IDS120j WITH AND WITHOUT RESISTIVE MAGNETS

PION AND MUON STUDIES WITHIN TAPER REGION, III
(20 cm GAPS BETWEEN CRYOSTATS)

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IDS120j GEOMETRY, WITH/WITHOUT RESISTIVE COILS:

WITH 20 cm GAPS

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MUONS SPREADING WITHIN THE TAPER REGION AND BEYOND.
MUONS DETECTED WITHIN 40 cm RADIUS IN z PLANES ALONG THE TAPER REGION AND BEYOND.
MAGNETIC FIELD FOR IDS120j WITH AND WITHOUT THE RS MAGNETS WILL BE USED. (ONLY SC MAGNETS ARE LEFT IN THE GEOMETRY FOR THE MARS SIMULATIONS).
BEAM PIPES WITH TAPERING FROM z = 0.0 cm TO z = 1,500 cm [BASELINE] USED FOR BOTH CASES ALTHOUGH THE MAGNETIC FIELD IS NOT 1.5 T AT THE END POINT.

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>SIMULATIONS CODE: mars1512

>NEUTRON ENERGY CUTOFF: 10^{-11} MeV

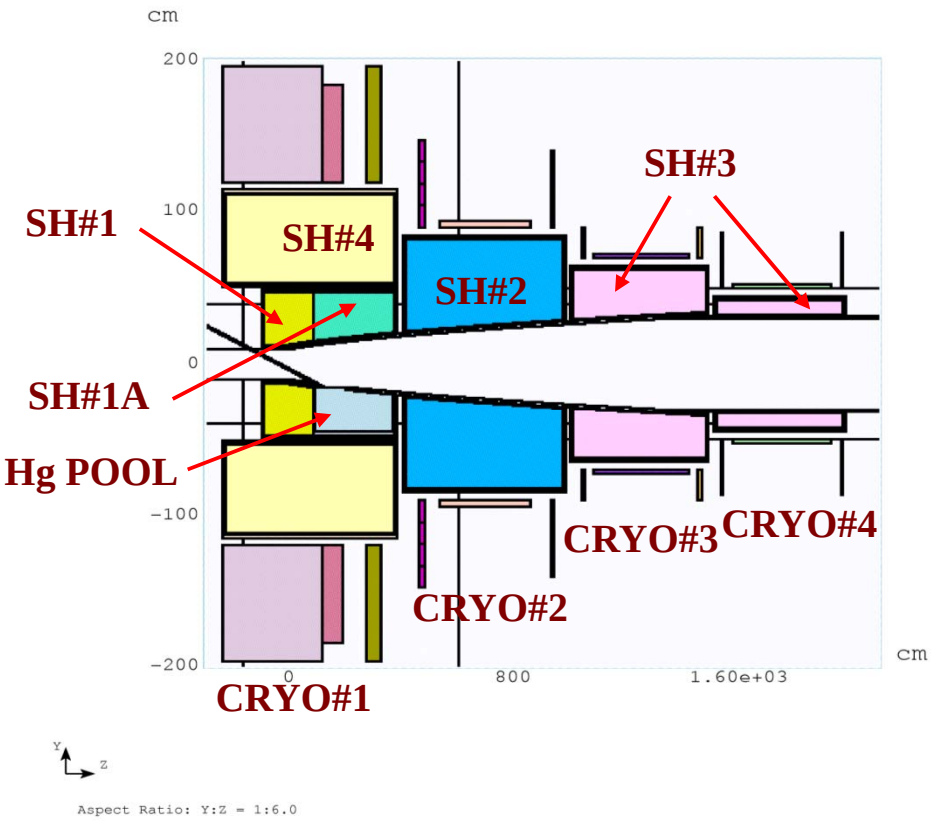
>PROTON BEAM POWER: 4 MW

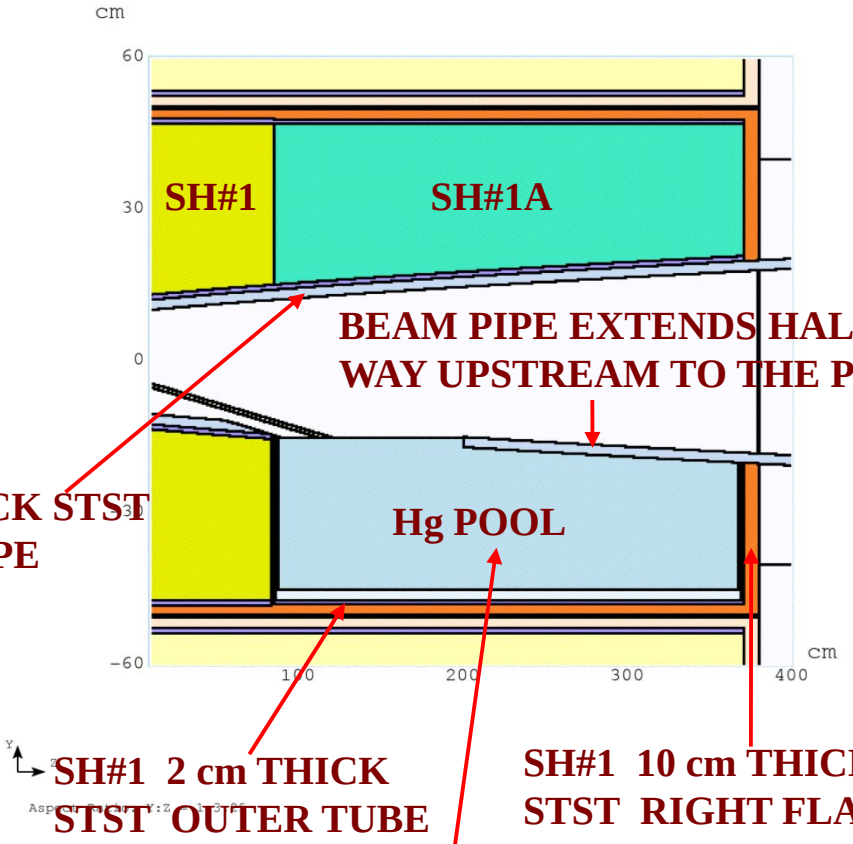
>PROTON ENERGY: E = 8 GeV

>PROTON BEAM PROFILE: GAUSSIAN, $\sigma_x = \sigma_y = 0.12$ cm (P12 POINT)

>EVENTS IN SIMULATIONS : $N_p = 200{,}000$

IDS120j: REPLACING RESISTIVE MAGNETS AND FILLING UPPER HALF OF Hg POOL WITH SHIELDING. GENERAL OVERVIEW (LEFT), POOL REGION DETAILS (RIGHT). [20 cm GAPS]

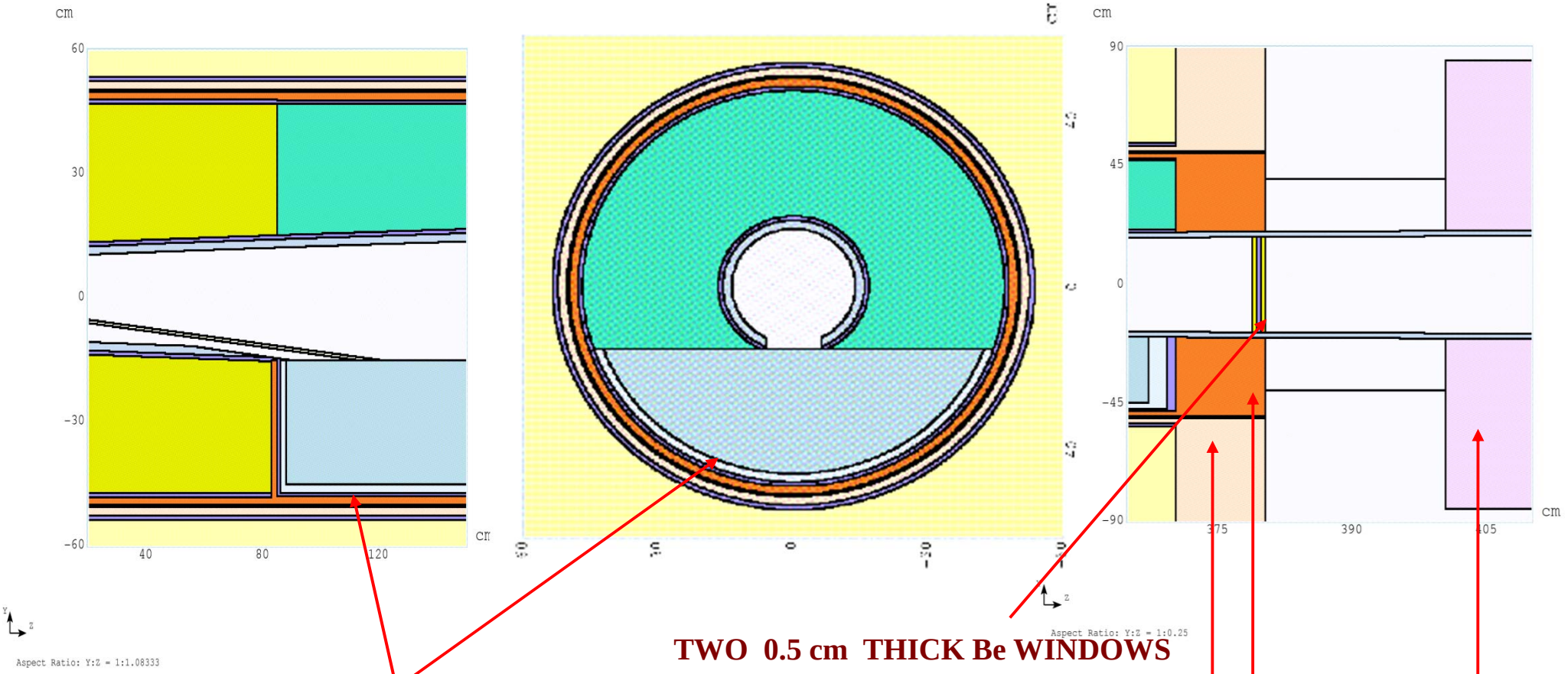




Hg POOL STARTS ~ 85 cm AND EXTENDS ALL THE WAY TO THE END OF THE FIRST CRYOSTAT ~ 370 cm.

SHVS WALLS, Hg POOL VESSEL DOUBLE WALLS, Be WINDOW, He GAP IN Be WINDOW AND IN HG POOL HAVE NOMINAL VALUES FOR THEIR THIKNESS. STRESS FORCES ANALYSIS AND LOCAL DPD DISTRIBUTION WILL BE USED TO DETERMINE THEIR VALUES.

IDS120j: WITHOUT RESISTIVE MAGNETS. DETAILS OF THE DOUBLE STST Hg POOL VESSEL (LEFT, MIDDLE) AND THE DOUBLE Be WINDOW (RIGHT). [20 cm GAPS]

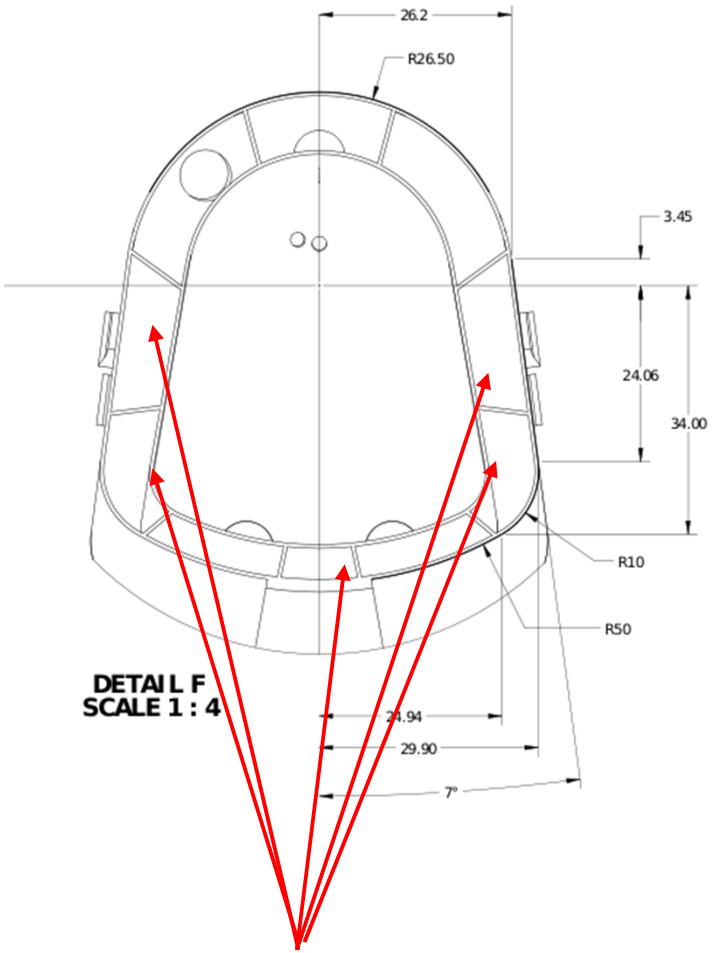


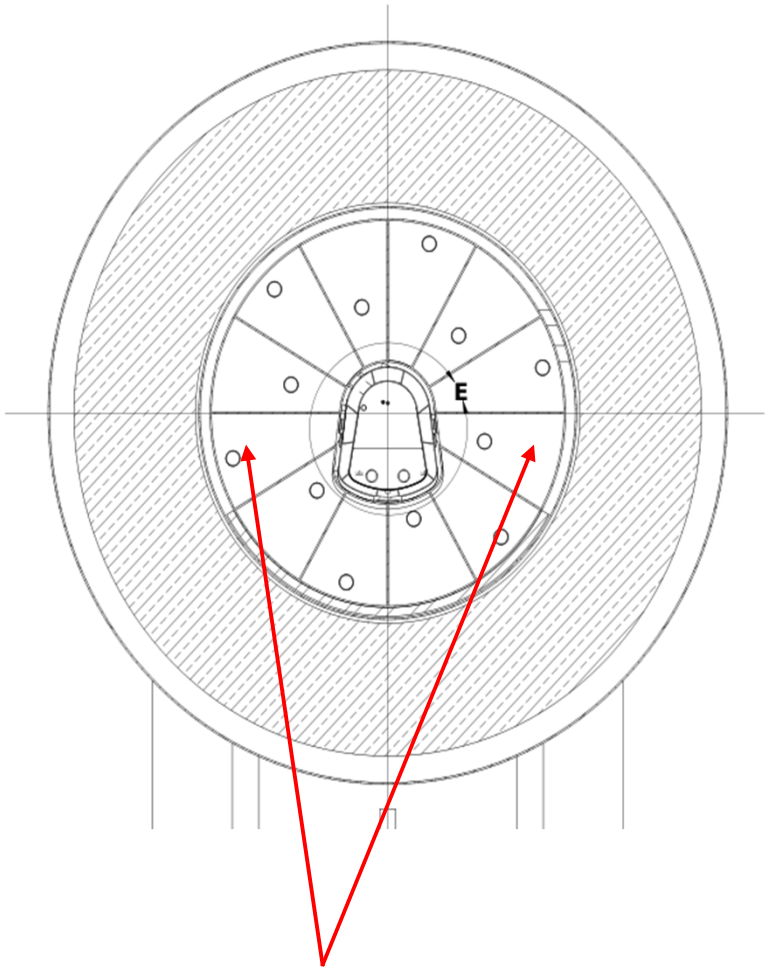
2 cm THICK STST INNER Hg POOL VESSEL WITH 1 cm He GAP FOR COOLING.

TWO 0.5 cm THICK Be WINDOWS AT THE END OF CRYO#1 WITH 0.5 cm He GAP BETWEEN THEM FOR COOLING.

10 cm THICK STST RIGHT / LEFT FLANGE OF SHVS#4, SHVS#1 / SHVS#2 WITH 20 cm GAP BETWEEN THEM.

IDS120j: DETAILS OF THE DOUBLE WALL Hg POOL VESSEL ENVISIONED BY VAN GRAVE.
(PLOTS ARE FROM VAN GRAVE'S 8 / 9 / 2012 PRESENTATION)





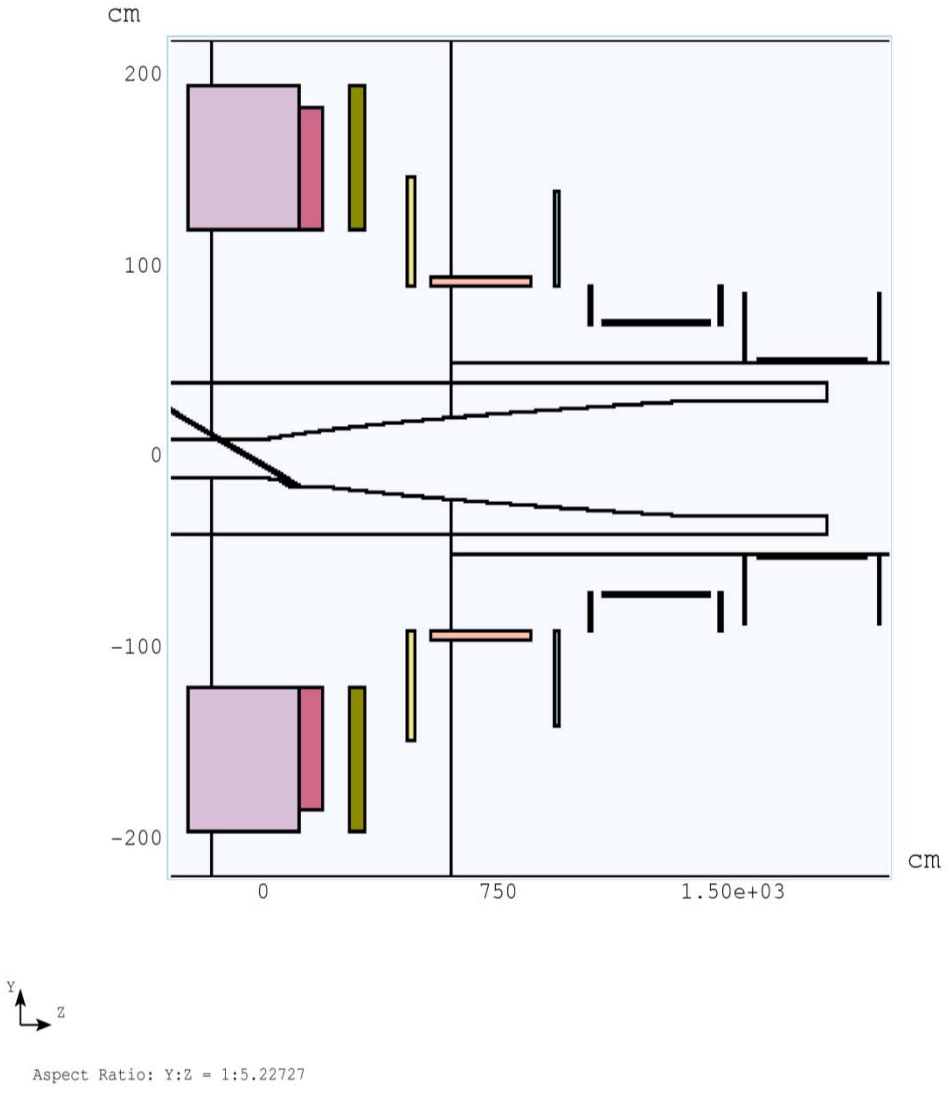
He GAS WILL BE FLOWING BETWEEN THE TWO WALLS FOR COOLING.
COOLED
THE BEAM PIPE IN THAT AREA WILL BE PART OF THE POOL VESSEL AND REMOVING THE HEAT LOAD WILL BE A CHALLENGING TASK.
SEGMENTATION ANALYSIS WILL BE PERFORMED TO DETERMINE THE AZIMUTHAL DPD DISTRIBUTION.

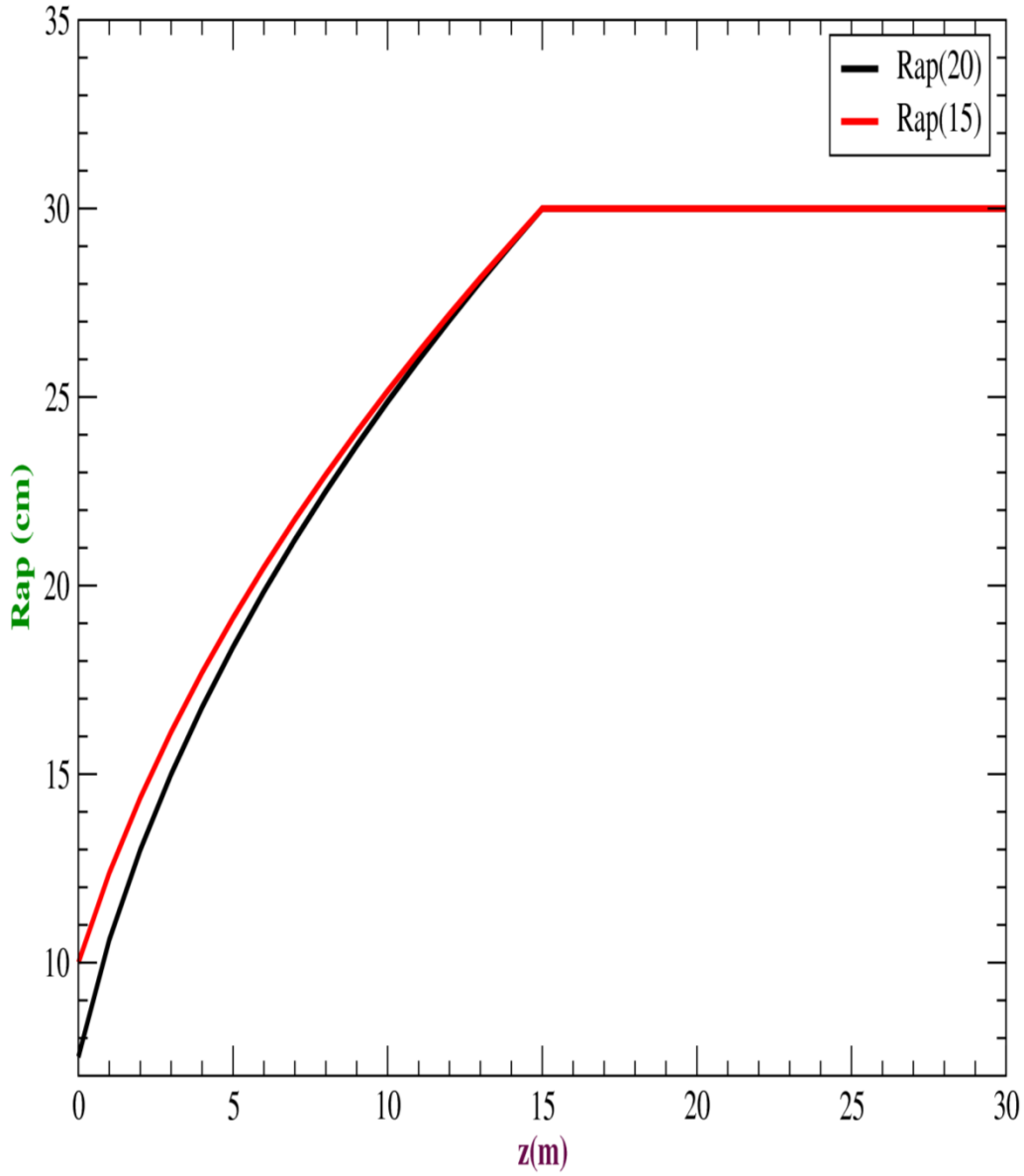
VESSEL FILLED WITH He

W BEADS FOR SCs SHIELDING.

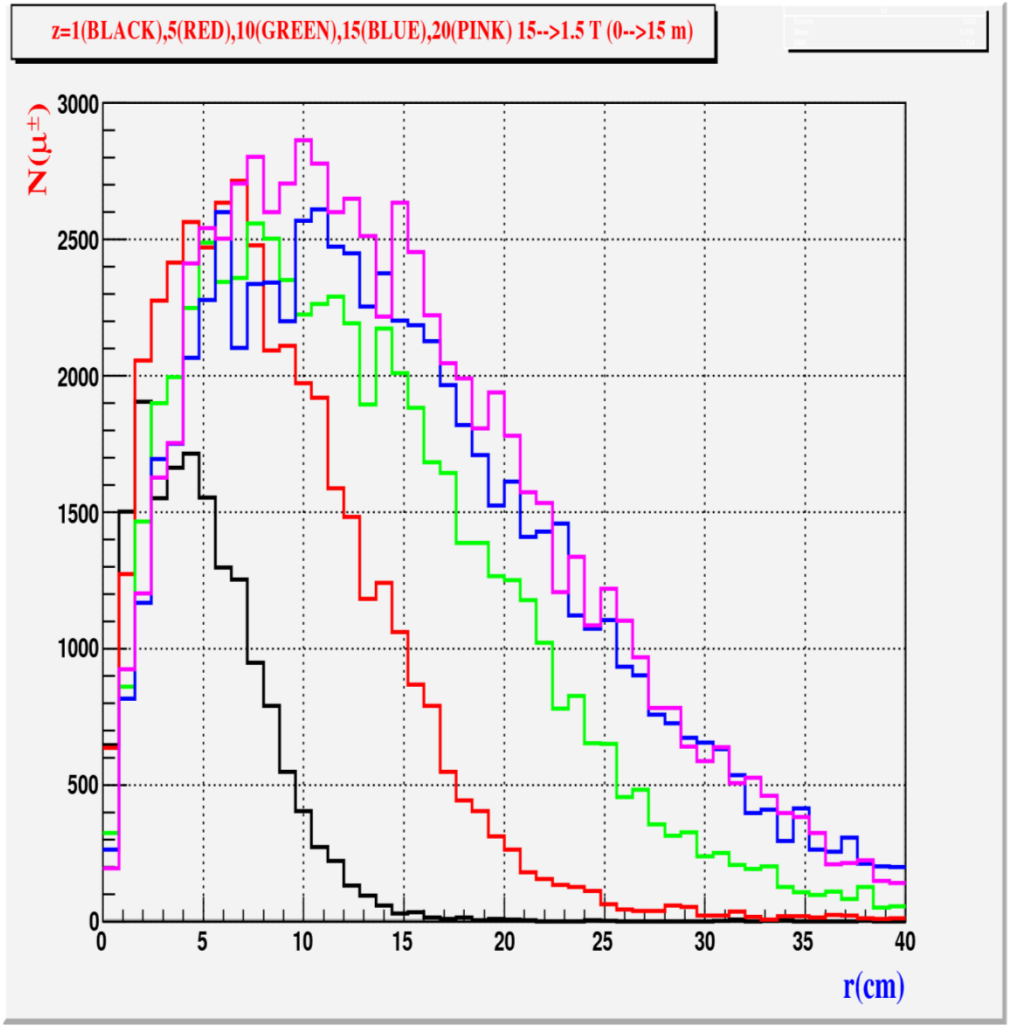
IDS120j: FOR THE PIONS AND MUONS DISTRIBUTIONS STUDIE WITHIN THE TAPER REGION ONLY THE SCs ARE PRESENT IN MARS SIMULATIONS [LEFT].

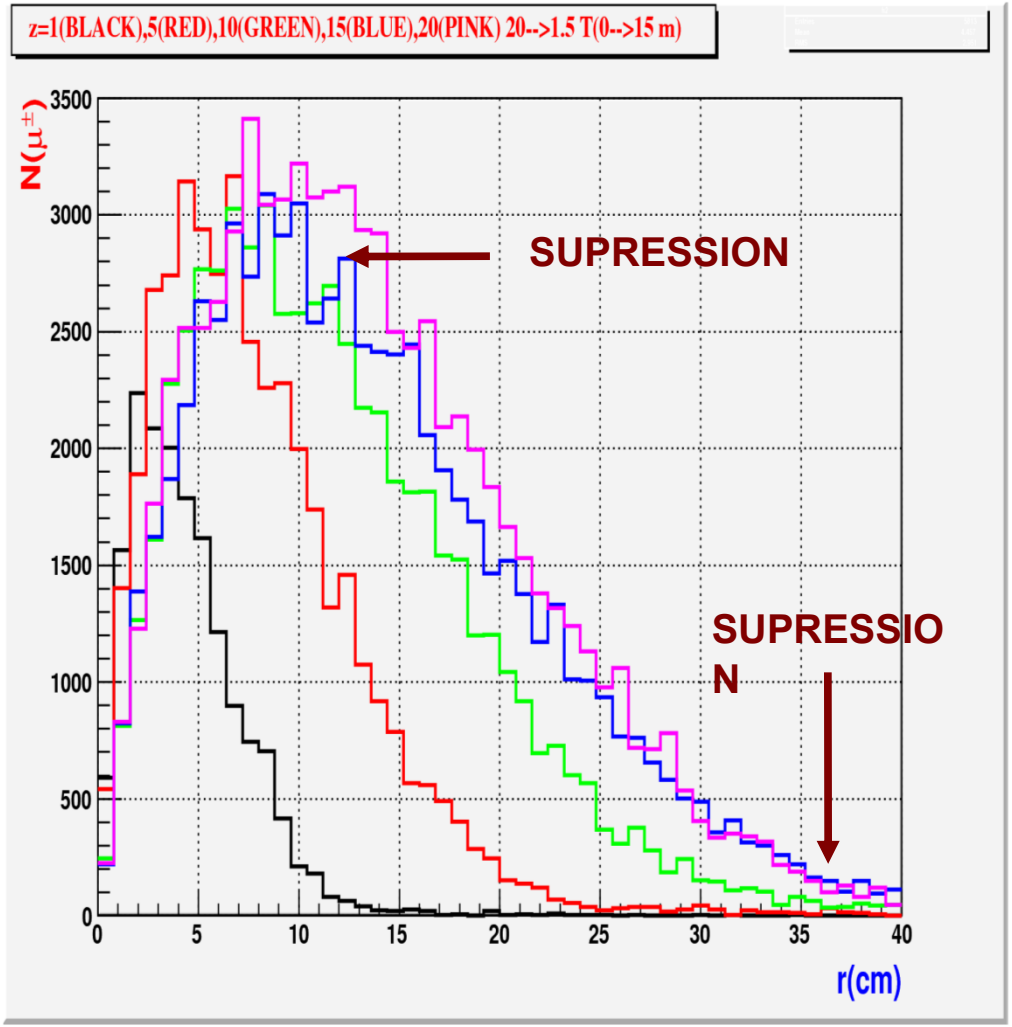
BEAM PIPE PROFILE WITH / WITHOUT RS WITH END OF TAPER AT z = 15 m [RIGHT].





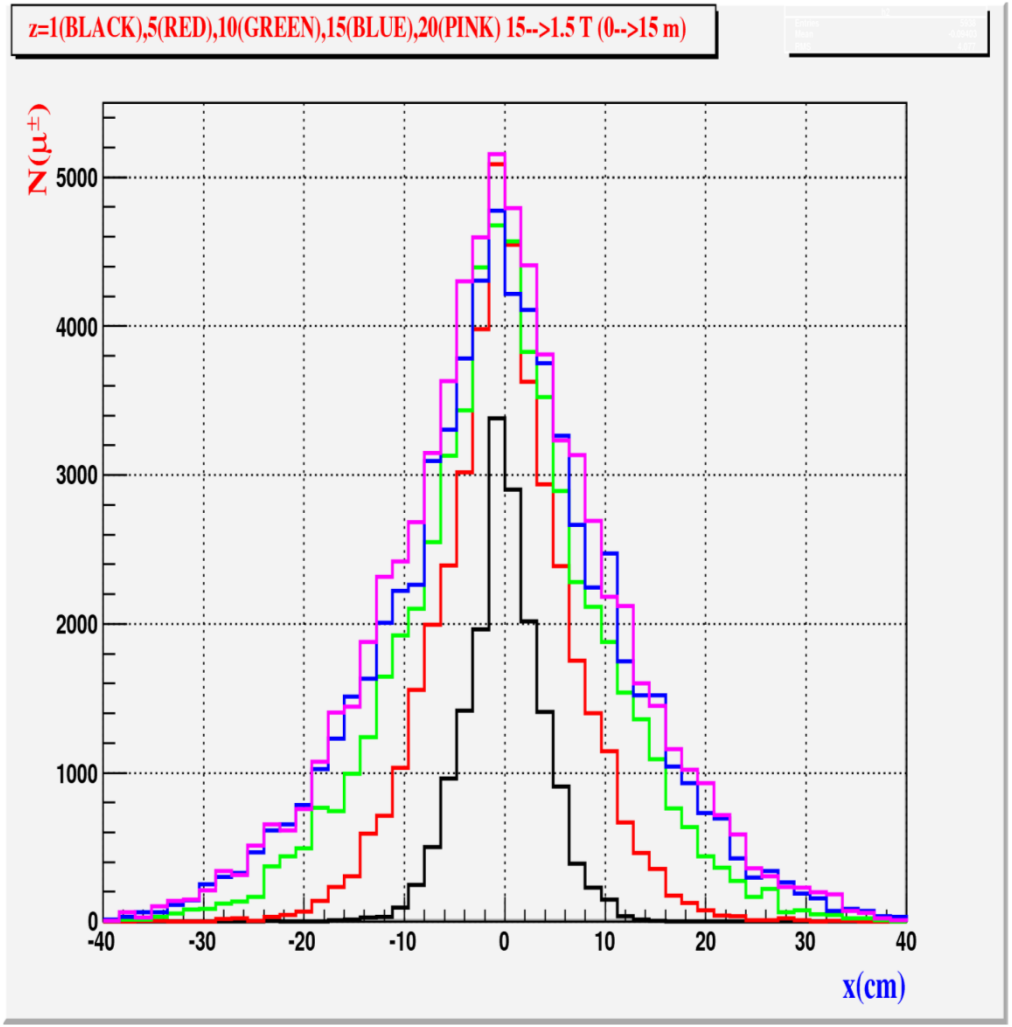
MUONS RADIAL DISTRIBUTION HISTOGRAMS z (IN m) = 1 (BLACK), 5 (RED), 10 (GREEN), 15 (BLUE), 20 (PINK) FOR 15 T (LEFT) AND 20 T (RIGHT) MAGNETIC FIELD IN THE TARGET REGION. [40 < Ekin < 180 MeV]

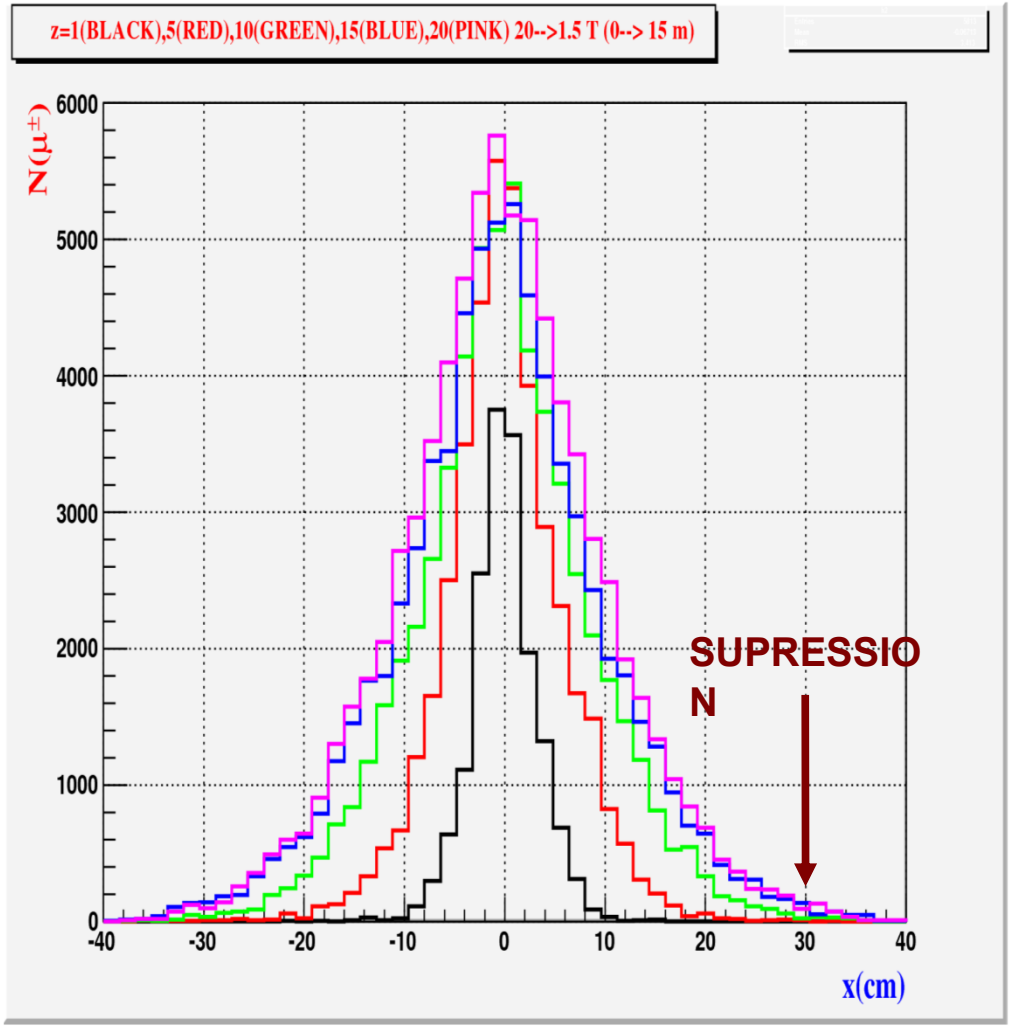




PIONS AND MUONS DISTRIBUTIONS DEPEND ON: RELATIVE POSITIONS OF PROTON BEAM AND Hg JET (--> PIONS INITIAL CONDITIONS), DECAY (PIONS) / GENERATION (MUONS) OF PARTICLES, THE MAGNETIC FIELD. ONE CAN SEE THE EFFECT (SENSITIVITY) ON MUONS YIELDS, DISRTIBUTIONS OF A STRONGER MAGNETIC FIELD IN THE TARGET REGION. IN BOTH CASES THE TAIL HAS REACH A LIMIT AT ~ 15 m AND IS CLEARLY MORE SUPRESSED IN THE 20 T FIELD CASE. ONE CAN ALSO SEE HOW THE CENTER OF THE DISTRIBITION CHANGES WITH z [<r> ~ 5 / 3 cm --> 10 / 7 cm (15 / 20 T)] .

MUONS DISTRIBUTION HISTOGRAMS IN x, z (IN m) = 1 (BLACK), 5 (RED), 10 (GREEN), 15 (BLUE), 20 (PINK) FOR 15 T (LEFT) AND 20 T (RIGHT) MAGNETIC FIELD IN THE TARGET REGION. [40 < Ekin < 180 MeV]

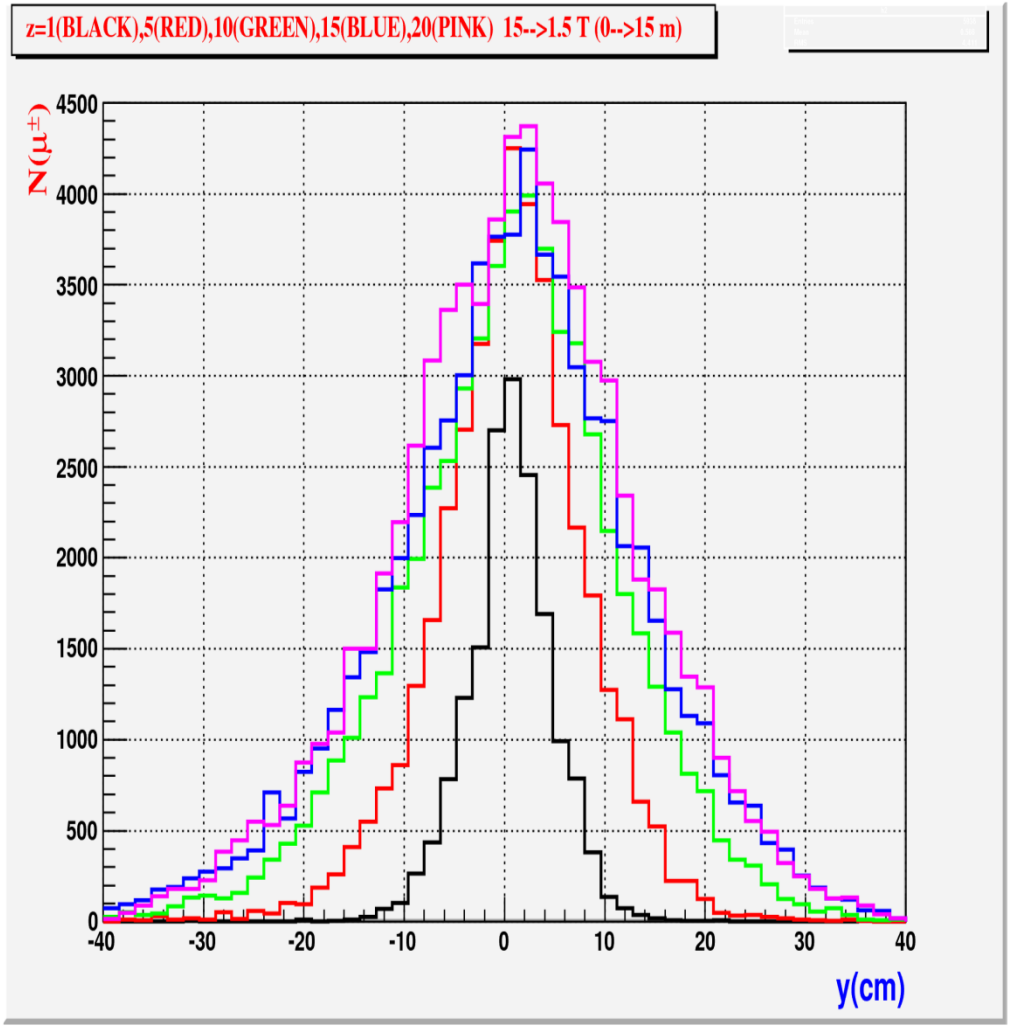


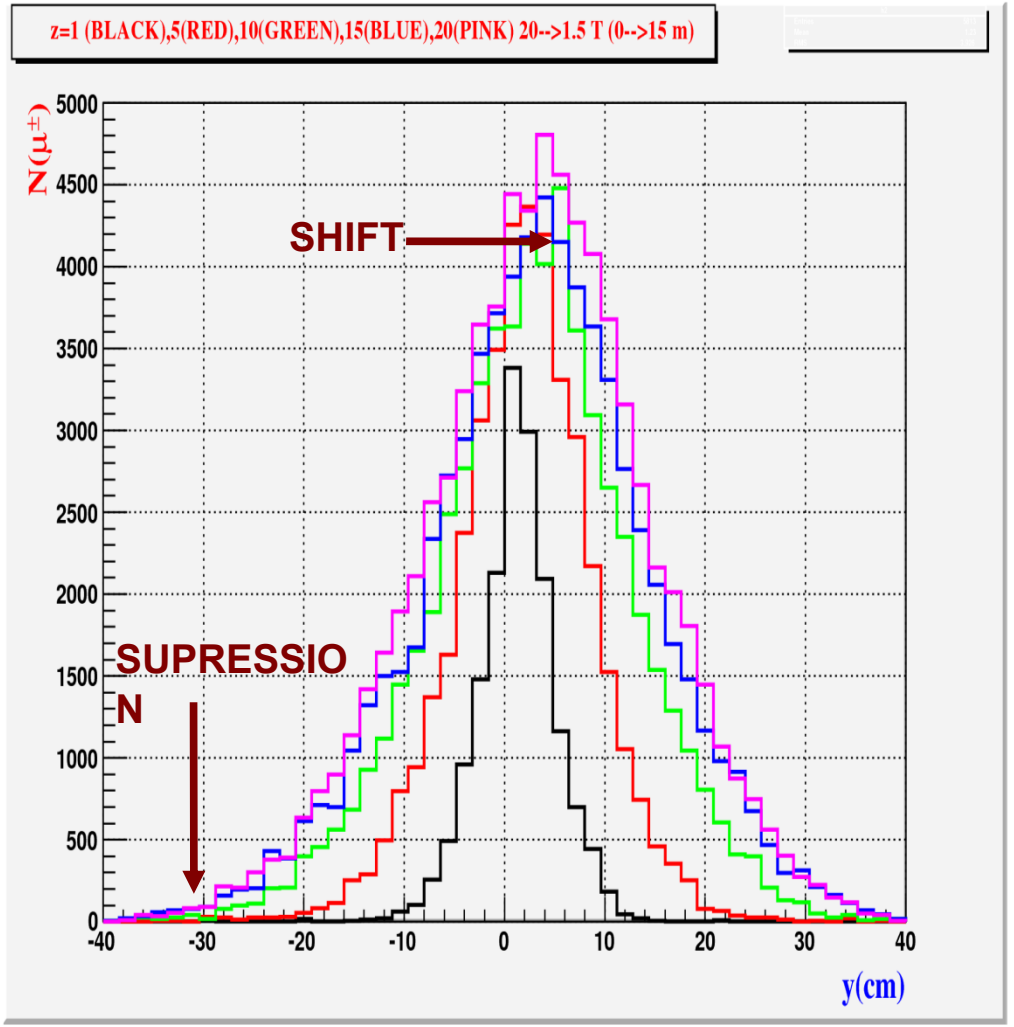


THE CENTER OF THE DISTRIBUTIONS IS IN THE NEGATIVE x DIRECTION (-1 ≲ <x> ≲ 0 cm) AND DOES NOT VARY MUCH WITH z, IT ALSO LOOKS LIKE MOST OF THE SUPRESSION IN THE DISTRIBUTIONS TAILS IS IN THE +x DIRECTION WHEN 15 --> 20 T.

**** POSSIBLE CANCELLING EFFECTS BETWEEN POSITIVE AND NEGATIVE MUONS x DISTRIBUTIONS ? ****

MUONS DISTRIBUTION HISTOGRAMS IN y, z (IN m) = 1 (BLACK), 5 (RED), 10 (GREEN), 15 (BLUE), 20 (PINK) FOR 15 T (LEFT) AND 20 T (RIGHT) MAGNETIC FIELD IN THE TARGET REGION. [40 < Ekin < 180 MeV]

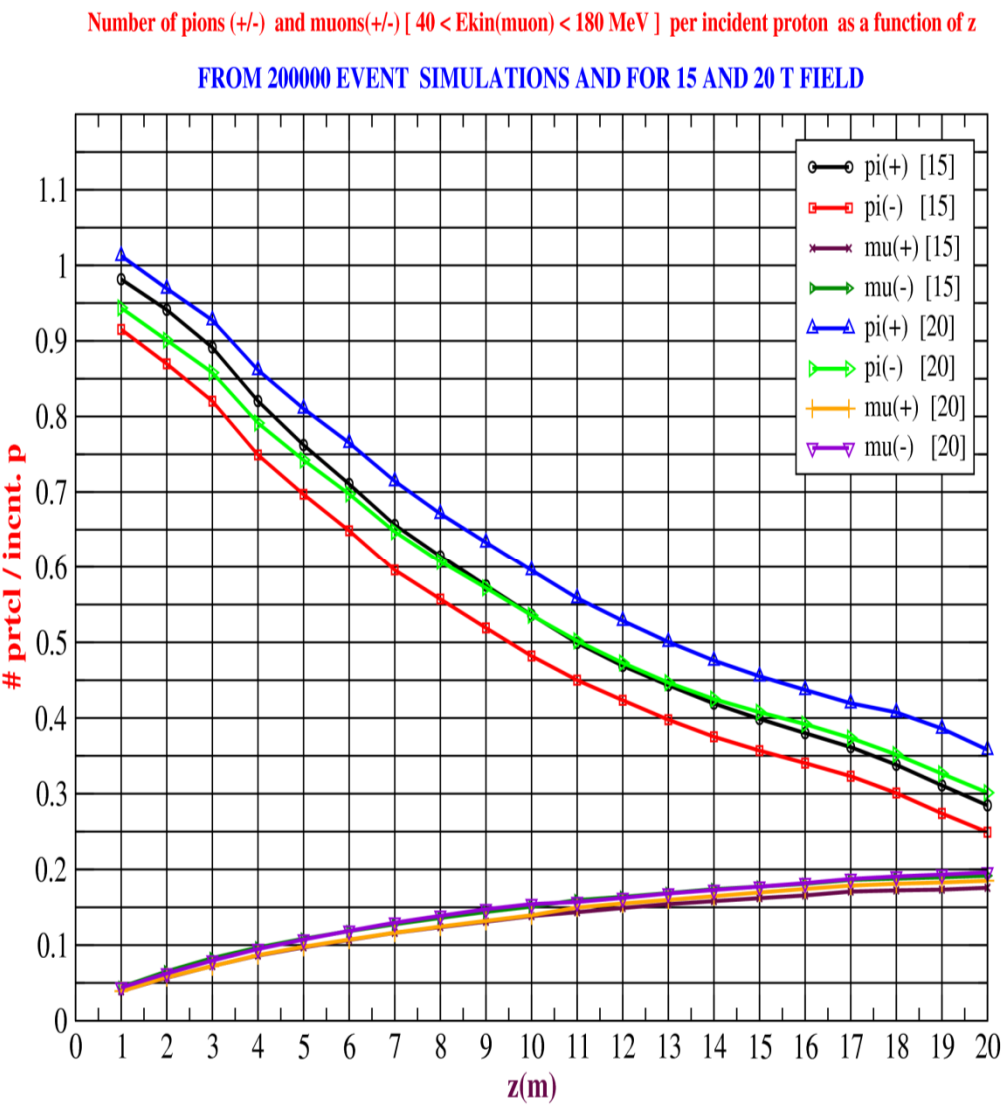


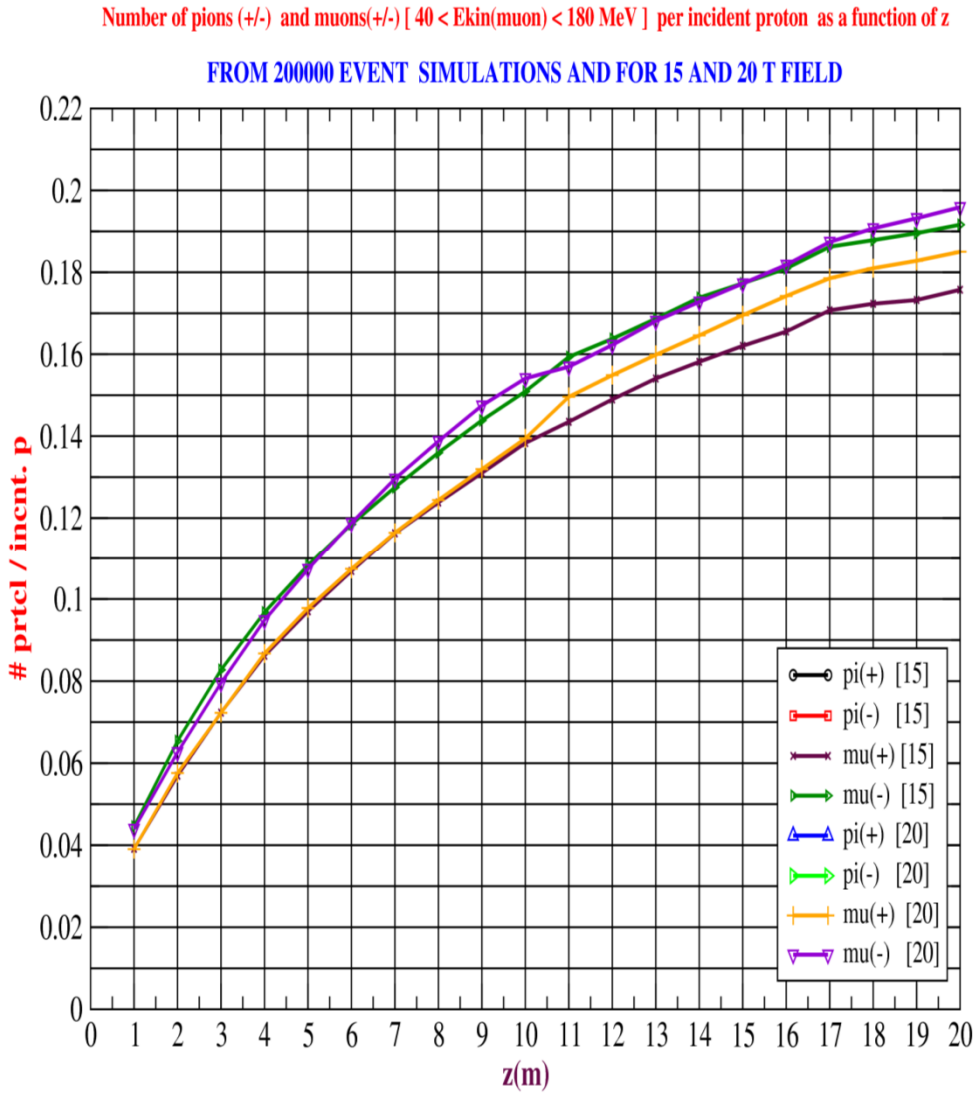


THE CENTER OF THE DISTRIBUTIONS IS IN THE POSITIVE y DIRECTION (0 ≲ <y> ≲ 1 cm INITIALLY). THERE IS A WEAK INCREASE WITH z FOR THE 15 T FIELD AND A RELATIVELY STRONGER INCREASE FOR THE 20 T. [FROM ~ 1 cm FOR 15 / 20 T TO ~ 2 cm FOR 15 T AND ~ 6 cm FOR 20 T CASE. IT ALSO LOOKS LIKE MOST OF THE SUPRESSION IN THE DISTRIBUTIONS TAILS IS IN THE - y DIRECTION WHEN 15 --> 20 T.

**** POSSIBLE CANCELLING EFFECTS BETWEEN POSITIVE AND NEGATIVE MUONS y DISTRIBUTIONS ? ****

NUMBER OF PIONS AND MUONS PER INCIDENT PROTON AS FUNCTIONS OF AXIAL DISTANCE [LEFT] AND FOR MUONS ONLY [RIGHT].





MOST SIGNIFICANT DIFFERENCE IS IN THE YIELD OF POSITIVE MUONS (FROM 15 TO 20 T) AND STARTS AT ~ 10 cm.