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Выявление точечных объектов математическим микроскопом в дистанционных исследованиях

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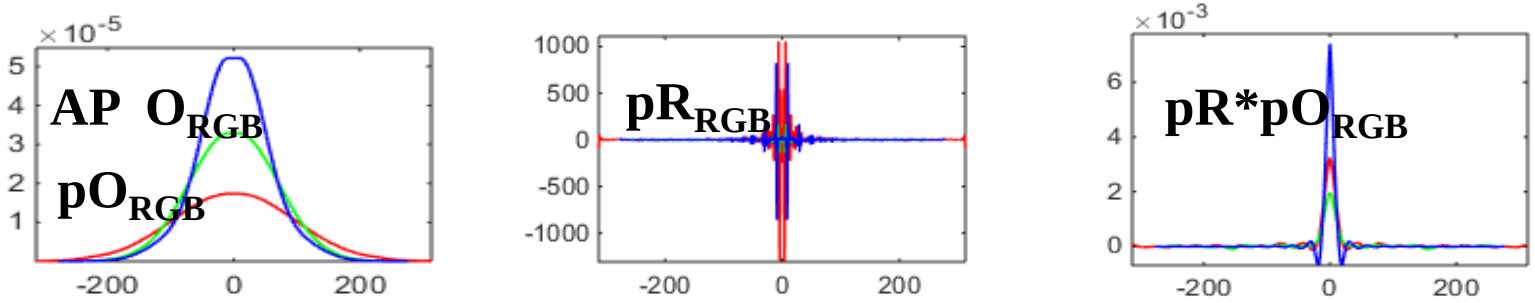
Methods of the **C**onditioned **S**uper **R**esolution (**CSR in MM**) of objects are intended for the intelligent analysis of data on objects observed through measuring devices whose Apparatus Functions (AF) or Antenna Pattern (AP) are **not defined, are known with errors and even when they are precisely known!!!**

The methods of **CSR, RSR in MM** objects are based on the **R**econstructions of mathematical models of discrete AF O with **minNor(pR), $pR=pO^{-1}$**, in accordance with **Physical Fundamental Assumption (PFA)**

Conditioned Super-Resolution AP O:



The main problem of the controlled AF selection **pO=pR^{-1}** is set as a minimum task (pO <->pR):

$$\min_{LO}\{\|pR\| \mid Err(pO) \le err\},\ \ LO = \{pO \mid [Loc, SDx,\ DI\ ]\},\ \|pR\| \sim DI$$

Теорема: Если значение индикатора обратимости II(R*O)(0,0)=(R;O)=1, то **R=O^{-1}, pR=pO^{-1}** .

Super Resolution* (SR) *Values. If there is a normalization of AF O: ∑ O = 1, then at zero MTF M(O)(0,0) = 1, then we will evaluate SuperResolution (SR) by the value: **SR**=pSR=∑M(pR)M(O)/∑M(O)

Mathematical Microscope & Physical Fundamental Assumption

We need to find a solution of the set of systems of equations **Y|A = {O} X.** Note that we do not know the AP **A.** The parametric set of discrete reversible **AP {O}** corresponds (in accordance with our "a priori information about") the unknown AP A.

The solution **Y|A = {O} X** can be found in the following **PFA:**
there are separate isolated objects-points in X .

The MM&PFA solution includes three aspects:

1) a reversible **AP O~A**, and
2) a super-resolved image **X=R Y, R=O^{-1}**, with a minimum norm **Nor (R).**If in the resulting super-resolved image X,
3) we **detect individual objects-points**. PFA becomes a fact.

We have a correct solution in this cases.

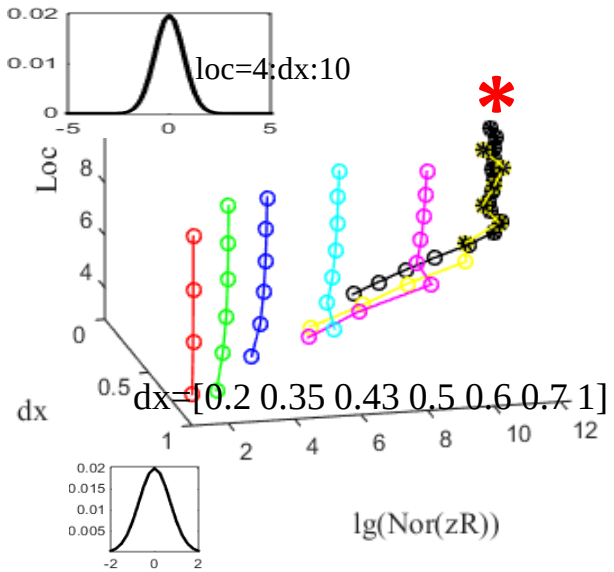
Iz Inversion, zSR *, Characteristics of Circumstances :

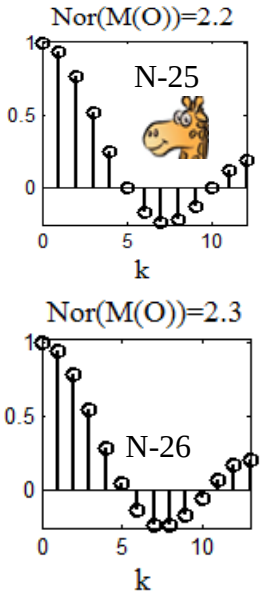
$$M(zR)=\begin{cases}1/M(O), & for\ all\ |M(O)|>Iz\\ M(O)\end{cases}$$

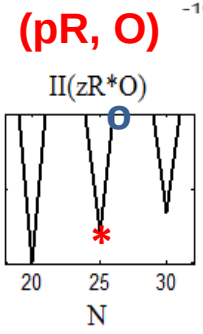
c **CC** AF zO:

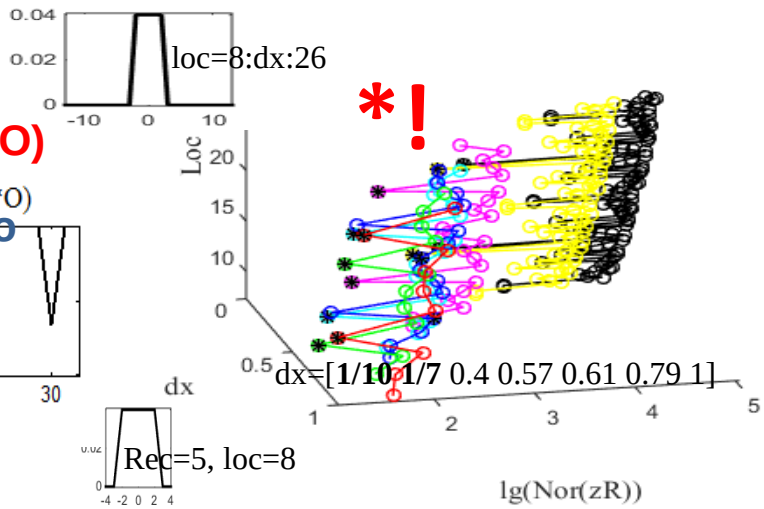
CAMz={x=Nor(zR), y=Err(zO), z=II(zR*O)}

Value zSR. **zSR**=∑M(zR)M(O)/∑M(O)



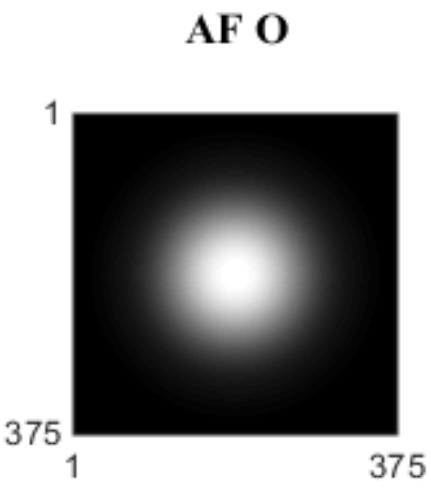


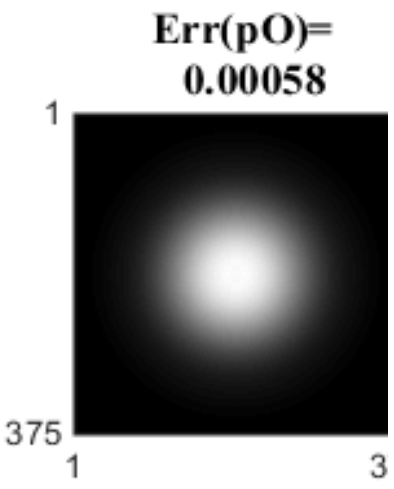


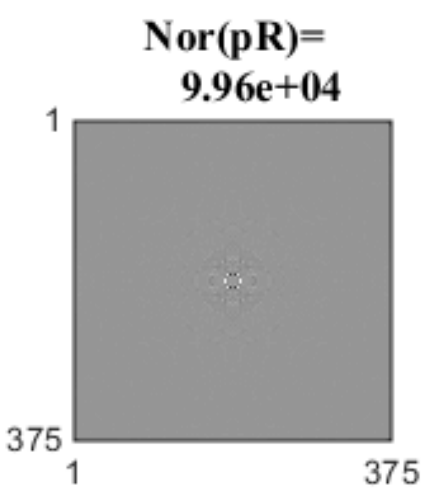


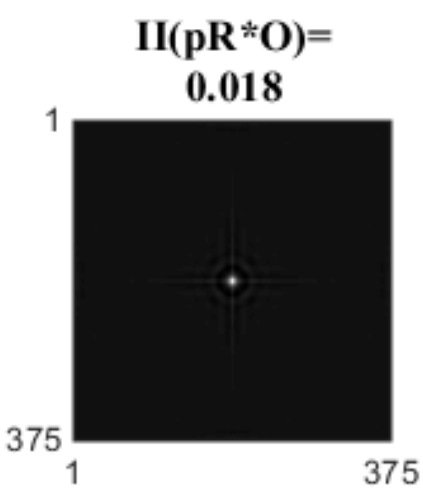
CC={x=Dx, y=lg(Nor(zR)), z=loc}

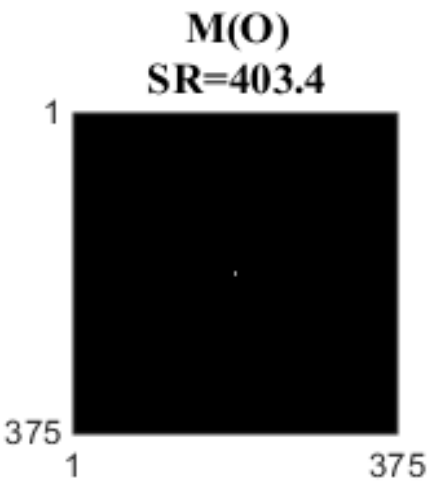
Conditionality in adjustment of inversion AP O_B, DI=100000

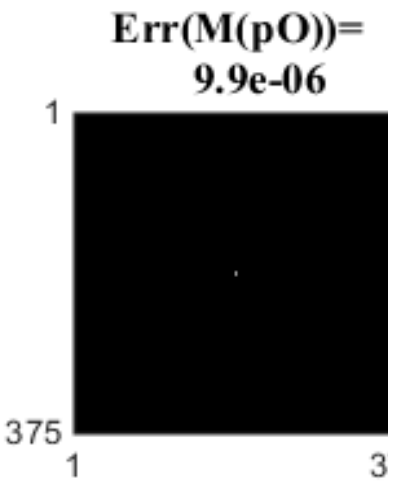


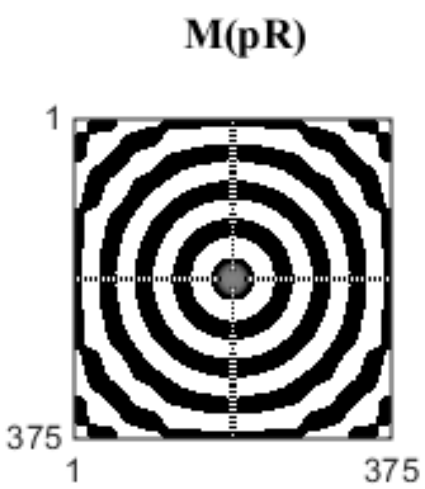


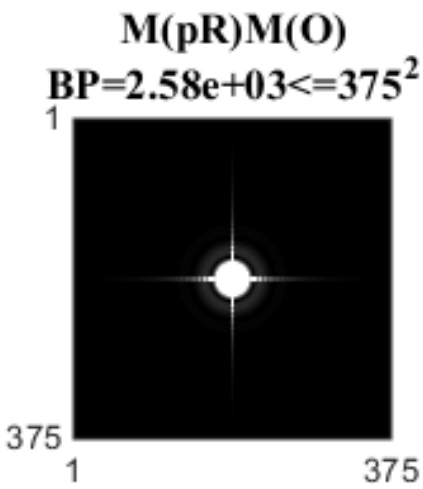






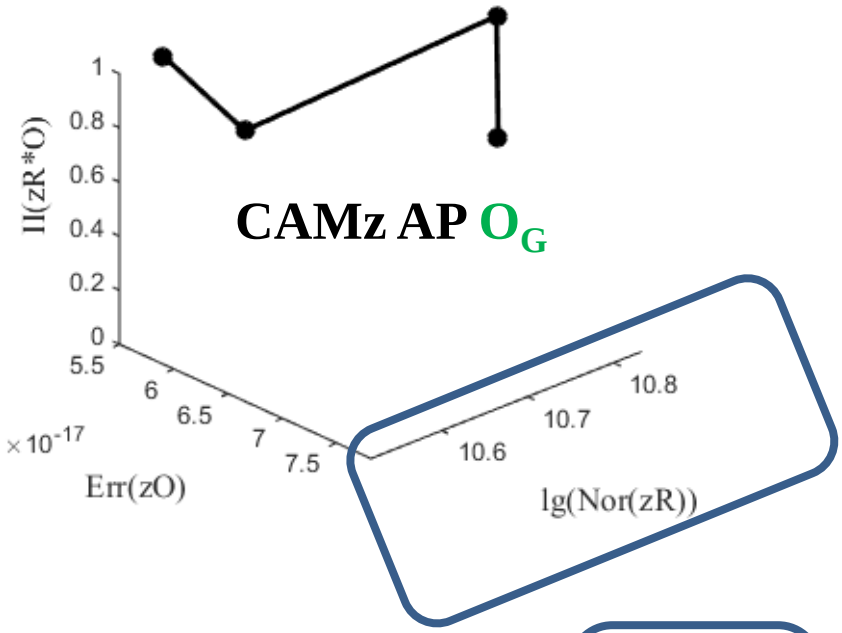


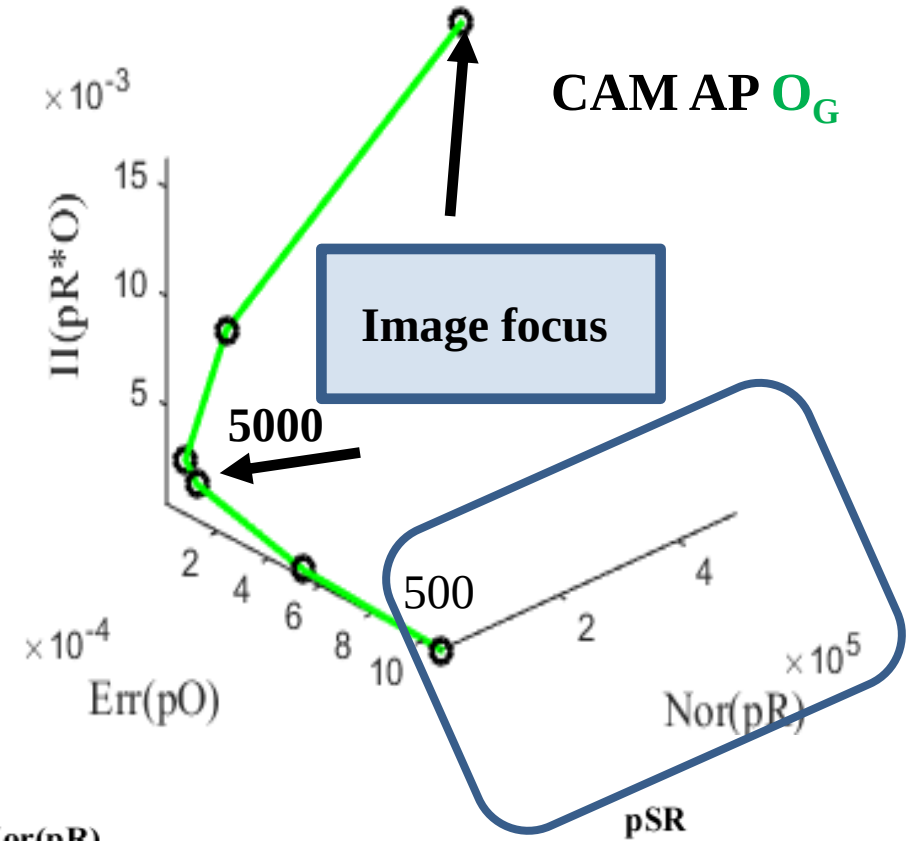


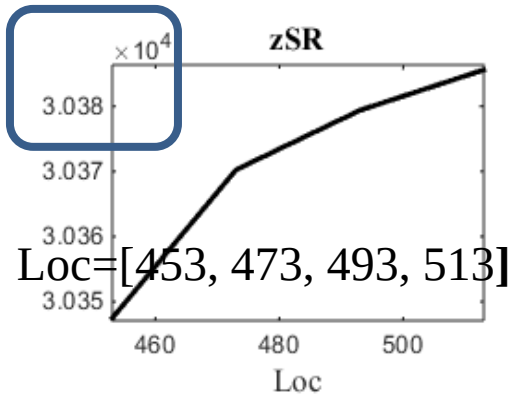


Characteristics of the Adequacy of the Models AP O_G

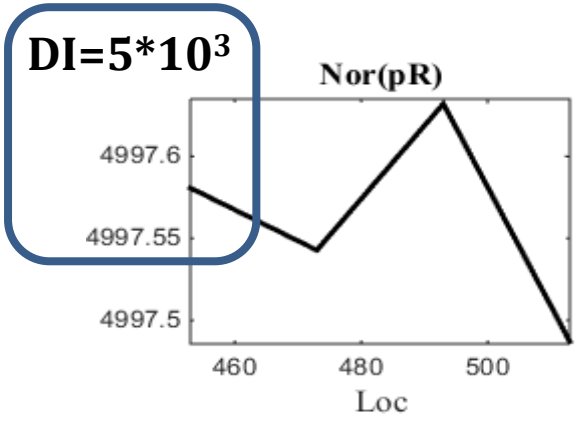
DI=[500, 10^3, **5*10^3**, 10^4, 10^5, **5*10^5**]

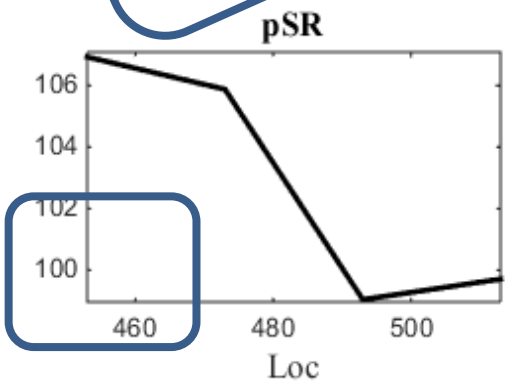




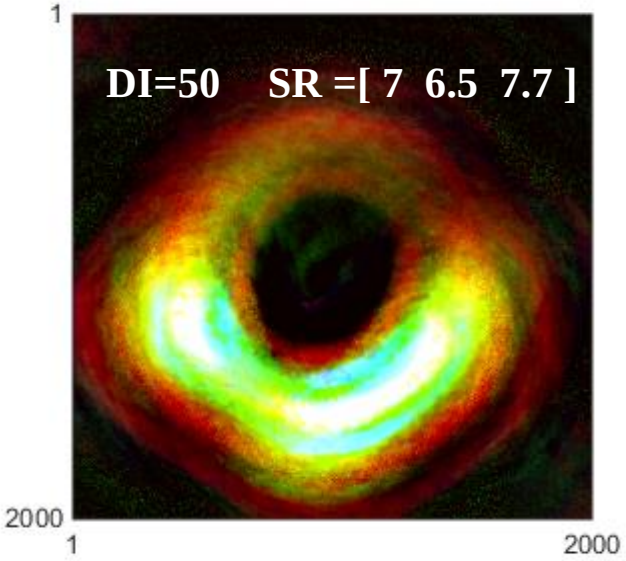


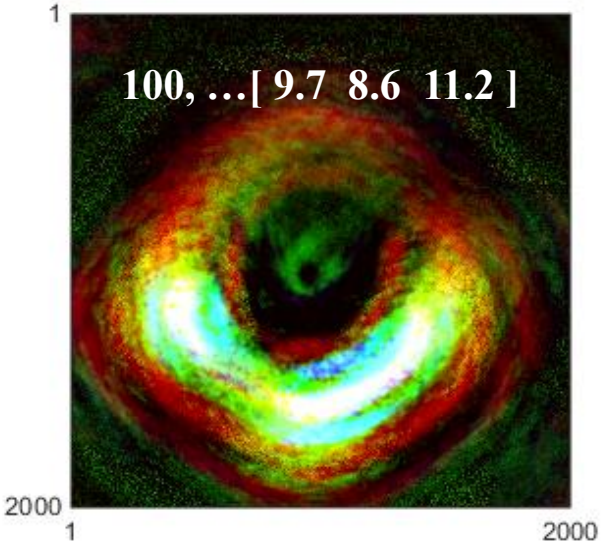
Loc=[453, 473, 493, 513]

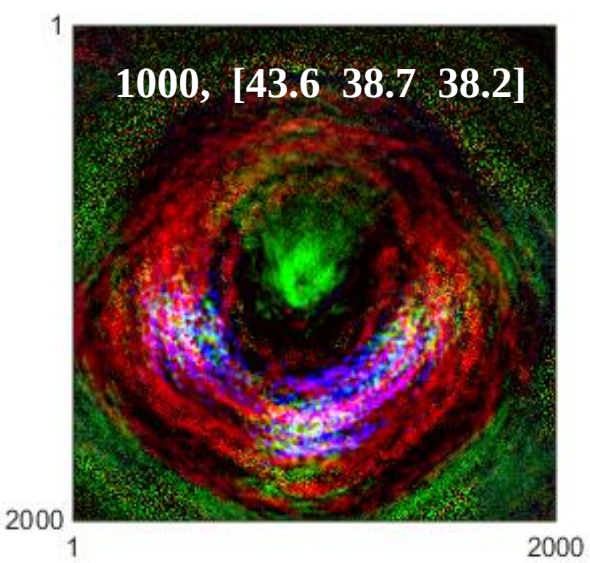


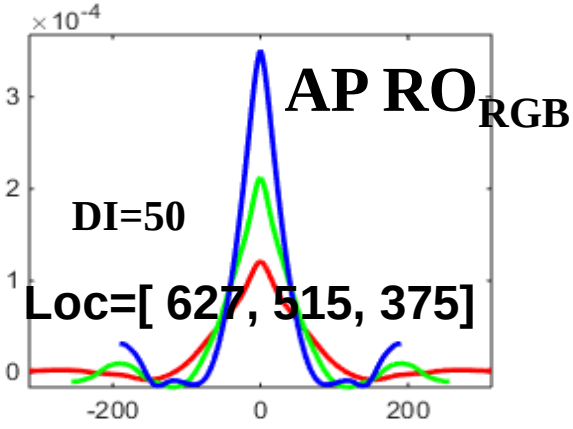


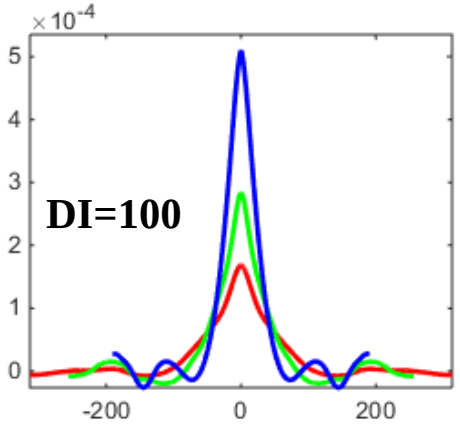
Powehi Black Hole Shadow CSR Focusing in MM for EHT

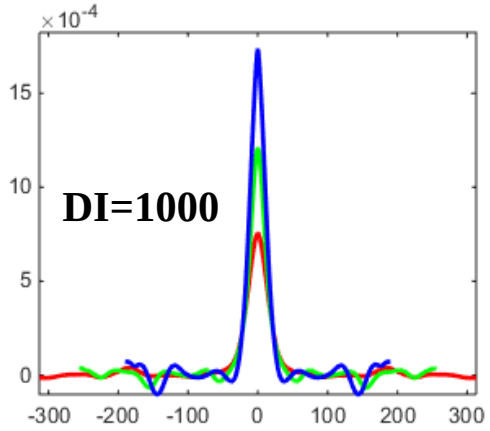




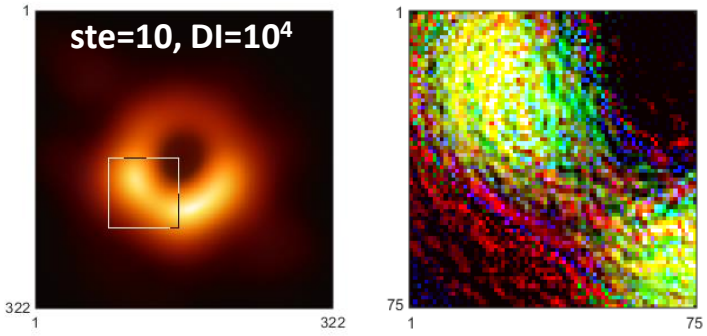


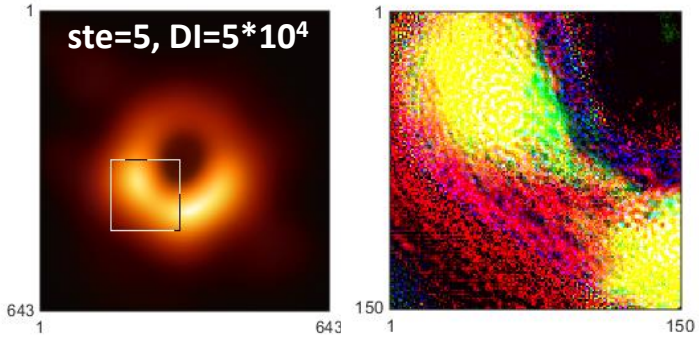


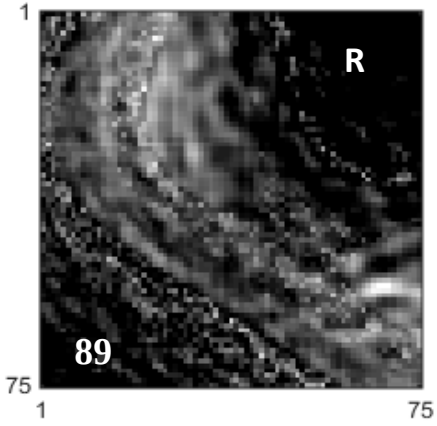




Presetting MM on coarse grids: ste=10 and 5

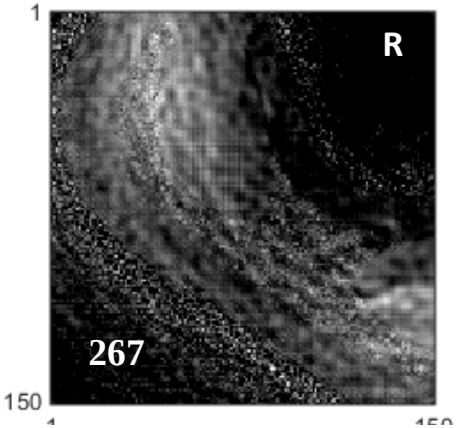


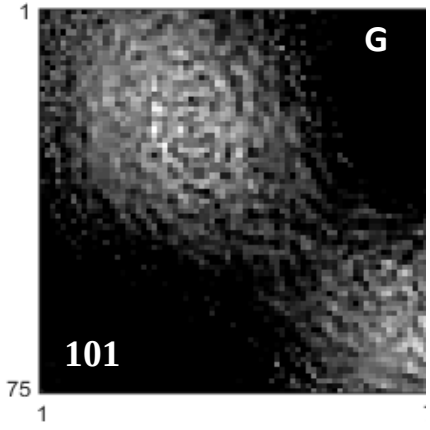


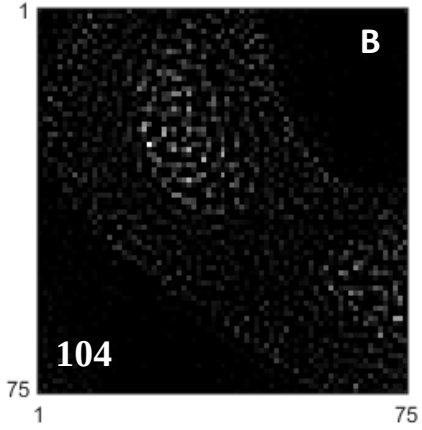


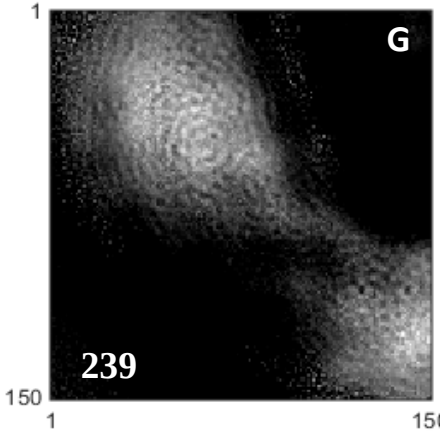
ste=10,
DI =10^4

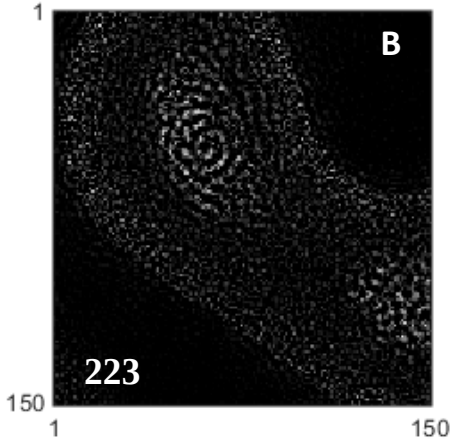
ste=5,
DI =$5*10^4$



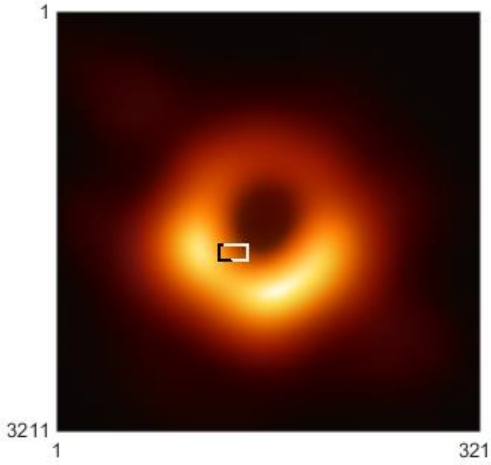


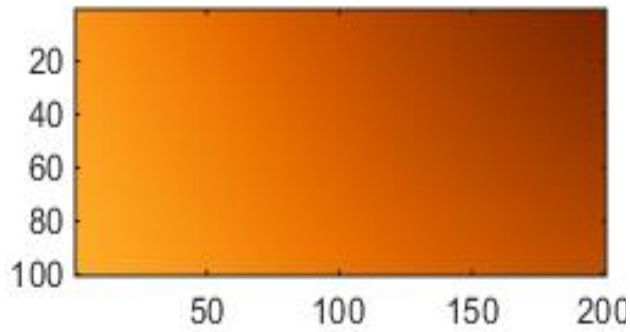


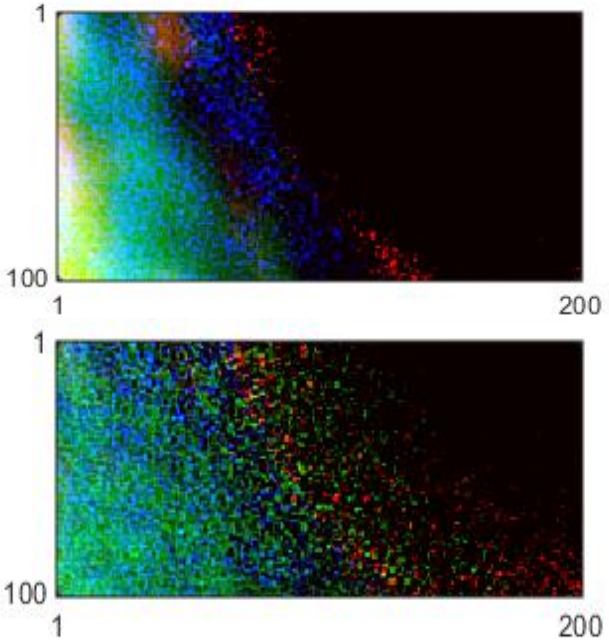




Presetting MM on the full grid, ste=1



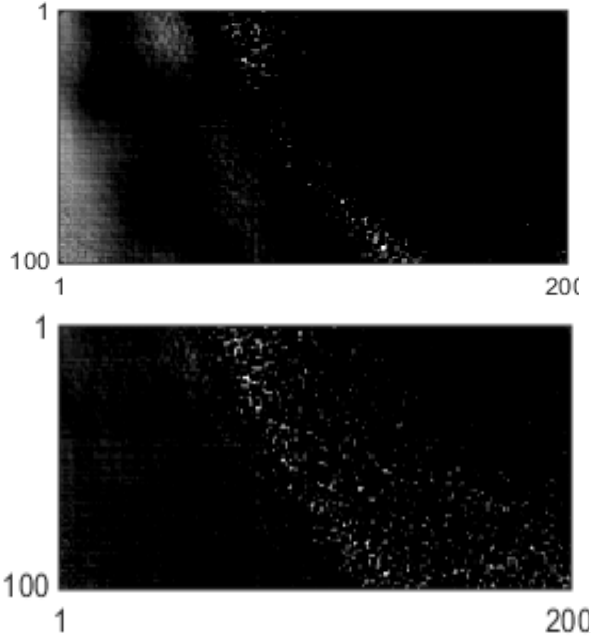




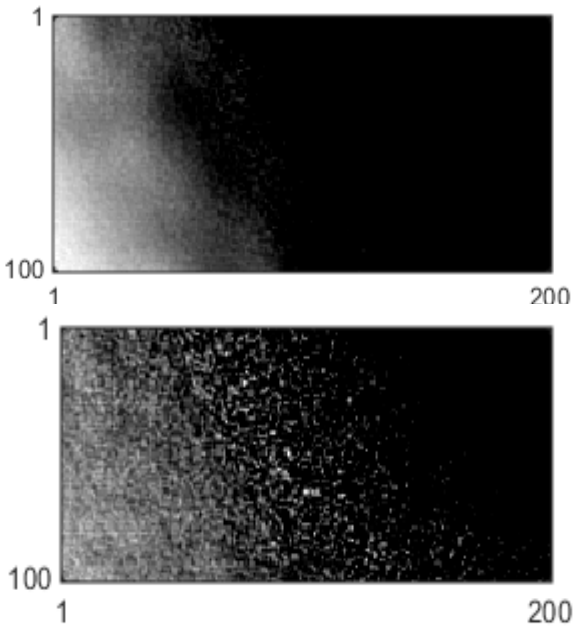
*DI=**10**⁴* , SR=[111.2, 135.5, 121.2]

*DI=**5*10**⁴* , SR=[1062, 1120, 1047]

R



G



B

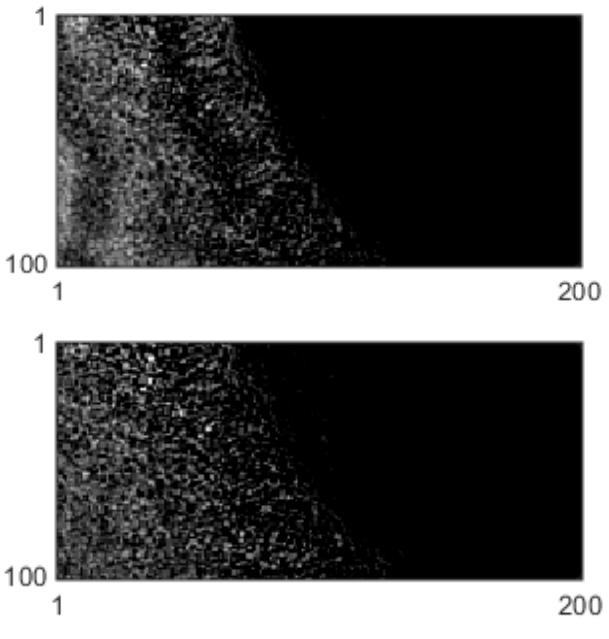
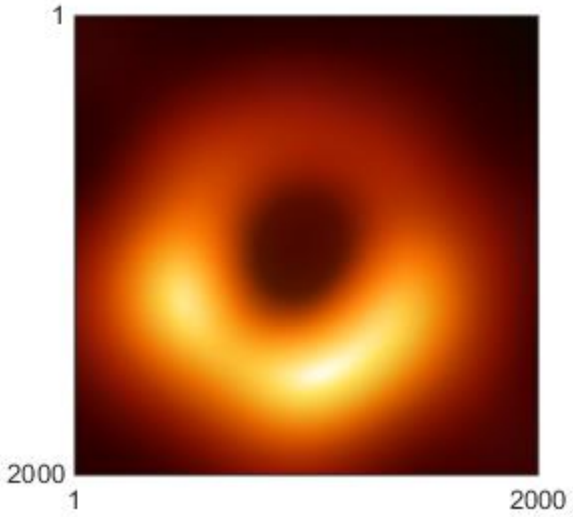
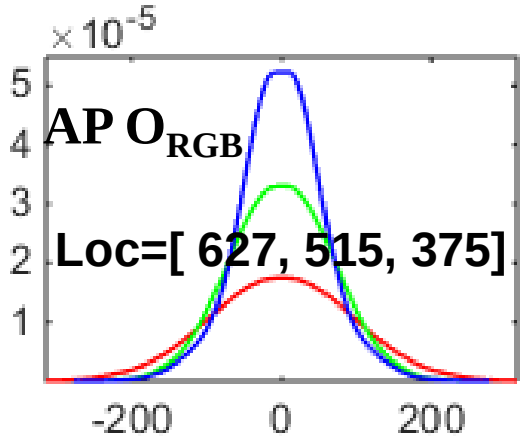
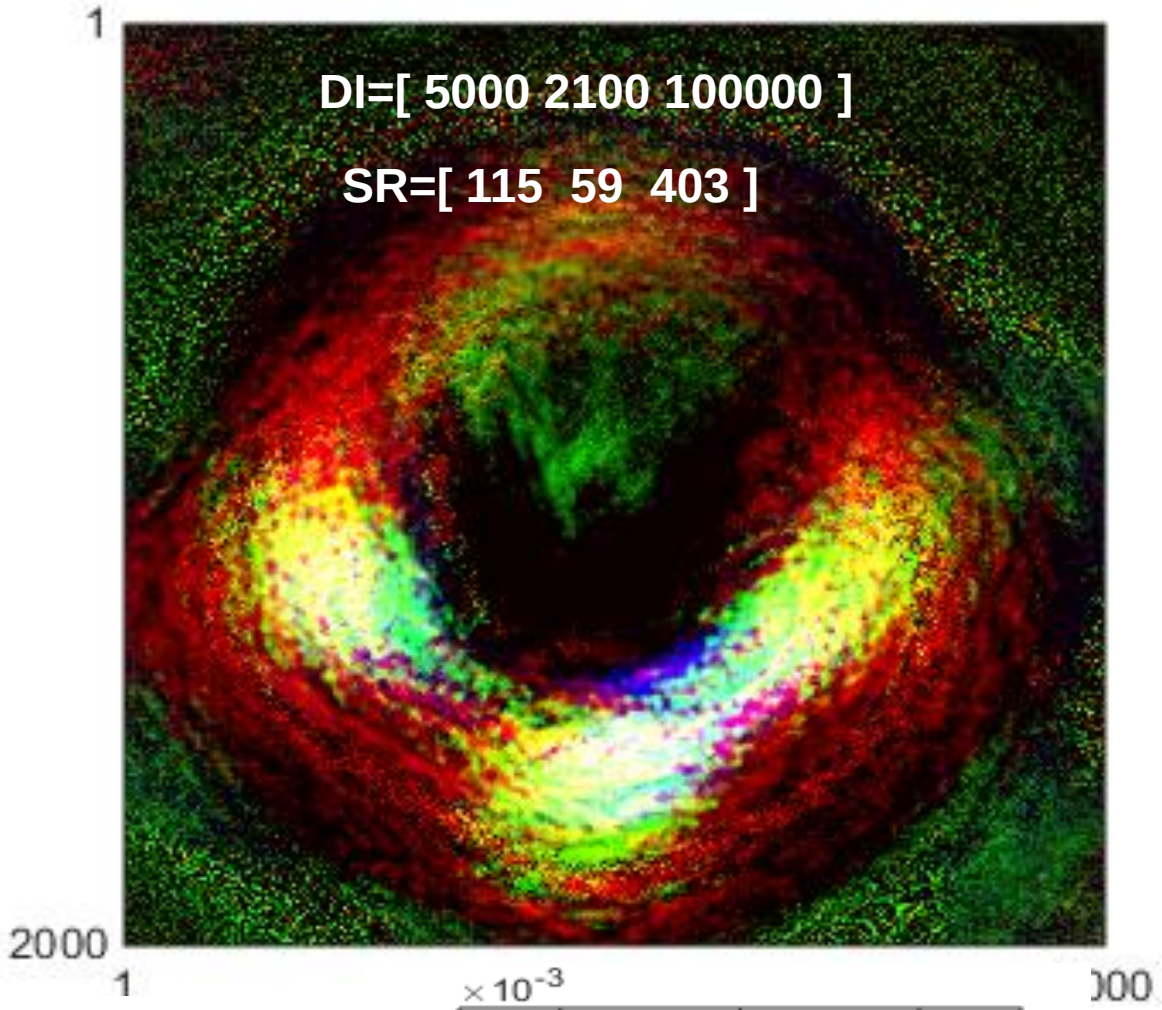
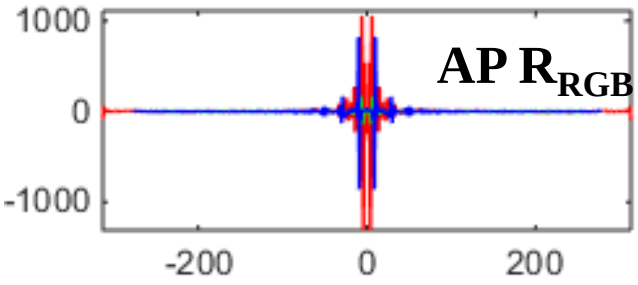


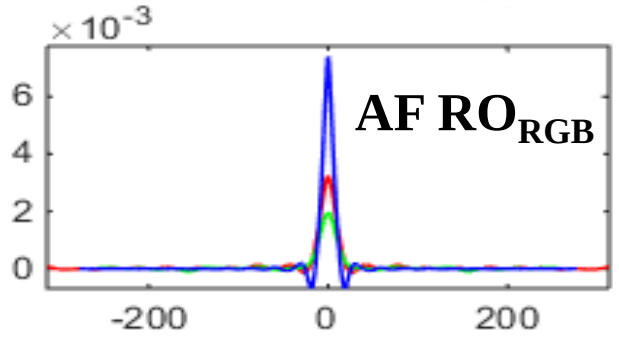
Image from MM



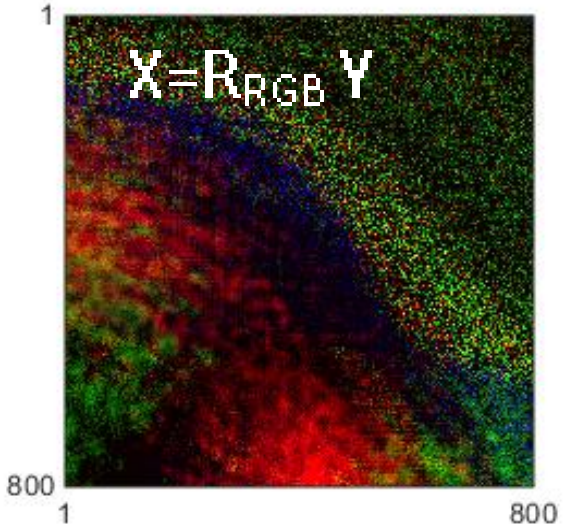


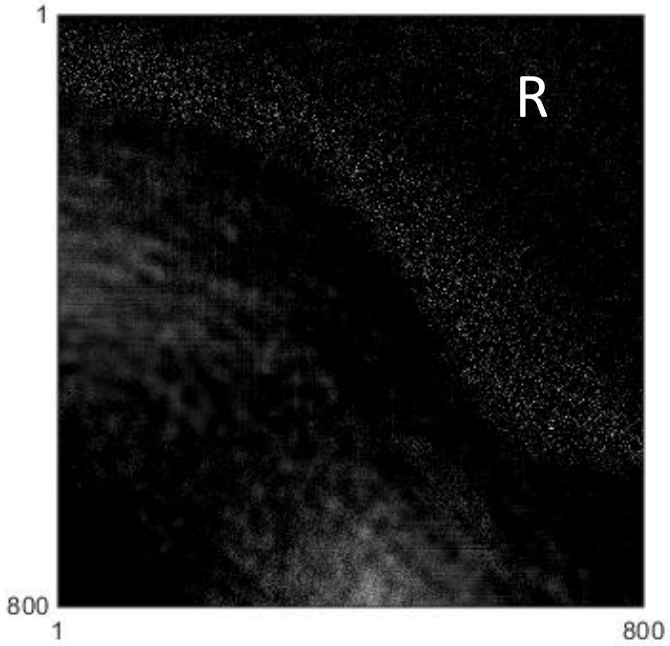


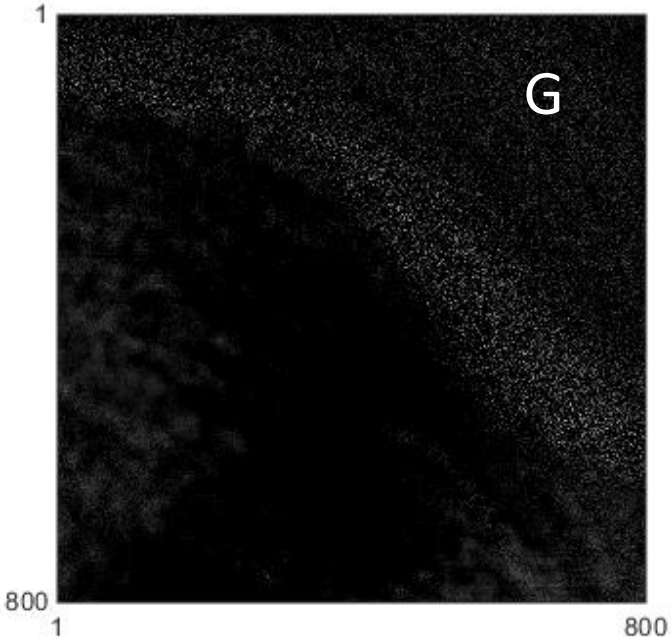


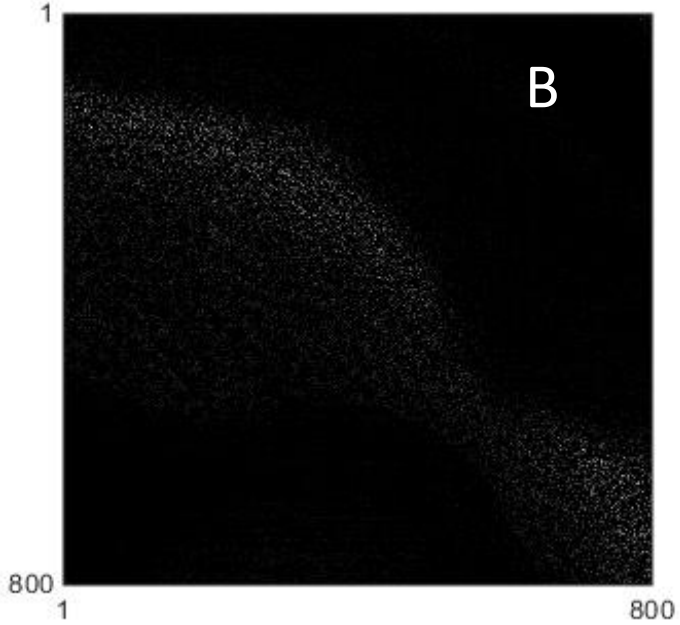


PFA for EHT

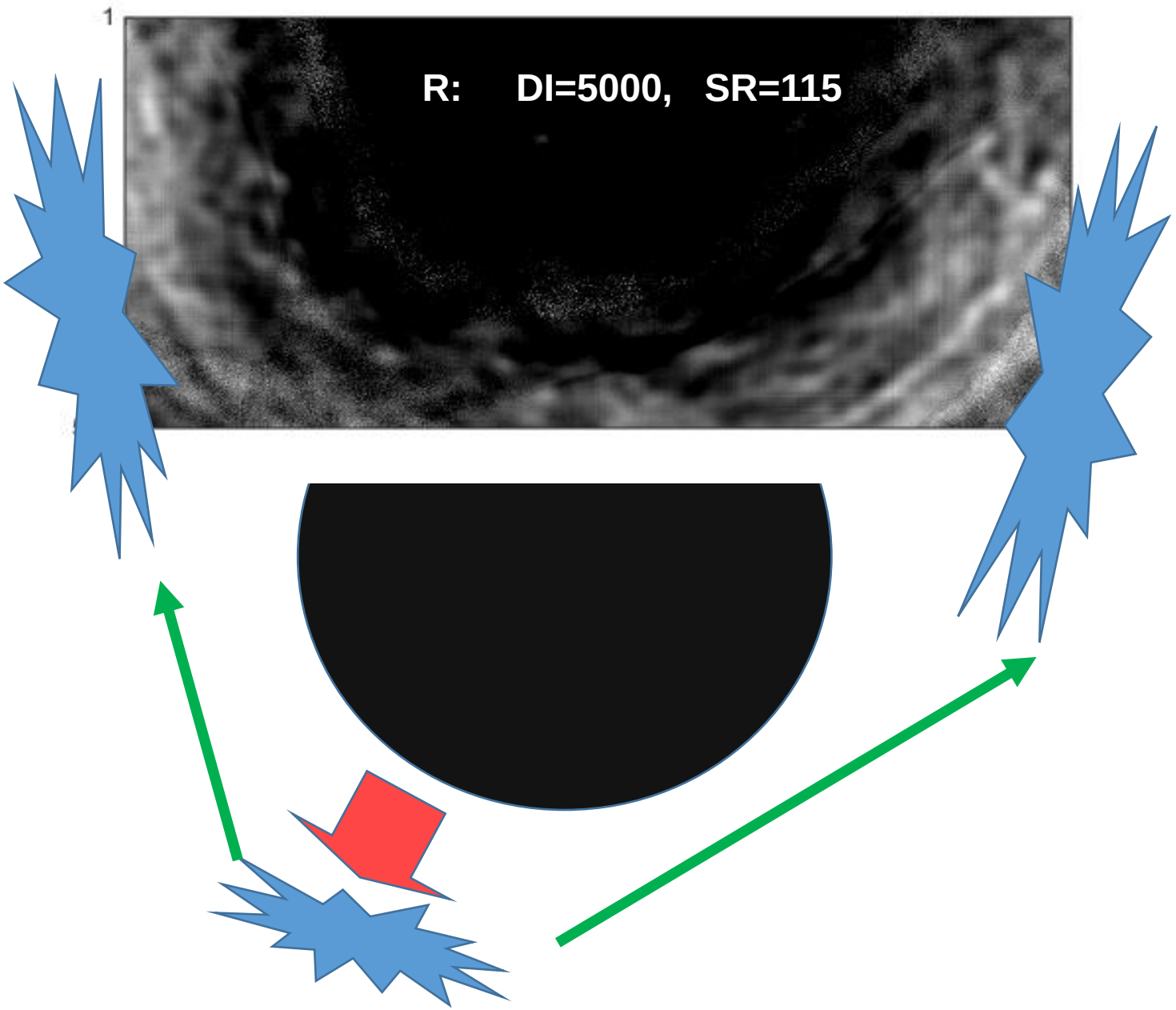






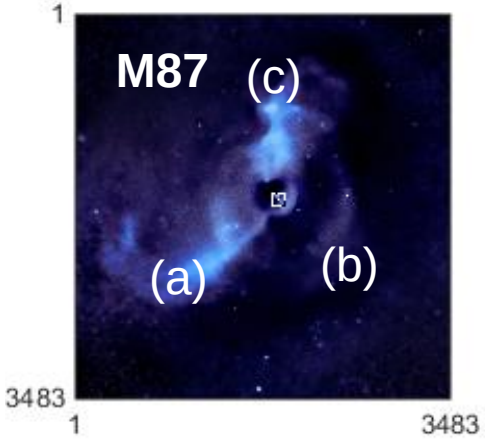


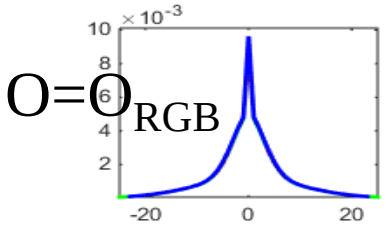
SR image in R with two star channels

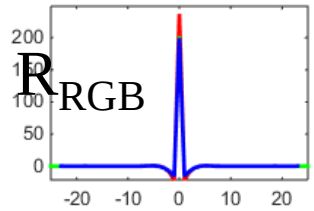


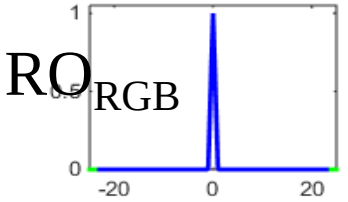
MM for X-ray telescope Chandra, M87

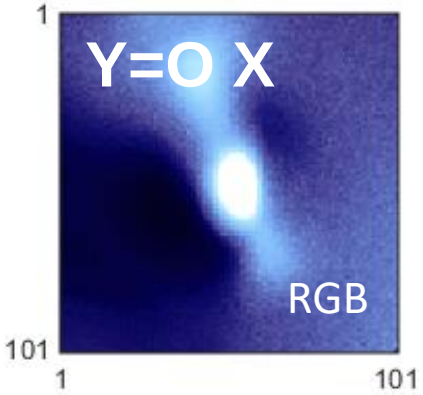
[Chandra :: Photo Album :: M87 :: August 18, 2010 (harvard.edu)]

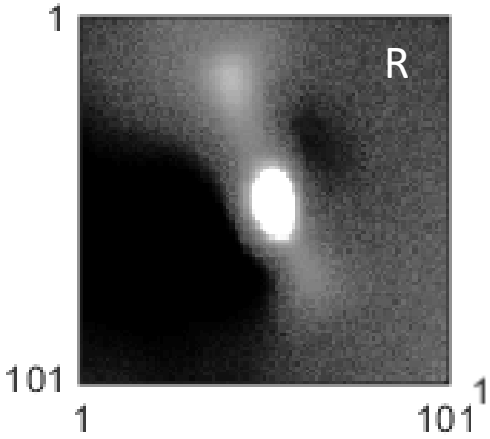


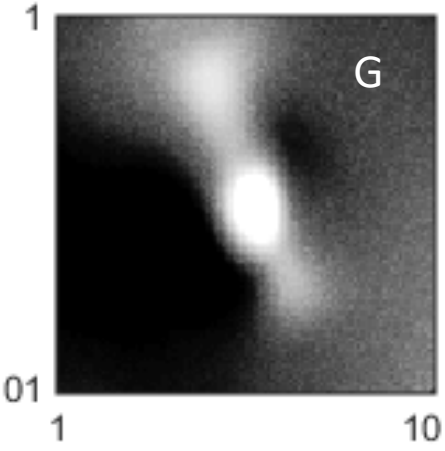


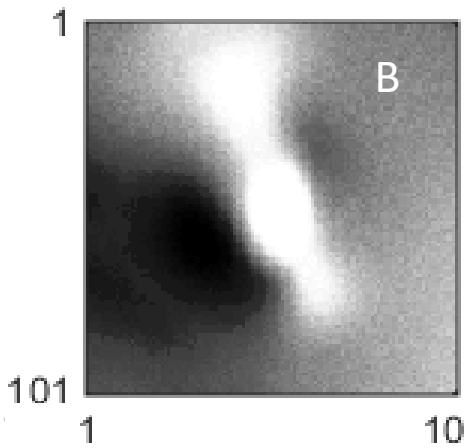


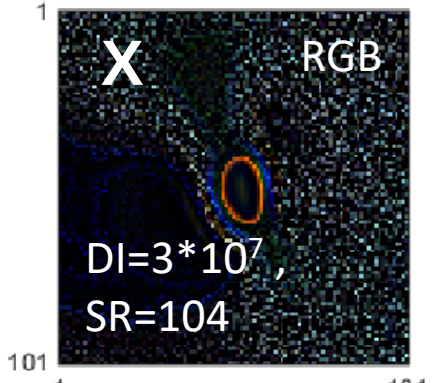


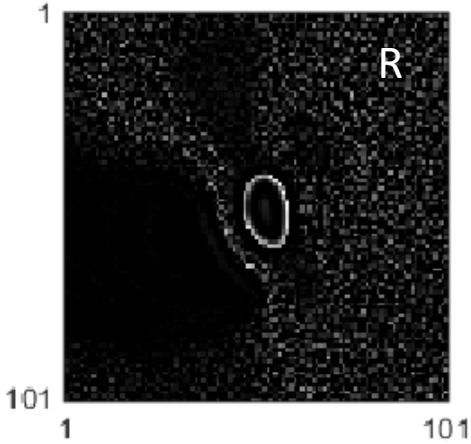


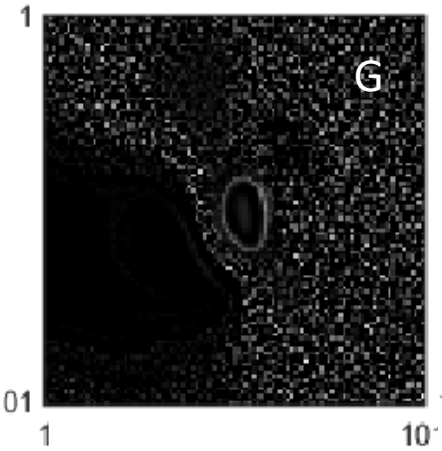


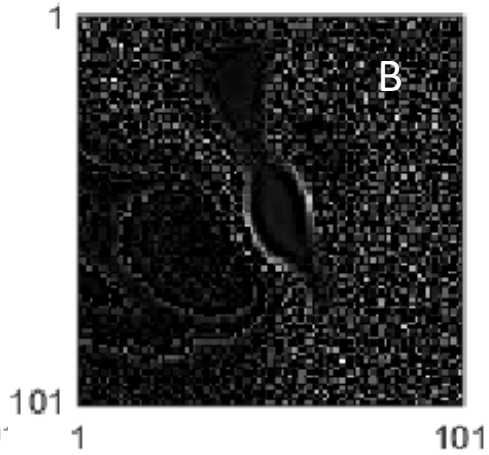








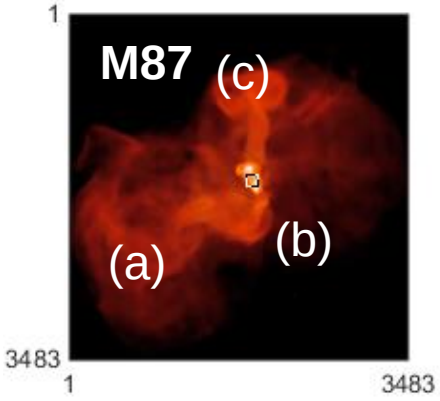


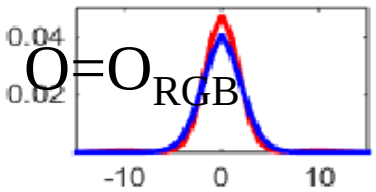


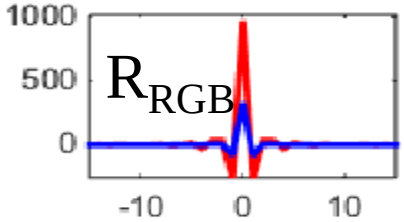
MM for radio telescope, M87

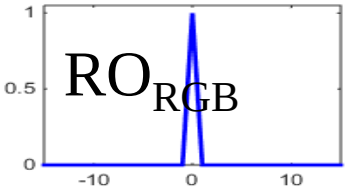
Chandra :: Photo Album :: M87 :: August 18, 2010 (harvard.edu)

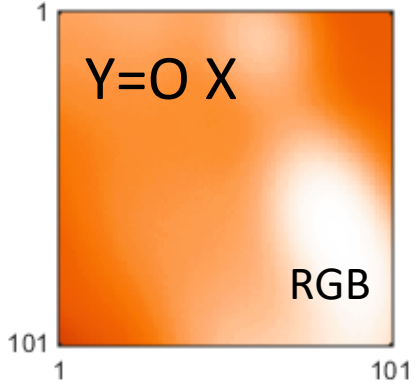
M87: Galactic Super-volcano in Action

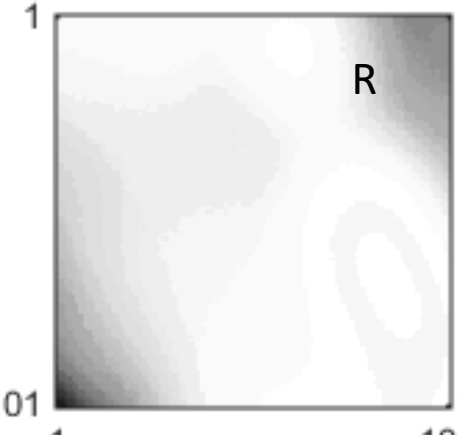


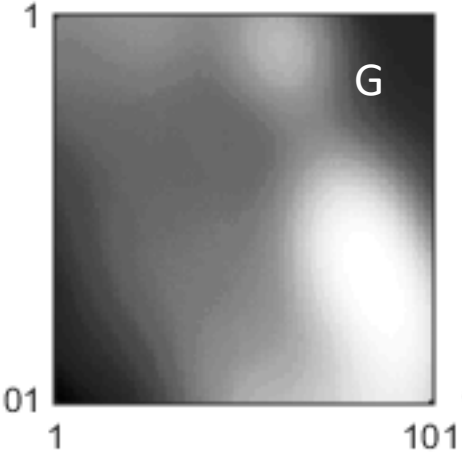


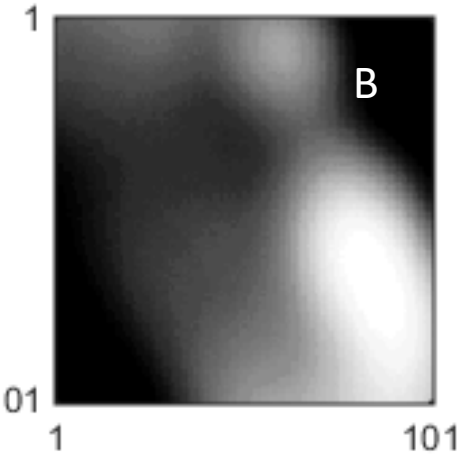


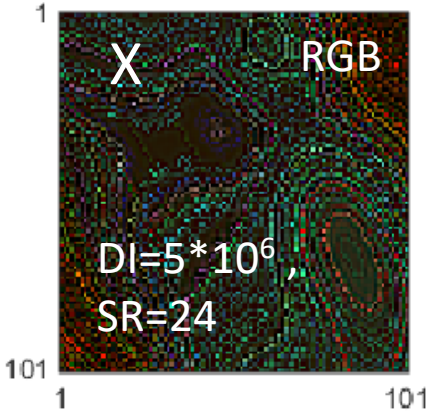


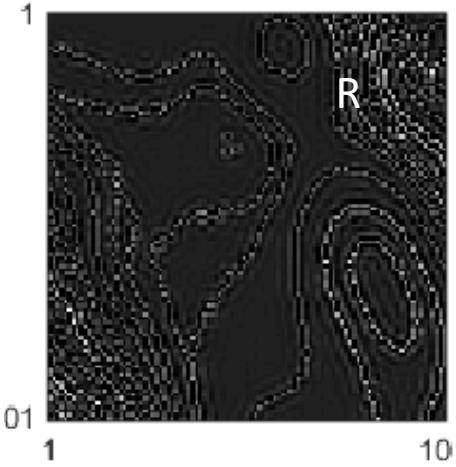


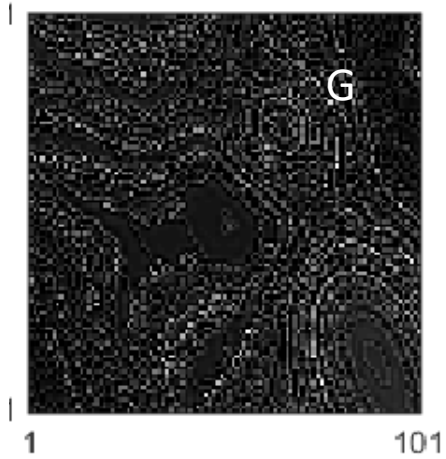


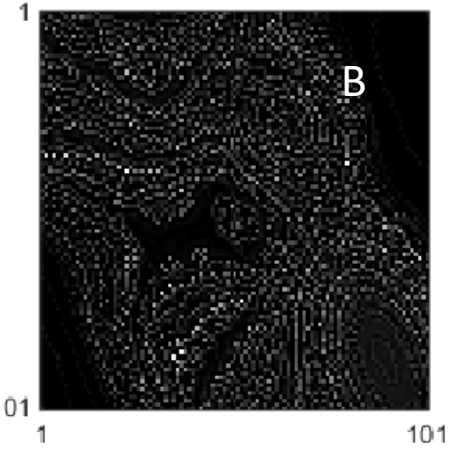




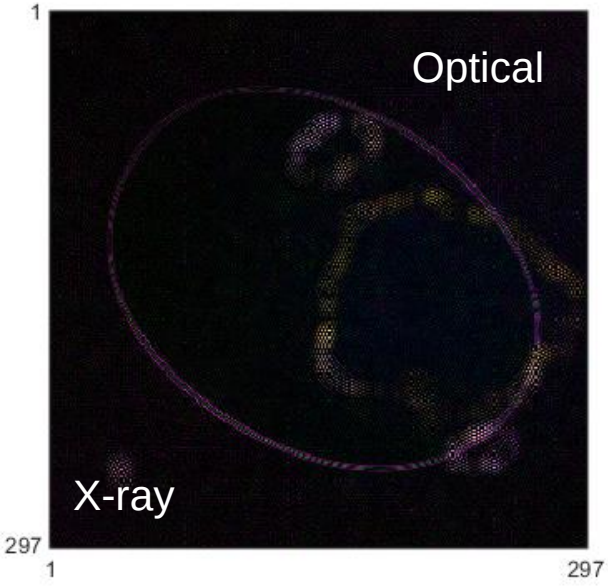


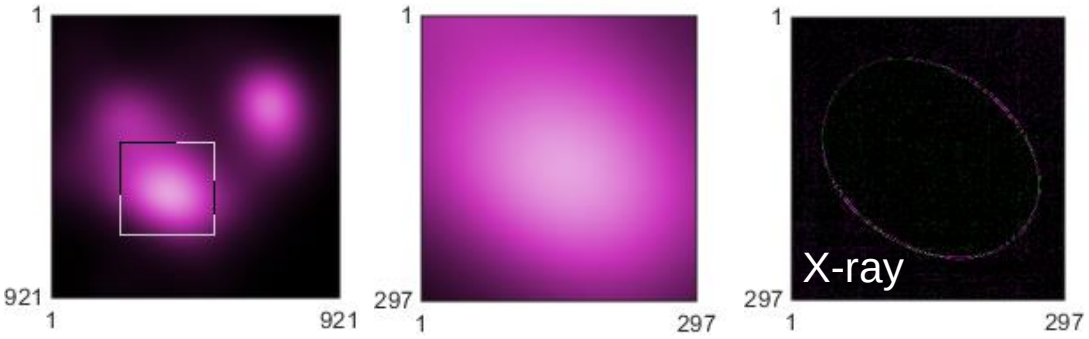


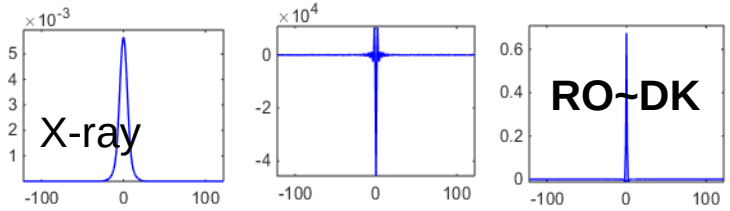


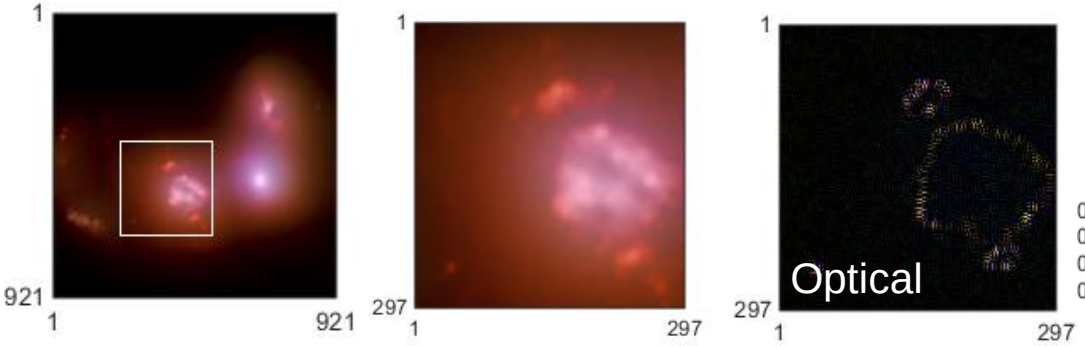


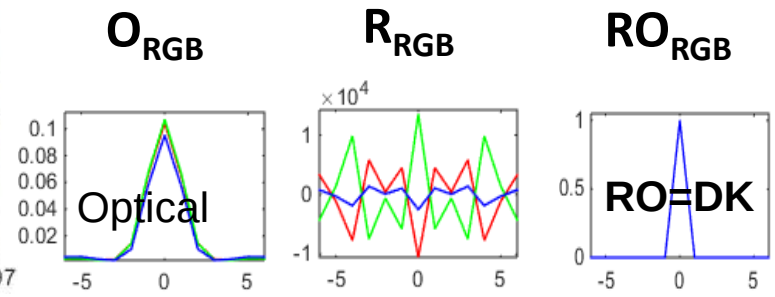
Analysis of collisions of three galaxies in the X-ray and Optical ranges





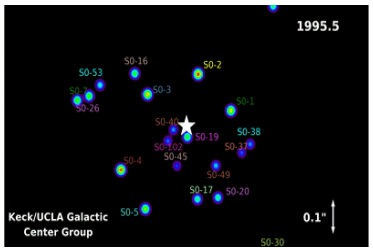






Results in Collaboration EHT. 2020 Nobel laureates in physics

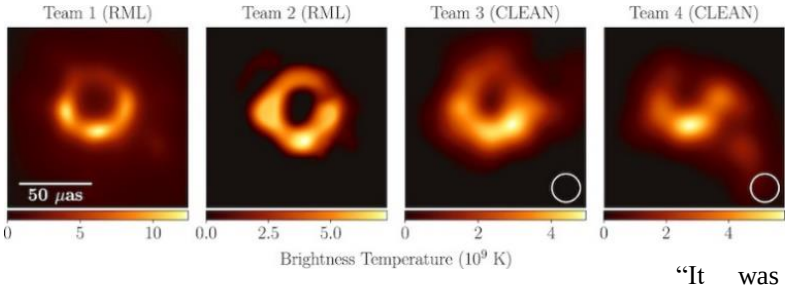
Roger Penrose, Reinhard Genzel, and Andrea Ghez are to be awarded the 2020 Nobel Prize in Physics for their theoretical and observational work on black holes, the Royal Swedish Academy of Sciences

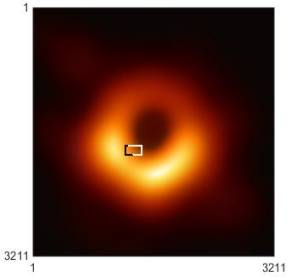


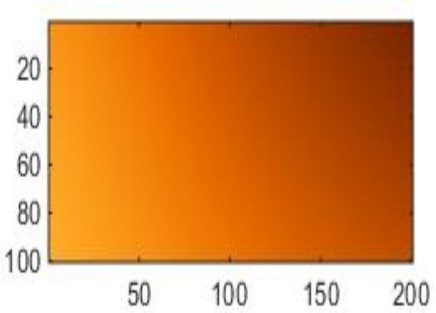
.. and analyze the motion of stars tightly orbiting *Sagittarius A**, the radio source at the Milky Way's center.

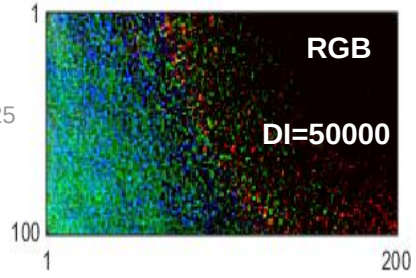
Other members of the EHT team had developed general ***relativistic magneto hydrodynamic simulations*** to first predict what EHT might see and then validate what it did see. The researchers ran thousands of simulations, each one with slightly different values for properties such as plasma temperature and the black hole's spin and magnetic flux.

Katie Bouman
California Institute of Technology
330 South Chester Avenue, Room 346
Pasadena, CA 91125

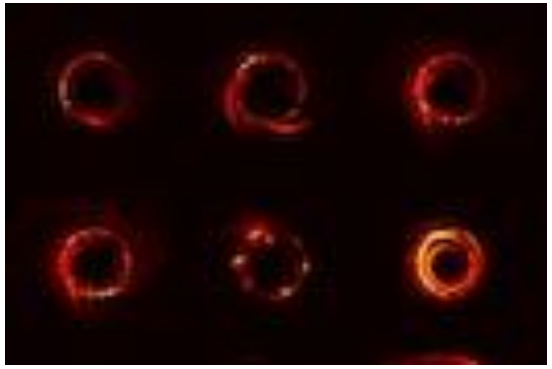


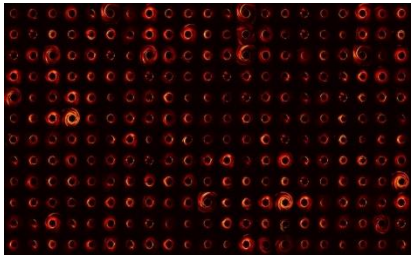






"It was a remarkable moment," says imaging team coleader Kazunori Akiyama of MIT





Conclusions

1. **Modifications of the AF intelligent control methods can be implemented in electron microscopy, in new radar technologies, synthesized aperture locators, CT, MRT tomography, telescopes, etc.**
2. **In the ideal case, it is necessary to design intelligent, self-tuning devices (antenna systems) for CC and CAM AF O. We assume that all this can be implemented "in hardware" and in programs for modern radars, telescopes, microscopes, tomography devices, etc.**
3. **Of course, all this will be widely used in astrophysics when analyzing data from Black Holes, etc.**
4. **Possible wide applications R&SR method in the production of processors.**

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