22nd Accelerator Test Facility (ATF) Users' Meeting
December 3-5, 2019 - Brookhaven National Laboratory

BROOKHAVEN NATIONAL LABORATORY

# A compact, tunable plasma beam dump *and* *Energy Recovery*

## Feasibility study 2019 report

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Stony Brook University

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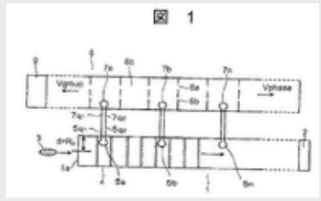
# Energy Recovery

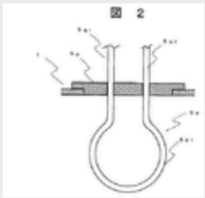
## Beam terminating method and beam terminating device

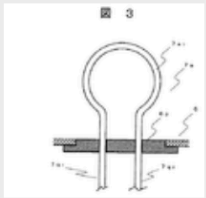
### Abstract

<P>PROBLEM TO BE SOLVED: To terminate a high-energy particle beam by efficiently decelerating it without generating radiation. <P>SOLUTION: Plasma of an encapsulated gas is generated with the incident high-energy particle beam 3 by encapsulating the gas in a waveguide 1 of a linear decelerator, the generated plasma is resonated and vibrated in the waveguide, and the plasma vibration energy is supplied to a load device 9 by taking it out to the outside by electrodes 5a-7a as electrical energy. <P>COPYRIGHT: (C)2009,JPO&INPIT

### Images (3)








JP2009140673A
Japan

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**Other languages:** Japanese

**Inventor:** W Chao Alexander, Toshiki Tajima, ダブリュウ．アレキサンダー チャオ, 俊樹 田島

**Worldwide applications**

2007 • JP

**Application JP2007314155A events**

2007-12-05 • Application filed by Japan Atomic Energy Agency, Univ Stanford, スタンフォード ユニバーシティ, 独立行政法人 日本原子力研究開発機構

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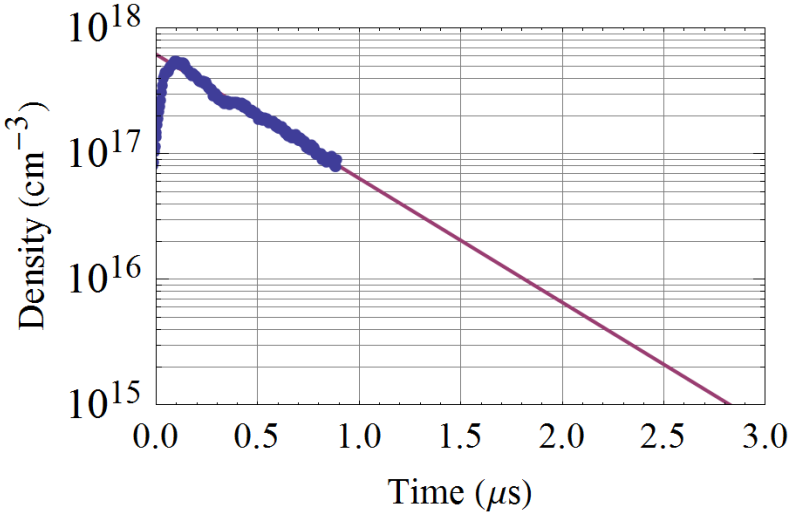
# Feasibility Study - setup limited

*Discharge capillary*
Discharge struck - plasma builds up to its highest density
Density decays to lower values - over several μs
Stationary conditions - few tens of ps e-beam traversing

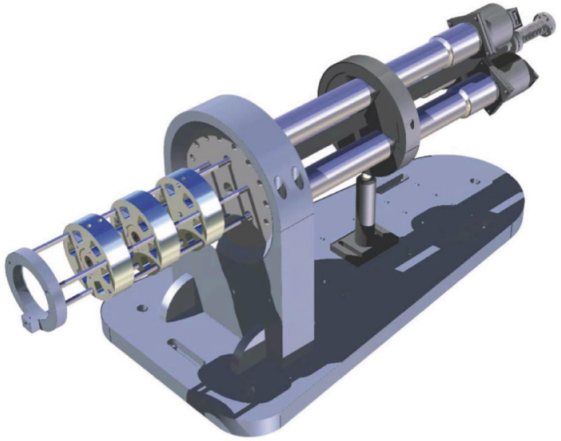



Discharge vs. e-beam – relative timing – density choice
NEED ionization laser (lower pressure)

*Plasma Density Diagnostics*
Stark-shift of emission line – was not available

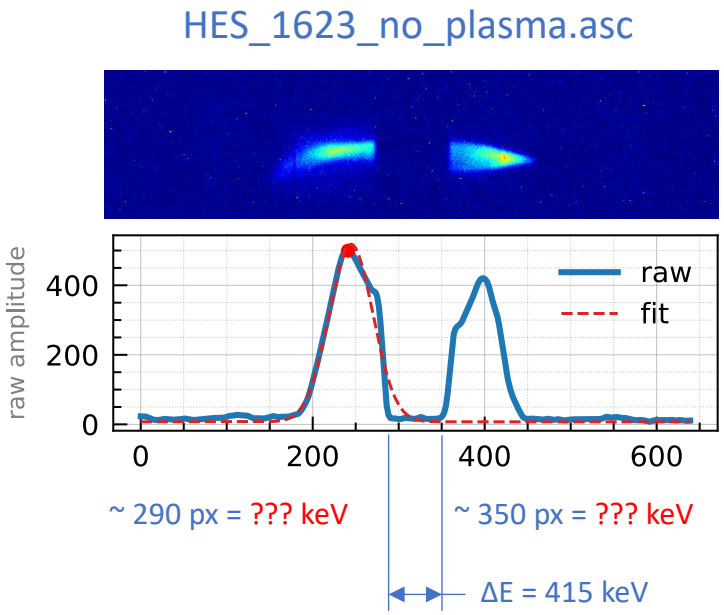
Bunch compressor stability – 100fs

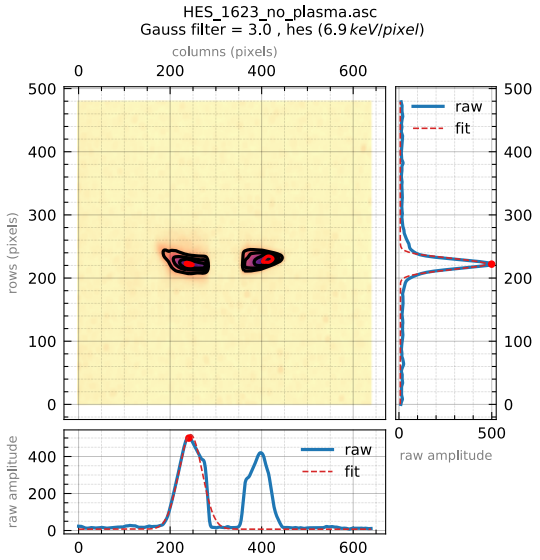
*PMQ Triplet: (T-PMQ)*
2 x T-PMQ – 1st ahead of the plasma IP & 2nd after exit ahead of spectrometer
1 adjustable focus T-PMQ – ahead of the IP
fixed focus T-PMQ – after plasma exit
needed to increase beam density



# BNL-ATF beam dump experiment - preliminary raw data analysis - 20190509

## Beam energy filtering:

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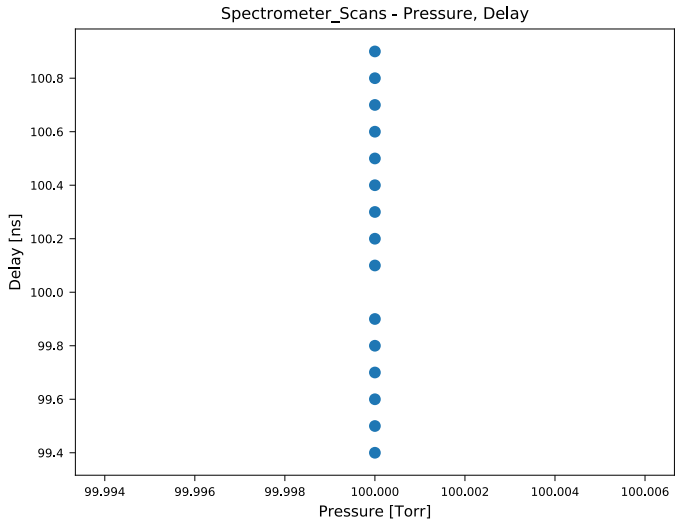


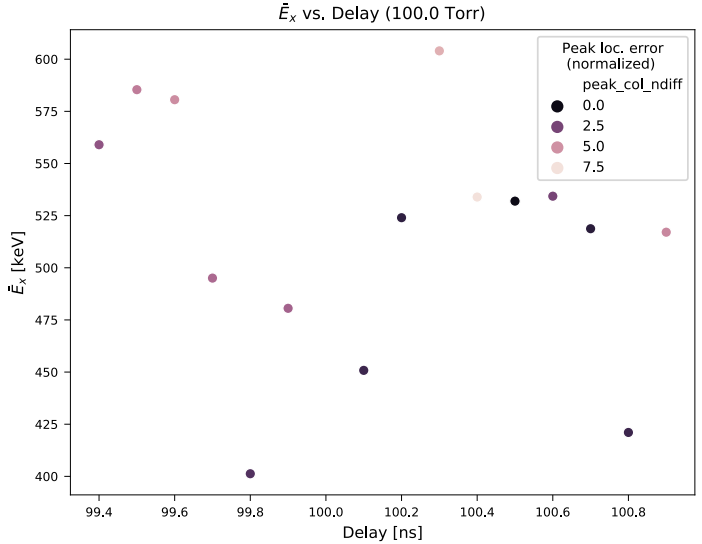


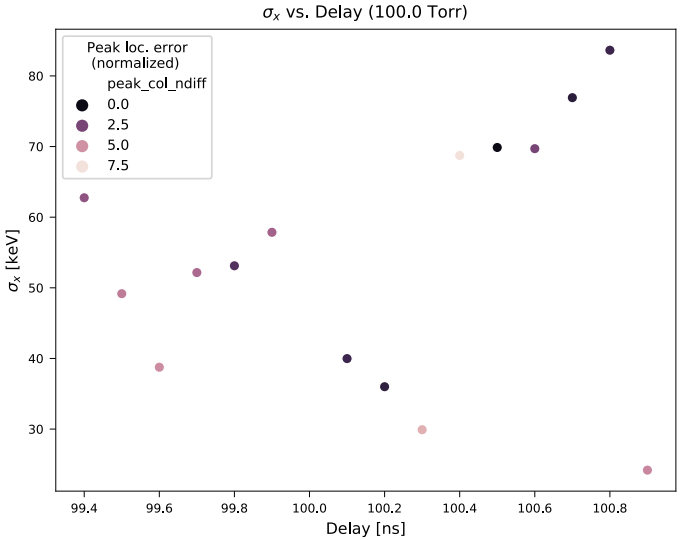


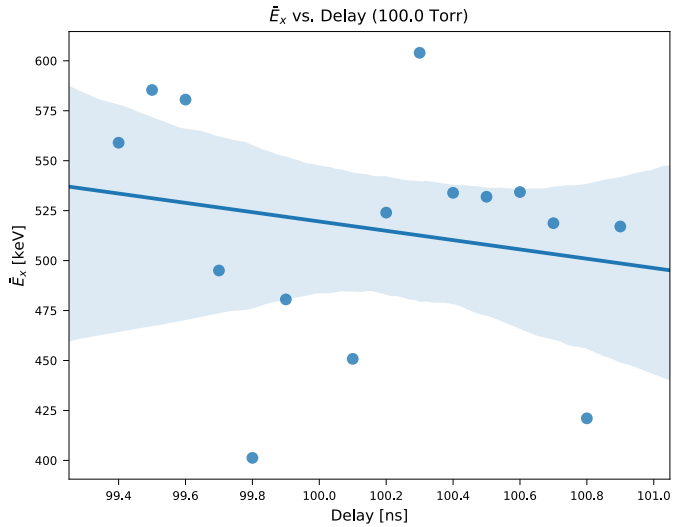


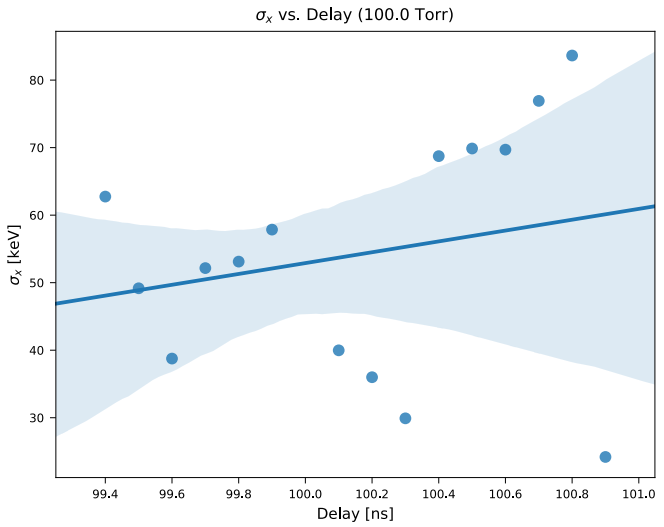


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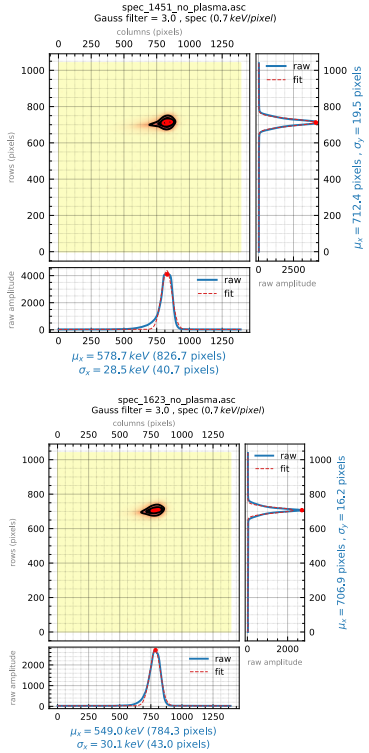
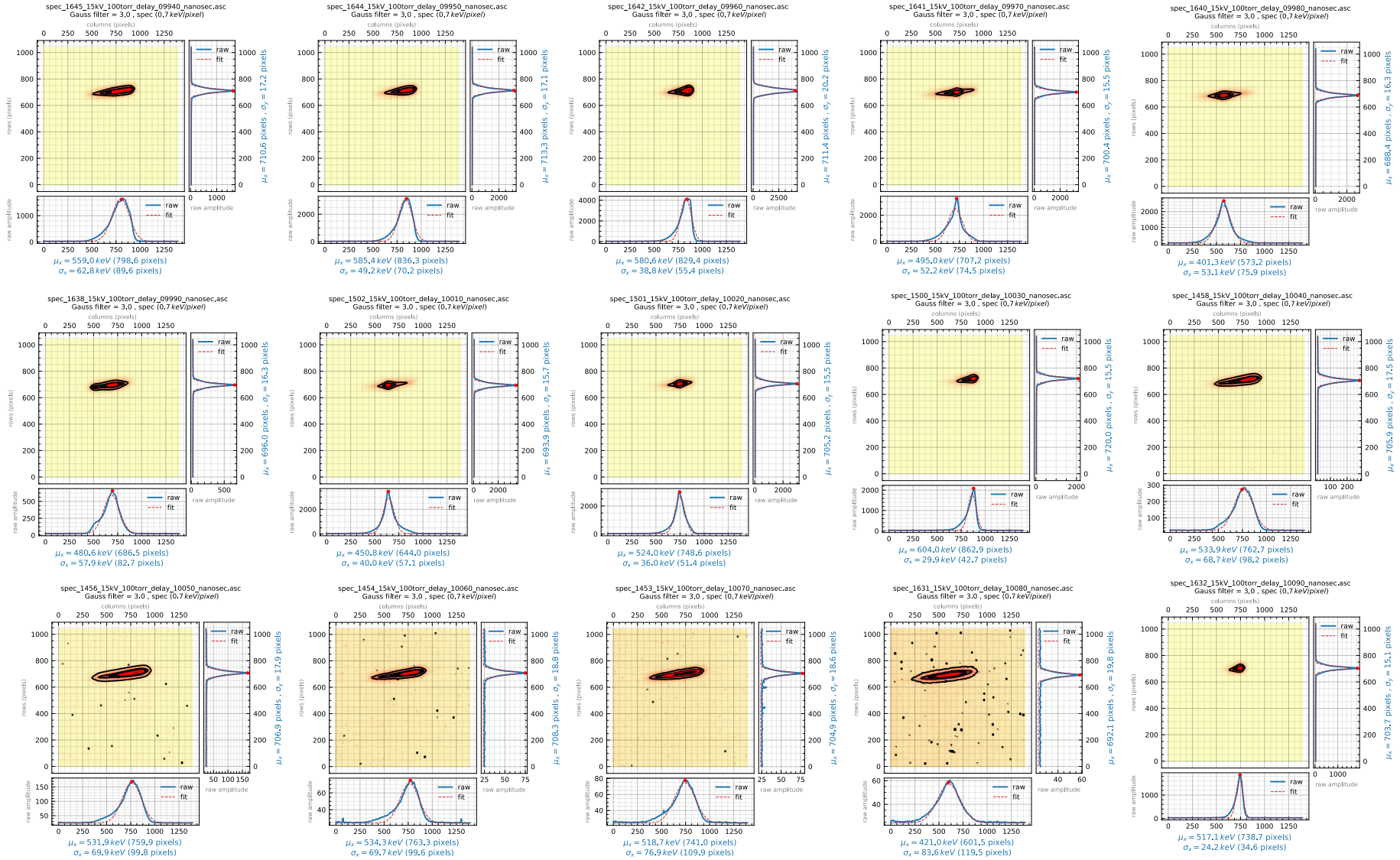
## No plasma:

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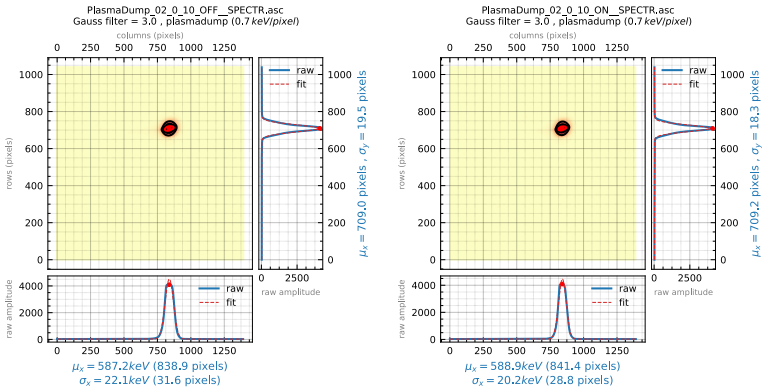
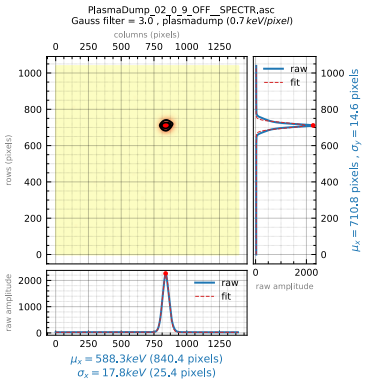
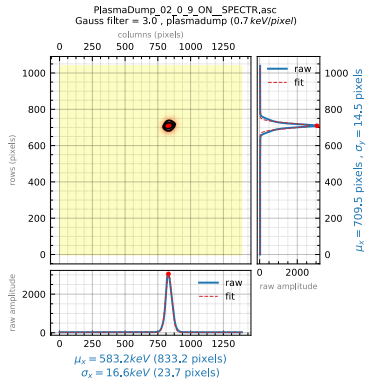
## Plasma Dump OFF vs. ON ???

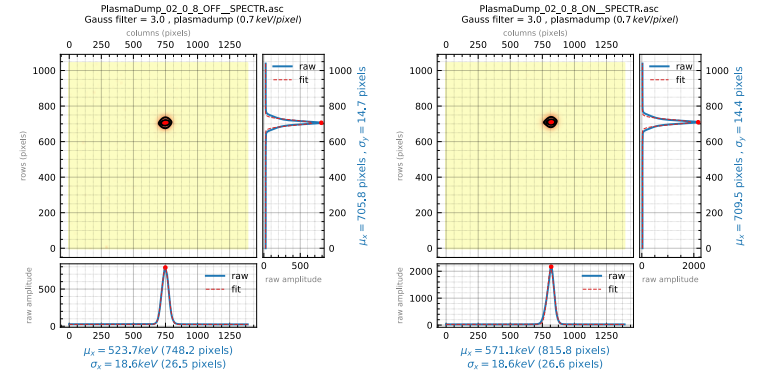






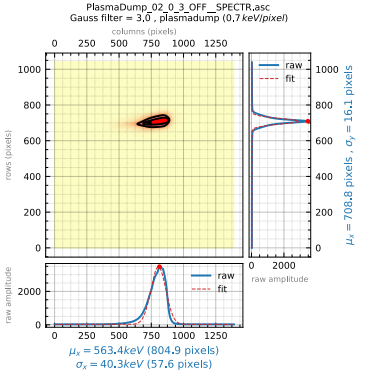


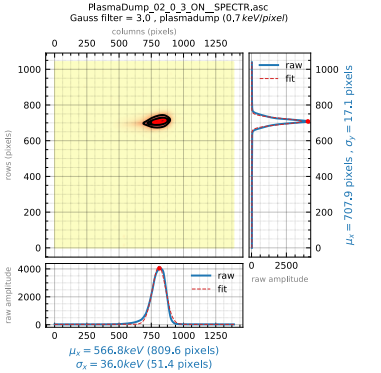







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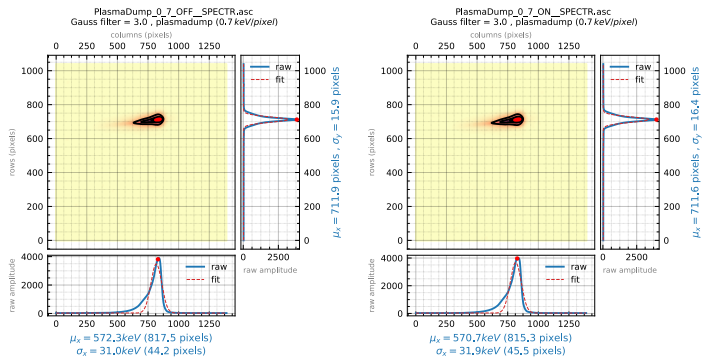





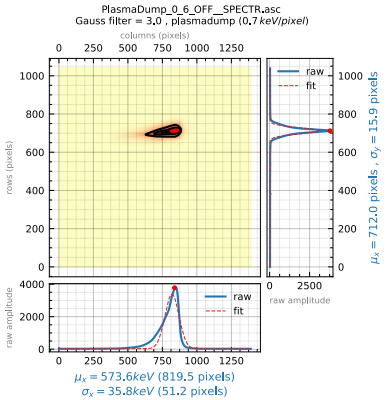


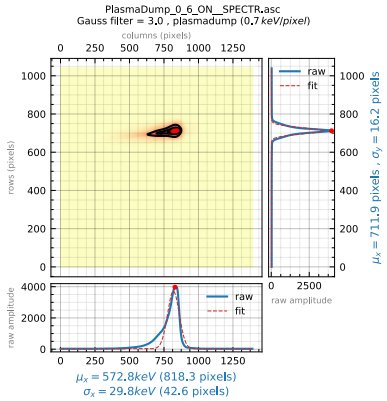


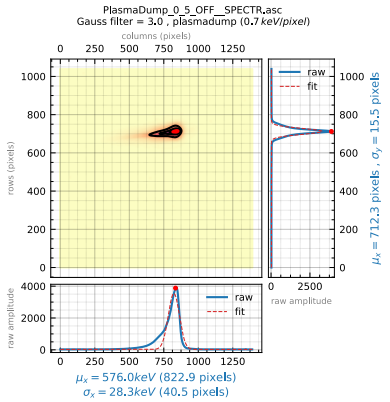


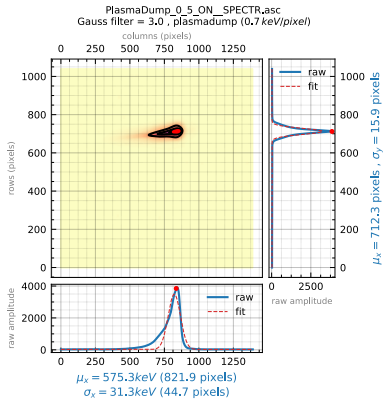


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# BNL-ATF beam dump experiment - preliminary raw data analysis - 20190510

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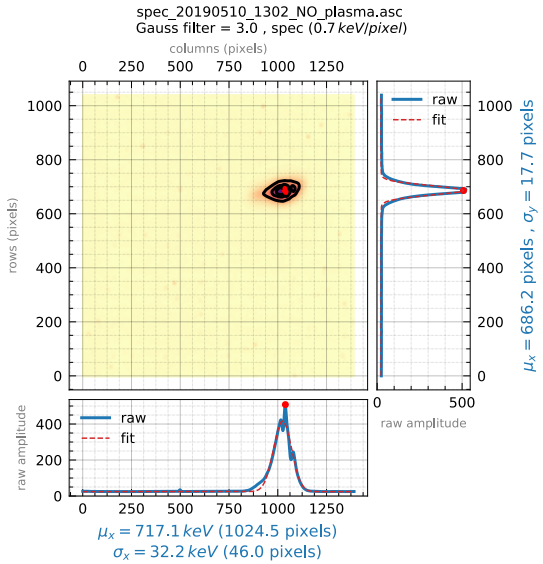


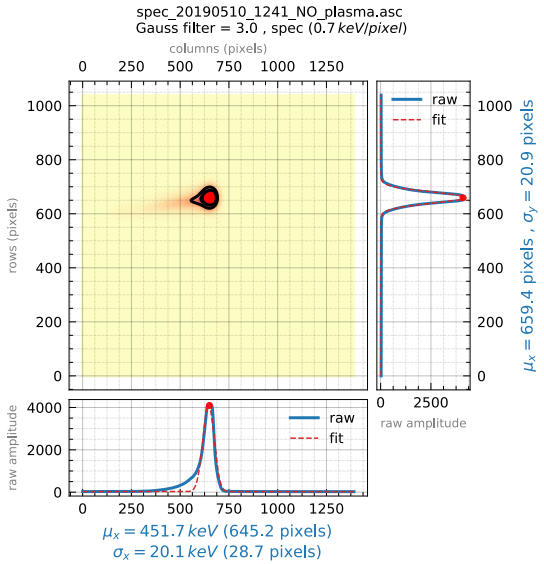


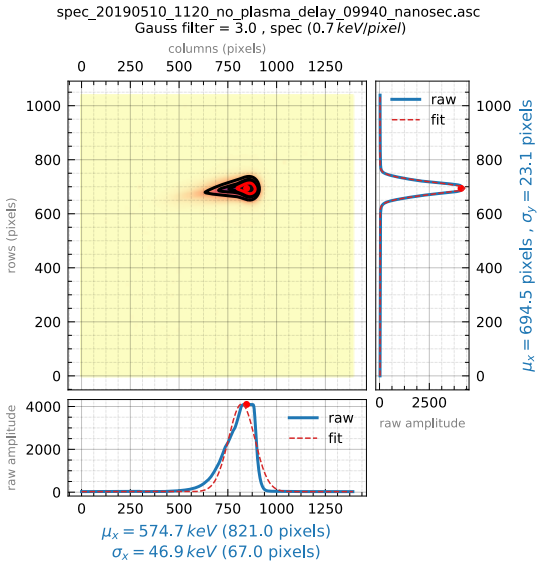


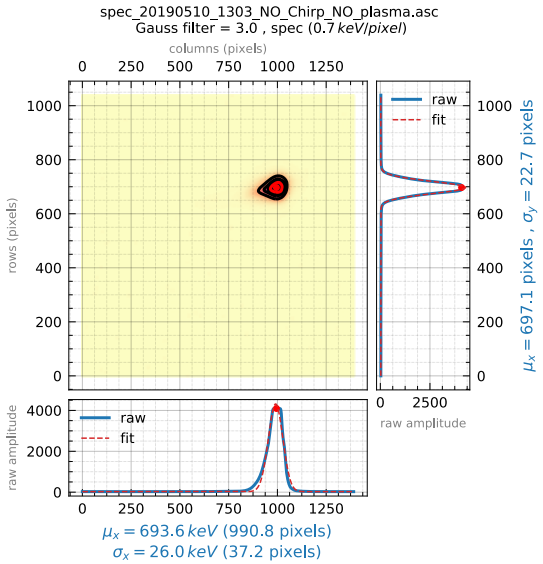


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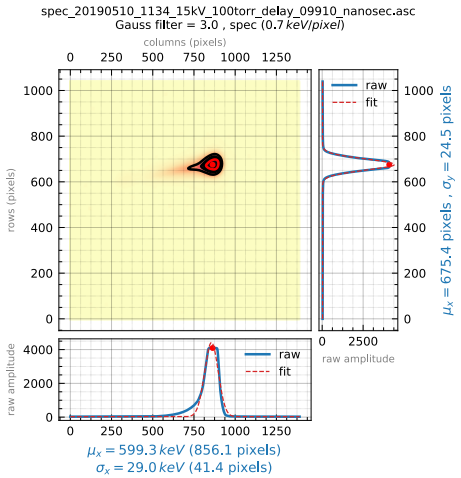
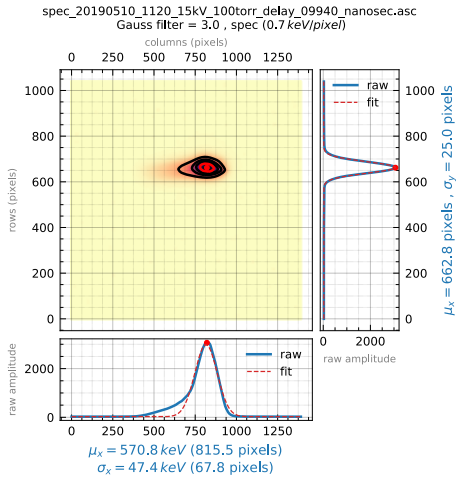
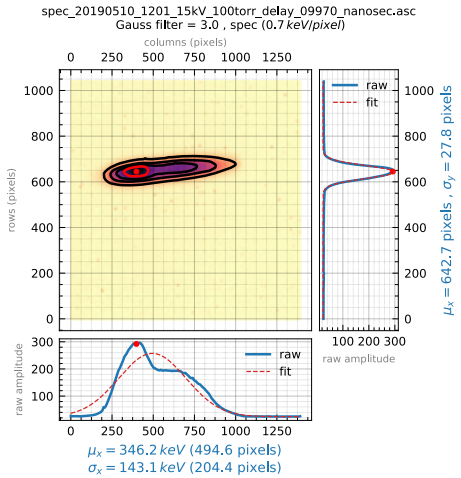
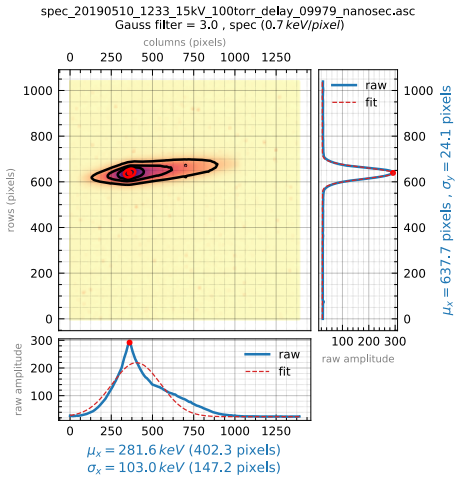
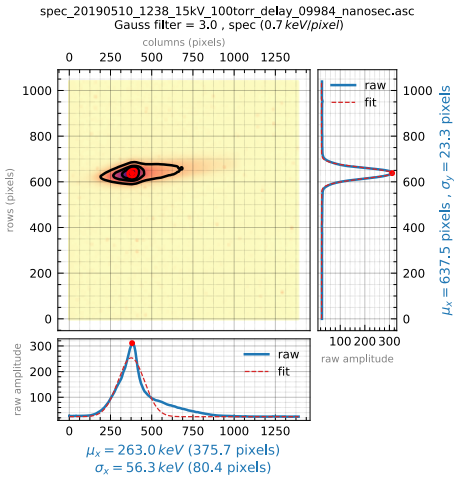
## Some images (external PDF has all images):

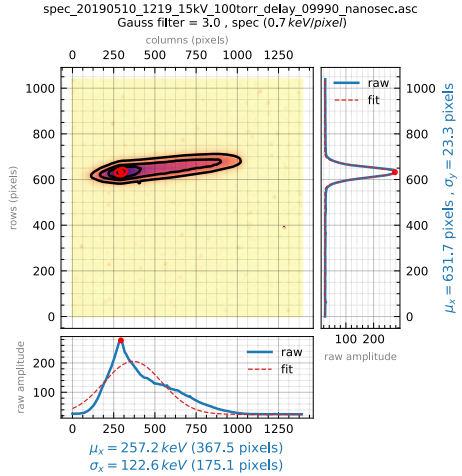


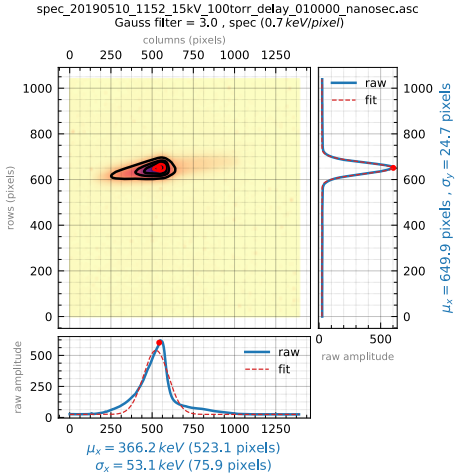



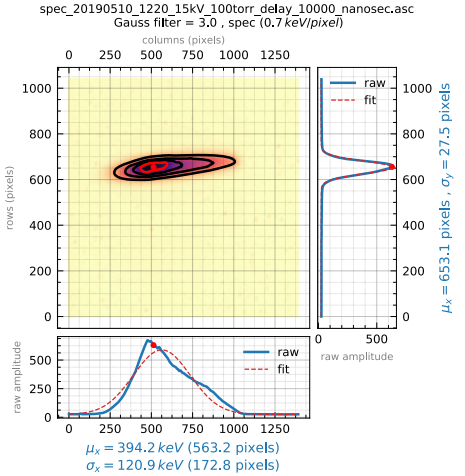



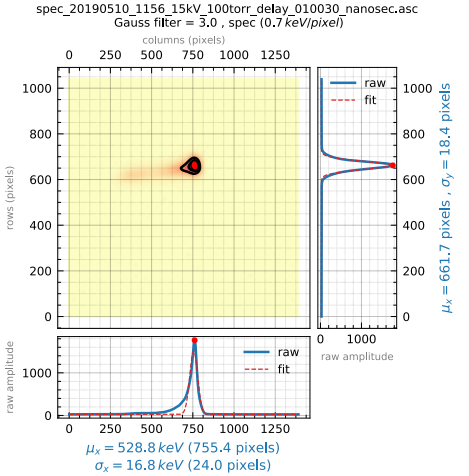

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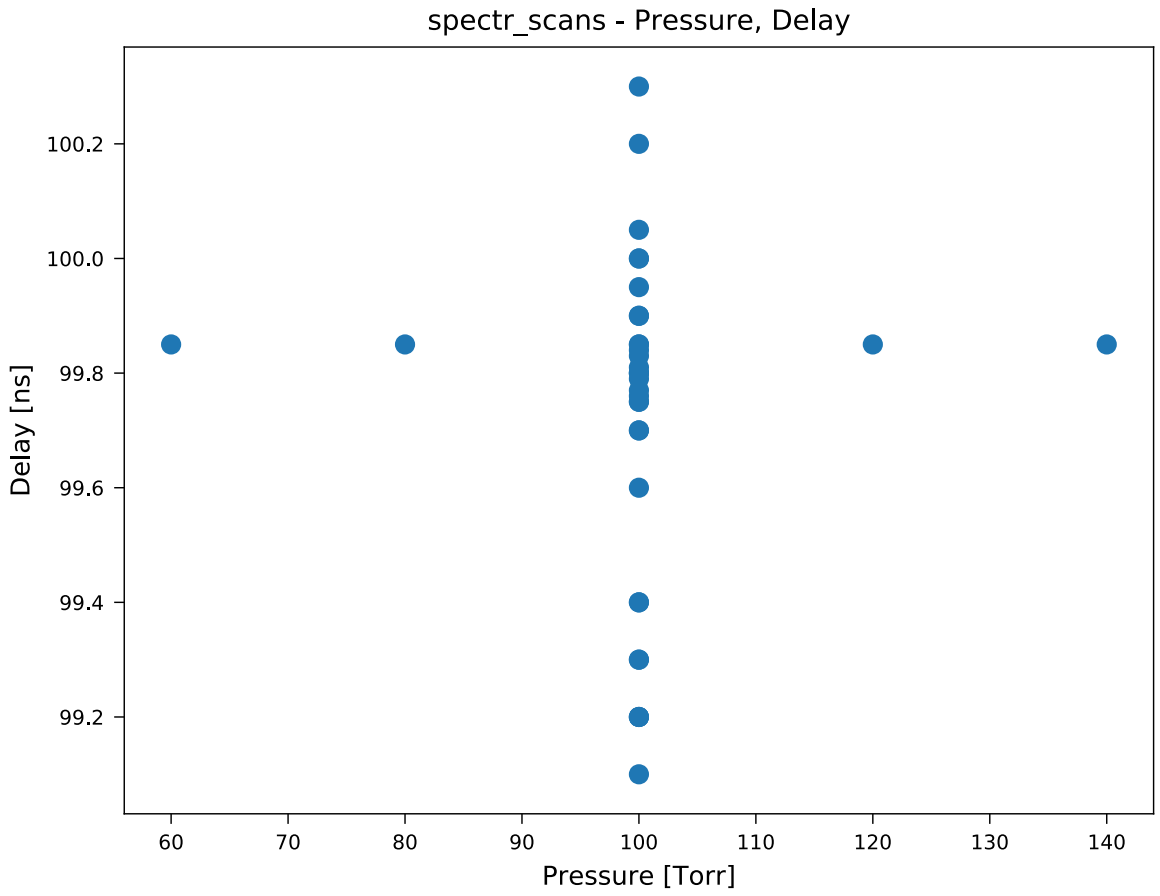
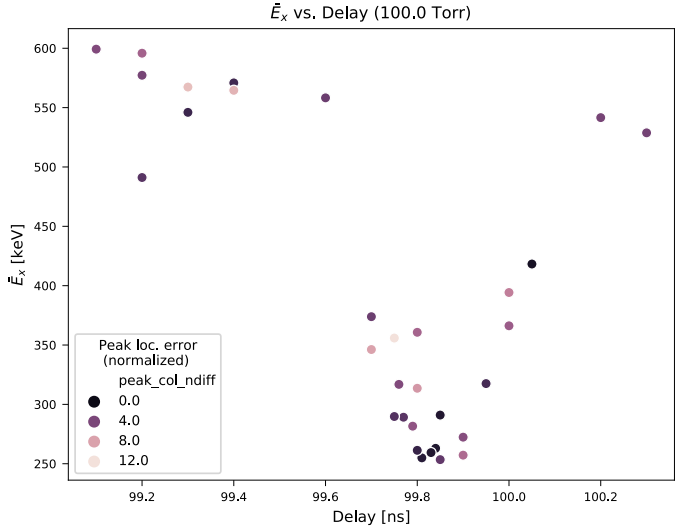
# BNL-ATF beam dump experiment - preliminary raw data analysis - 20190510

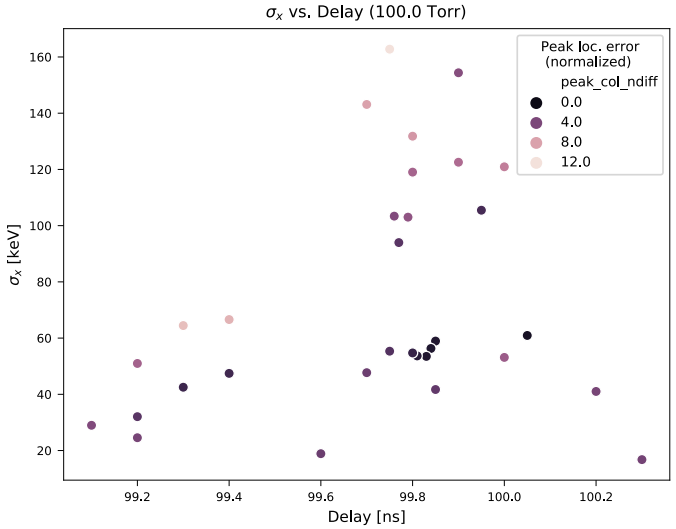
## Parameters:

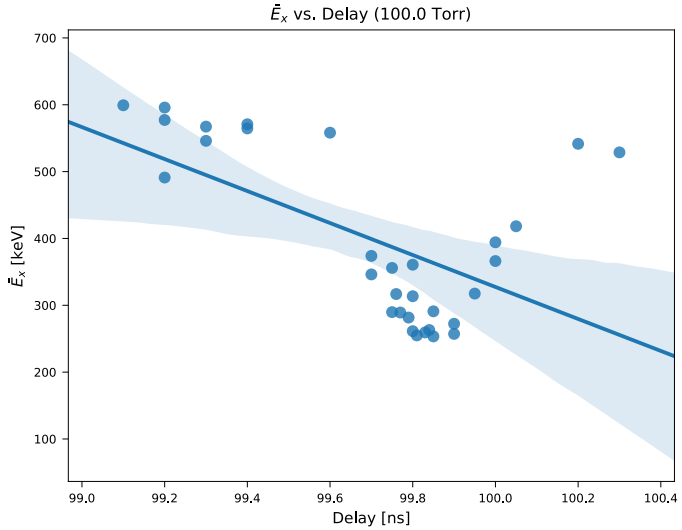


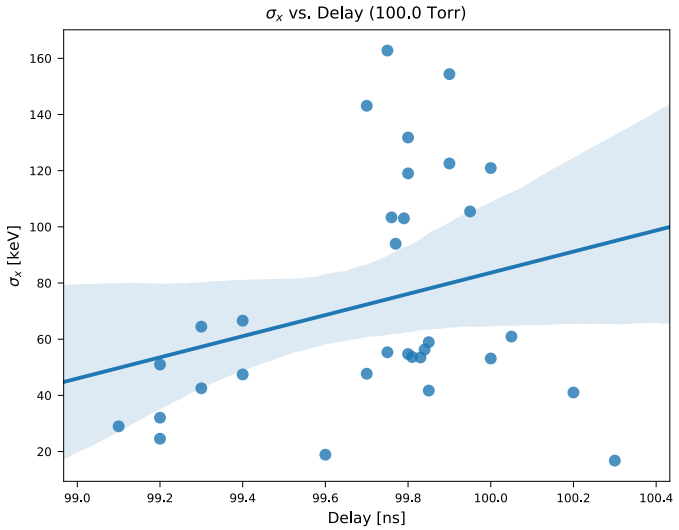
# BNL-ATF beam dump experiment - preliminary raw data analysis - 20190510

## Average energy and energy dispersion vs. delay (pressure = 100 Torr):

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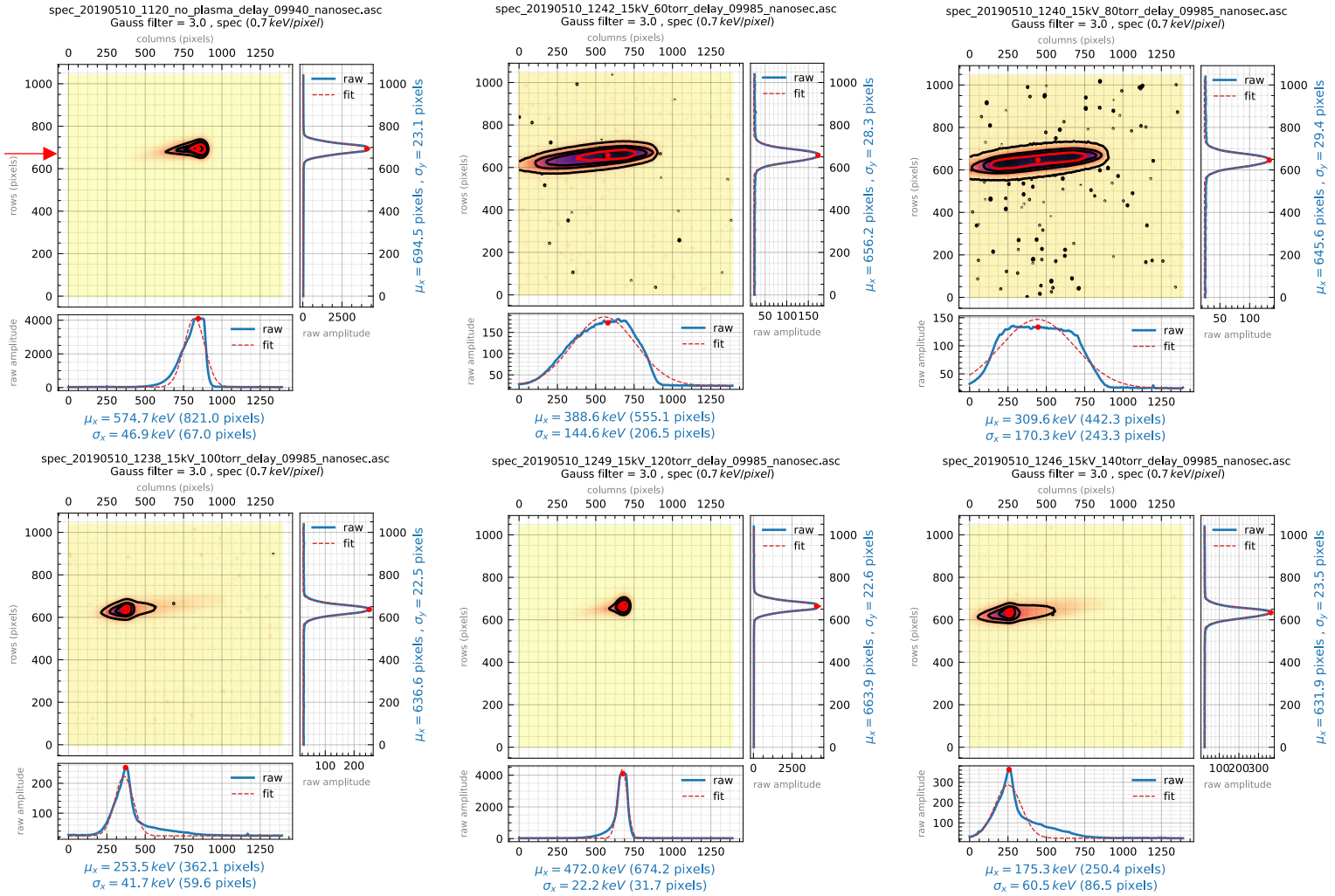
## Average energy and energy dispersion vs. pressure (delay = 99.8 ns):

99.40 ns

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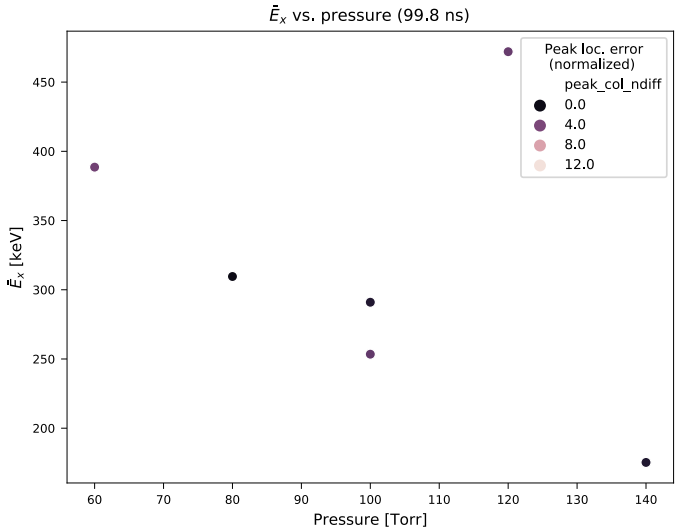
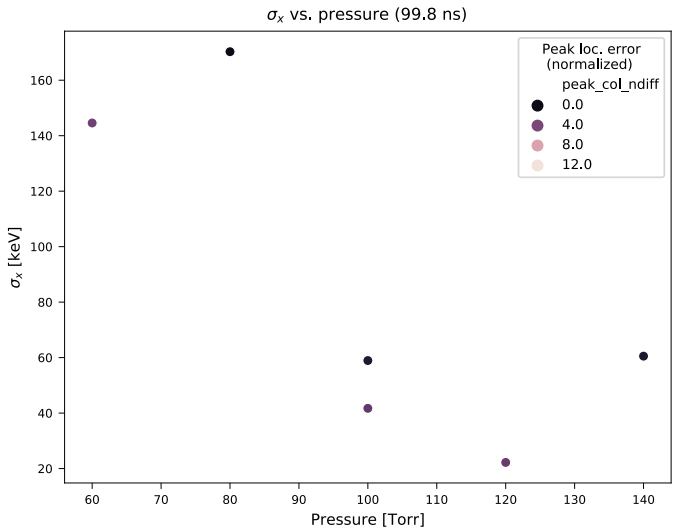
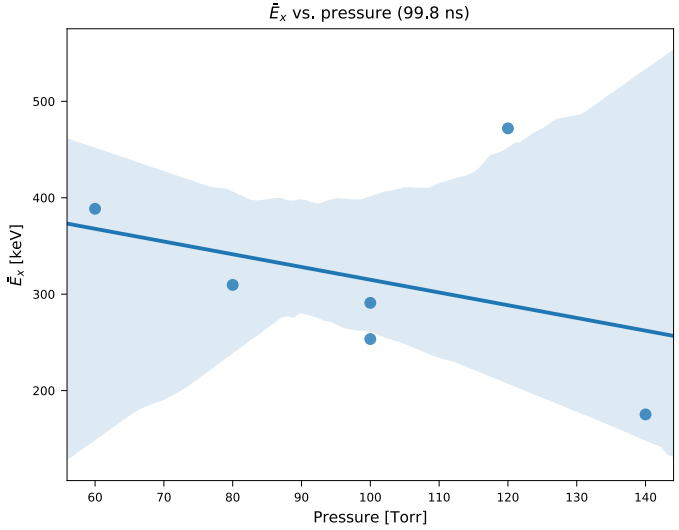
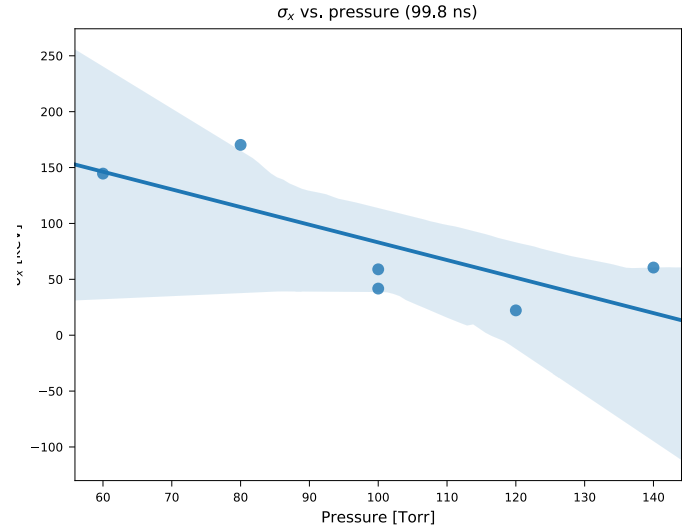
# BNL-ATF beam dump experiment - preliminary raw data analysis - 20190510

## Average energy and energy dispersion vs. pressure (delay = 99.8 ns):

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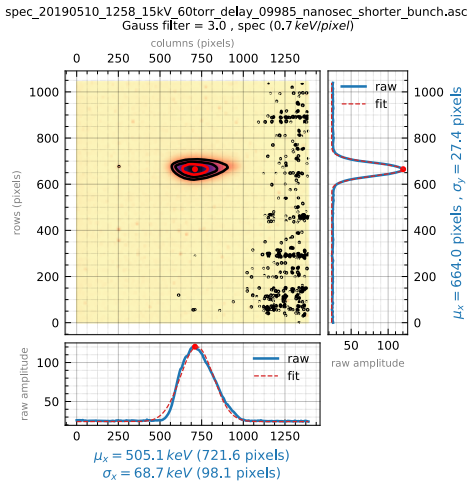
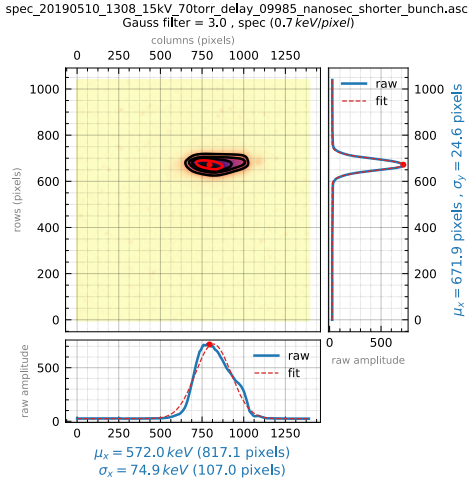
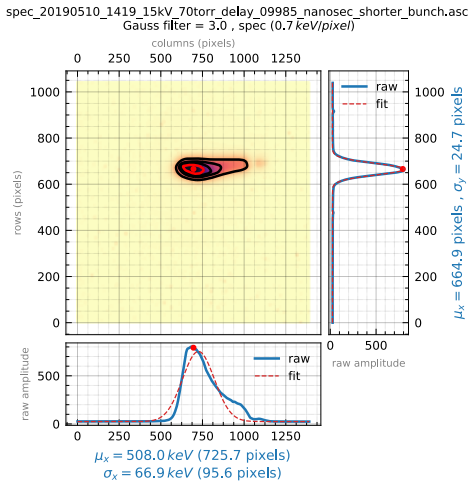
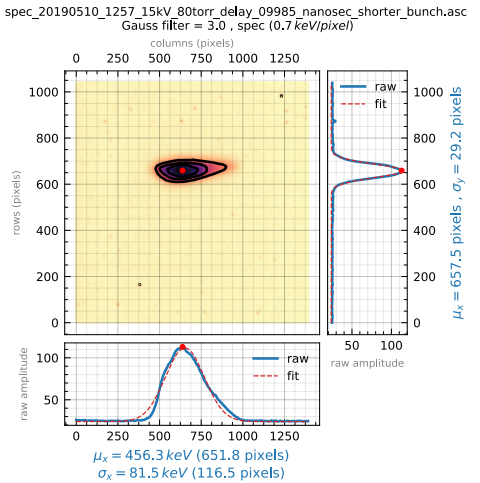
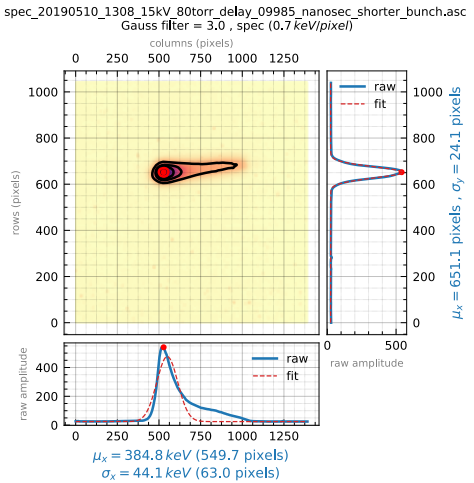
## Shorter bunch (BC on?) – Energy / energy dispersion vs pressure (99.85 ns):

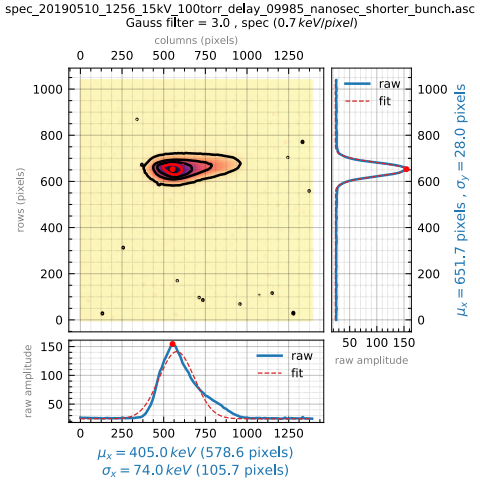


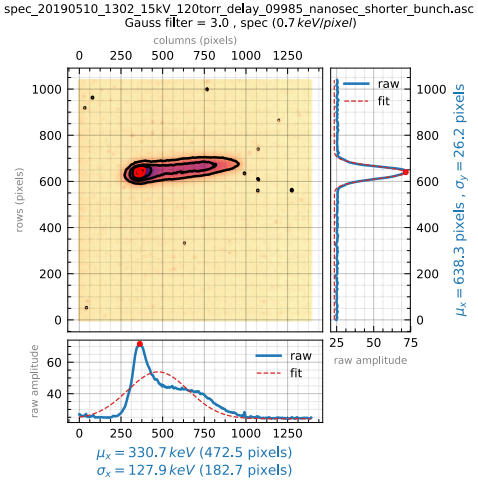



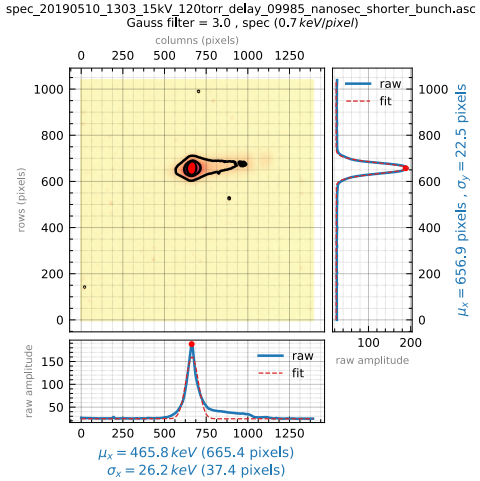



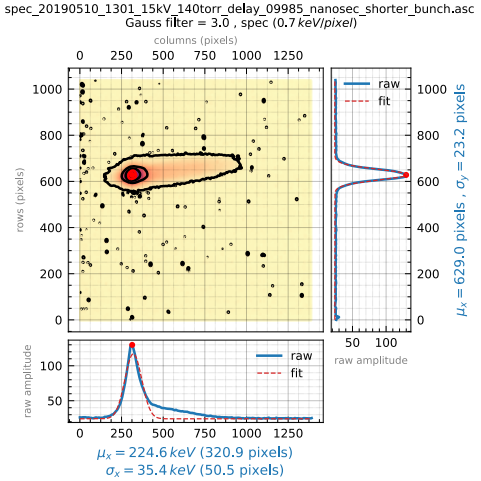

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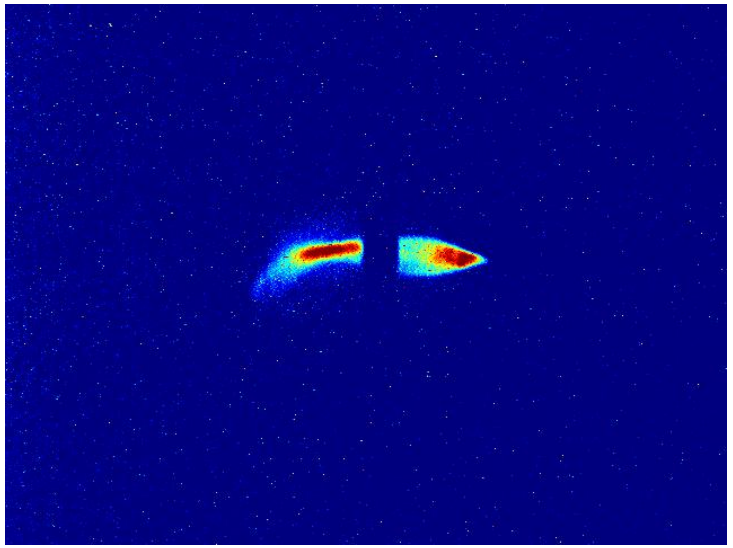
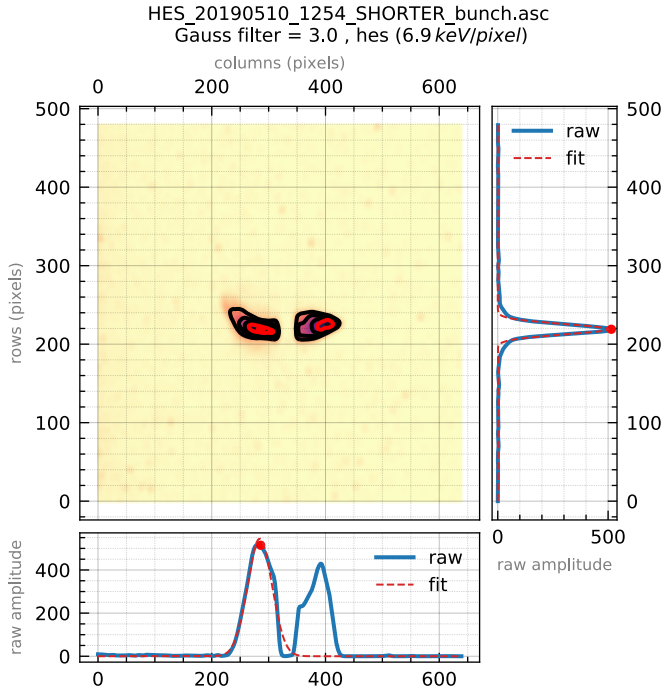
# BNL-ATF beam dump experiment - preliminary raw data analysis - 20190510

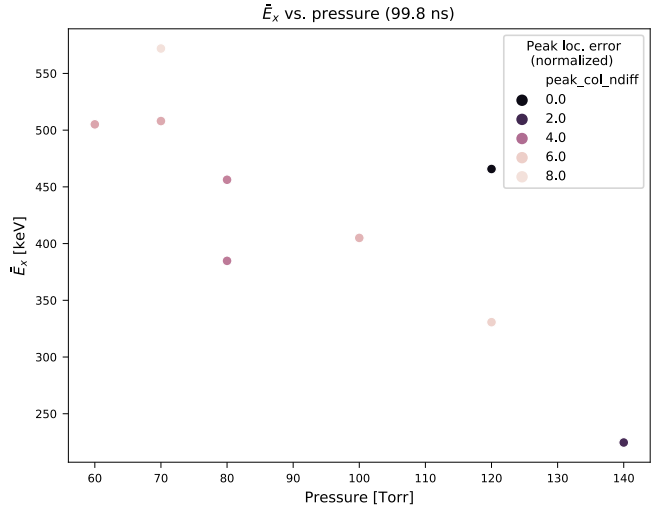
## Shorter bunch (BC on?):

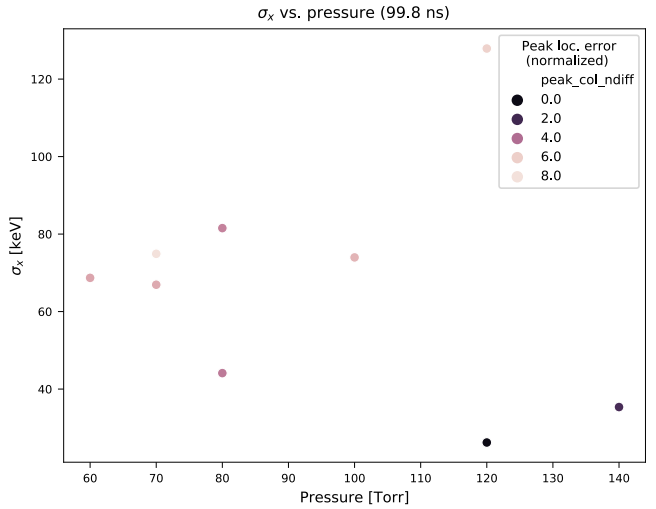


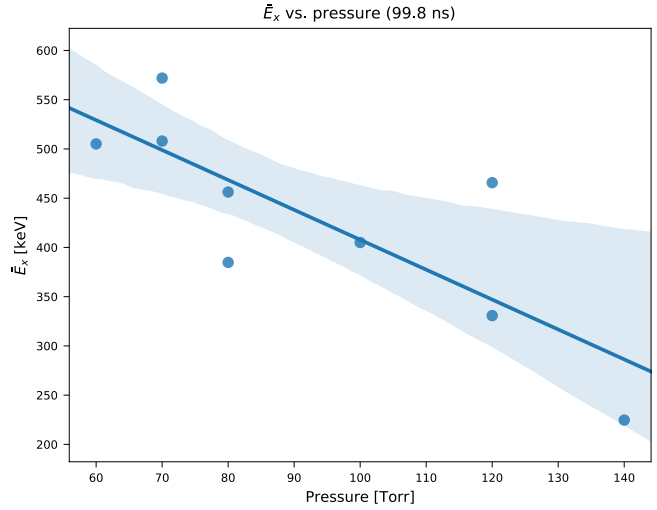


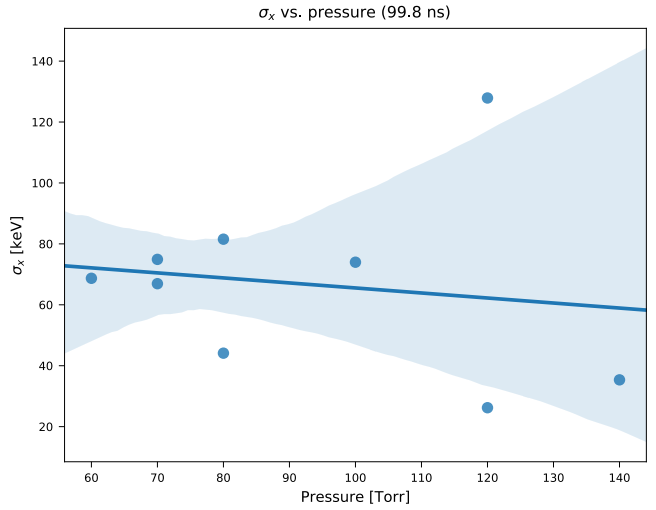
# BNL-ATF beam dump experiment - preliminary raw data analysis - 20190510

## Shorter bunch (BC on?) – Energy / energy disp. vs pressure (delay = 99.85 ns):

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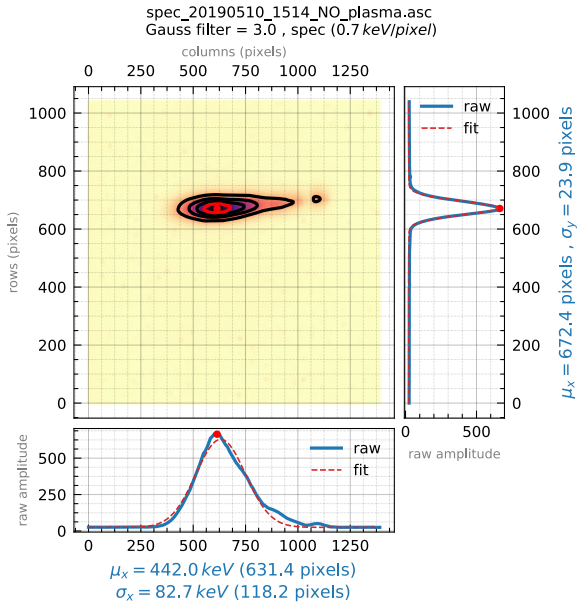
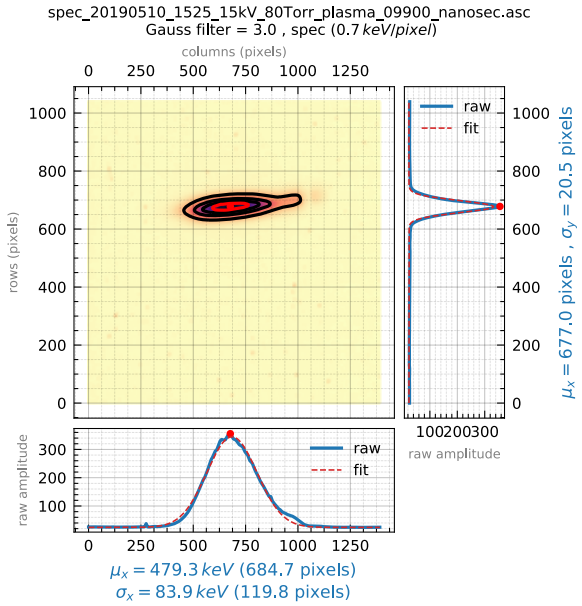
# BNL-ATF beam dump experiment - preliminary raw data analysis - 20190510

## Shorter bunch (BC on?) – Files from "BC_ON_3PM" folder:

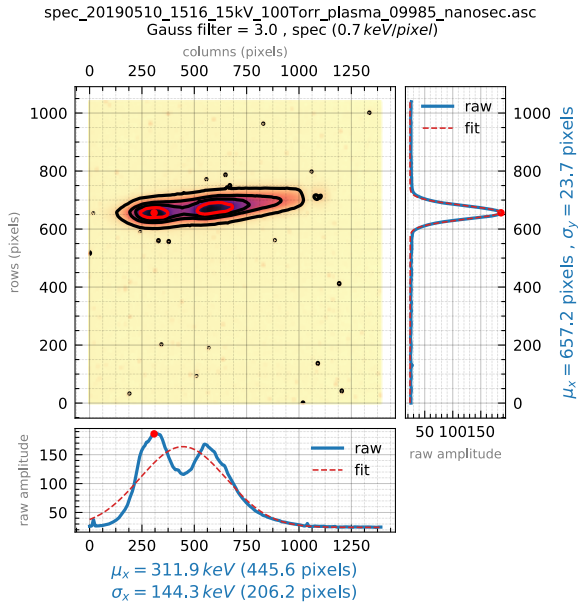
No plasma



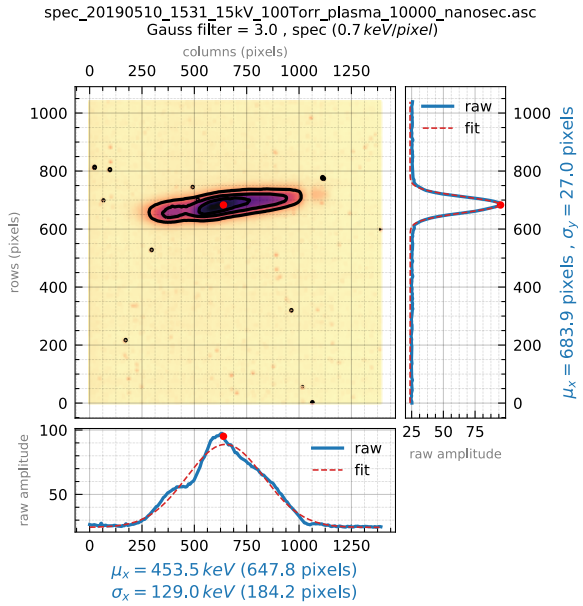

80 Torr , 99,00 ns




100 Torr , 99,85 ns




100 Torr , 100,00 ns

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