



MAD Instrumentation and Documentation

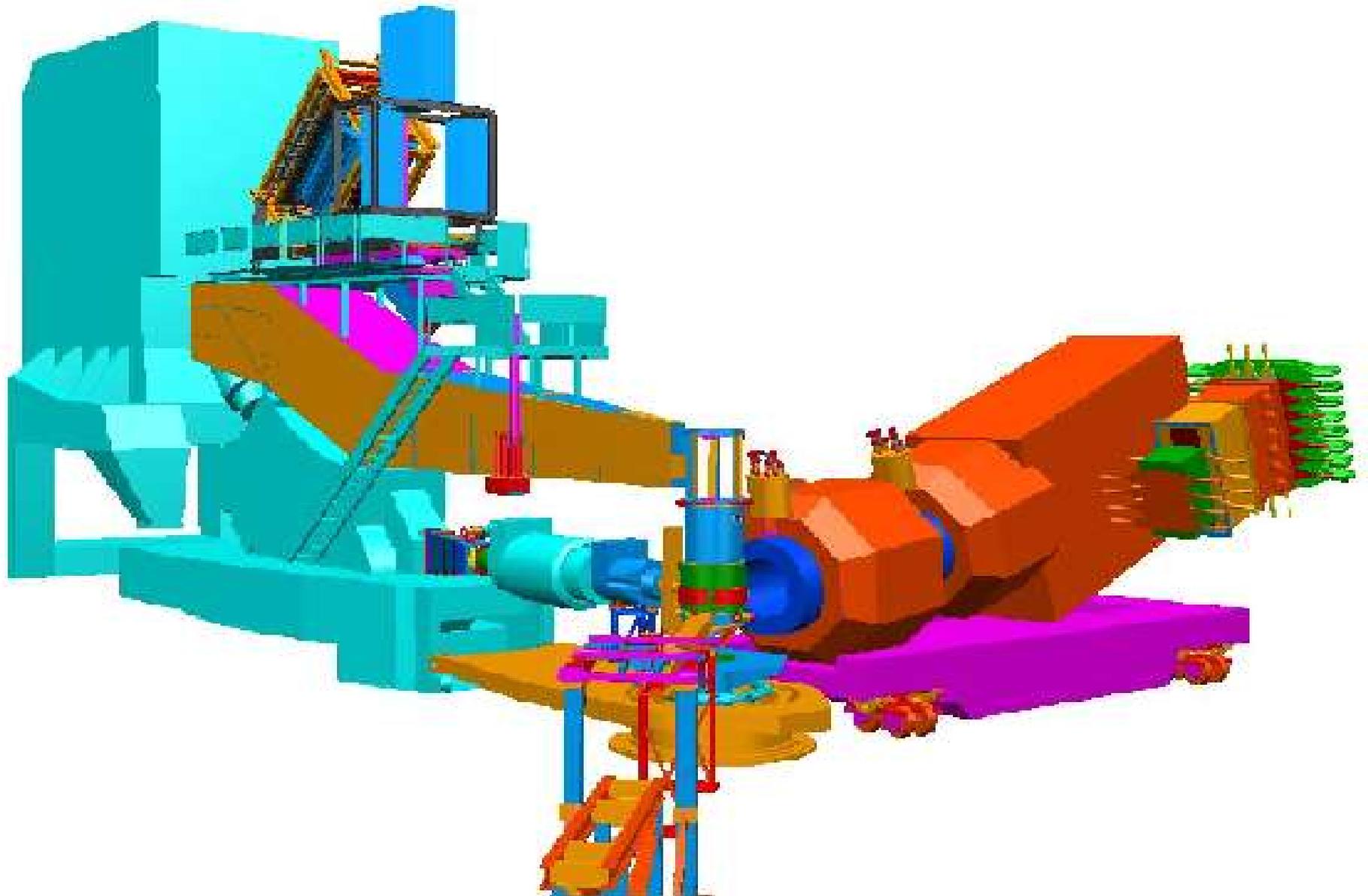
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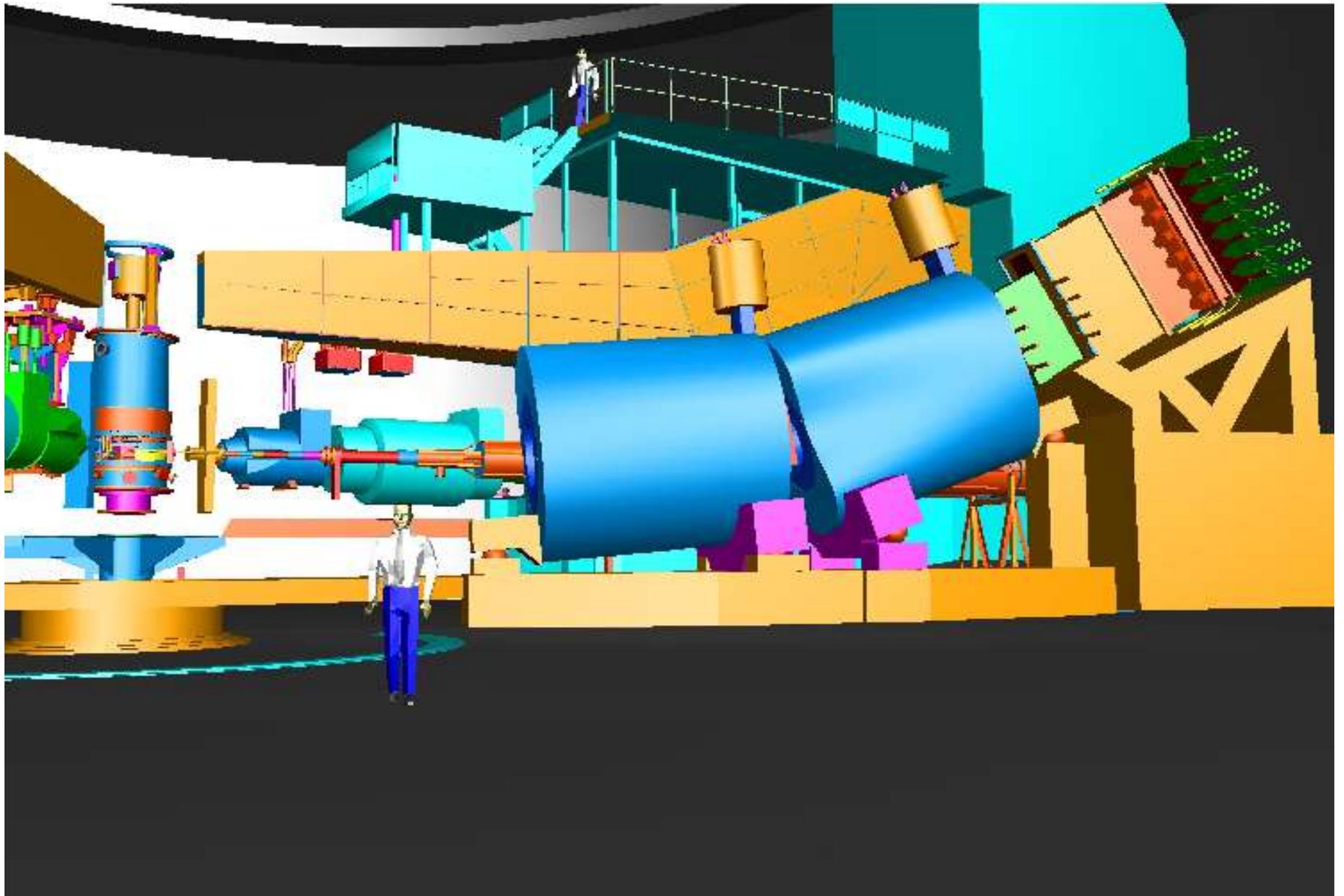
Overview of MAD

- ◆ Two Superconducting QD Magnets
- ◆ Flexible Design
- ◆ Large Acceptance
- ◆ Moderate Resolution

Old CAD MAD Drawing



New CAD Model of MAD

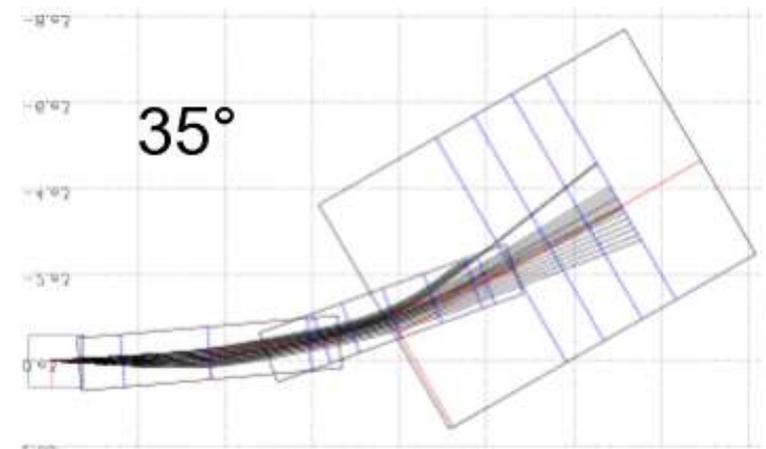
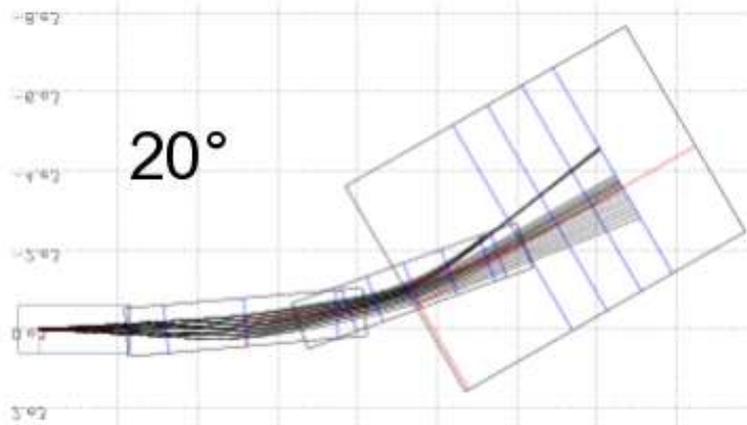
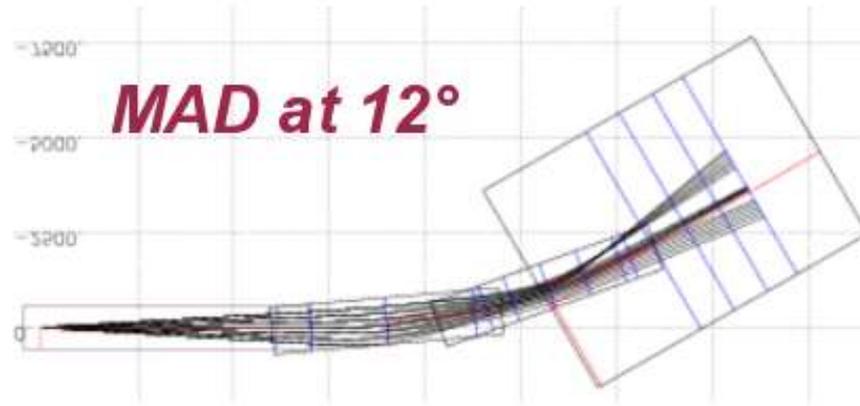


Magnet Design Parameters

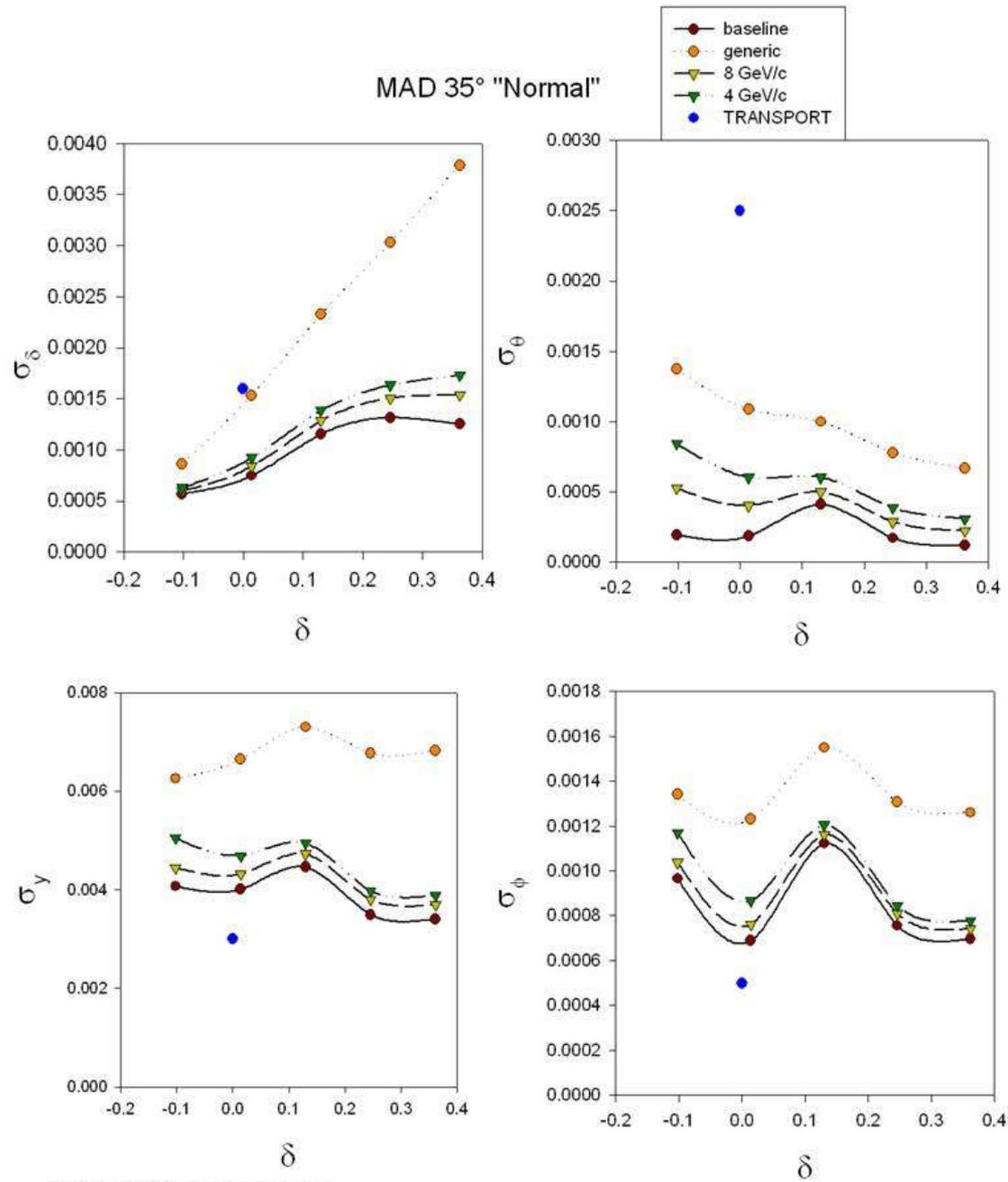
Combined Function QD120

Large aperture: 120 cm warm bore
NI dipole: 2.89×10^6 ampere turns
NI quad: 4.1×10^6 ampere turns
Current dipole: 5250 Amps
Current Quad: 5125 Amps
Dipole $\int B dl$: 10.2 Tm
Quadrupole: 9.8 (T/m)m, gradient 3.3 T/m
Central field: 3.66 T
Effective length: Dipole 2.78 m, Quad 2.96 m
Over all length: 4 m
stored energy: dipole 38.96 MJ , quad 6.22 MJ
approximate weight: Coil 56,000 lbs, Yoke 410,000 lbs.
Inductance: dipole 2.83 H, quad 0.474 H
Dump Voltage: 250 Volts (dipole)
Dump Resistor: 0.050 Ohms (dipole)

Adiabatic Hot spot: 65 Kelvin (dipole)



- ◆ See <http://www.jlab.org/~lerose/madat12deg/madat12d.htm>
- ◆ And http://hallaweb.jlab.org/news/minutes/mad/mad35b_transfer_functions.htm



MAD at 35° "normal" tune
 $-16\% < \delta < +42\%$, $-0.287 < y_0 < 0.287$ (1 m along the beamline)
 $\Delta\Omega \sim 24$ m-sr (thin target at $\delta = 0$)

35 Degrees and Greater

- ◆ 8 GeV/c Central Momentum (1.65m drift)
- ◆ 30 Degrees Bend (10+20)
- ◆ Large Solid Angle (24 msr)
- ◆ -16 to +42% Range
- ◆ 0.1% Momentum Resolution
- ◆ 0.9 mrad phi 0.4 mrad theta 0.4 cm y

20 Degrees

- ◆ 8 GeV/c Central Momentum (3.2m drift)
- ◆ 14 msr Solid Angle
- ◆ -20 to +40% Range
- ◆ 0.1% Momentum Resolution
- ◆ 0.9 mrad phi 0.3 mrad theta 0.6 cm y

12 Degrees

- ◆ 8 GeV/c Central Momentum (7m drift)
- ◆ 6 msr Solid Angle
- ◆ -21 to +42% Range
- ◆ 0.1% Momentum Resolution
- ◆ 0.7 mrad phi 0.3 mrad theta 0.7 cm y

5 Degrees

- ◆ Add Septum Magnet !!
- ◆ 8 GeV/c Central Momentum (7m drift)
- ◆ 4.6 msr Solid Angle (down to 4 Degrees)
- ◆ -21 to +42% Range (approx.)
- ◆ 0.1% Momentum Resolution
- ◆ 0.9 mrad phi 0.5 mrad theta 0.7 cm y

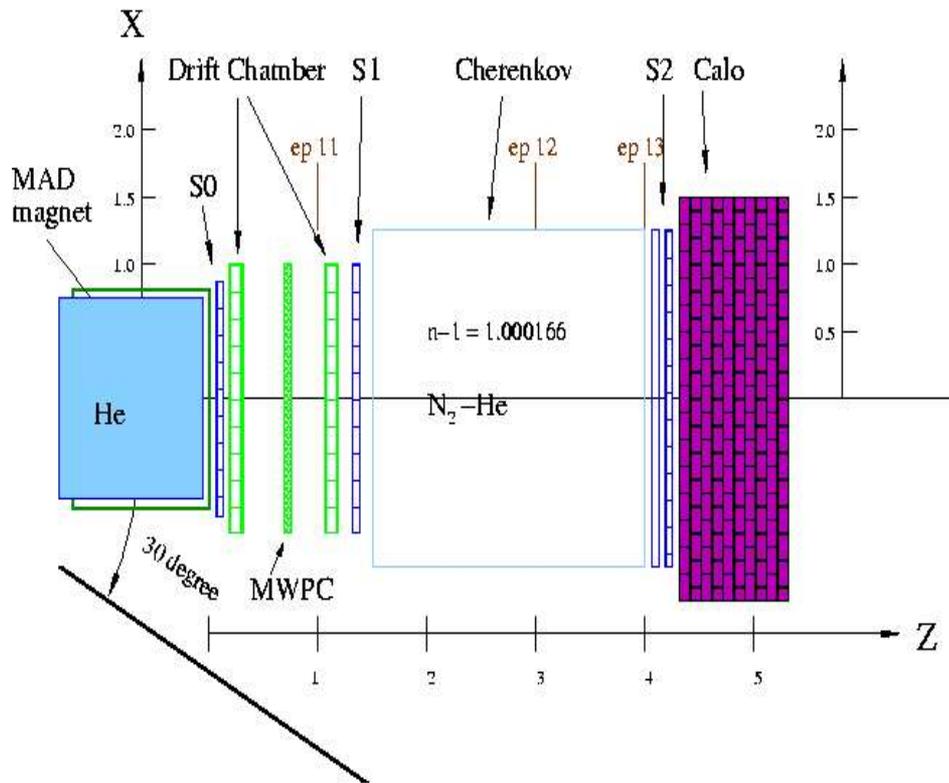
Other Options

- ◆ No Quad. Field
- ◆ Reverse Quad. Field
- ◆ Quads. Rewired to Boost Max. Dipole Field
- ◆ Or Completely Rearrange The Magnets

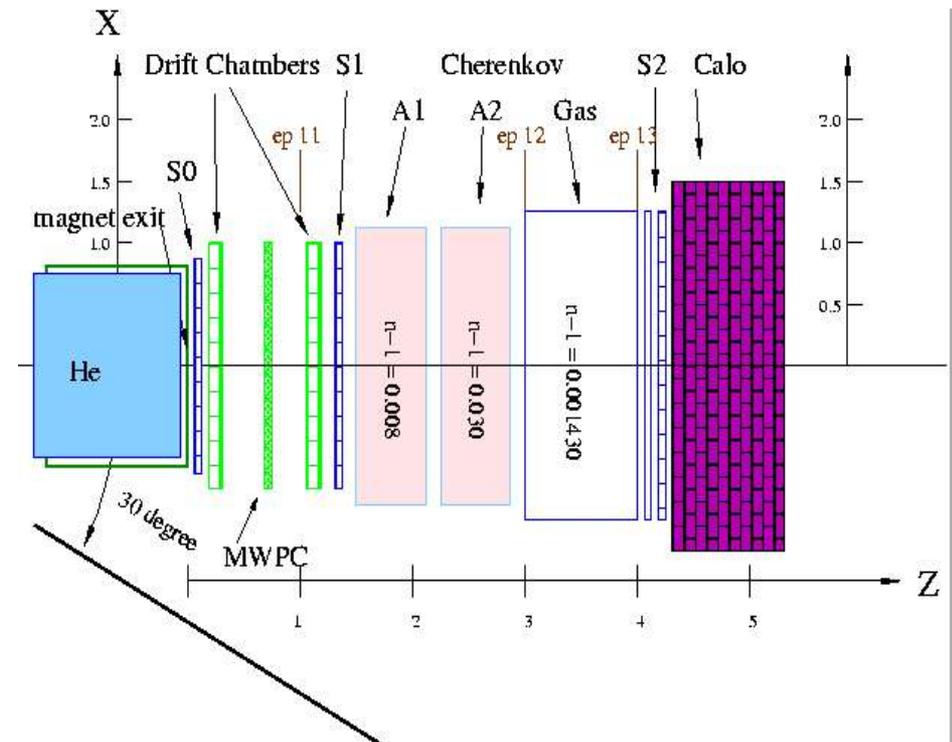
Example 12 Degrees No Quad.

- ◆ 9.5 GeV/c Central Momentum
- ◆ 6 msr reduces to 2.4 msr
- ◆ 0.09% delta resolution to 0.06%
- ◆ 0.7 mrad phi to 0.3 mrad
- ◆ 0.3 mrad theta to 0.1 mrad
- ◆ 0.7 cm y to 0.4 cm

Detector Packages



Lepton Configuration

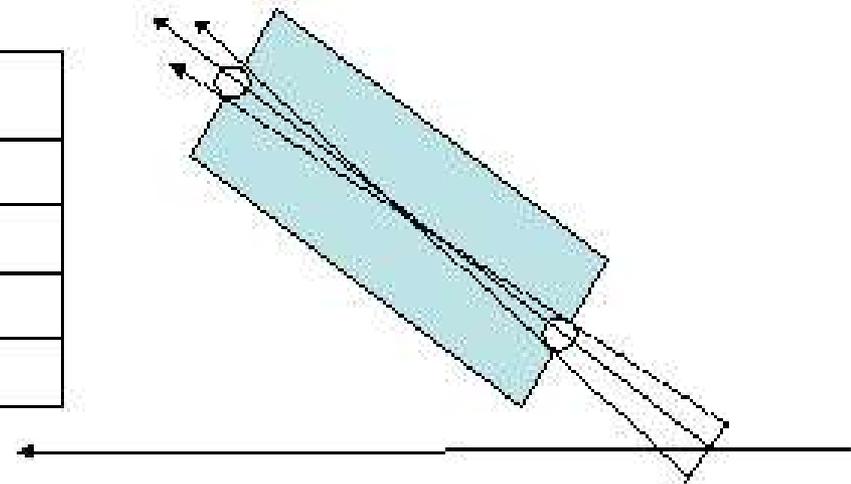


Hadron Configuration

A Focal Plane Polarimeter for MAD has also been designed.

Alignment Study Underway

D = 2.54 cm	angle error	0.00317 rad	0.18°
angle	drift	Δy	$\Delta \delta$
35°	1.65	0.018 m	±1.5%
20°	3.2	0.023 m	±1.8%
12°	7	0.035 m	1.3%



D = 0.1 cm	angle error	0.000125 rad	0.007°
angle	drift	Δy	$\Delta \delta$
35°	1.65	0.0007 m	±0.1%
20°	3.2	0.0009 m	±0.1%
12°	7	0.0014 m	0.1%

Assumes you know exactly where the beam and target are!

You don't!

MAD compared to SHMS

- ◆ Pointing (Alignment)
- ◆ Background
- ◆ Flexibility
- ◆ Acceptance
- ◆ Septum Magnet

Upgrade Documents

- ◆ Hall A pCDR is being updated
- ◆ Please send me final updates
- ◆ Copies of the JLab pCDR available
- ◆ JLab pCDR also being updated
- ◆ CDR will be a 40 page document