# AFNI & SUMA

## Concepts, Principles, Demos

Analysis of Functional NeuroImages

by

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AFNI User

Released under the GNU General Public License Version 2 (GPL) [or any later GPL version]

AFNI is a research tool.

*Clinical uses are not supported or advised.*

**http://afni.nimh.nih.gov/afni**

# Some Goals of FMRI Analyses

- **Task-based experiments**
  - **Per subject:** estimate amplitude of BOLD response to each different type of stimulus
  - Find+model inter-regional correlations between fluctuations in BOLD responses
- **Resting-state experiments**
  - Measure spatial patterns in coherent fluctuations in spontaneous BOLD
- **Group level**
  - Combine and contrast per subject results

*pre-processing*

# Conceptual Basis - 1

- **Time shifting** = pretend get 3D snapshot
- **Despiking** = remove large blips
- **Image Registration** (AKA alignment)
  - intra-EPI time series, and EPI-Structural
- **Blurring in space** = lower resolution :-( *&* less noise :-) *&* more group overlap :-)
- **Masking** = ignore non-brain voxels
- **Scaling** = normalizing data amplitude
  - Makes inter-subject comparisons more valid

# Conceptual Basis - 2

- **Time series regression**
  - model of the BOLD response in the data = **H**emodynamic **R**esponse **F**unction ⊗ stimulus timing
  - plus baseline (null hypothesis) model
  - plus physiological noise
  - plus allowing for serial correlation

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- **Talairach-ing** = Spatial Normalization
  - Talairach, MNI-152, …
  - affine and nonlinear spatial transformations

# Conceptual Basis - 3

- **Group Analyses** = Putting it all together

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- – **ANOVA**, **LME**, Meta-Analyses, …
- **Blobs** = Spatial models of activation

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- – Assigning statistical significance to blobs
- **Connectivity** = Inter-regional analyses
  - – **SEM**, **PPI**, **SVAR**, **DCM**, Granger, …

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  - – Resting state FMRI (Connectome*!*)
- **Dimensional factorization**
  - – Components, such as PCA, ICA

# Conceptual Basis - 4

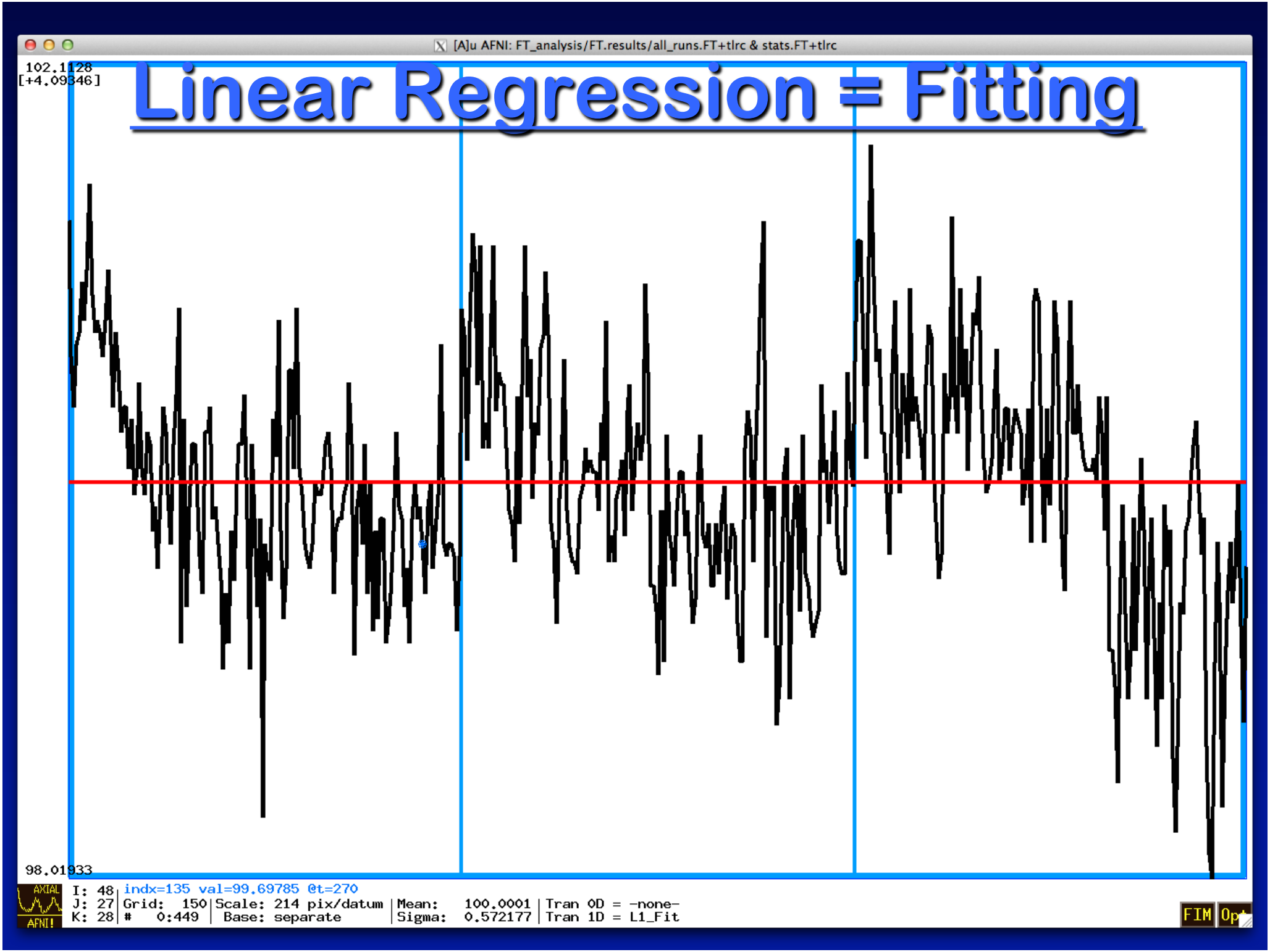
- **Data Formats** = NIfTI-1.x is your friend

- **Software** for FMRI analyses: **open-source*
  - **AFNI***, **BrainVoyager**, **FSL***, **SPM***, **…**
  - Whichever you use, **don't blindly assume** the software works perfectly all the time

- Most important thing I will say today

  **Understand and check the steps applied to your data!**

- 2nd most important: **Is no "best" way to analyze data, just "reasonable"** ***ways***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[+4.09346]
Linear Regression = Fitting
98.01933
AXIAL
AFNI!
I: 48 J: 27 K: 28
indx=135 val=99.69785 @t=270
Grid: 150
# 0:449
Scale: 214 pix/datum
Base: separate
Mean: 100.0001
Sigma: 0.572177
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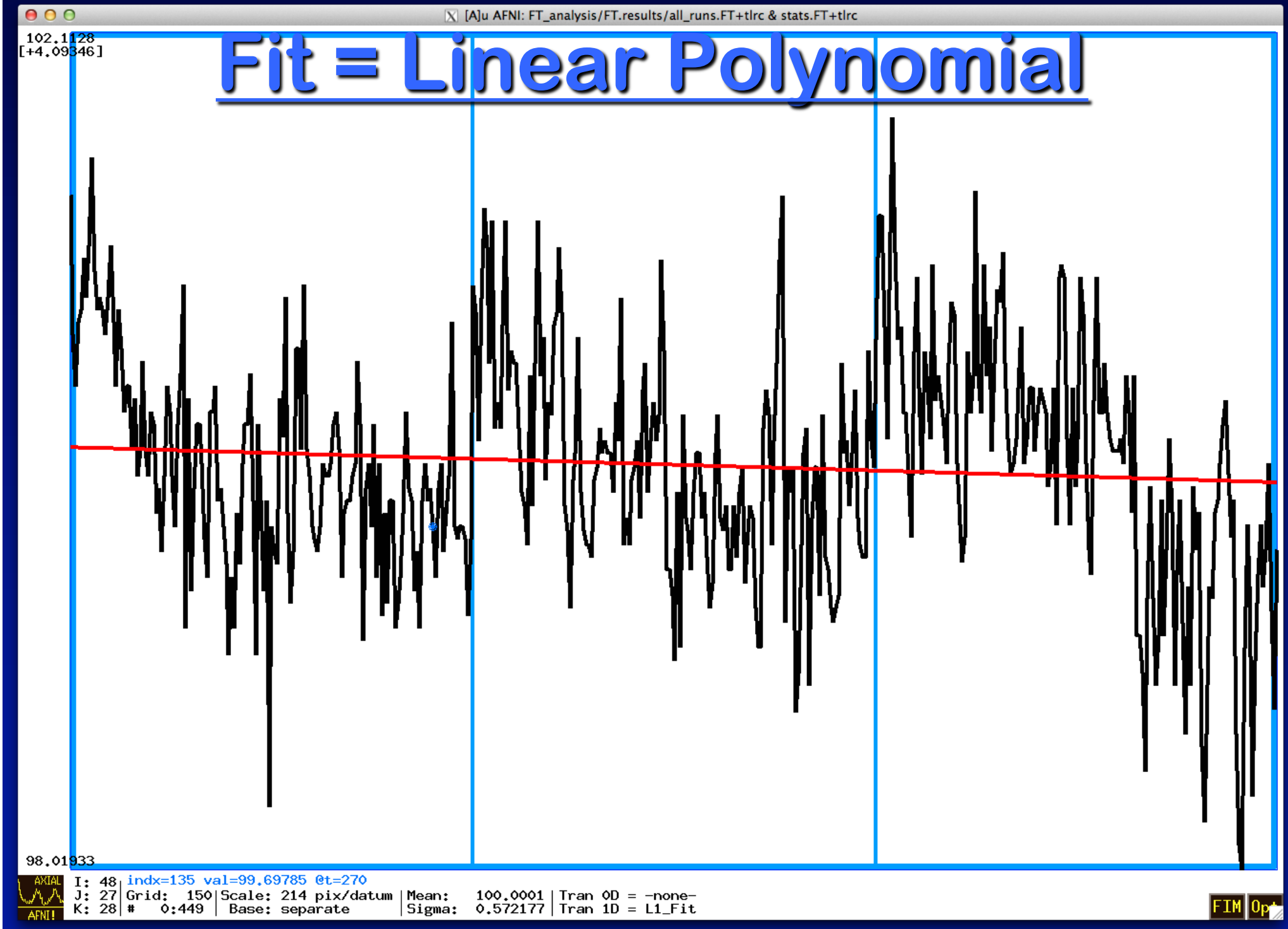
Tran 1D = L1_Fit
FIM
Opt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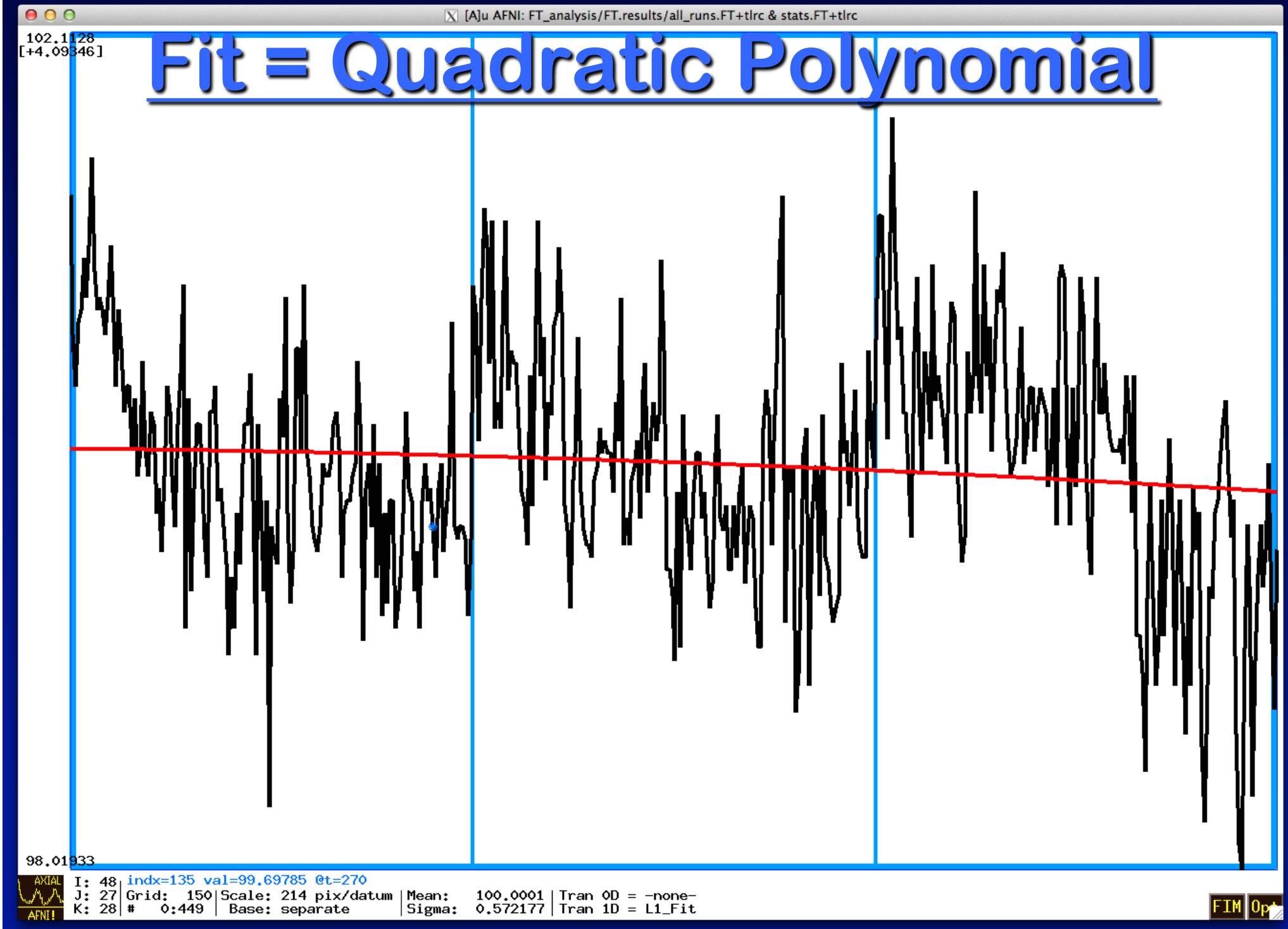
102.1128
[+4.09346]
Fit = Linear Polynomial
98.01933
AXIAL
AFNI!
I: 48 indx=135 val=99.69785 @t=270
J: 27 Grid: 150 Scale: 214 pix/datum Mean: 100.0001 Tran 0D = -none-
K: 28 # 0:449 Base: separate Sigma: 0.572177 Tran 1D = L1_Fit
FIM
Opt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[+4.09346]
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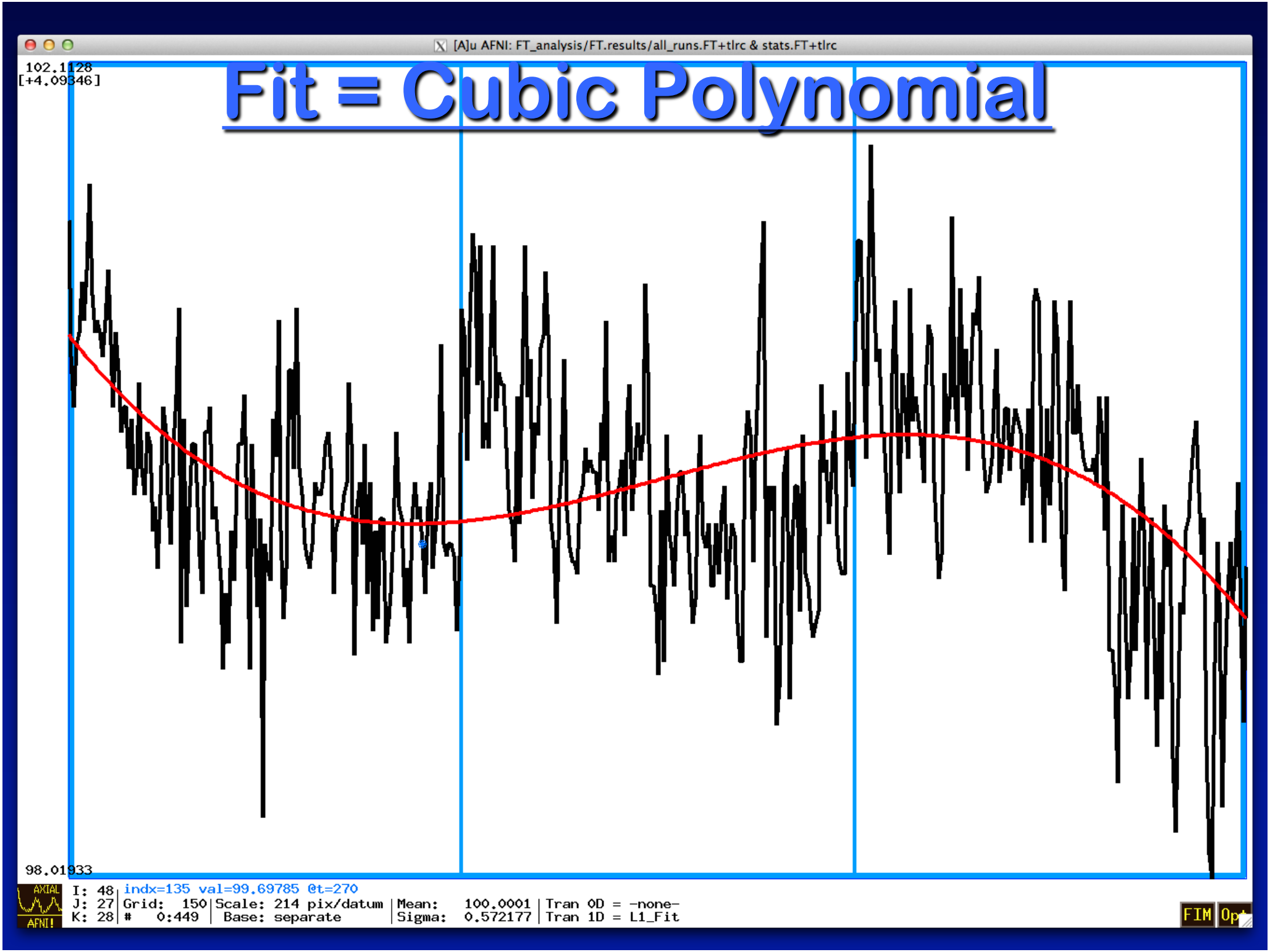
98.01933
AXIAL
AFNI!
I: 48 indx=135 val=99.69785 @t=270
J: 27 Grid: 150 Scale: 214 pix/datum Mean: 100.0001 Tran 0D = -none-
K: 28 # 0:449 Base: separate Sigma: 0.572177 Tran 1D = L1_Fit
FIM
Opt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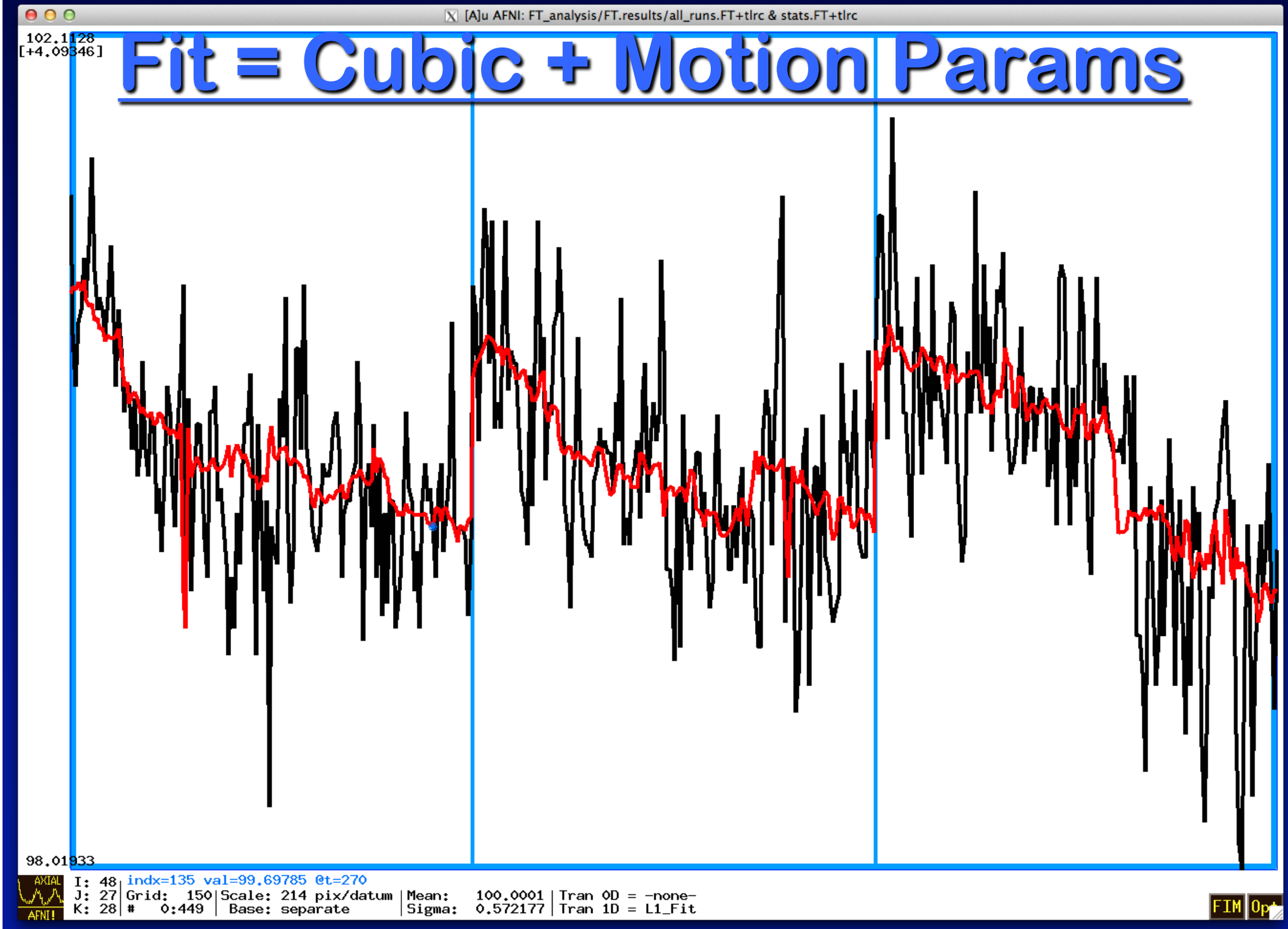
102.1128
[+4.09346]
Fit = Cubic Polynomial
98.01933
AXIAL
AFNI!
I: 48 indx=135 val=99.69785 @t=270
J: 27 Grid: 150 Scale: 214 pix/datum Mean: 100.0001 Tran 0D = -none-
K: 28 # 0:449 Base: separate Sigma: 0.572177 Tran 1D = L1_Fit
FIM
Opt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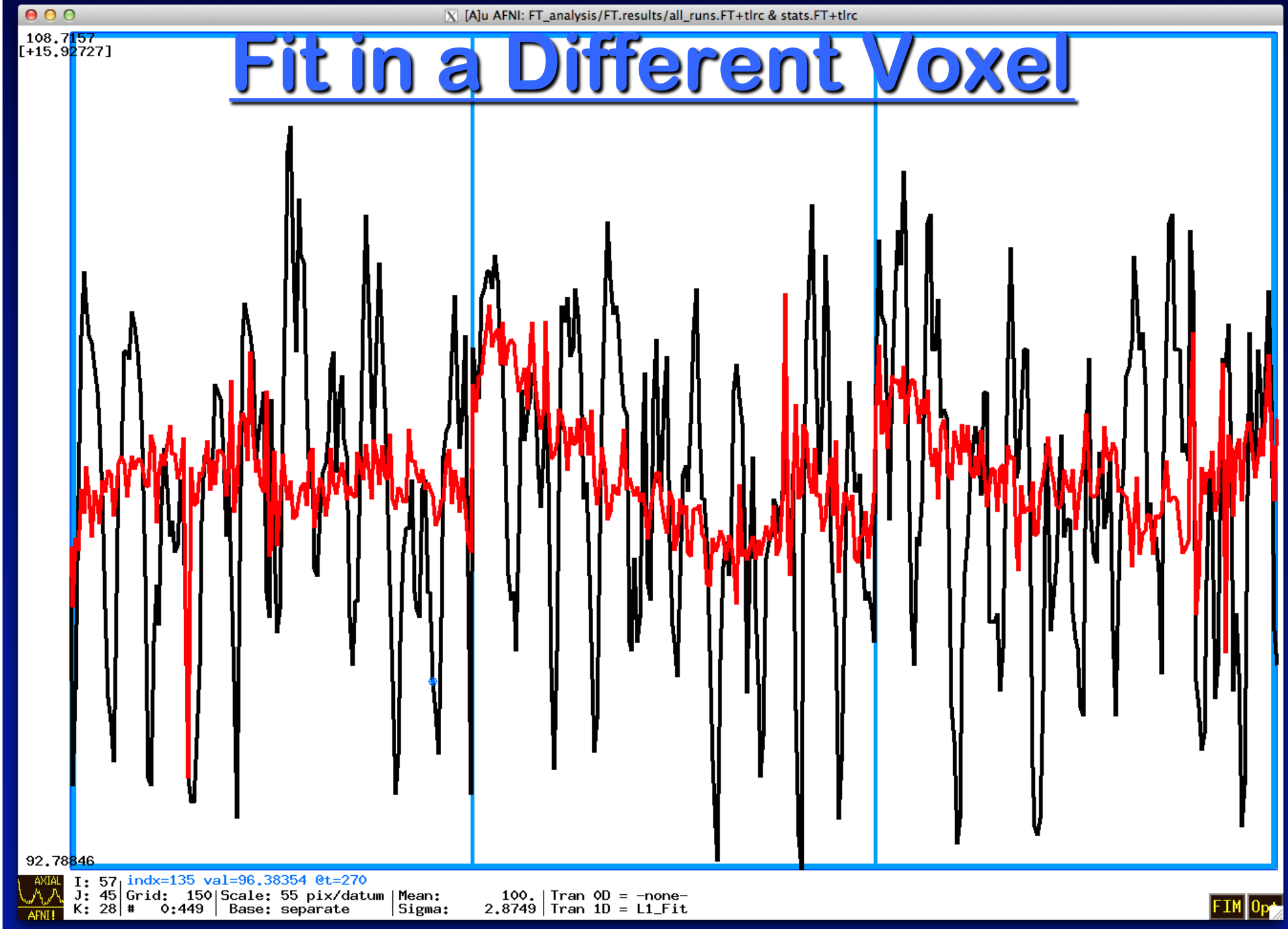
102.1128
[+4.09346]
Fit = Cubic + Motion Params
98.01933
AXIAL
AFNI!
I: 48 indx=135 val=99.69785 @t=270
J: 27 Grid: 150 Scale: 214 pix/datum Mean: 100.0001 Tran 0D = -none-
K: 28 # 0:449 Base: separate Sigma: 0.572177 Tran 1D = L1_Fit
FIM
Opt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108.7157
[+15.92727]
Fit in a Different Voxel
92.78846
AXIAL
AFNI!
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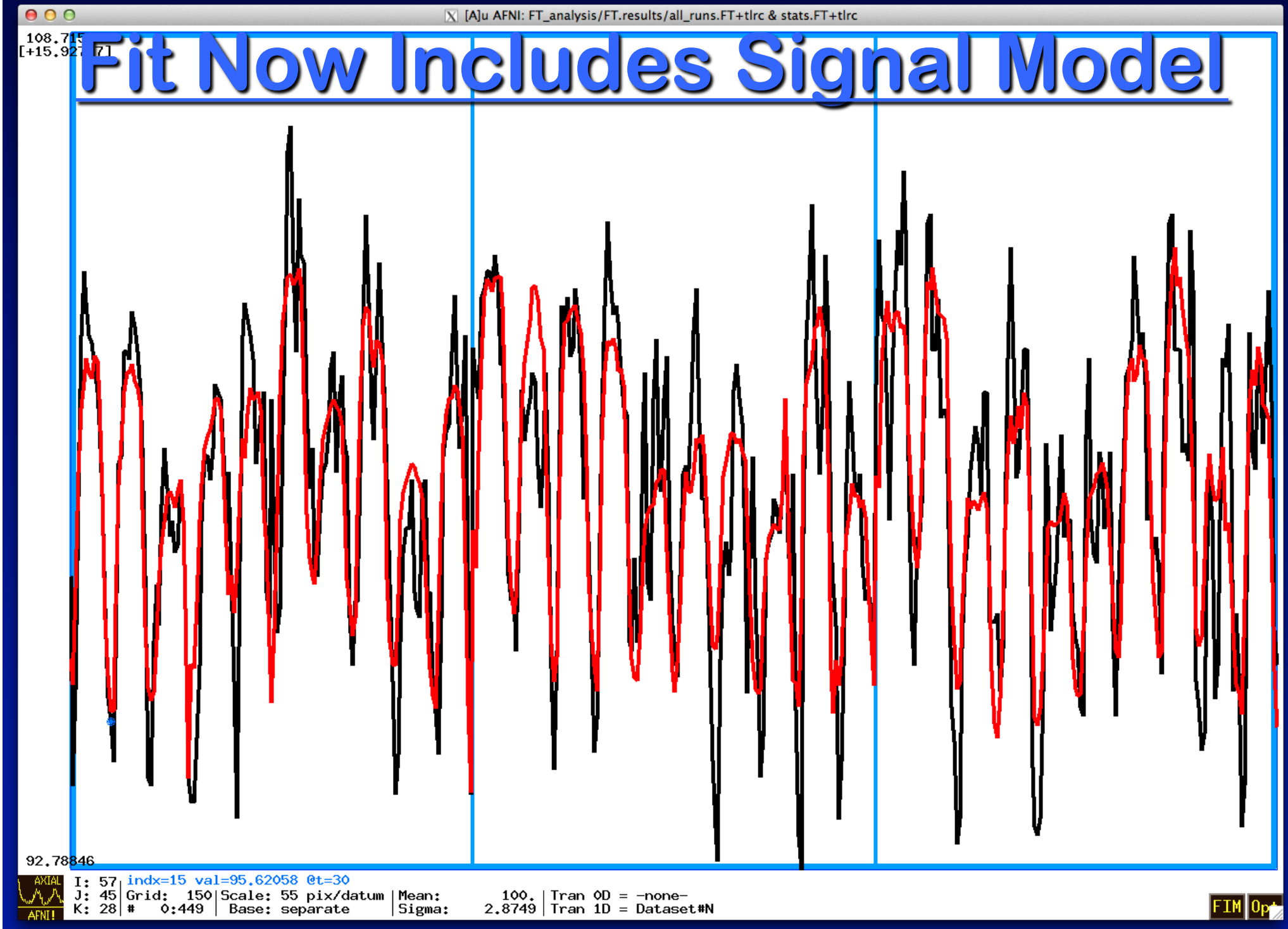
J: 45 Grid: 150 Scale: 55 pix/datum Mean: 100. Tran 0D = -none-
K: 28 # 0:449 Base: separate Sigma: 2.8749 Tran 1D = L1_Fit
FIM
Opt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Fit Now Includes Signal Model
108.715
92.78846
AXIAL
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K: 28
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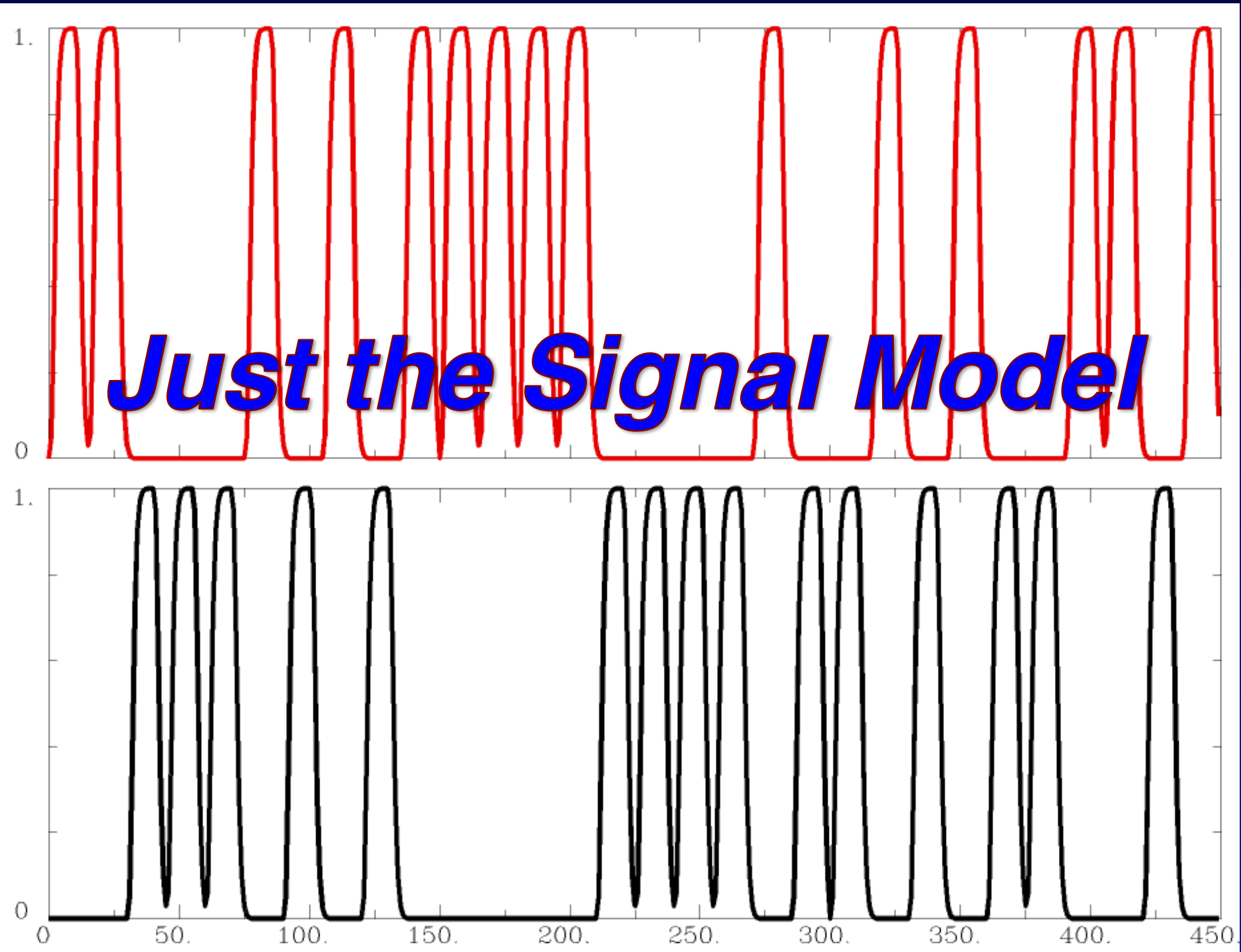
Grid: 150
# 0:449
Scale: 55 pix/datum
Base: separate
Mean: 100.
Sigma: 2.8749
Tran 0D = -none-
Tran 1D = Dataset#N
FIM
Opt


All The Regressors
= The Full Model
0
50.
100.
150.
200.
250.
300.
350.
400.
450.




# Just the Signal Model

# Analysis by Super-Script – by GUI