

# Magnetic field measurement of new "QM7R" (TOKIN 3581)

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# Motivation for measuring TOKIN3581

Aperture issue of current QM7R (TOKIN3393)

Beam extraction at  $x=22.5$  mm nominally while its bore radius is 16 mm. B (field gradient and other multipole) components change drastically around the extraction position, which is not nice for delivering a stable beam.

Replacement of this magnet with a magnet with larger bore is recommended (needed) if we can find one.

Do we have one?

TOKIN3581 is available

Larger bore ( $r=21$  mm) but the size is similar

Can provide strong enough field with a 200A power supply

Field quality??  $\Rightarrow$  Measurement needed.

# Measurements

Tokin 3581 magnet

$r=21$  mm

Length = 60 mm

expected operating current = 146 A

(1) Harmonic coil measurement

$B'L$  (integrated field gradient) at various currents  
to obtain an excitation curve ( $B'L$  [T] vs  $I$  [A]).

(2) Mapping with Lakeshore Model 460 3-channel Gaussmeter

every 1-2 mm in  $X$  (median plane, where  $y=0$ )

$-42\text{mm} < x < 42$  mm

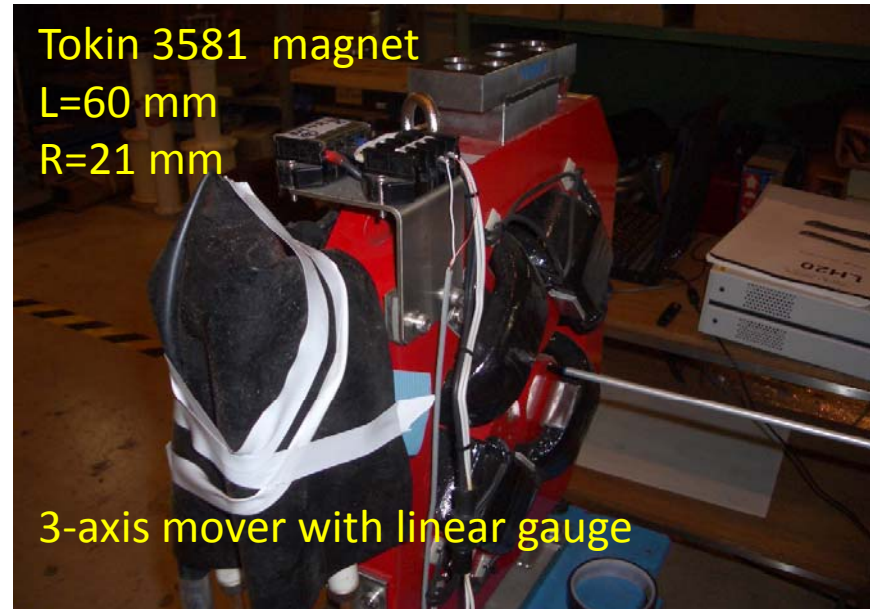
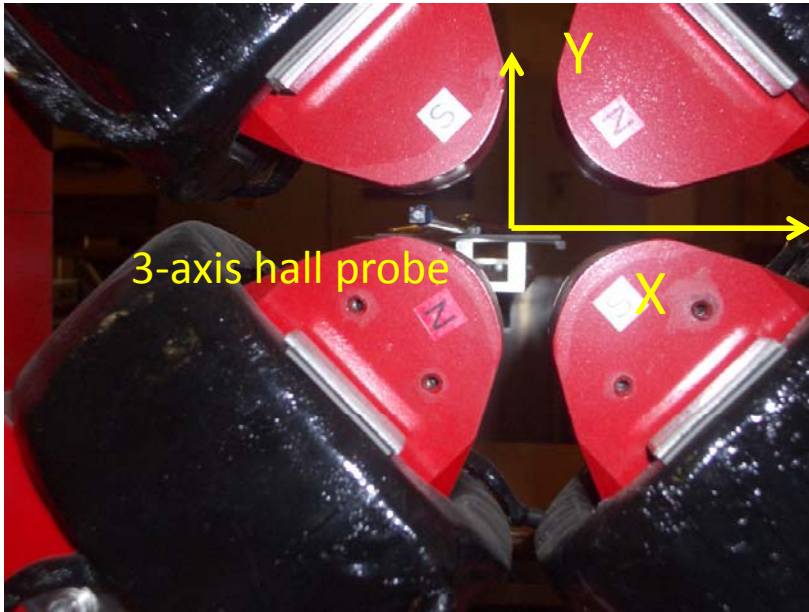
every 5-10 mm in  $Z$  (beam-direction)

some data along  $z$  for  $y = +/- 2$  mm at  $x=20$  mm, 22.5 mm and 25 mm

To obtain the effective length,  $L_{\text{eff}}$  [m] and to obtain 2-dim (3-dim) data for Philip & his team to evaluate multiples etc. at  $x \sim 22.5$  mm

**Note: Standardization pattern  $0A \Rightarrow 195A \Rightarrow 0 \Rightarrow 195A \Rightarrow 0 \Rightarrow 195A \Rightarrow 0A \Rightarrow$  target current (146A for example)**

# Measurement Systems



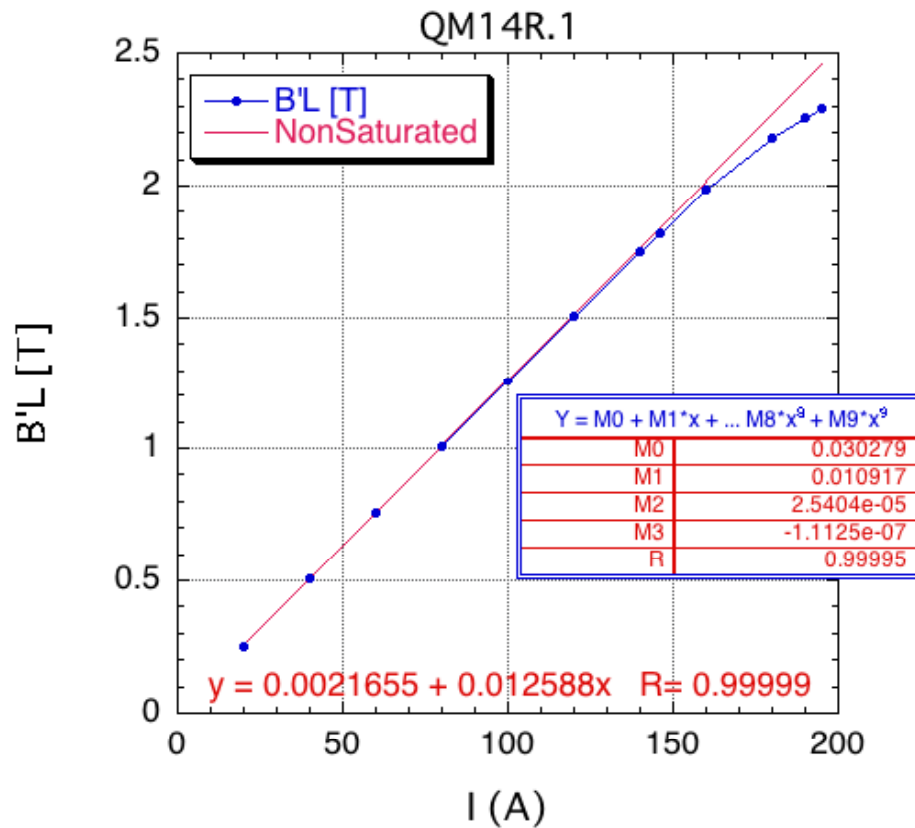
Three-Axis Probes



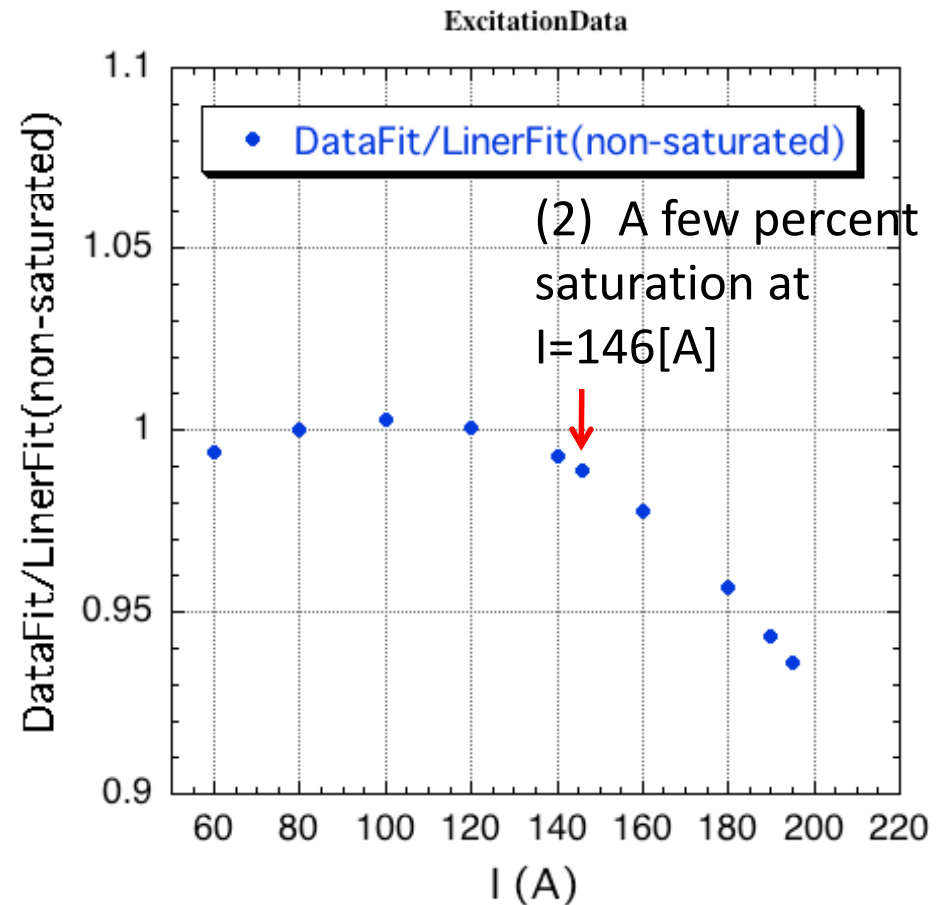
Two systems (3-axis hall probe on 3-axis mover & Harmonic coil ) were used to evaluate Tokin 3581 magnet.

Harmonic coil system, currently being used to measure Iwashita-san's permQ.

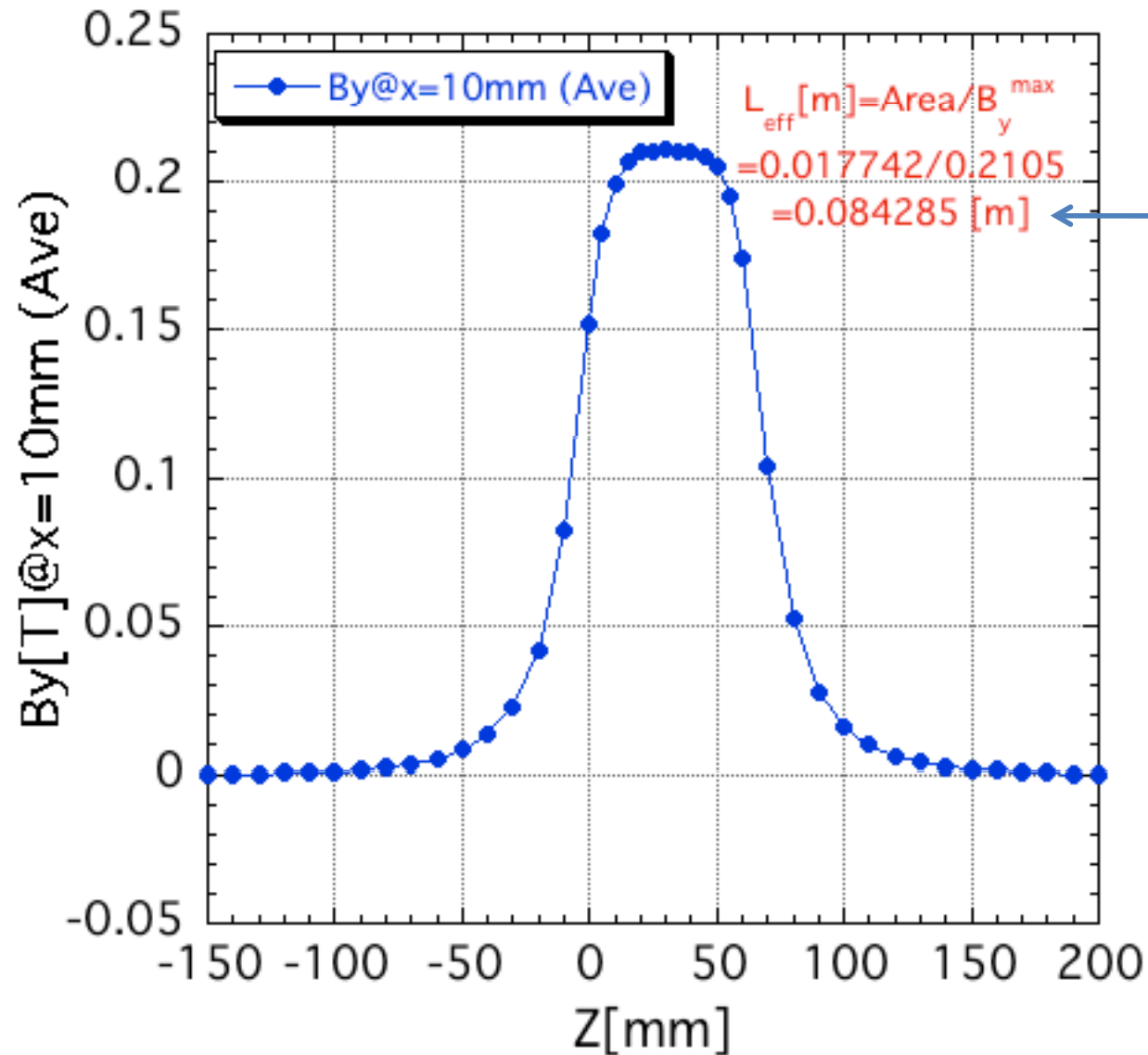
# Harmonic coil measurement



(1)  $B'L = 1.8194$  [T] at  $I = 146$  [A]



# Mapping results (effective length)



I found the data taken by Tokin?  
 $L_{\text{eff}} = 0.08433 [\text{m}]$   
Good agreement  
Though no notation about which current their data were taken.

$L_{\text{eff}}$  is a function of current (saturation).

Mapping results, evaluation  
at  $x$ =off center

Philip's talk

# Comparison between TOKIN 3581(QM14R)&TOKIN 3393(QM7R)

Parameter	TOKIN 3581(QM14R) “new” QM7R	TOKIN 3393(QM7R) Currently in the beamline
Bore diameter [mm]	42	32
Core Length [mm]	60	60
Magnet length [mm]	120	120
Magnet width [mm]	540	540
# of turns/pole	26	17
(Max) Current[A]	245(design) (195 max for ATF2)	139
Voltage [V]	9.6/magnet	3.4/magnet
Effective length [mm]	84.3	78.9
B'L [T]	1.8194 @ 146A ⇒satisfies the requirement	Not measured

“New” one will fit in the space.