MO system for Hall D

Signal parameters:

Fiber or coaxial ?

Frequency: 499 MHz or 249.5 MHz. Signal has to follow CEBAF path length so we have to use 499 MHz MO rather than 10/ 70 MHz MO

Preferable location of MO source for Hall D: Zone NL26 because of distance to Hall D is shortest (~350m) and NL MO cables are temp. stabilized.

Other option is MCC via new Hall D trench but the length is approximately 800m

Signal requirements:

Frequency: 499 MHz/249.5 MHz

Jitter (1Hz-1MHz) – 2/4 ps

Signal drift (slower than a second) should not exceed 2 deg or 11/22 ps

Signal level: a few dBm should be sufficient to produce PECL clock in Tagger/Hall D

Coaxial Cable: Heliax LDF2 (3/8”) or LDF4 (1/2”)

Phase drift vs temperature

Estimated length from NL26 is about 320m total. (220 m NL26-Tagger + 100m Tagger- Hall D)

LDF2/LDF4 electrical length change is 10/5 ppm /1 deg C for temp between 20 deg C and 40 deg C

For 220 m cable and 400 MHz, 1 deg C will change phase by 1.5/ 0.75 deg (LDF2/LDF4)

For 220 m cable and 250 MHz , 1 deg C will change phase by 0.75/ 0.37 deg (LDF2/LDF4

Because we do not plan to build temperature stabilized line other type of phase drift compensation needs to be applied

We have to split system for two parts (NL-Tagger and Tagger-Hall D) and provide phase feedback for both

Attenuation

LDF2 5.5 dB/100m for 250 MHz or 19.25 dB total

LDF2 8 dB/100m for 499 MHz or 28 dB total [at least 2 W/33 dBm amplifier has to be installed in NL]

MO system for Hall D

Attenuation

LDF4 3.5 dB/100m for 250 MHz or 7.7 dB for 220m

LDF4 5 dB/100m for 499 MHz or 12.1 dB total [> 20 dBm amplifier has to be installed in NL]

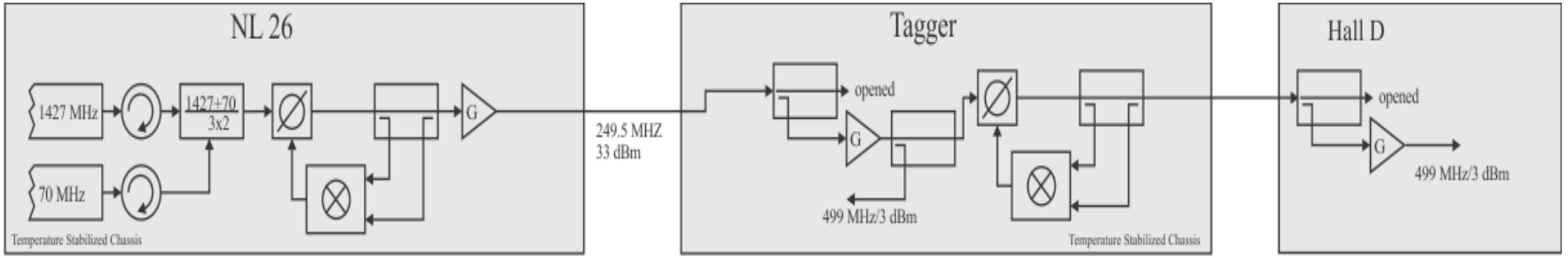
Phase regulation

To be able to precise (0.5 deg) measure phase drift, reflected signal needs to be substantially larger than forward one leaking into reflected port due to limited directivity of directional coupler . Therefore lower frequency (250 MHz) and ½ “ (LDF4) is strongly recommended.

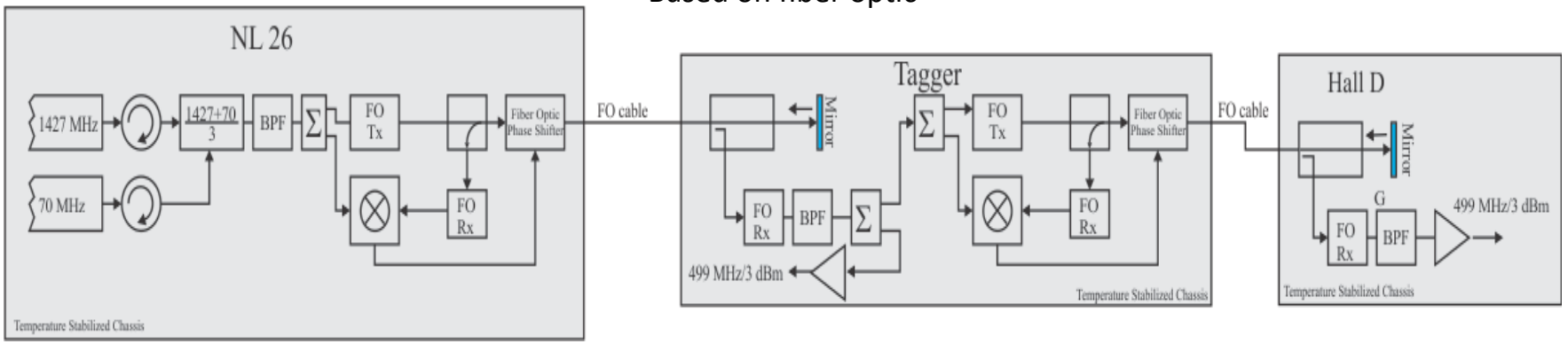
Fiber Optics although equally susceptible (phase) for temperature change demonstrates much lower losses therefore it will be easier to build phase stabilization system . Other advantage of using fiber optic cable is smaller diameter hence easy installation. Cost of fiber cable is smaller than coaxial one but laser transmitter and phase feedback system are expensive. I assume the **costs of both systems are similar.**

System Block Diagram

Based on coaxial cable



Based on fiber optic



Cost estimation (coax)

Hall D MO distribution system												
Task/Milestone		**SE**	**EE**	**ET**	**ED**	**CS**		**Materials**	**Shipping**	**Travel**	**Start**	**Finish**
Conceptual Design			2									
Phase compensation chassis design			2									
Cables, cabinets, chassis			1	3	0.4			$ 13,220.00				
MO System Acceptance Test			0.4	0.4								
Documentation			0.2		0.4							
			0									
Total (weeks)		**0**	**5.6**	**3.4**	**0.8**	**0**						
SE: Senior Engineer												
EE: Electrical Engineer												
ET: Electronic Technician												
ED: Electrical Designer												
CS: Computer Scientist												

Detailed hardware (coax) cost (included in cost estimation)

	quantity	[]	price [$]	per …	total cost
Heliax LFD2 or 4	1300	feet	2.4	1 feet	3120
add/divider	1		1000	per 1	1000
phase drift diagnostic	2		1500	1	3000
2 W amplifier	2		550	1	1100
circulators/ dir copulers, attenuators, etc	1		2000	1	2000
				S	10220
chassis/cabinet	2		1500		3000
				S	3000
				S	13220