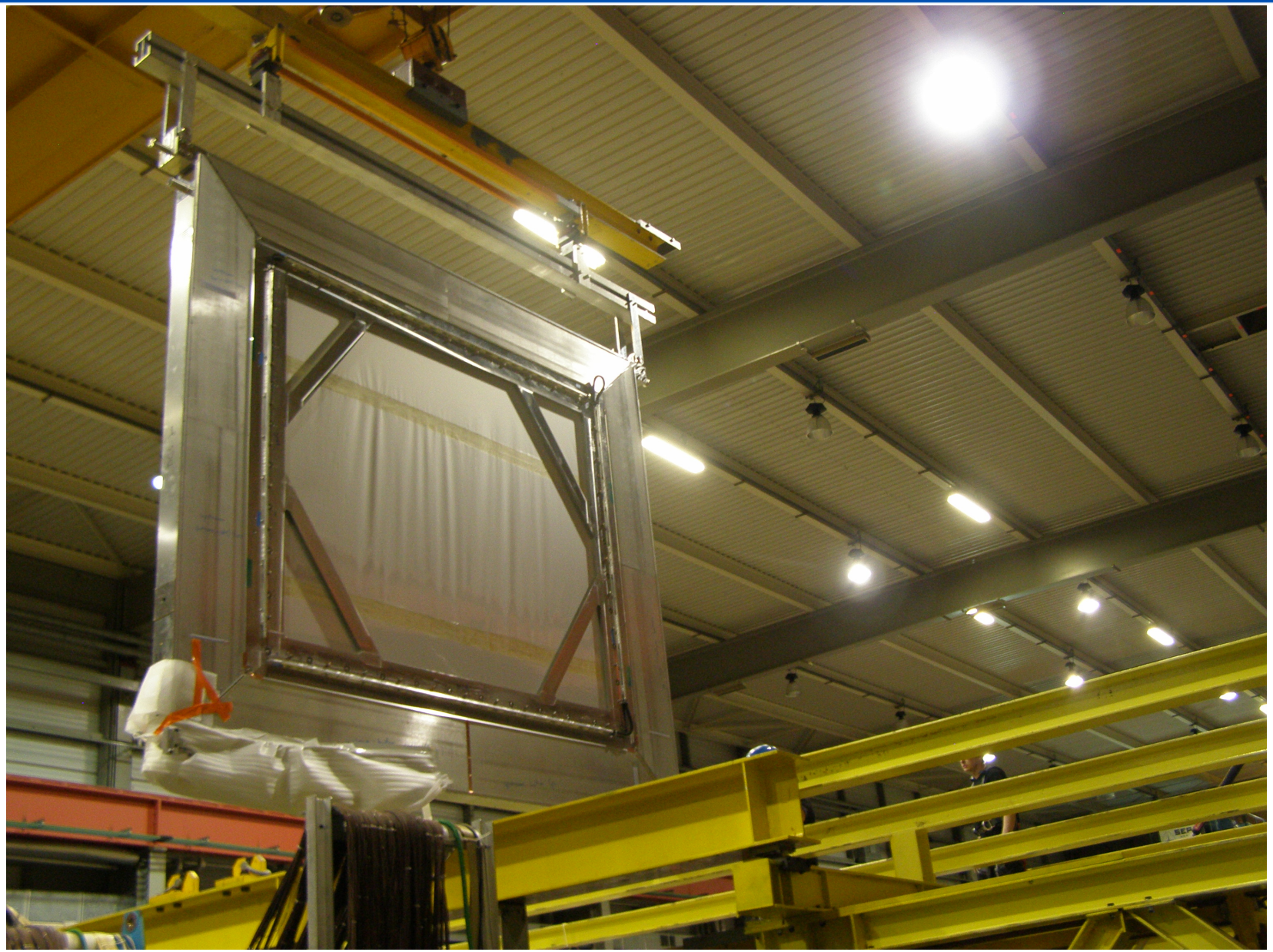
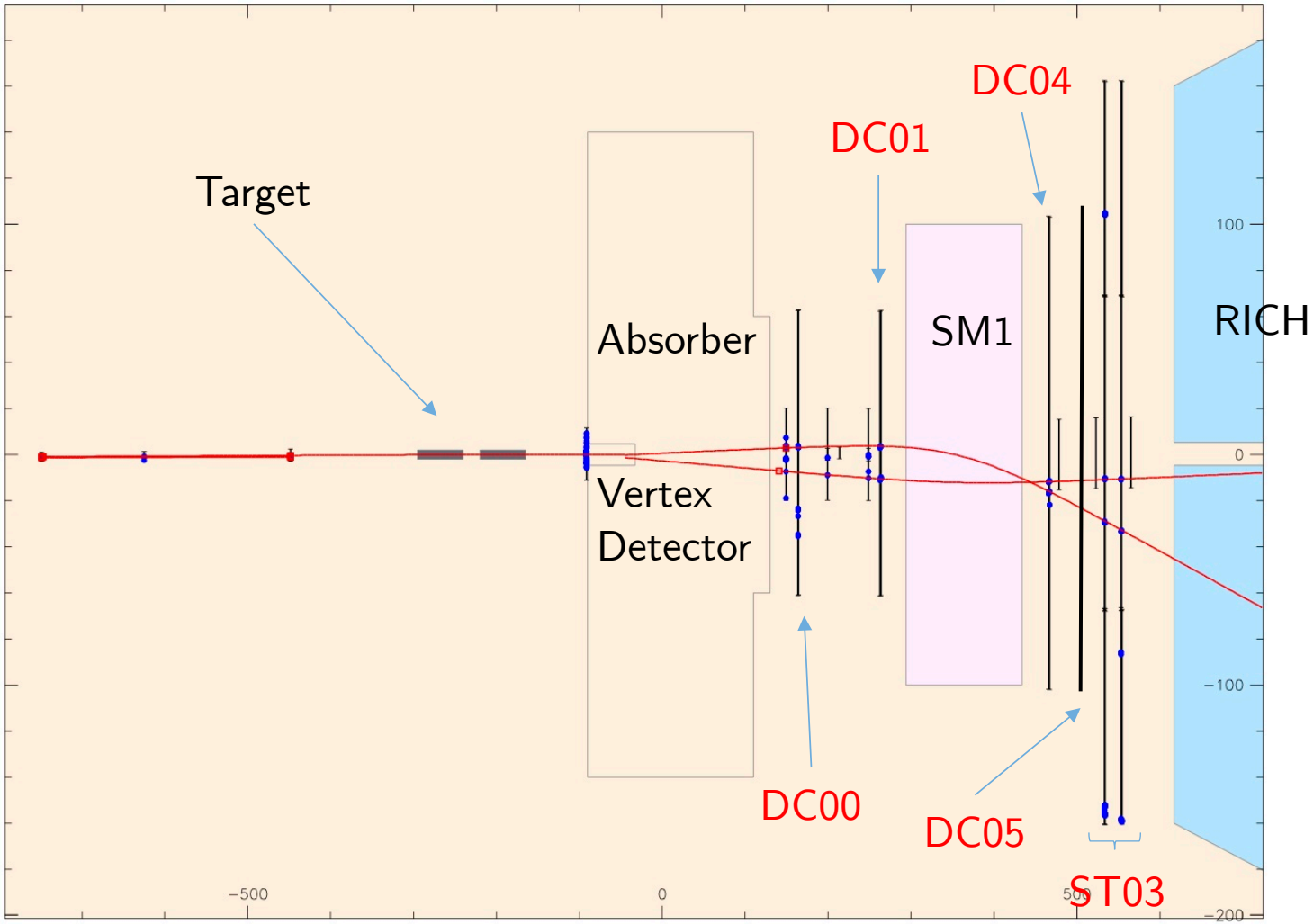


DC05 - Installation & Commissioning

Large Angle Spectrometer tracking detectors and Software

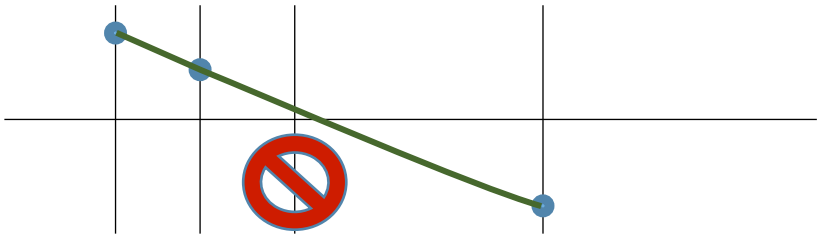


Event display from the COMPASS reconstruction program: CORAL

Procedure to achieve nominal performance

Prepare the data

- From raw data; reconstruction of tracks using CORAL and excluding the detector view to analyze



Run PHysics Analysis Software Tools (PHAST)

- PHAST will use preset RT relation for the analysis.
- Creation of different plots, such as the efficiencies and residuals of the analyzed views (show the precision and accuracy of the view)

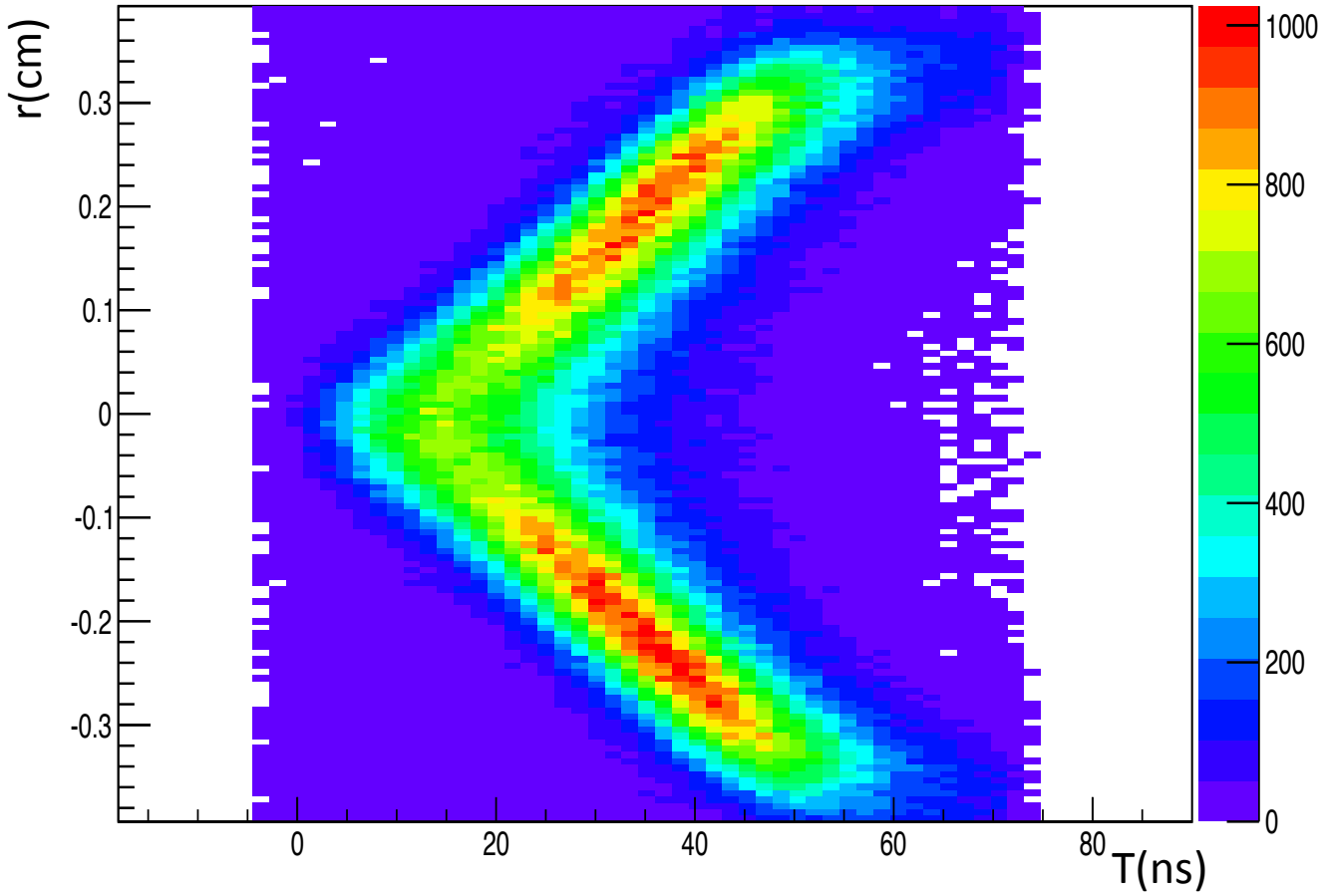
Make a better RT relation fit

- Make a new fit for the RT histogram and obtain a new RT relation

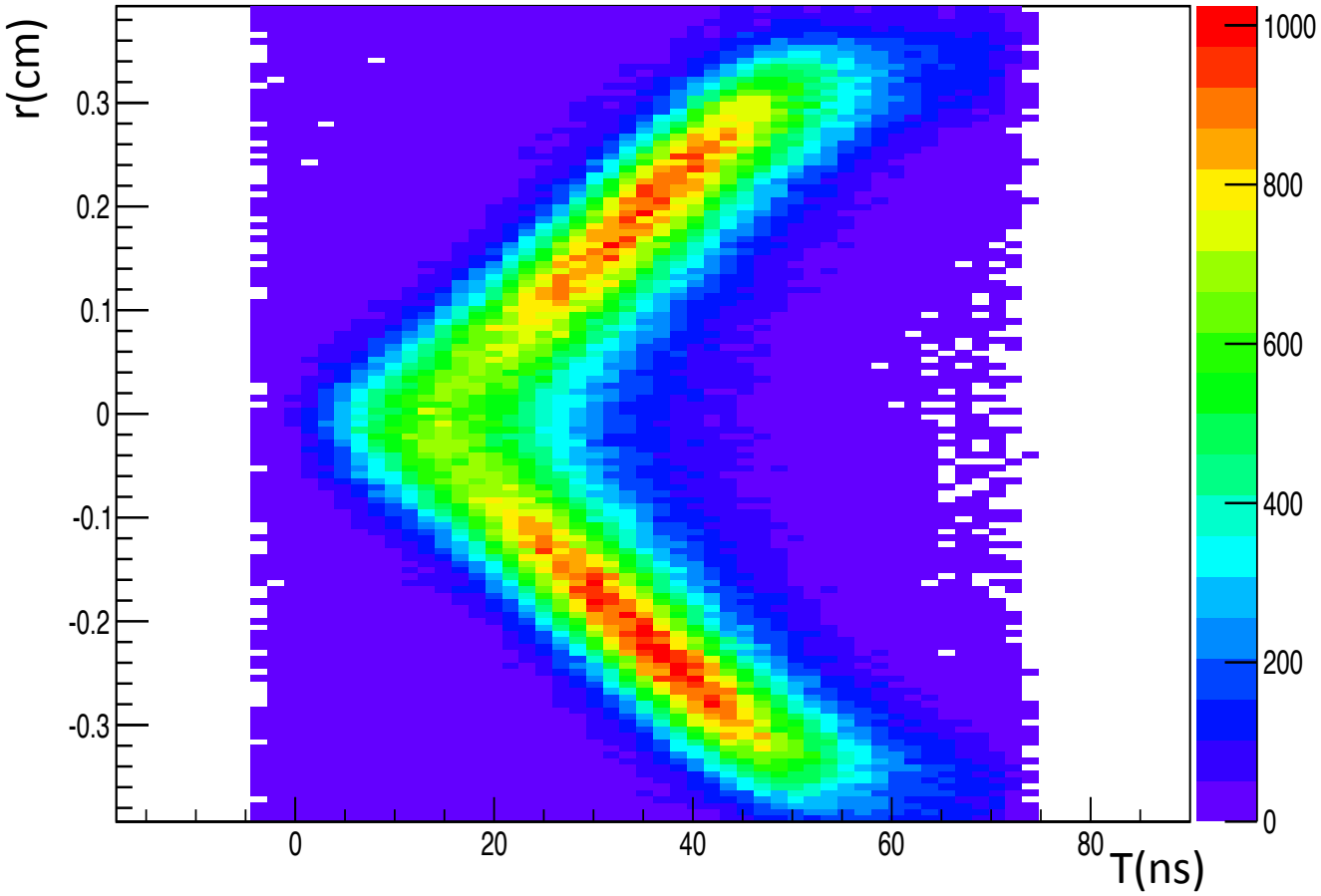
Run PHAST again with the new RT relation

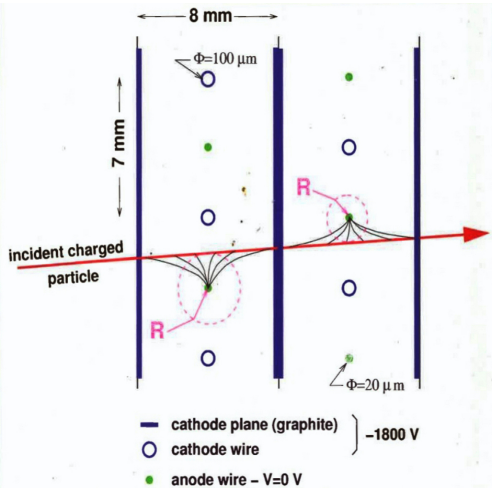
- Comparison before and after the new fit

Example - DC00 X view

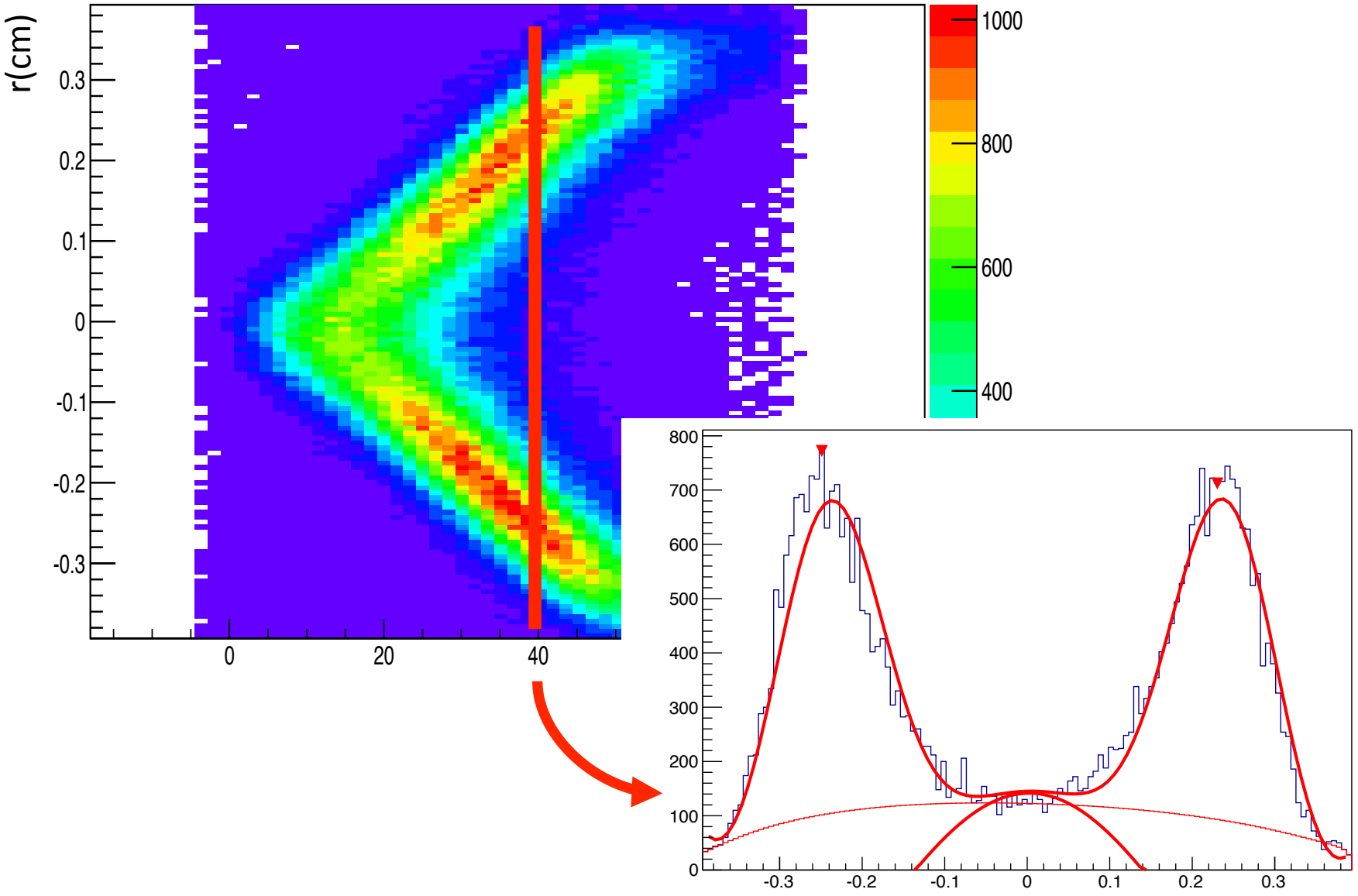


Example - DC00 X view





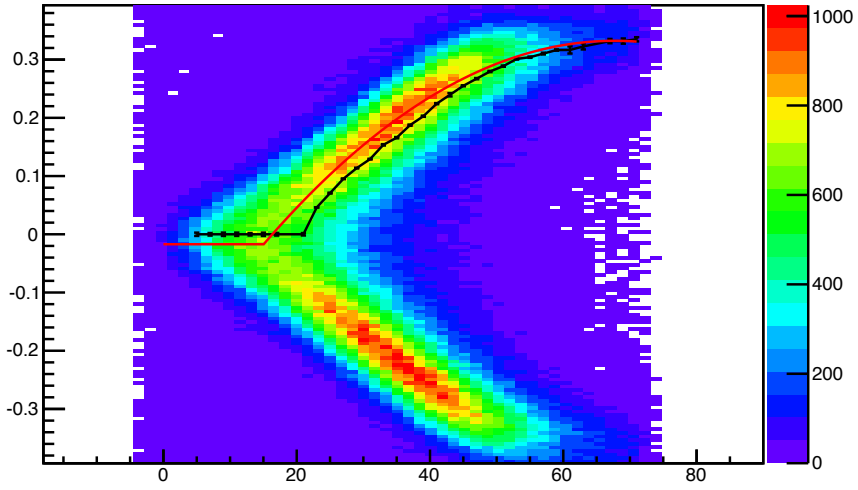
Example - DC00 X view



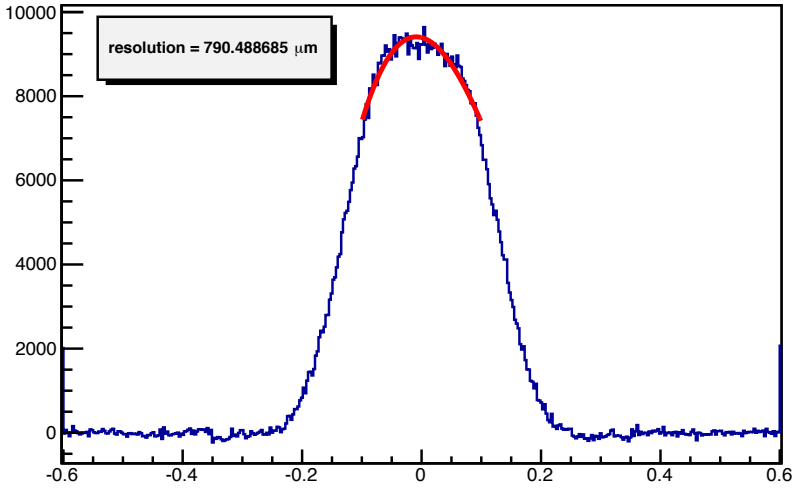
Example - DC00 X view

High Intensity hadron beam: 4.77 * 10^8 particles/sec

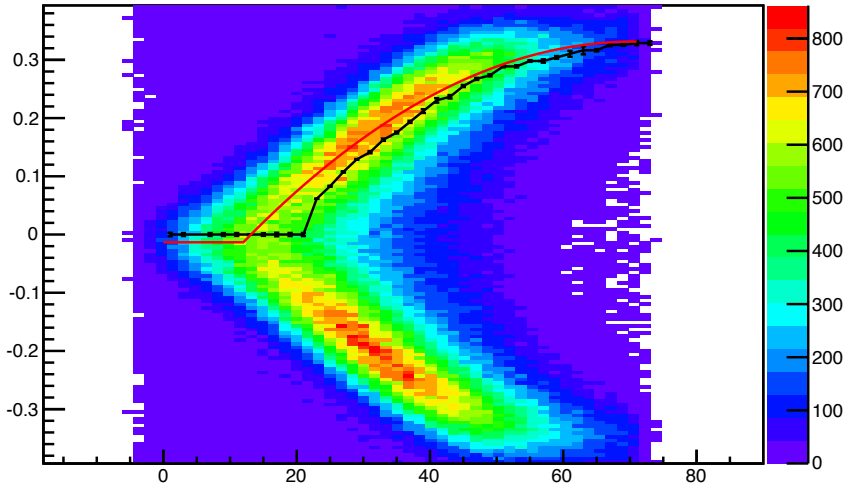
DC00X1__: R *vs.* T



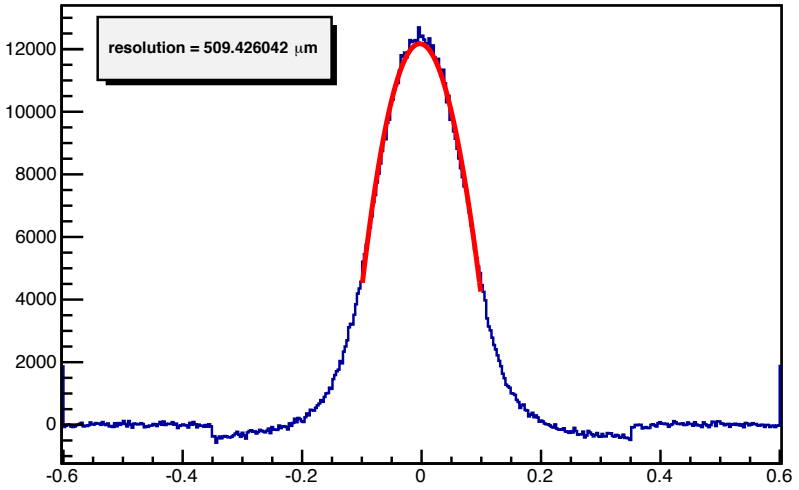
DC00X: DbL Residuals in bins of u(cm)



DC00X2__: R *vs.* T

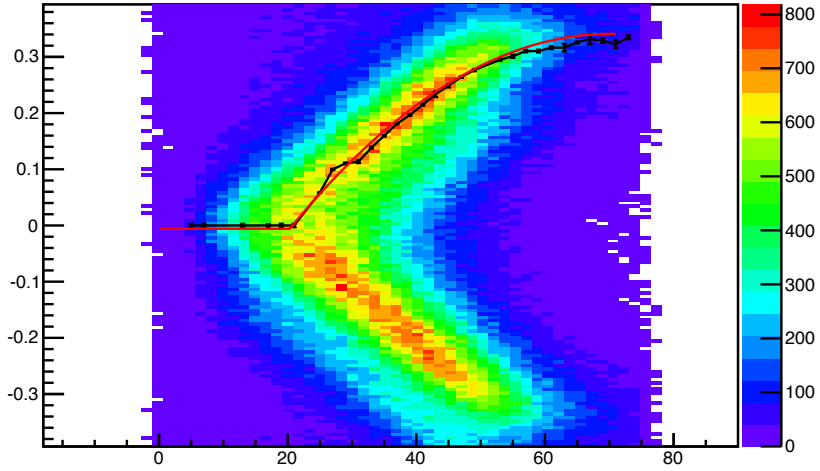


DC00X: DbL Residuals in bins of u(cm)

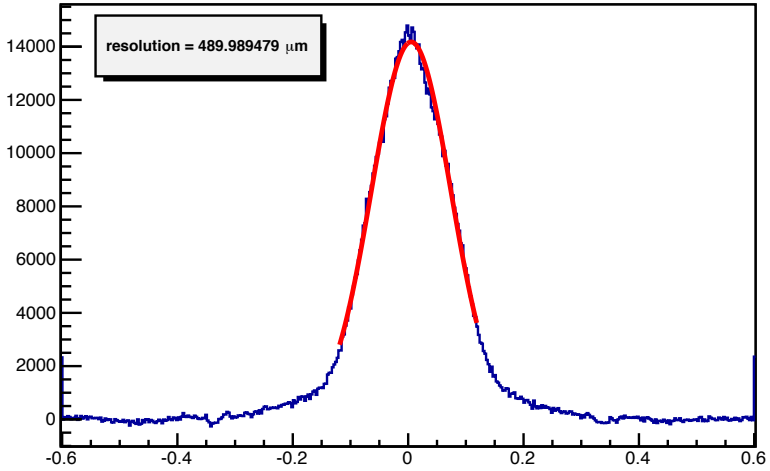


Results

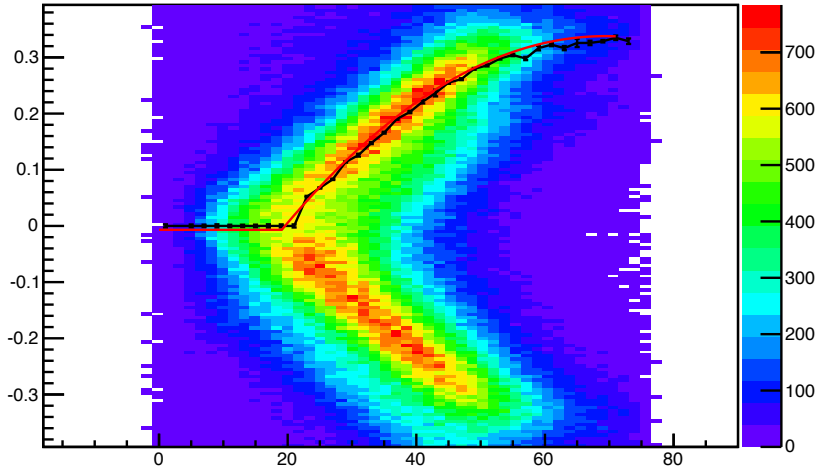
DC00Y1__: R *vs.* T



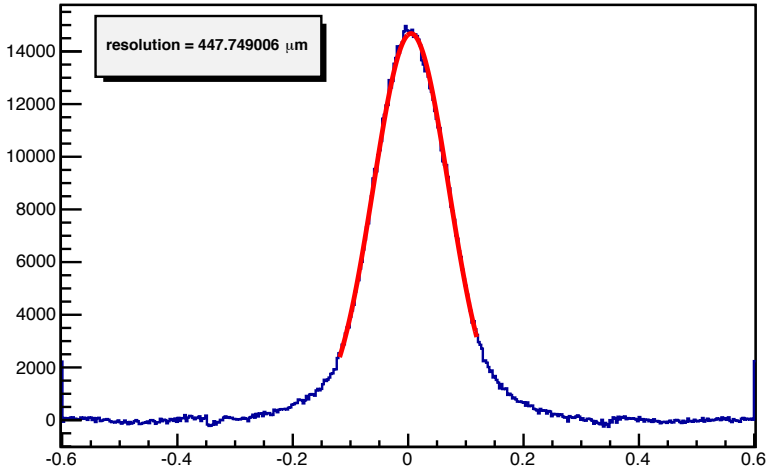
DC00Y: DbL Residuals in bins of u(cm)



DC00Y2__: R *vs.* T

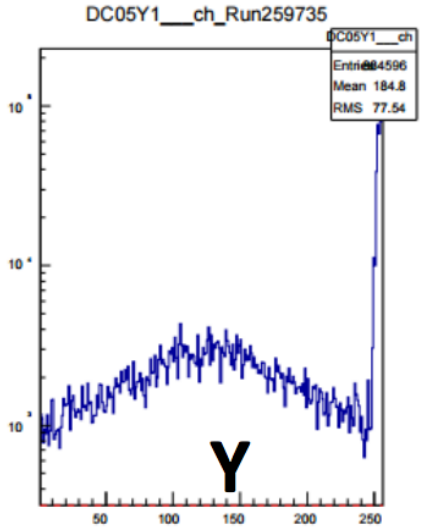


DC00Y: DbL Residuals in bins of u(cm)



Conclusion and Future Work

- **DC05 was successfully installed and is taking data!**

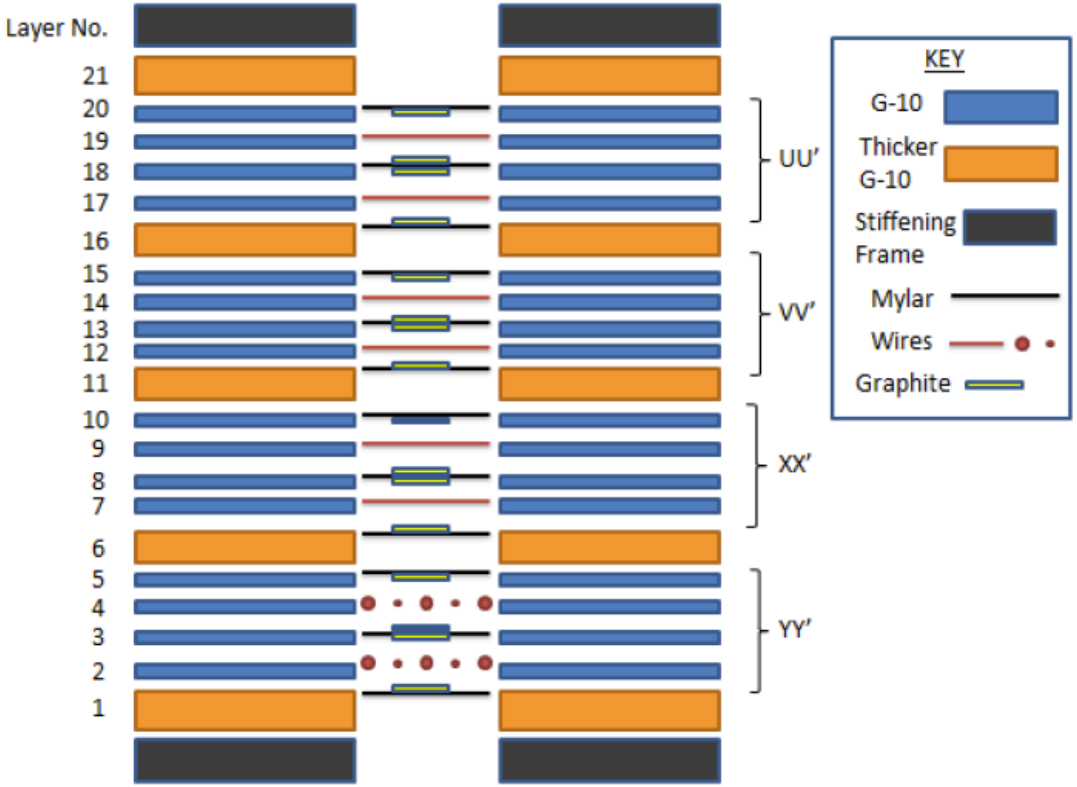


- Production of new RT relations for DC00, DC01 and DC04, improved the spatial resolution of the drift chambers
- We now have the tools to analyze other tracking detectors such as DC05 and ST03
- Questions:
  - Dependence on intensity?
  - Radial position dependence of the RT relation?

Acknowledgements

Supervisors: Caroline Riedl and Alain Magnon
(UIUC) Francesca G., Matthias G. P., Robert H.
(IPAS) Chia-Yu H., (CERN) Didier C., Erwin B., (UPMC) Jose S.
And the COMPASS collaboration

Backup I


Layer No.
21
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17
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8
7
6
5
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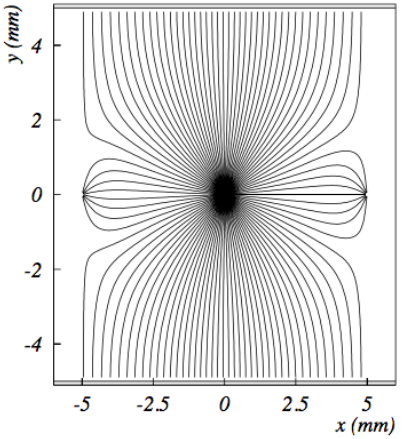
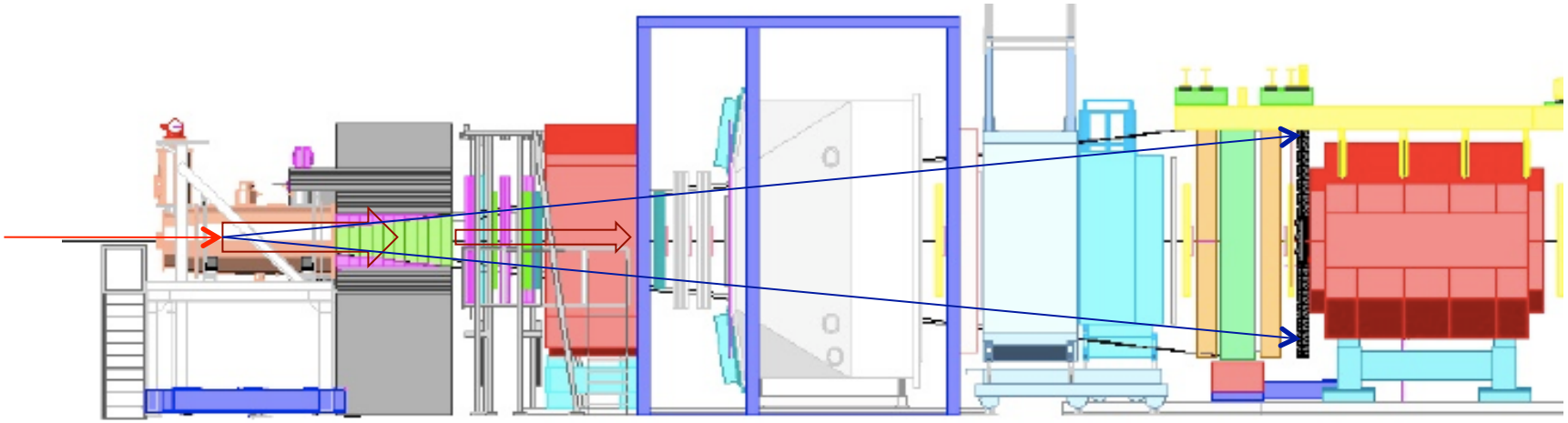
UU'
VV'
XX'
YY'
KEY
G-10
Thicker G-10
Stiffening Frame
Mylar
Wires
Graphite

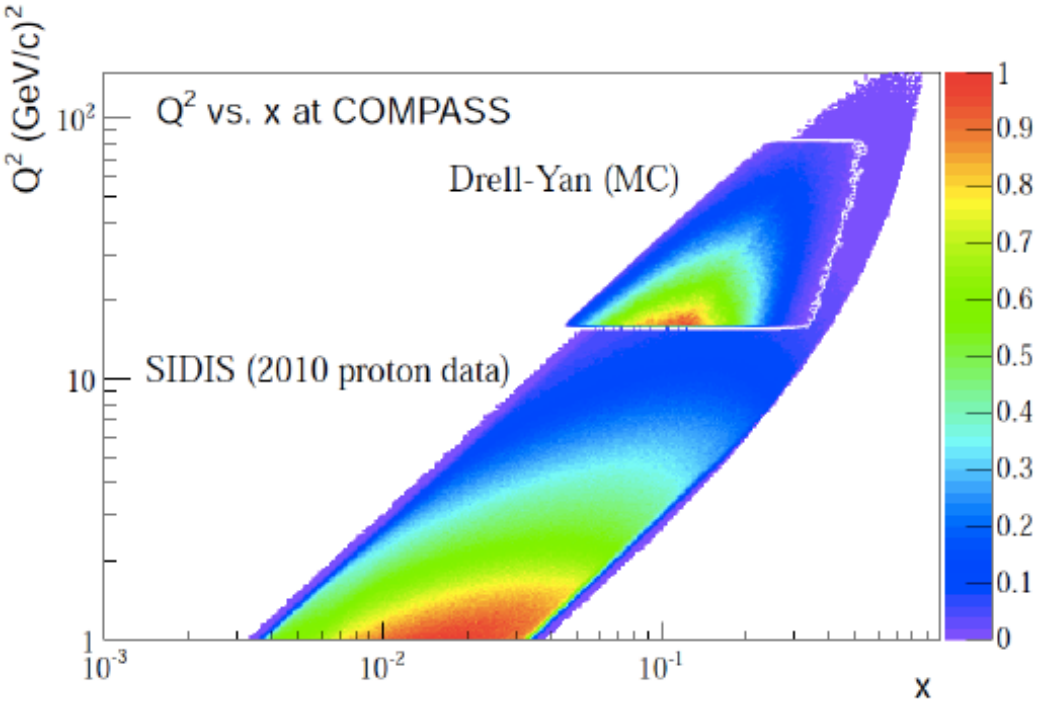

y (mm)
4
2
0
-2
-4
-5
-2.5
0
2.5
5
x (mm)

Backup II



Backup III

In COMPASS we have the opportunity to access these TMD PDFs from both DY and SIDIS processes.



There is a phase space overlap between the two measurements.