

# Physics Aspects of the ACR MR Accreditation Program

The Good, the Bad, and the Ugly

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# ACR MRAP Milestones

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- ▶ 1994 Start of Program Development
- ▶ Nov 1996 Program Publicly Introduced
- ▶ Mar 1997 First Applications Accepted
- ▶ Incorporation Into Regulatory/Reimbursement Plans
  - ▶ Late 1997 RI Department of Health (CON)
  - ▶ Jan 1, 2000 Aetna US Healthcare
  - ▶ Sept 1, 2006 BCBS of AL (PRP Program)
    - ▶ Dec 18, 2009 CareCore enforces MRI Equipment Performance
  - ▶ March 1, 2008 United Healthcare

# ACR MRAP Morphing

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- ▶ May 2, 2002            QC Requirements Changed
  - ▶ Daily Program Optional, Weekly Program Mandatory
- ▶ July 1, 2005            Physicist's Annual Surveys Required
- ▶ Oct 5, 2008            Interslice RF Interference Test Dropped
- ▶ Oct 20, 2008          ACREdit Activated
  - ▶ Web Front End to MRAP Database
  - ▶ Seventeen-Point QC Questionnaire Dropped
- ▶ Nov 1, 2008            Modular Program Started
- ▶ May 2010                Breast MRAP Started

# The Good Aspects of MR Physics Support

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- ▶ Good to the Facilities
  - ▶ Professional, Periodic, and Independent Assessment of MRI Equipment Performance
  - ▶ Site Specific Troubleshooting and Problem Solving
  - ▶ Help With Equipment Acquisitions
- ▶ Good to the Profession
  - ▶ Rises Awareness of Medical Physics Profession
- ▶ Good to the Physicists
  - ▶ Although Sometimes I Wonder...

# The Bad

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- ▶ ACR MRAP Commoditizes the MR Scanners
  - ▶ Definitely Not True Today
- ▶ Scope and Methodology of Physics Tests
  - ▶ Change Towards Prescriptive, Rigid Structure
  - ▶ Individual Tests Are Simple, But the Entire Package Is Not
    - ▶ Several Tests Are Old and No Longer Appropriate
    - ▶ Some of the Tests Are Doable Only On Specific Platforms
    - ▶ Pass/Fail Criteria Murky
  - ▶ Required Phantom Has Its Own Flaws
    - ▶ Best Known Bugaboo: Gibbs Artifact on Slice Thickness Ramps
  - ▶ Paperwork is Mind-bogglingly Ornate

# The Bad

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- ▶ Decoupling of Yearly Survey Tests And ACR MRAP Application Phantom Testing Tests
- ▶ Laser Camera Requirements Hopelessly Quaint
  - ▶ Grayscale Calibration Issues
  - ▶ Requires Access to SMPTE Pattern Image
- ▶ Display Test In Current Form Is a Joke
  - ▶ Who Knows How to Test Calibration of **Color** AMLCD for Display of Medical Grayscale Images?

The Ugly

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# Ten Ugly Secrets of the MRAP Physics Tests

# The Ugly Secret #10

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## ▶ Phantom Losses

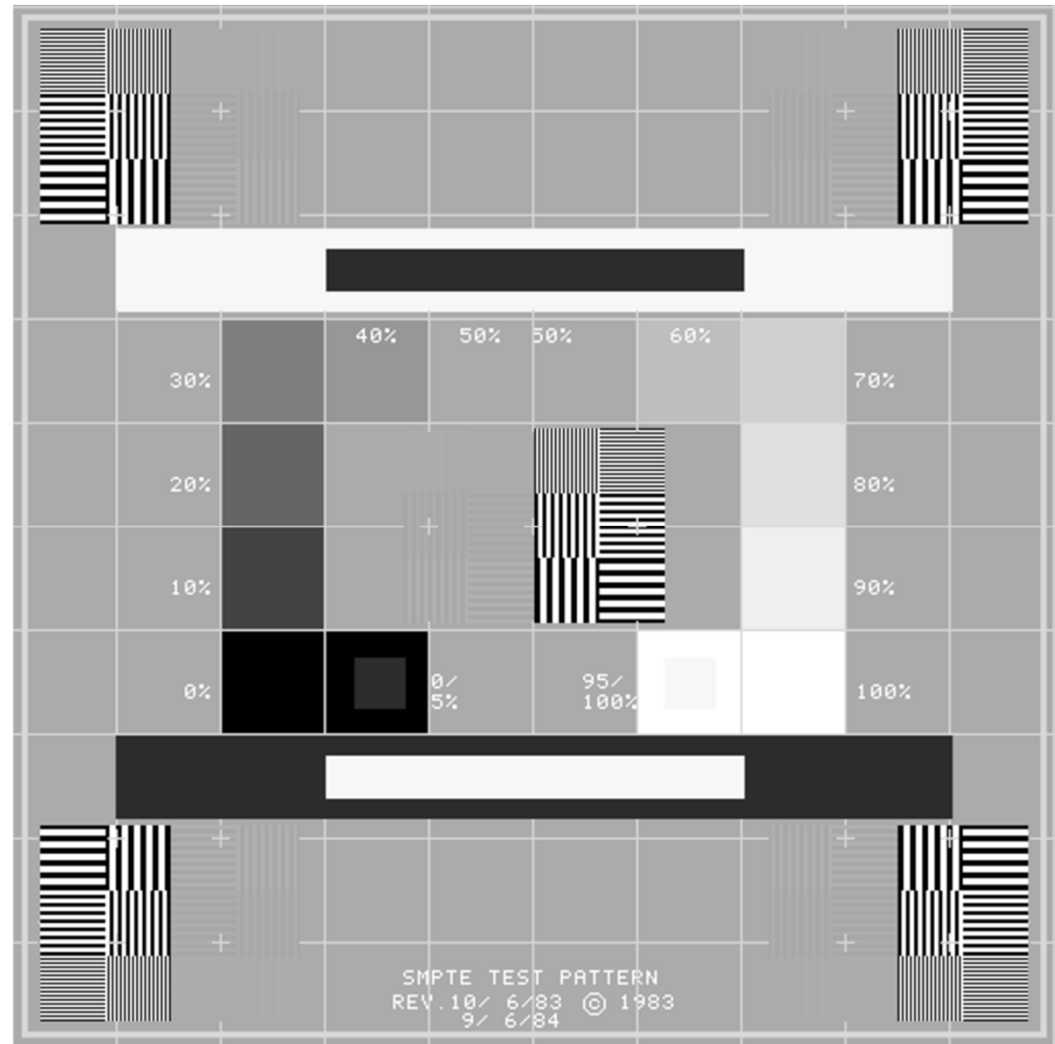




# The Ugly Secret #9

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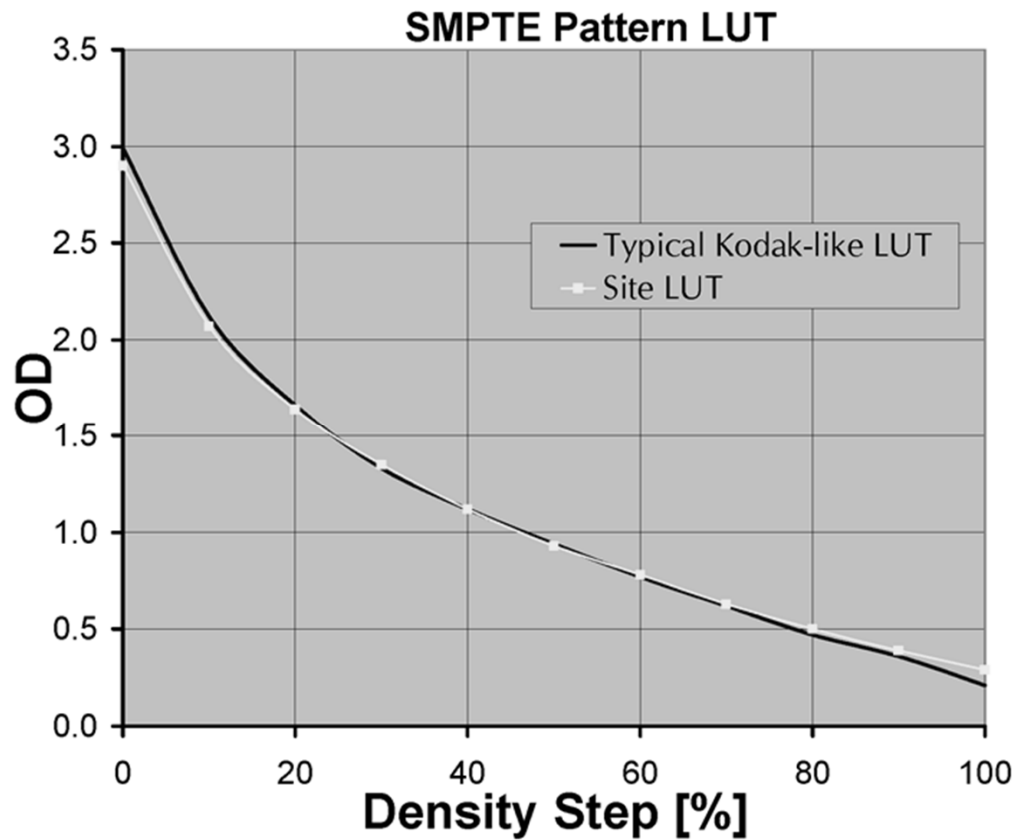
▶ Do You SMPTE?



# The Ugly Secret #8

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## ► Film Camera Calibration



# The Ugly Secret #7

## ► Center Frequency and Transmitter Attenuation (Gain)

The screenshot displays a medical imaging console interface with several key sections:

- PATIENT INFORMATION:** Includes fields for Accession Number, Patient ID, Patient Name, and Landmark. A diagram of a patient on a table is shown.
- PATIENT POSITION:** Controls for Patient Position (Supine), Patient Entry (Head First), and Coil (HEAD).
- IMAGING PARAMETERS:** Includes Plane (3-Plane), Mode (2D), Pulse Seq (Localizer), Grad Mode, Imaging Options (None), and Psd Name (STL 66%).
- AUTOVIEW:** A small window showing a scan image with technical details like E: 182, S: 120, and TR: 7.8.
- RX MANAGER:** A list of scan series with columns for State, #, and Series Description. The current series is 'INRX 3-p1 T2\* FGRE'.
- SCAN TIMING:** A table for adjusting scan parameters:
 

Parameter	Value	Min.	Max.
# of Echoes	1	1.0	1.0
TE	1.7	1.7	1.7
TEC	0.0	0.0	0.0
TR	7.8	7.8	7.8
T1	0	0	0
T12	0	0	0
Flip Angle	30	30	30
Echo Train Length			
Bandwidth	31.2	31.2	31.2
Bandwidth2	31.2	31.2	31.2
- ADDITIONAL PARAMETERS:** Includes SAT, Graphic RX, Image Enhance, and User Off Screen.
- ACQUISITION TIMING:** Includes Freq (256), Phase (128), NEX (1.00), and Phase FOV (1.00).
- SCANNING RANGE:** Includes FOV (24), Slice Thickness (5.0), Spacing (5.0), and # Slices Per Plane (7).

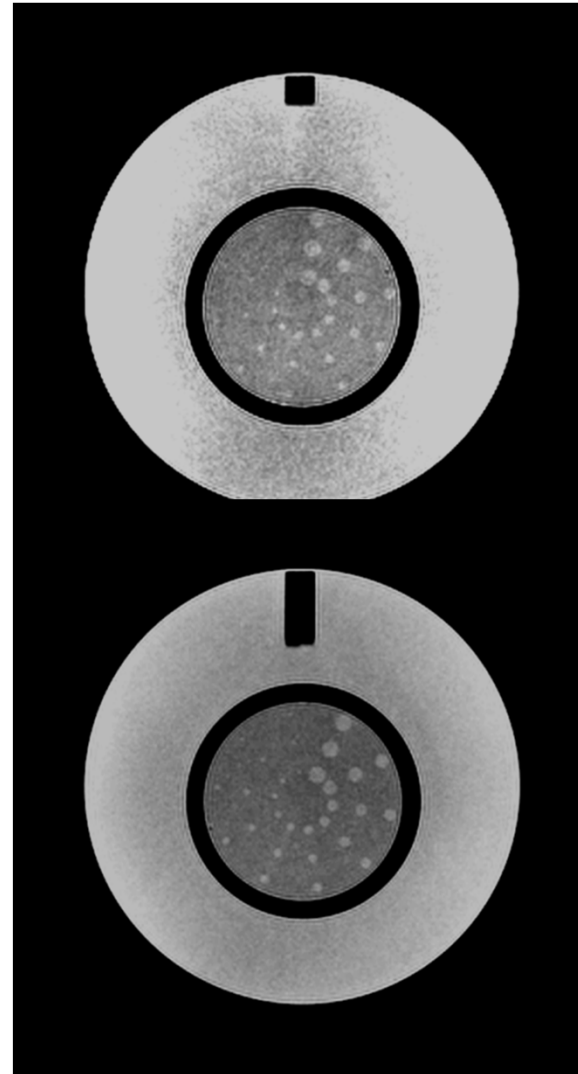
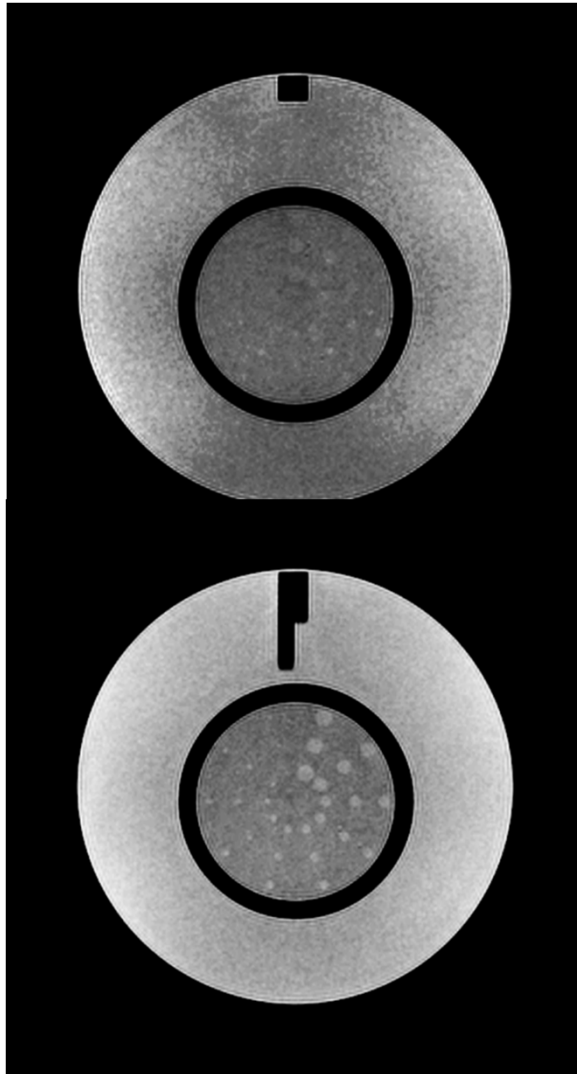
At the bottom, there are status indicators and control buttons:

- Rx Scan Time:** 0:23
- Rel. SNR(%):** 100
- Temp Res:** >
- Max # of Slices /Acq.:** 1
- Save Series** button
- Est. SAR:** 0.0167
- Average Coil SAR:** 0.0167
- Peak SAR:** 0.0416
- # of Acqs.:** 3
- Reset Values** button
- Exam 182, Series 1 - scanned.**
- Scan Time:** 0:04
- dB/dt:** 66%
- Auto Prescan**, **Manual Prescan**, **Prep Scan**, and **Scan** buttons.

# The Ugly Secret #6

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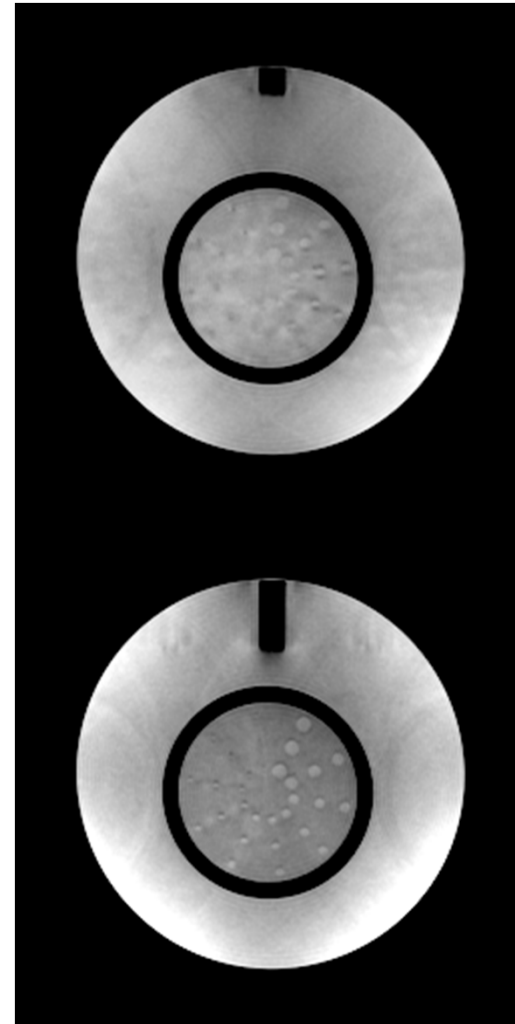
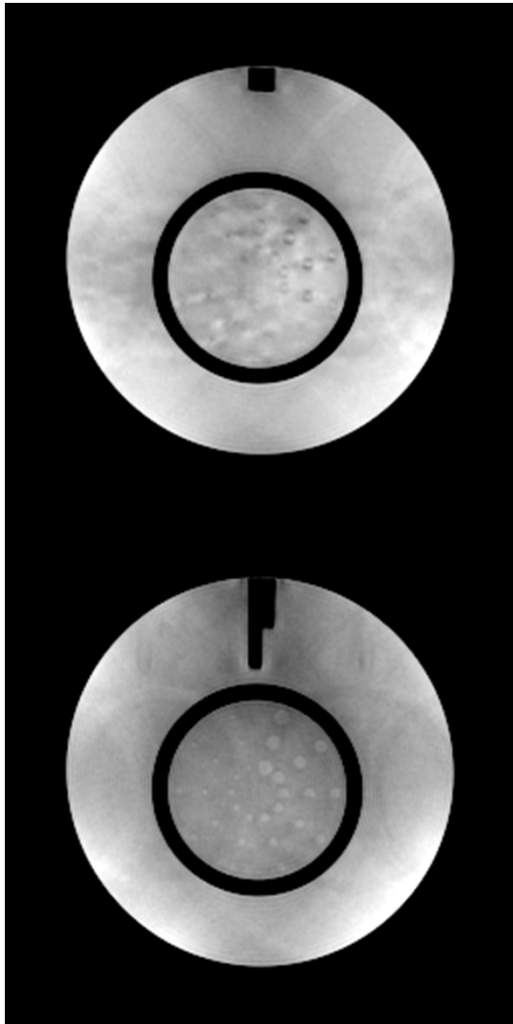
- ▶ Low Contrast Detectability



# The Ugly Secret #6

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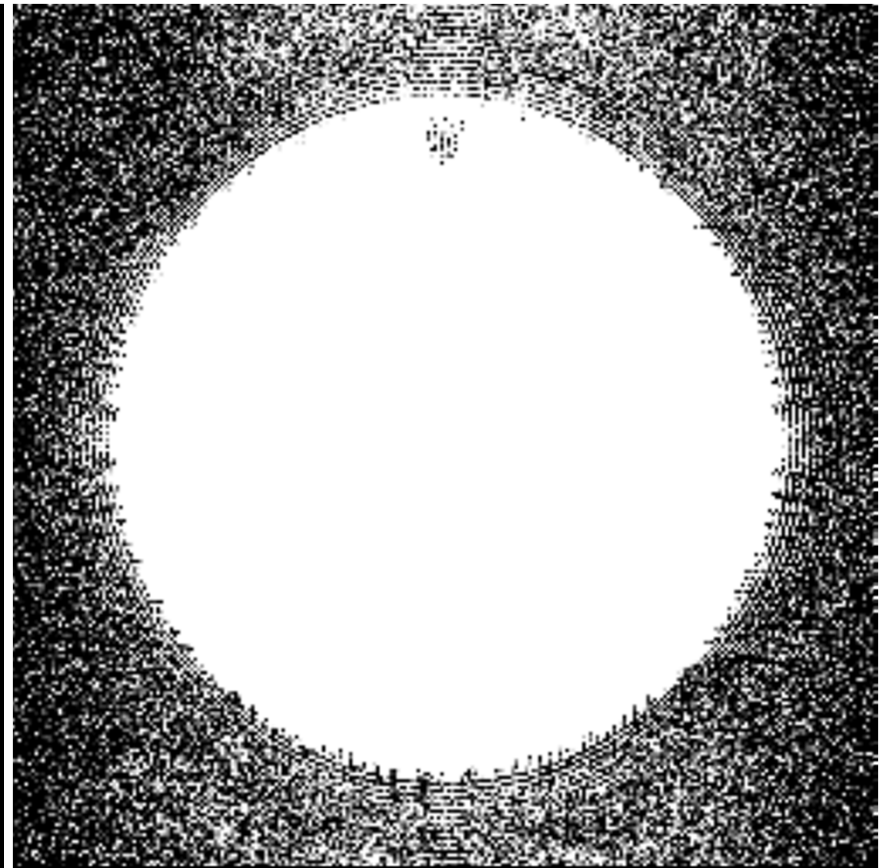
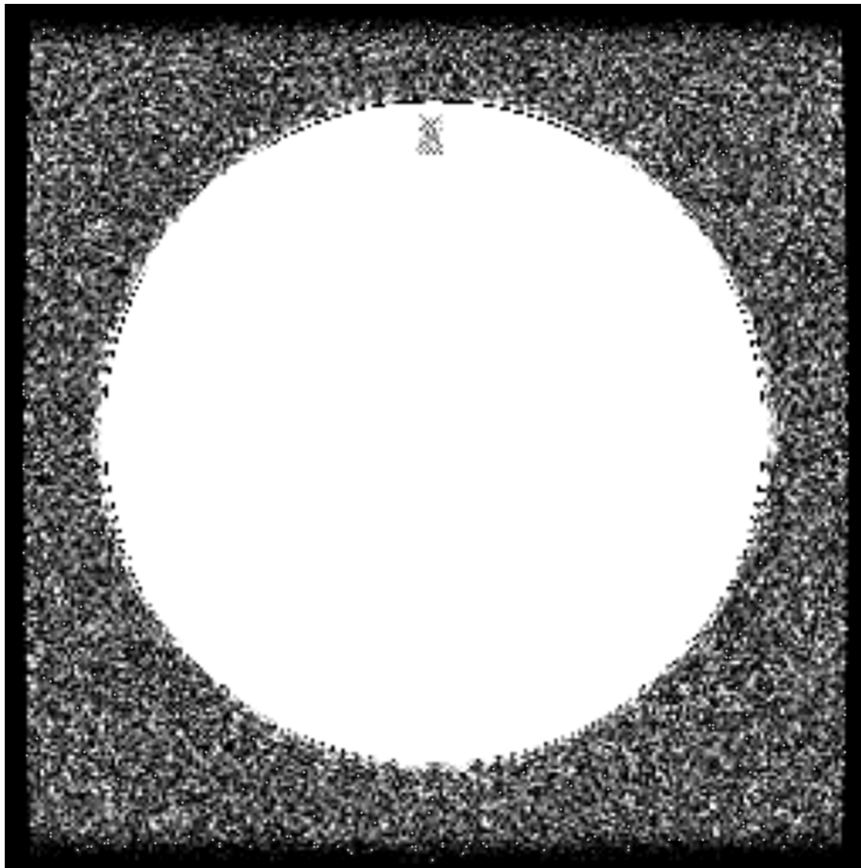
- ▶ Low Contrast Detectability



# The Ugly Secret #5

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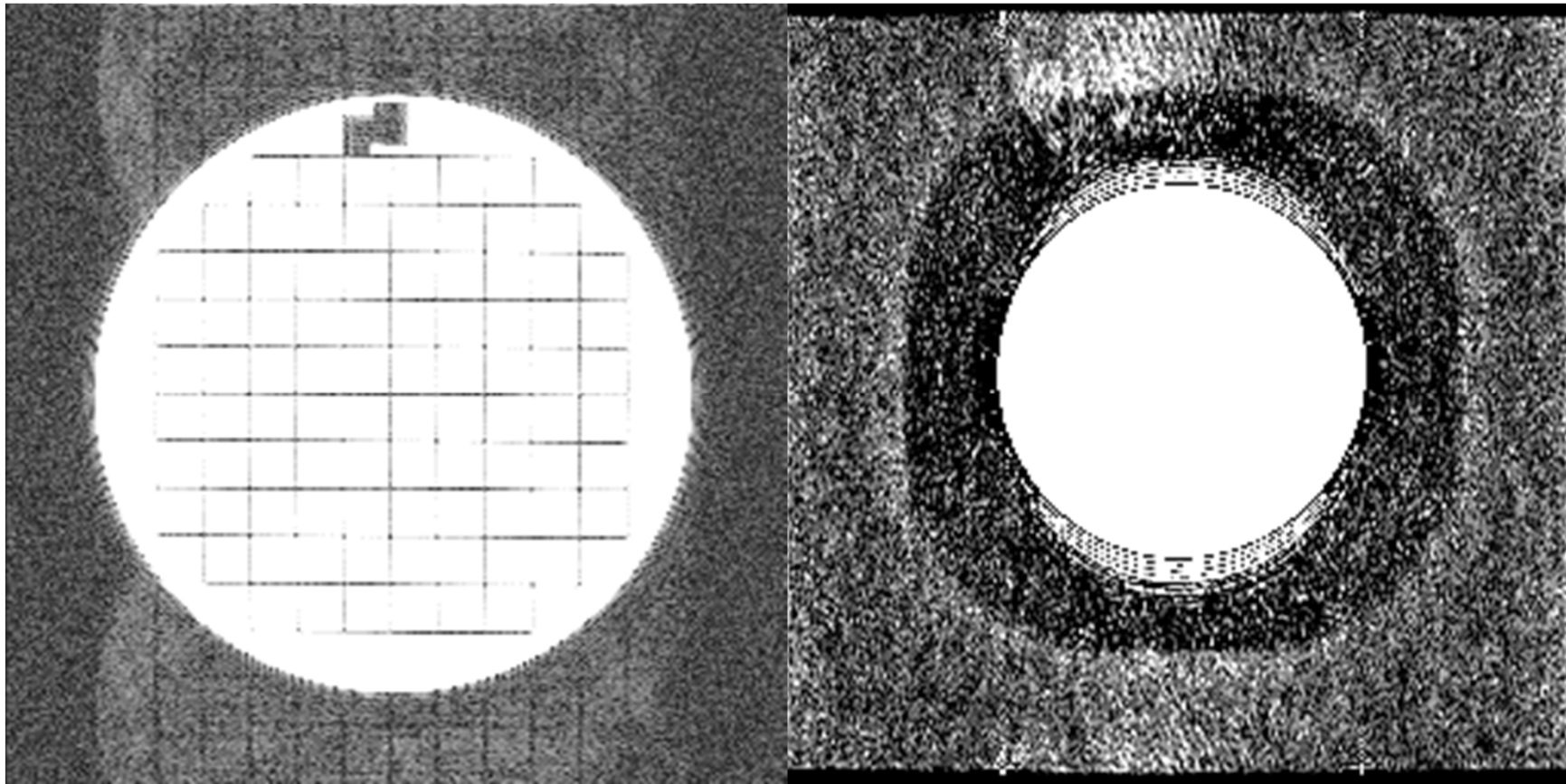
## ▶ Noise and Ghosting



# The Ugly Secret #5

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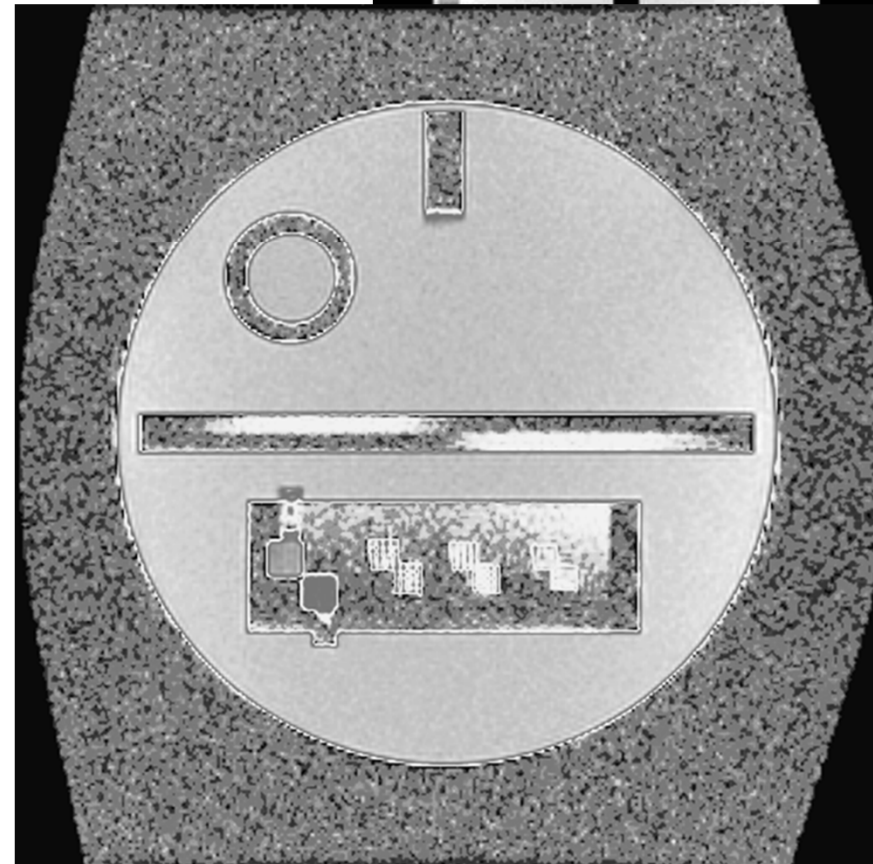
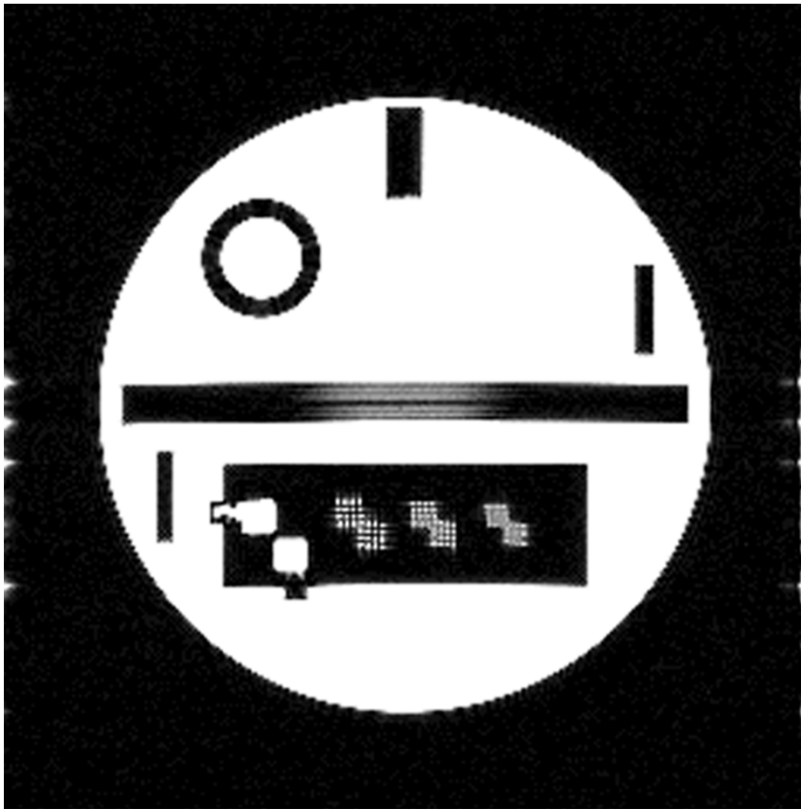
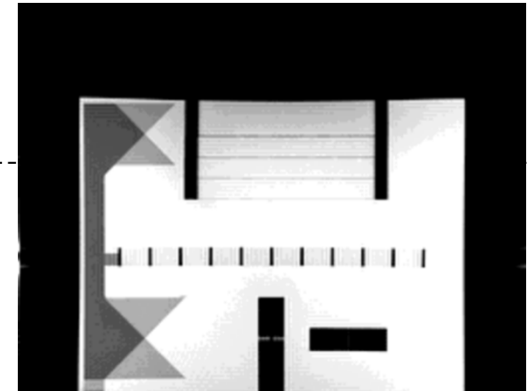
## ▶ Noise and Ghosting



# The Ugly Secret #4

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- ▶ Slice Position Accuracy

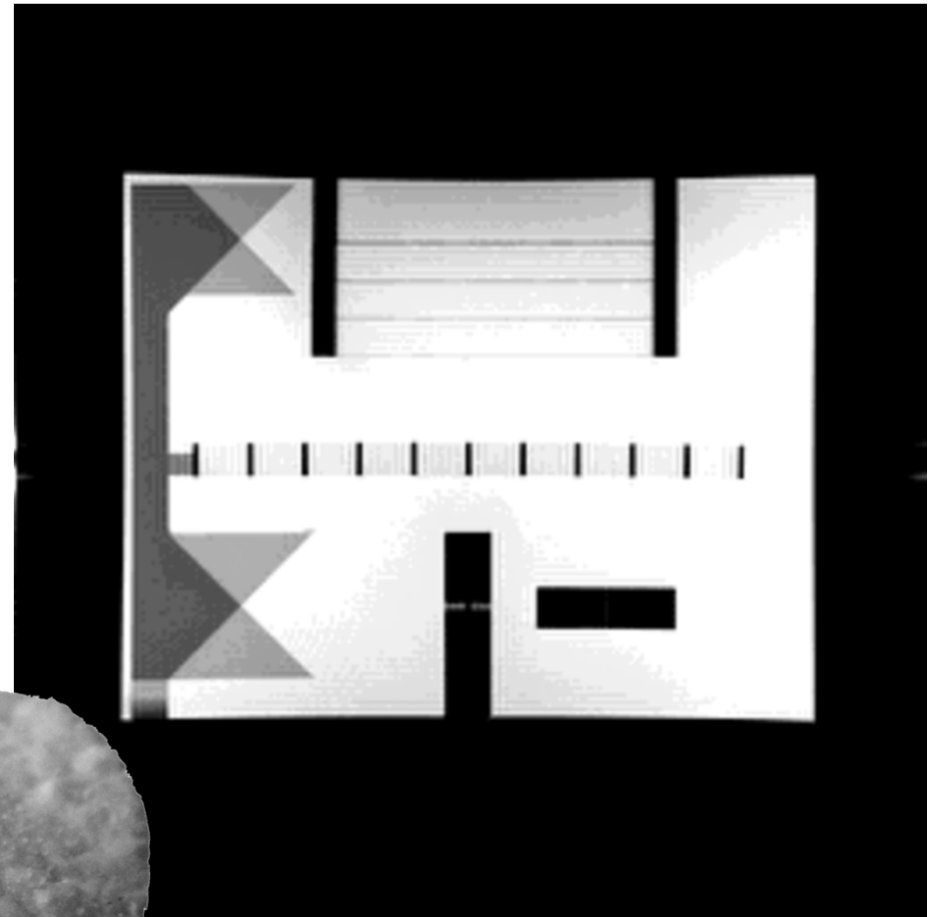
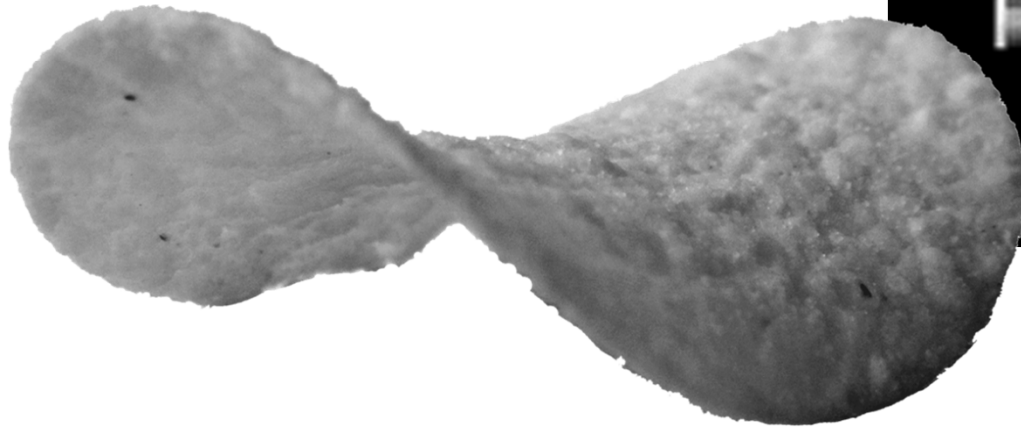




# The Ugly Secret #4

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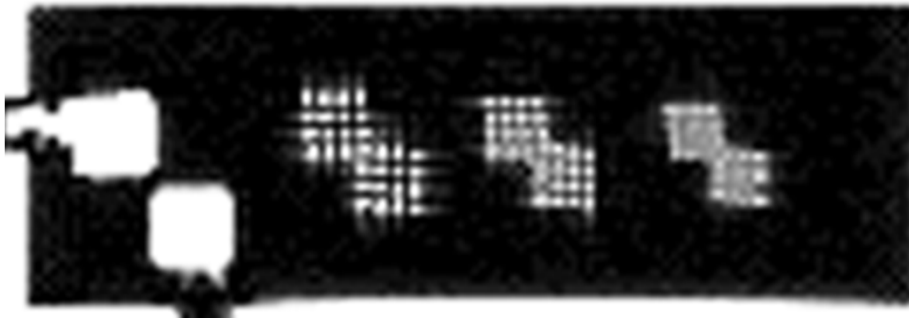
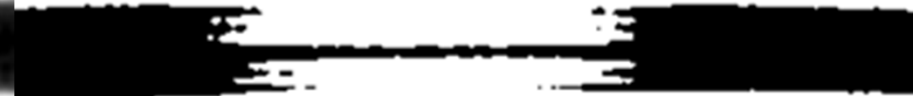
- ▶ Slice Position Accuracy



# The Ugly Secret #3

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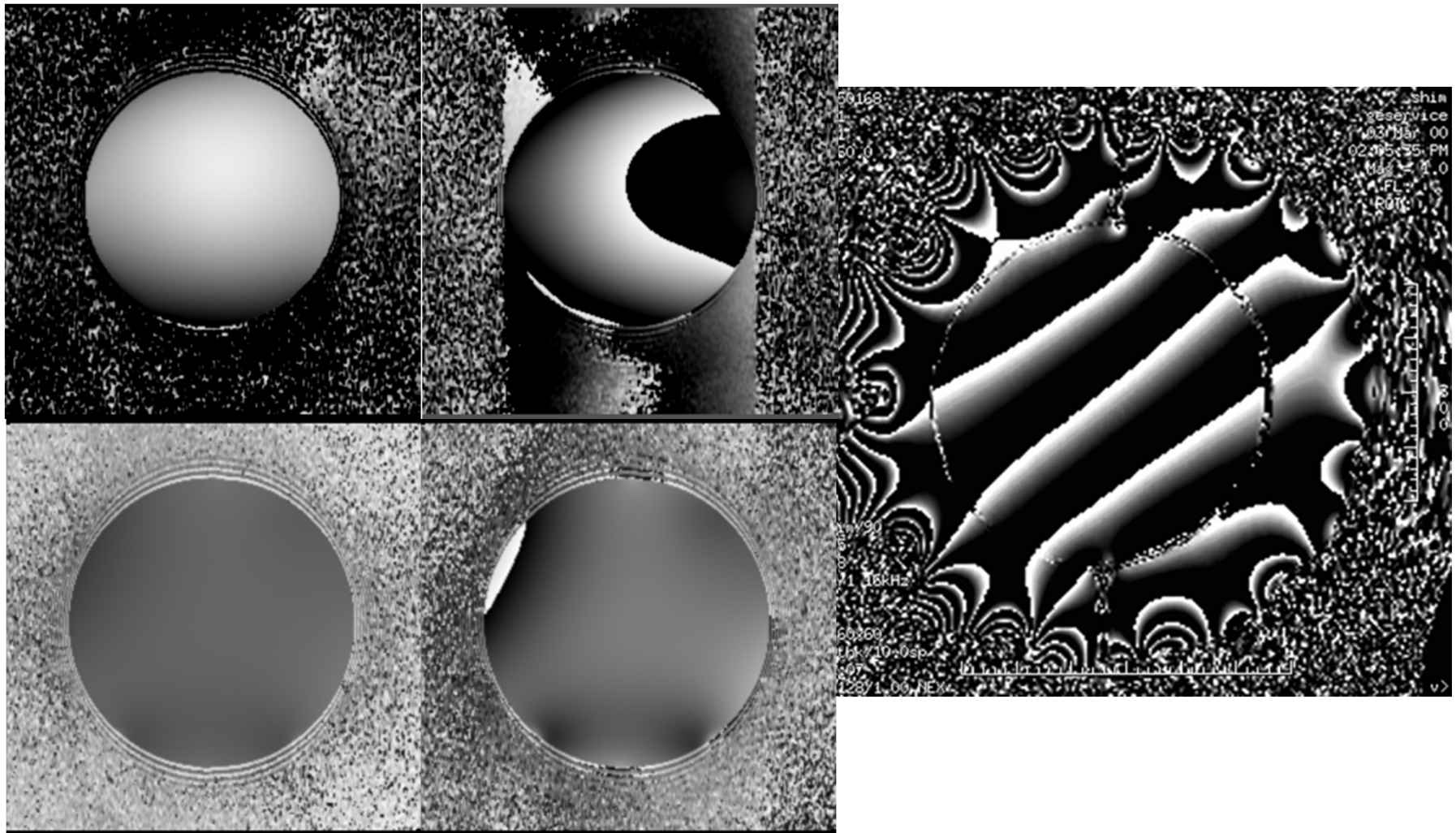
- ▶ Slice Thickness Accuracy



# The Ugly Secret #2

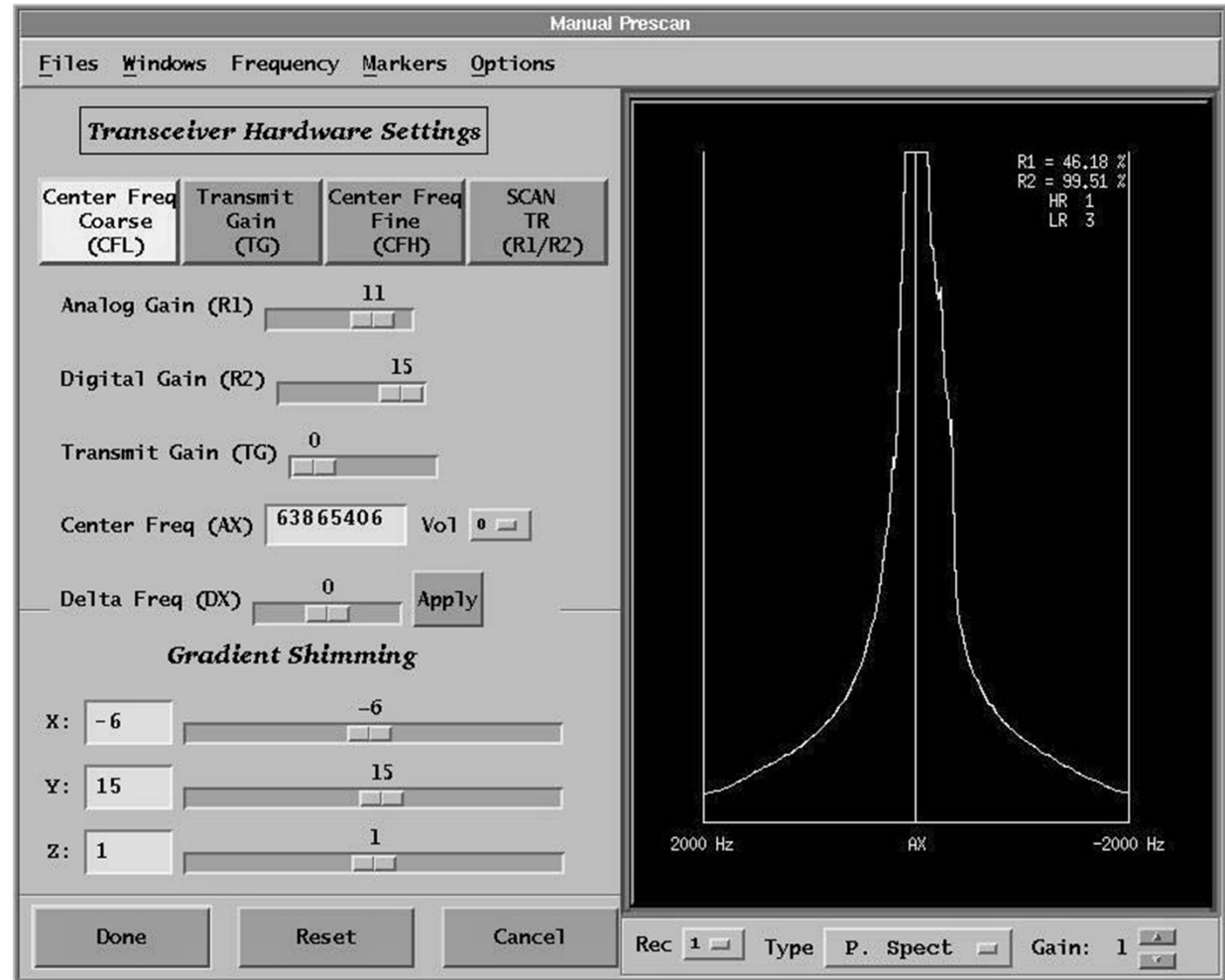
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## ► Magnetic Field Homogeneity Check



# The Ugly Secret #2

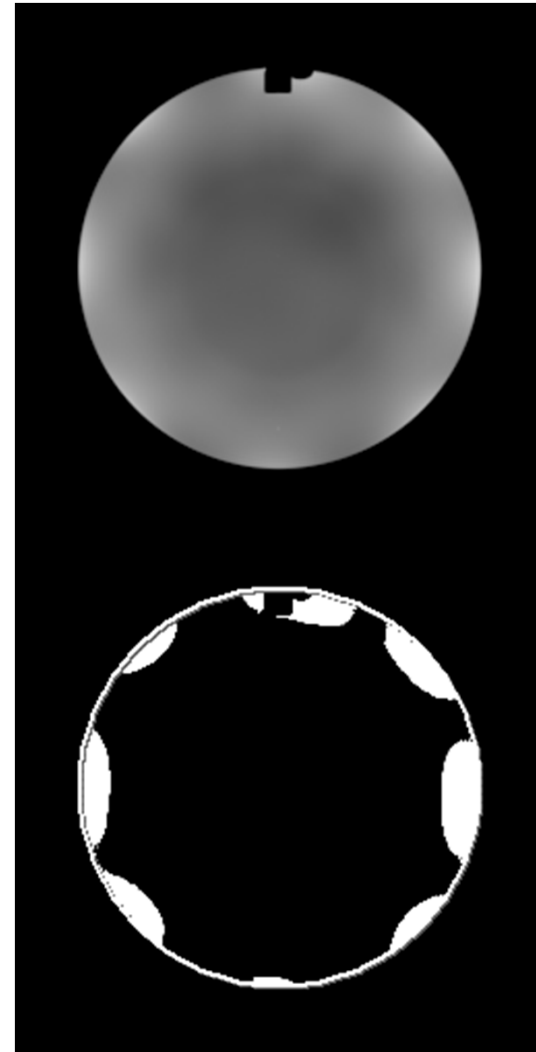
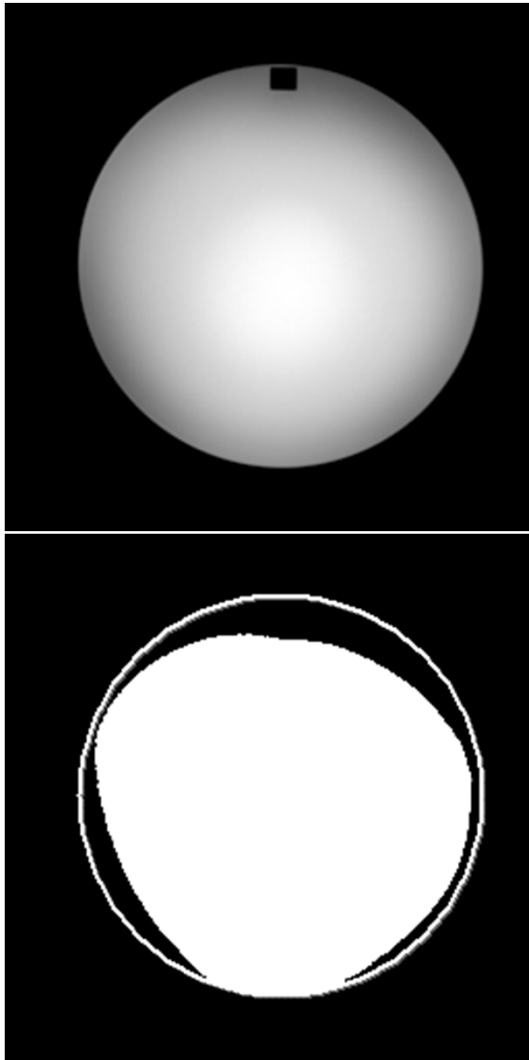
## ► Magnetic Field Homogeneity Check



# The Ugly Secret #1

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## ▶ Volume Coil Tests



# ACR MRAP Support

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- ▶ Physicist's Challenges
  - ▶ Change Facilities Perceptions
    - ▶ From Being Part of the Problem to Being Part of the Solution
  - ▶ Get the Service Engineers on Board
    - ▶ Develop a Strategy for Standoff Scenarios
      - Physicist Test Fails, Vendor Test Passes
  - ▶ Keep Up With The Paperwork
  - ▶ Find Good Resources for the CMEs

# The ACR MRAP Physics Support

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- ▶ Physicist's Dream List
  - ▶ The Required Tests Non Redundant
  - ▶ Physics Mode on Clinical Scanners
  - ▶ Flexibility in Setting the Site QC Program