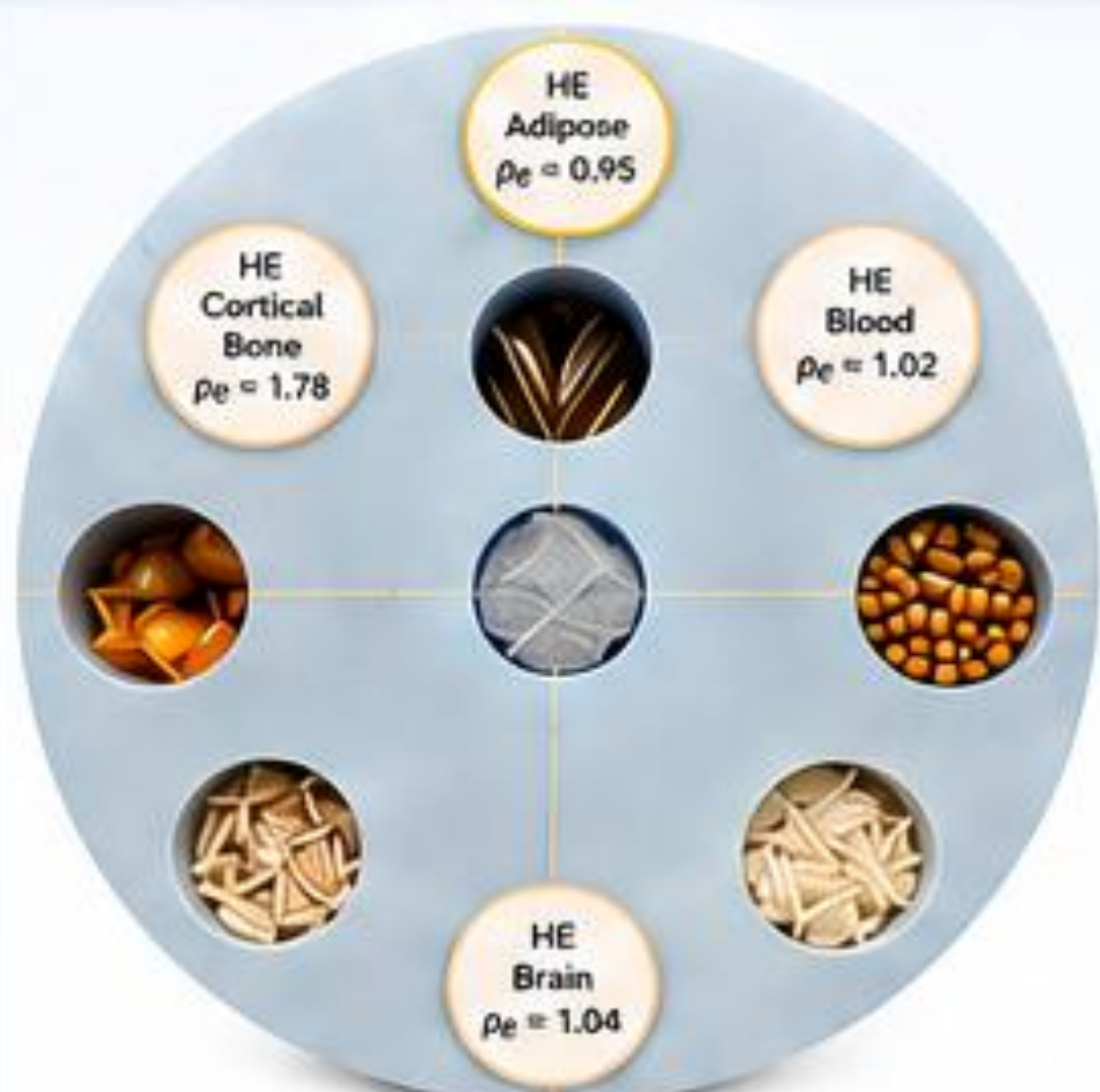


1 Data Acquisition

Electron Density Phantom
Scanned on
GE Apex Revolution



Electron Density Phantom



- Adipose ($\rho_e \approx 0.95$)
- Blood ($\rho_e \approx 1.02$)
- Brain ($\rho_e \approx 1.04$)
- Cortical Bone ($\rho_e \approx 1.55$)

- 4 tissue-equivalent inserts spanning a range of electron densities
- Used to evaluate reproducibility and electron density sensitivity

2 Radiomics Feature Extraction

12 Spectral Reconstructions
(40 & 50 keV, Fat/Water Maps)
Each with 3 Deep Learning Levels

40 keV
Monochromatic



Low

50 keV
Monochromatic



Medium

Fat/Water
Material Maps



High

GE Deep Learning Reconstruction Levels

ROIs on 4 Inserts
(across all protocols)



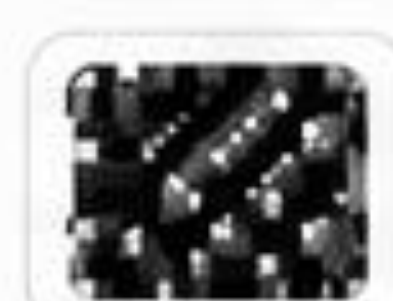
3D ROI

PyRadiomics (v3.x)
Standardized Settings
93 Features / Protocol

Feature Classes Extracted



First
Order



GLCM
(Texture)



GLDM
(Texture)



GLRLM
(Texture)



GLSZM
(Texture)

...

Total: 93 features × 12 protocols

3 Feature Evaluation

All extracted radiomics features ($n = 93$ per protocol)
were evaluated across 12 spectral reconstructions.

Reproducibility
(Across Inserts)

Coefficient of Variation (CV)

$$CV = \frac{\sigma}{\mu} \times 100\%$$

σ : SD across 4 inserts
 μ : Mean across 4 inserts

Reproducible if
 $CV < 5\%$
(for all 12 protocols)

Electron Density
Sensitivity

Spearman Rank Correlation (ρ_e)

$$\rho_e = \text{corr}(\text{Feature}, \rho_e)$$

Across 4 inserts
(adipose, brain, blood, bone)

Sensitive if
 $|\rho_e| \geq 0.8$

Physics-Informed
Feature Identification

Reproducible
($CV < 5\%$)

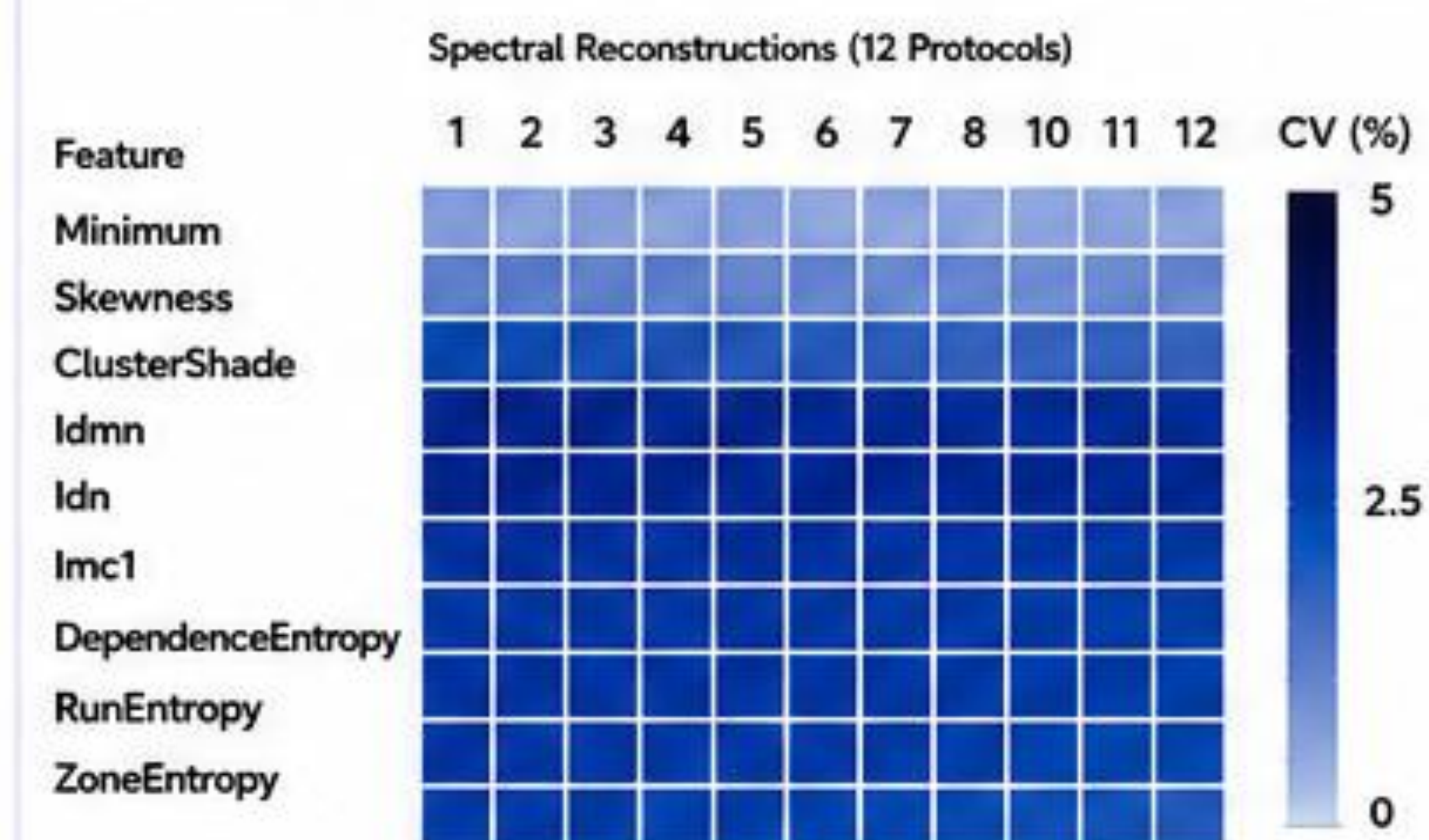
Electron Density
Sensitive
($|\rho_e| \geq 0.8$)

Physically Meaningful Features
($CV < 5\%$ AND $|\rho_e| \geq 0.8$)

4 Results

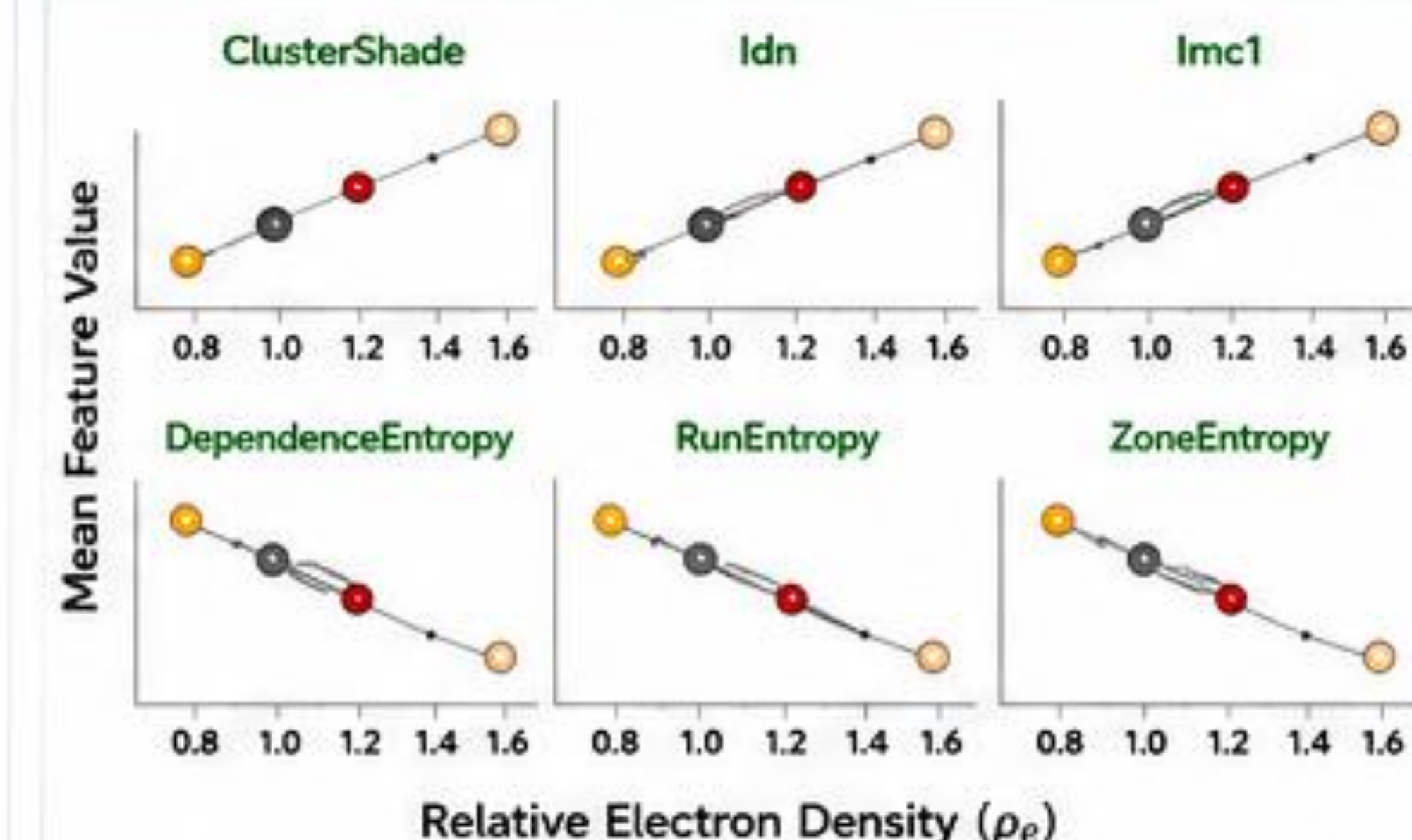
Reproducibility (CV Across All Protocols)

All 9 reproducible features had $CV < 5\%$
for all 4 inserts across 12 protocols



Electron Density Sensitivity (ρ_e)

Mean Feature Value vs. Relative Electron Density



- Adipose (0.95)
- Brain (1.04)
- Blood (1.02)
- Bone (1.55)

✓ 9 Reproducible Features ($CV < 5\%$ across all protocols)

🎯 6 Physically Meaningful Features
($CV < 5\%$ AND $|\rho_e| \geq 0.8$)

★ These six features showed strong monotonic
association with electron density across
adipose, brain, blood, and bone.