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Flexible Bowtie Antennas: Modeling, Simulations and Measurements

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Flexible Display Center

The Flexible Display Center is a collaboration among government, industry and academia designed to advance the development of full-color flexible display technology and flexible electronics industry to produce integrated electronic systems with advance functionality.




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Flexible Display Center

1. Displays
2. Digital Electronics
3. Electronic ID Tags
4. Integrated Sensor Systems
 - Smart medical bandages
 - Detectors
5. Flexible-Conformal Antennas?



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FDC Flexible Material

Flexible Display Center PEN (Polyethylene Naphthalate) Plastic.

Triangular Thin Aluminum

$\epsilon_r = 7$	0.7 microns = 0.0007 mm	- Silicon Nitride	0.0007 mm
$\epsilon_r = 3$	128 microns = 0.128 mm	- Rogers 3003	0.128 mm

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Monopole Design

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Solid Monopole Design



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Solid Monopole Design



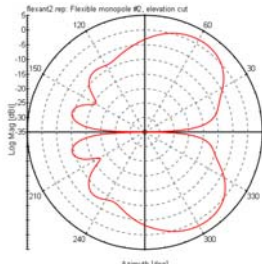
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Solid Monopole Design

Amplitude pattern of monopole antenna at $f = 3.605$ GHz
(max. gain of 1.94 dBi at 56°)

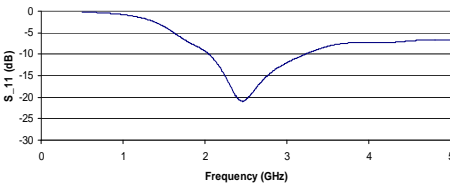


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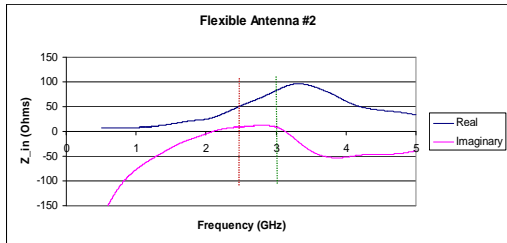
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Solid Monopole Design

$Z_{in}(f = 2.5 \text{ GHz}) = 50 + j10$
 $Z_{in}(f = 3 \text{ GHz}) = 80 + j10$



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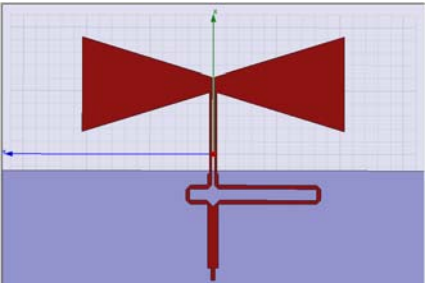
Bow-Tie Design

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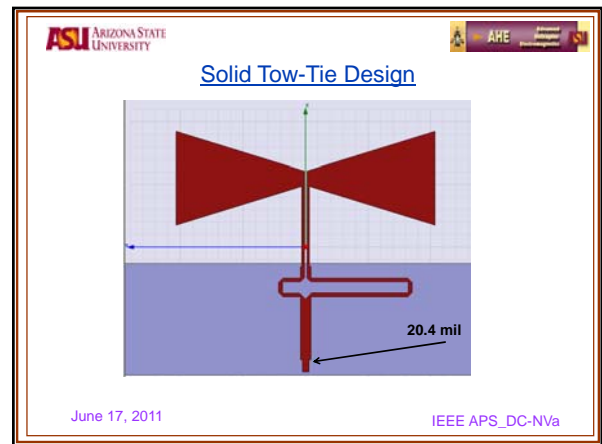
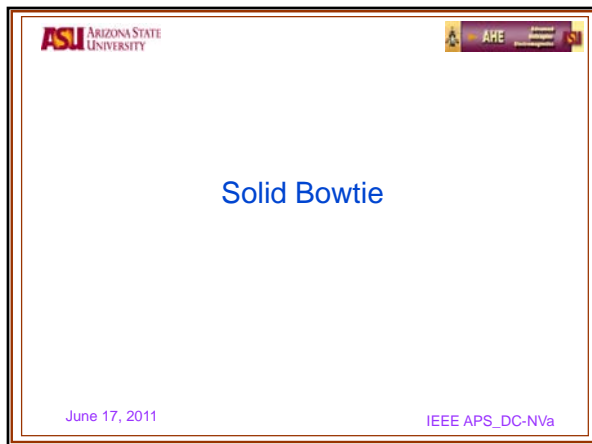
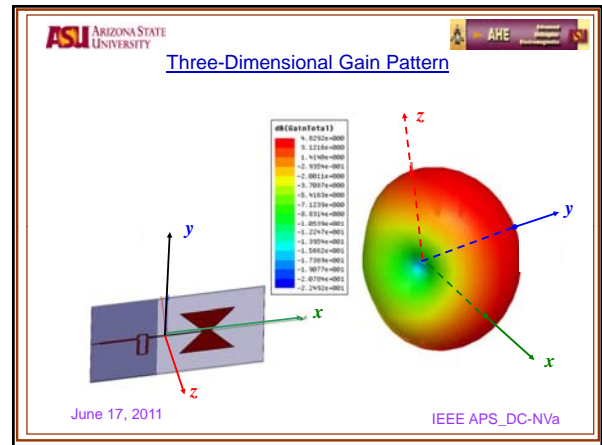
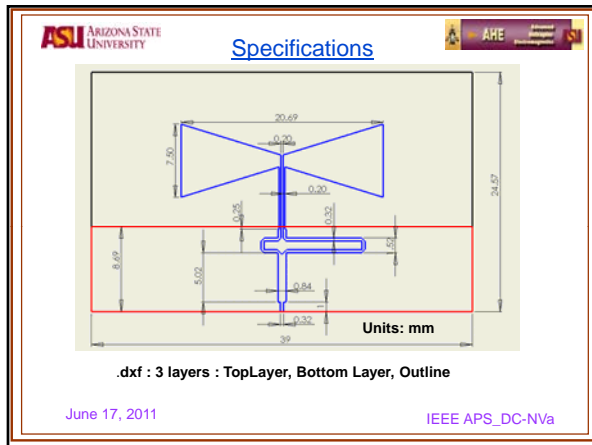
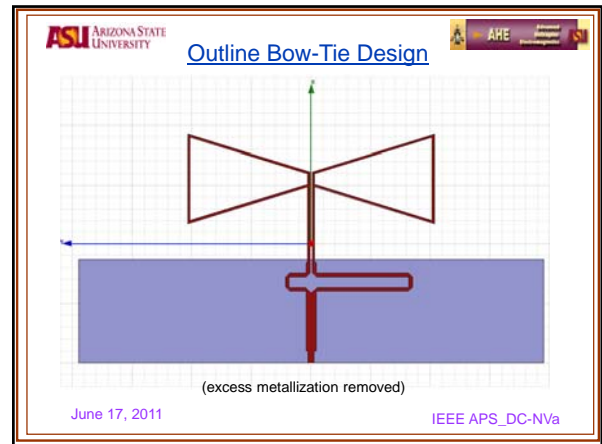
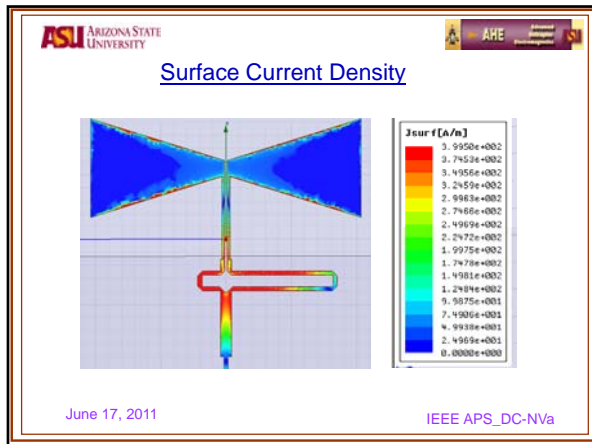
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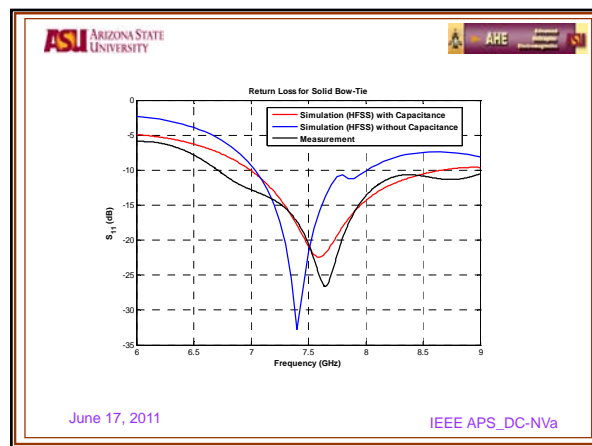
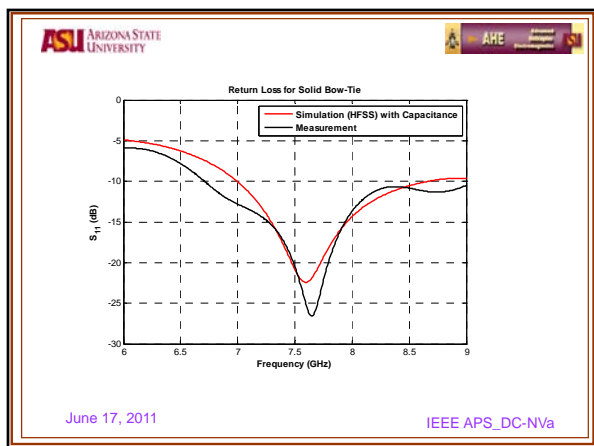
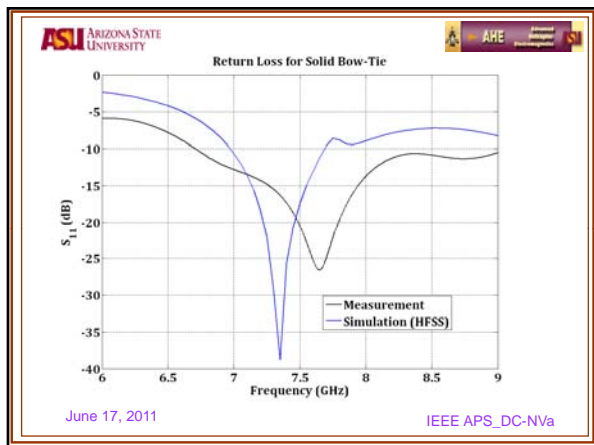
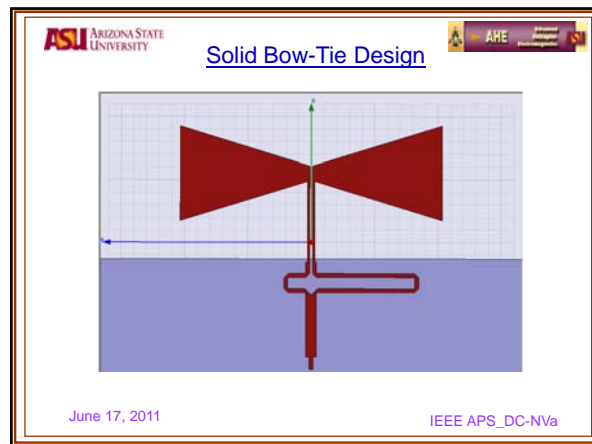
Solid Bow-Tie Design

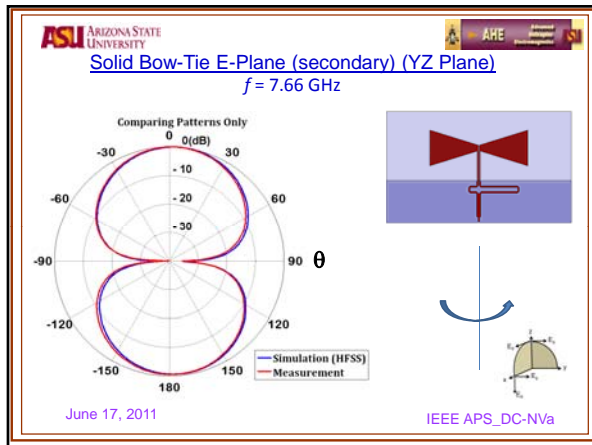
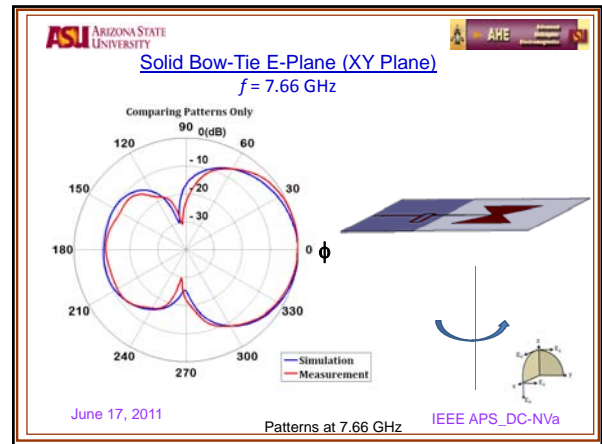
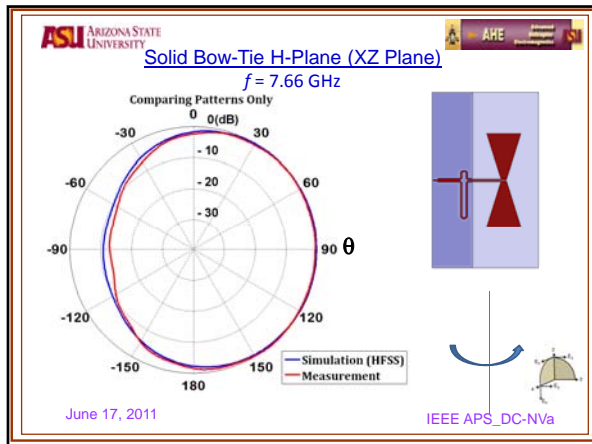


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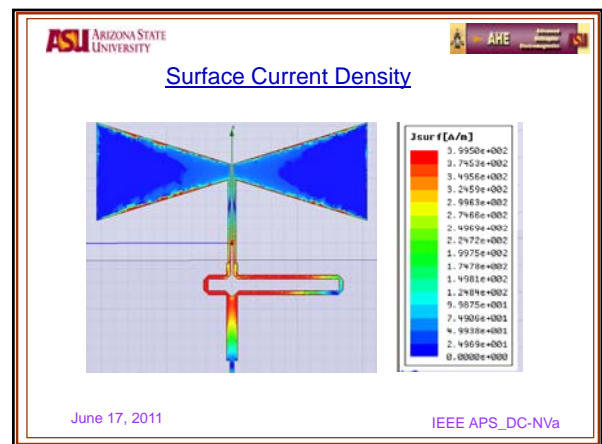
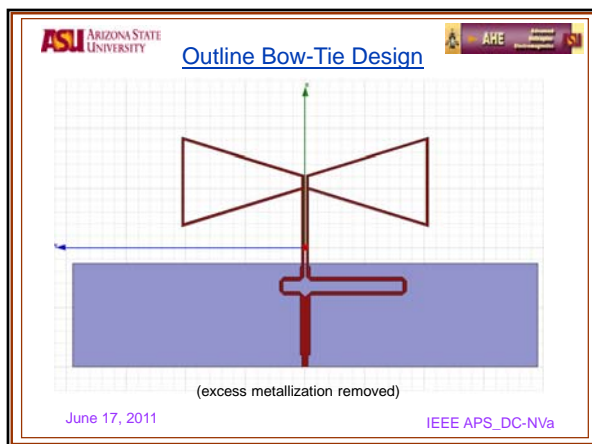


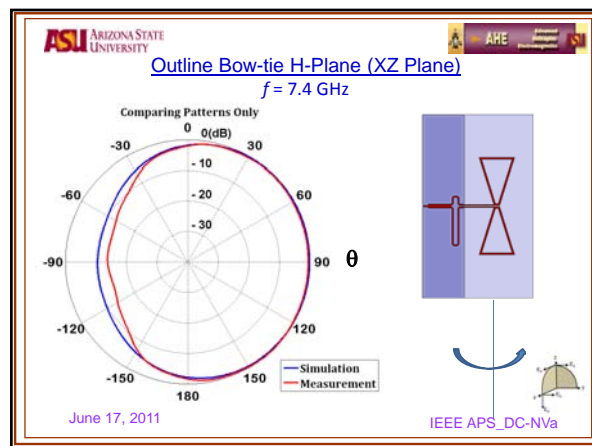
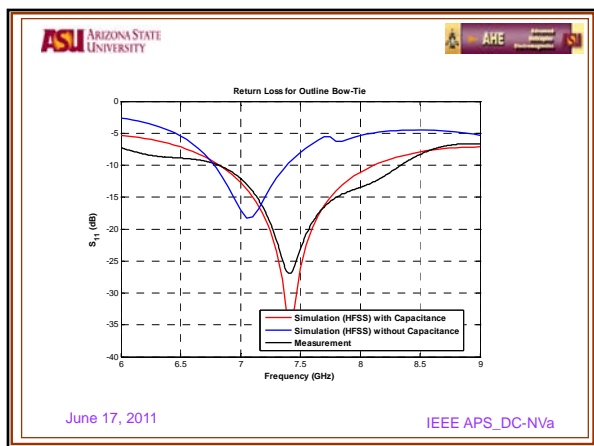
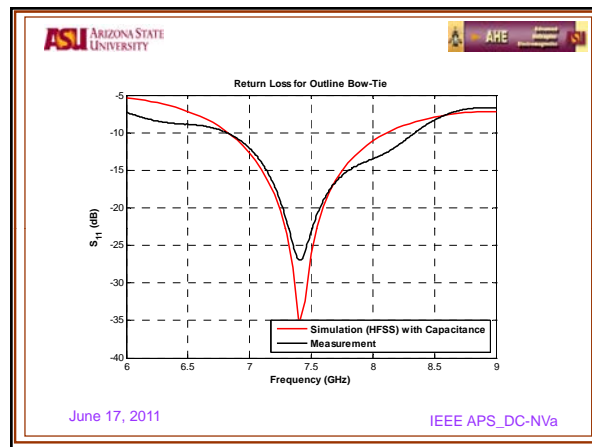
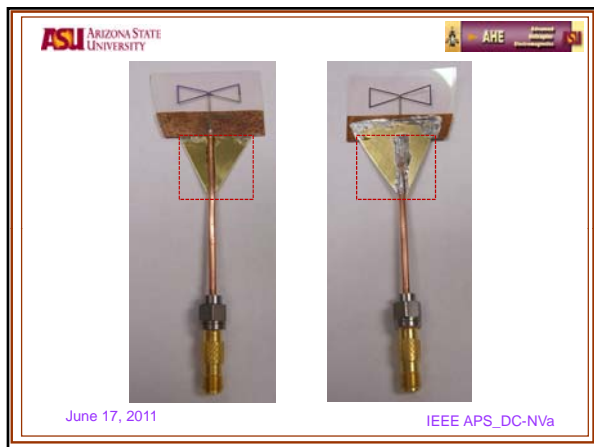
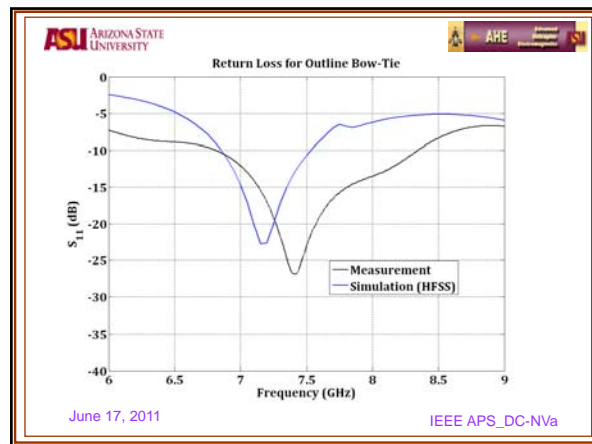


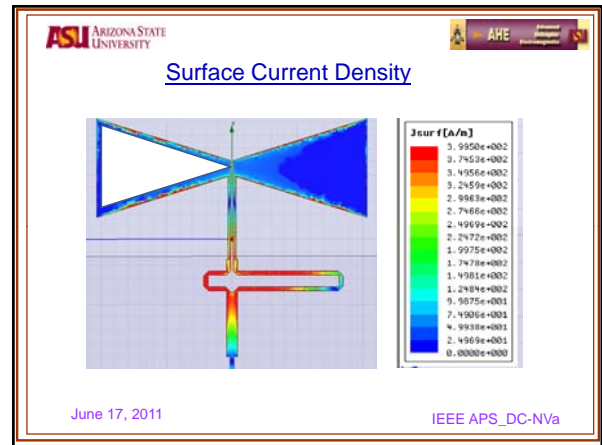
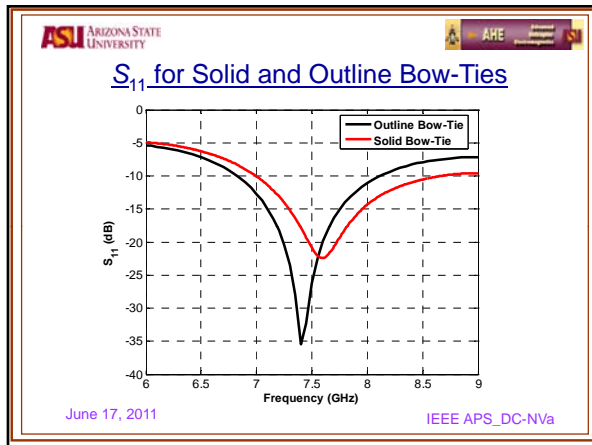
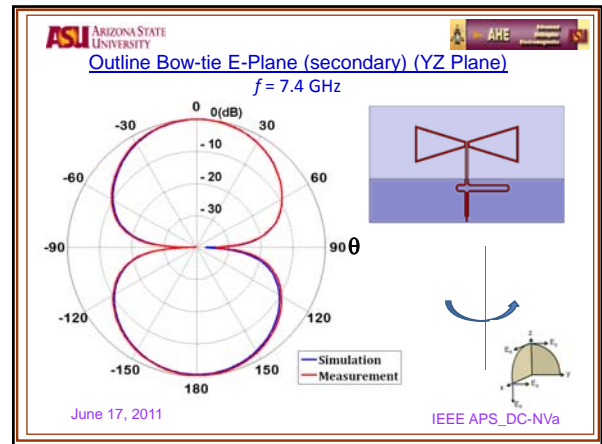
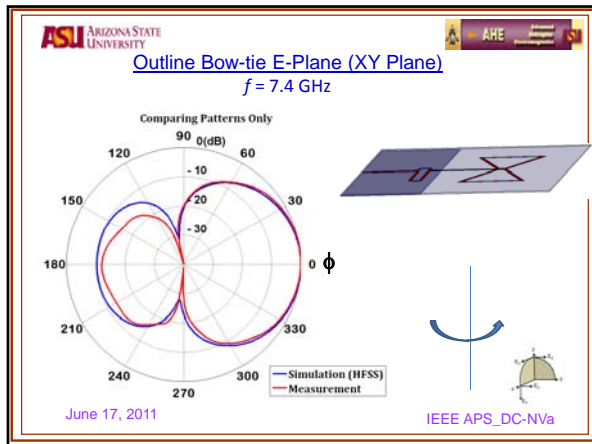
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Outline Bowtie

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Gain
 Solid vs Outline

	Solid Bow-Tie	Outline Bow-Tie
Center Frequency (GHz)	7.66	7.4
Simulated Gain (dBi)	2.33	1.83
Measured Gain (dBi)	2.5	1.7
Fractional Bandwidth (%)	8.75	8.92

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Gain
 Solid (7.66 GHz vs Outline 7.4 GHz)

	Antenna	Ground Plane	Support Structure	Gain (dBi)	
				Solid	Outline
Model 1	PEC	PEC	NA	4.48	4.7
Model 2	Copper	Copper	NA	4.03	4.006
Model 3	FDC metal	Copper	NA	2.61	1.95
Model 4	FDC metal	Copper	PEC	2.52	1.95
Model 5	FDC metal	Copper	Copper	2.33	1.83
Measurement	FDC metal	Copper	Copper	2.5	1.7

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Flexed Bowtie

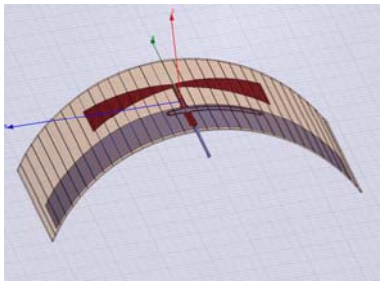
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Flexed Bow-Tie



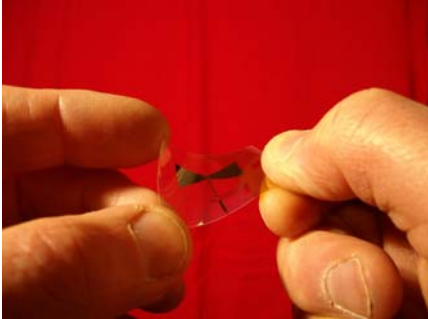
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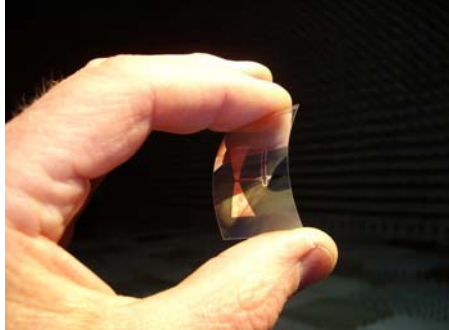
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Flexed Bow-Tie



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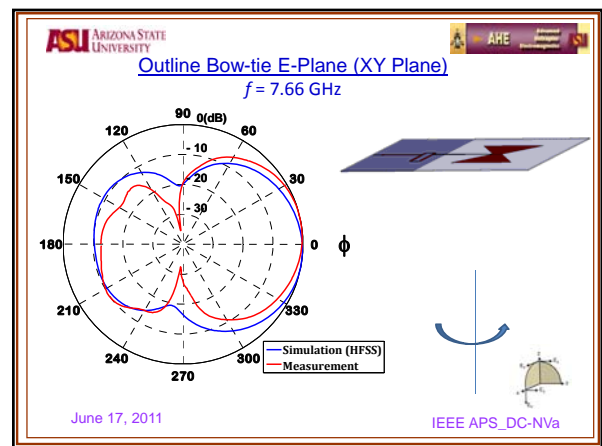
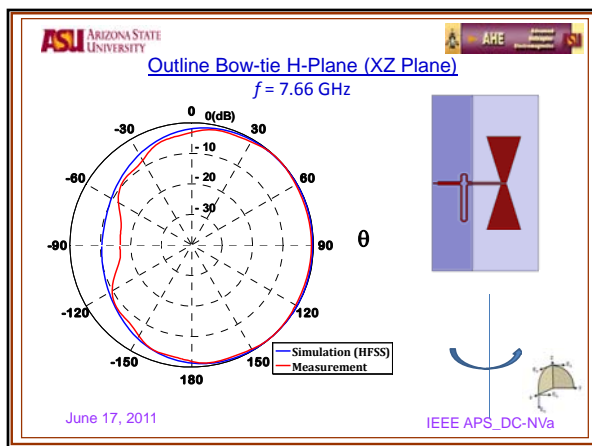
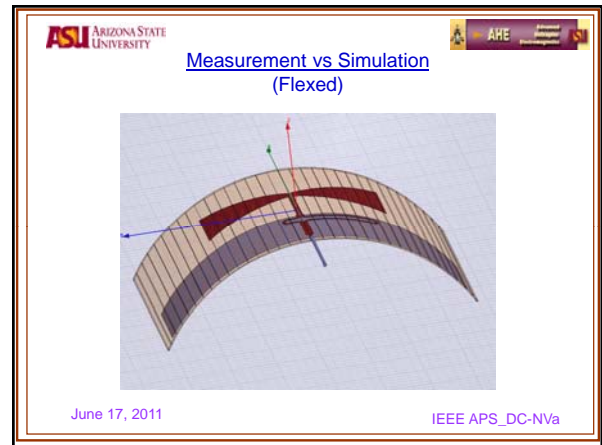
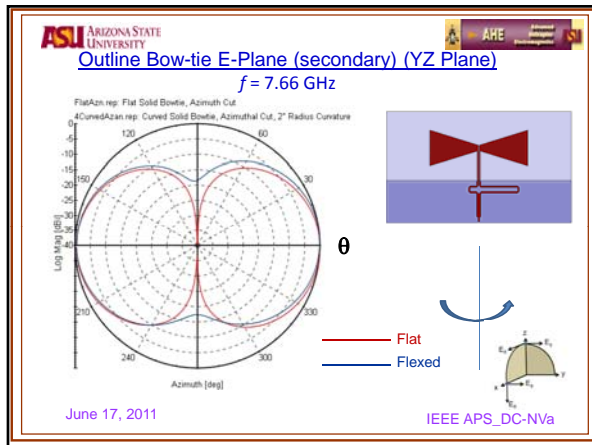
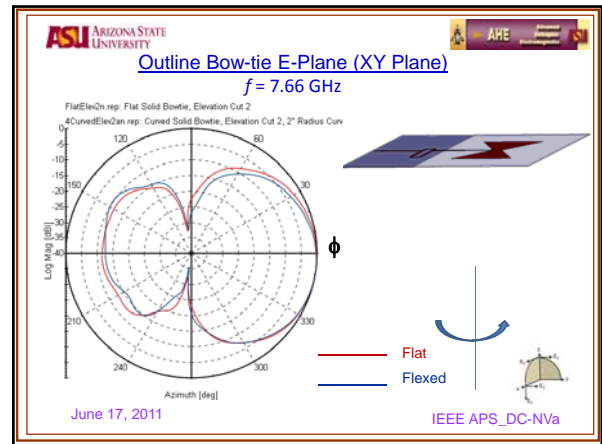
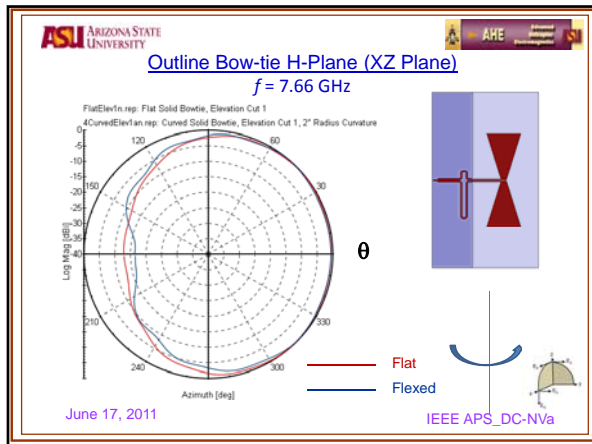
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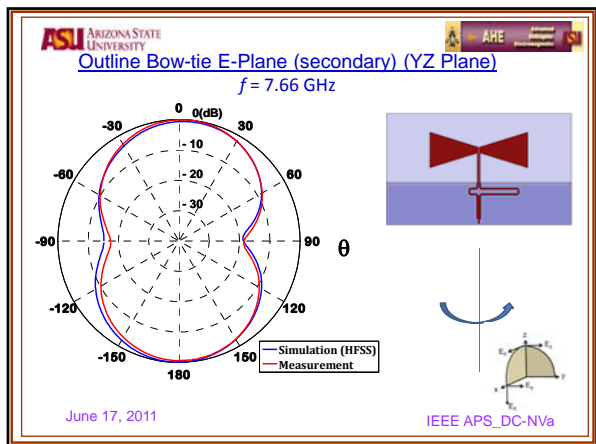
Flat vs Flexed (measurements)



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Gain (measured): Solid
 Flat vs Flexed
 $f = 7.25$ GHz
 Gain (dBi)

	H-Plane	E-Plane	Secondary E-Plane
Flat	2.6	2.6	0.3
Flexed	2.6	2.6	-0.6

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