COMPASS polarized target for Drell–Yan studies

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On behalf of the COMPASS Polarized target group.

COMPASS experiment

- Located in CERN North Area.
- Beam from SPS accelerator, hadron and muon beams, up to 280 GeV.
- Two–staged spectrometer with great particle identification capability (tracking, calorimetry, RICH, μ detection, see fig. 1).
- Used with both polarized and unpolarized targets.
- Studies mainly hadron (especially spin) structure and hadron spectroscopy. For more detailed information on physics program see [1].

Drell–Yan program at COMPASS

- See the fig. 3, π^- beam & proton target on COMPASS.
- Low cross section → larger hadron flux required → need for hadron absorber (to prevent detector saturation).
- Main goal: Measurement of transversity and TMD PDFs of proton [1].
- Complementary to SIDIS processes, which were studied on COMPASS before.
- Radiation dose in the hall would probably slightly exceed CERN limit → Control room will be moved to office building.
- Physics run planned on fall 2014 (after end of accellerator shutdown) and on 2015.

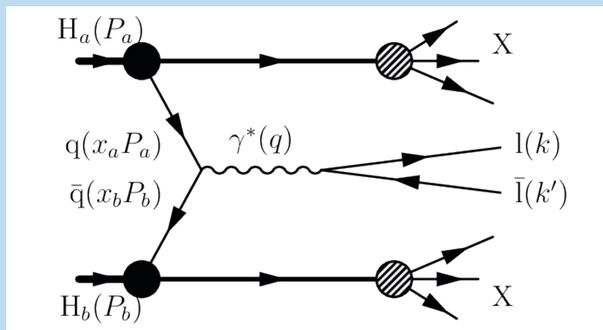

Fig. 3: Drell–Yan process. Quark and antiquark from 2 hadrons anihilate, two leptons are produced. In case of COMPASS μ^+, μ^-.

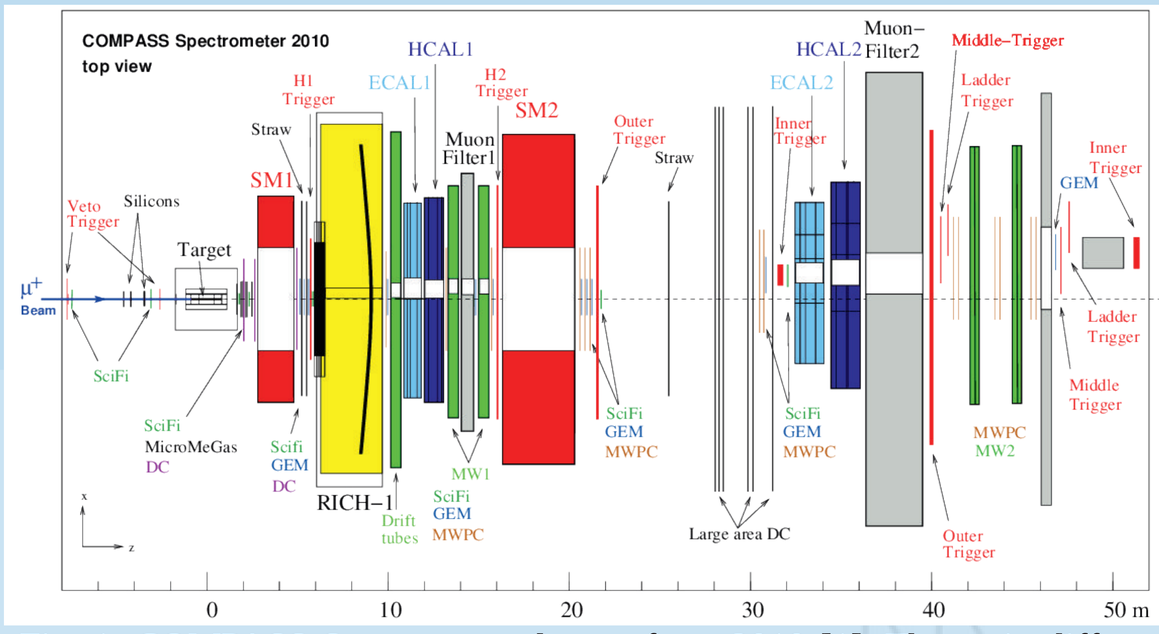

Fig. 1: COMPASS Spectrometer layout from 2010 [1]. The main difference in setup in DY run will be addition of the hadron absorber (see fig. 5).

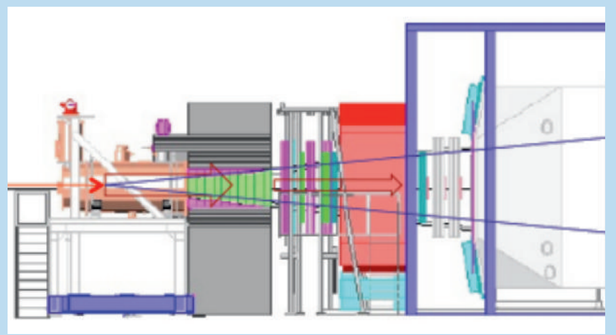

Fig. 5: Hadron absorber between the PT and trackers.

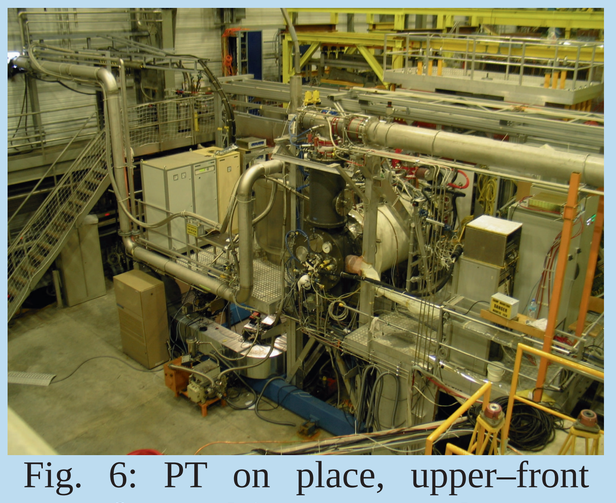

Fig. 6: PT on place, upper–front view. ^{3}He and ^{4}He pumping lines are visible on right and left.

Refrigerator monitoring system

- PT dilution refrigerator: Pressure gauges, flow meters, >30 thermo-meters...
- Previously LabVIEW system.
- Now software package ptread is being developed (see fig. 7).
- Linux platform, Perl and C++, open–source, modular.
- Outputs to MySQL/SQLite data-bases and via DIM service.
- DIM interface is for communi-cation with COMPASS DCS (PVSS–based, centralised Detector Control System).

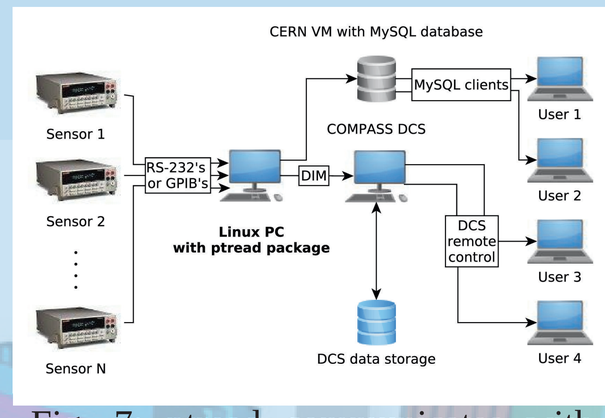

Fig. 7: ptread communicates with sensors, sends data to databases and publishes via DIM service for DCS.

Polarized target overview

- Superconducting solenoid (2.5 T) and dipole (0.65 T) magnets allow both longitudinal and transversal polarization and polarization rotation (to cut down systematics).
- Powerful dilution refrigerator (cool. power of 5 mW at 65 mK) [2].
- Polarized by dynamic nuclear polarization (DNP) at ~0.5 K.
- "Frozen spin mode" at ~65 mK.
- Polarization measurement by continuous–wave NMR (multiple coils & Q–meters) [3].
- COMPASS PT benefits from experience with the SMC PT (summarized in [4]).
- See figures 2 and 6.

Polarized target during 2010-2011

- 3 target cells 30-60-30 cm long, 4 cm in diameter.
- Solid NH_3 as a proton target material, paramagnetic centers for DNP induced by e^- irradiation on Ruhr-University, Bochum.
- Average maximal polarization 83%.

Polarized target for Drell–Yan program

- 2 target cells (55-55 cm) with 4 cm in diameter (see fig. 4).
- NH_3 as target material.
- The 2–cell design bring need of cavity modification (see fig. 4).
- Kevlar/torlon considered for cell construction.
- Target magnet refurbishment is being done in CERN workshop.
- Control room will be in office building → remote control needed.
- Hadron absorber (see fig. 5)
  → Target platform moved.
  → Wide 20 cm gap between cells to help vertex reconstruction.

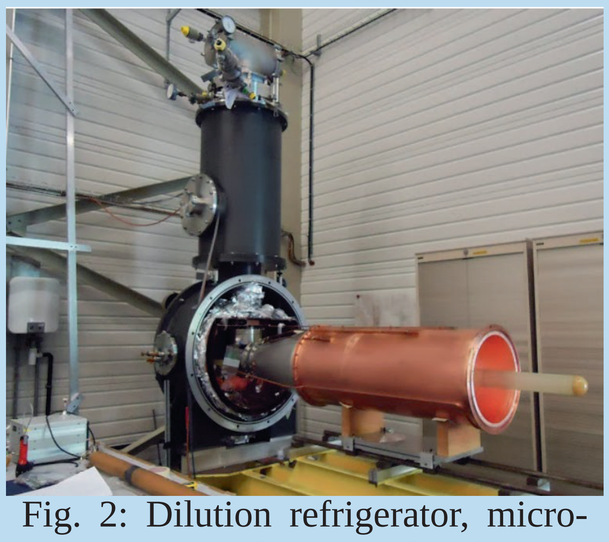

Fig. 2: Dilution refrigerator, micro-wave cavity and mixing chamber.

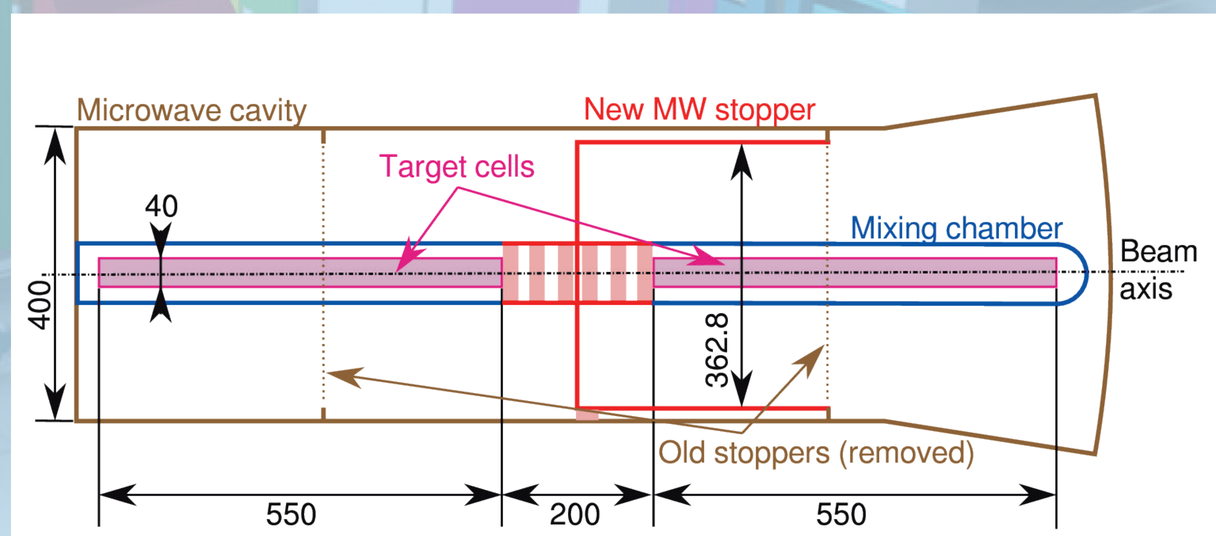

Fig. 4: 2 target cells and modified microwave cavity.

Current status & plans

- Cavity: New microwave stopper was installed, cavity tested.
- DR was leak–tested with He at room temperature, no leaks found.
- 2-cell target holder is being prepared.
- Magnet: Refurbishment and new control and safety system will be ready by end of November.
- PT platform movement: Probably during October.

Conclusion

- COMPASS PT preparation for DY is progressing well.
- Target will be ready for 2014–2015 physics run.

References

[1] The COMPASS Collaboration. COMPASS-II Proposal. Available at: http://wwwcompass.cern.ch/
[2] Doshita, N. et al. Nucl. Instrum. Methods Phys. Res. A 526 (2004) 138.
[3] Kondo K. et al. Nucl. Instrum. Methods Phys. Res. A 526 (2004) 70.
[4] Adams, D. et al. Nucl. Instrum. Methods Phys. Res. A 437 (1999), 23.