

Measuring the Density of Laser-Cooled Atoms

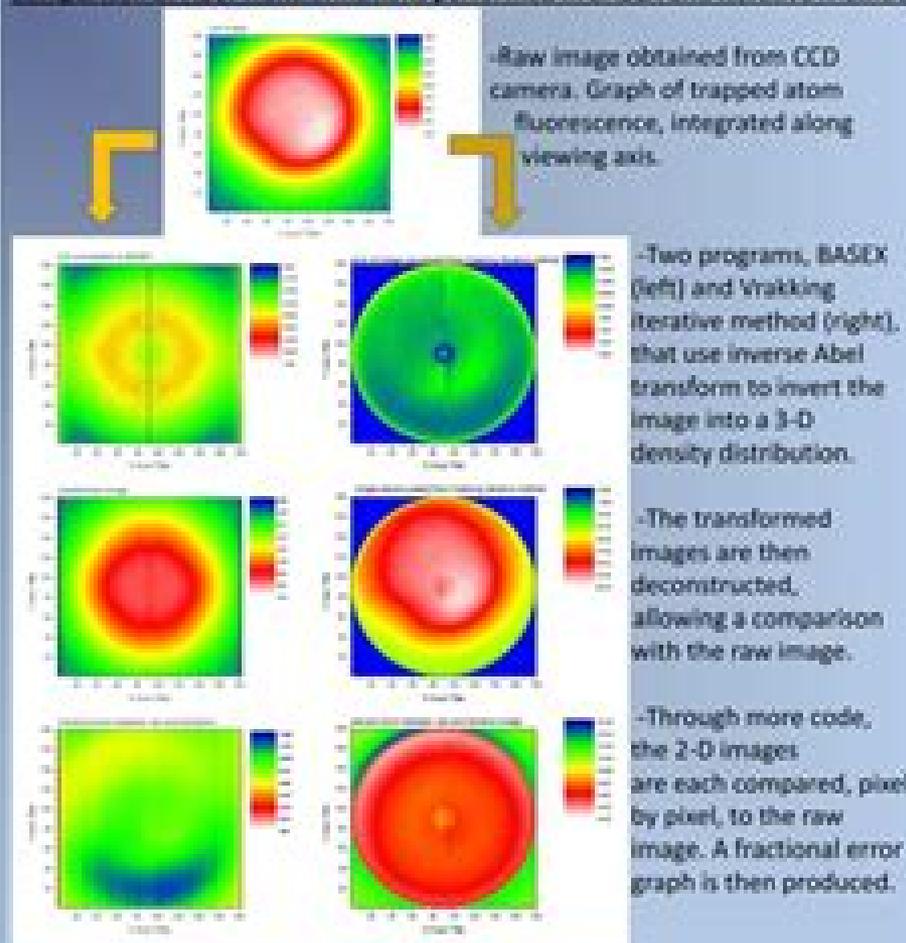


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Motivation: Coherent excitation in cold collision processes depends delicately on the density of the atomic objective. The density of atoms cooled and trapped in a MOT (magneto optical trap) typically depends on position in the chamber. The goal is to find a method that will measure this density quickly, accurately, and in a fashion that is reproducible.

Comparison of Abel Transformations performed in BASEX and Iterative Method



Camera Calibration

Spatial: At a distance of r cm from the viewing port, the camera measures about 60 pixels per mm.

Intensity: By relating the power of a calibration laser to observed pixel values, the relationship follows:

$$P = \frac{N \cdot S \cdot C}{k \cdot F(G)}$$

where P is laser power as measured by a power meter, N is the attenuation of a neutral density filter (ND3.0), S is the shutter speed fixed by the user, C is the sum total pixel count of the entire image, k is a constant defined below, and $F(G)$ is the gain function of the camera.

There was a linear relationship between the shutter speed on the camera and the pixel count measured on the computer.

The camera's gain function was measured to be exponential in the gain value set by the user. This equation is:

$$F(G) = y_0 + Ae^{G/x}$$

Results

For $F(G)$, several computer images were compared in intensity for specific gain values. After plotting pixel count and gain, the exponential curve shown above was observed. The following parameters were determined: $y_0 = -19.7$ with an error of: $\Delta y_0 = 13.3$

$$A = 74.0$$

$$\Delta A = 14.2$$

$$x = 293.2$$

$$\Delta x = 31.3$$

For a gain of 603, this gives $F(G) = 508.64$ and a propagated error, $\Delta F(G) = 169.73$. Solving for k when laser power is 77.4 mW (x2mW), shutter speed is set at 40, sum total pixel count is 1361276, and a measured camera lens attenuation of 8.13%, we obtain $k = 1.16 \cdot 10^7$ counts per mW. The propagated error is dependent on the error in power and $F(G)$; so $\Delta k = 0.35 \cdot 10^7$ counts per mW. The fractional error, $\frac{\Delta k}{k}$, equals 0.30.

Knowing this, one may determine the intensity of spontaneous emission in photons per second that the camera detects. Using the lifetime of the upper state, $\tau = 25.63 \text{ ns}$, and the solid angle of the camera, $\frac{\Delta \Omega}{4\pi r^2}$ at a distance r from the MOT, one may determine the number of excited

atoms that the camera senses using $n_{\text{exc}} = \frac{I \cdot C \cdot 2 \cdot 4\pi \cdot r^2}{k \cdot F(G) \cdot \Delta \Omega}$

where C is the pixel count from the transform images.

Acknowledgements

We would like to thank Richard Lammiman, Hyounguk Jang, and Yavor Novichkov for their technical support and expertise.

THE NIST Mission of Laser Cooling and Trapping (LCT)



Funding: AFFOR F19958-05-1-0020
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plot in 1981 a man named forrest gump recounts his life story to strangers who happen to sit next to him at a bus stop as a boy in 1956 forrest has an iq of 75 and is fitted with leg braces to correct a curved spine he lives in greenbow alabama with his mother who runs a boarding house and encourages him to live beyond his disabilities

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forrest gump just saying that film s title will create polarized conversation on the internet at the time it was beloved tom hanks made oscar history with his best actor win it took home best

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feb 16 2023 it is based on a novel of the same name published in 1986 by author winston groome it is a motivational film based on the life of a fictional man named forrest gump gump battles through all the obstacles in his life and becomes a part of many historic moments in america s history he overcomes difficulties and at last fulfills all his wishes

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may 11 2022 starring tom hanks in an oscar winning performance the adaptation follows the events of forrest s life from his childhood in alabama all the way through his military service in vietnam and his successful career choices to meeting his

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forrest alexander gump is a fictional character and the title protagonist of the 1986 novel by winston groom robert zemeckis 1994 film of the same name and gump and co the written sequel to groom s novel

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aug 24 2022 ultimately forrest tom hanks has learned for himself that life is a confluence of destiny and whirlwind of happenstance and chaos that this world often brings forrest gump has often been

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by eric kohn july 4 2019 10 30 am forrest gump paramount forrest gump is an easy target a sweet movie featuring one of the most beloved movie stars of all time it s a slick and

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jul 6 1994 forrest gump directed by robert zemeckis with tom hanks rebecca williams sally field michael conner humphreys

the history of the united states from the 1950s to the 70s unfolds from the perspective of an alabama man with an iq of 75 who yearns to be reunited with his childhood sweetheart

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forrest gump is a 1994 epic historical comedy drama film starring tom hanks and directed by robert zemeckis it is based on the 1986 novel of the same name by winston groom the film tells the tale of forrest gump a good natured but simple minded man from greenbow alabama telling his life story to other people while waiting at a bus stop

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nov 13 2009 on july 6 1994 the movie forrest gump opens in u s theaters a huge box office success the film starred tom hanks in the title role of forrest a good hearted man with a low i q who winds up

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may 5 2023 a the integration of real life historical events in the narrative forrest gump expertly blends fact and fiction to portray american history movingly the film s depiction of the vietnam war is poignant offering a glimpse into the era s political and social upheaval

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feb 21 2023 as forrest gump explores the life of tom hanks titular character he finds himself in the midst of some of the biggest historical events of the 1960s and 70s but the forrest gump true story is anything but and this deliberate disregard for historical accuracy is where the movie gets its charm

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during the film august 11 1951 forrest gets his new leg braces and walks through greenbow town with his mother august 13 1951 forrest s mother visits the school principal to enroll forrest however the principal takes advantage of forrest s disability and

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