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Introduction to the Workshop, and a Brief Review of the Early Experiments on Multiple Crossing Laser Beams

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Introduction to the Workshop, and a Brief Review of Early Experiments on Multiple Crossing Laser Beams

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Purpose of the Workshop:

To review recent experiments on the laser plasma inteactions Of multiple laser beams, and encourage interaction and collaboration On future experiments in this exciting emerging area.

Format:

A series of nine, 10 min. talks followed by a 5 min. question period Covering the major topics of

1) Scattering and transfer of power by multiple beams in ICF experiments

2) Basic studies of KEEN wave physics especially as facilitated by multi-beam interactions.

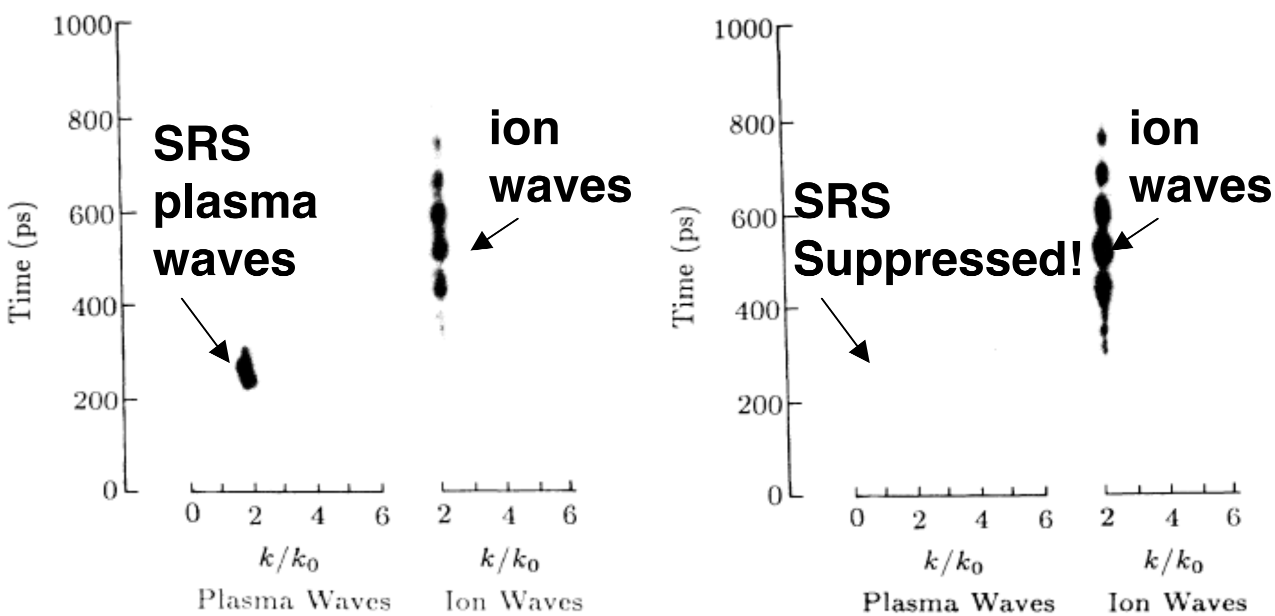
3) Compression of laser pulses by multi-beam interactions.

Brief Review of Early Multi-Beam Interaction Experiments

Early Experiments showed An Effect of An Intersecting Laser Beam on the Stimulated Scattering of a Pump

The National Ignition Facility

As early as 1987 experiments showed that a second beam Could drive large ion wave and suppress the plasma Wave producing Stimulated Raman Scattering (SRS)



Both beams are10.6 micron wavelength

plasma density < 1 x 10^18 /cm^2

Probe beam intensity ~ 1% of pump.

D. M. Villeneuve, H. A. Baldis, and J. E. Benard, Phys. Rev. Lett. (1987)

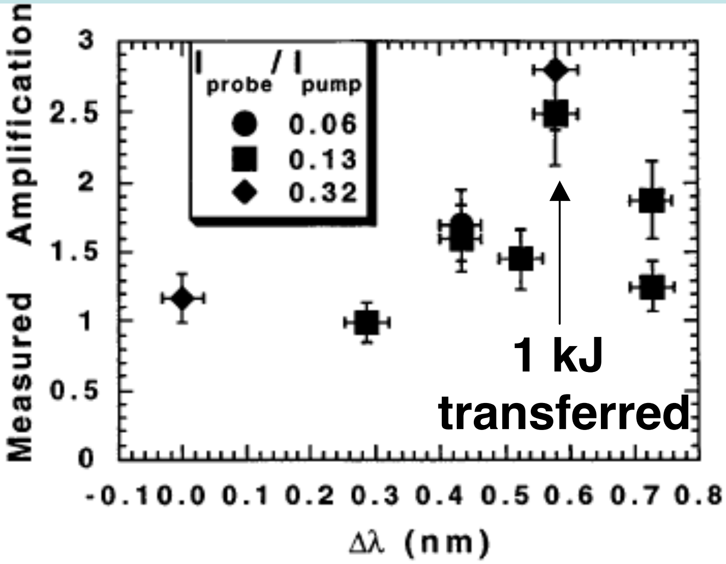
Brief Review of Early Multi-Beam Interaction Experiments

With the Advent of the NIF Program in the 1990's Multi-Beam Effects and Control by Frequency Tuning was First Addressed

The National Ignition Facility

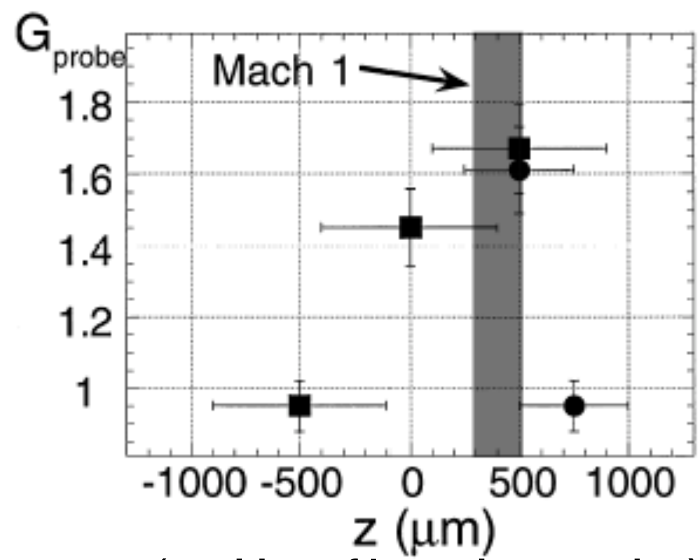
A seminal theoretical paper [1] considered how *power could be transferred between beams* when their frequency separation was matched to the frequency of the beat ion wave, stimulating new experiments:

Frequency tuned beams created, or suppressed beam amplification in a stationary plasma [2]



(frequency shift of second beam)

Foil plasmas [3] showed Mach 1 flows cause beam amplification even for single frequency beams



(position of beam intersection)

[1] W. L. Kruer et. al. Physics of Plasmas (1996).
[2] R. K. Kirkwood, et. al. Phys. Rev. Lett. (1996).
[3] K. B. Wharton et. al. Phys. Rev. Lett (1998).

Brief Review of Early Multi-Beam Interaction Experiments

More Recent Experiments showed a Probe Beams Causes Resonant and Non-Resonant Effects on Backscatter of the Pump

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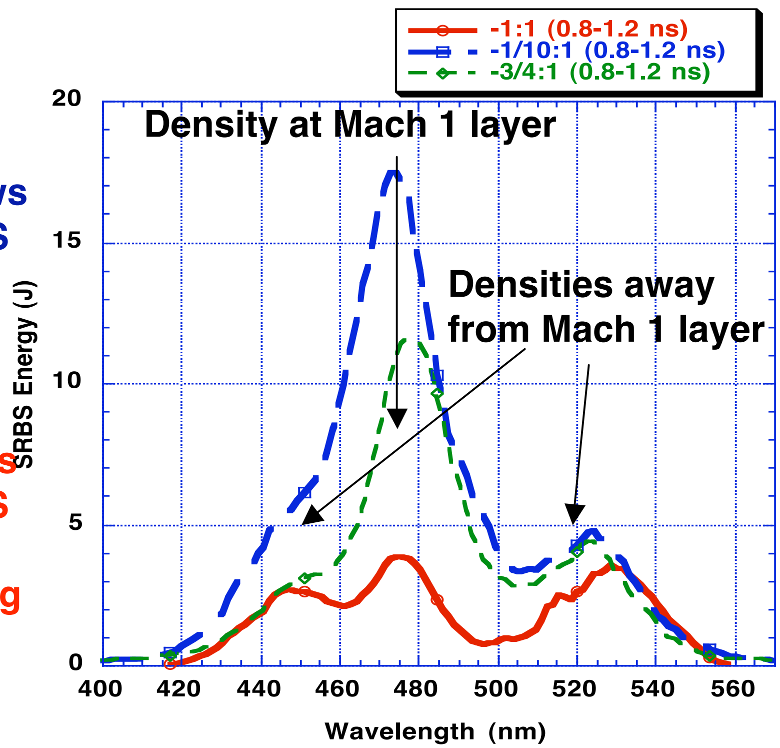
Extensive Diagnostics at OMEGA allowed simultaneous measurement of the backscatter of the pump beam and transmission of the probe beam.

The backscatter of a pump was suppressed by a probe beam of the Same frequency, both Resonantly (near Mach 1) and Non-Resonantly [1]

Blue shows pump SRS spectra with weak probe.

Red shows pump SRS spectra with strong probe



(or plasma density)

Other Expts. Have shown:

1) Power transfer between co-propagating, Single frequency beams.
2) Saturation of power transfer at large amplitude
3) Power transfer between blue and green beams via electron waves

[1] B. B. Afeyan et. al., IFSA 1999 proceedings

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Workshop Schedule

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Part 1 (10:00am - 11:00am)

Controlling Backscattering by Reducing the Coherence of Three Wave Instabilities Via Optical Mixing Generated Plasma Turbulence,
B. B. Afeyan, Polymath Research.

Experiments on the Polarization Dependence of Co-propagating Beam Energy Transfer, and Multi-beam Backscatter of Single Frequency Beams on the Omega Laser,
R. K. Kirkwood LLNL

Two-color mitigation of forward SBS induced power transfer between the inner and outer beams in ignition targets,
E. A. Williams LLNL

Crossing Blue and Green Beams and Novel Parametric Interactions: Double Raman Amplification
.D. S. Montgomery, LANL

Break (10 min.)

Part II (11:15am to 12:30pm)

Introduction to KEEN Waves and Self-Consistent Nonlinear Coherent States in Plasmas.
B. B. Afeyan, Polymath Research

Necessary Elements for KEEN Wave Experiments: Raman Cells, Gas Jets and Two Thomson Scattering Diagnostics to Capture the hysics of Driven KEEN Waves,
J. Kline, LANL

KEEN Like Waves in Electron Penning Trap Plasmas,
W. Bertsche, UC Berkeley

Modeling ultra-short pulse amplification by intersecting beams in plasmas,
J. Wurtele, UC Berkeley/LBL

Experiments on Raman Amplification of a 1 ps Beam Relevant to compression of a 1 ns Beam,
E. Dewald, LLNL