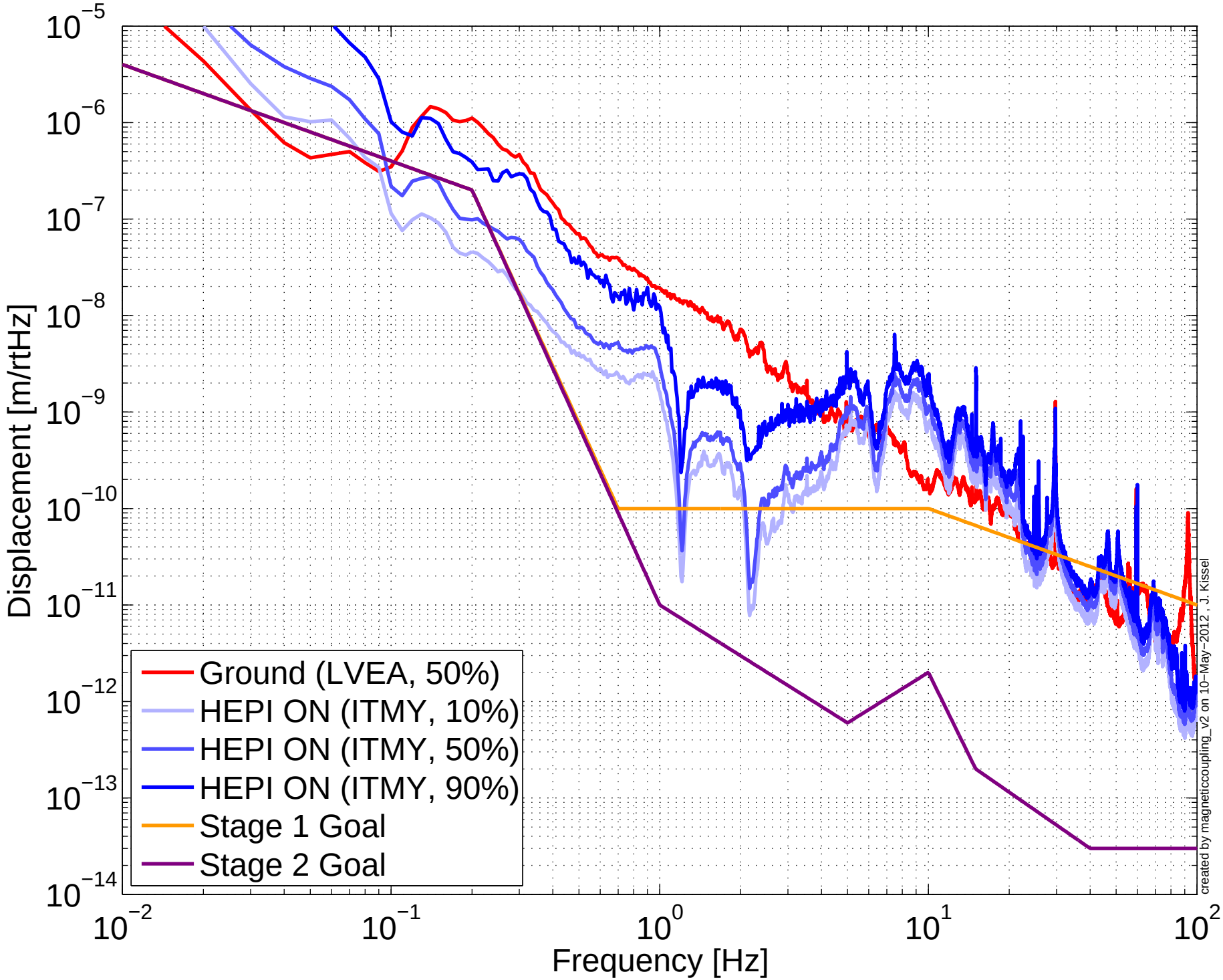
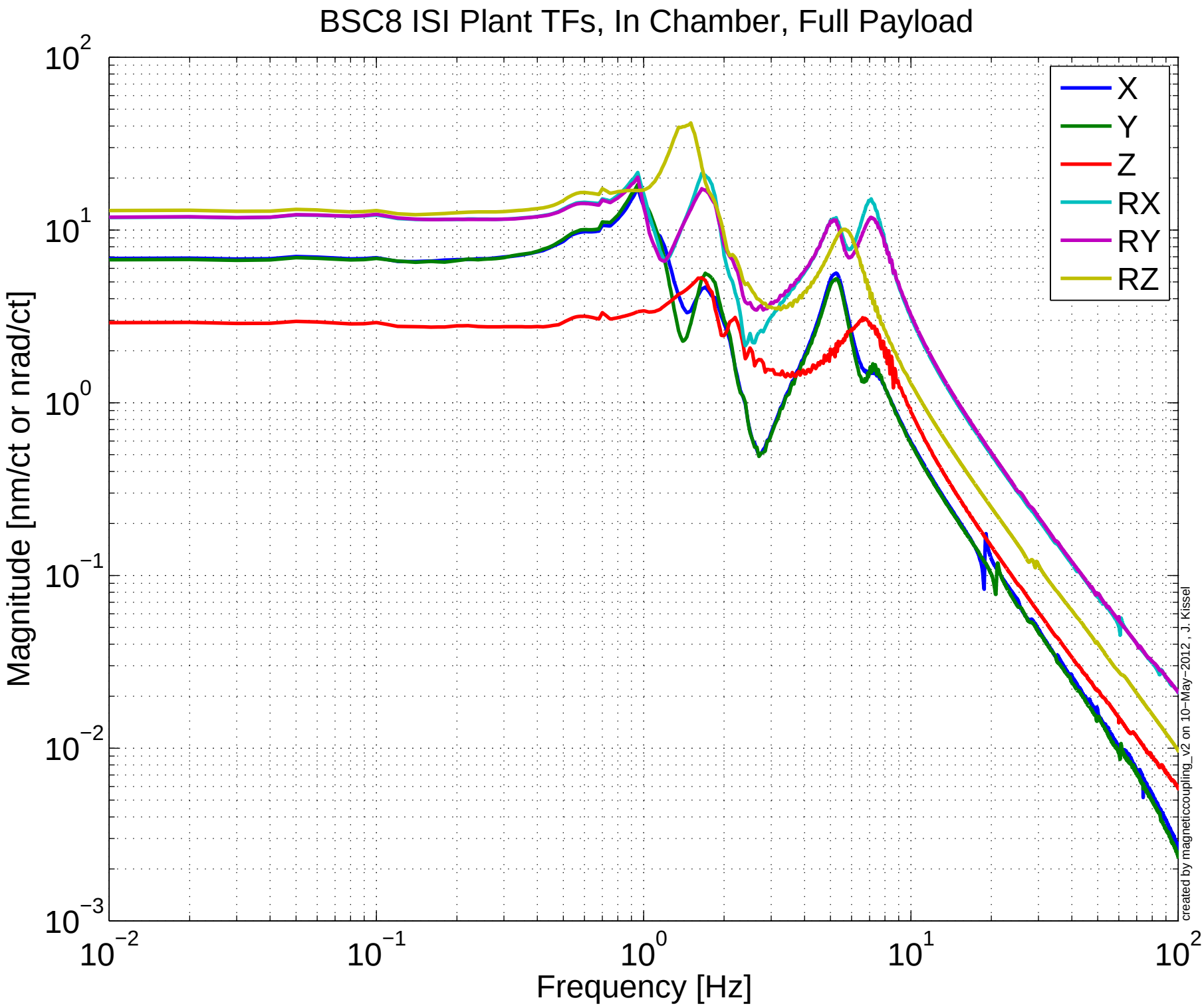
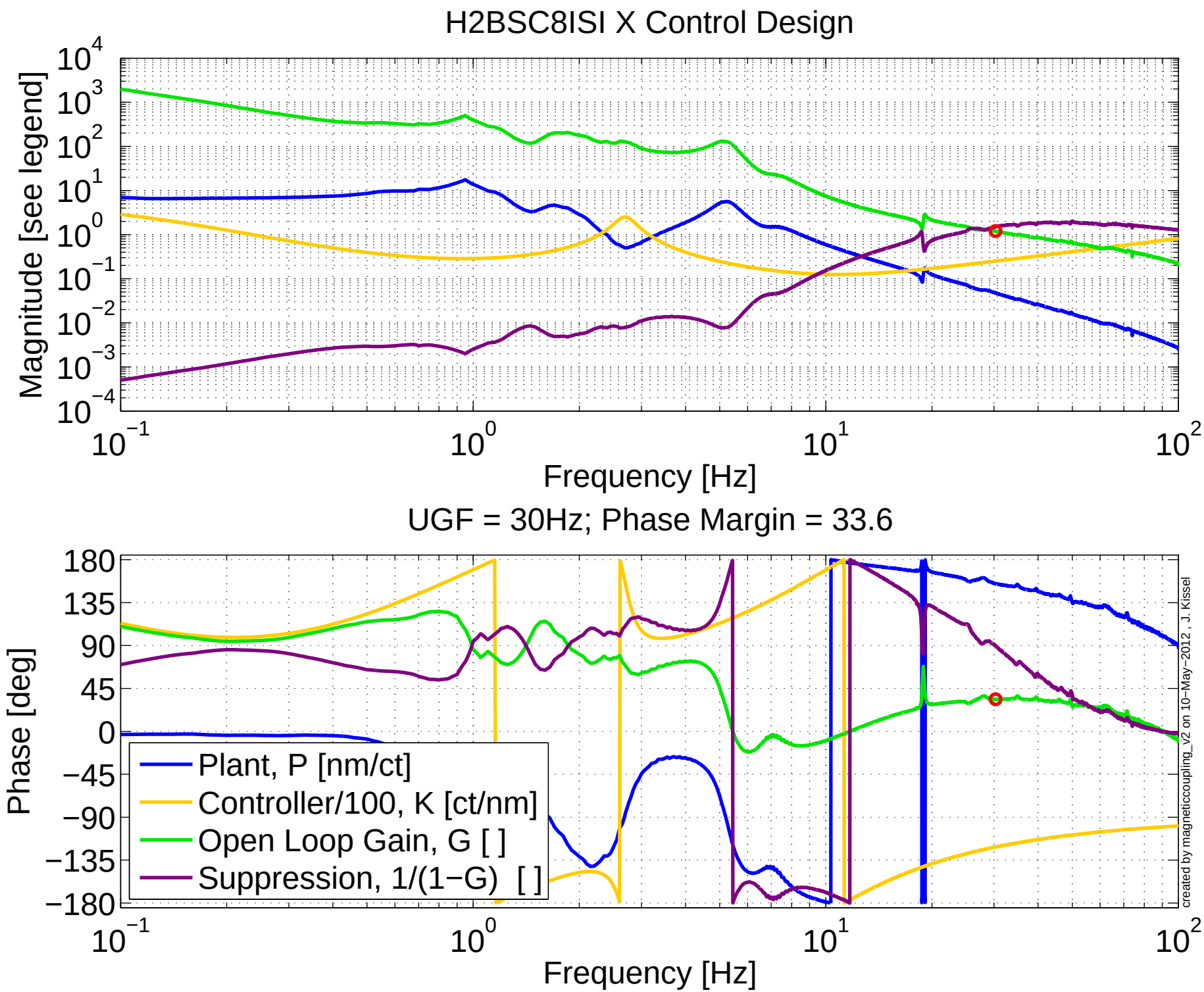
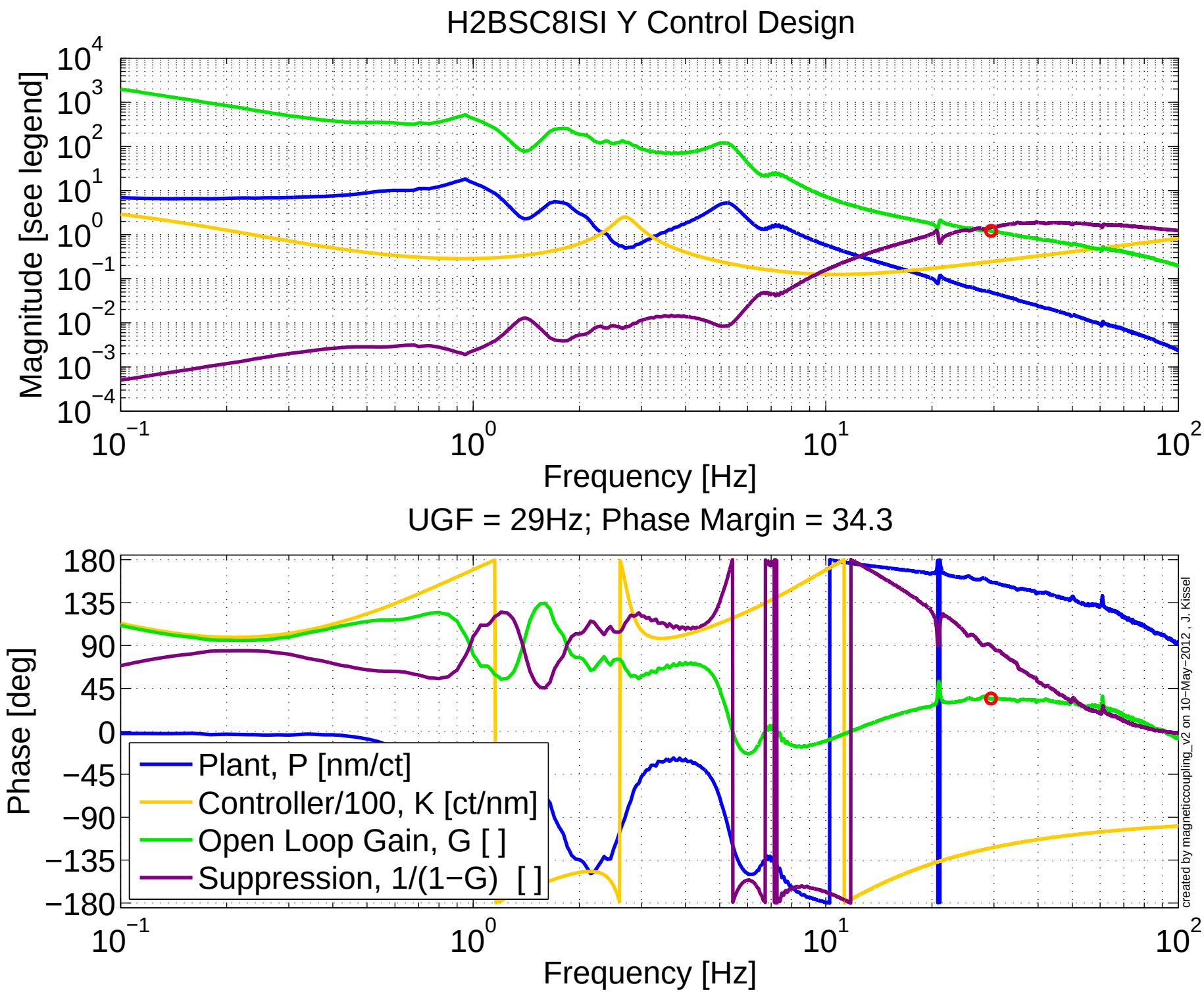
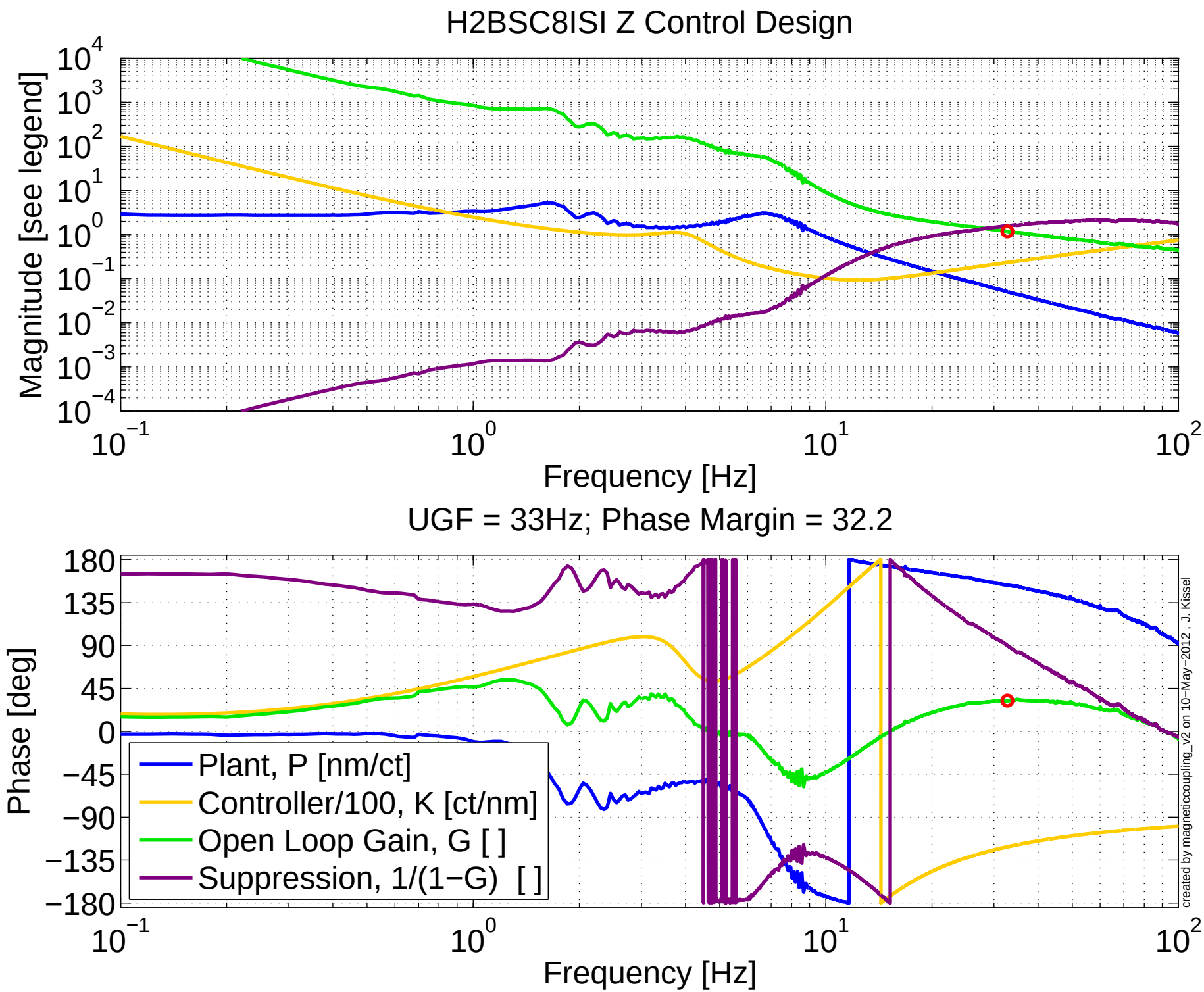
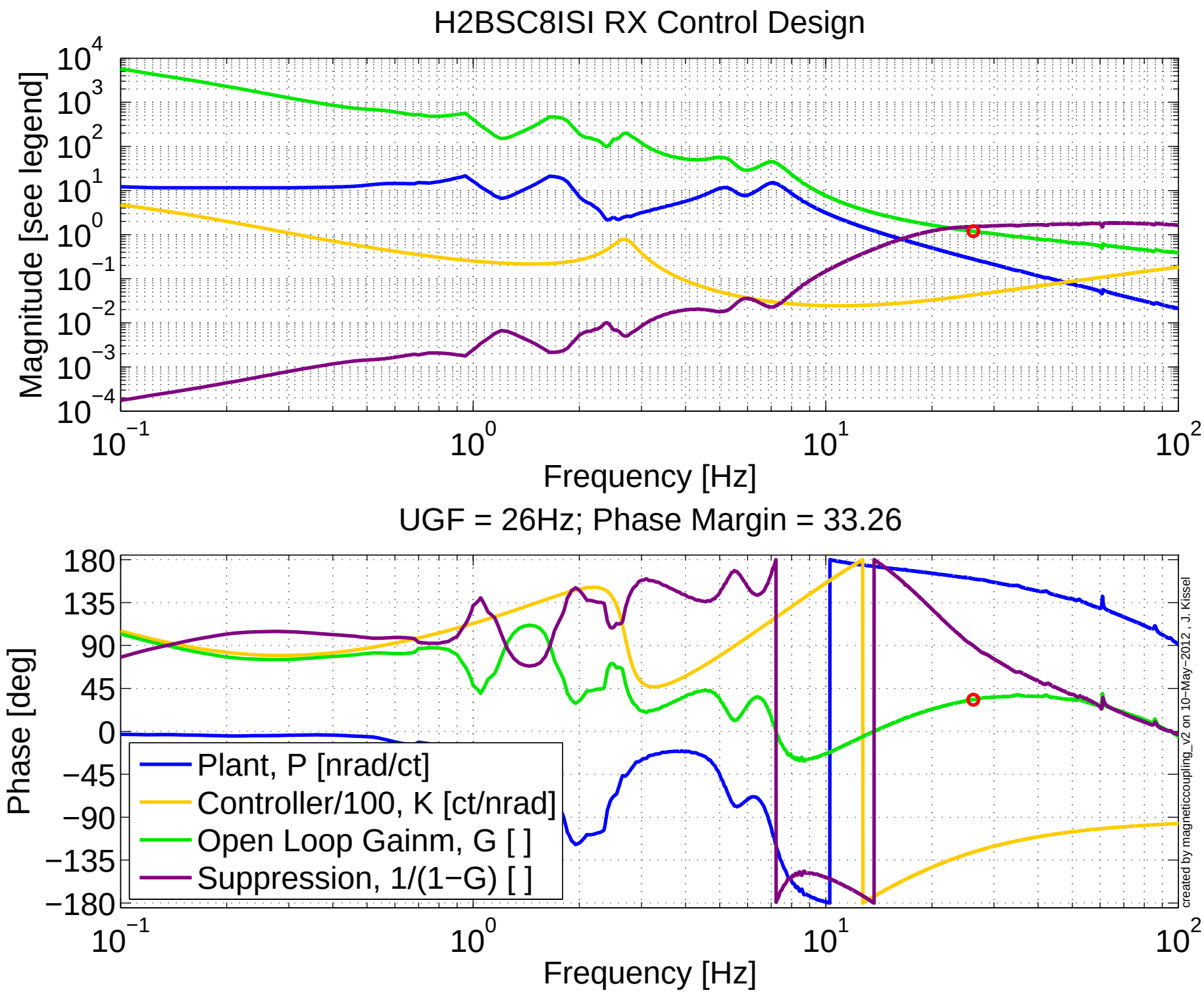

Displacement [m/rtHz]
Frequency [Hz]
Ground (LVEA, 50%)
HEPI ON (ITMY, 10%)
HEPI ON (ITMY, 50%)
HEPI ON (ITMY, 90%)
Stage 1 Goal
Stage 2 Goal
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

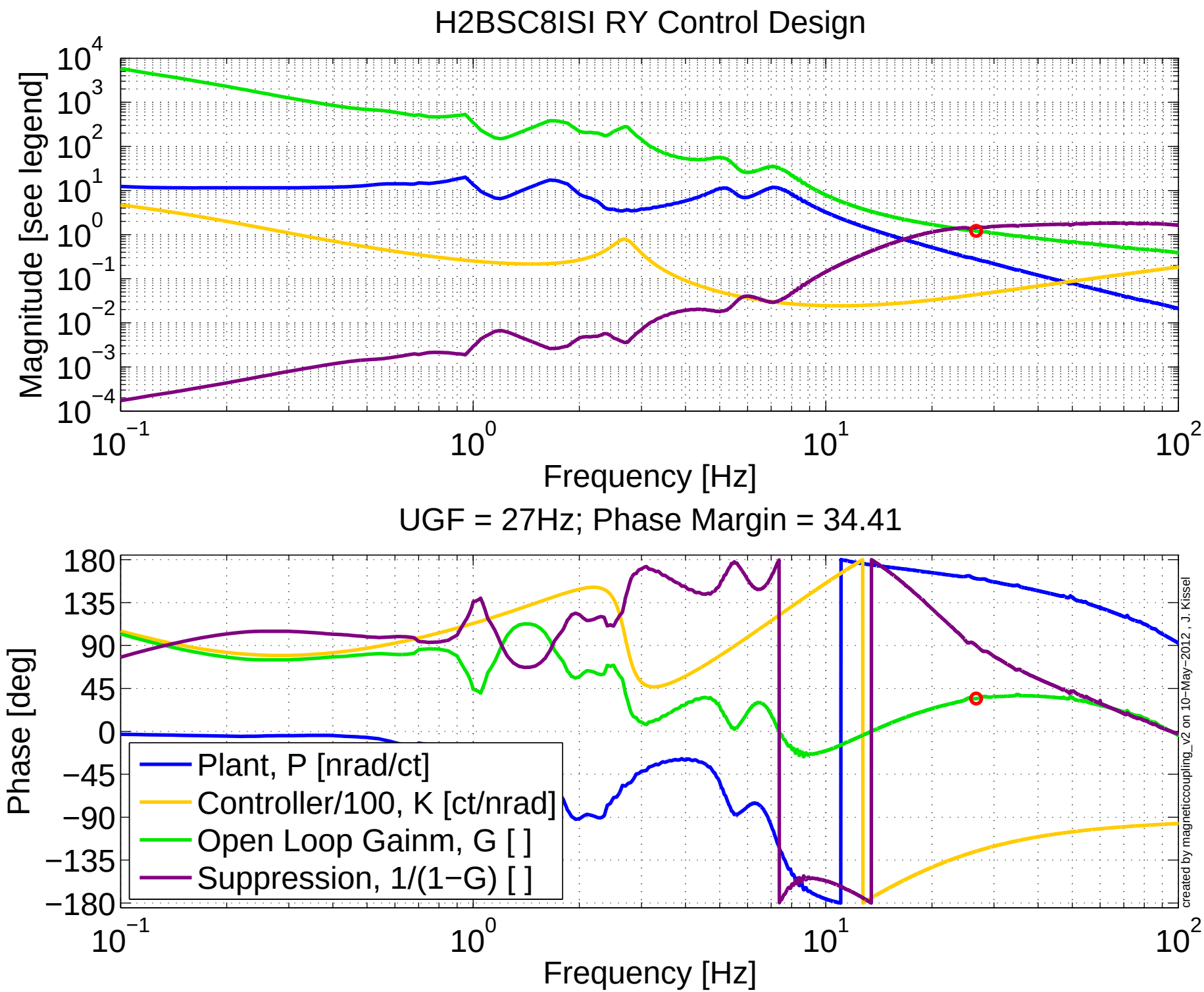

BSC8 ISI Plant TFs, In Chamber, Full Payload
Magnitude [nm/ct or nrad/ct]
Frequency [Hz]
X
Y
Z
RX
RY
RZ
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

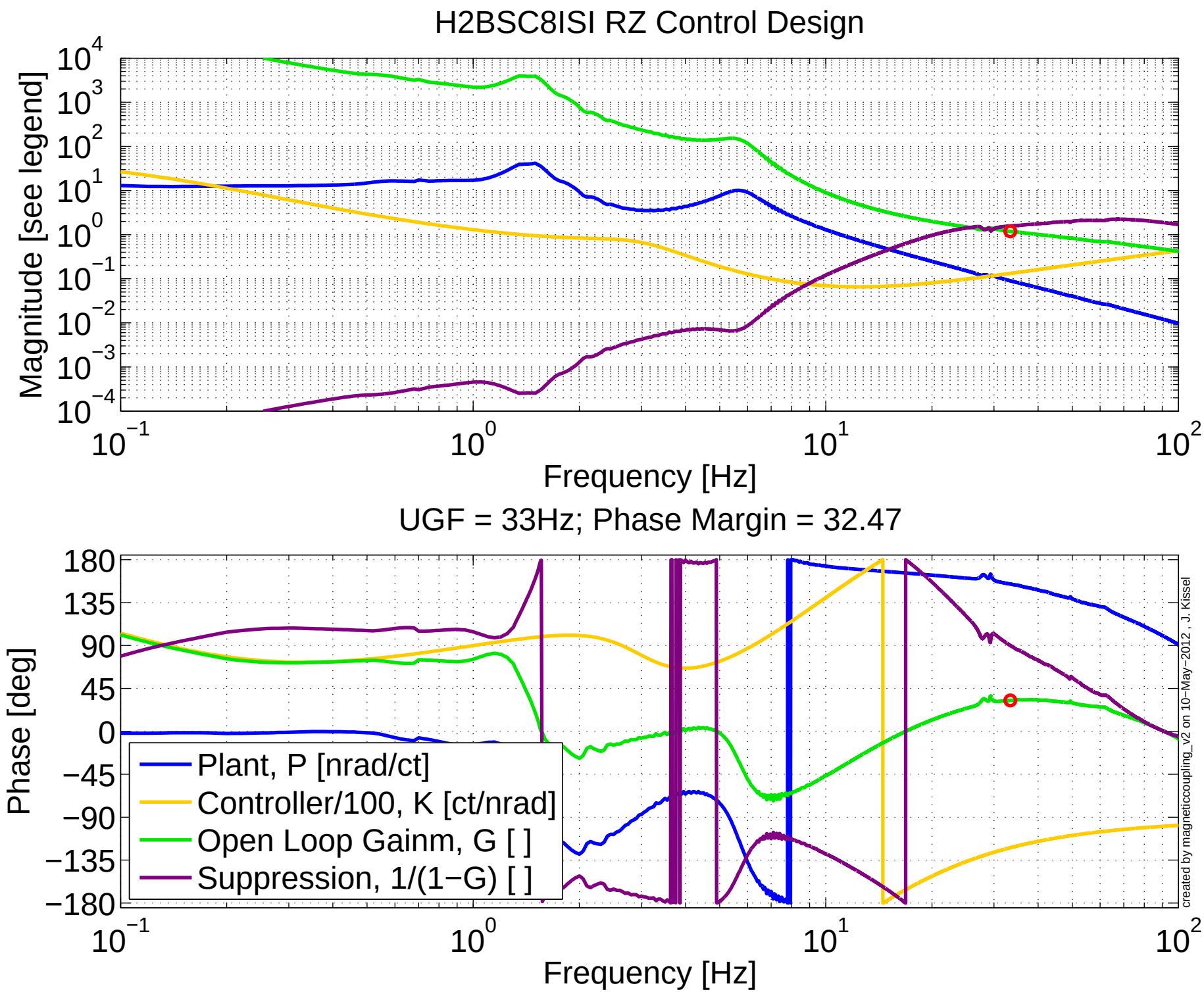

H2BSC8ISI X Control Design
Magnitude [see legend]
Frequency [Hz]
UGF = 30Hz; Phase Margin = 33.6
Phase [deg]
Frequency [Hz]
Plant, P [nm/ct]
Controller/100, K [ct/nm]
Open Loop Gain, G [ ]
Suppression, 1/(1−G) [ ]
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

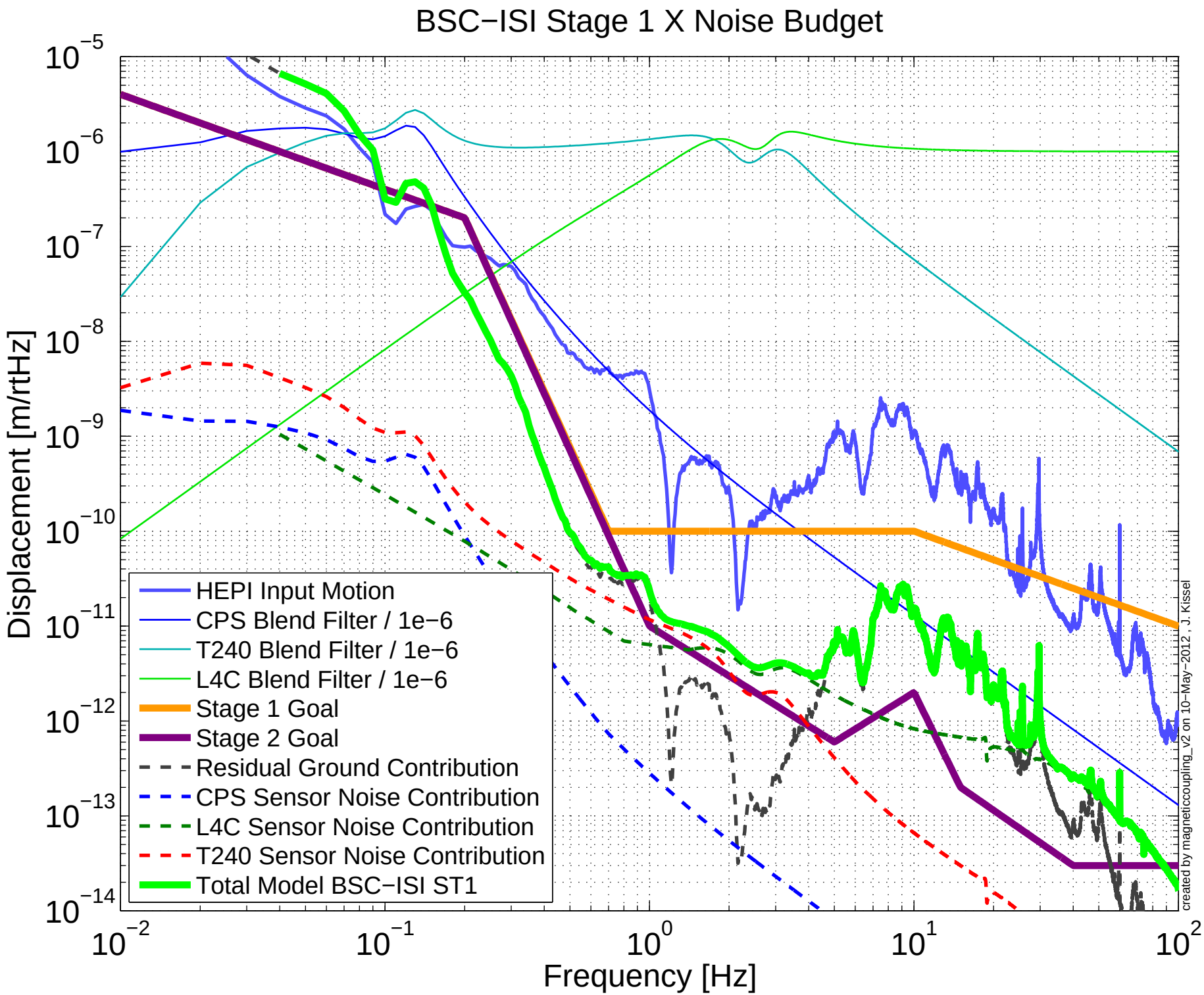

H2BSC8ISI Y Control Design
Magnitude [see legend]
Frequency [Hz]
UGF = 29Hz; Phase Margin = 34.3
Phase [deg]
Frequency [Hz]
Plant, P [nm/ct]
Controller/100, K [ct/nm]
Open Loop Gain, G [ ]
Suppression, 1/(1−G) [ ]
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

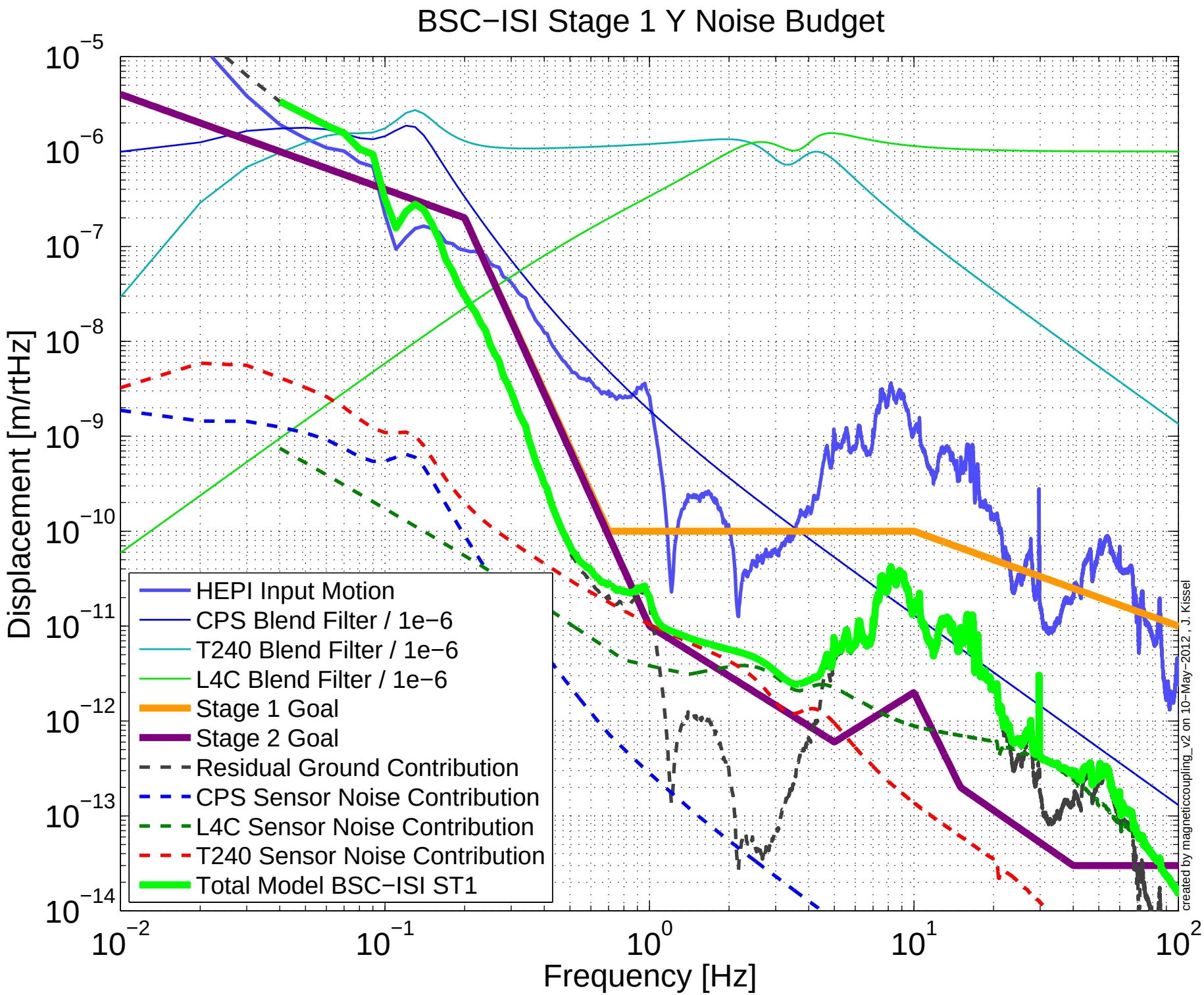

H2BSC8ISI Z Control Design
Magnitude [see legend]
Frequency [Hz]
UGF = 33Hz; Phase Margin = 32.2
Phase [deg]
Frequency [Hz]
Plant, P [nm/ct]
Controller/100, K [ct/nm]
Open Loop Gain, G [ ]
Suppression, 1/(1−G) [ ]
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

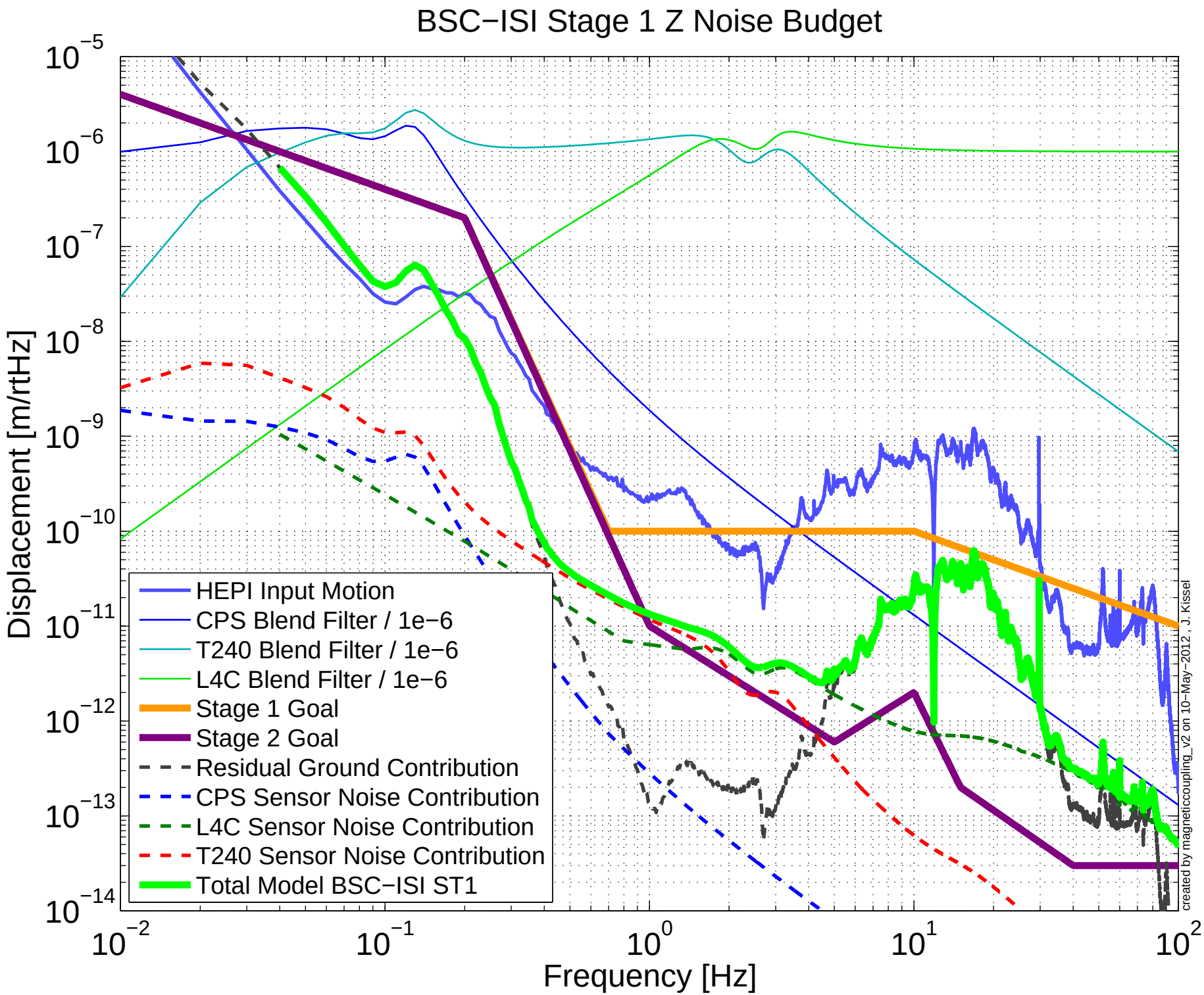

H2BSC8ISI RX Control Design
Magnitude [see legend]
Frequency [Hz]
UGF = 26Hz; Phase Margin = 33.26
Phase [deg]
Frequency [Hz]
Plant, P [nrad/ct]
Controller/100, K [ct/nrad]
Open Loop Gainm, G [ ]
Suppression, 1/(1−G) [ ]
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

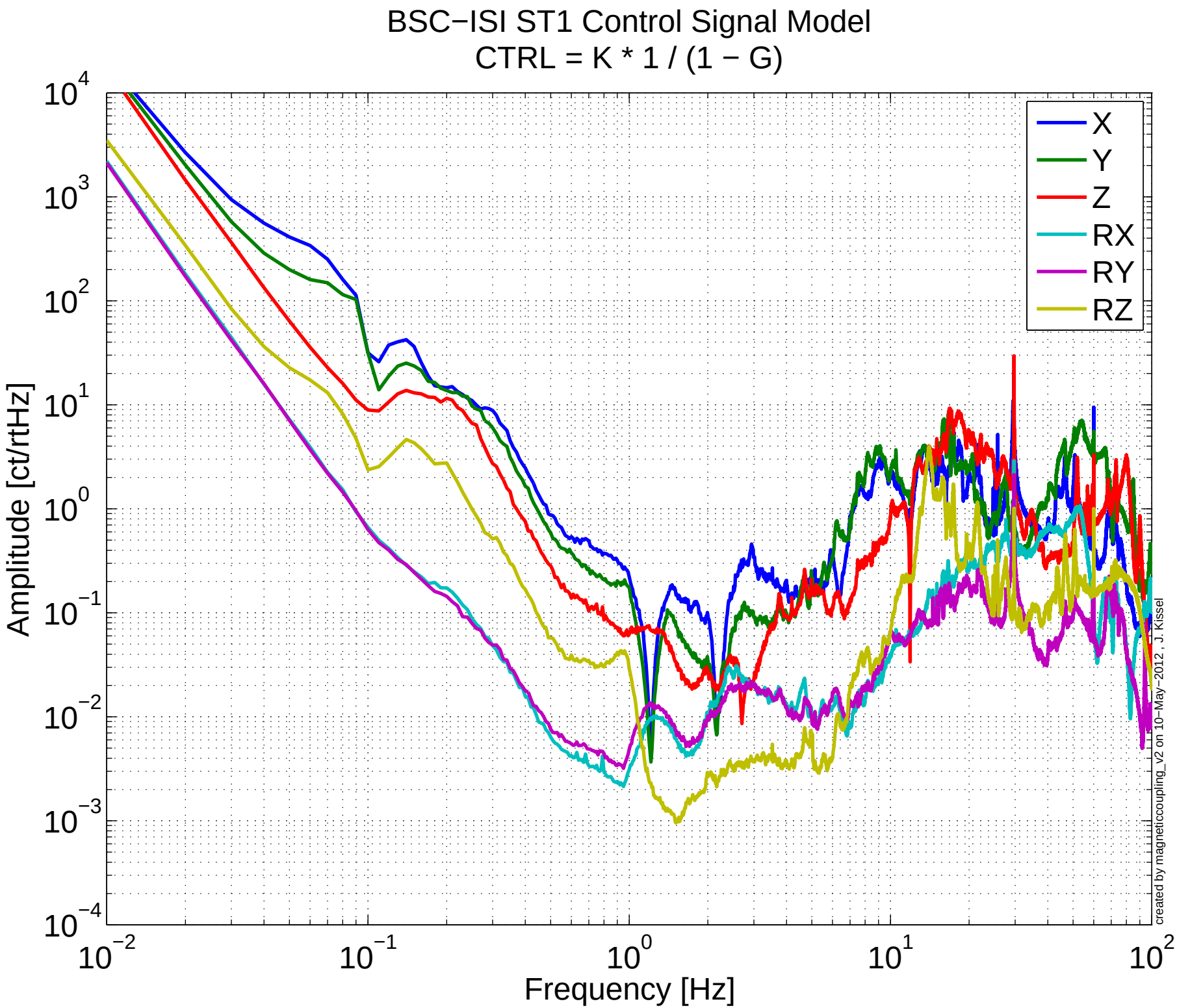

H2BSC8ISI RY Control Design
Magnitude [see legend]
Frequency [Hz]
UGF = 27Hz; Phase Margin = 34.41
Phase [deg]
Frequency [Hz]
Plant, P [nrad/ct]
Controller/100, K [ct/nrad]
Open Loop Gainm, G [ ]
Suppression, 1/(1−G) [ ]
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

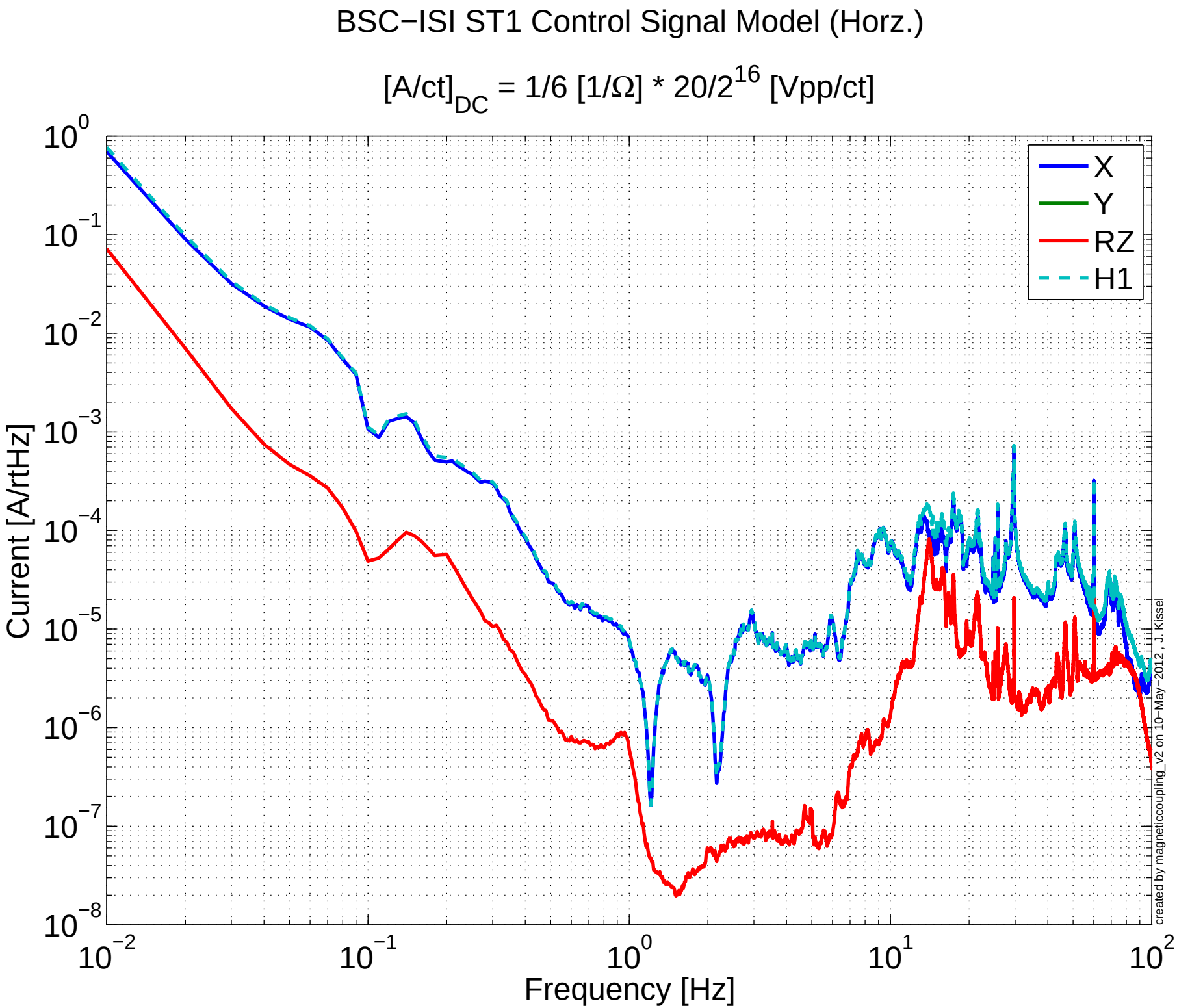

H2BSC8ISI RZ Control Design
Magnitude [see legend]
Frequency [Hz]
UGF = 33Hz; Phase Margin = 32.47
Phase [deg]
Frequency [Hz]
Plant, P [nrad/ct]
Controller/100, K [ct/nrad]
Open Loop Gainm, G [ ]
Suppression, 1/(1−G) [ ]
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

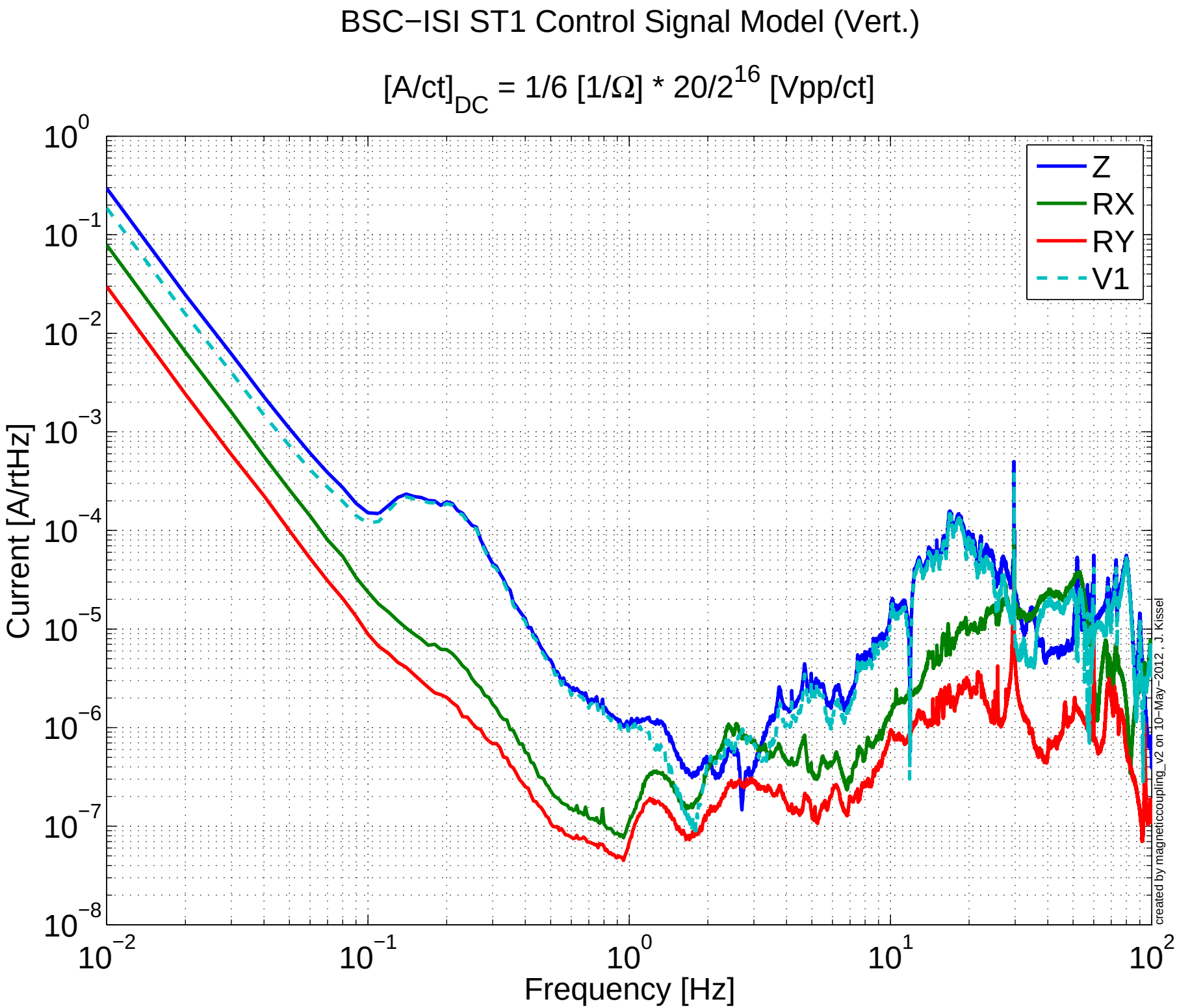

BSC−ISI Stage 1 X Noise Budget
Displacement [m/rtHz]
Frequency [Hz]
HEPI Input Motion
CPS Blend Filter / 1e−6
T240 Blend Filter / 1e−6
L4C Blend Filter / 1e−6
Stage 1 Goal
Stage 2 Goal
Residual Ground Contribution
CPS Sensor Noise Contribution
L4C Sensor Noise Contribution
T240 Sensor Noise Contribution
Total Model BSC−ISI ST1
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

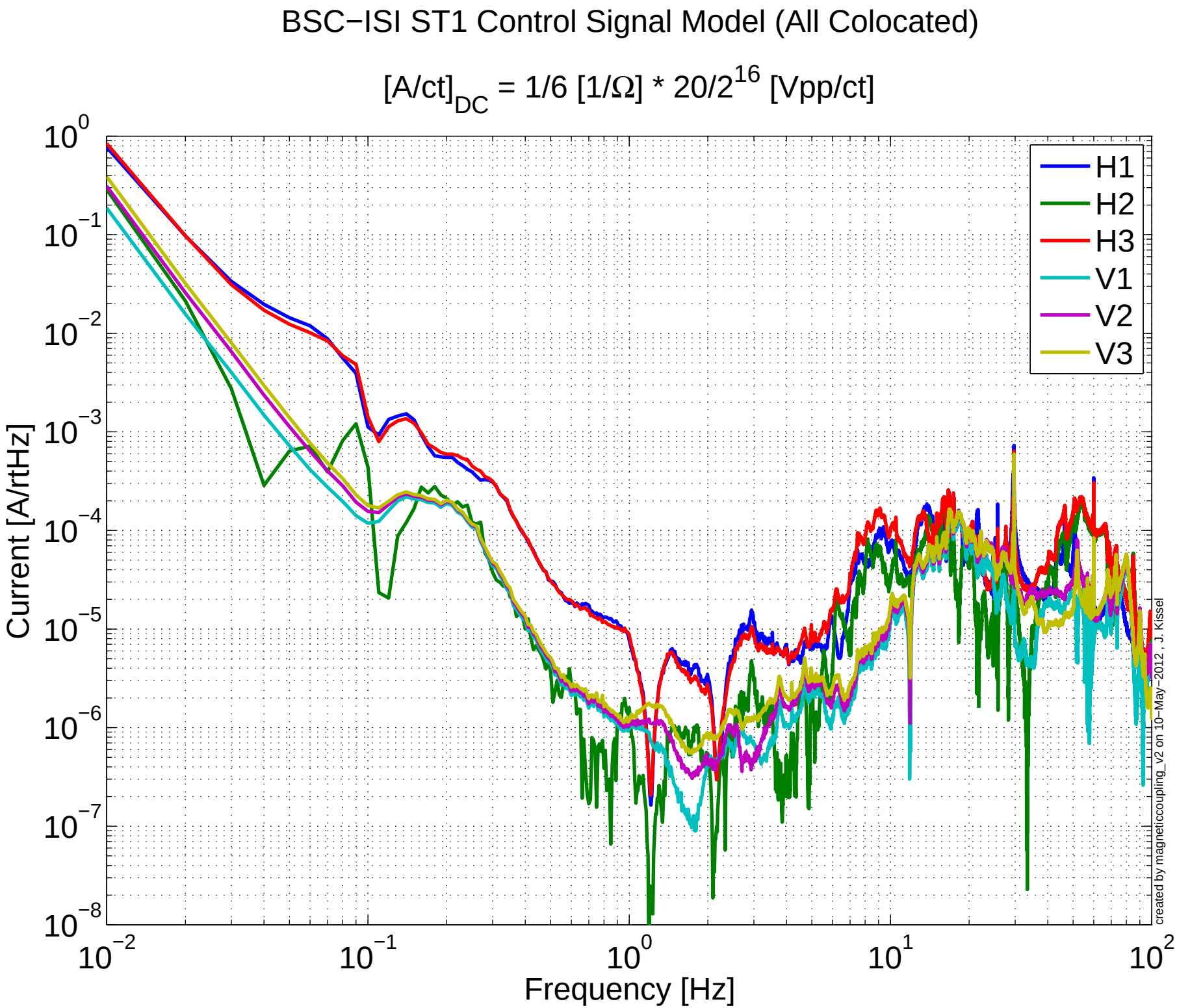

BSC−ISI Stage 1 Y Noise Budget
Displacement [m/rtHz]
Frequency [Hz]
HEPI Input Motion
CPS Blend Filter / 1e−6
T240 Blend Filter / 1e−6
L4C Blend Filter / 1e−6
Stage 1 Goal
Stage 2 Goal
Residual Ground Contribution
CPS Sensor Noise Contribution
L4C Sensor Noise Contribution
T240 Sensor Noise Contribution
Total Model BSC−ISI ST1
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

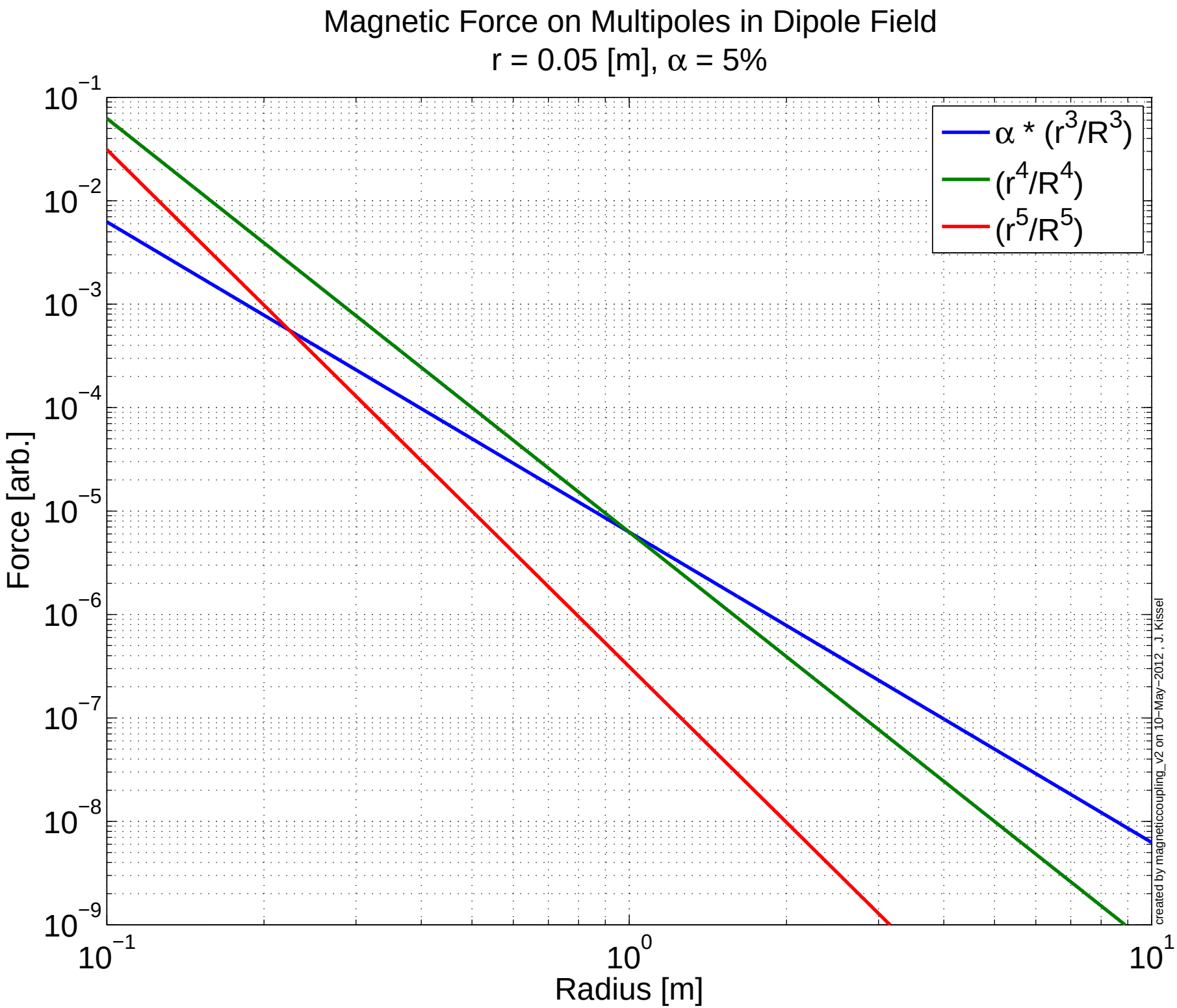

BSC−ISI Stage 1 Z Noise Budget
Displacement [m/rtHz]
Frequency [Hz]
HEPI Input Motion
CPS Blend Filter / 1e−6
T240 Blend Filter / 1e−6
L4C Blend Filter / 1e−6
Stage 1 Goal
Stage 2 Goal
Residual Ground Contribution
CPS Sensor Noise Contribution
L4C Sensor Noise Contribution
T240 Sensor Noise Contribution
Total Model BSC−ISI ST1
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

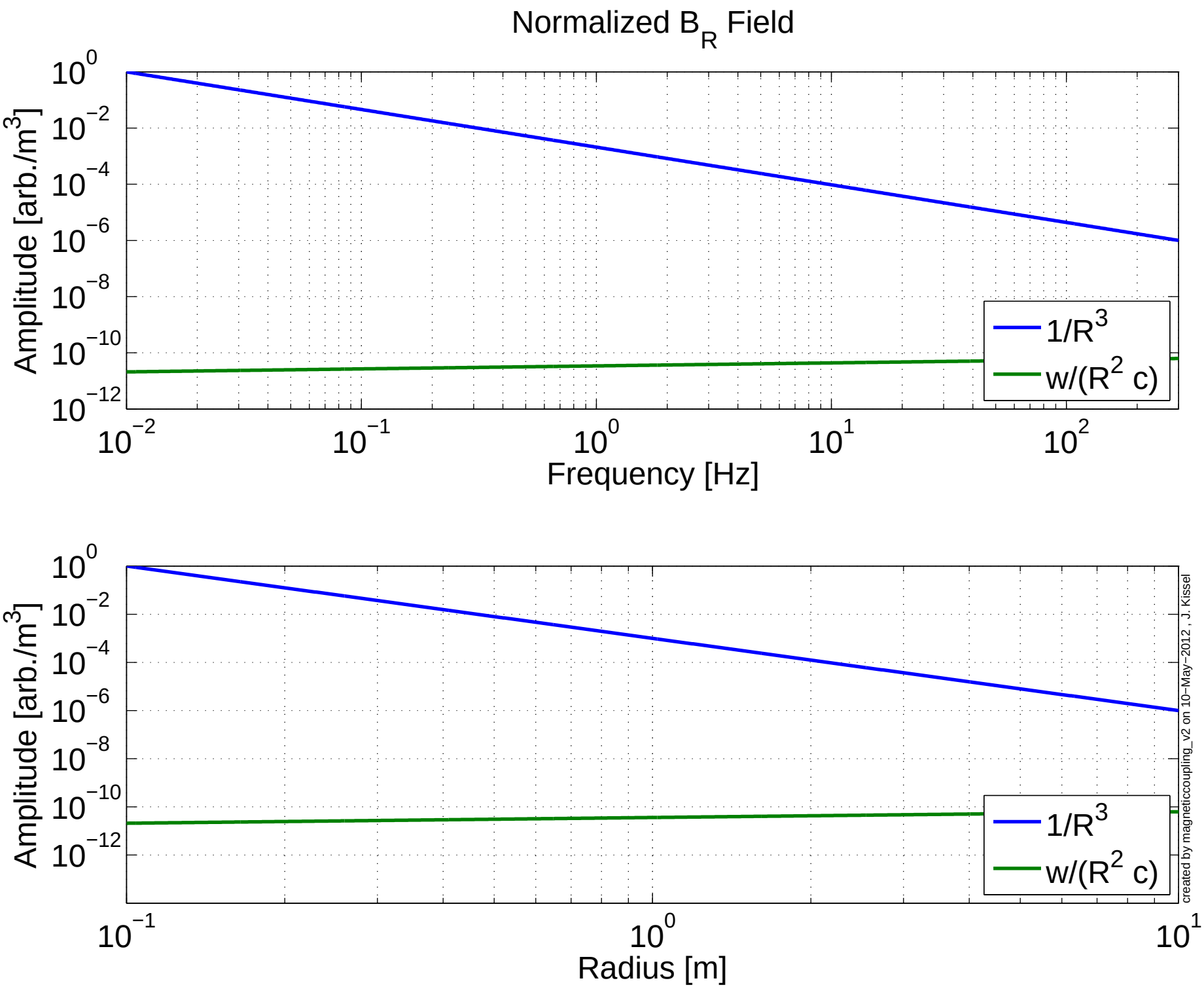

BSC−ISI ST1 Control Signal Model
CTRL = K * 1 / (1 − G)
Amplitude [ct/rtHz]
Frequency [Hz]
X
Y
Z
RX
RY
RZ
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

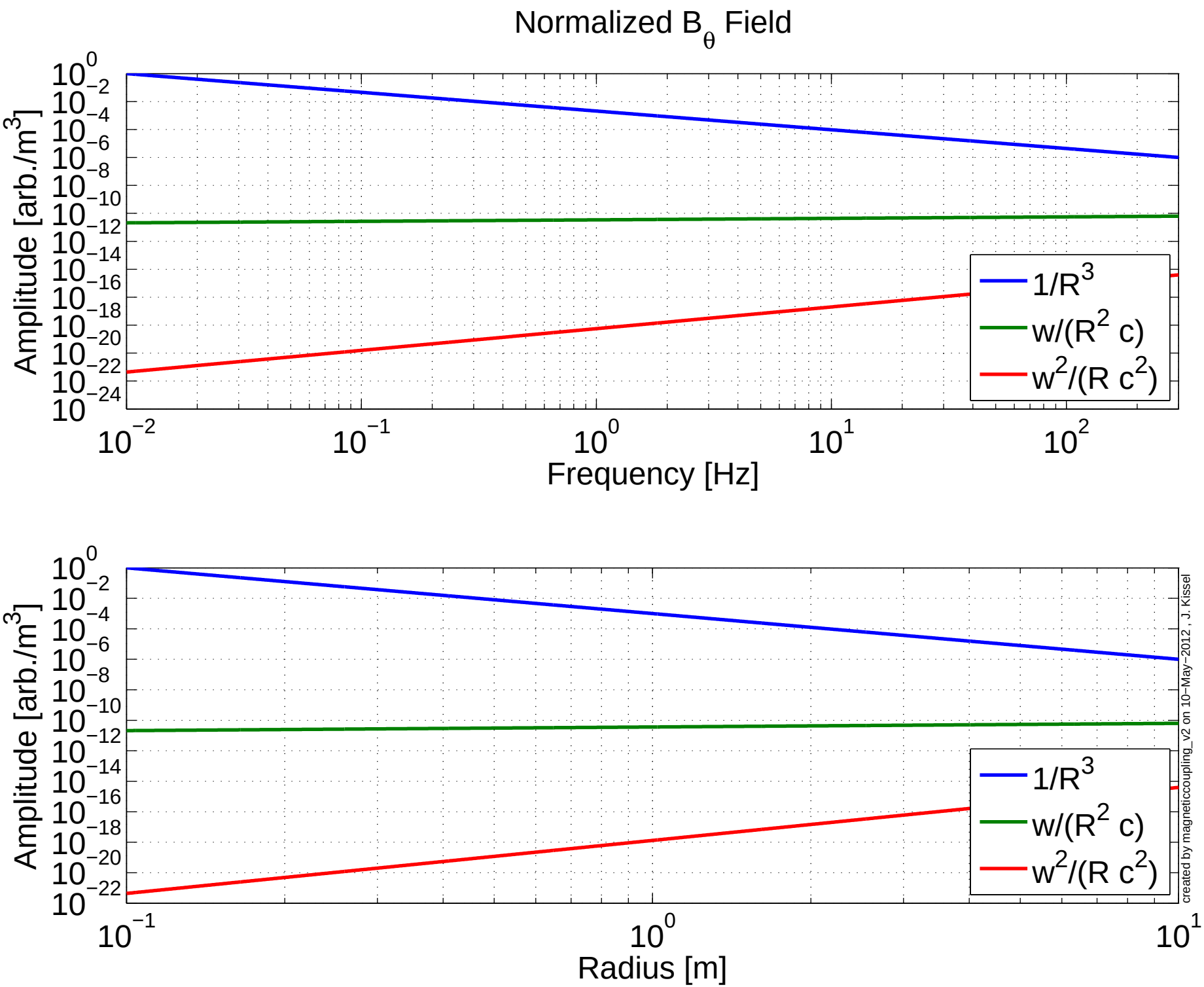

BSC−ISI ST1 Control Signal Model (Horz.)
[A/ct]DC = 1/6 [1/Ω] * 20/2^16 [Vpp/ct]
Current [A/rtHz]
Frequency [Hz]
X
Y
RZ
H1
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

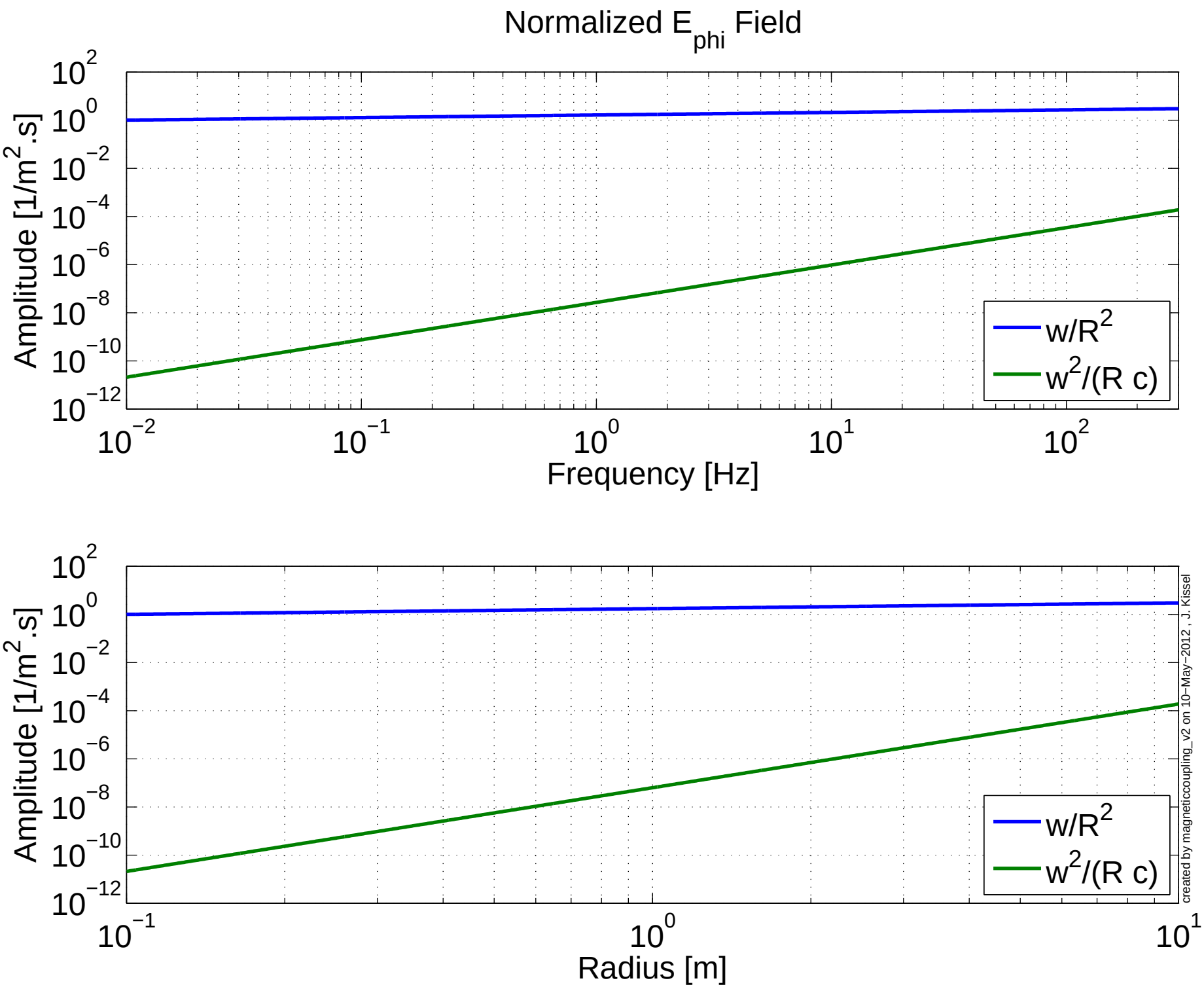

BSC−ISI ST1 Control Signal Model (Vert.)
[A/ct]DC = 1/6 [1/Ω] * 20/2^16 [Vpp/ct]
Current [A/rtHz]
Frequency [Hz]
Z
RX
RY
V1
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

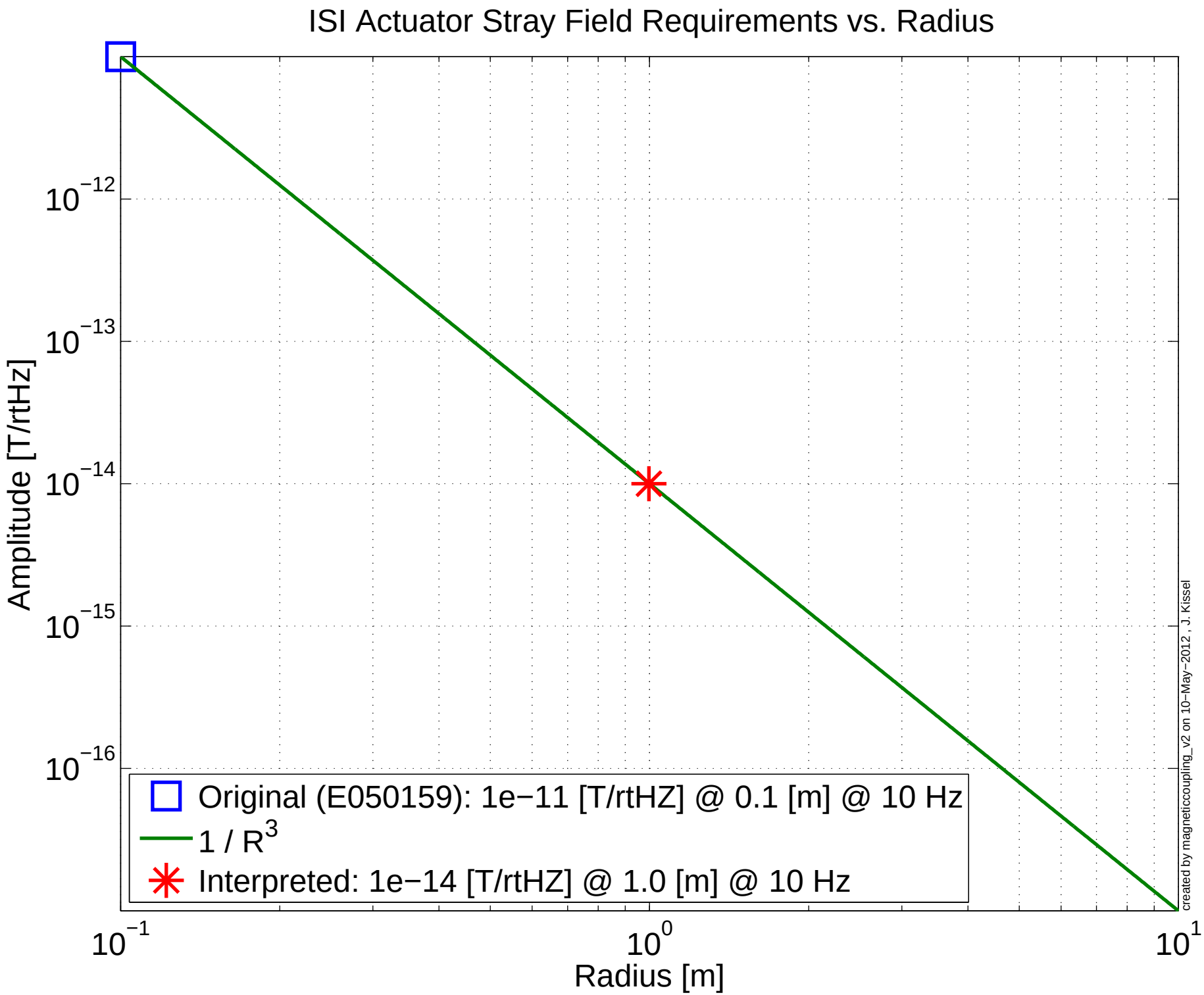

BSC−ISI ST1 Control Signal Model (All Colocated)
[A/ct]DC = 1/6 [1/Ω] * 20/2^16 [Vpp/ct]
Current [A/rtHz]
Frequency [Hz]
H1
H2
H3
V1
V2
V3
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

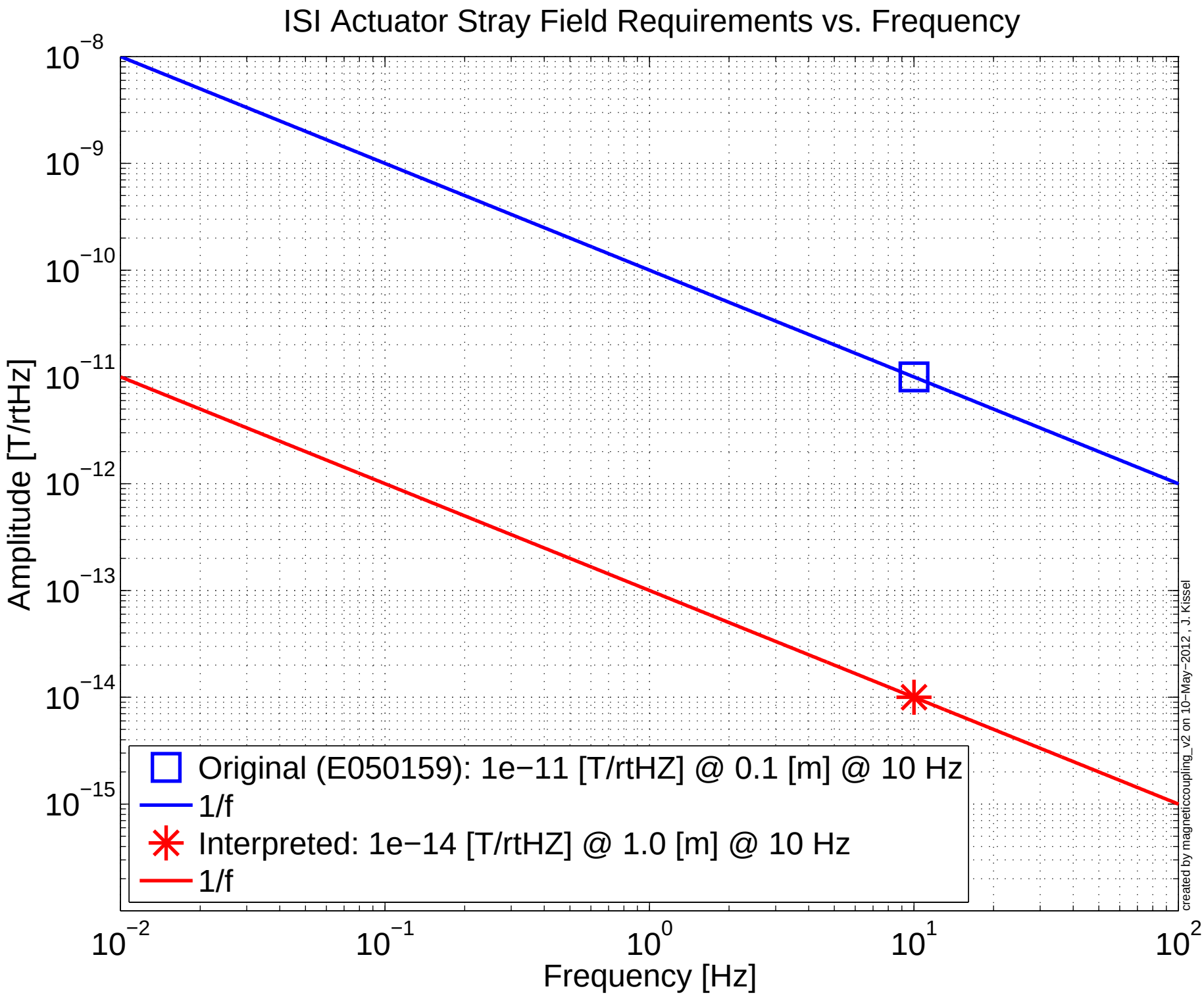

Magnetic Force on Multipoles in Dipole Field
r = 0.05 [m], α = 5%
α * (r^3/R^3)
(r^4/R^4)
(r^5/R^5)
Force [arb.]
Radius [m]
10^−1
10^−2
10^−3
10^−4
10^−5
10^−6
10^−7
10^−8
10^−9
10^0
10^1
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

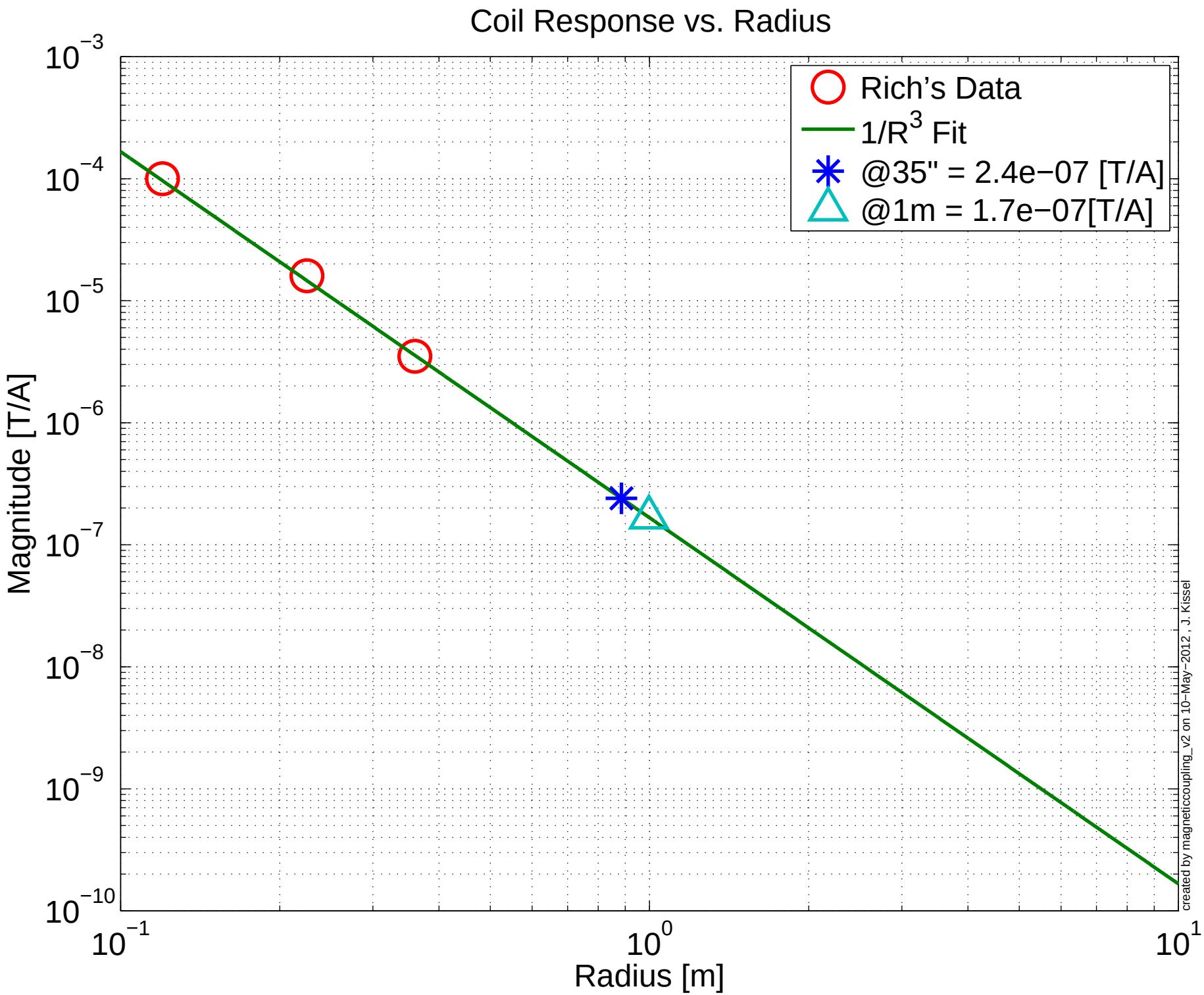

Normalized B_R Field
Amplitude [arb./m^3]
Frequency [Hz]
1/R^3
w/(R^2 c)
Amplitude [arb./m^3]
Radius [m]
1/R^3
w/(R^2 c)
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

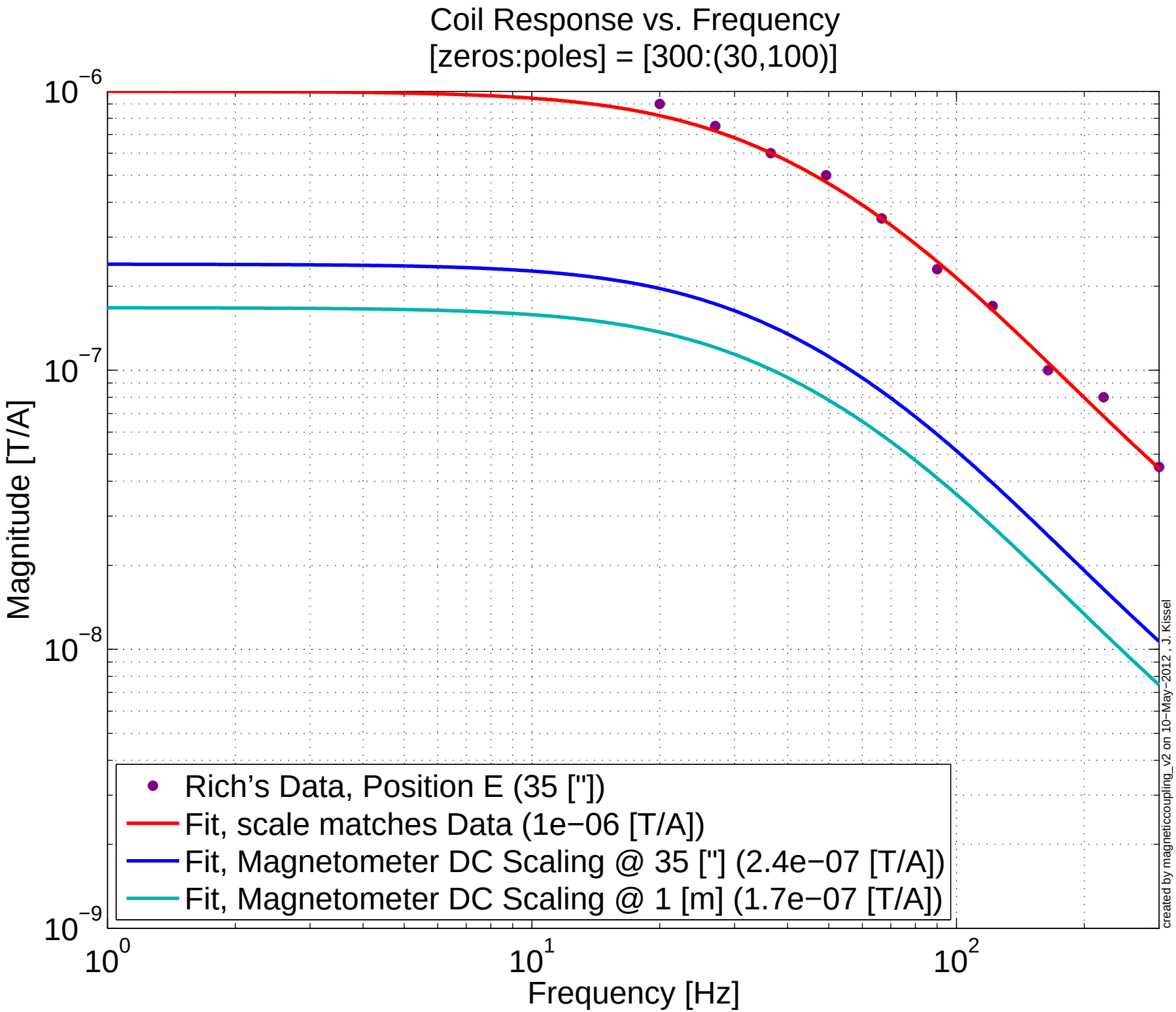

Normalized B$_\theta$ Field
Amplitude [arb./m^3]
Frequency [Hz]
1/R^3
w/(R^2 c)
w^2/(R c^2)
Amplitude [arb./m^3]
Radius [m]
1/R^3
w/(R^2 c)
w^2/(R c^2)
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

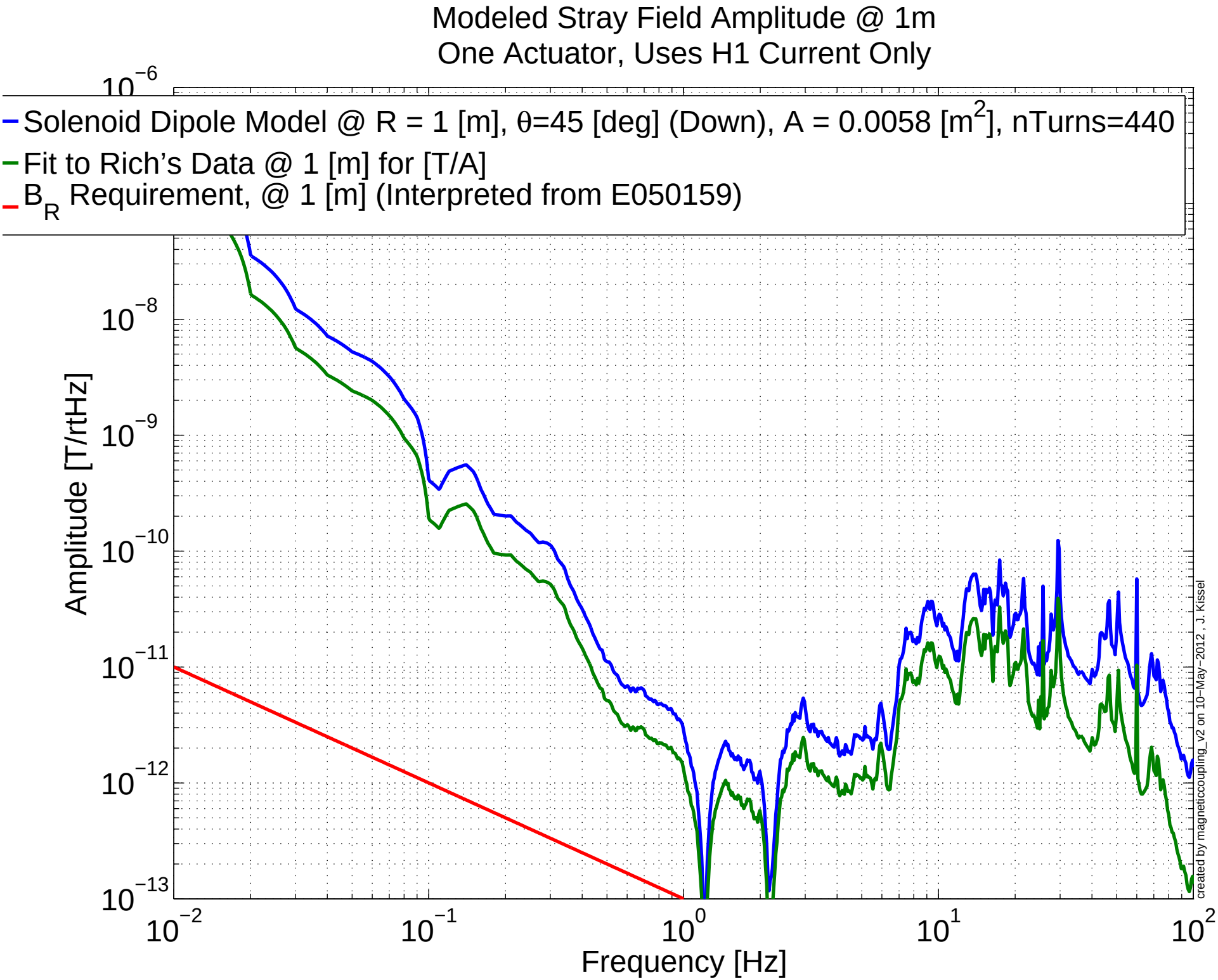

Normalized E_phi Field
Amplitude [1/m^2.s]
Frequency [Hz]
w/R^2
w^2/(R c)
Amplitude [1/m^2.s]
Radius [m]
w/R^2
w^2/(R c)
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

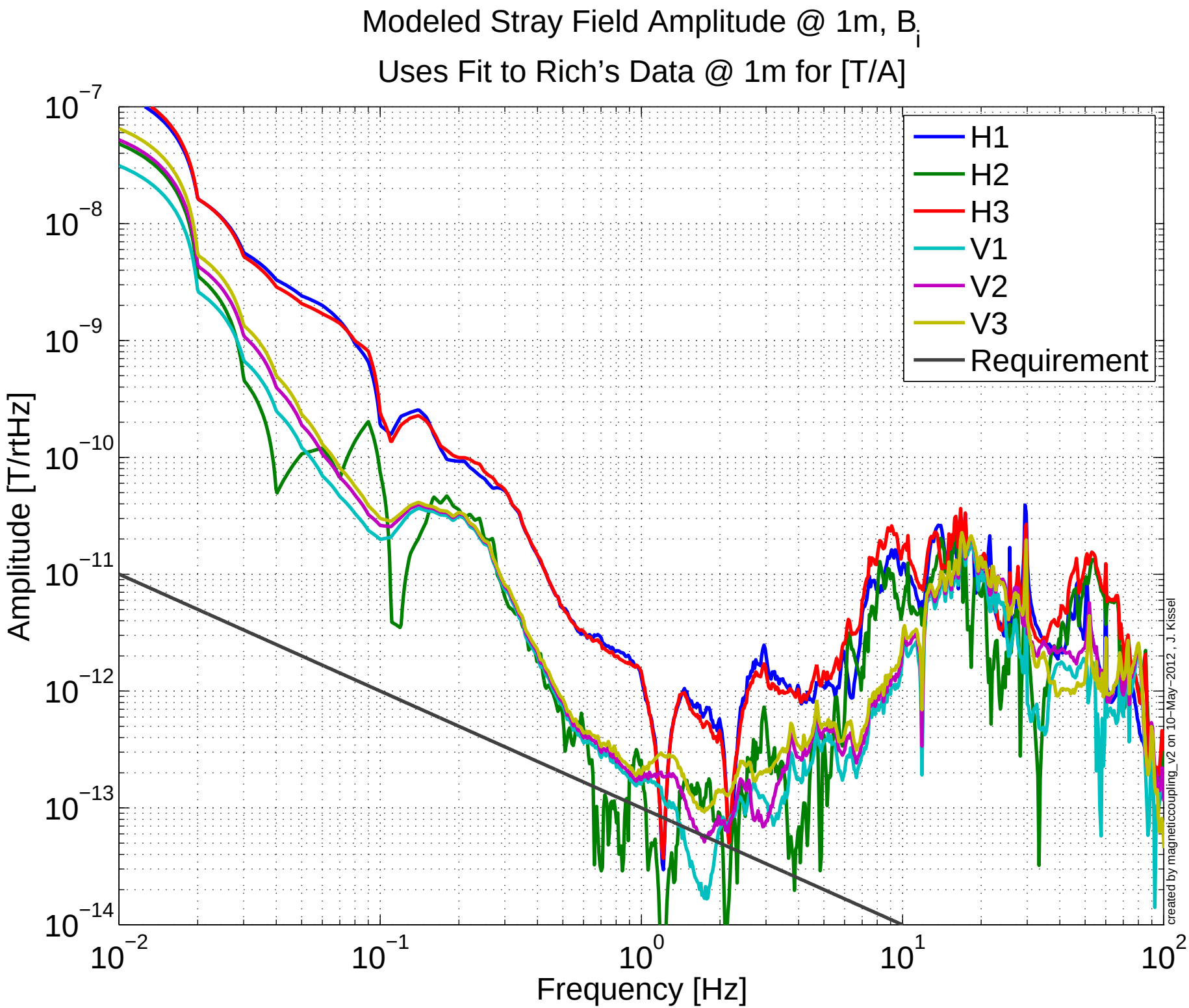

ISI Actuator Stray Field Requirements vs. Radius
Amplitude [T/rtHz]
Radius [m]
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-16}
10^{-1}
10^{0}
10^{1}
Original (E050159): 1e−11 [T/rtHZ] @ 0.1 [m] @ 10 Hz
$1 / R^3$
Interpreted: 1e−14 [T/rtHZ] @ 1.0 [m] @ 10 Hz
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

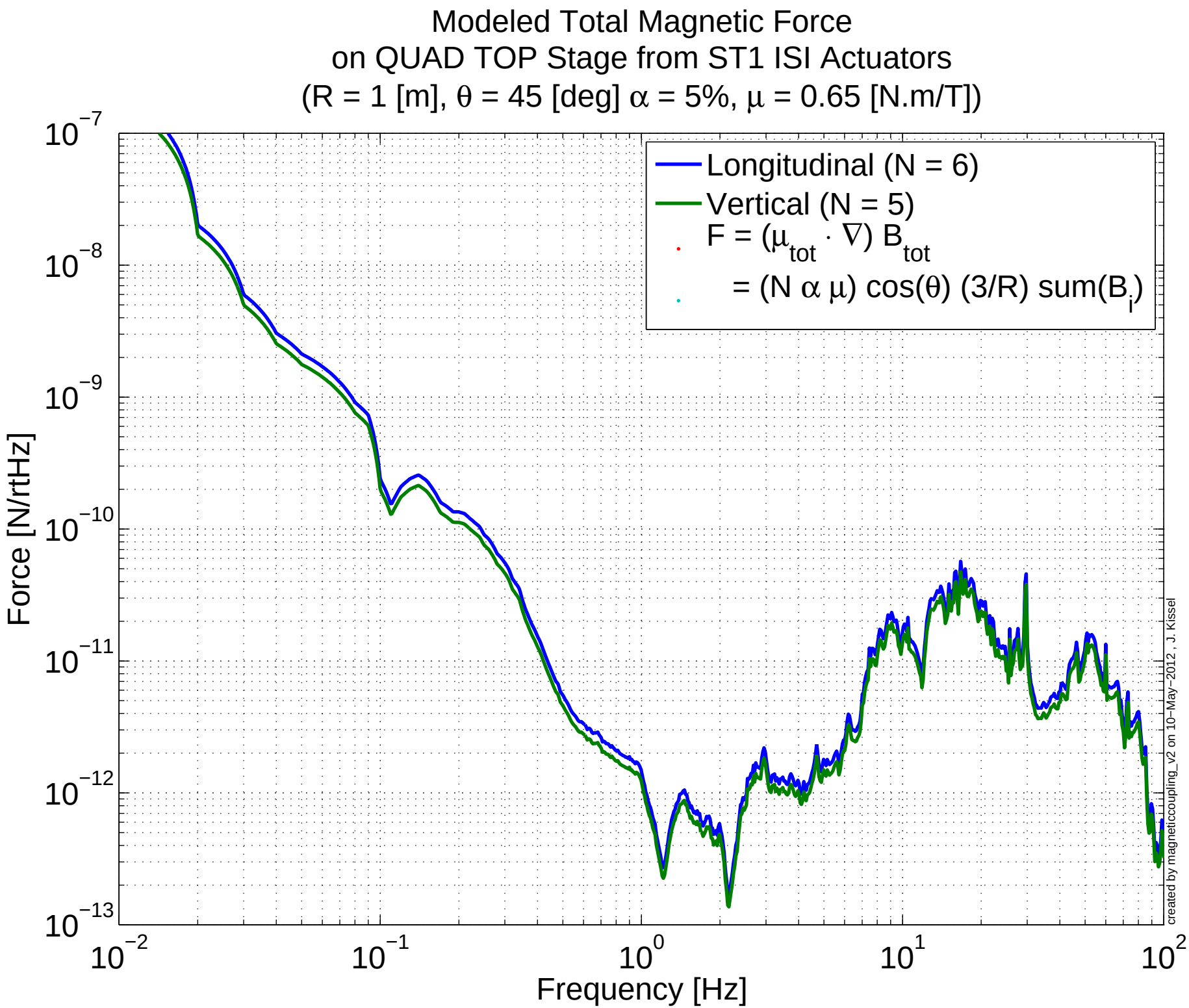

ISI Actuator Stray Field Requirements vs. Frequency
Amplitude [T/rtHz]
Frequency [Hz]
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Original (E050159): 1e−11 [T/rtHZ] @ 0.1 [m] @ 10 Hz
1/f
Interpreted: 1e−14 [T/rtHZ] @ 1.0 [m] @ 10 Hz
1/f
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

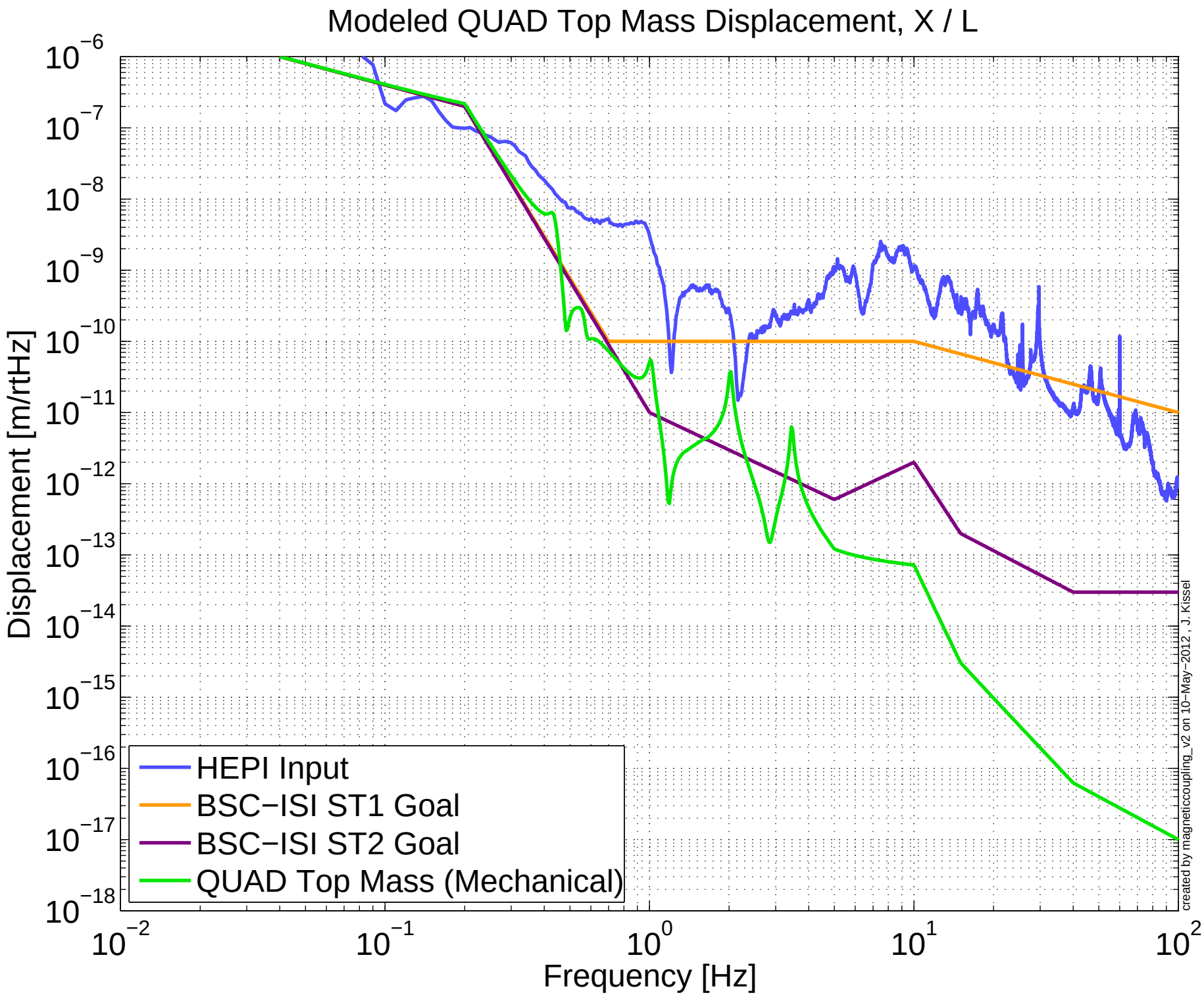

Coil Response vs. Radius
Rich's Data
1/R^3 Fit
@35" = 2.4e−07 [T/A]
@1m = 1.7e−07[T/A]
Magnitude [T/A]
Radius [m]
10^−3
10^−4
10^−5
10^−6
10^−7
10^−8
10^−9
10^−10
10^−1
10^0
10^1
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

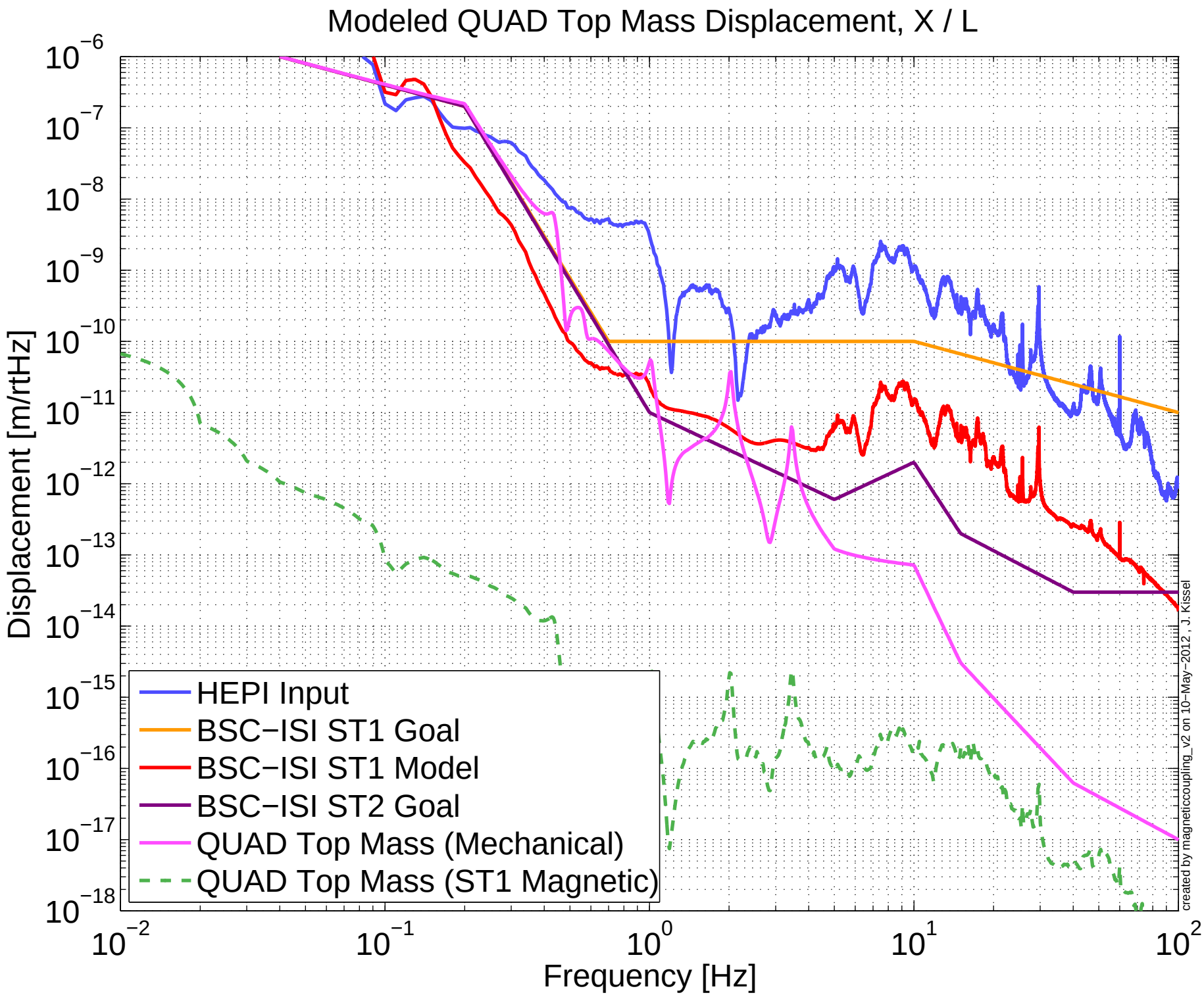

Coil Response vs. Frequency
[zeros:poles] = [300:(30,100)]
Magnitude [T/A]
Frequency [Hz]
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{0}
10^{1}
10^{2}
Rich's Data, Position E (35 ["])
Fit, scale matches Data (1e−06 [T/A])
Fit, Magnetometer DC Scaling @ 35 ["] (2.4e−07 [T/A])
Fit, Magnetometer DC Scaling @ 1 [m] (1.7e−07 [T/A])
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel

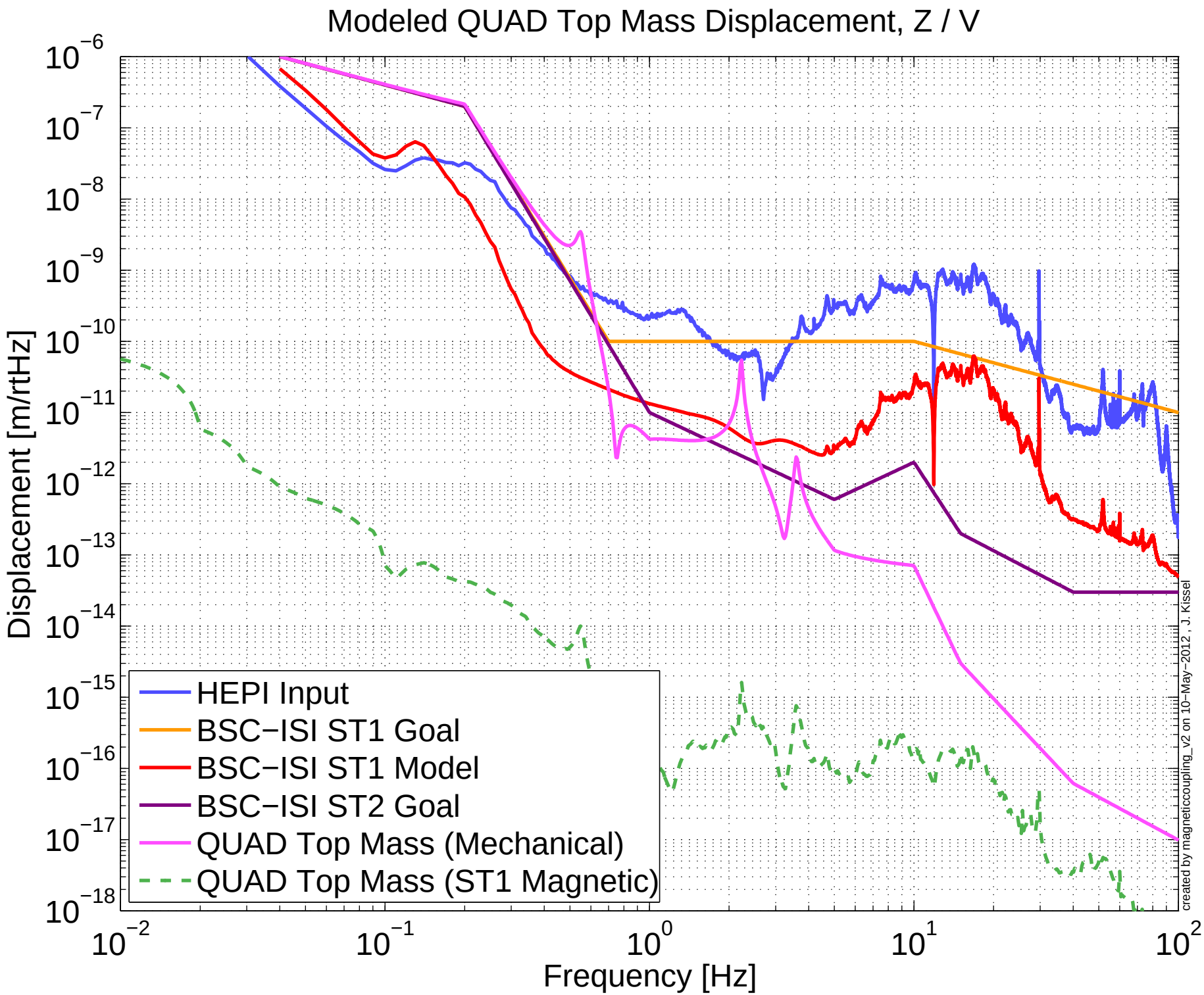

Modeled Stray Field Amplitude @ 1m
One Actuator, Uses H1 Current Only
Solenoid Dipole Model @ R = 1 [m], θ=45 [deg] (Down), A = 0.0058 [m2], nTurns=440
Fit to Rich's Data @ 1 [m] for [T/A]
BR Requirement, @ 1 [m] (Interpreted from E050159)
Amplitude [T/rtHz]
Frequency [Hz]
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel


Modeled Stray Field Amplitude @ 1m, B_i
Uses Fit to Rich's Data @ 1m for [T/A]
Amplitude [T/rtHz]
Frequency [Hz]
H1
H2
H3
V1
V2
V3
Requirement
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel


Modeled Total Magnetic Force
on QUAD TOP Stage from ST1 ISI Actuators
(R = 1 [m], θ = 45 [deg] α = 5%, μ = 0.65 [N.m/T])
Longitudinal (N = 6)
Vertical (N = 5)
F = (μtot · ∇) Btot
= (N α μ) cos(θ) (3/R) sum(Bi)
Force [N/rtHz]
Frequency [Hz]
10−7
10−8
10−9
10−10
10−11
10−12
10−13
10−2
10−1
100
101
102
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel


Modeled QUAD Top Mass Displacement, X / L
Displacement [m/rtHz]
Frequency [Hz]
HEPI Input
BSC−ISI ST1 Goal
BSC−ISI ST2 Goal
QUAD Top Mass (Mechanical)
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel


Modeled QUAD Top Mass Displacement, X / L
Displacement [m/rtHz]
Frequency [Hz]
HEPI Input
BSC−ISI ST1 Goal
BSC−ISI ST1 Model
BSC−ISI ST2 Goal
QUAD Top Mass (Mechanical)
QUAD Top Mass (ST1 Magnetic)
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel


Modeled QUAD Top Mass Displacement, Z / V
Displacement [m/rtHz]
Frequency [Hz]
HEPI Input
BSC−ISI ST1 Goal
BSC−ISI ST1 Model
BSC−ISI ST2 Goal
QUAD Top Mass (Mechanical)
QUAD Top Mass (ST1 Magnetic)
created by magneticcoupling_v2 on 10−May−2012 , J. Kissel