Ideas for first physics projects at SUNY Cortland

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Projects:

1. Summer research at the Max Planck Institut für Plasmaphysik
2. Development of visualization tool for calculating optical configurations
3. Hyrdrodynamic studies

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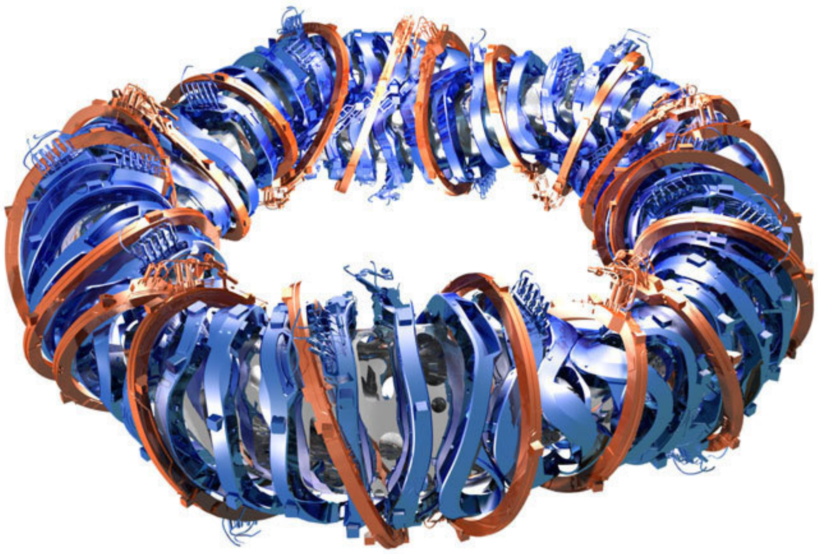
Part 1: The Max Planck Institut für Plasmaphysik Greifswald, Germany

Greifswald

Overview of the Wendelstein 7-X Stellarator

- Helias design based on quasi-isodynamic symmetry
- Coil shapes optimized to reduce neoclassical transport
- 5-fold symmetry
- 50 non-planar coils and 20 planar superconducting coils
- 10 island divertor units (currently intertially cooled) intercept edge heat flux
- Upgrade to water-cooled divertor units in 2019 for OP2



- Major radius: 5.5 m
- Minor radius: 0.5 m
- Axis magnetic field: 2.5 T
- 8 MW ECRH (current)
- ICRH & NBI (OP1.2b)

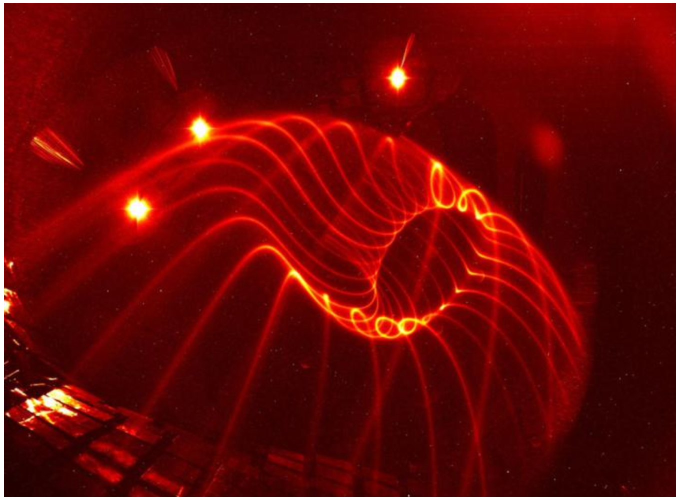
Major Research Thrusts

The Wendelstein 7-X Project:

- Show feasibility of constructing and operating a superconducting optimized stellarator
- High density operation with 140 GHz ECRH heating
- Long-pulse (~30 minute) divertor operation at 10+ MW auxiliary heating, with good divertor performance and density control
- Reduced neo-classical transport

  (tokamak-like performance)
- Stability at high β
- fast particle confinement

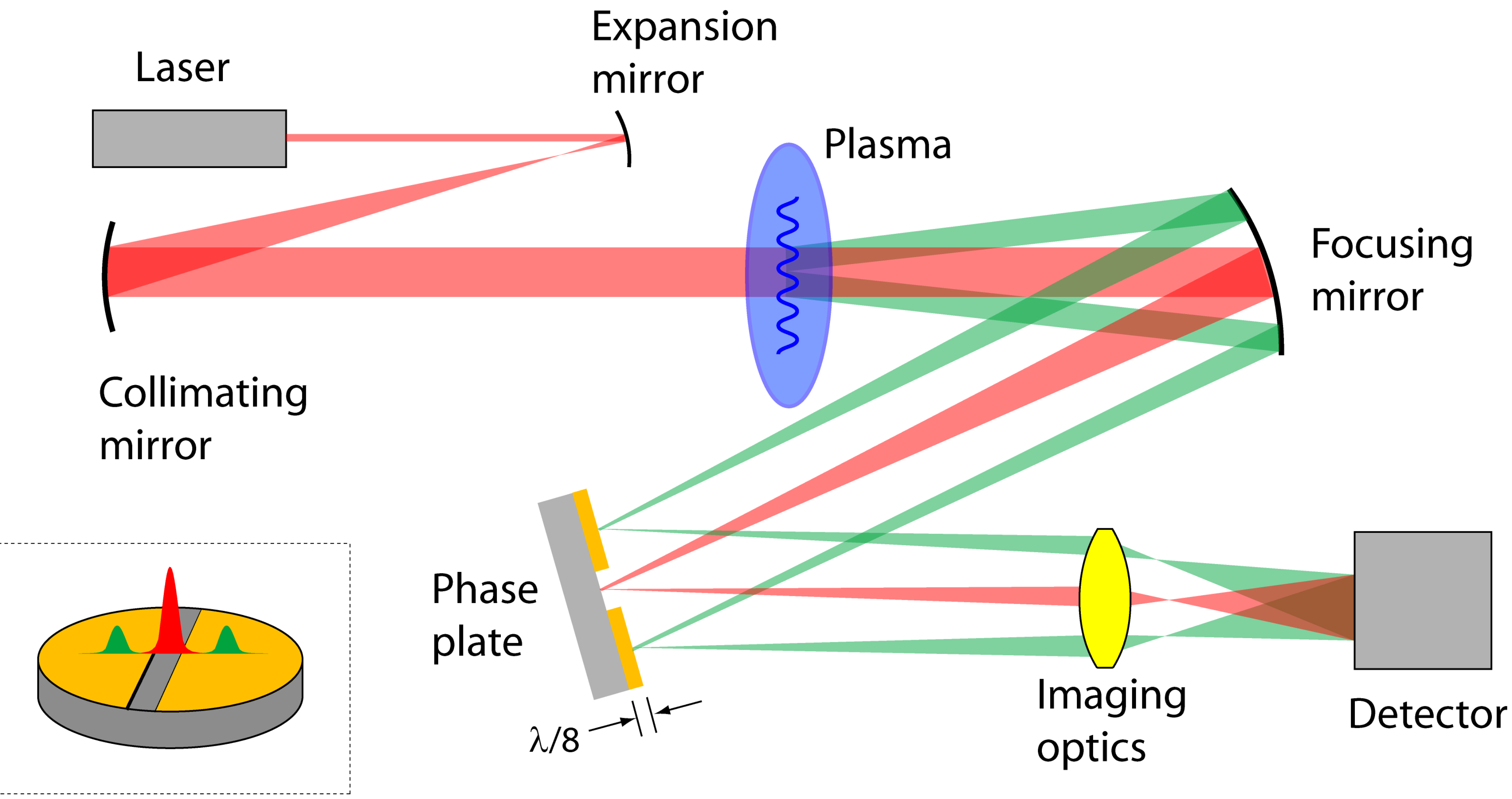
T. Sunn-Pedersen *et al.*, Nature Comm. **7**, 13493 (2016).



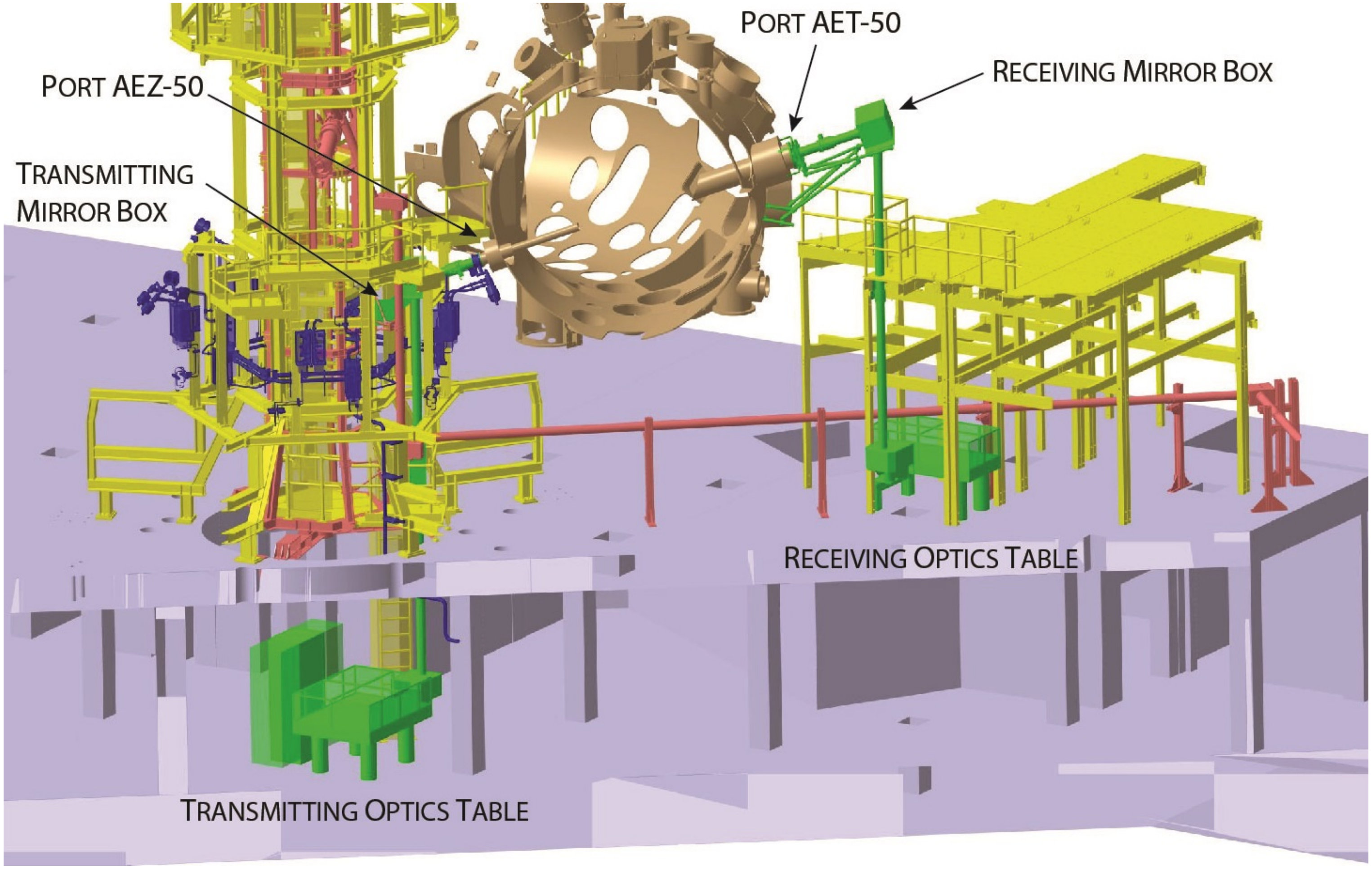
Goals of the OP1.2 campaign:

- Commission and measure new magnetic configurations
- Symmeterization of heat loads with control and error-field coils
- Density control and pellet injection
- Ion heating using NBI and ICRH (OP1.2b)

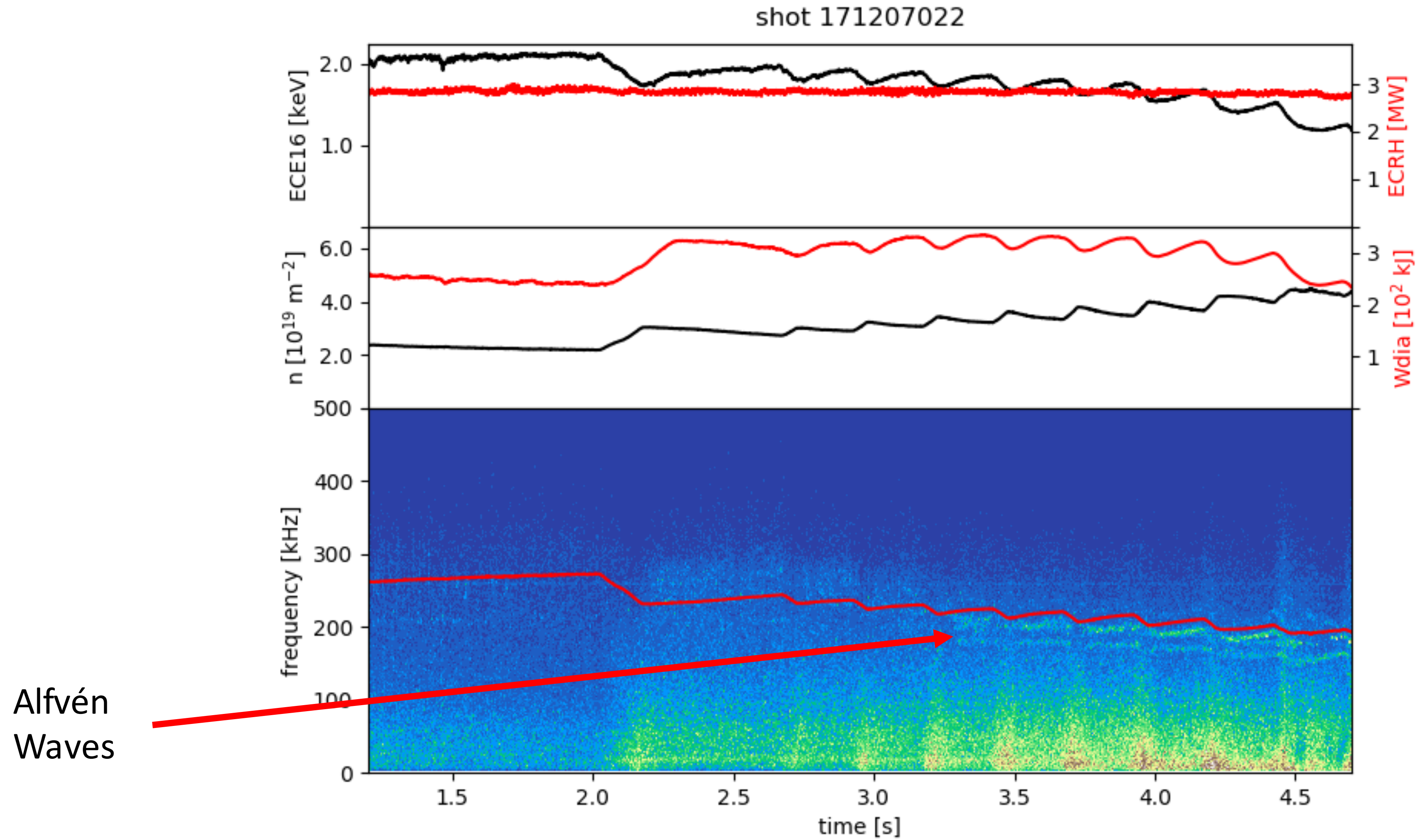
Phase Contrast Imaging (PCI) is a versatile diagnostic technique for measurement of fluctuations



Our PCI laser beam passes from the inboard side of the machine to the outboard side



Major research topics focus on turbulent energy transport and coherent mode excitation



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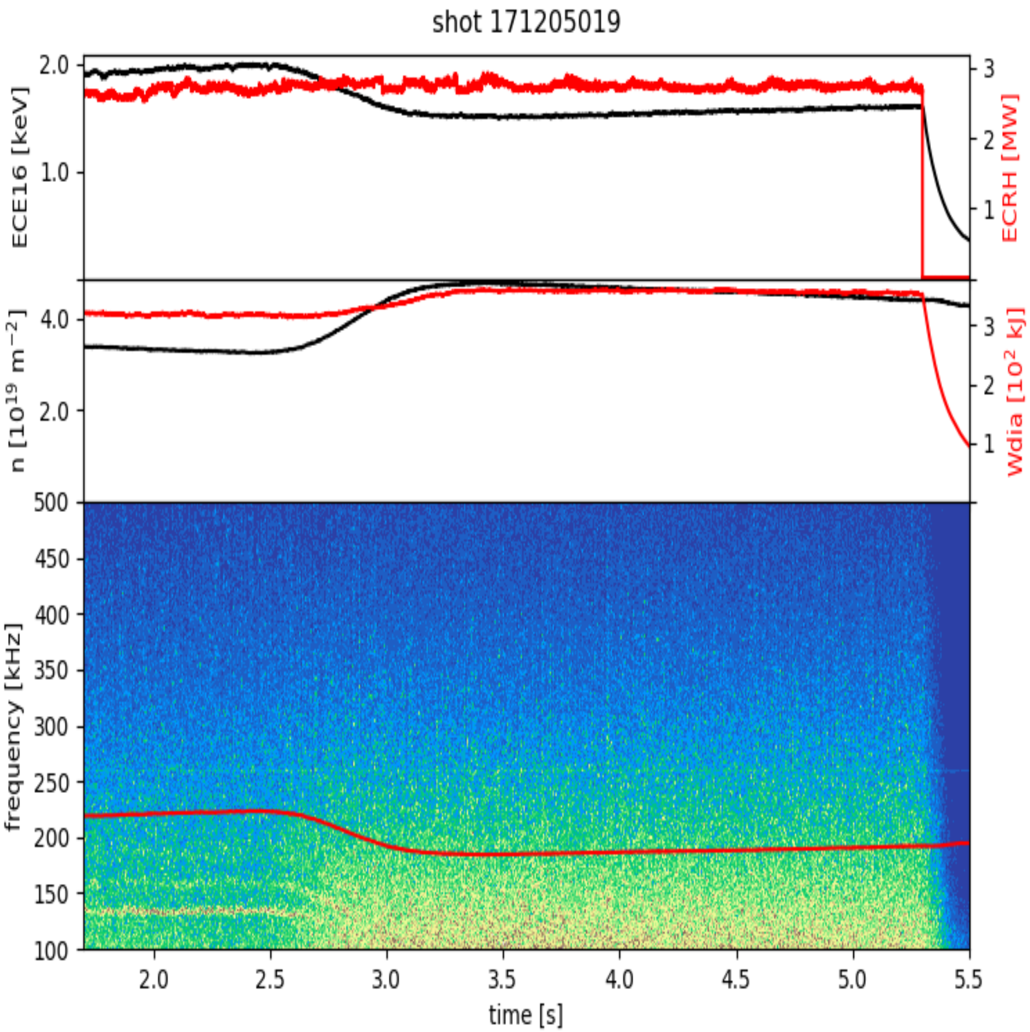
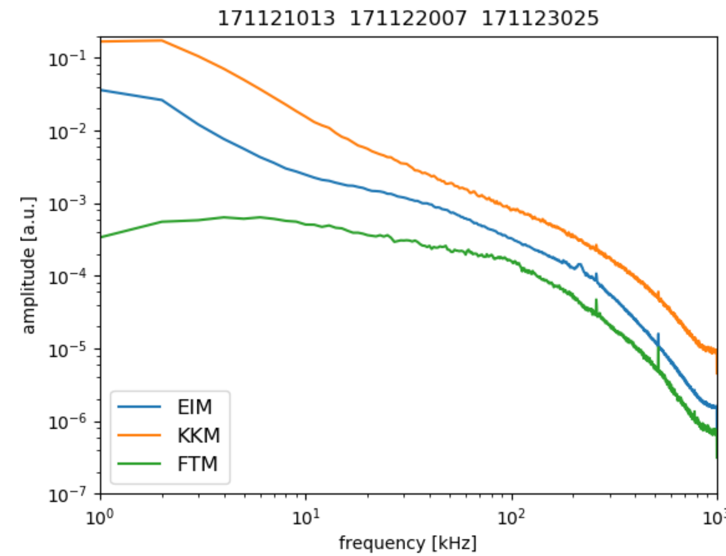




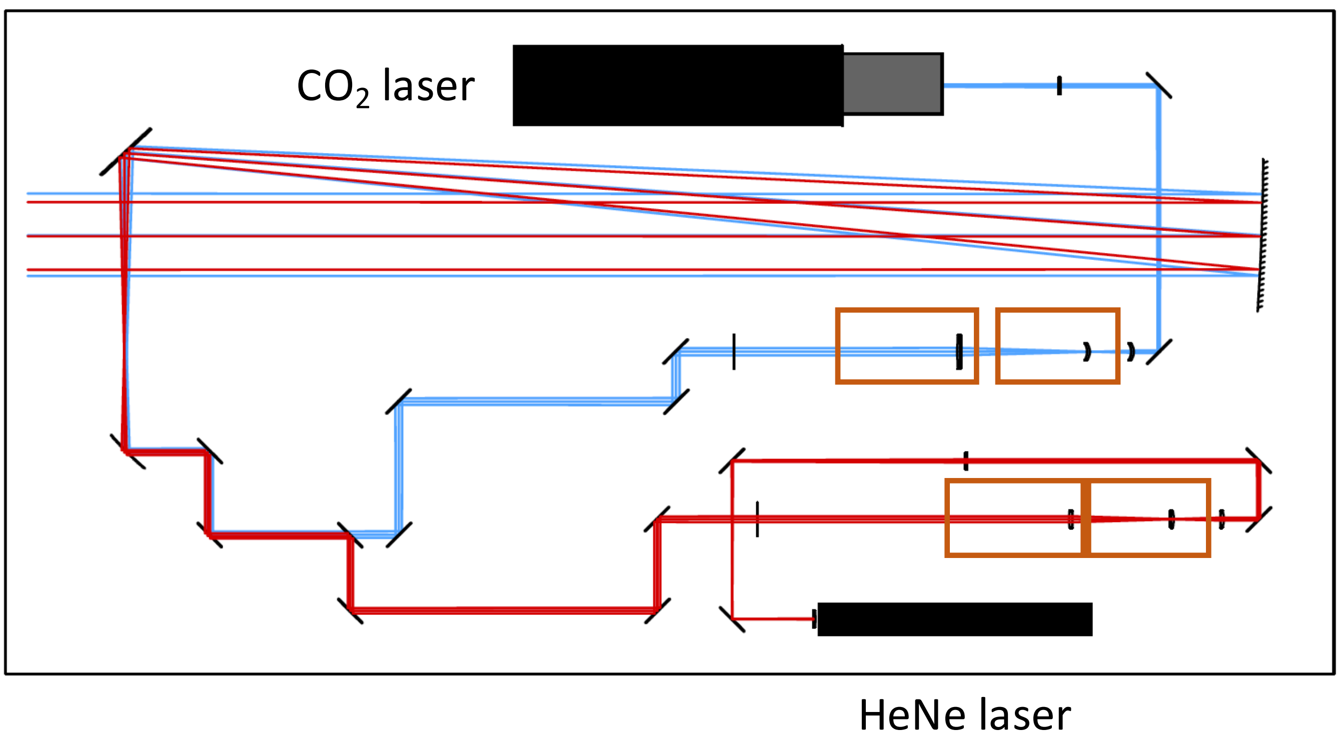
Collaborative research with IPP involves the following

- Goal of furthering data analysis toward publication quality research
- Travel to Germany during summer 2018
- Requirements:
  - Immediate need to apply for summer travel & stipend
  - Familiarity with advanced data analysis
- Good to have:
  - some familiarity with python
  - some knowledge of optics
  - Passport
- Outcomes:
  - Summer travel to Europe
  - Possible attendance at conferences in the following year
  - Possible co-authorship on publications

Part 2: Creating optical design tools

We have an optical system with multiple adjustable telescopes to allow for different beam sizes and image magnifications at the detector.

Transmitting Table Optical Layout

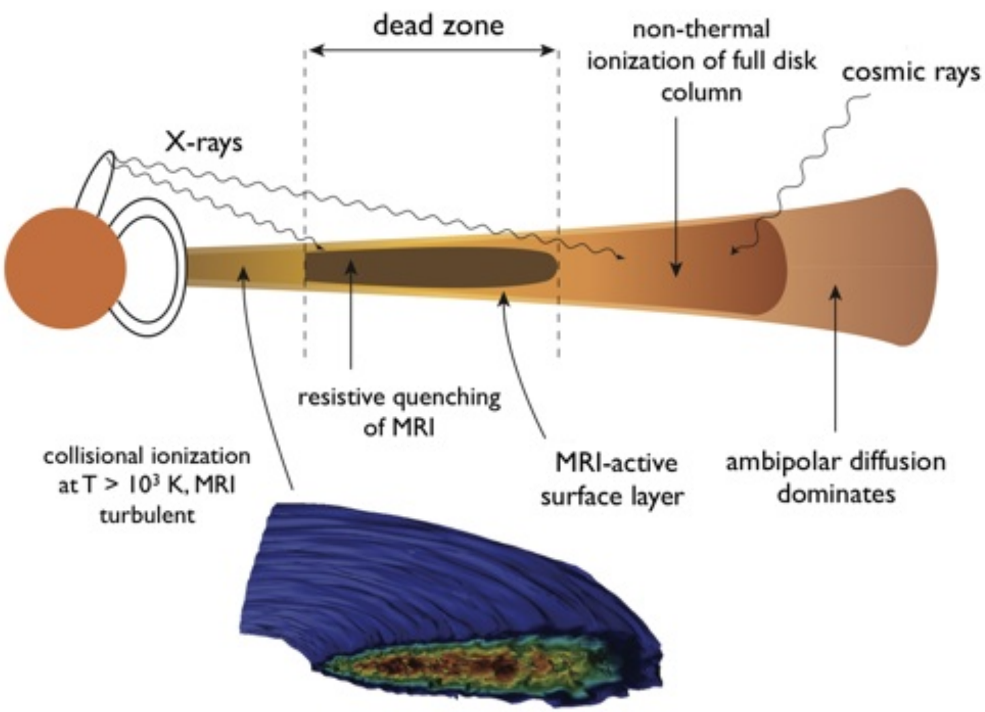


A visual interface with adjustable parameters for our optics would greatly help with alignment

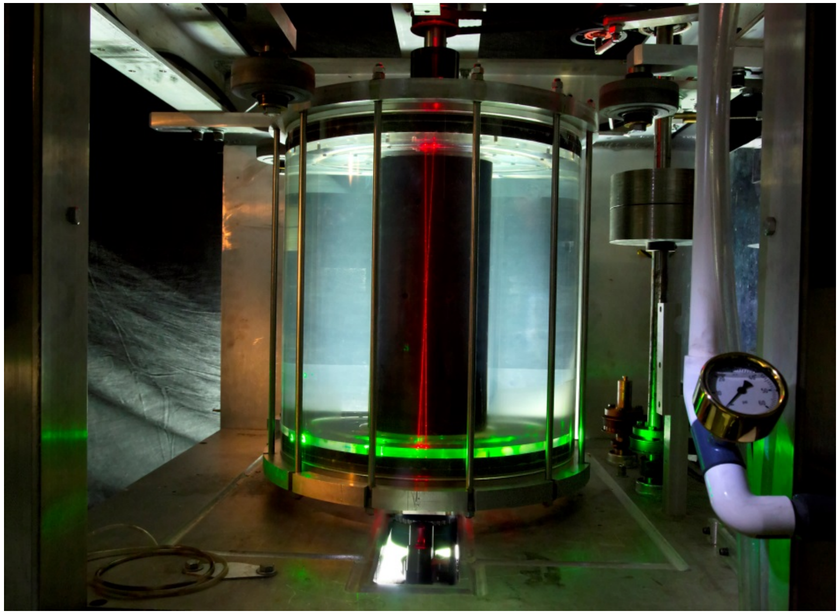
- Goal of creating a working GUI for optical layout
- Use Gaussian ray transfer calculations (linear algebra)
- Requirements:
  - access to a computer
  - some familiarity with python (or willing to learn asap)
  - some knowledge of optics
- Currently unfunded, but we can apply for funding
- Outcomes:
  - More programming experience

Part 3: Hydrodynamics

Accretion disks around proto-planetary systems



The HTX experiment at the Princeton Plasma Physics Laboratory



Many possibilities for hydrodynamic research

- Theoretical projects (angular momentum transport):
  - 3D simulations
  - boundary optimization calculations

- Experimental projects (angular momentum transport):
  - Design of new components for HTX
  - Scoping study for small experiment at SUNY Cortland
  - Analysis of old HTX data

- Ideas for new projects (fun stuff):
  - Study of zeta potentials near bubble surfaces (theory)
  - Phased array Fourier transform acoustics
  - Compressible flows