

# *Rapid Non-destructive Identification of Degraded Magnetic Tape*

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23 Sept 2014

Design of Storage Architectures Meeting

Library of Congress

Preservation Research and Testing Division



# THE NEED

## Cultural Heritage Index (U.S.)

- 46 million tapes  
(reel to reel, VHS, DAT, cassette, etc.)
- >40% in unknown condition

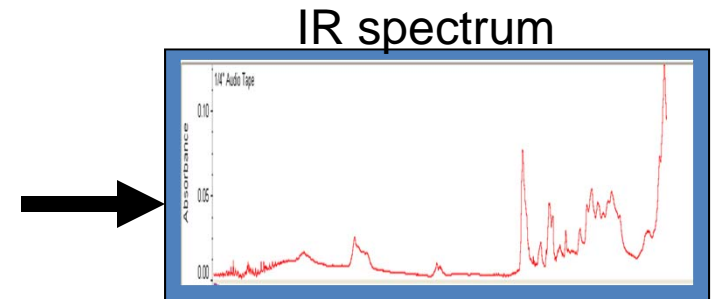
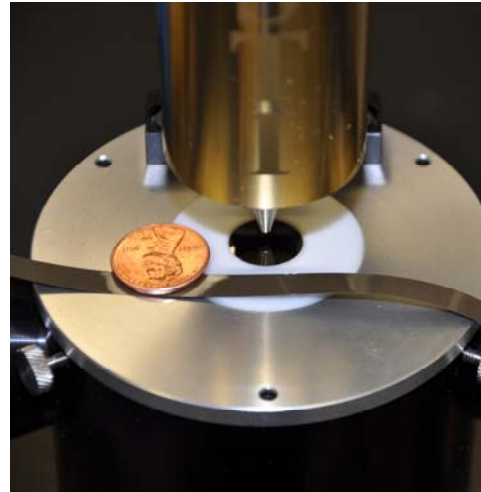
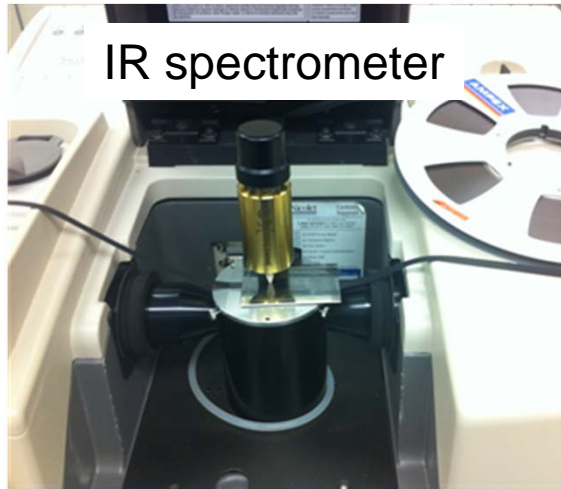
## Current evaluation methods:

- Visual inspection
- Playing (potentially destructive)
- If the tape squeals, flakes, breaks, or sticks to playback equipment, it is removed and treated. This process may render the playback device unusable until it is cleaned and can permanently damage the tape, which leads to loss of data.



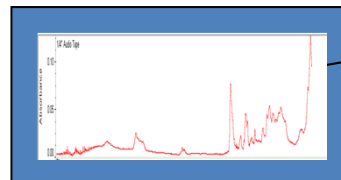
A reliable, non-destructive identification system is not available

# Spectroscopic system for differentiating degraded and non-degraded tapes:

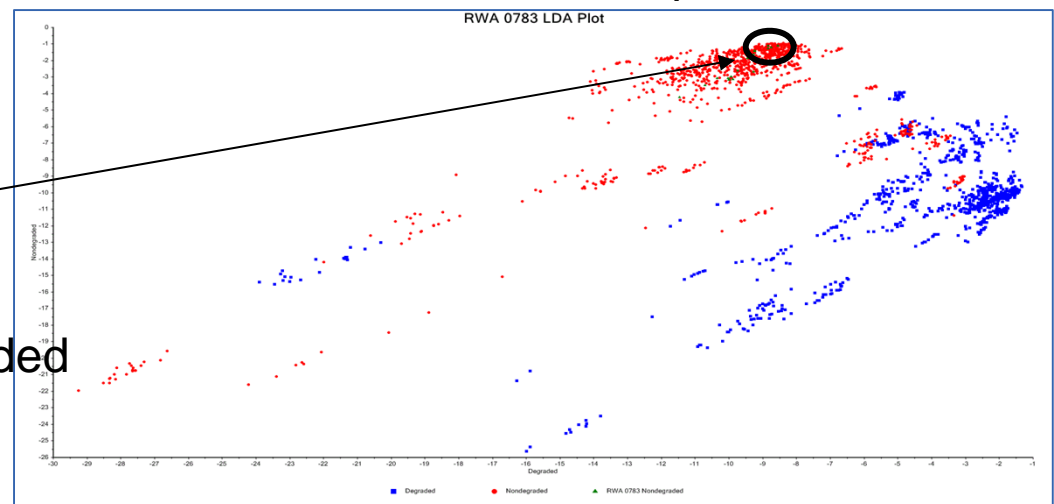


↓ Chemo-  
metrics

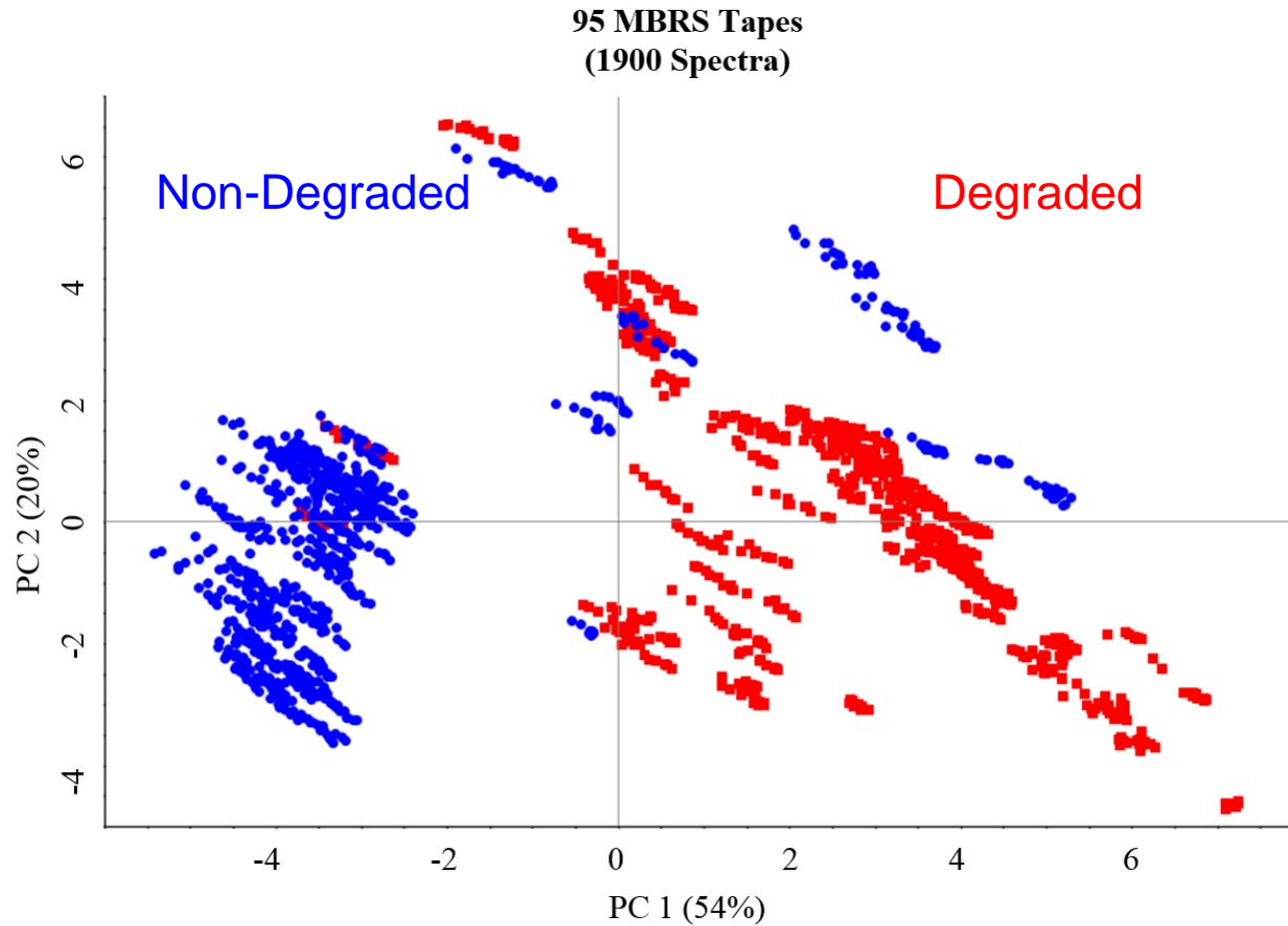
Chemometric output



Classification as non-degraded

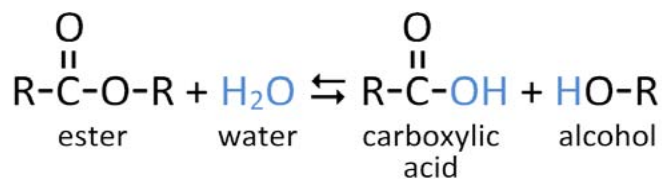
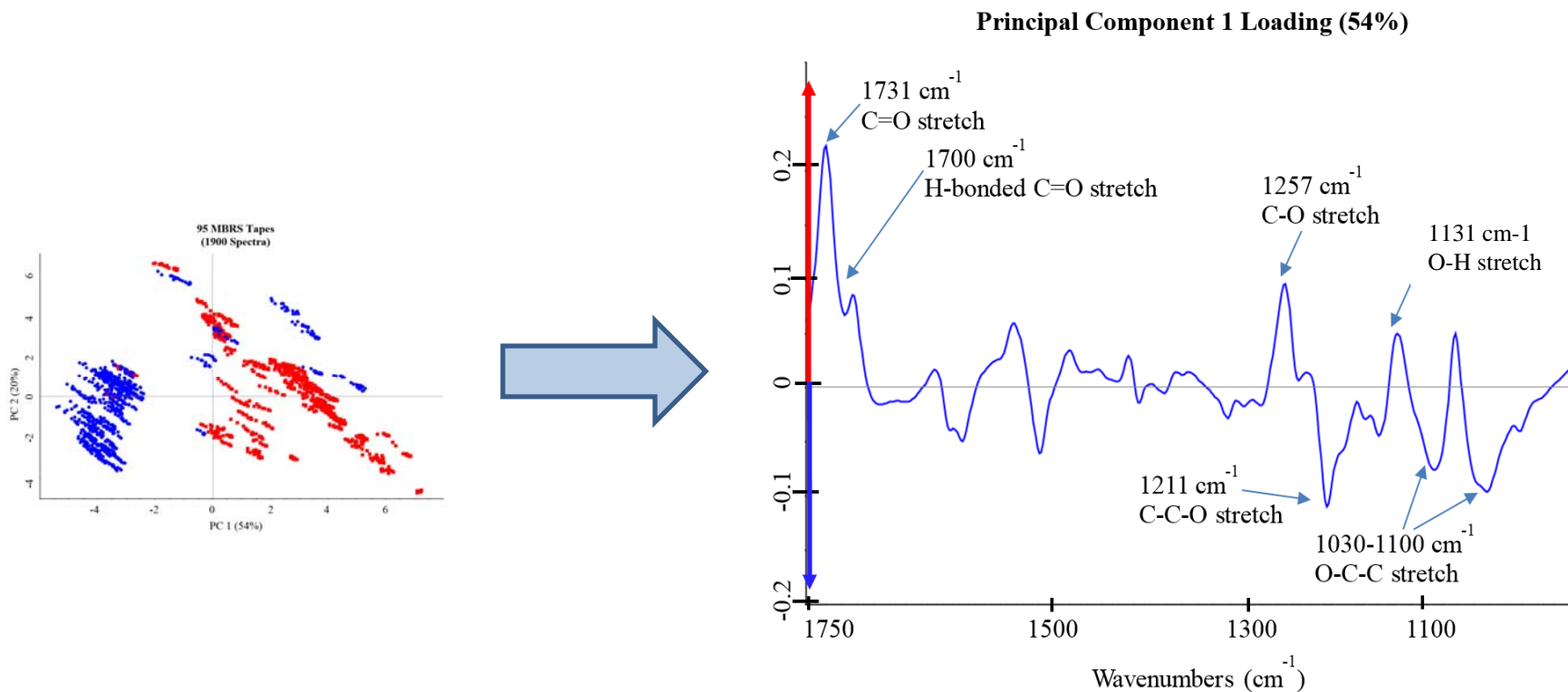


# PCA Analysis of 95 LC ¼" tapes



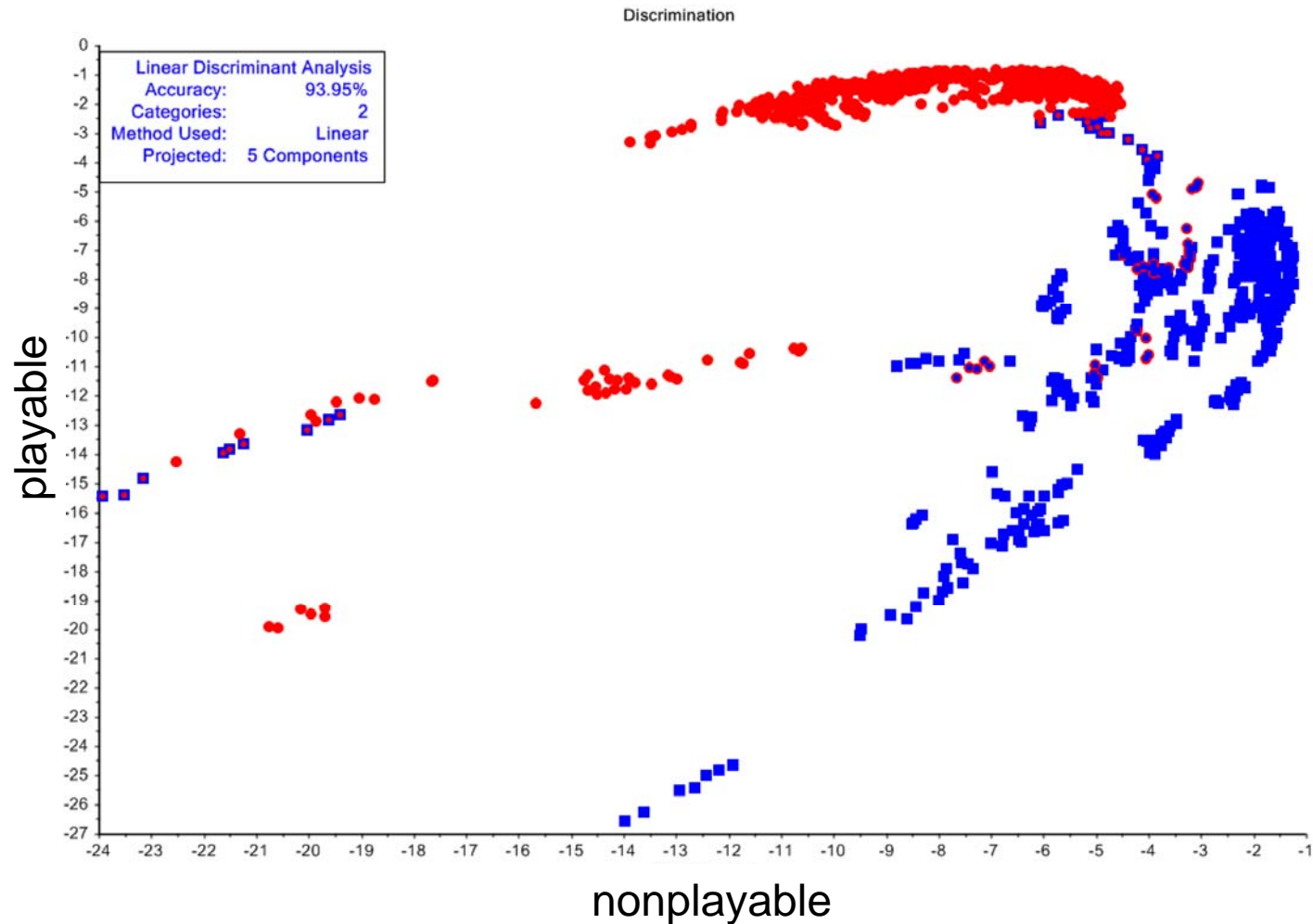
Degraded and nondegraded are chemically different

# What are the chemical differences?



PC loadings corroborate binder degradation theory

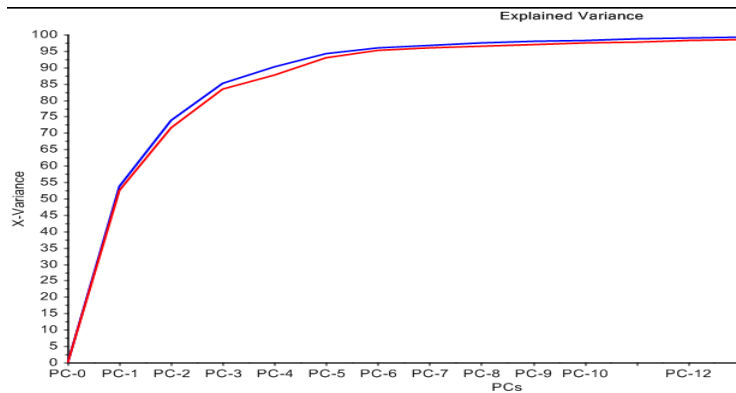
# LDA Analysis of 95 LC ¼" tapes



Use as a model for classifying tapes for the LC?

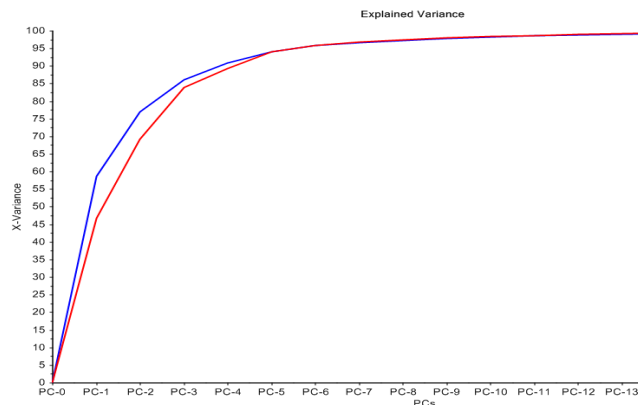
**Model Optimization – the correct way for large datasets**  
**model = 95 LC Collection tapes analyzed in 2011 (1900 spectra)**  
**test set = 38 LC Collection tapes analyzed in 2013 (760 spectra)**

2013: Leave one tape out cross validation –**suggested 7 PCs be used for LDA classification**



Overall Classification: 84.2%  
 Non-playable: 92.3%  
 Playable: 80.0%

2014: Split the model into a model subset (1140 spectra) and a validation set (760 spectra) using Kennard Stone. The validation set is a better representative of the test set than the model – 1 tape. –**suggested 5 PCs be used for LDA classification**



Overall Classification: 85.5%  
 Non-playable: 92.3%  
 Playable: 82.0%

**Slide 7**

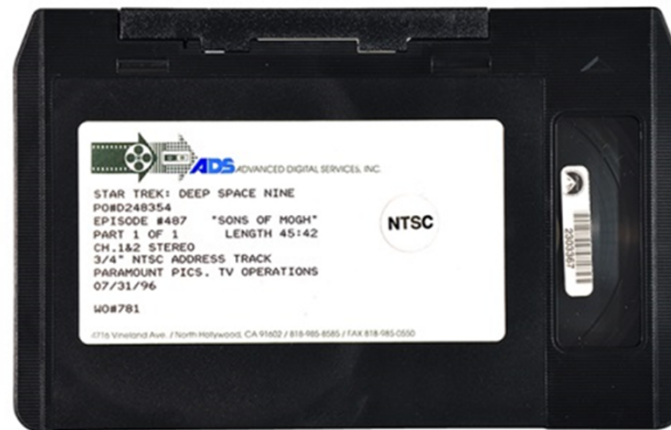
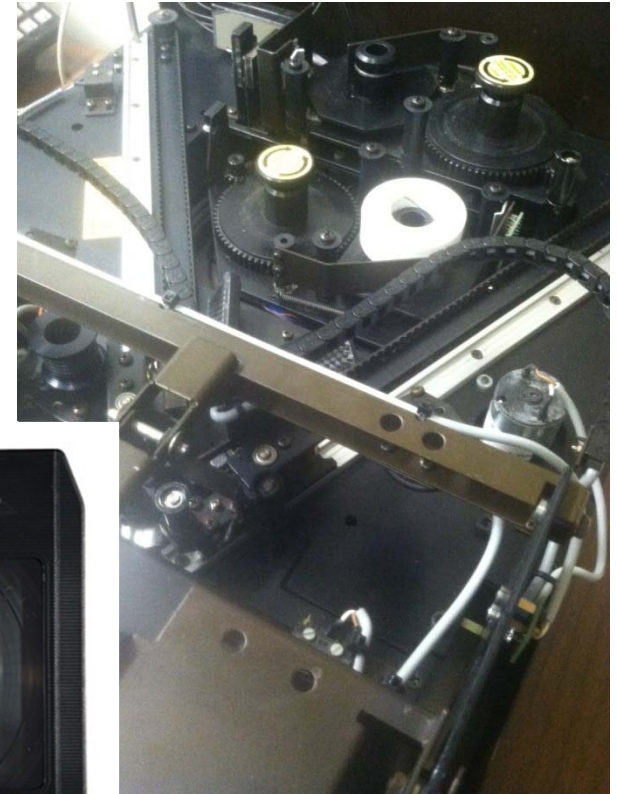
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**BC1**

Brianna Cassidy, 9/17/2014



# Translate Concept to Other Formats

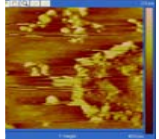
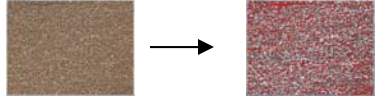


Measured more than 80 tapes 2014

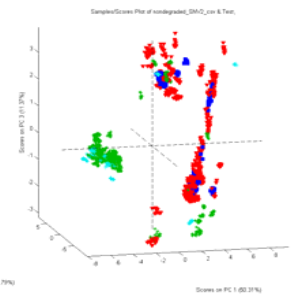
Consistent condition assessment option



# Summary

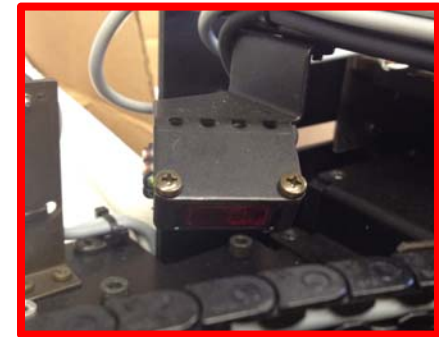
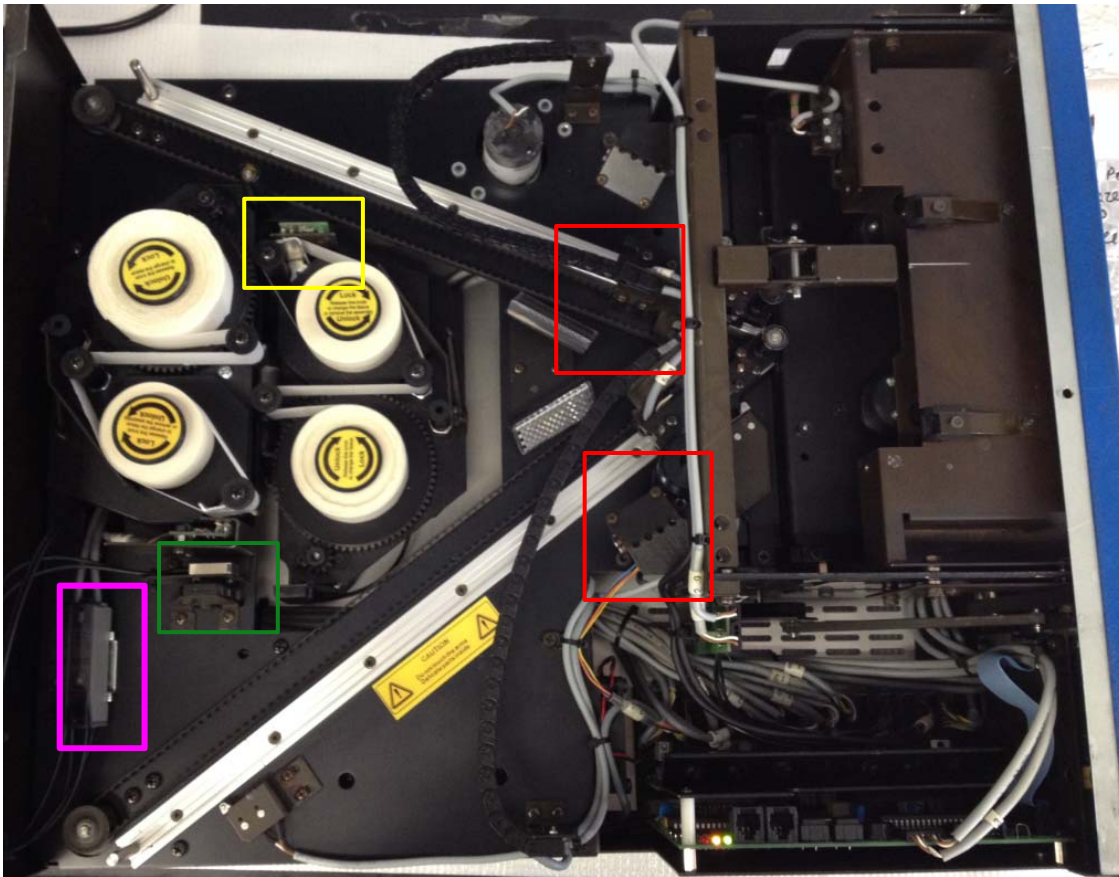
- Differences in surface roughness identified 
- Small circular surface features identified on degraded
  - Quantification underway 
  - Possibly useful for inexpensive non-contact identification
- Confirmed presence of adipic acid in degraded tapes via GC/MS

- Chemometric analysis of IR data allows excellent categorization of both LC and non-LC 1/4" tapes!



Next steps are to evaluate non- 1/4" formats.

# SAMMA Clean Equipment



Detects the beginning and ends of the magnetic tape



Ensures tape doesn't break

Sensors are one the way to measure tape reflectivity and tape width

# Chemometric analysis of tapes in unknown condition vs. known LC collection tapes:

