LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Single Pendulum Parameter Descriptions and Naming Convention

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Table of Contents

1 Introduction

1.1 Purpose and Scope

Describes the parameter names used in the Mathematica and Matlab single pendulum dynamics models used for HAUX, HTTS and OFIS.

1.2 References

LIGO-T1400446: aLIGO SUS Pendulum Dynamics Modeling

LIGO-T020205: Models of the Advanced LIGO Suspensions in Mathematica™

LIGO-T080188: Models of the Advanced LIGO Suspensions in MATLAB

1.3 Version history

7/7/2014: -v1. Initial version based on triple version, T040072.

2 Parameters

The following parameters are the minimum set necessary to define a case of the Mathematica TwoWireSimpleBlades and FourWireSimpleBlades models used for the aLIGO HAUX, HTTS and OFIS, or the equivalent Matlab model (ssmake1MBf.m). The choice of the two-wire and four-wire matrix elements in the matlab is determined by whether the parameters dx1 and dx2 (for the wire front-back separations) are both defined. As near as practical, all of the parameters have the same names in both models. The parameters for blade and wire stiffness are defined per side in the Matlab but per blade in the Mathematica, and to prevent (total) confusion have been given different names. The Mathematica model has a large number of additional parameters for the damping of the elastic elements which are beyond the scope of this document. The Matlab model also handles certain additional Mathematica models that were generated for R&D purposes such as TwoWireSimple, etc, but the extra parameters which trigger this are beyond the scope of this document.

2.1 Parameters common to Mathematica and Matlab

Parameter	Unit	Description
g	m/s^2	local gravity
m0	kg	mass of optic/bench
I0x, I0y, I0z	kg.m^2	diagonal components of optic/bench MOI
I0xy, I0yz, I0zx	kg.m^2	off-diagonal components of optic/bench MOI
dtop, dpitch	m	vertical offsets of wire attachments from COM (positive outward, towards wire) - see diagrams
dyaw1, dyaw2	m	two-sided lateral (y-direction) wire attachment point separations at top and bottom, - see diagrams

dx1, dx2 (OFIS only)	m	two-sided front-back (x-direction) wire attachment point separations at top and bottom. If these are defined, matrix elements for a four-wire suspension are used.
l0	m	stretched lengths of wires
Y0	Pa	Young's moduli of wires
r0	m	radii of wires
b0x, b0y,b0x	N/(m/s)	linear velocity damping coefficients (optional)
b0yaw, b0pitch, b0roll	N.m/(rad/s)	angular velocity damping coefficients (optional)

2.2 Parameters unique to Matlab

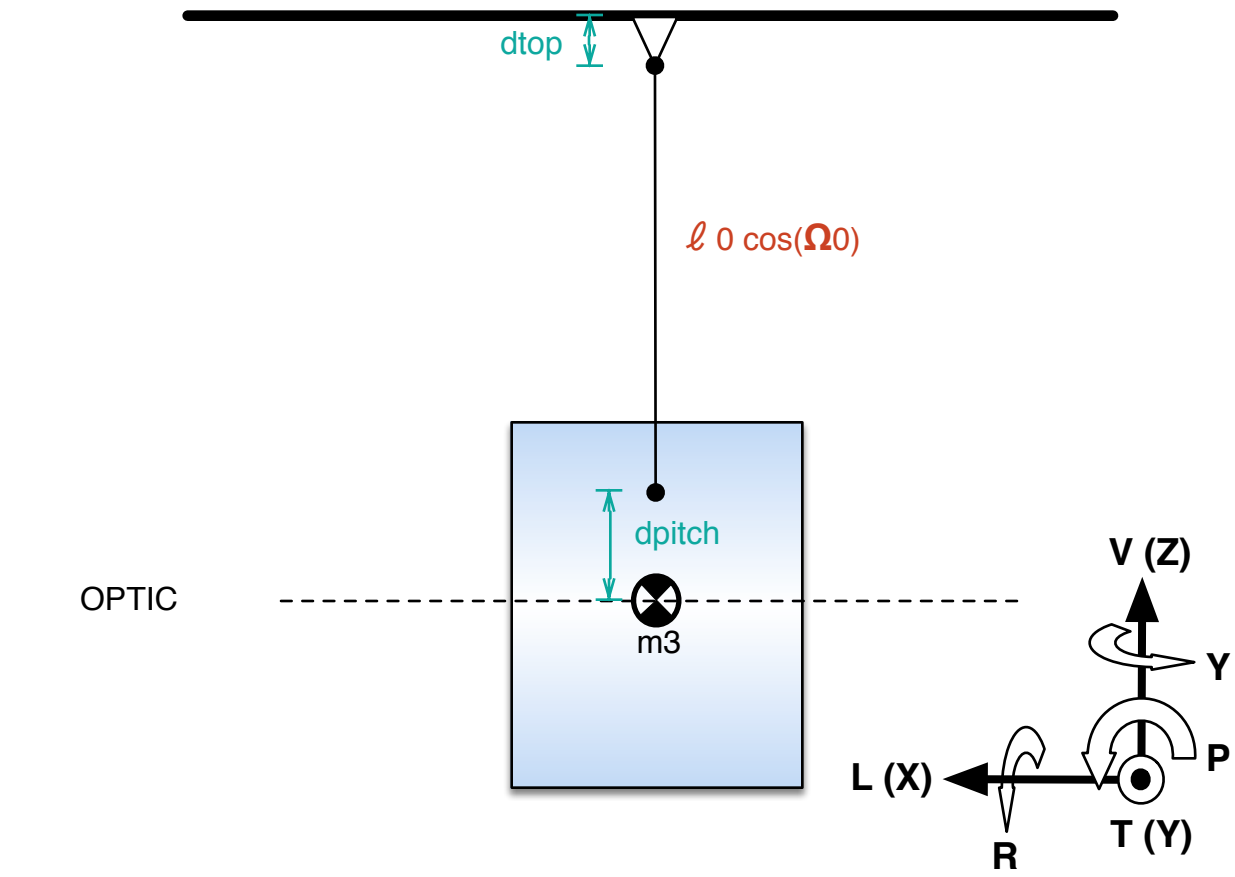
Parameter	Unit	Description
kc0	N/m	blade vertical stiffnesses ***per side***, equivalent to kbz
stage2	-	switch governing the interpretion of the d's: state2=1 => d's are physical, apply flexure correction; stage2=0 => d's are effective, flexure correction already included, don't reapply.
bd	N/(m/s), N.m/(rad/s)	a small amount of damping which is added to all DOFs to avoid unrealistically peaky TFs; defaults to 0.001.

2.3 Parameters unique to Mathematica

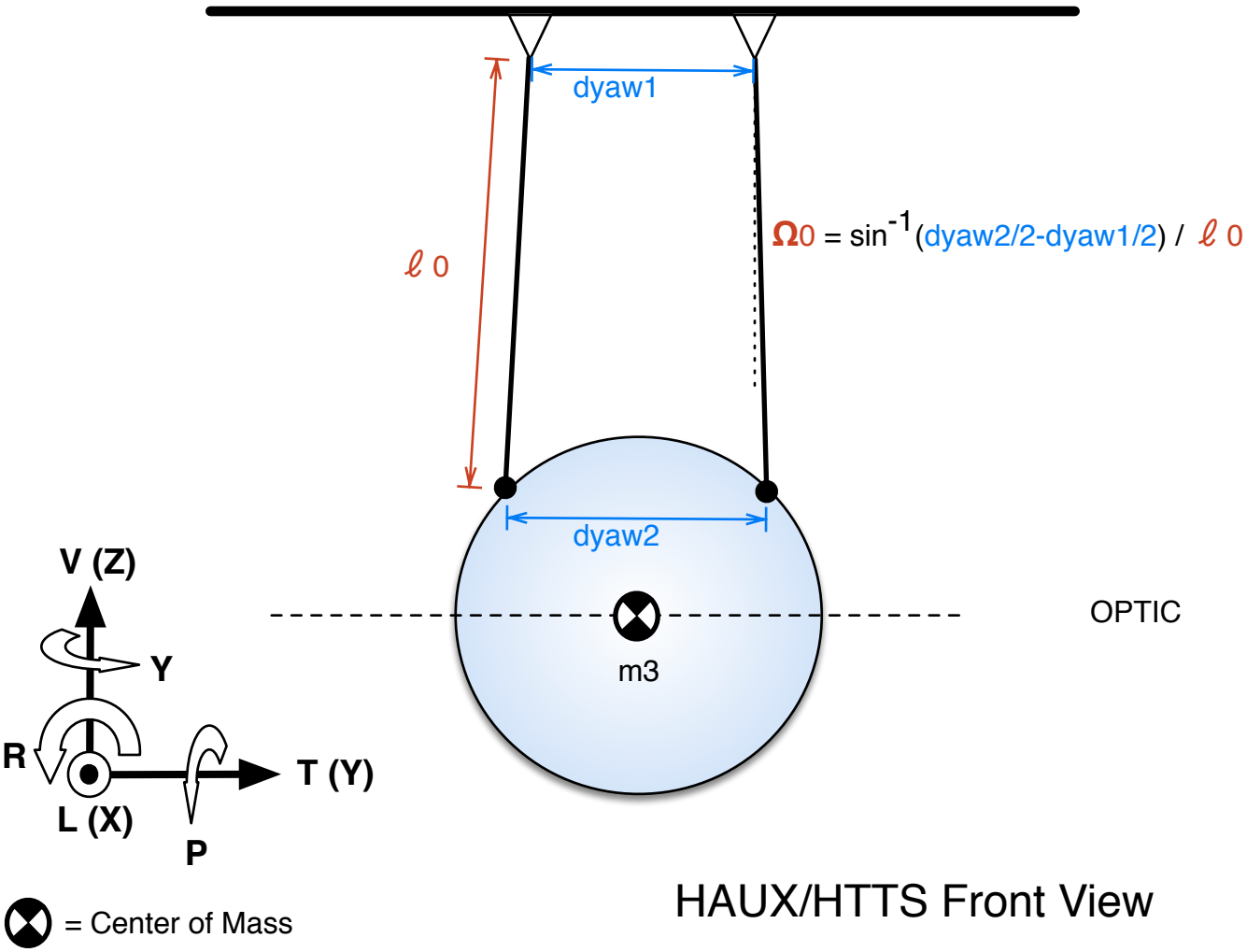
Parameter	Unit	Description
kbz	N/m	blade vertical stiffnesses ***per blade***, equivalent to kc0 Matlab
kw0	N/m	wire vertical stiffness, per wire; case definer needs to calculate these manually whereas they are calculated automatically in the Matlab

3 Diagrams

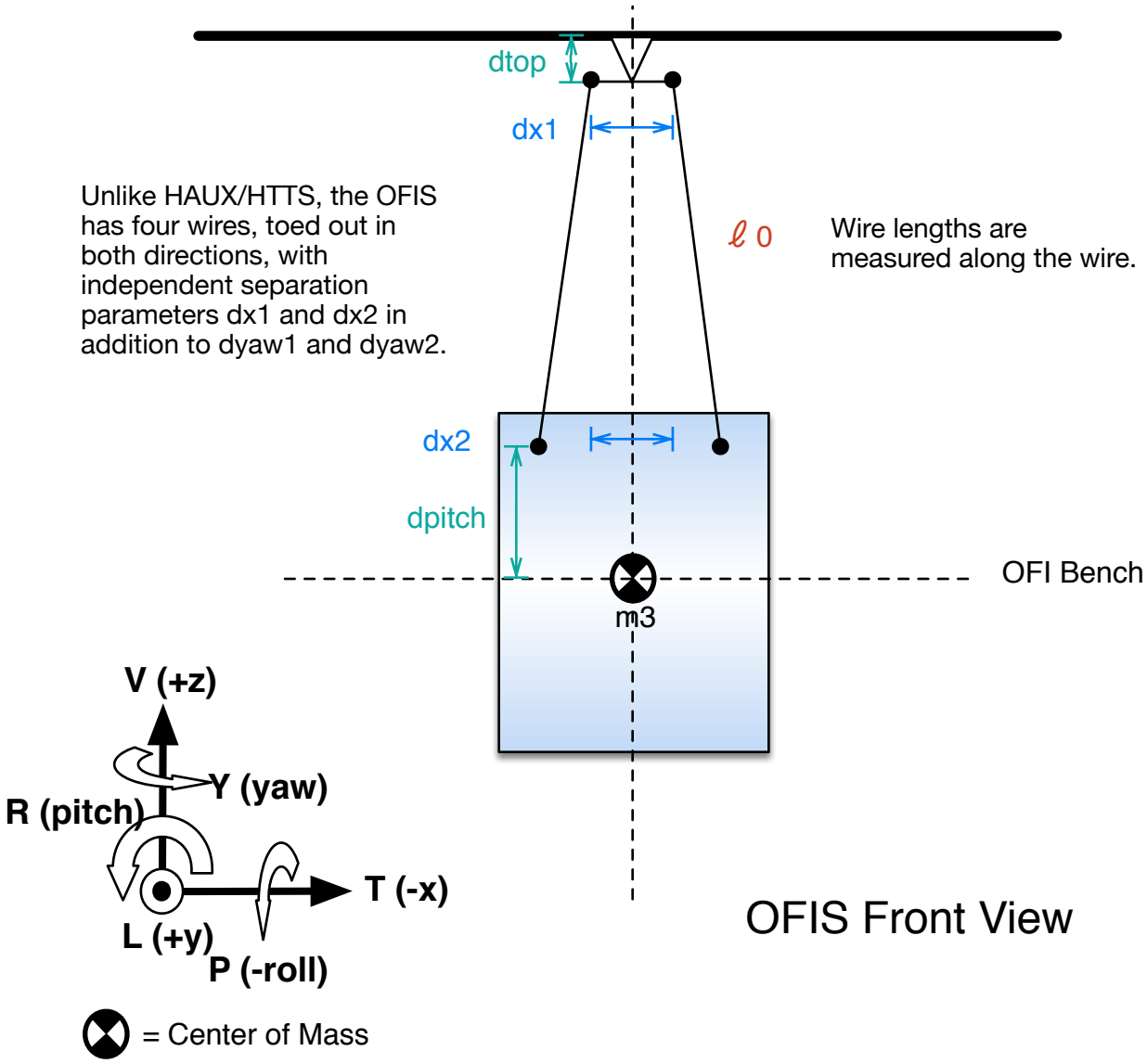
In the final PDF of this document, OmniGraffle diagrams of the dimensional parameters will be appended.



HAUX/HTTS Side View



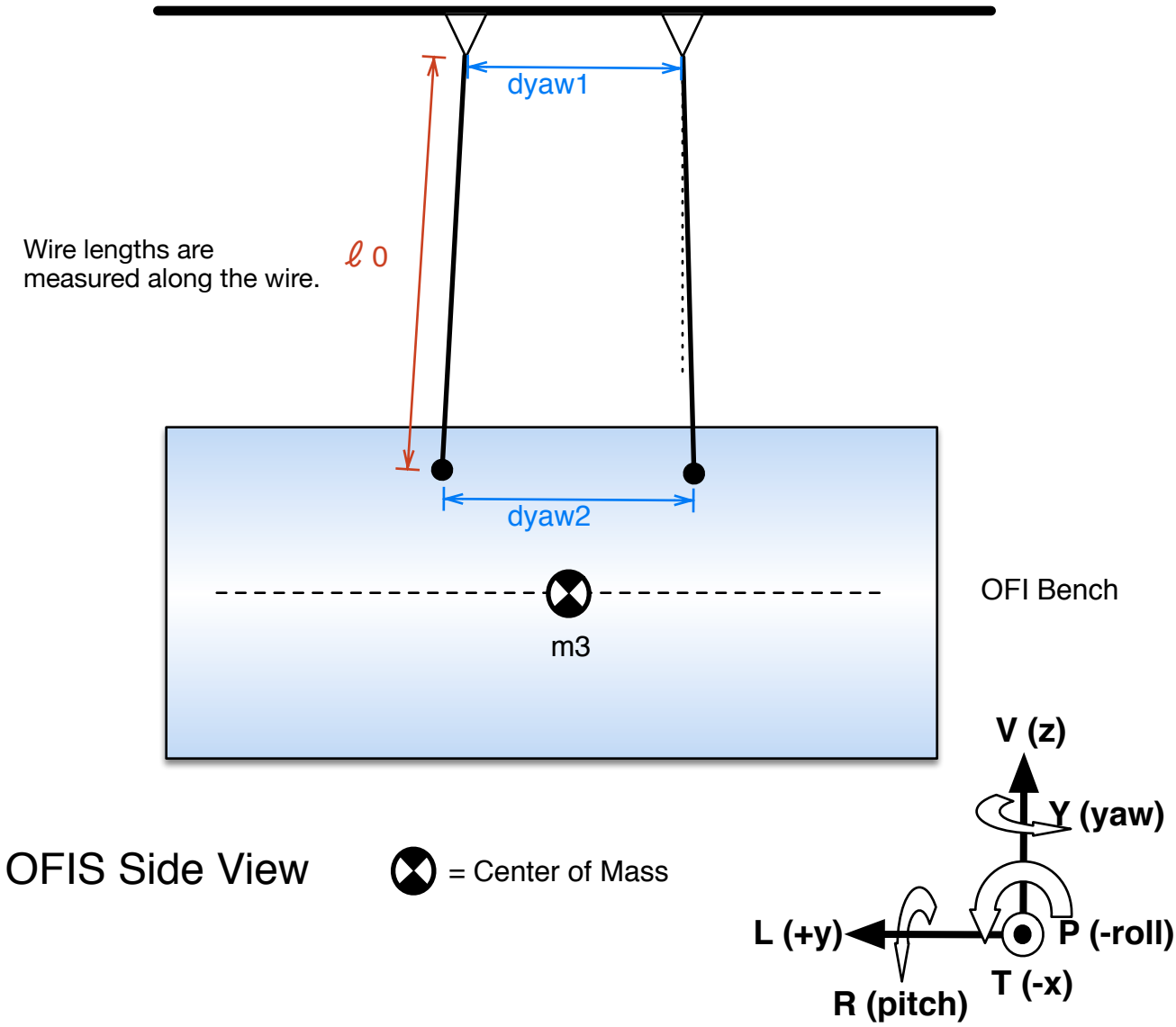
HAUX/HTTS Front View



Unlike HAUX/HTTS, the OFIS has four wires, toed out in both directions, with independent separation parameters dx1 and dx2 in addition to dyaw1 and dyaw2.

Wire lengths are measured along the wire.

OFIS Front View



OFIS Side View

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