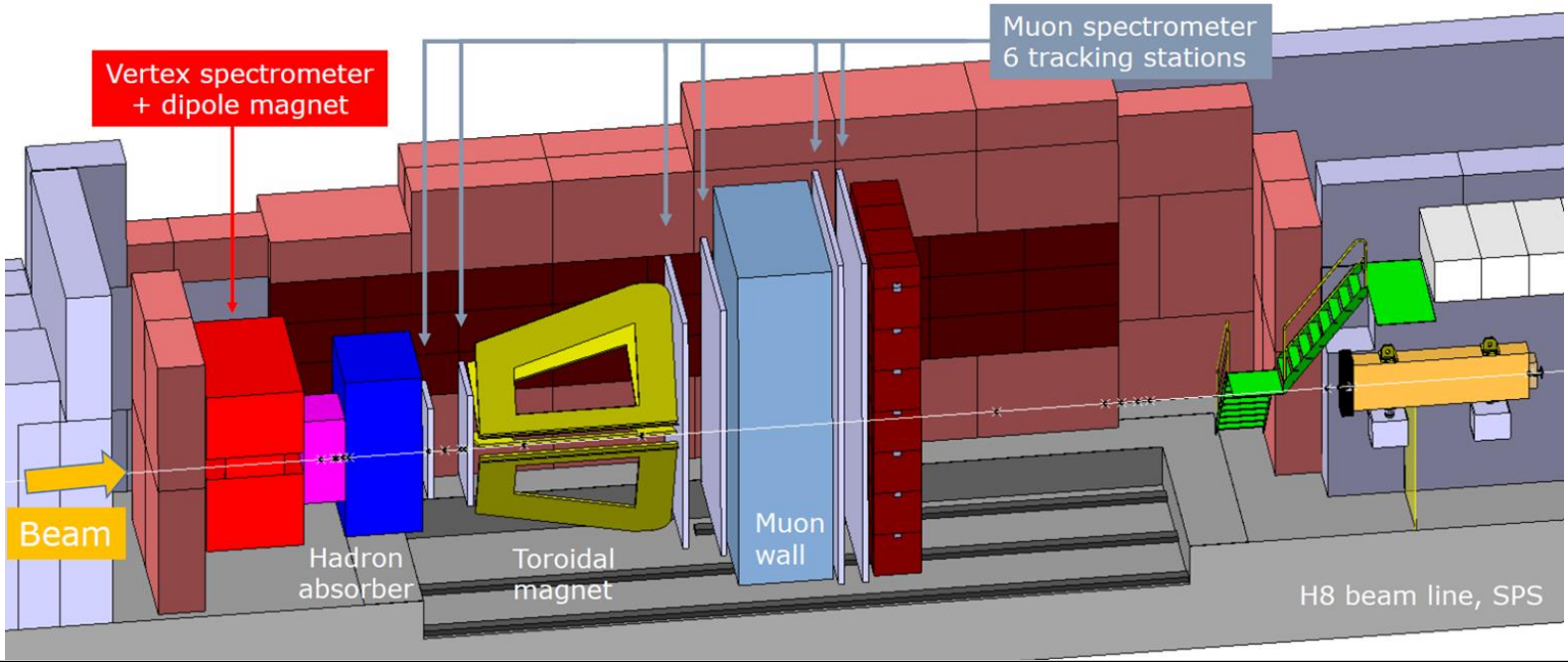
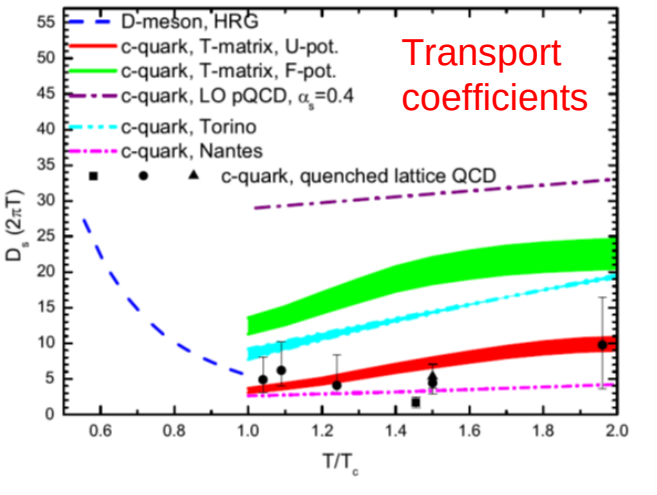
NA60+: overview

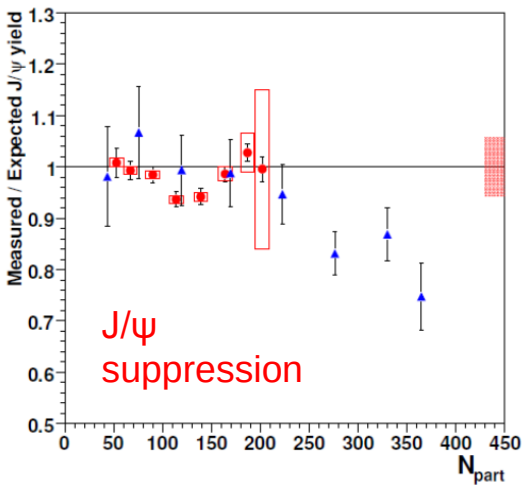
- Aim: perform accurate measurements of the **dimuon spectrum** from threshold up to the charmonium mass region, and of hadronic decays of charm and strange hadrons
- **Energy scan** with a Pb beam from top SPS energy ($\sqrt{s_{NN}}$=17 GeV) down to $\sqrt{s_{NN}}$~ 6 GeV (E_{lab}~20 A GeV)
- Based on a **muon spectrometer** (toroid field) coupled to a **vertex spectrometer** (dipole field)
- **High luminosity** is an essential requirement →10^6 s^{-1} Pb ions/s

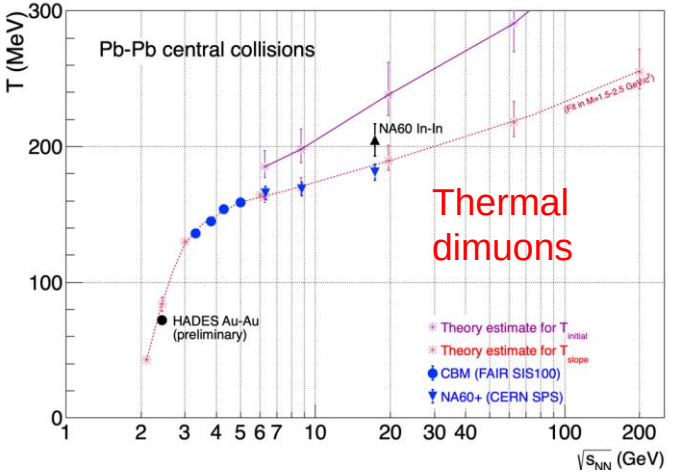


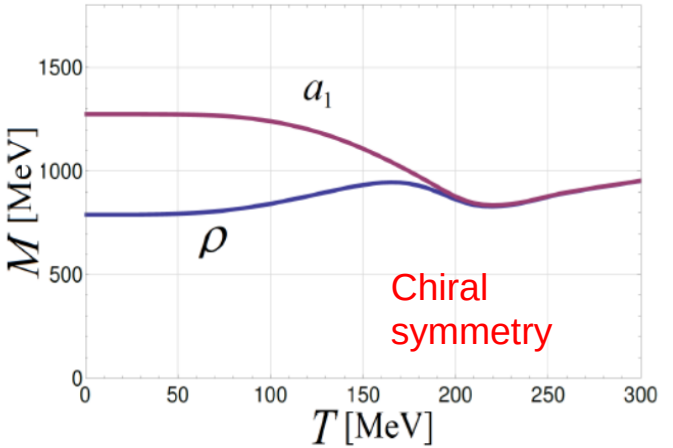
NA60+: physics case

- **Four main "pillars"**
  - Thermal dimuons from QGP/hadronic phase: caloric curve
  - ρ-a_1 modifications: chiral symmetry restoration
  - Quarkonium suppression: signal of deconfinement
  - Open charm mesons/baryons: QGP transport coefficients





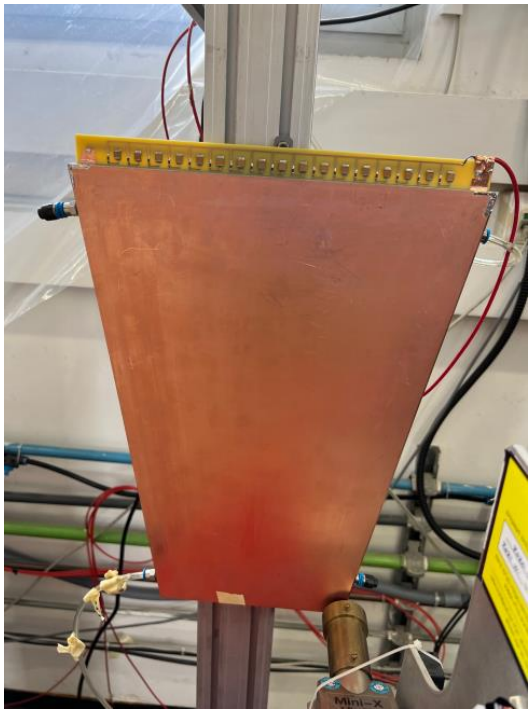


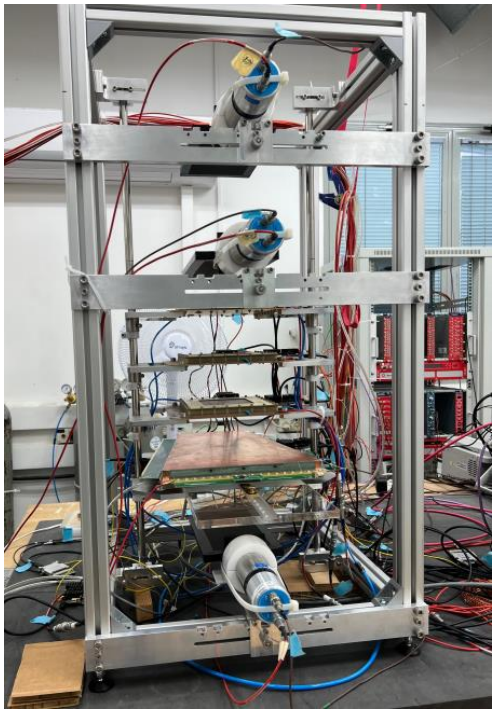


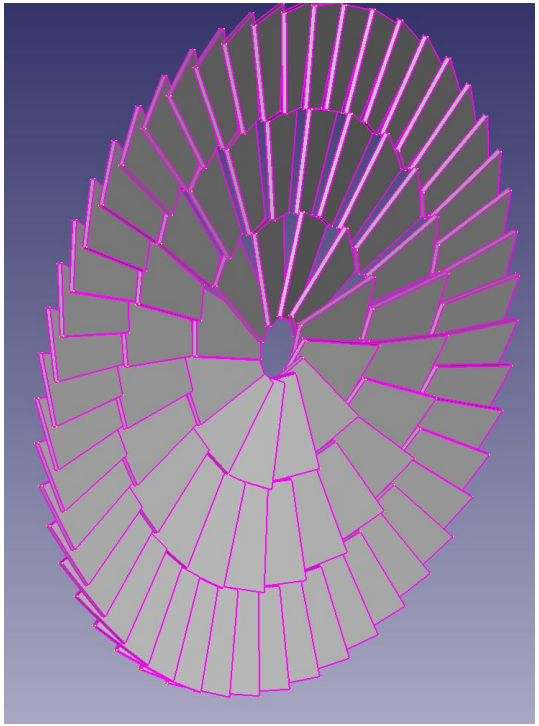
No accurate data exist for any of these observables below top SPS energy

NA60+: R&D for muon spectrometer

Hadron absorber + toroidal magnet + 6 tracking stations





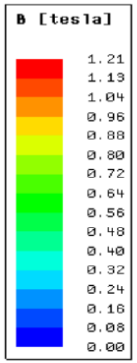


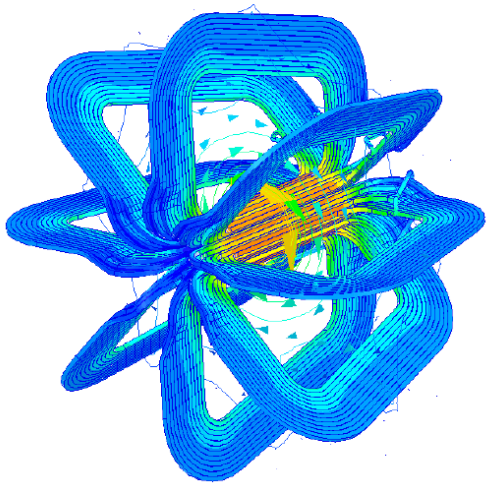
Complete spectrometer
→ 264 modules
→ ~ 100 m^2 surface

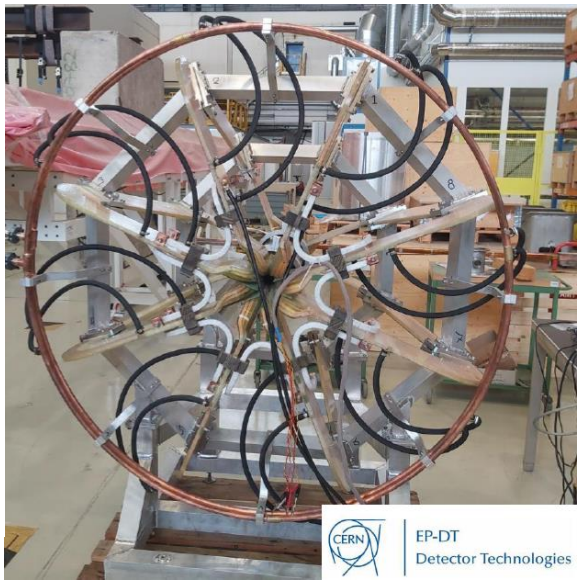
- ❑ Relatively low incident flux: < 2kHz/cm^2
- ❑ Considering MWPC or GEM options
- ❑ First prototype on cosmic test bench and then SPS test beam in spring 2023

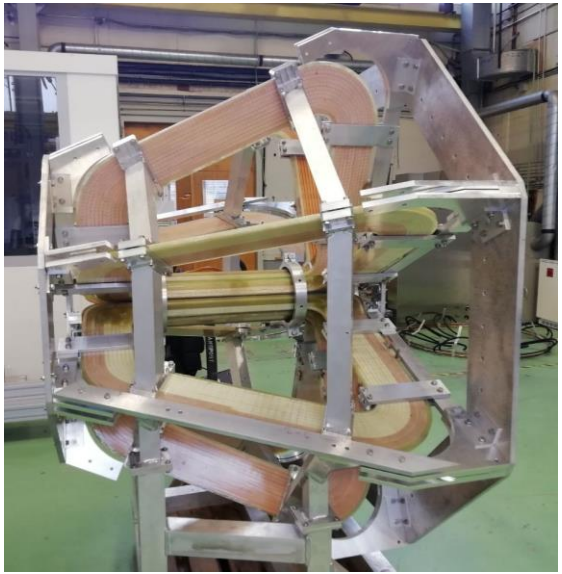
R&D carried out by Israel (Weizmann) and US (StonyBrook) groups

NA60+: R&D for muon spectrometer (magnet)









- Warm pulsed magnet → 0.5 T of magnetic field over 120 m^3
- Eight sectors, 12 turns each
- Current → 190 kA, total power 3 MW.

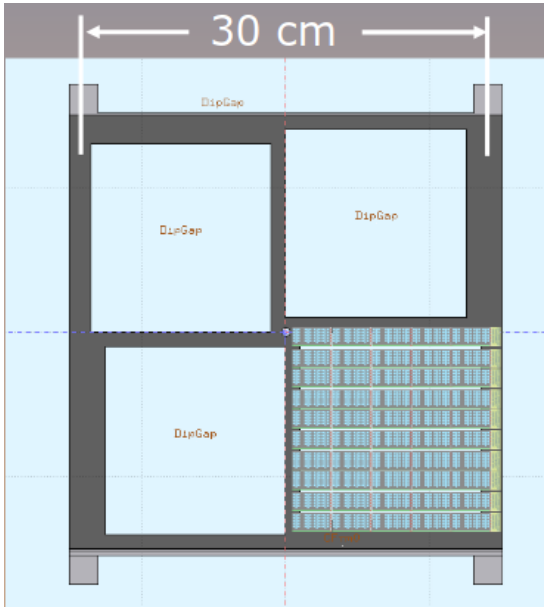
- **Demonstrator (scale 1:5) constructed and tested (CERN/INFN)**
  → cross-check of various aspects of the design.
- Measurements of the magnetic field in the prototype in agreement with simulations within 3%.

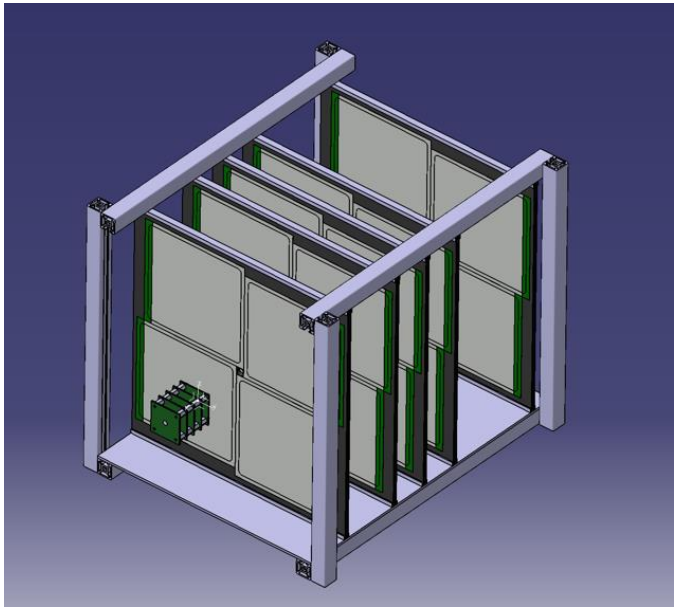
Next step: design of full scale object

NA60+: R&D for vertex spectrometer (MAPS)

Common development
ALICE ⟷ NA60+

State-of-the-art imaging technology TowerJazz 65 nm



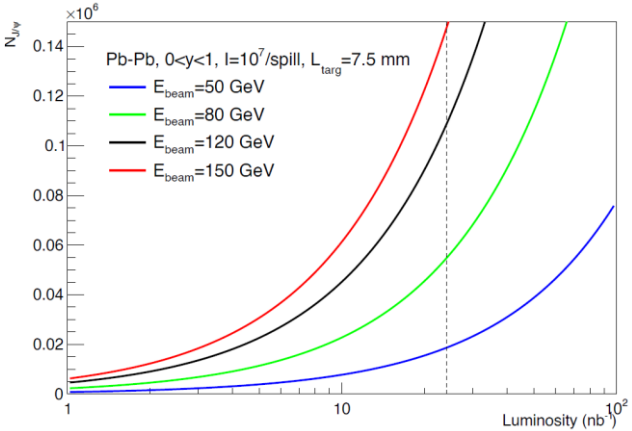


- Sensor thickness: few tens of microns of silicon → **material budget < 0.1% X_0**
- **Spatial resolution 5 μm**
- Cooling studies for NA60+ geometry → mixed air+fluid

- Four sensors per station
- Five to ten stations in the vertex spectrometer
- Dipole field → use MEP48 magnet, available at CERN

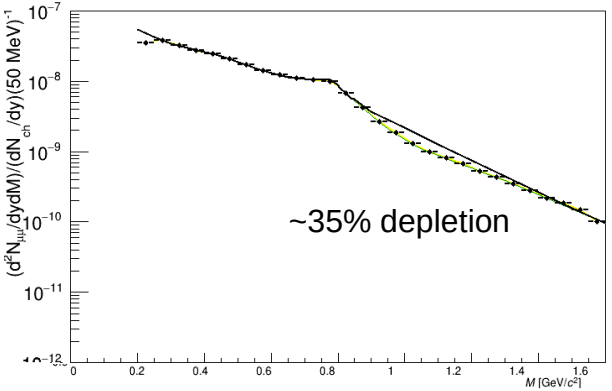
R&D carried out by Cagliari, Padova, Torino groups (Italy)

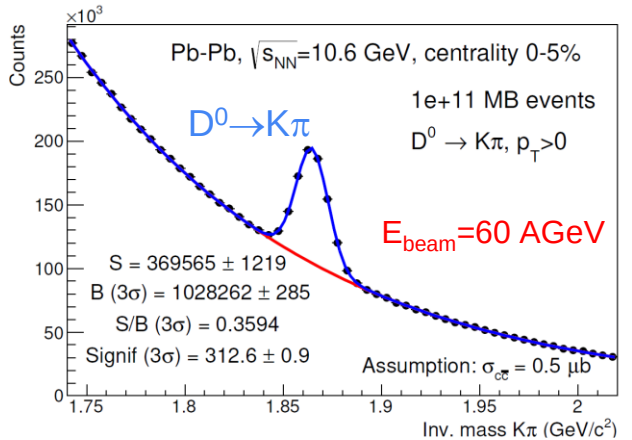
NA60+: physics performance



Open/hidden charm

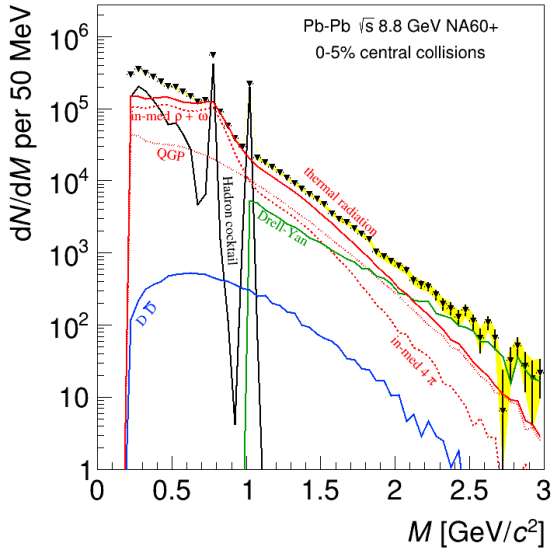
- Large statistics for differential (centrality, p_T) studies down to fairly low SPS energy (~50 A GeV)
- Onset of J/ψ suppression
- R_{AA}, v_2 of open charm and baryon/meson studies





Dimuon studies

- Excellent resolution (<10 MeV at ω mass),
- Measure T_{slope} with a 2-3% uncertainty
- Detect modification of continuum in 1<m<1.4 GeV, related to chiral symmetry restoration



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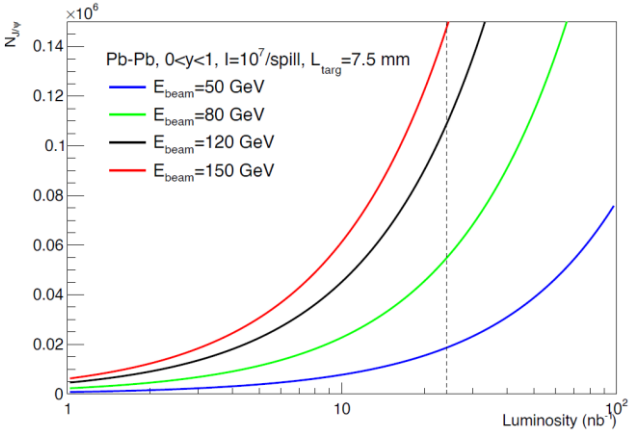

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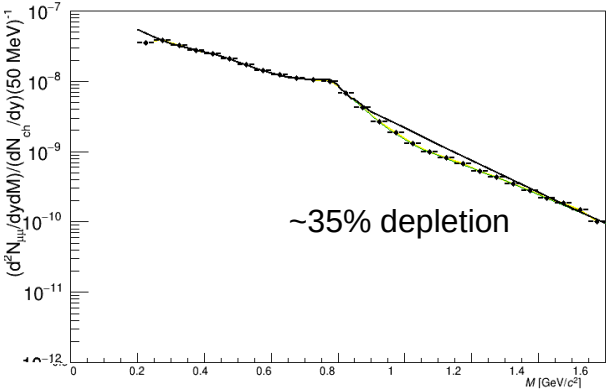

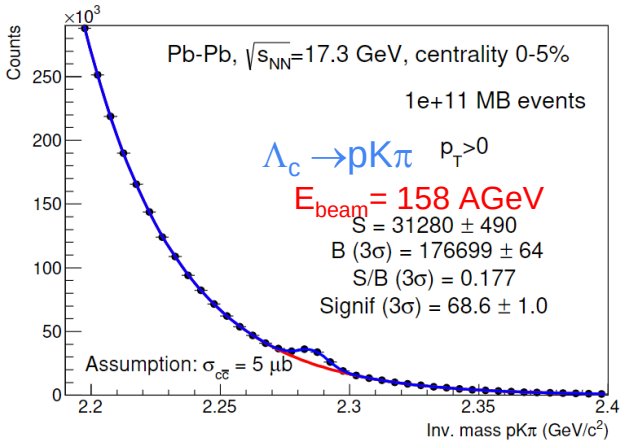

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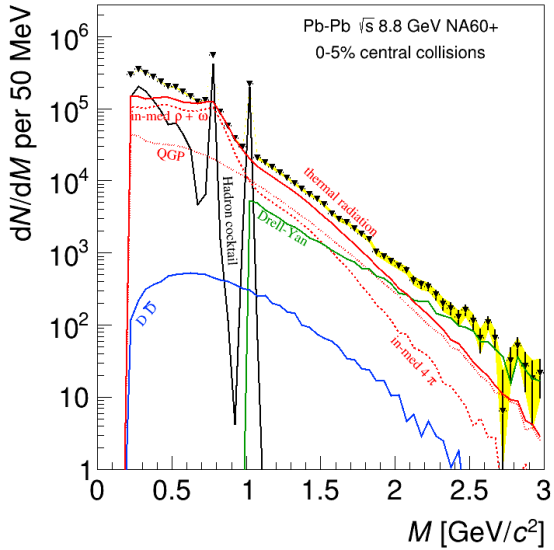
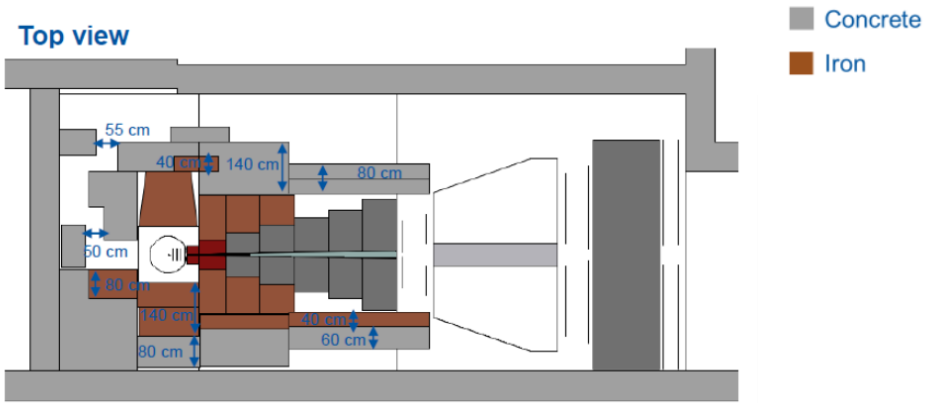


NA60+: installation, beam, planning

- Experiment will be installed in the PPE138 experimental area in the SPS Nort Hall (H8 beam)
- Integration studies, including radioprotection aspects (shieldings), already quite advanced



- Sub-mm beam optics was designed (σ_x~ σ_y~ 0.2-0.4 mm down to low SPS energy) → tested last week at CERN

- Project recognized by CERN in the frame of the "Physics Beyond Collider" initiative →technical support from CERN groups
- Expression of Interest: May 2019
- **Letter of Intent**: ready for submission, by 2022

- Aim at taking **first data in 2029** (after LHC long shutdown 3)
- 5-6 years data taking with a 1 month period with a primary Pb ion beam, one energy point per year
- Corresponding data taking with proton beams, for reference and QCD studies