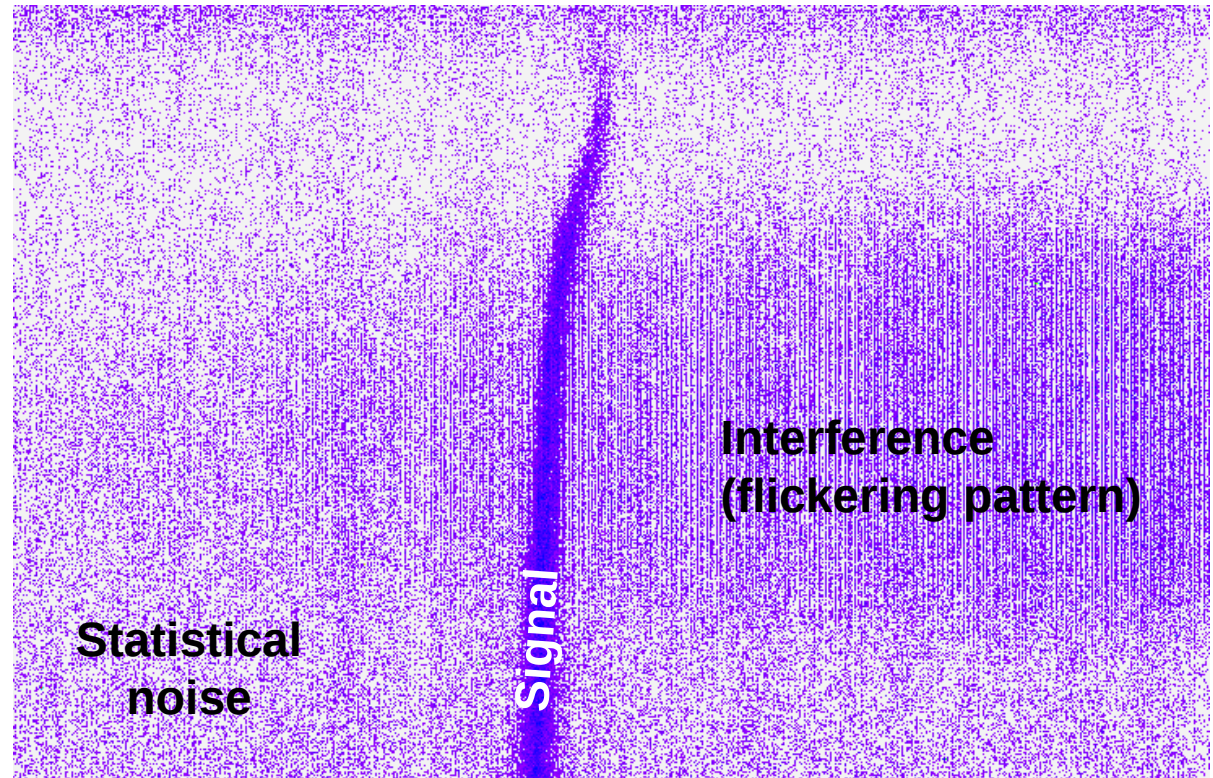


# DEVELOPMENT QUESTIONS OF IMAGE PROCESSING FILTERS FOR PITZ

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PITZ Physics Seminar,  
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- **Intro**
- **Pure statistical analysis**
- **Frequency-gate based interference filter**
- **Filters sky map**
- **Image processing existing filters and possible future developments.**

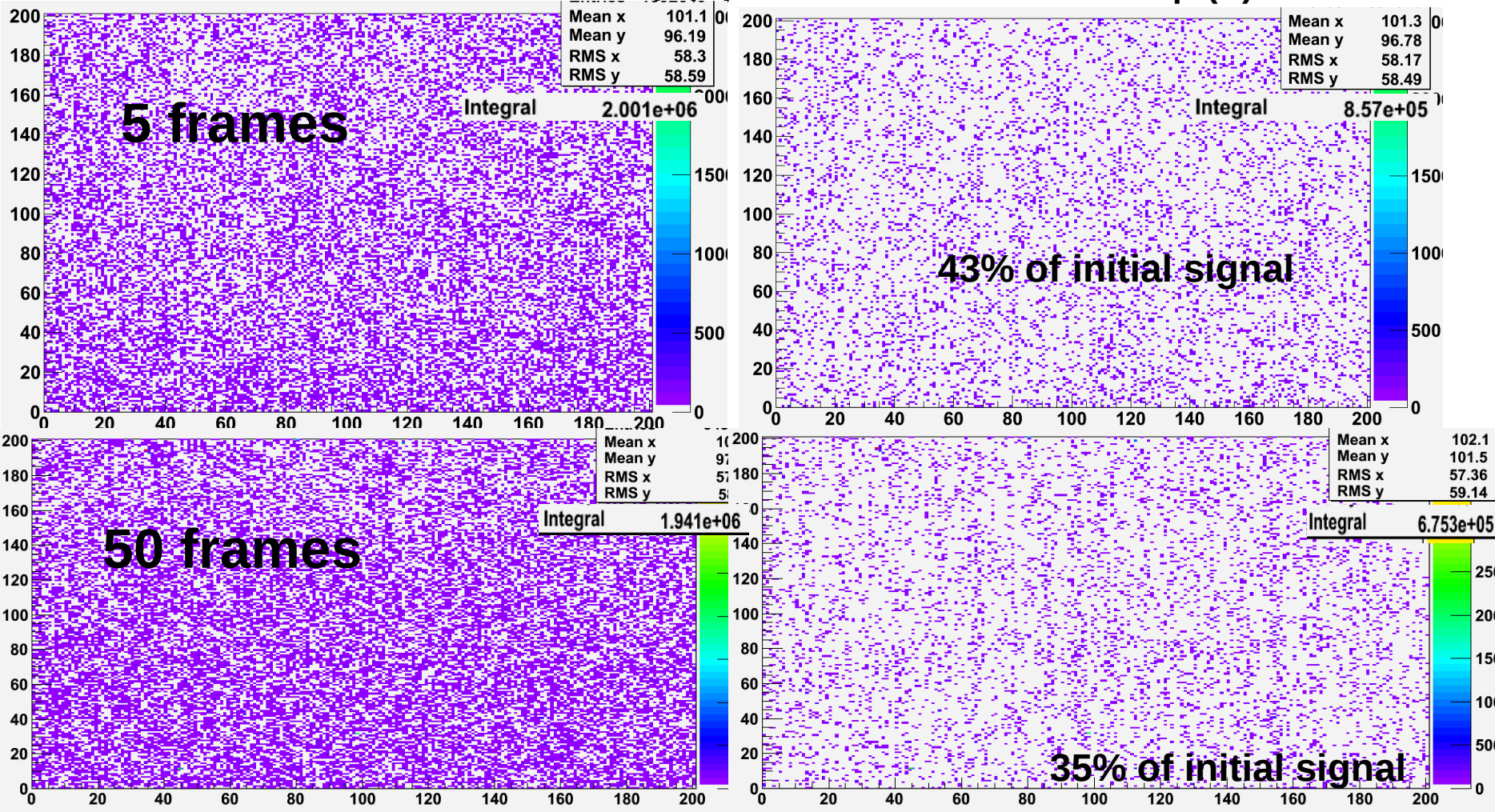
- > Any information we get contains  
“noise”, “interference”, “distortions”.
- Noise is fought with statistical analysis
  - Interference can be excluded by target filters (systematic)
  - Distortions include measurement system imperfections



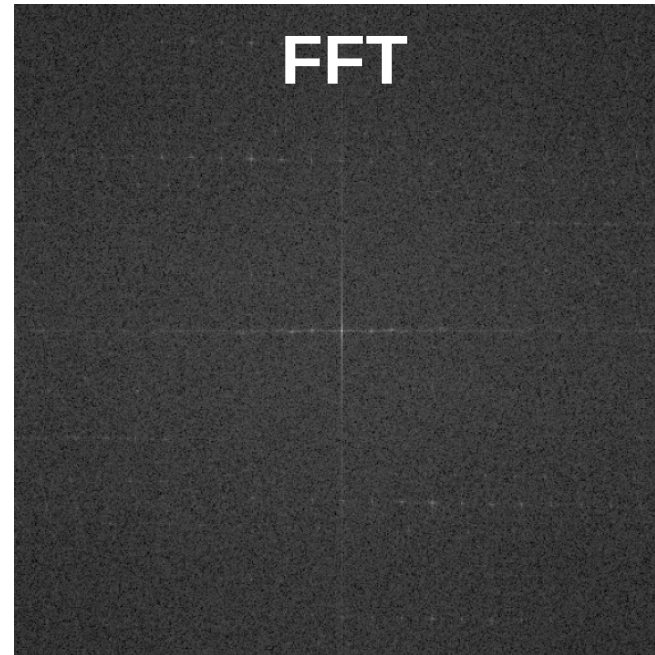
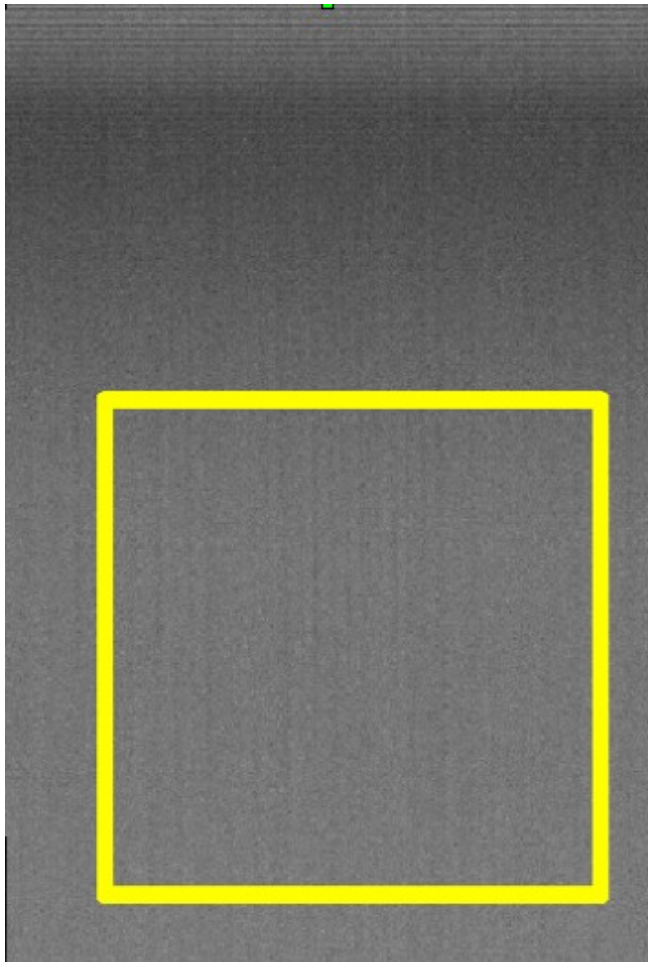
## > Noise can be distinguished from (signal+noise)

- Statistical properties: Mean, rms of dark frame for each pixel. Mean distribution has RMS of  $\text{rms}/\sqrt{N}$  ( $N$  – number of frames).

$$\text{MeanDark} + 3 \cdot \text{rmsDark} / \sqrt{N} < \text{MeanIllum} + 3 \cdot \text{rmsIllum} / \sqrt{N}$$



- **The noise is not random. One can use frequency filter.  
FFT of a pure random distribution is a random distribution  
The stars on FFT are signs of “interference”.**



Fast scan  
Special case

MK:Beam  
size/shape  
Specific filters

Neighbours  
(only 2D)

Flickering  
pattern filter

**DATA**  
Signal  
+  
Background  
Multi-frame  
Background

3D FFT + Filter

Filter introduced  
uncertainty  
estimation

Statistical  
analysis

X-ray filter

Semi-manual  
filters

Sigma ROI

**NEW  
FILTERS**

- **Mostly C/C++ ( ..., SW, DL, VM, LS, GA, YI, ...)**
- **Several developers at PITZ.**
  - ...
  - ...
  - **YI image processing library is 1300 lines of code, about 10 functions, still in development.**
  - ...
- **The great image processing libraries unification (PITZ standard image processing library). To be or not to be?**
- **Filters benchmark is needed to judge on filter quality. Virtual filter test laboratory.**
  - **Artificially created ETHALON images with pseudo-real noise distributions, and with known properties of the signal distributions.**
    - GA: Astra created objects
    - MK: Optics lab hardware tests (beam distr like light source)
- **Video libraries are ported to MATLAB. Porting will be needed for the image processing libraries.**

- > 1<sup>st</sup> step is to check the physical aspects of the existing filters**
  - PPS or a special group. Outcome – a manual and a physical description of the applied image transformations.
- > 2<sup>nd</sup> step: Unification and optimization of the code:**
  - Best scenario: we agree on common rules how one modifies his code with the smallest effort. It should not become the piece of programming art, but easy to understand and to use.