On recent studies of laser-driven magnetic reconnection vs. plasma bubble collision

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Outline

- Laser- driven magnetic reconnection (LDMR) on Shenguang II and Gekko XII
- Plasma bubbles collisions

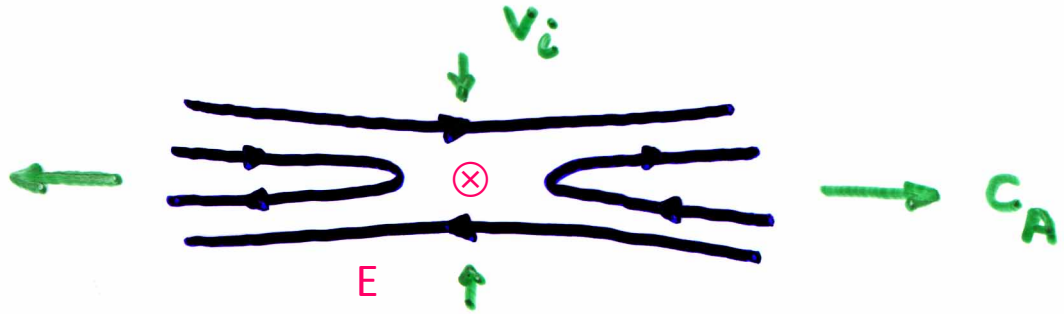
Results are very preliminary

Two topics are focused on SG and Gekko reconnection experiments:

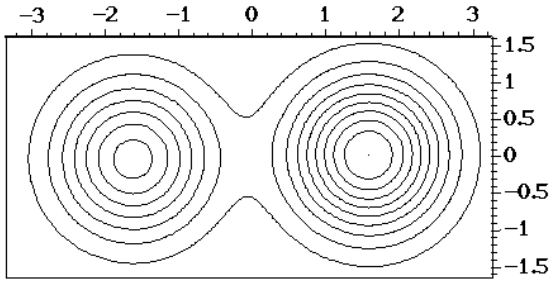
- Reconnection vs. collisions

- Particles accelerations in reconnection process

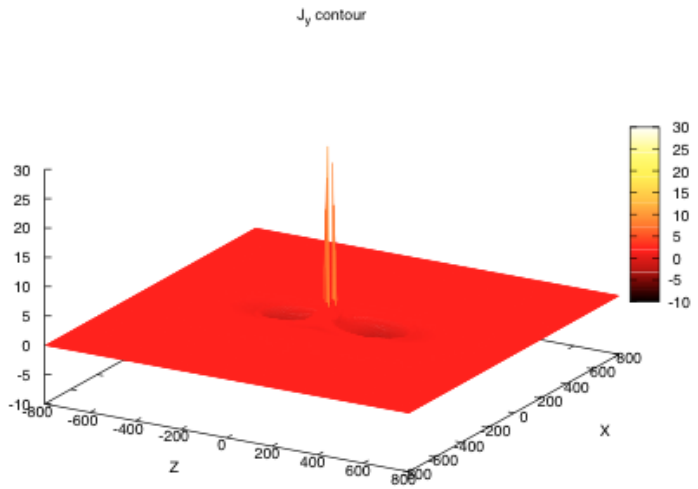
-Particles accelerations



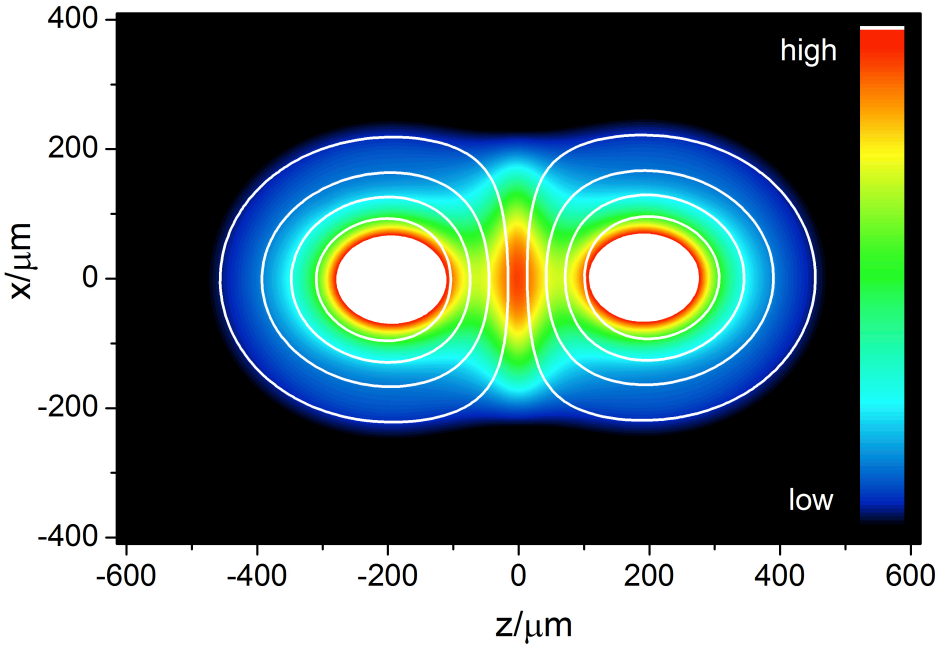
- In-plane magnetic field
- Reconnection current density (Out-of-plane)



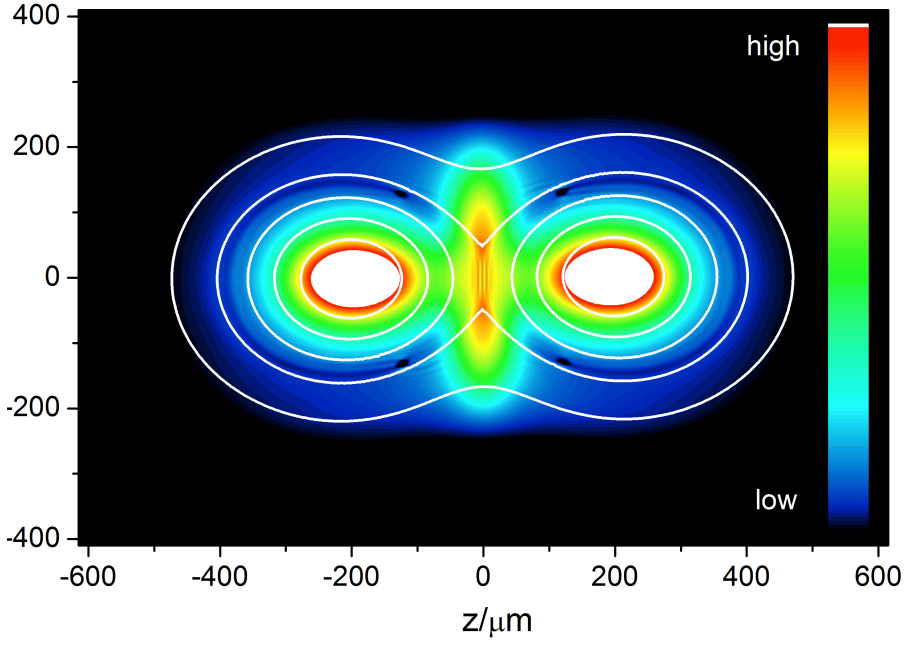
MHD Simulations



-Issue of reconnection vs. collisions

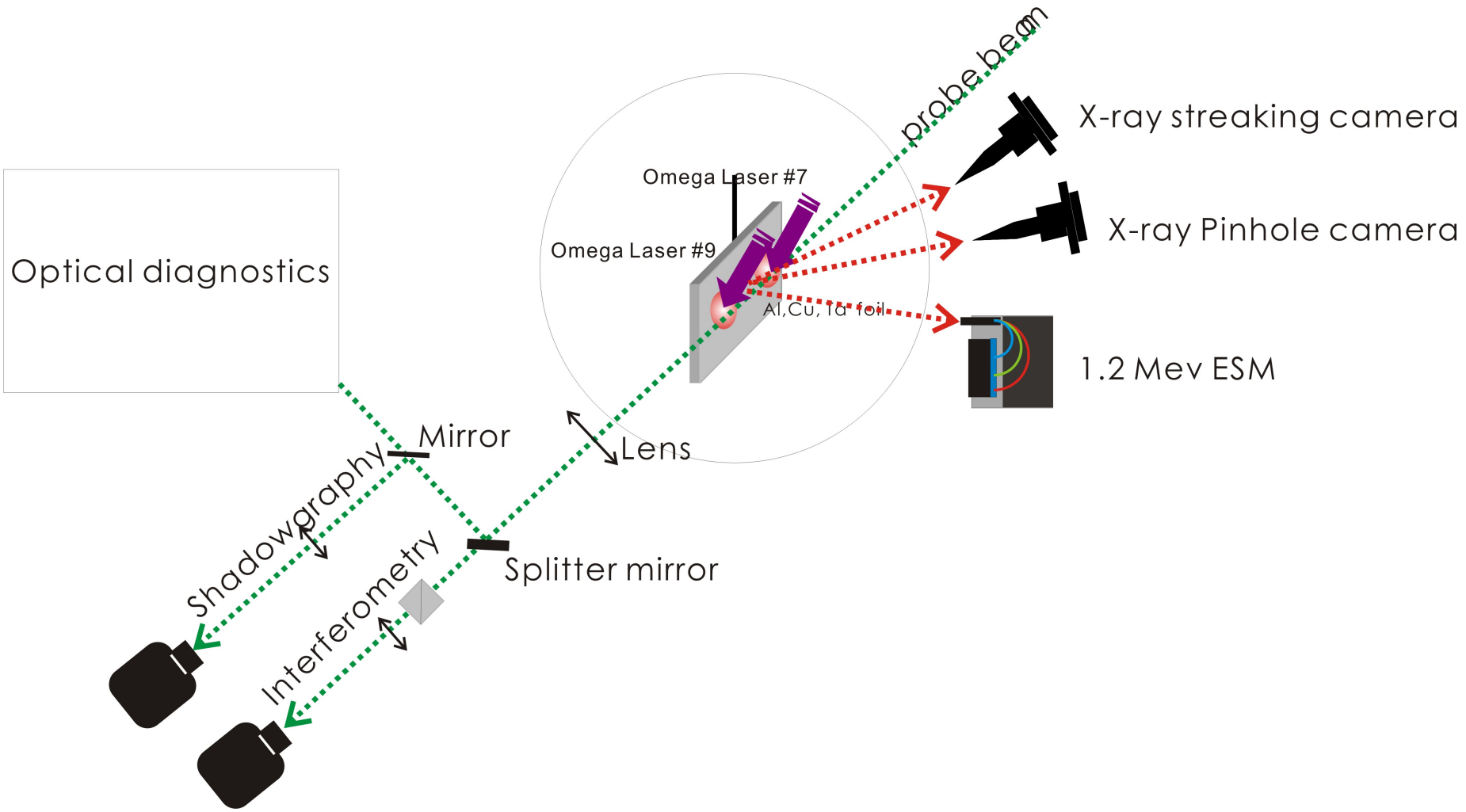


With parallel B fields
(opposite laser beams)
-- Collision

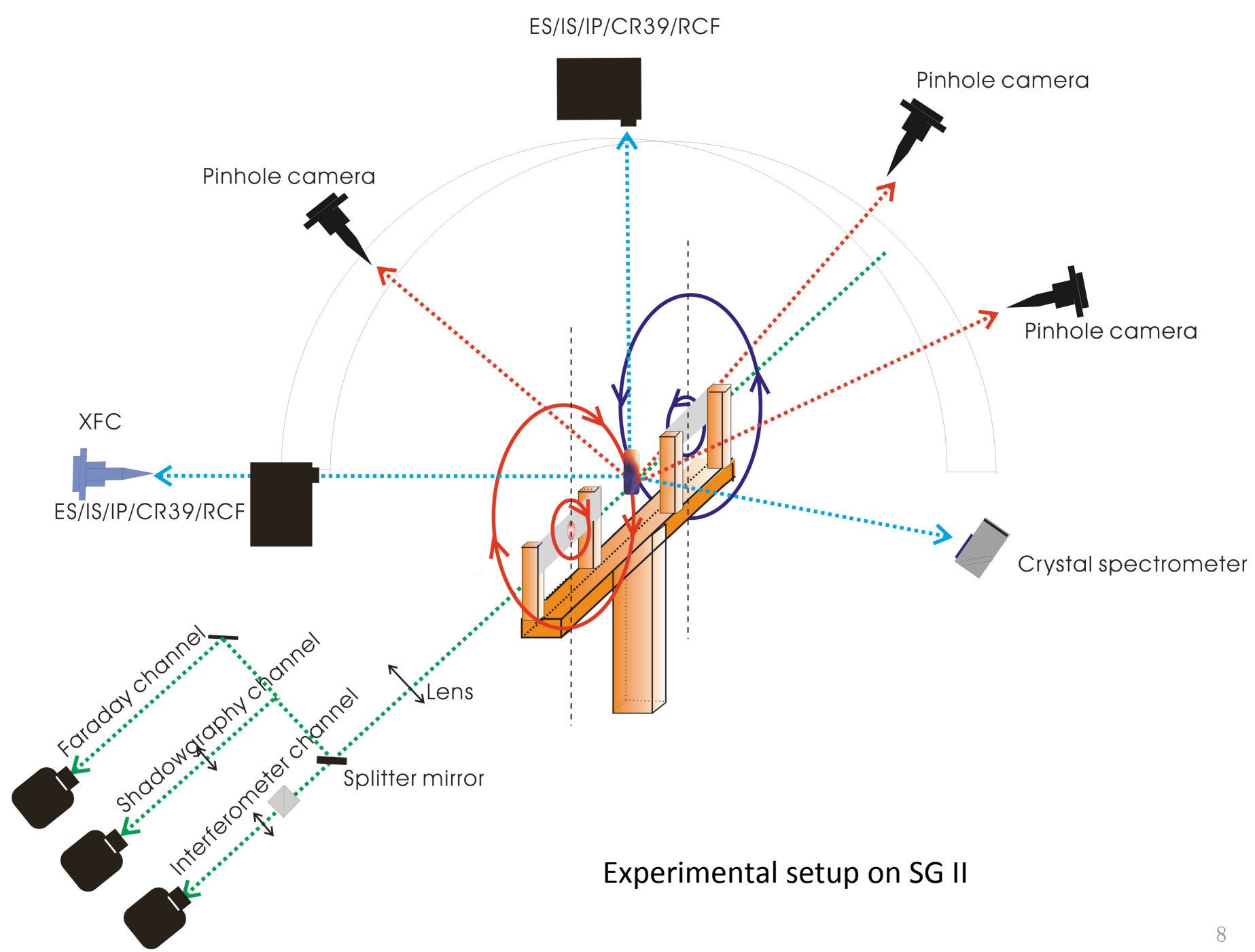


With antiparallel B fields
(parallel laser beams)
--MR

MHD Simulations (X-ray images)



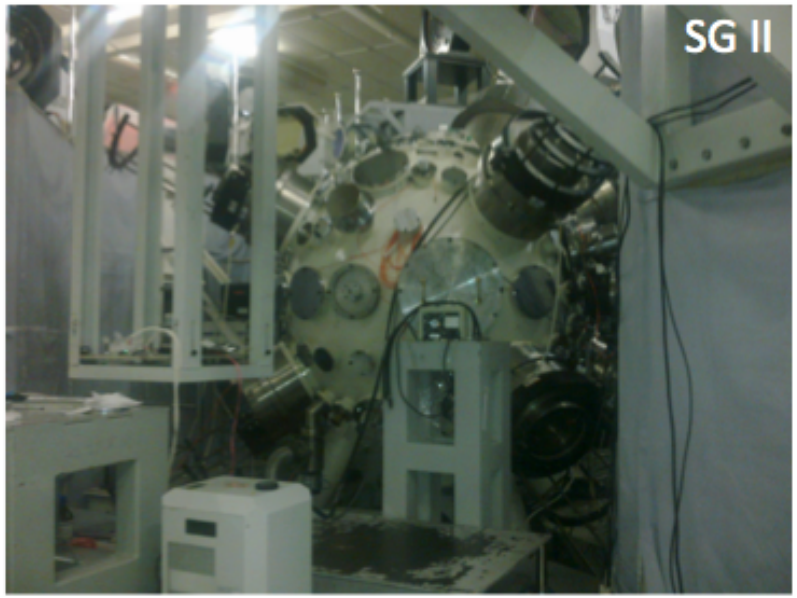
Experimental setup on Gekko XII

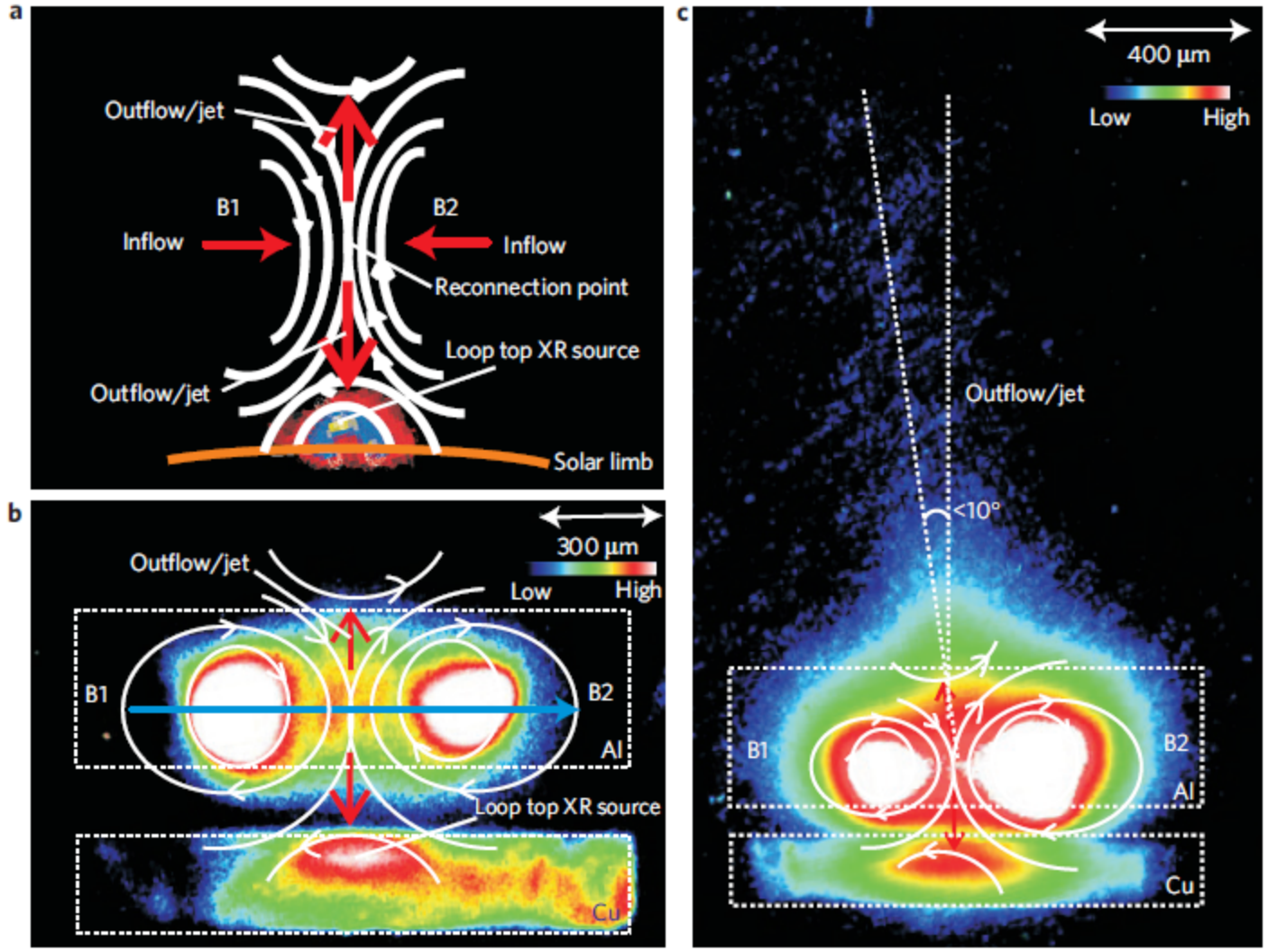


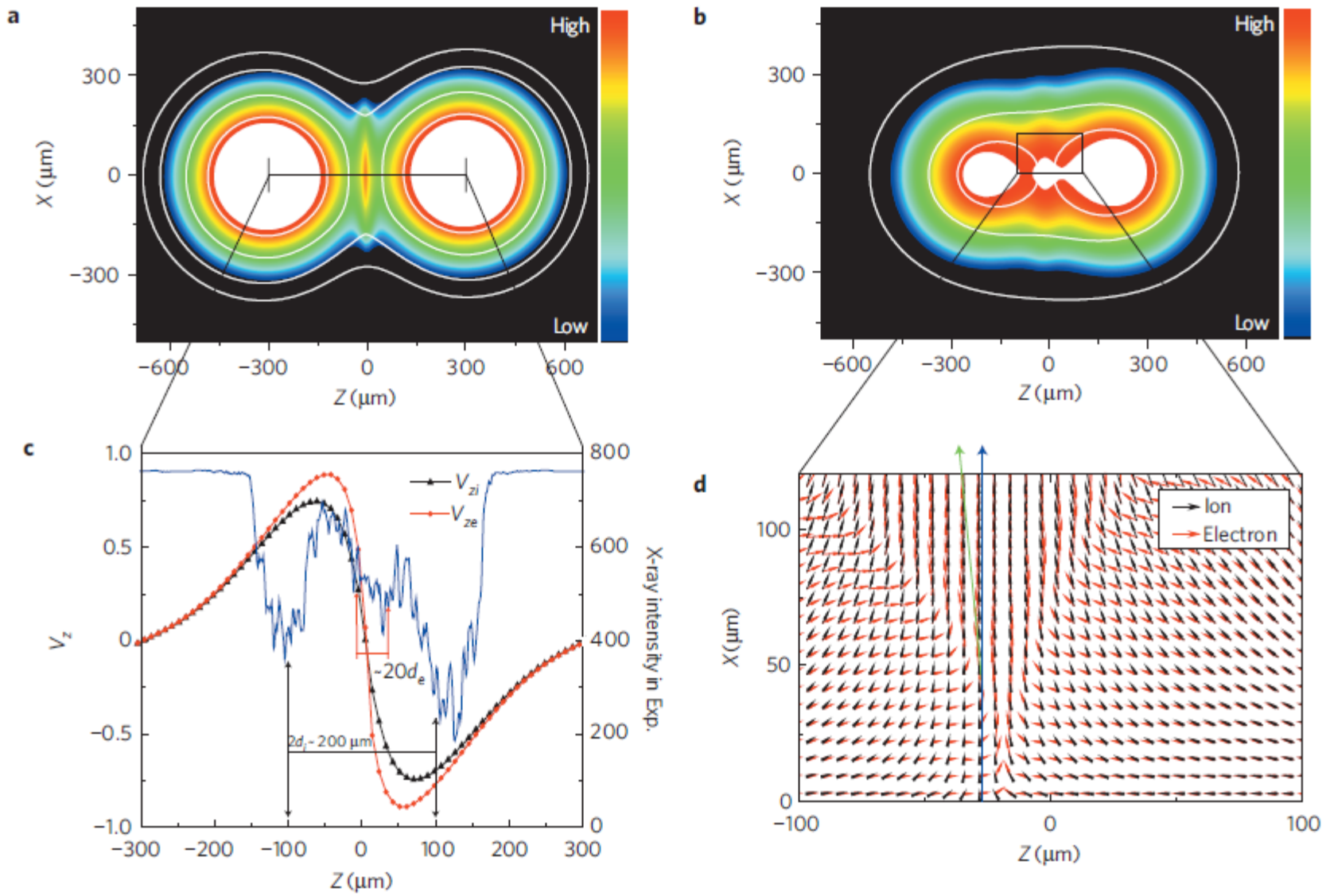
Experimental setup on SG II

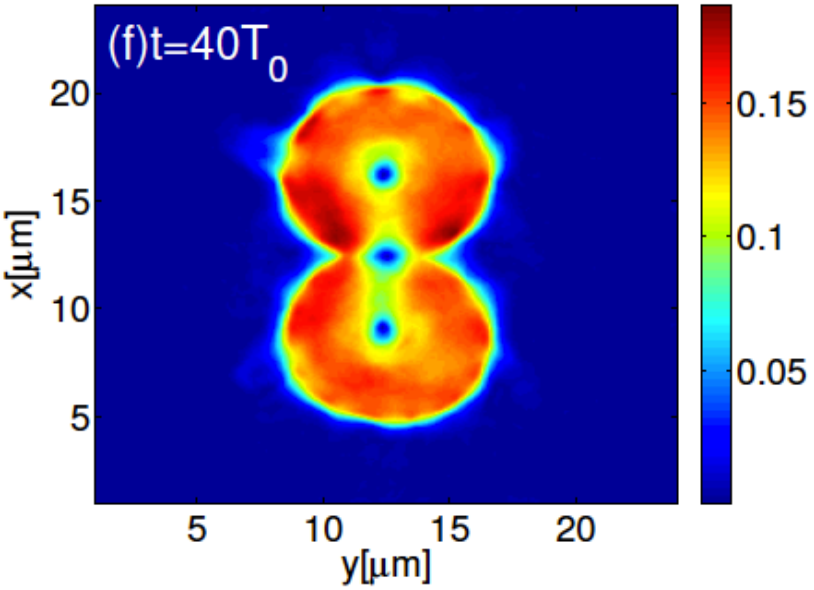
Laser Parameters

Facilities	Pulse duration	Wavelength	Energy per beam
SG II	1 ns square Pulse	0.35um	260 J
Gekko XII	500 ps Gaussian pulse	1.05um	300 -400 J
Omega EP	1-10 ps	1.05um	1-2.6 KJ

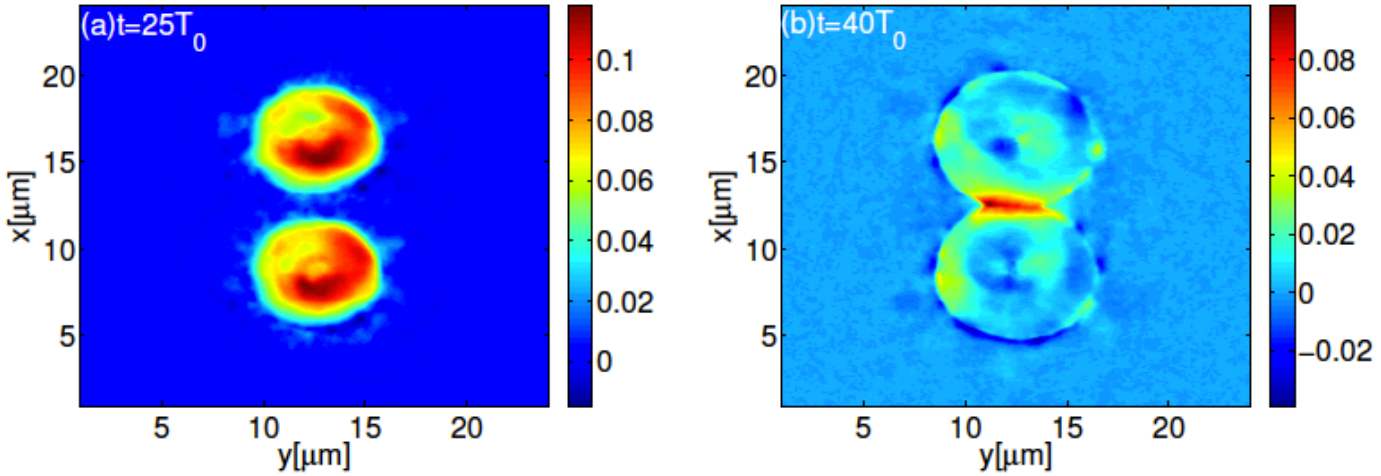



a
Outflow/jet
B1
Inflow
B2
Inflow
Reconnection point
Loop top XR source
Outflow/jet
Solar limb
b
300 µm
Low
High
Outflow/jet
B1
B2
Al
Loop top XR source
Cu
c
400 µm
Low
High
Outflow/jet
<10°
B1
B2
Al
Cu


a
High
Low
300
0
−300
X (μm)
−600
−300
0
300
600
Z (μm)
b
High
Low
300
0
−300
X (μm)
−600
−300
0
300
600
Z (μm)
c
1.0
0.5
0
−0.5
−1.0
V_z
800
600
400
200
0
X-ray intensity in Exp.
V_{zi}
V_{ze}
~20d_e
2d_i ~ 200 μm
−300
−200
−100
0
100
200
300
Z (μm)
d
100
50
0
X (μm)
Ion
Electron
−100
0
100
Z (μm)



Azimuthal magnetic fields

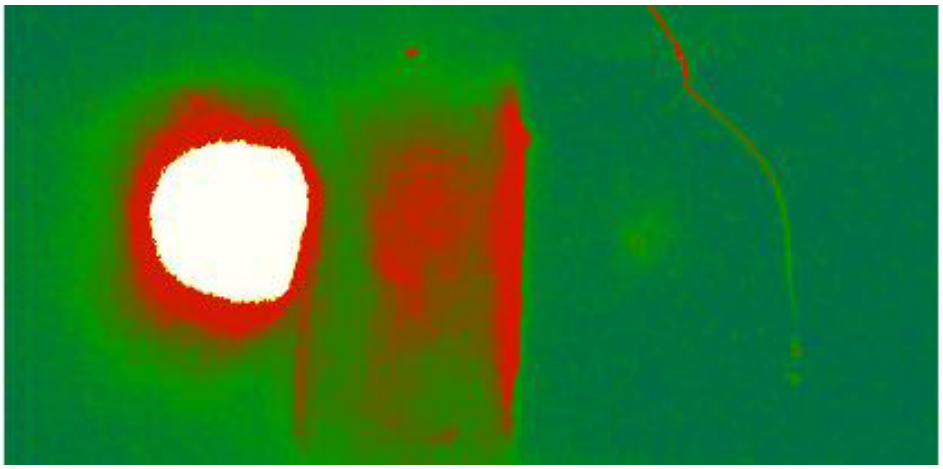


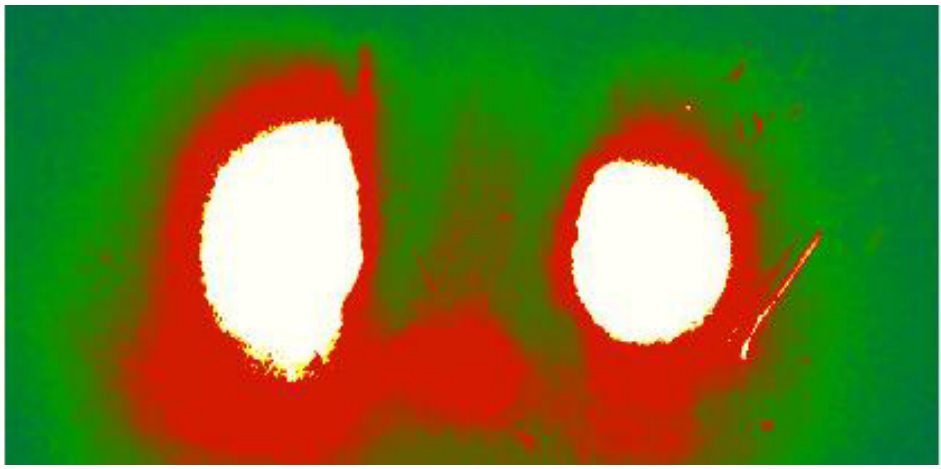
Reconnection electric field Ez

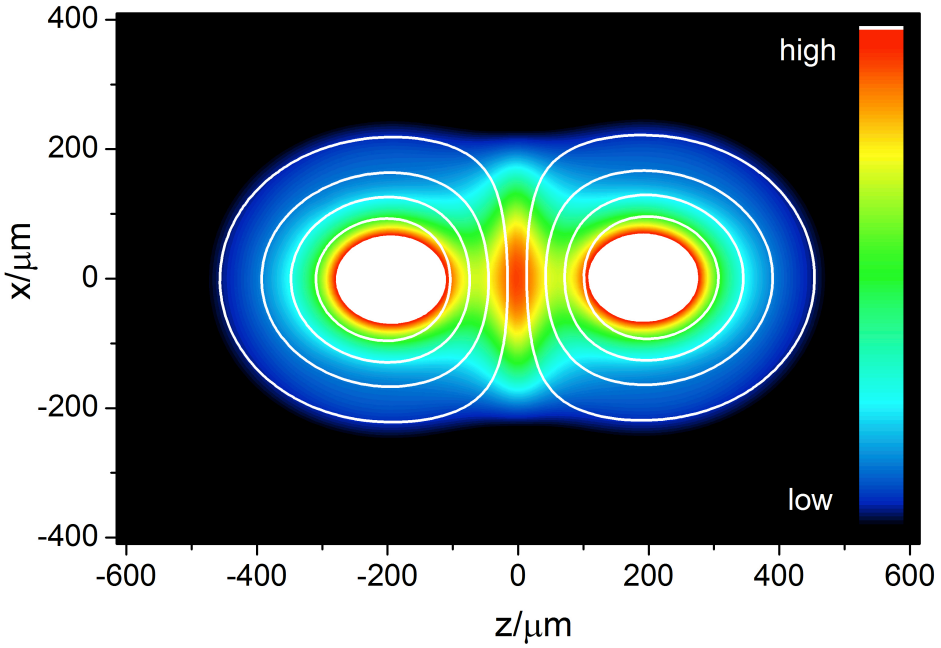
PIC Simulations (B and E) Laser energy flux 5*10^20 W/cm^2

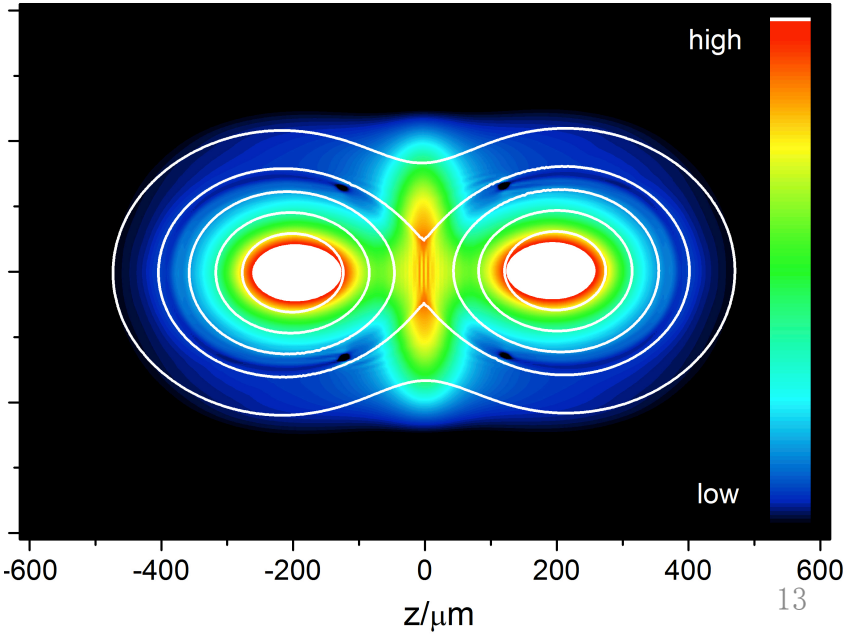
Opposite laser beams
Collision of bubbles

Parallel laser beams
Reconnection of bubbles



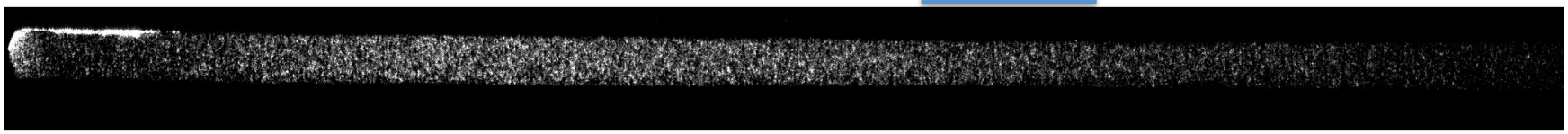


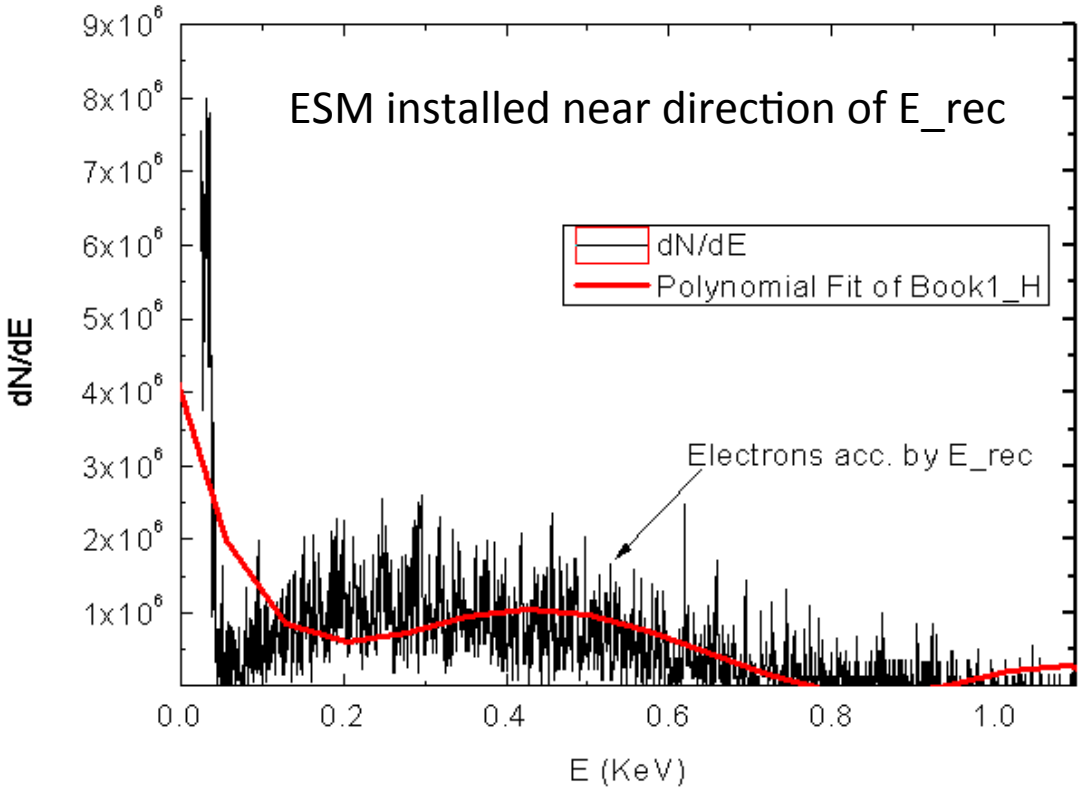




Only one spot on Cu target #7

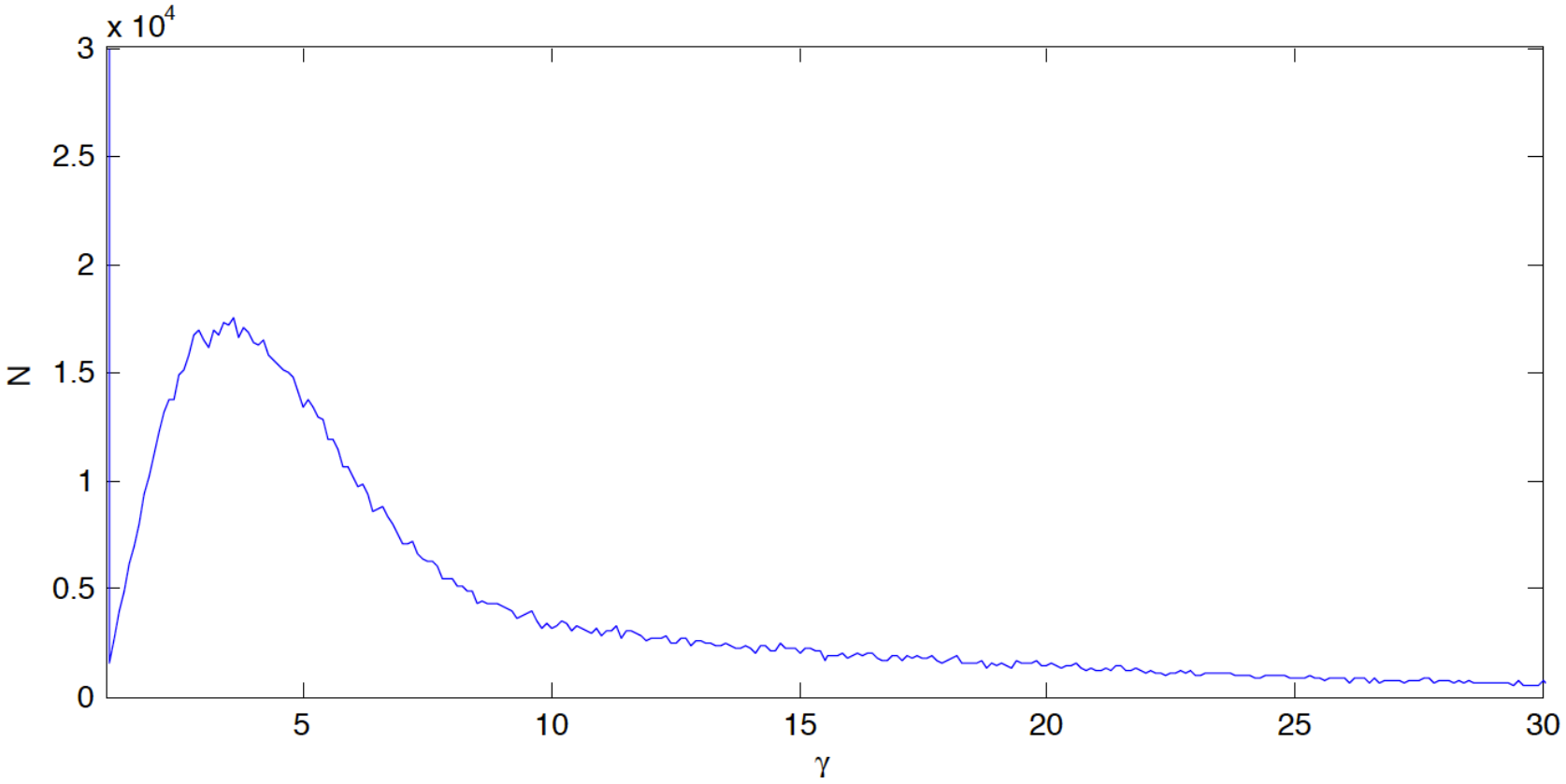
Two spots on Cu target #7 and #9

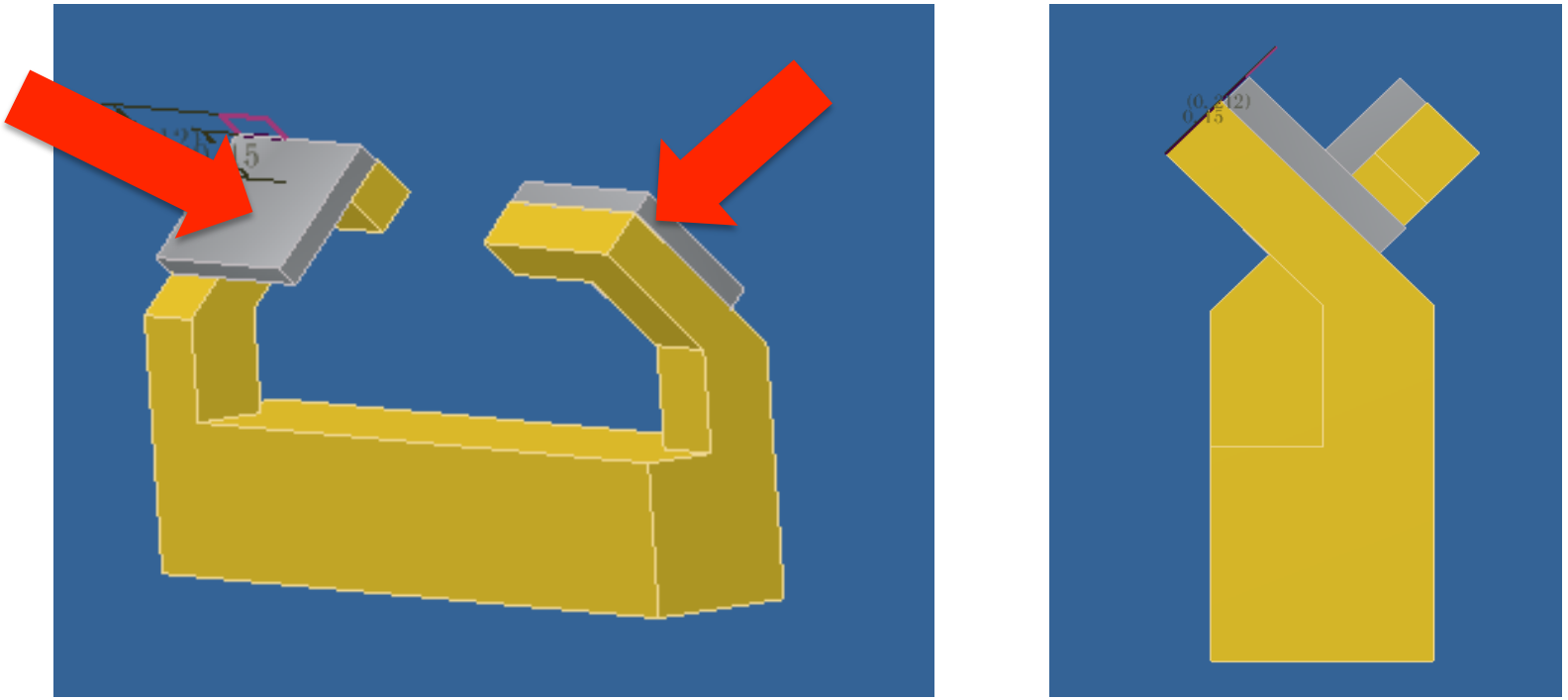




Shooting Cu target on Gekko XII, The ESM is set up outside of target Chamber

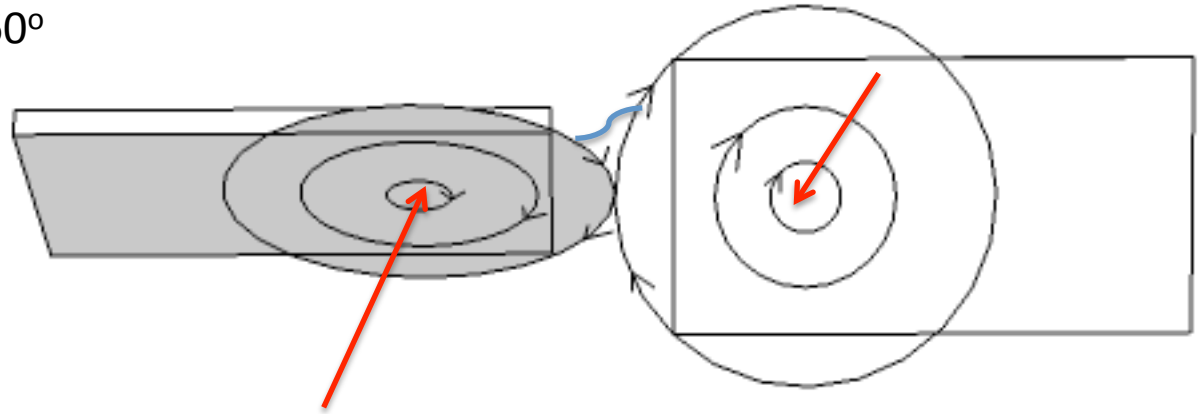
Energetic electrons accelerated by E_z

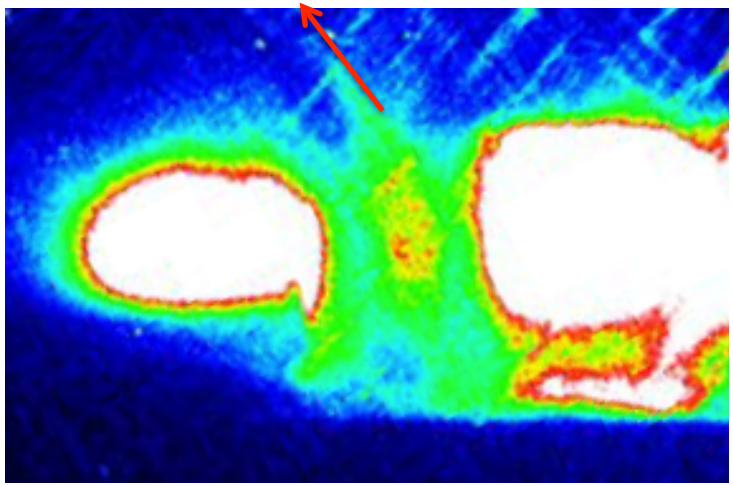




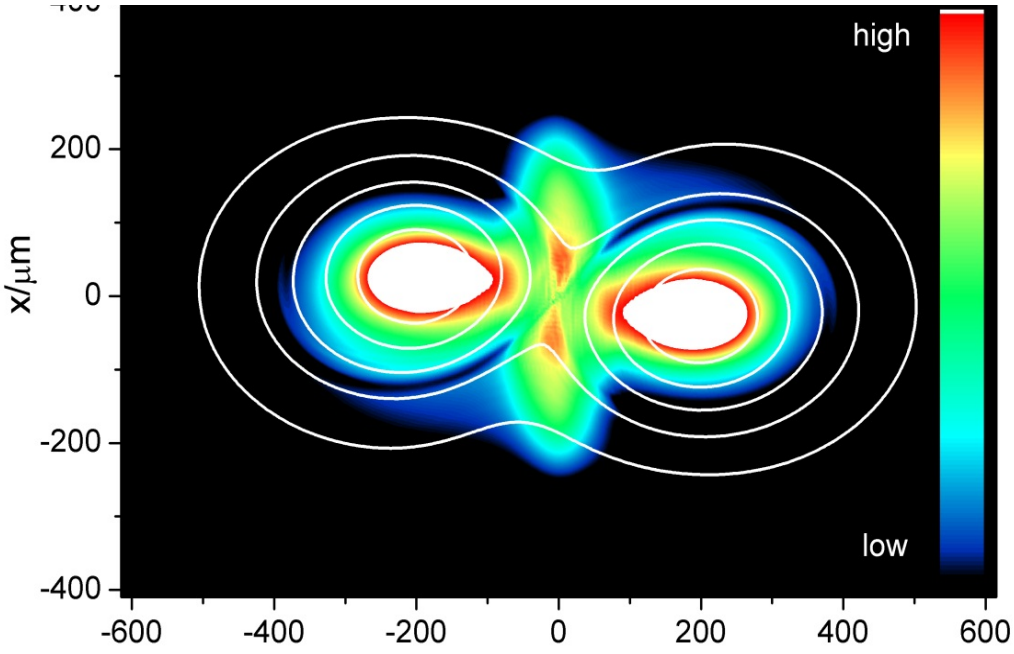
Component reconnection target

One case of 60°

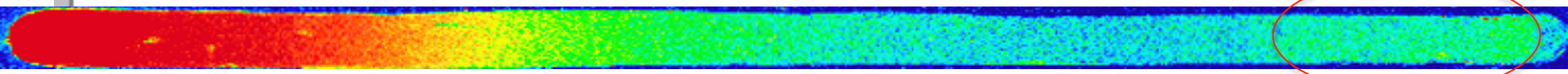


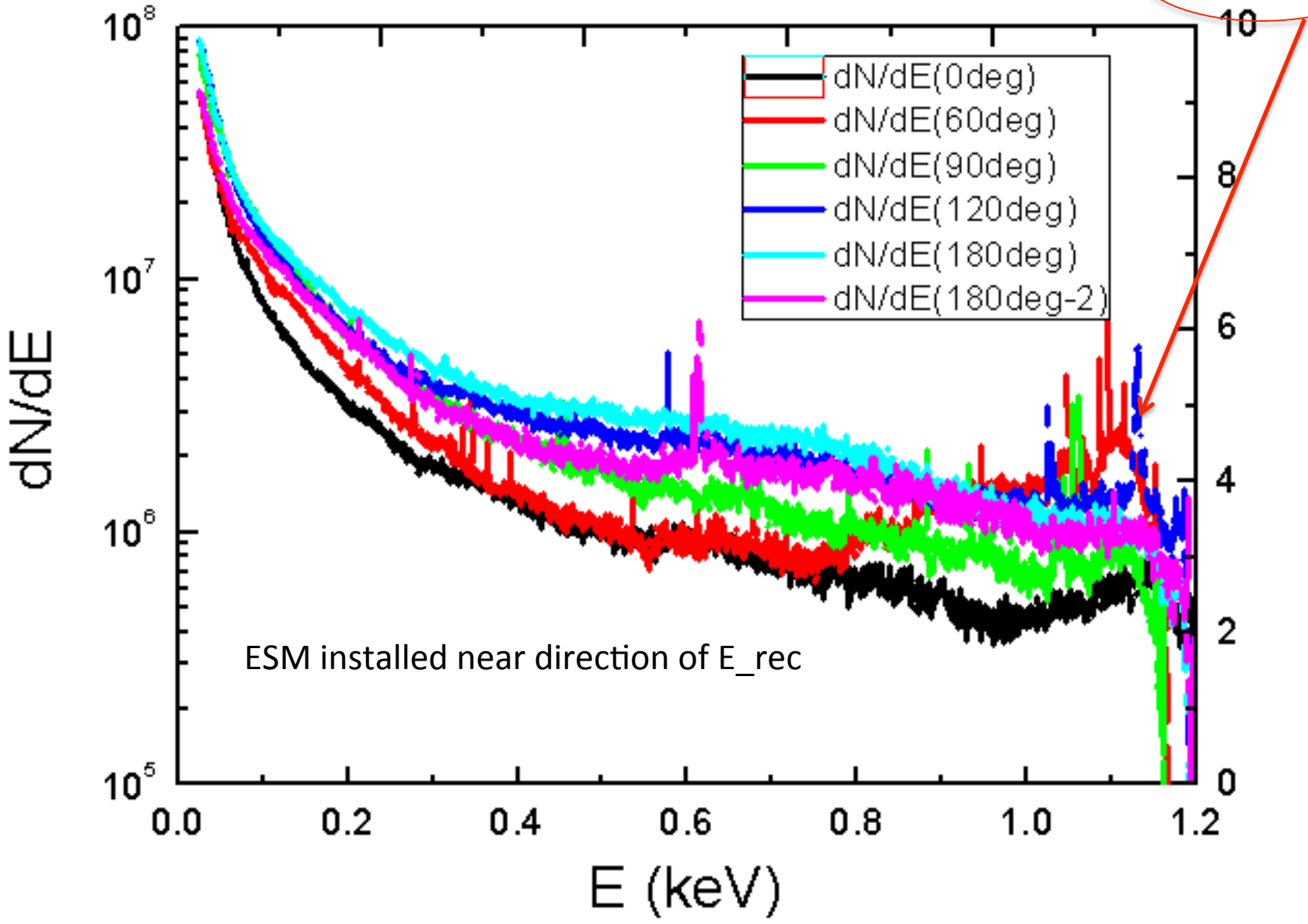


X-ray image with Pinhole-Camera



X-ray image with Simulation





Shooting Al target on SG II, The ESM is set up inside of target Chamber

SG Experiments

2012.09.11-2012.09.27

Gekko Experiments

2012.10.19-2012.11.09

Summary

- Collision and MR are compared in experiments
- MR particle acceleration have been observed
- Two plasma streaming perpendicularly to each other have been observed.

Further analyses are needed.

Thanks!