Diffraction Losses of Various Modes in Advanced LIGO Arm Cavity

Biplab Bhawal - *LIGO Laboratory,*

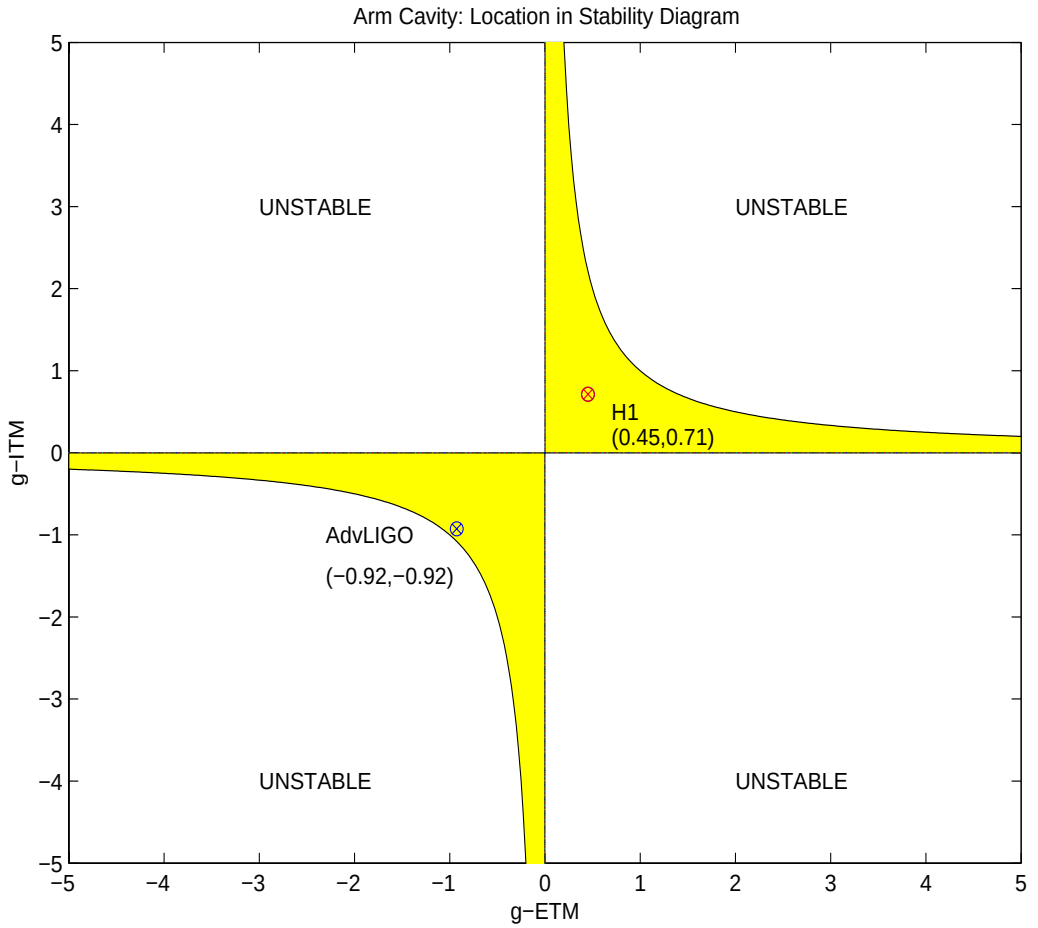
California Institute of Technology, USA

Meeting on 'Parametric Instability in Advanced LIGO'

Caltech, Pasadena 23 Aug'2005

The Arm Cavity

	LIGO-I (H1)	Adv LIGO (proposed)
ROC (ITM) meter	~14000	2076
ROC (ETM) meter	~7300	2076
Beam Radius At ITM (m)	0.036	0.06
Beam Radius At ETM (m)	0.045	0.06
Beam Waist Size (m)	0.035	0.01
Distance of waist from ITM (m)	990	2000



g = 1 – 'Length'/`ROC'

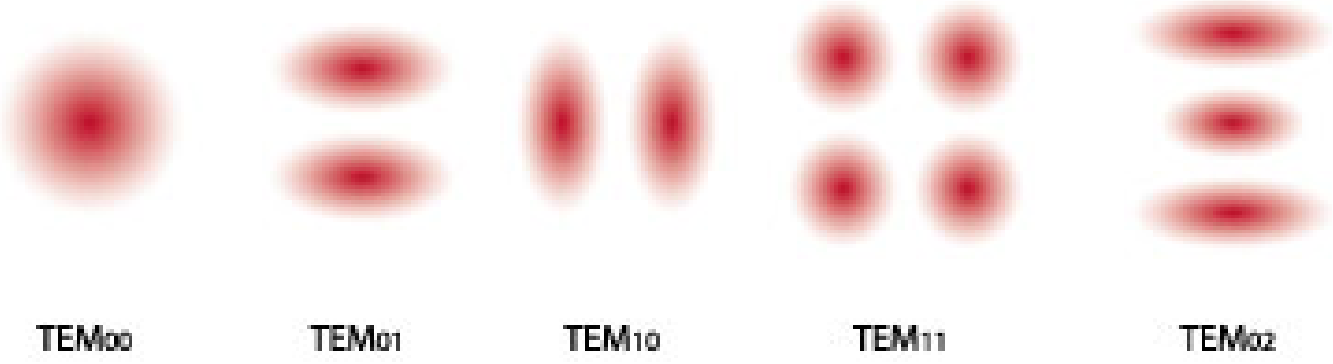
TEM Modes

TEM_mn

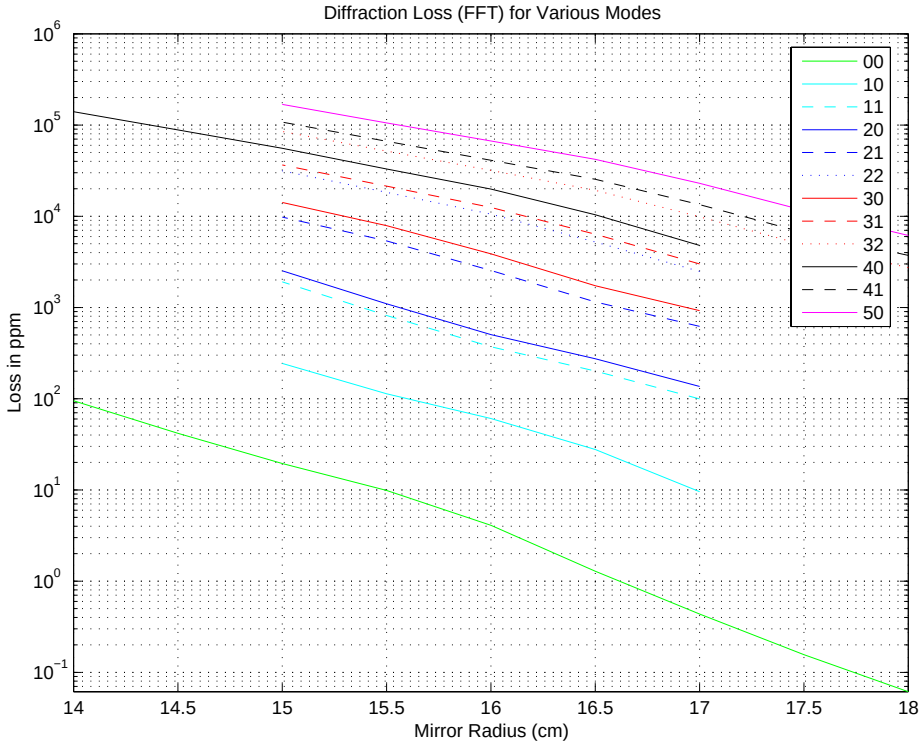
m+1 spots in X-dir

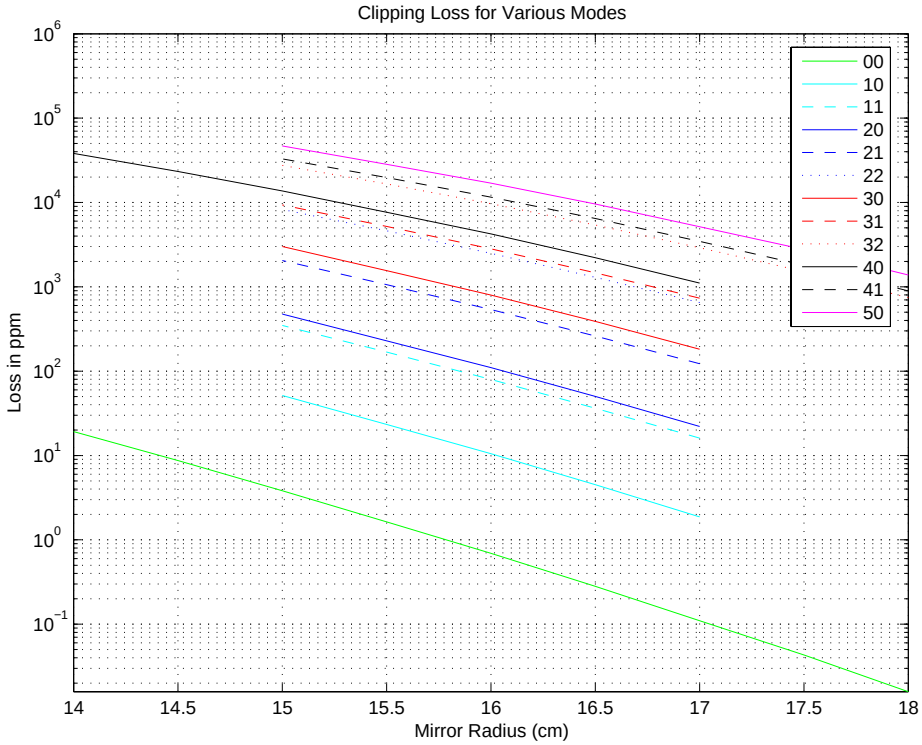
n+1 spots in Y-dir

00	10	20	30	40	50
	01	11	21	31	41
		02	12	22	32
			03	13	23
				04	14
					05



Diffraction & Clipping Losses

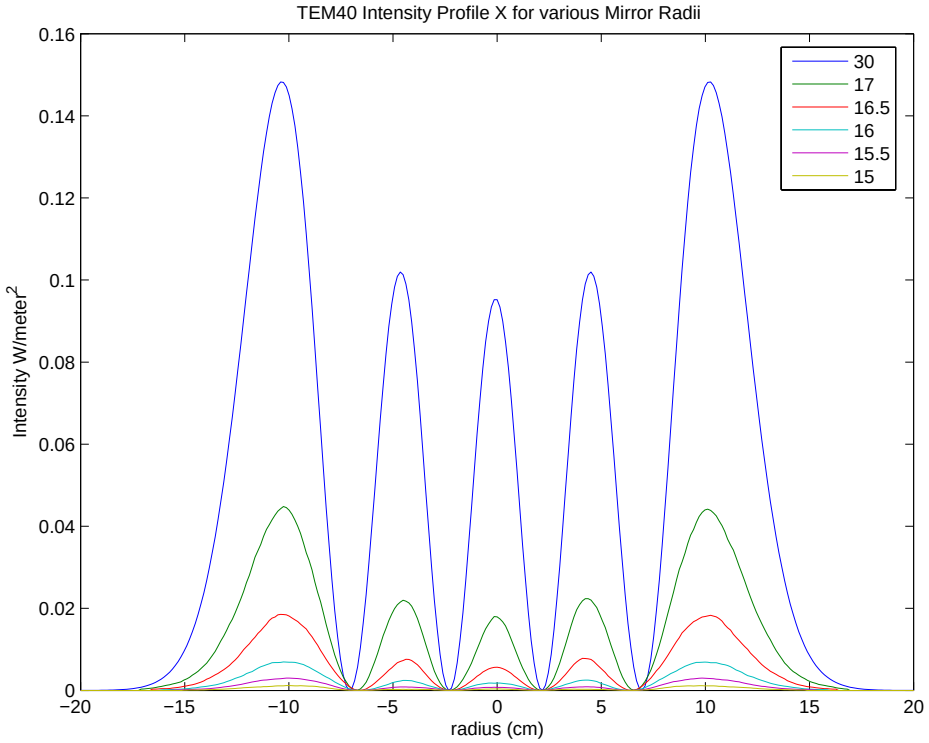


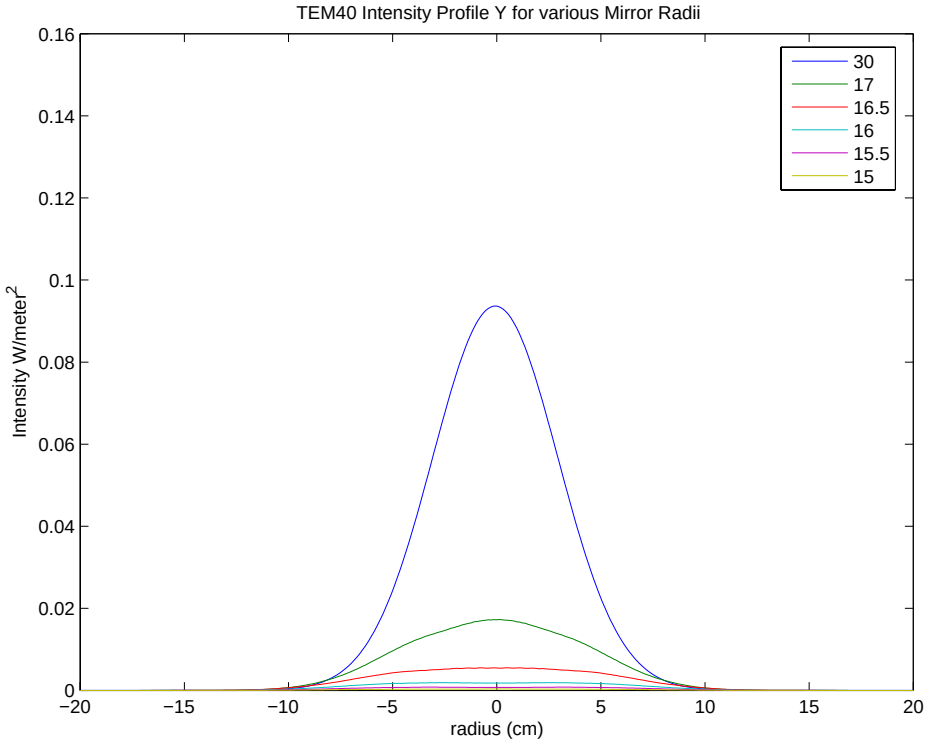


$$\text{Diff. Loss} = T_{\text{itm}}\sqrt{P_{\infty}/P_R} - T_{\text{itm}}$$

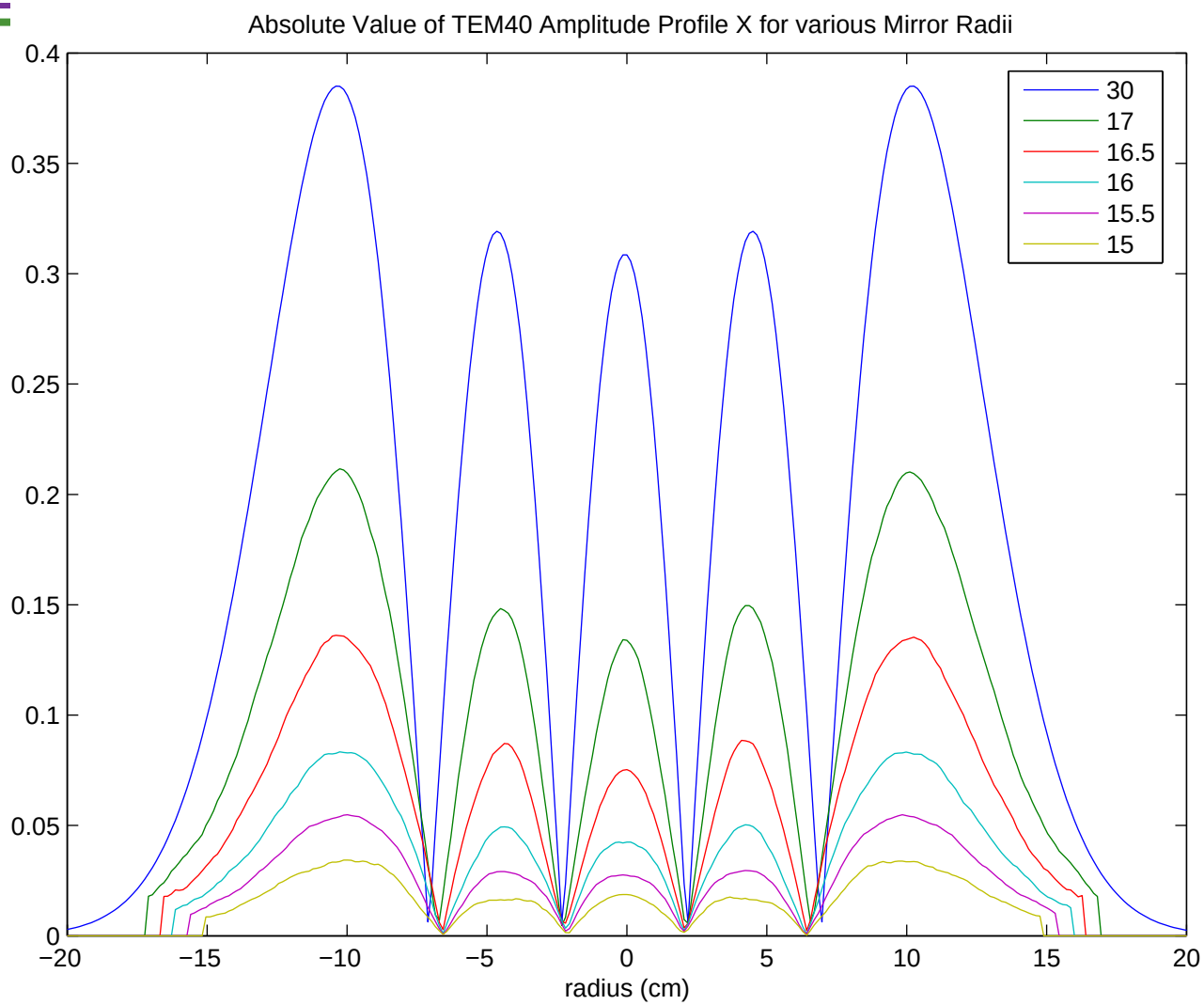
Clipping Loss = The ideal loss calculated by finding power falling outside a Radius of a perfectly Gaussian beam

TEM40 (an Example)





TEM40


Absolute Value of TEM40 Amplitude Profile X for various Mirror Radii
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
−20
−15
−10
−5
0
5
10
15
20
radius (cm)
30
17
16.5
16
15.5
15

Ratio of Diffraction Loss & Clipping Loss