GBT Holography
Claire Chandler
Ronald J. Maddalena

GBT PTCS Conceptual Design Review
April 8/9, 2003 Green Bank
Outline

• What we know
• What we need to improve upon
• Aim of Holography
• Why we need multiple Holography experiments
• Plans for Out-of-Focus holography
  – A preview…
• Plans for Traditional Holography
Telescope Efficiency

- Repeatable (Gravitational) Focus Tracking
  - Subreflector Axial Position
    - Require an accuracy of 1-3 mm in Ys
    - Currently known to ~10 mm
  - Subreflector Lateral Shifts
    - Require an accuracy of 3-6 mm in Xs and Zs.
    - Xs currently known to ~10 mm
    - Zs has yet to be determined due to limitations in subreflector motion.
  - Subreflector Tilts
    - Require an accuracy of 6’ in Xt, Zt
    - Currently known to 10’
Telescope Efficiency

• Repeatable (Gravitational) Large-Scale Surface Errors
  – Require 200 μm
  – 1.2 to 1.5 mm without FEM active surface
  – Probably 450 μm with FEM active
    • 70% at 2 GHz, 60% at 20 GHz, 35% at 42 GHz
  – FEM scale factor is currently assumed.
  – Projection to normal calculation may be wrong

• Small-Scale errors
  – Unknown magnitude
  – Probably the same at all elevations.
Current FEM Model

GBT PTCS Conceptual Design Review – April 8/9, 2003
Efficiencies at 20 GHz

- Red triangles: Surface Control - On
- Blue circles: Surface Control - Off
Aim of Holography

• Flatten efficiency curve
  – Improve Focus tracking
  – Determine FEM scale factor, projection to normal
  – Measure and fix large-scale distortions not predicted by FEM

• Raise high-frequency efficiencies
  – Improve Focus tracking
  – Determine FEM scale factor, projection to normal
  – Measure and fix small-scale surface errors
Types of Holography Experiments

• Phase-retrieval Holography
  – Requires very high signal-to-noise

• Out-of-Focus Holography
  – Large-scale errors
  – Focus tracking
  – Multiple elevations
  – No special hardware

• “Traditional” phase-reference holography
  – Large and small scale errors
  – Focus tracking
  – Small-scale errors can probably be measured over a small range of elevations. Maybe large-scale errors at multiple elevations.
  – Requires special hardware