

# Canadian Advanced Laser Light Source and the High-Intensity Femtosecond Rainbow

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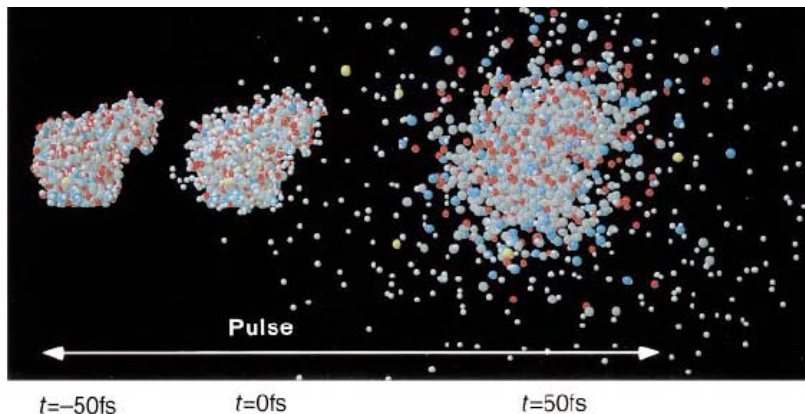
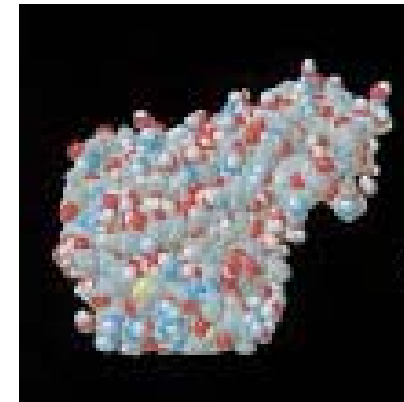
# The Dream: Molecular Imaging

- Scientific challenge for Genome Research
  - ◆ Dynamic molecular imaging at the nanometer scale, with femtosecond temporal resolution

Femtosecond IR laser

Femtosecond UV laser

Femtosecond X-rays

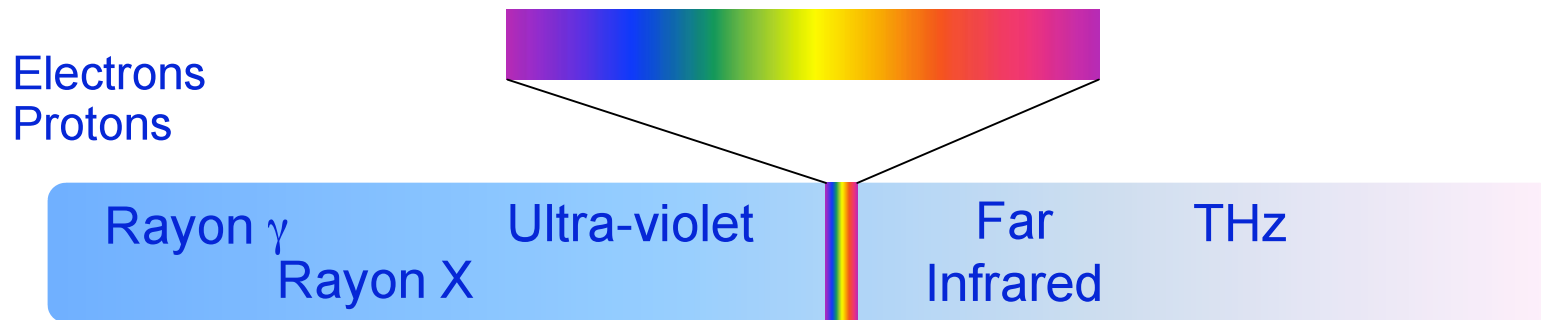


Need for a  
Femtosecond  
Rainbow

# ALLS: Le concept

- Femtosecond Rainbow

Use the ALLS infrared femtosecond lasers to create ultrafast light sources with different colors

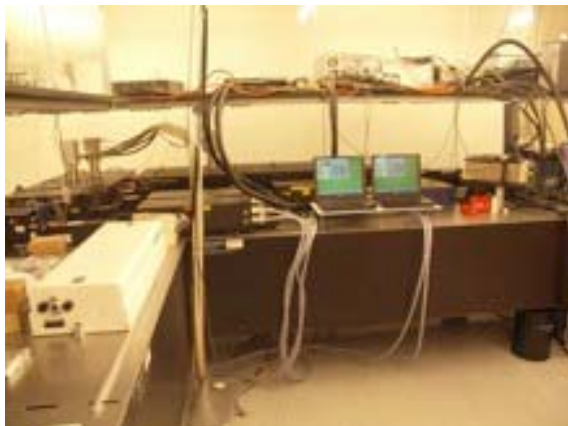


Combine femtosecond pulses with various colors, to realize ***dynamic imaging of complex systems***

# ALLS = Three laser systems

Jan 2007

5 kHz, 5 mJ, 25 fs +  
OPA + OPCPA



September 2005

1) 10 Hz / 300mJ  
2-3) 100 Hz / 100mJ,  
25fs + OPA



Summer 2008

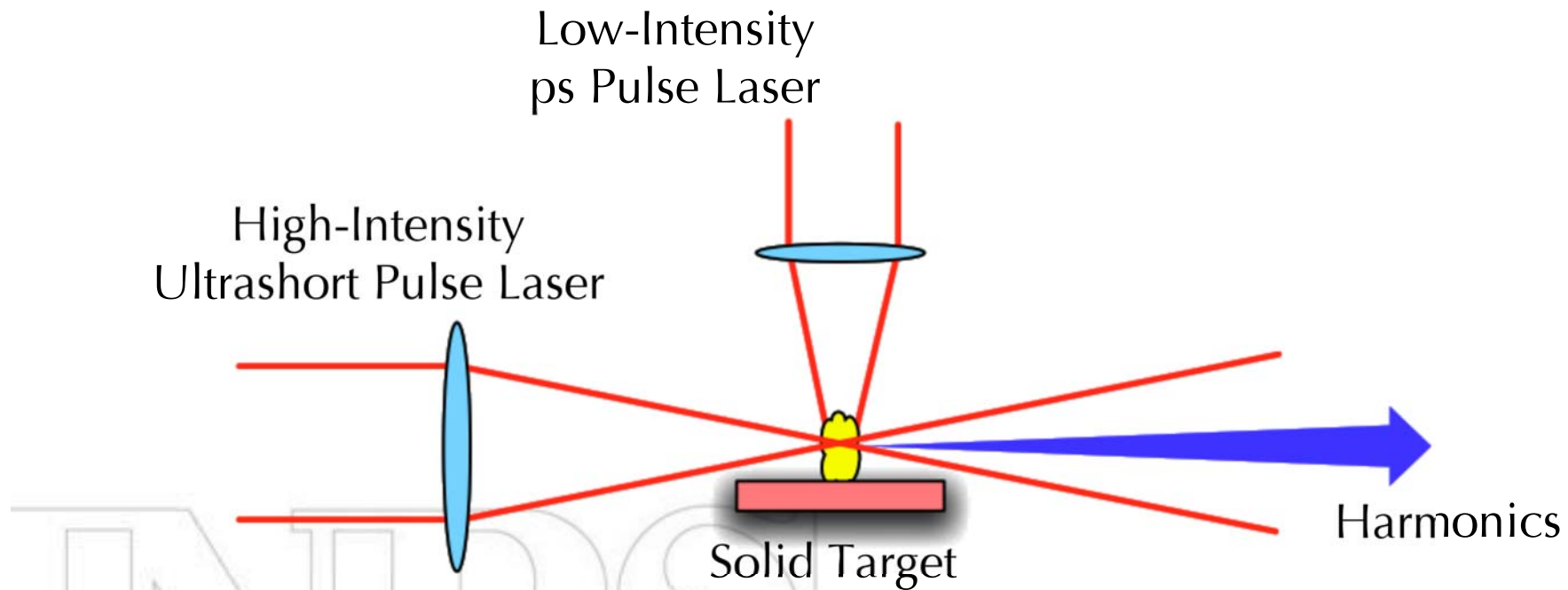
ALLS 200TW-  
10Hz, 25fs



*open to users from all countries and various horizons  
(Universities, Governmental laboratories, Industries)*

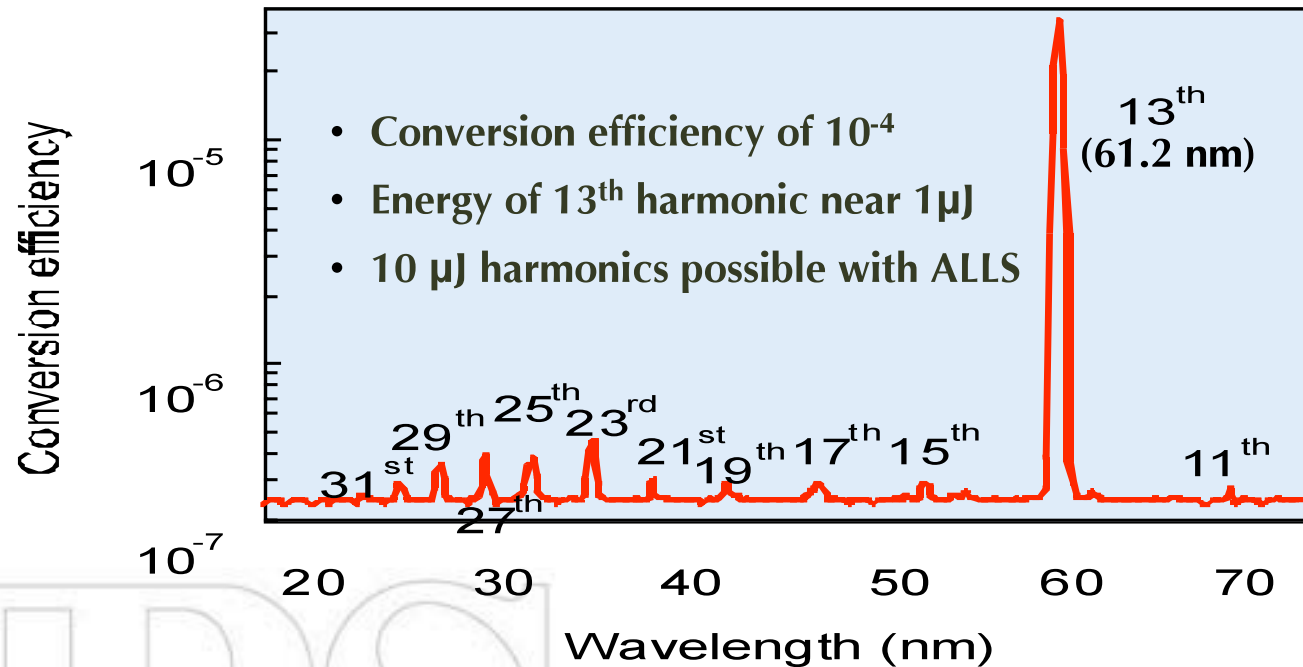
# Ablation Harmonics

An Alternative to High Intensity Harmonic Generation



# Intense Quasi-monochromatic Harmonics from Indium Ablation

Indium

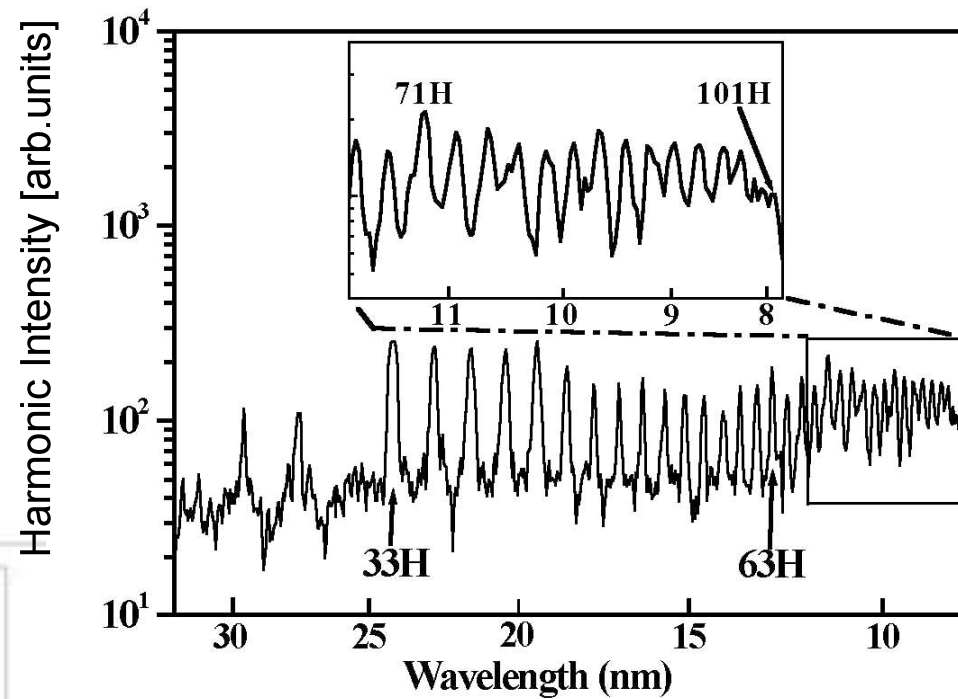


*Even Stronger harmonics from fullerenes*

# Going to Shorter Wavelengths

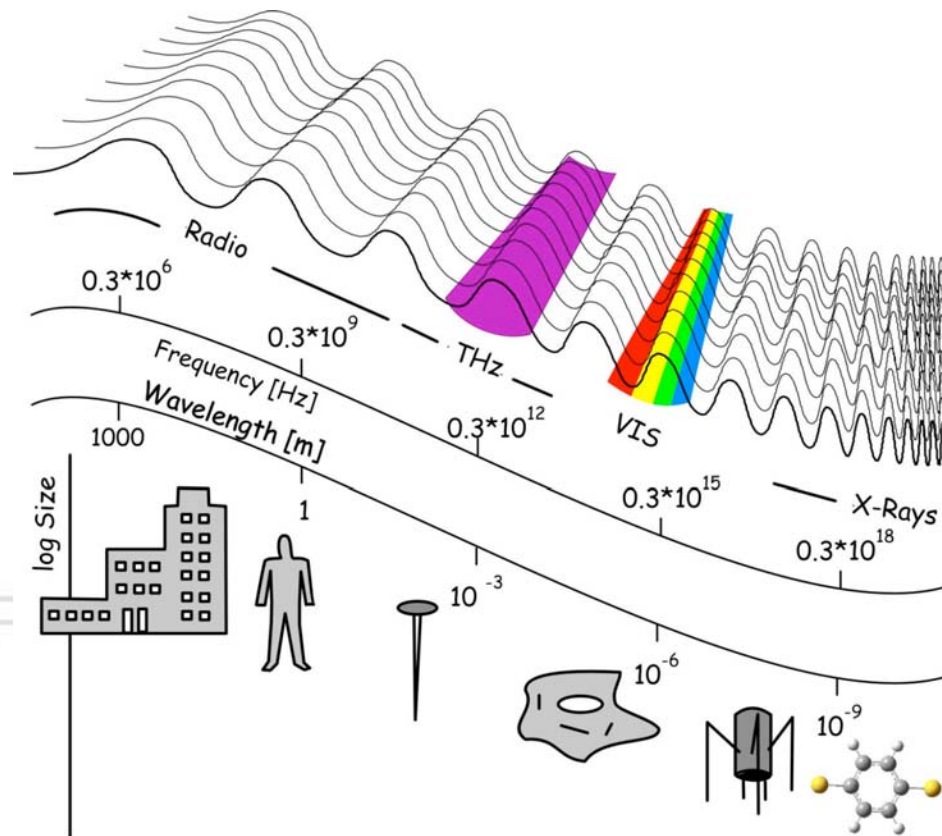
## Extending the Cut-off with Manganese

Harmonic Spectrum using Solid Manganese Target



# Terahertz Radiation

THz waves (or T-rays) are still by far the least explored portion of the electromagnetic spectrum



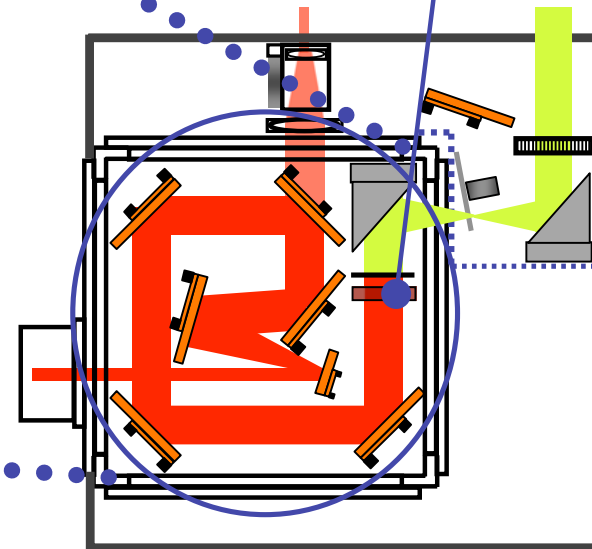
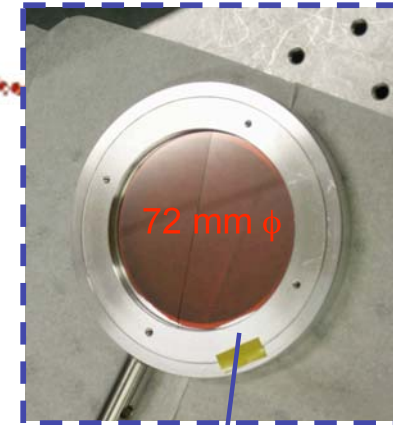
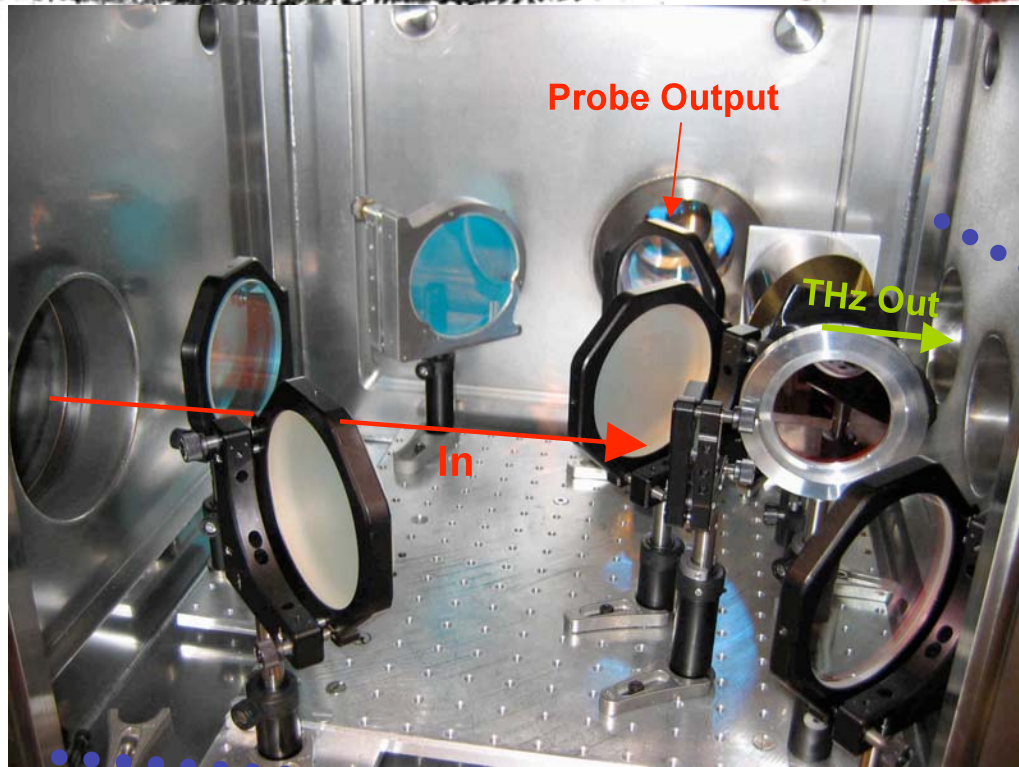
T-ray

0.1 to 10 THz

1 THz ~ 1 ps ~ 300  $\mu$ m  
~ 4.1 meV ~ 47.6 K

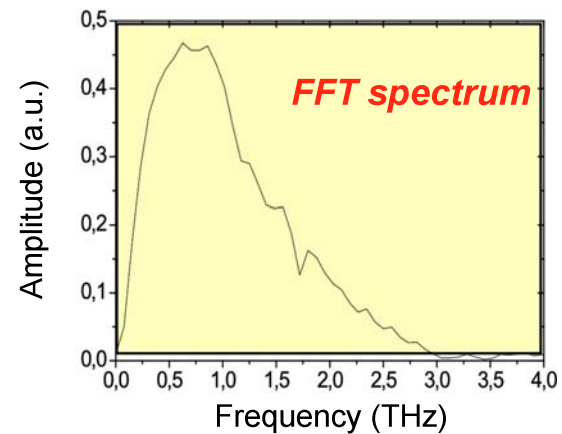
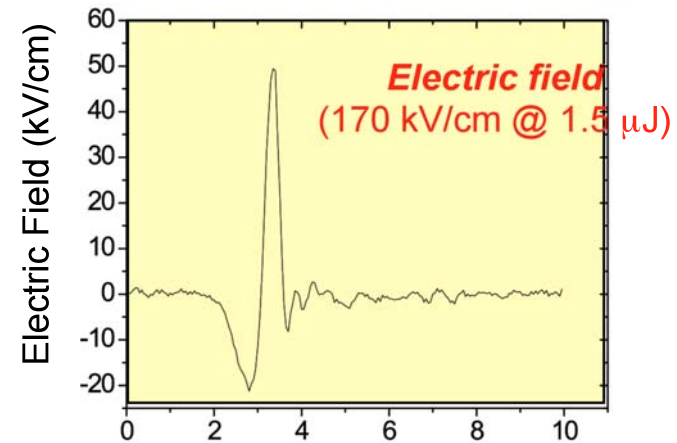
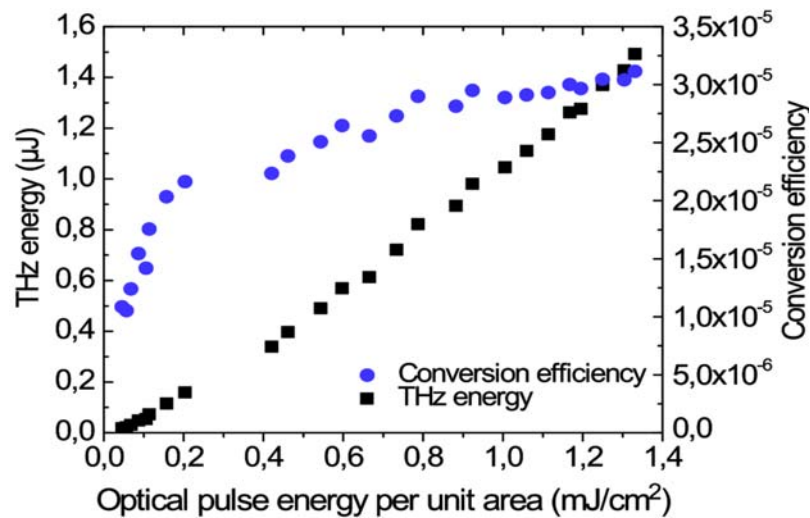


# ALLS THz Source



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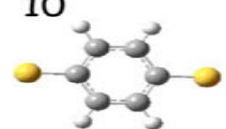
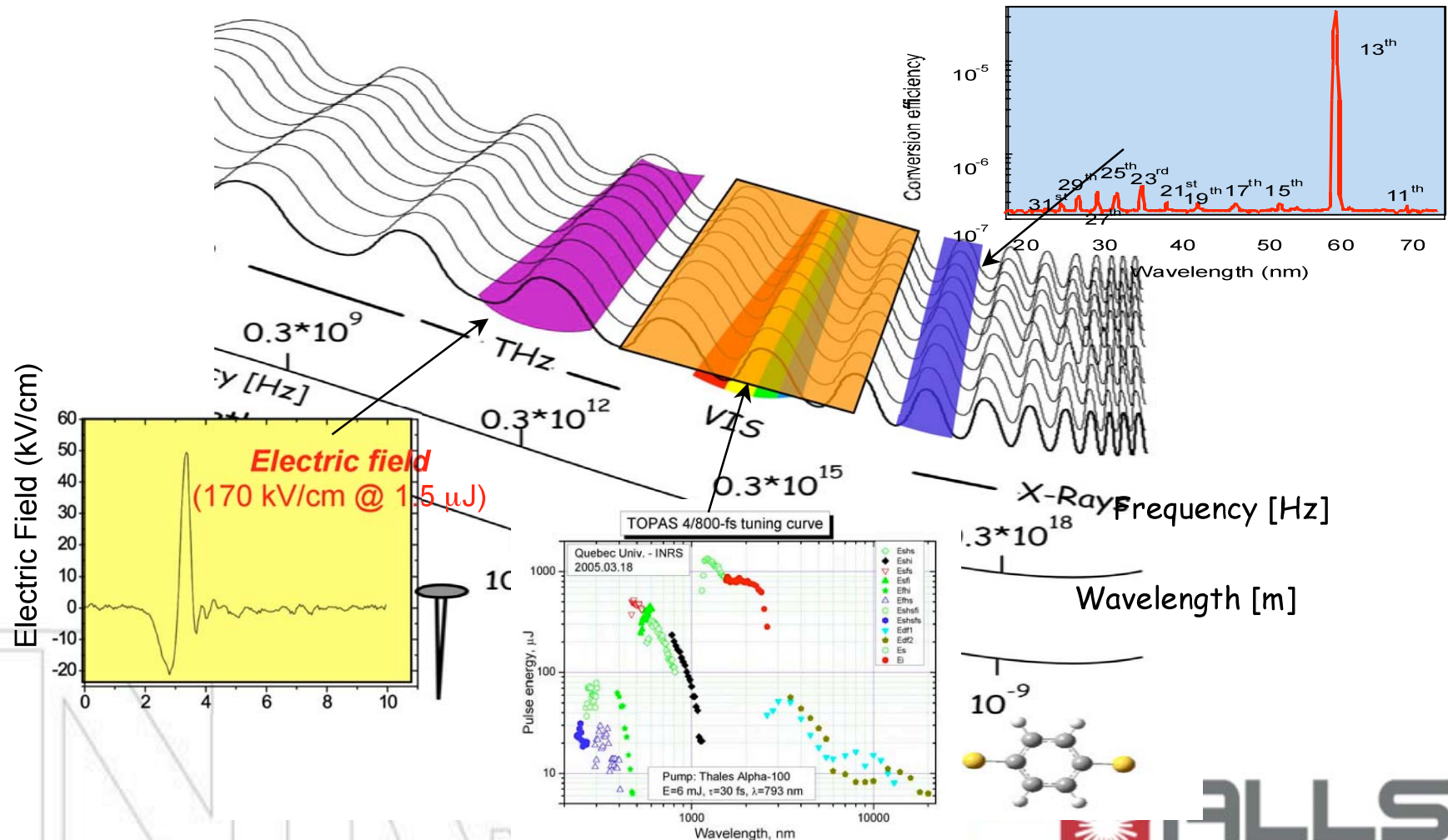
# THz Energy Measurement



**1 μJ, 1 ps, 1 mm focus: 100 MW cm<sup>-2</sup>**  
 **$I \lambda^2 = 10^{13} \text{ W cm}^{-2} \mu\text{m}^2$**

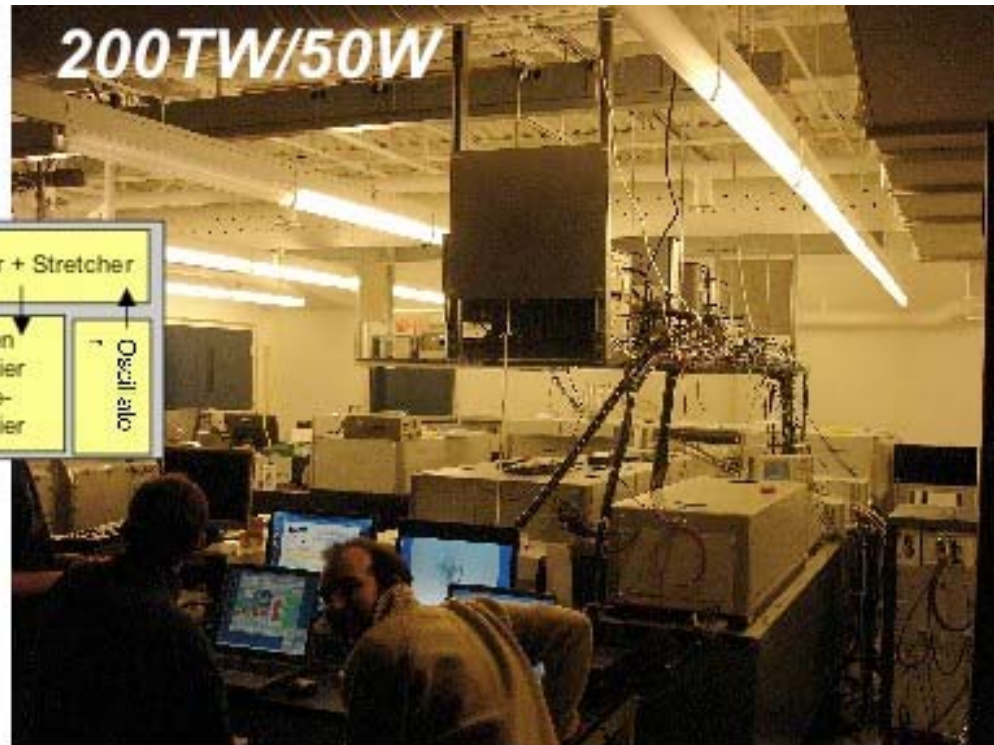
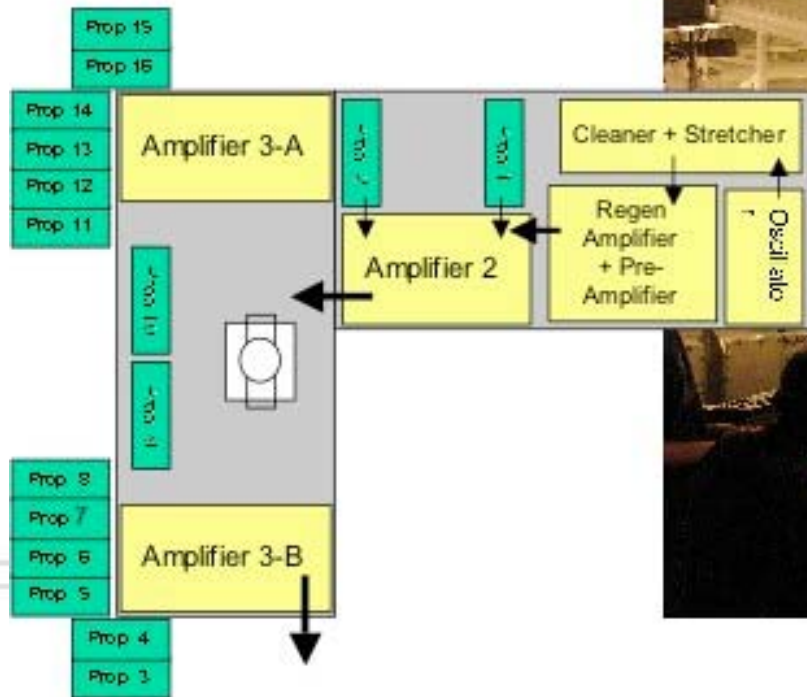
↓  
**Observation of Nonlinear THz effects**

# Intense Femtosecond Rainbow

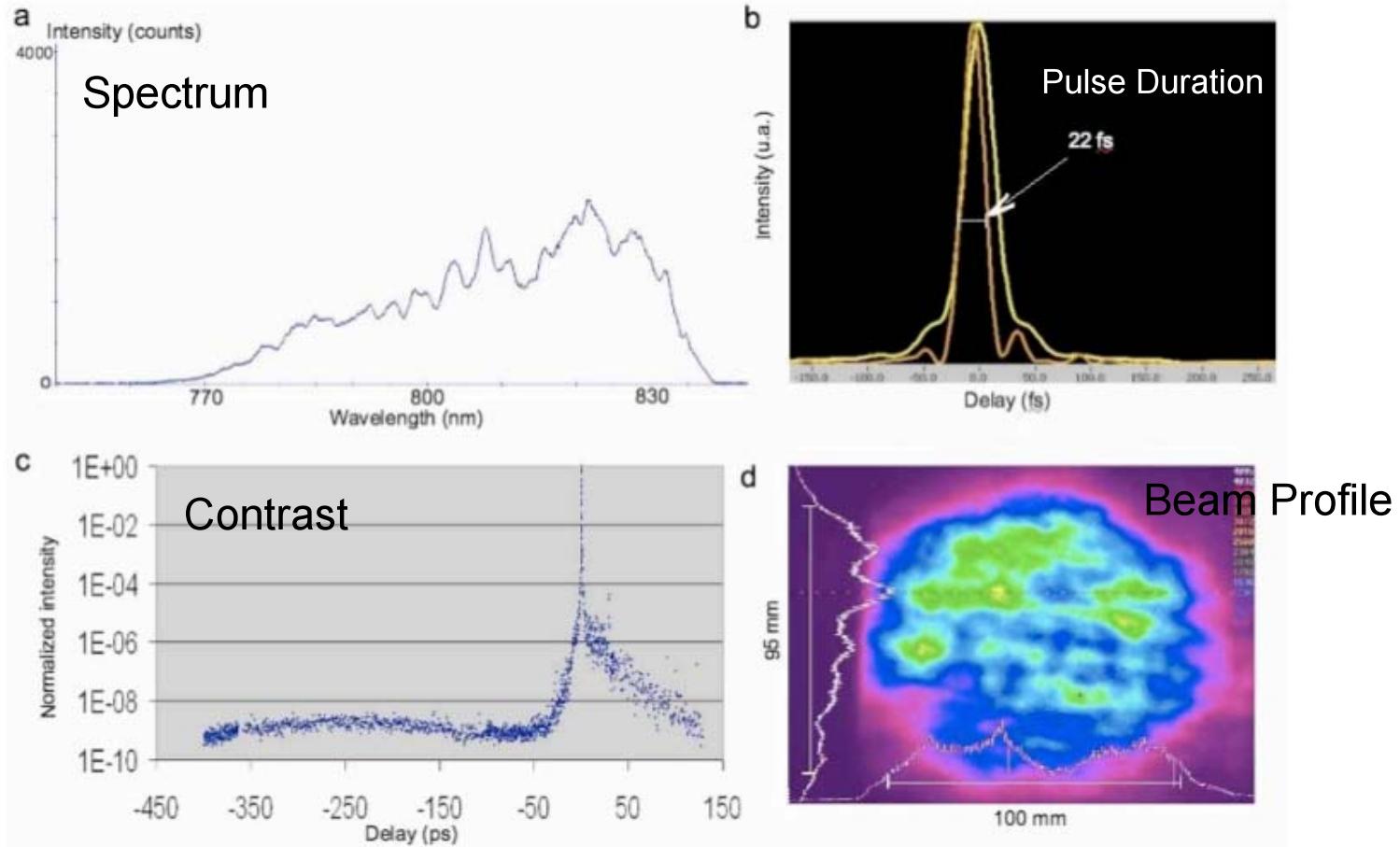


# 200 TW Beam Line

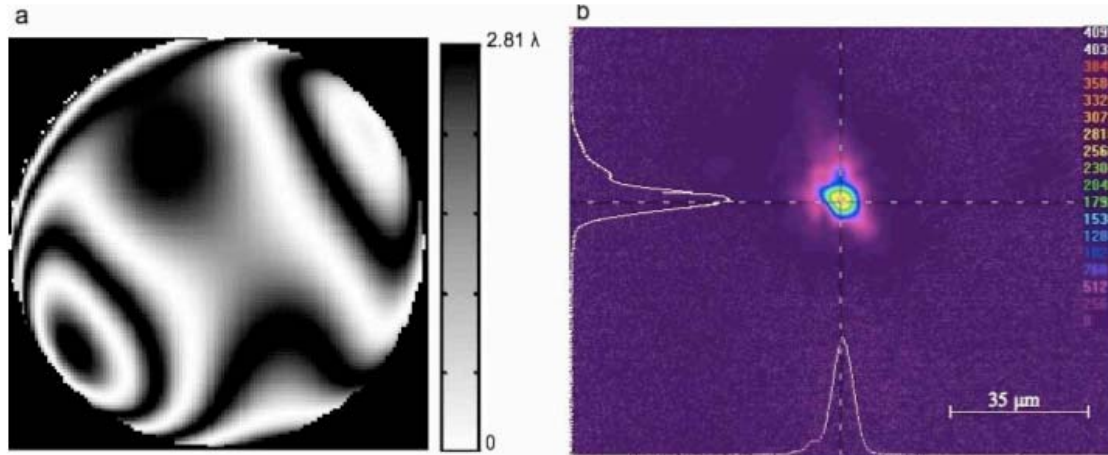
Ti:Sapphire Laser  
5J, 25fs @ 10Hz



# 200 TW Beam Line Performance



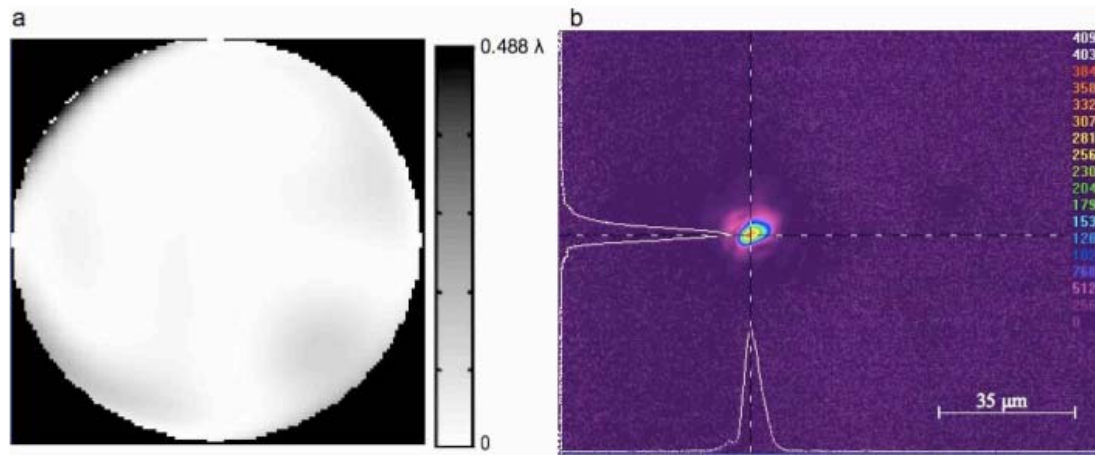
# Focusing Characteristics



f/3 off-axis paraboloid

Without Deformable Mirror

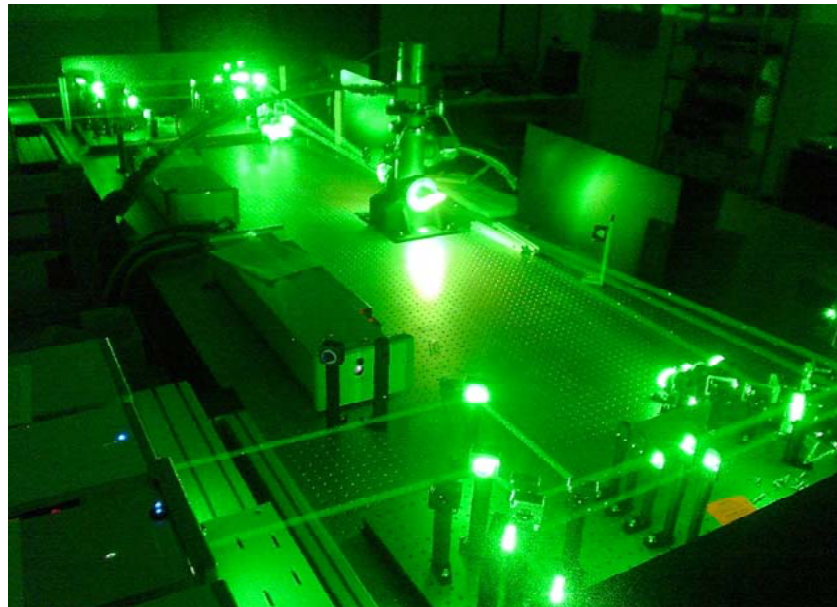
RMS wavefront:  $0.47 \lambda$   
Spot size:  $8.6 \times 14.8 \mu\text{m}^2$



With Deformable Mirror

RMS wavefront:  $0.063 \lambda$   
Spot size:  $7 \times 7.8 \mu\text{m}^2$

# Thank You



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