

From imaging nuclear reactions to analysis of nuclear reactions

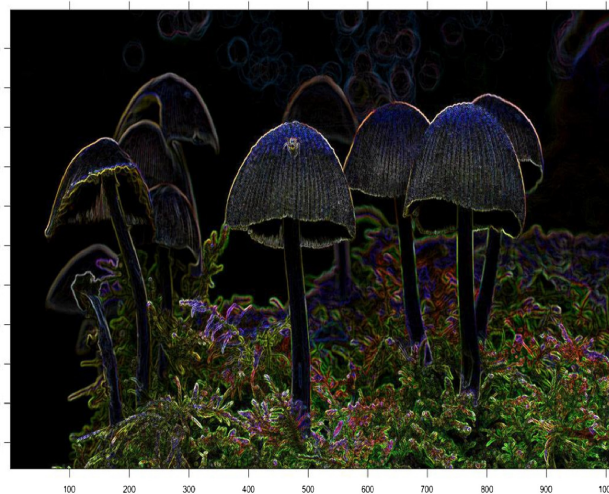
Wolfgang Mittig
Michigan State University-NSCL

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Science



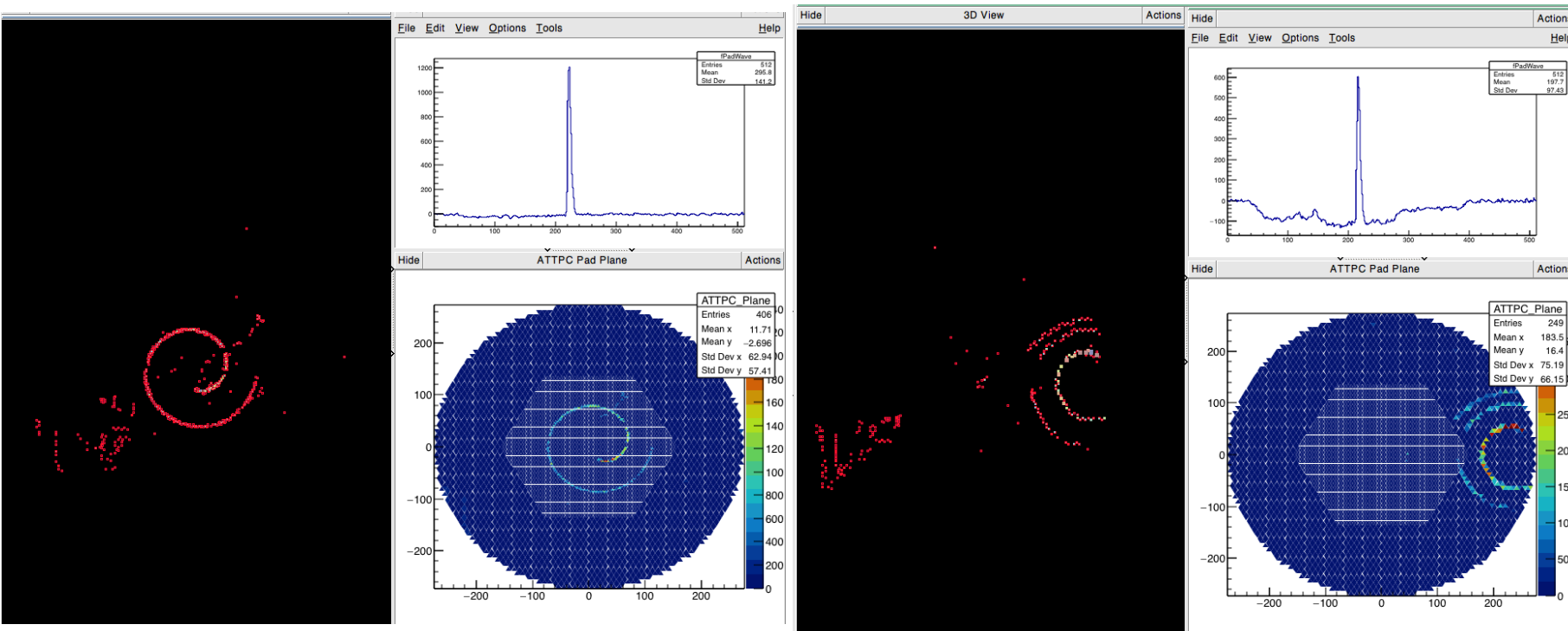
Recognizing geometric patterns in complex images: 1) Isolating structures of interest



Edge detection using G-lets based on matrix factorization by group representations
Rajathilagam B^a, Murali Rangarajan^b [Pattern Recognition](#)

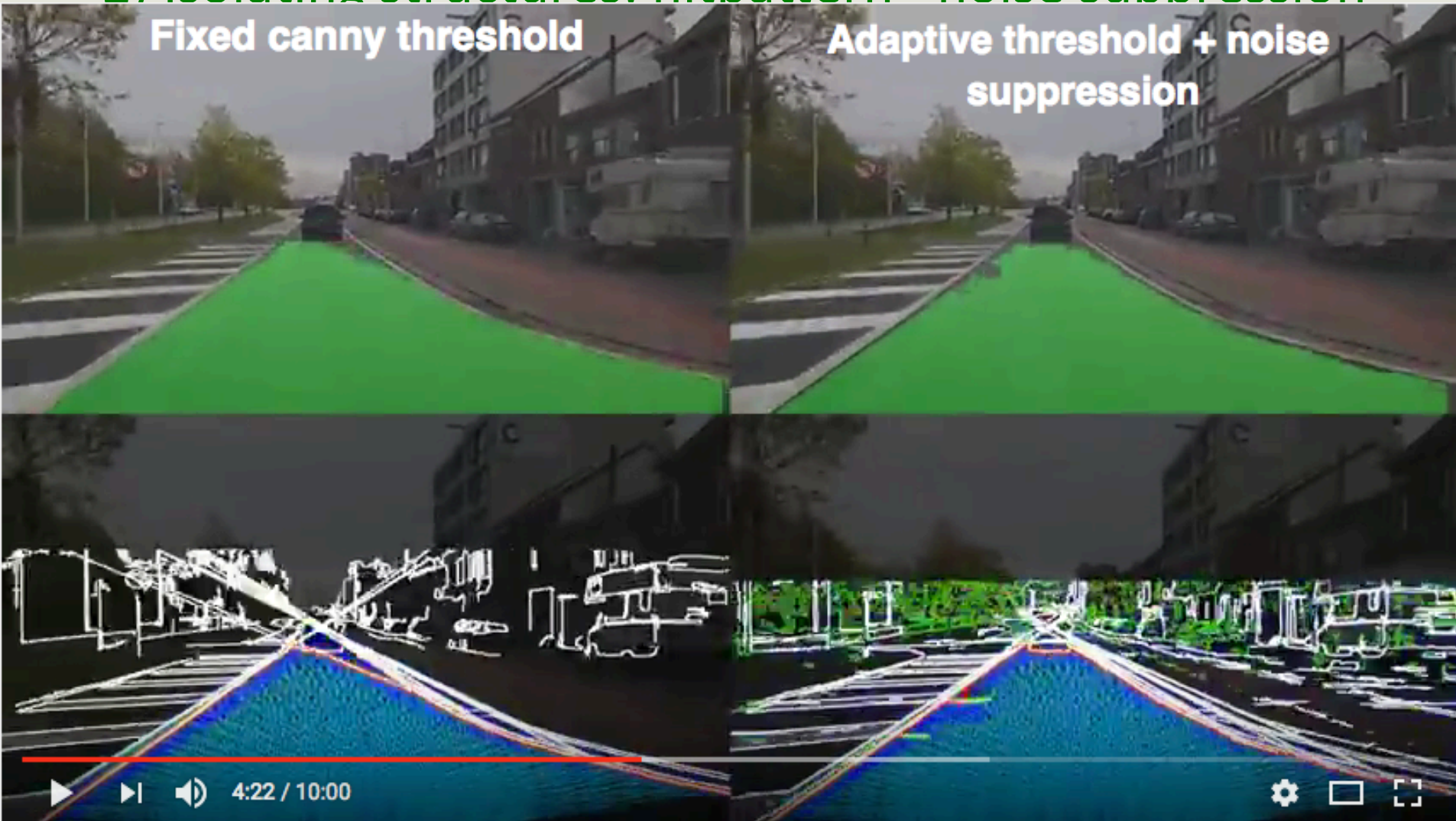
Recognizing geometric patterns in complex images:

1) Isolating structures of interest: hitpattern



Recognizing geometric patterns in complex images:

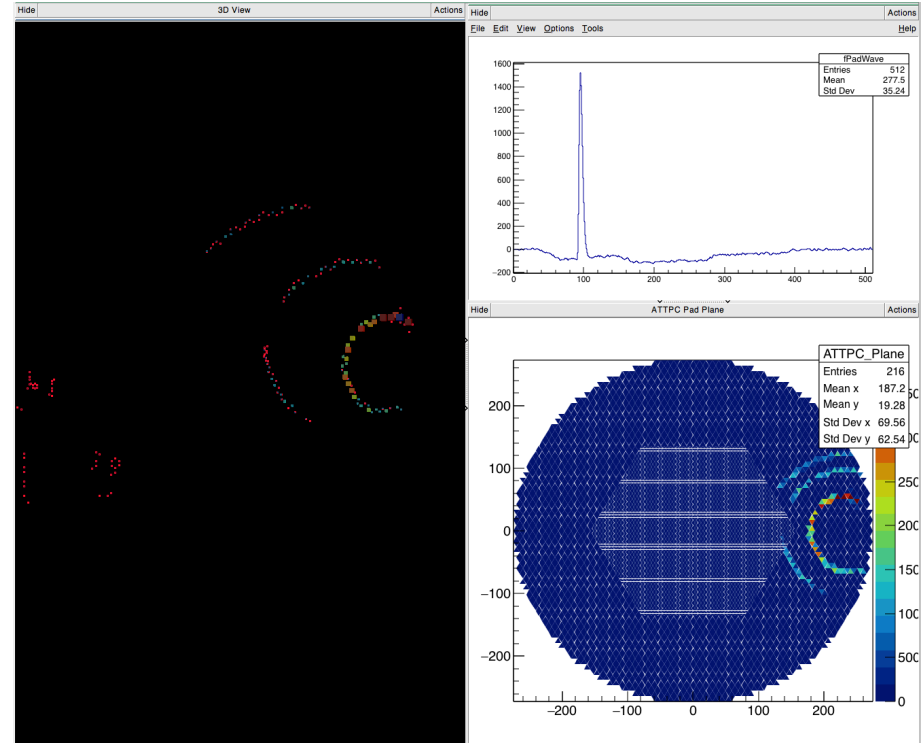
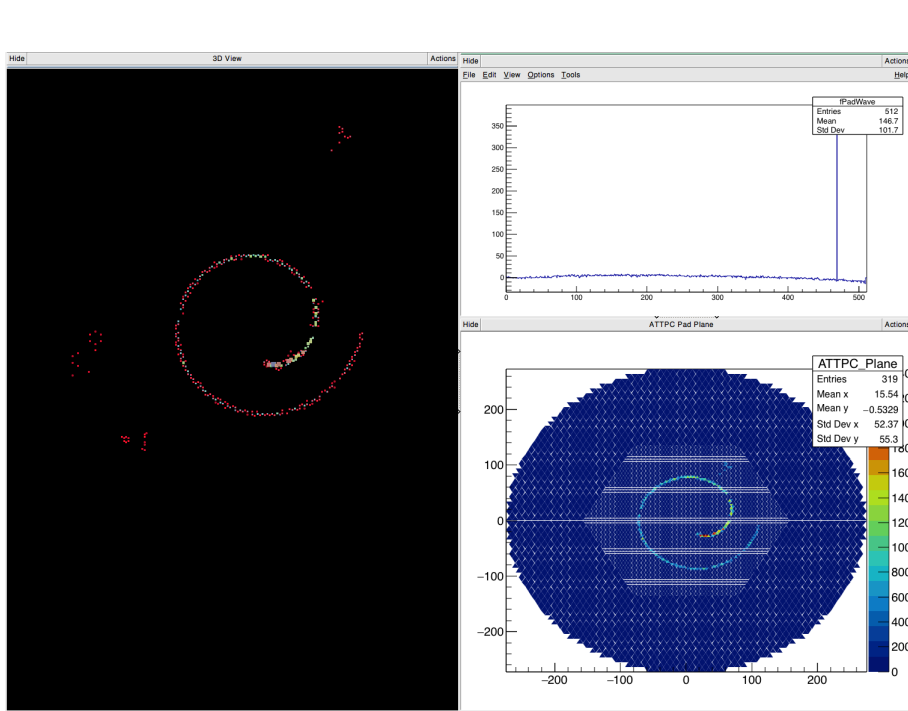
2) Isolating structures: hitpattern + noise suppression



<https://www.youtube.com/watch?v=e2uQc8CMpSE>

Recognizing geometric patterns in complex images:

2) Isolating structures: hitpattern + noise suppression



Recognizing geometric patterns in complex images:

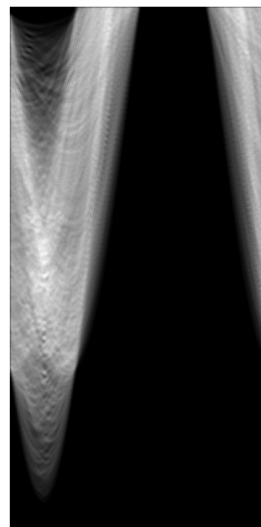
3) pattern recognition



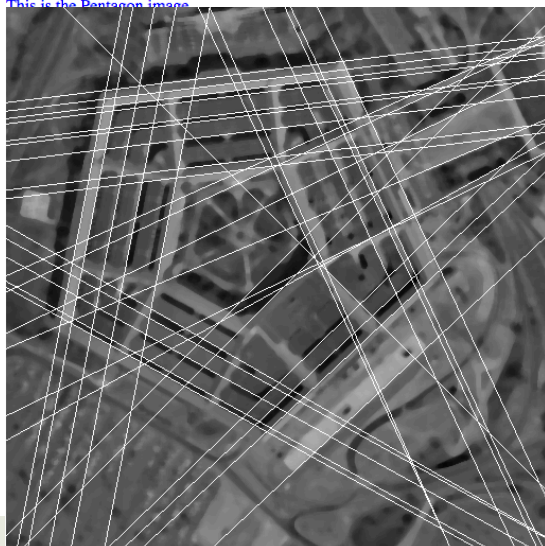
This is the Pentagon image



Canny Edge Detector (Threshold 15.0)



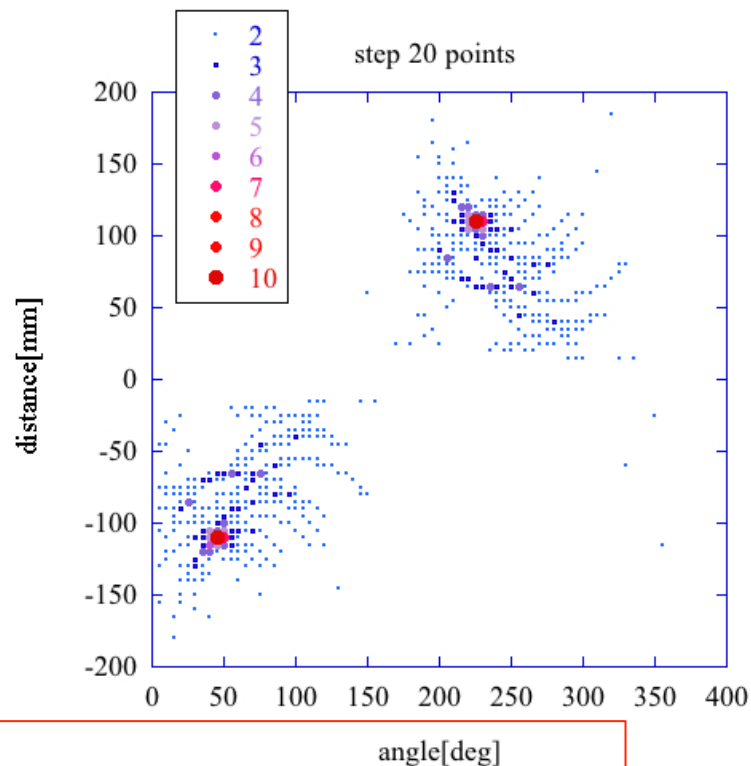
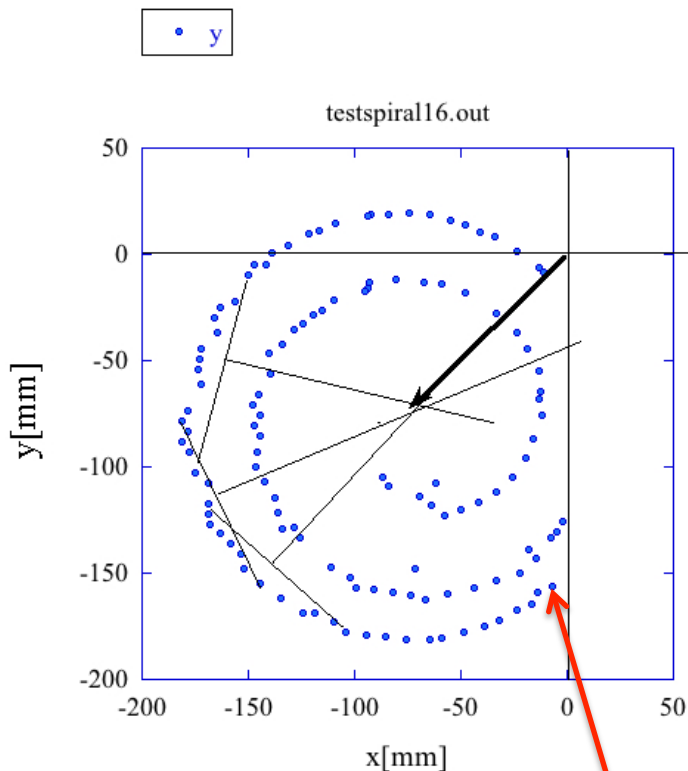
The Hough Image



<http://www.cs.utah.edu/~sbasu/ipprojects/project4/lineDetect.html>

Recognizing geometric patterns in complex images:

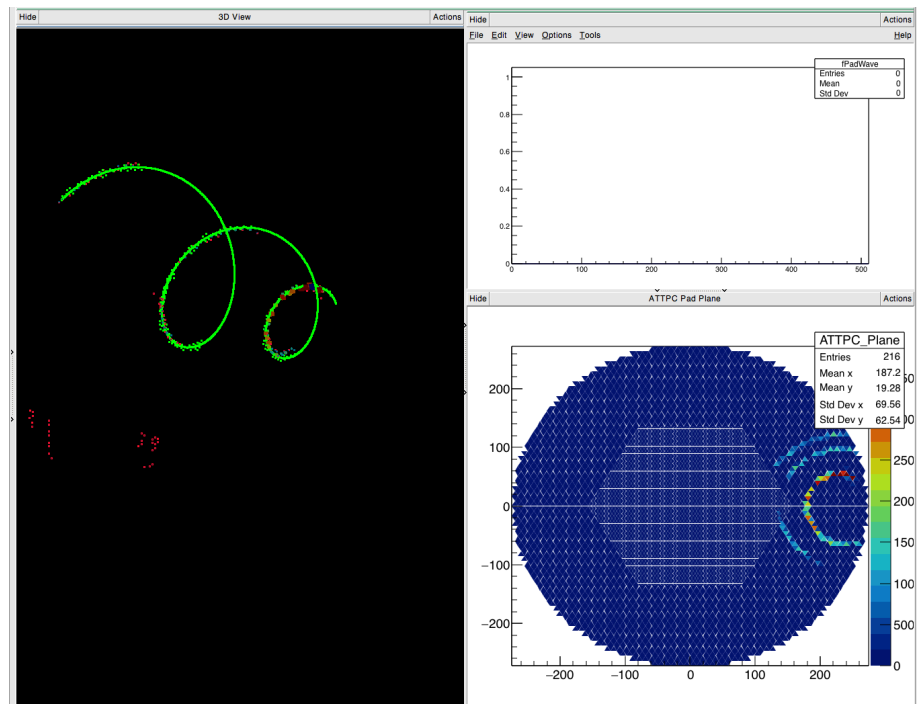
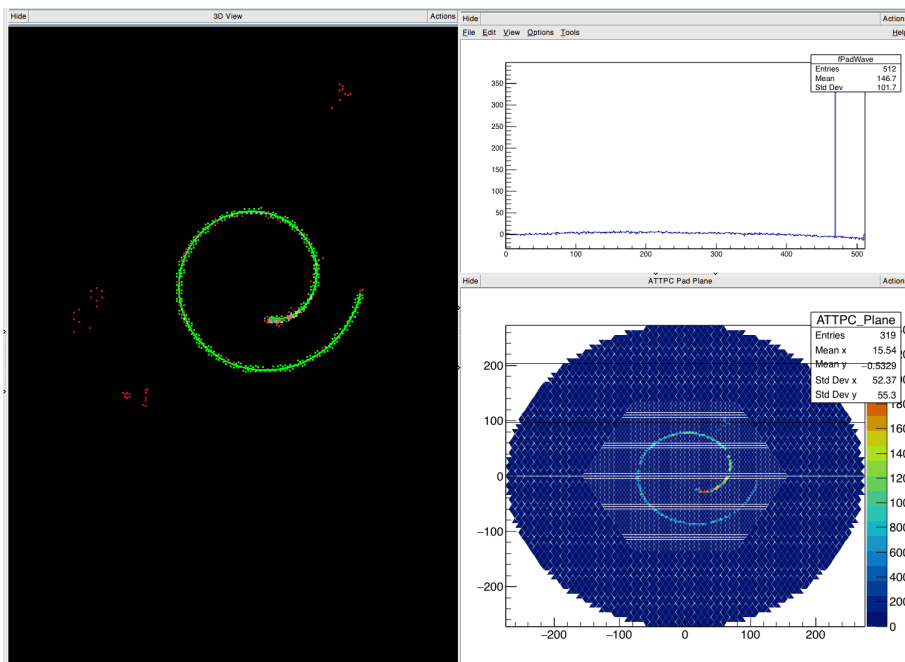
3) pattern recognition (circular Hough)



- Center of start (x,y,z)
 - Radius of circle
 - Angle of trajectory (phi, Theta)
- 6 dimensional space

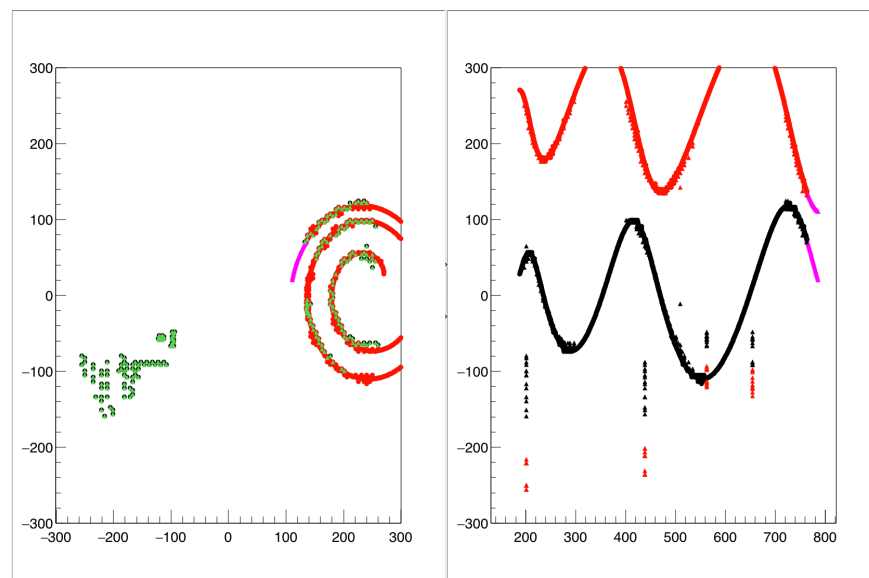
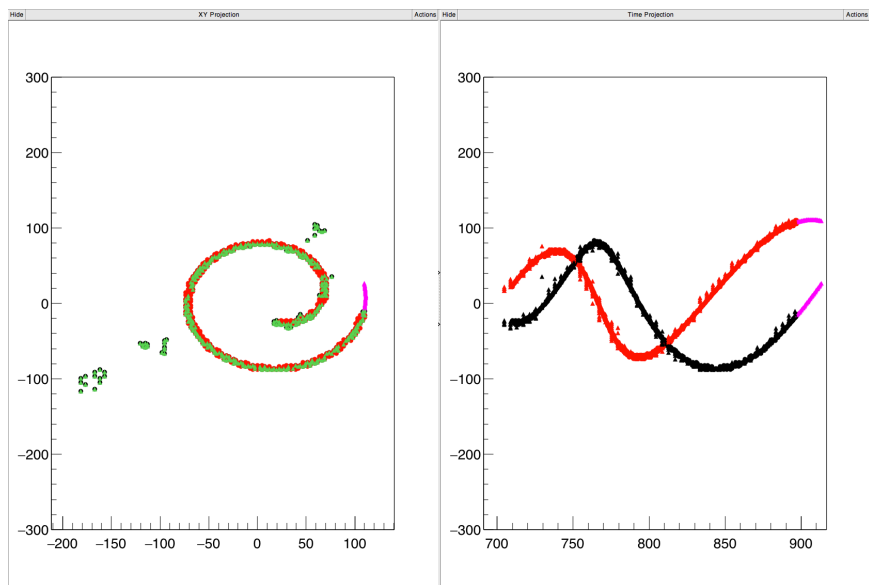
Recognizing geometric patterns in complex images:

4) Fine fit of the 6 parameters



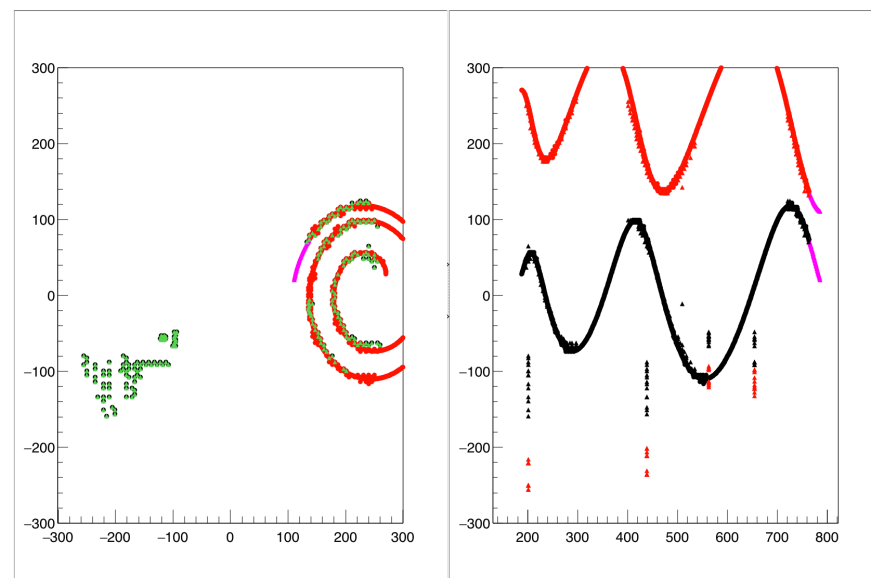
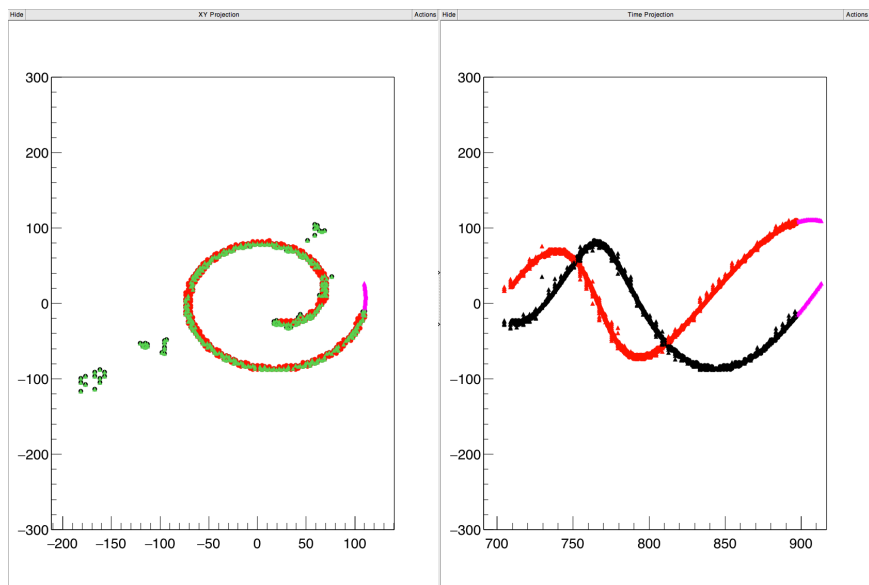
Recognizing geometric patterns in complex images:

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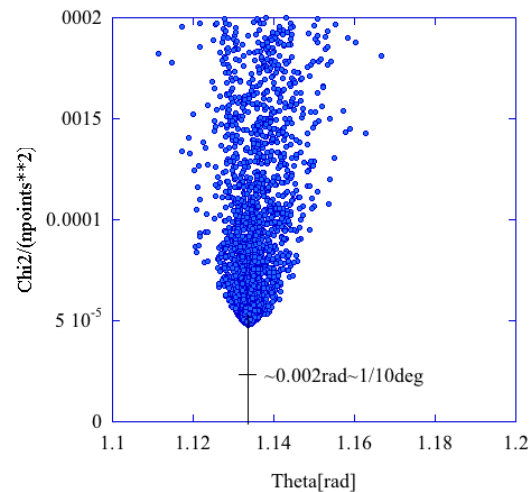
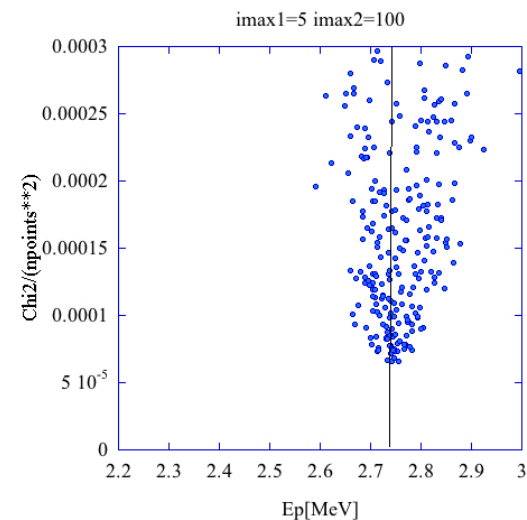
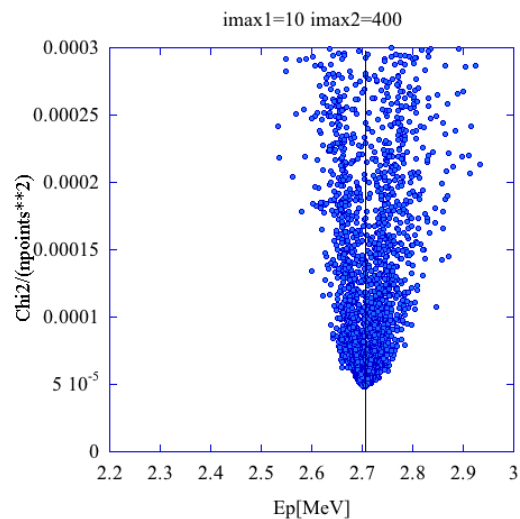
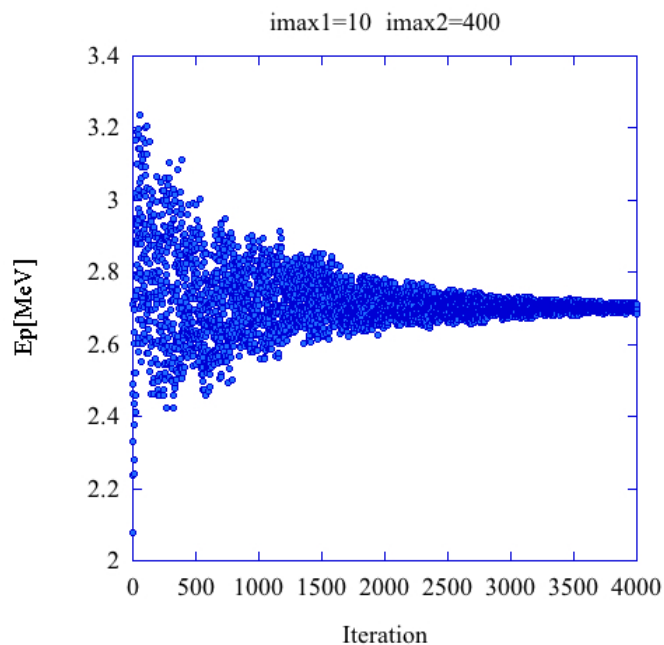
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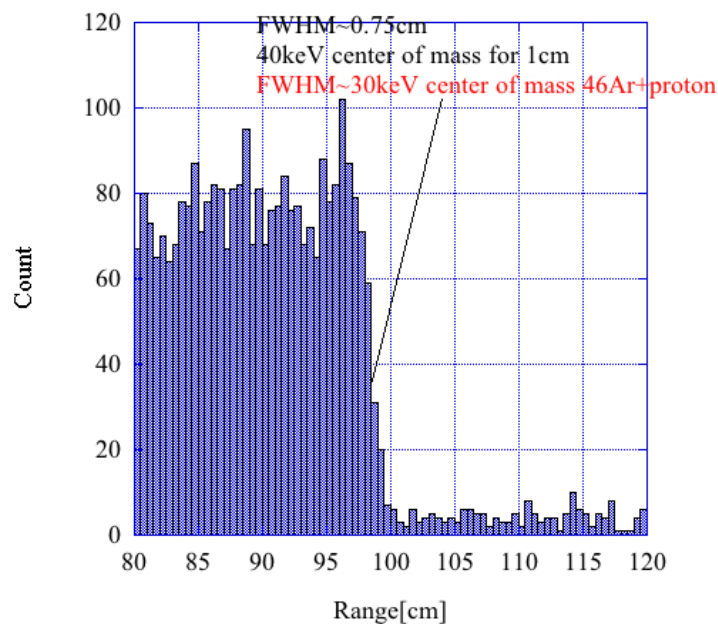
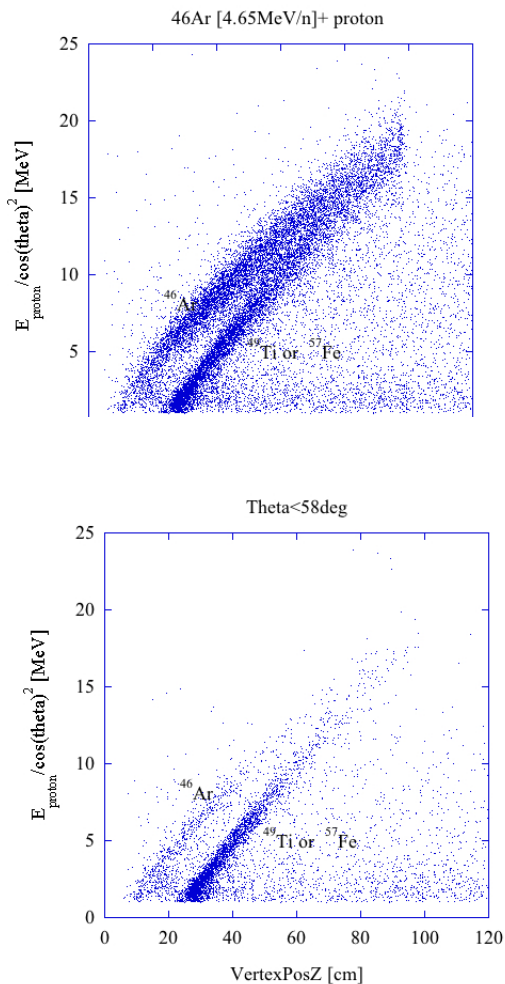
Recognizing geometric patterns in complex images:

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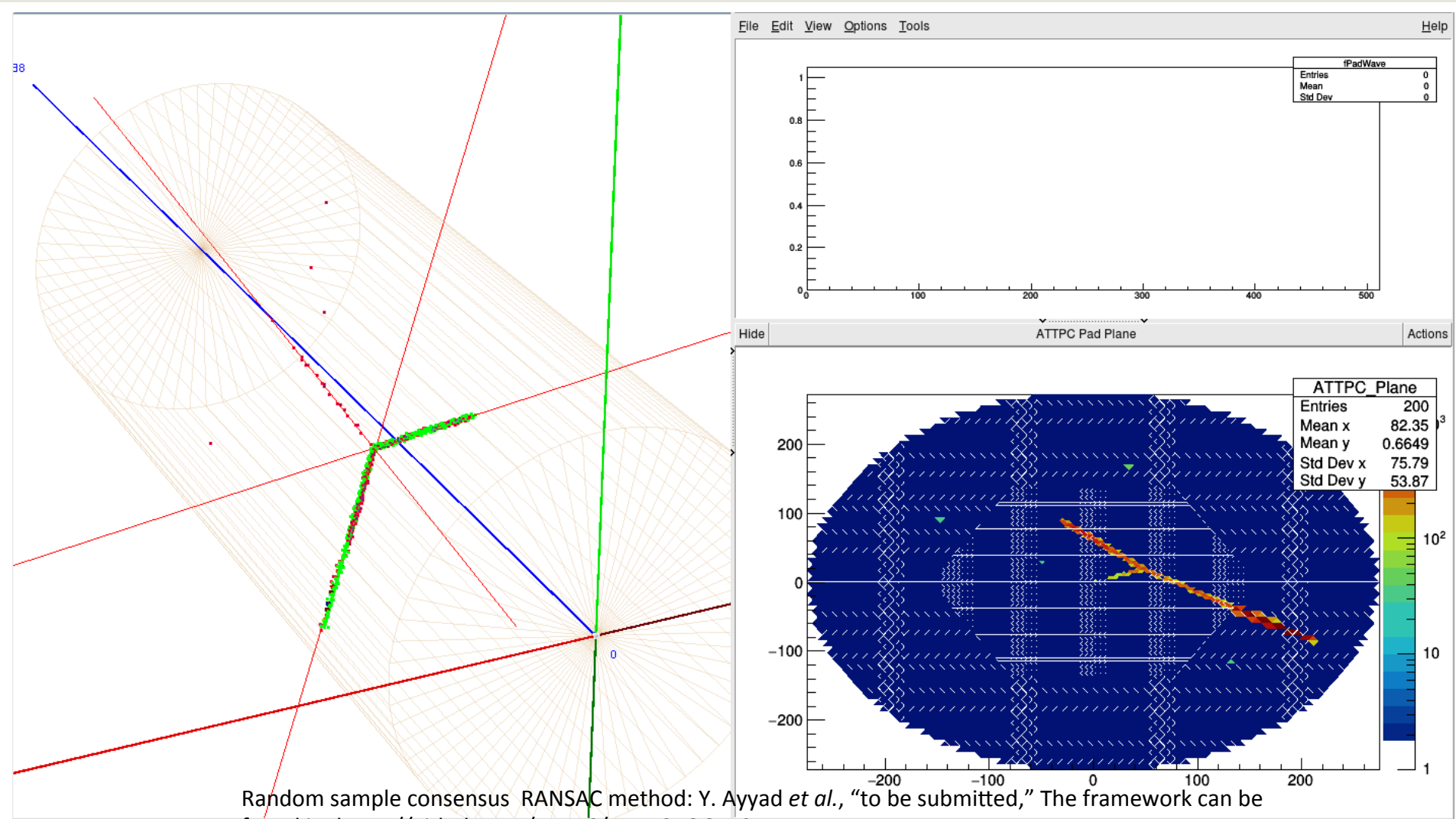


Recognizing geometric patterns in complex images:

4) Fine fit of the 6 parameters- results



Ransac: Random Sample Consensus



Random sample consensus RANSAC method: Y. Ayyad *et al.*, "to be submitted," The framework can be found in: <https://github.com/ATTPC/ATTPCROOTv2>.

Conclusion

- We have new powerful detectors for the imaging of nuclear reactions, with a large solid angle and high resolution
- These provide 4π - 3D images of reactions with charged particles and are a powerful tool especially for the reactions induced by secondary exotic beams
- Pattern recognition is an essential part of the data analysis

AT-TPC Collaboration

Lawrence Berkeley National Laboratory
I-Yang Lee, Larry Phair

Lawrence Livermore National Laboratory
Mike Hefner

University Notre Dame
Jim Kolata, Tan Ahn, ...

Michigan State University
Daniel Bazin, Wolfgang Mittig, Bill Lynch, Y.Ayyad,
Saul Beceiro Novo, Adam Fritsch, Lisa Carpenter, Josh Bradt, ...

Saint Mary's University (Canada)
Rituparna Kanungo

Western Michigan University
Michael Famiano