Gyrotron Technology, Inc.

GYROTRON MULTI-LAYER PROCESSING TECHNOLOGIES

Confidential

3412 Progress Drive Bensalem, PA 19020 USA 215-244-4740
gyrotrontech.com

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I. About the Gyrotron Beam

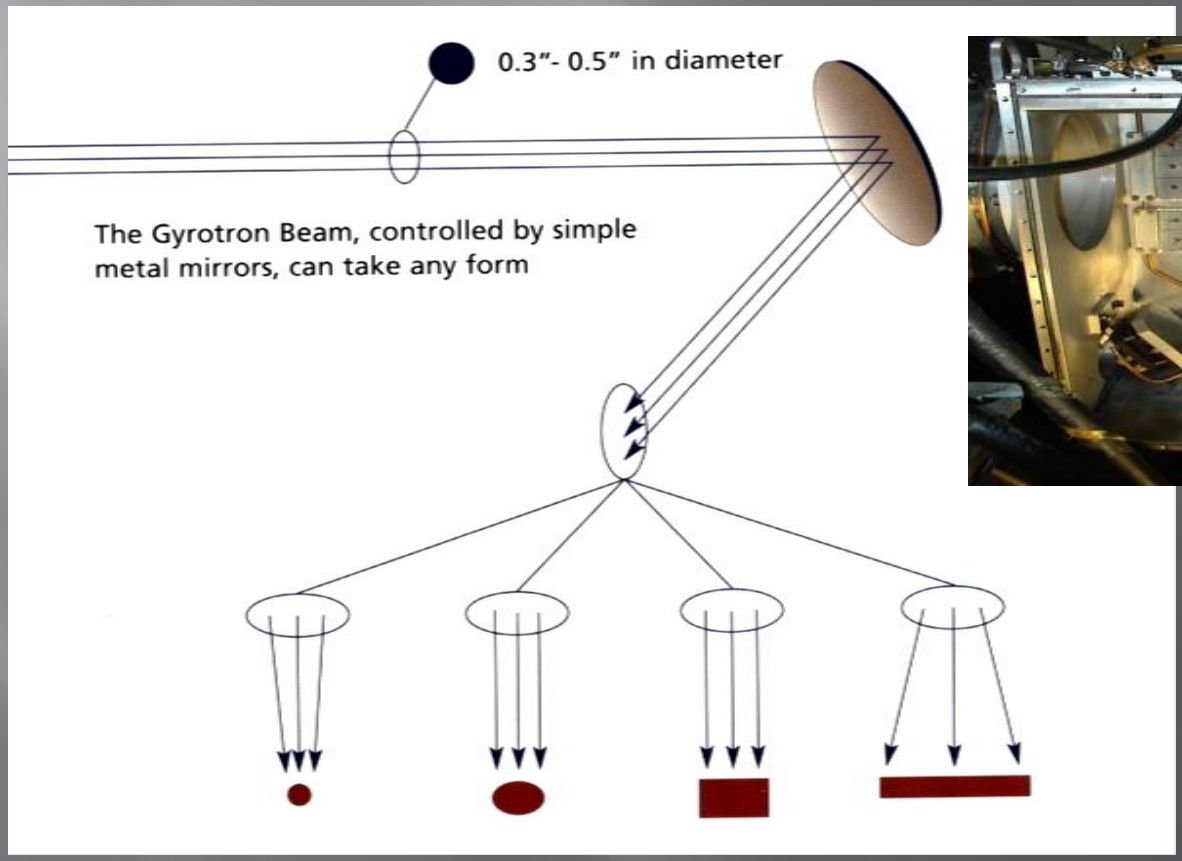
What is the Gyrotron beam?

The Gyrotron Beam is a new industrial heat source. Allows heating:

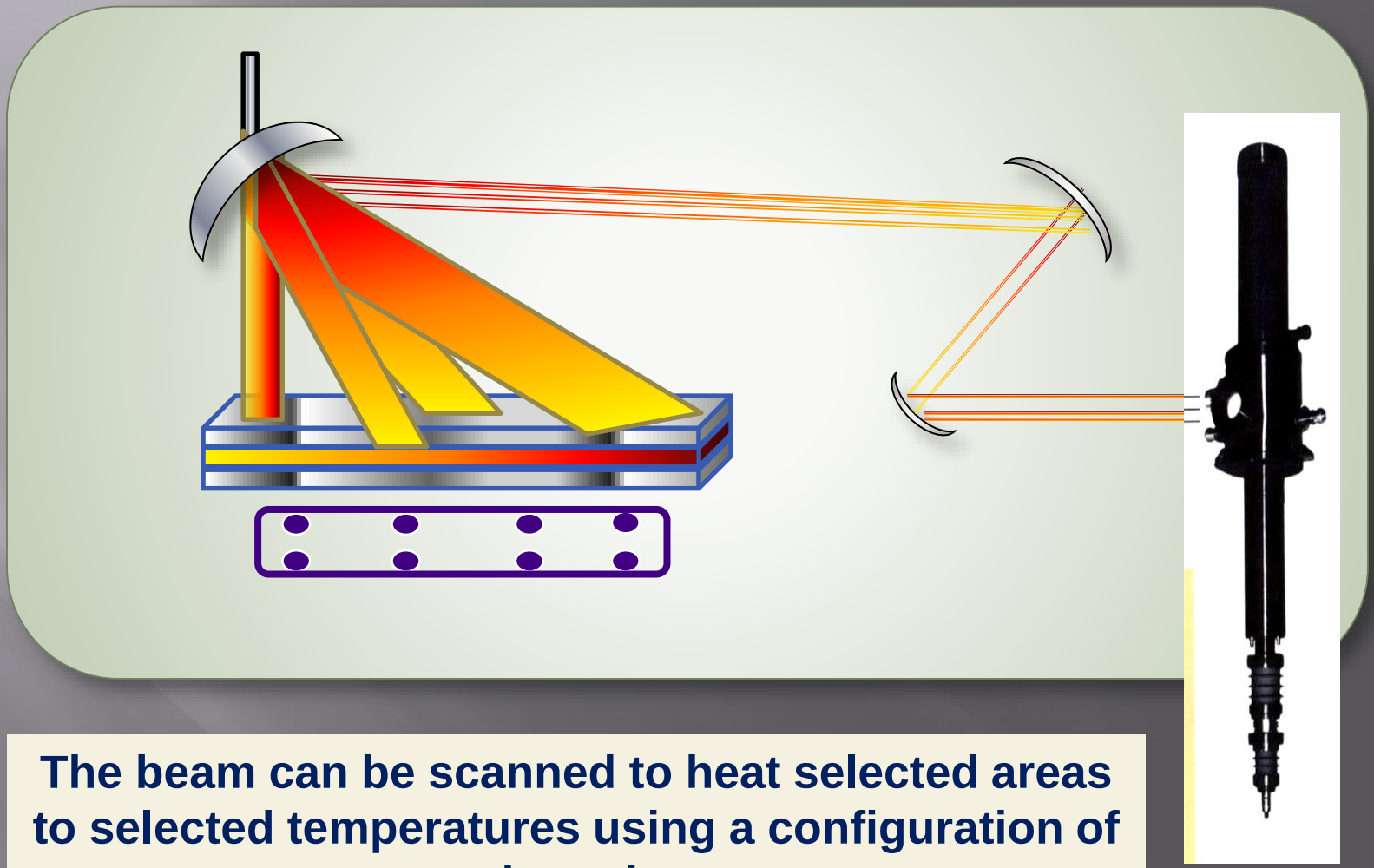
- **Ultra rapidly, with heating rate thousands of degrees per second large or small objects;**
- **To any temperature up to over 3,000^{0}C with high repeatability and accuracy better than 1%;**
- **With precise and controllable temperature distribution.**

Shaping the Gyrotron Beam

The bean can be shaped into any form – circular, strip, square, etc by using simple metal mirrors

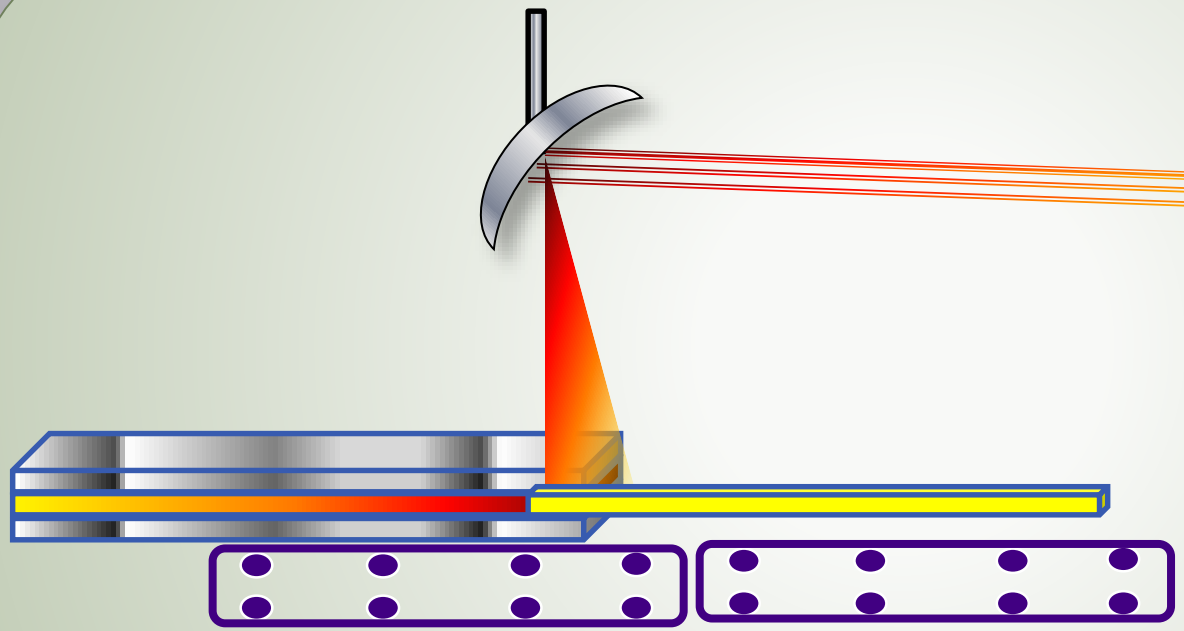


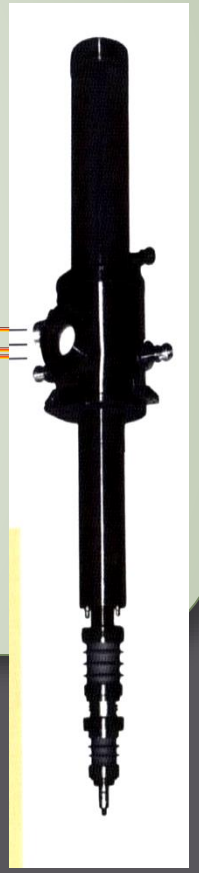
Heating Options - Scanning



The beam can be scanned to heat selected areas to selected temperatures using a configuration of moving mirrors

Heating Options - Ribbon





The beam can be formed into a ribbon shape and product can be rapidly conveyed through a stationary beam, or ribbon can be moved.

II. Gyrotron Adhesive Processing

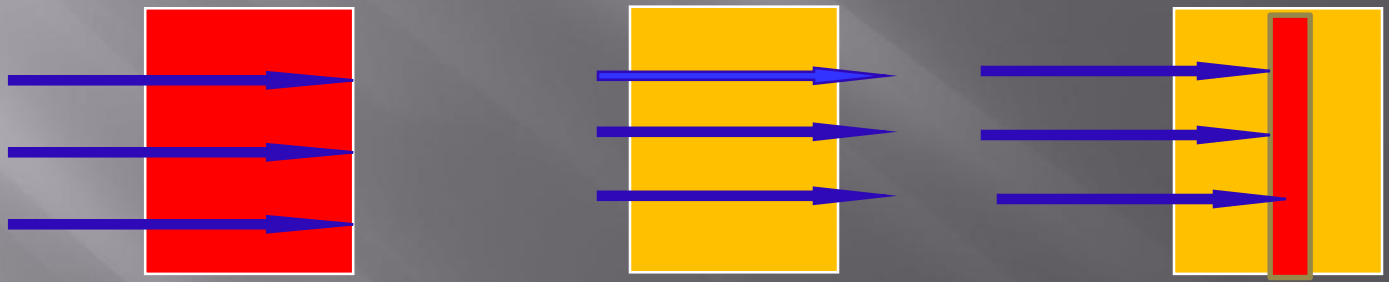
Gyrotron Beam Heating of Materials

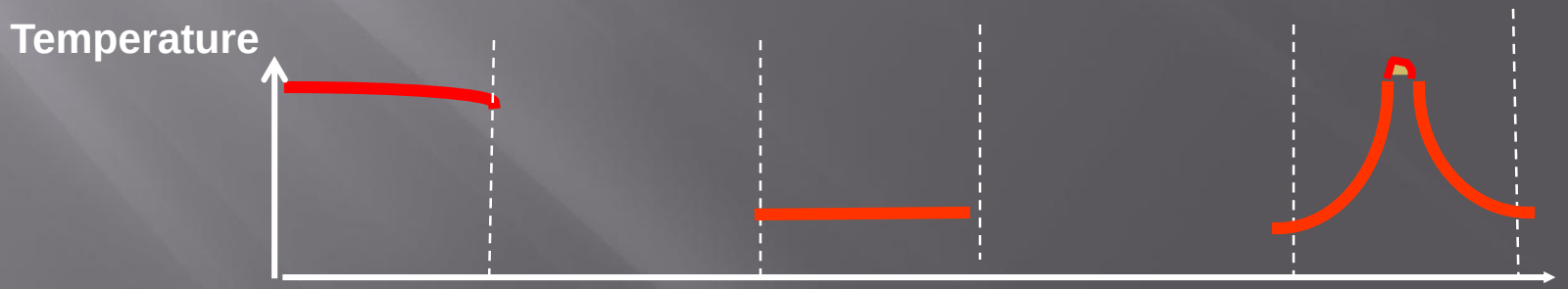
The depth of penetration (skin layer) or in another words heating ability of the gyrotron beam depends on material electrodynamics properties and the beam frequency

Absorbing material
Skin layer corresponds to material thickness

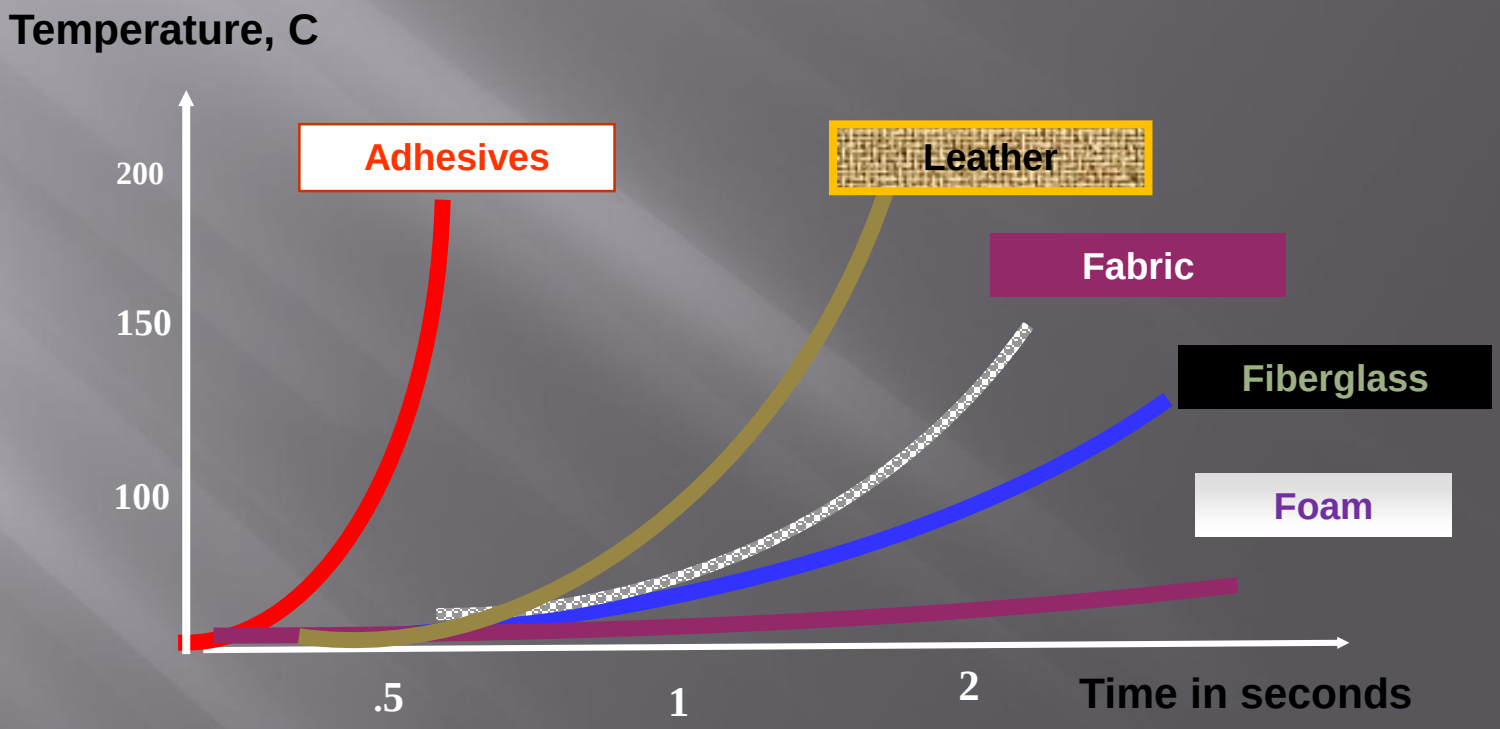
Transparent material
Skin layer is greater than material thickness

Composite material
For example adhesive inside multilayer structure





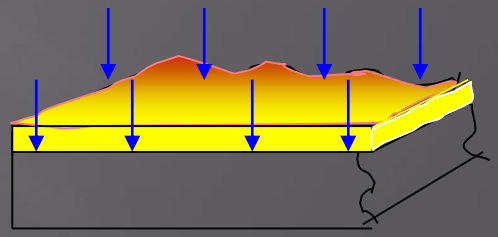
Gyrotron Material Heating Capability



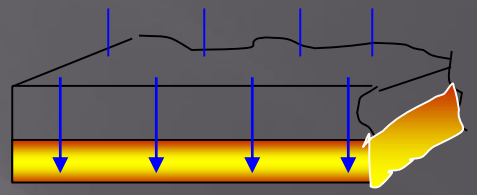
Multi-layer Processing

Gyrotron energy can be targeted in a multilayer system to heat only:

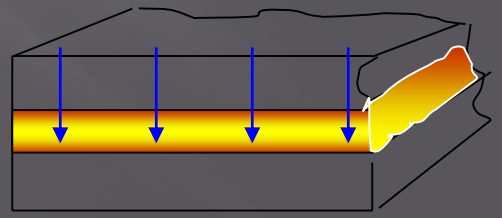
Top area (to required depth)



Bottom area (to required volume)



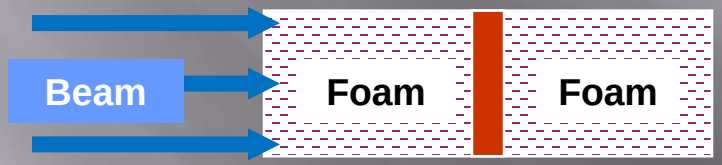
Inside (to required thickness)



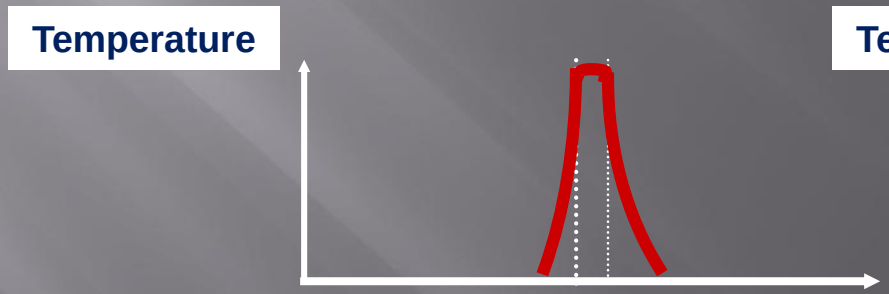
Adhesive Processing (examples)

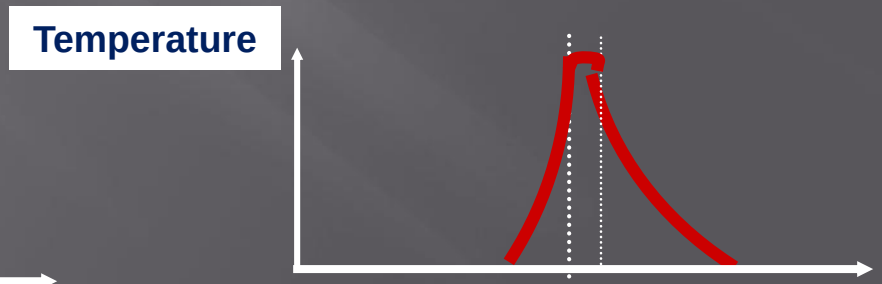
The Gyrotron Beam's ability to penetrate, heat rapidly and selectively, be focused and directed, allows rapid processing of adhesives and resins, with controllable heating of parts being joined.

Foam – Adhesive - Foam



Fiber – Adhesive - Fabric



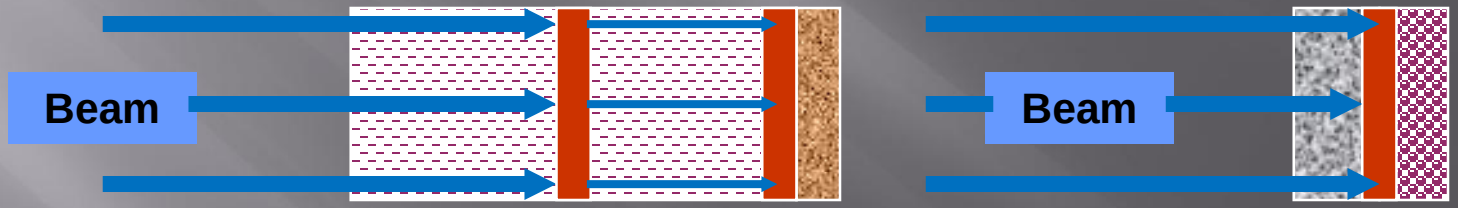


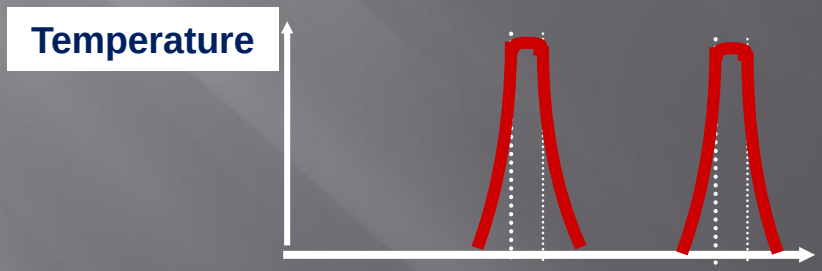
The temperature profiles after short (less than 1 second) exposure to the gyrotron beam

Adhesive Processing (examples)

Foam – Adhesive – Foam-Adhesives-Leather

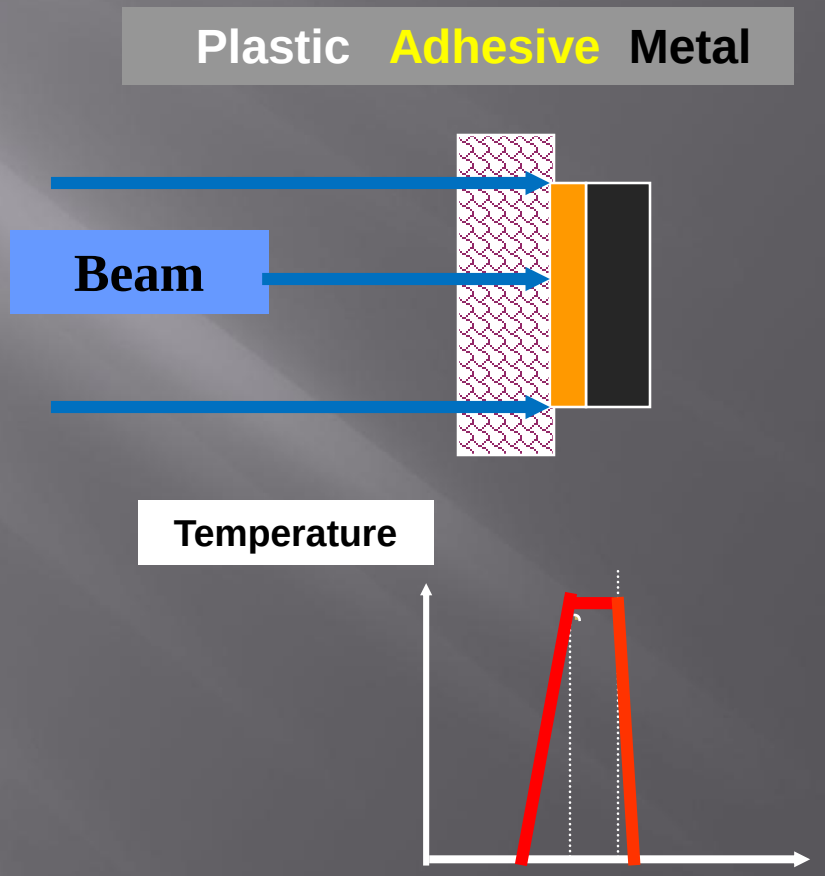
Board – Adhesive-Plastic



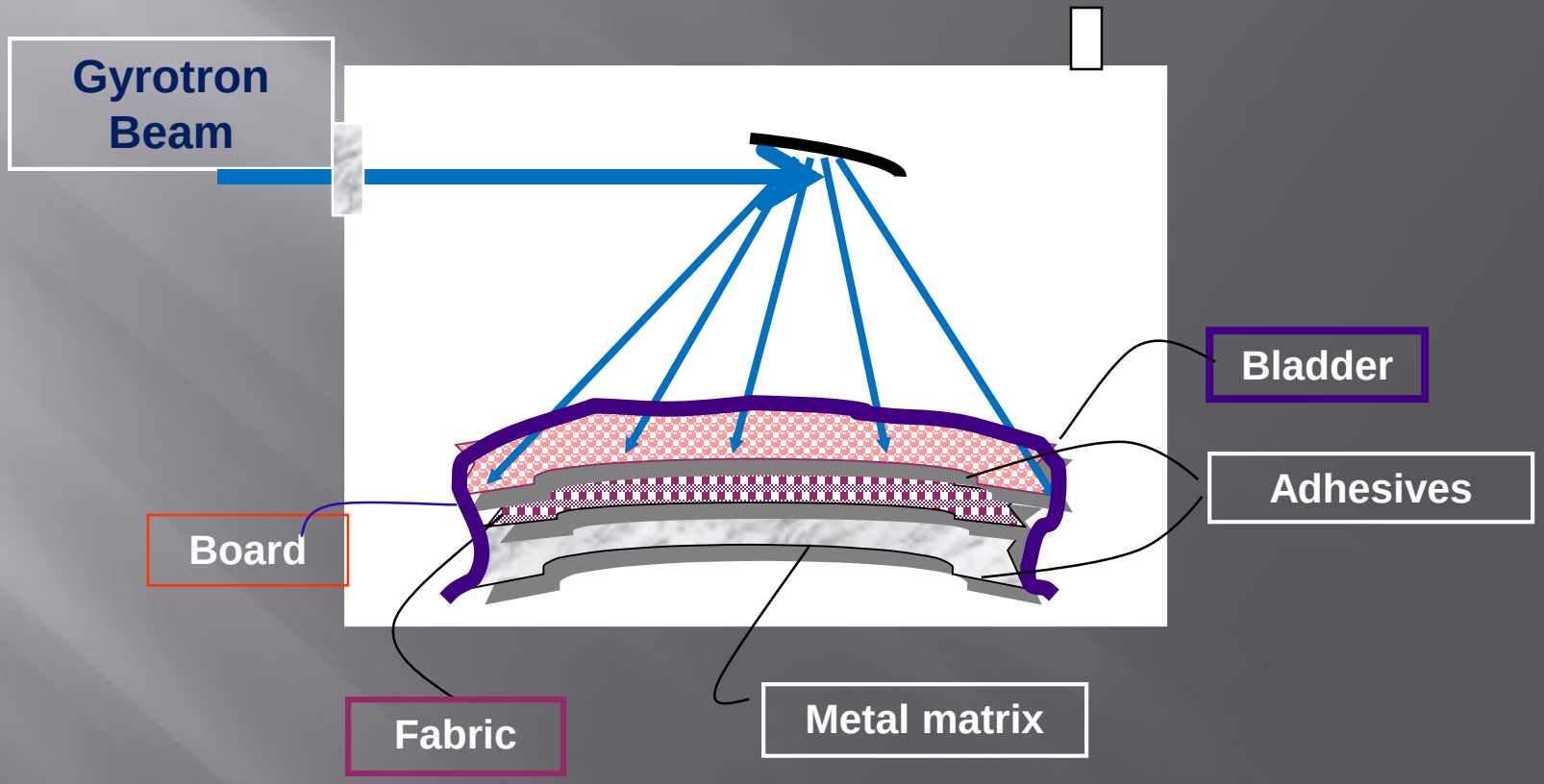


Adhesive Processing: Joining Example

Beam can be focused to size of metal part and directed to adhesive



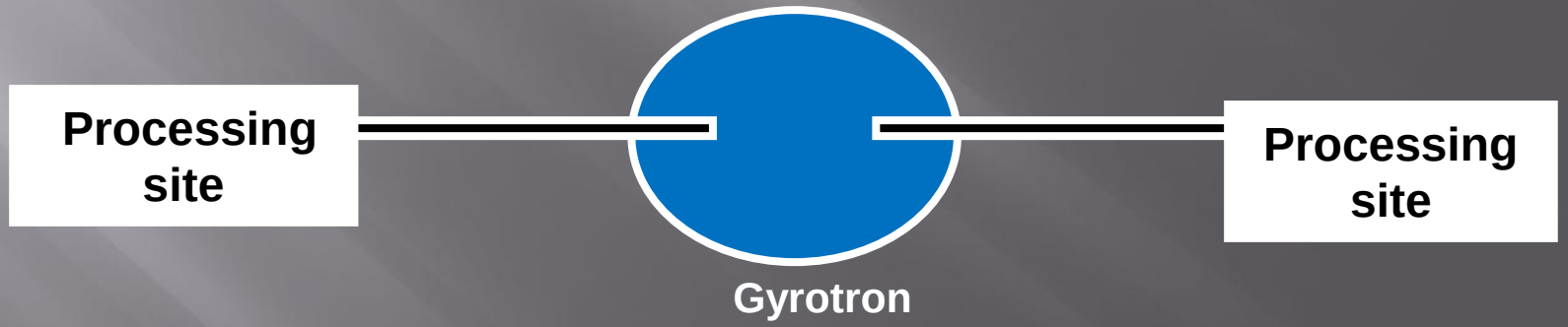
Adhesive Processing: Example of Shaped Product



Eliminates massive presses, saves energy, labor costs, and space, increases production rate

Example of Processing Layout

One gyrotron installation can serve at least two lines supporting a 5-10 second manufacturing cycle for multilayer interior products allowing annual production of millions of parts. No special cooling cycle is required.



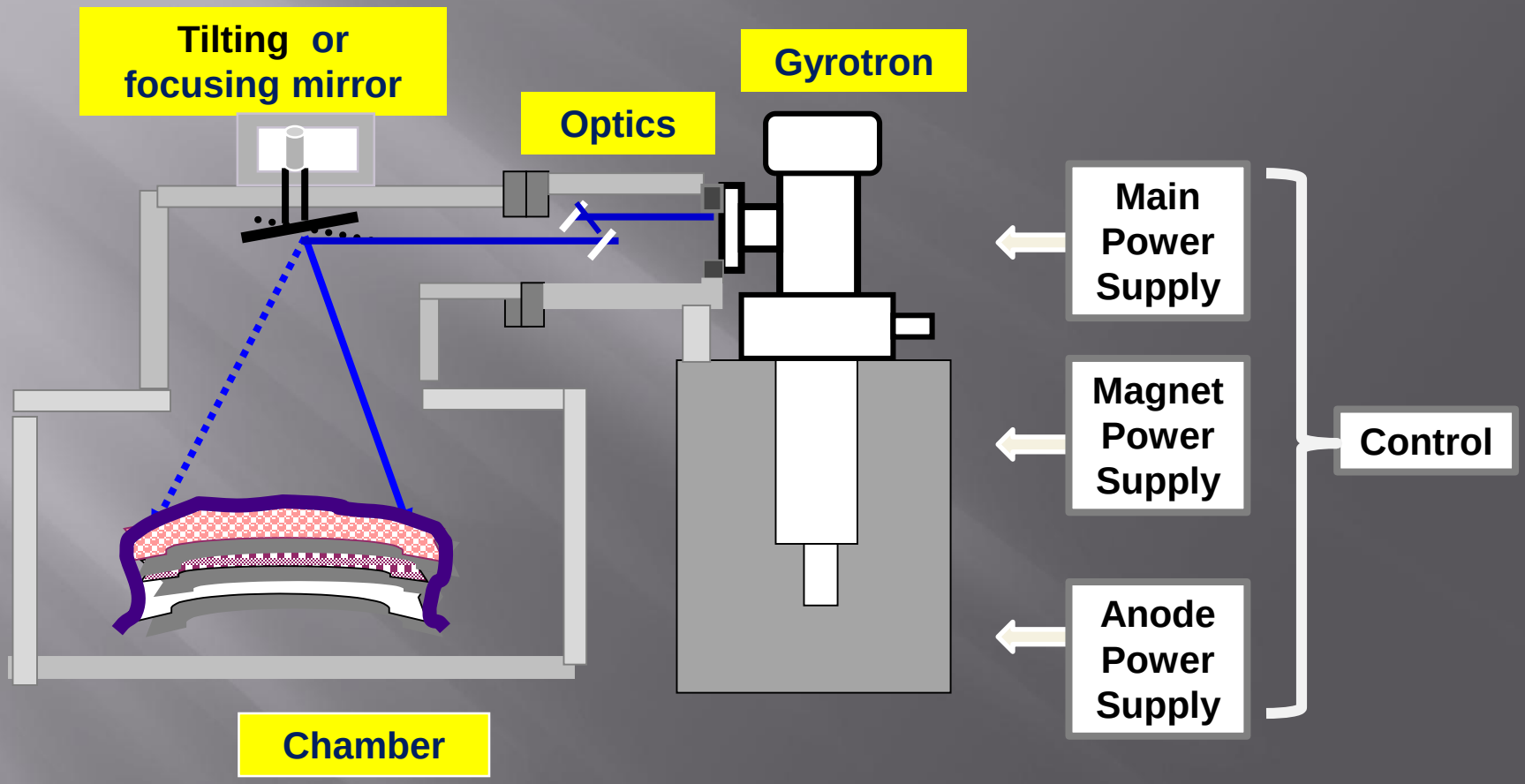
The Advantages of Gyrotron Adhesive Processing

Gyrotron Beam will:

- **Increase production rates many times by reducing cycle time and avoiding the need for a special cooling process**
- **Increase quality and yield by preventing the overheating of parts that should not be subject to thermal overload**
- **Reduce energy consumption radically**
- **Reduce footprint**
- **Reduce labor requirements**
- **Improve plant environment – reduce heat, emissions and dust**

III. Gyrotron Equipment Set

General Installation Layout



Main Installation Parts

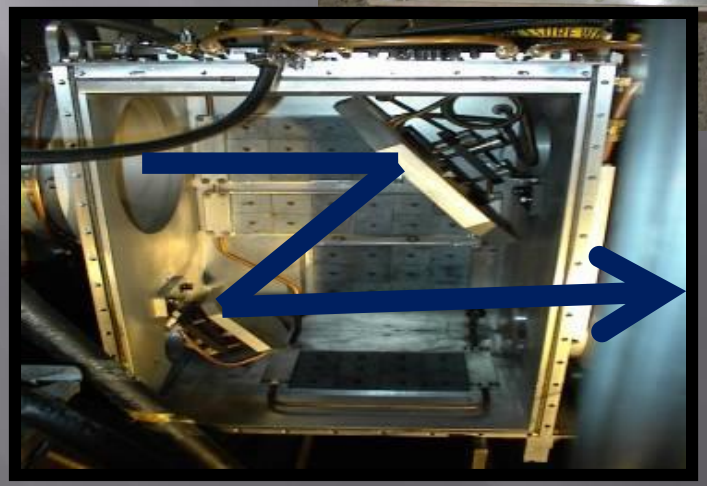
Power Supply

Auxiliary Equipment

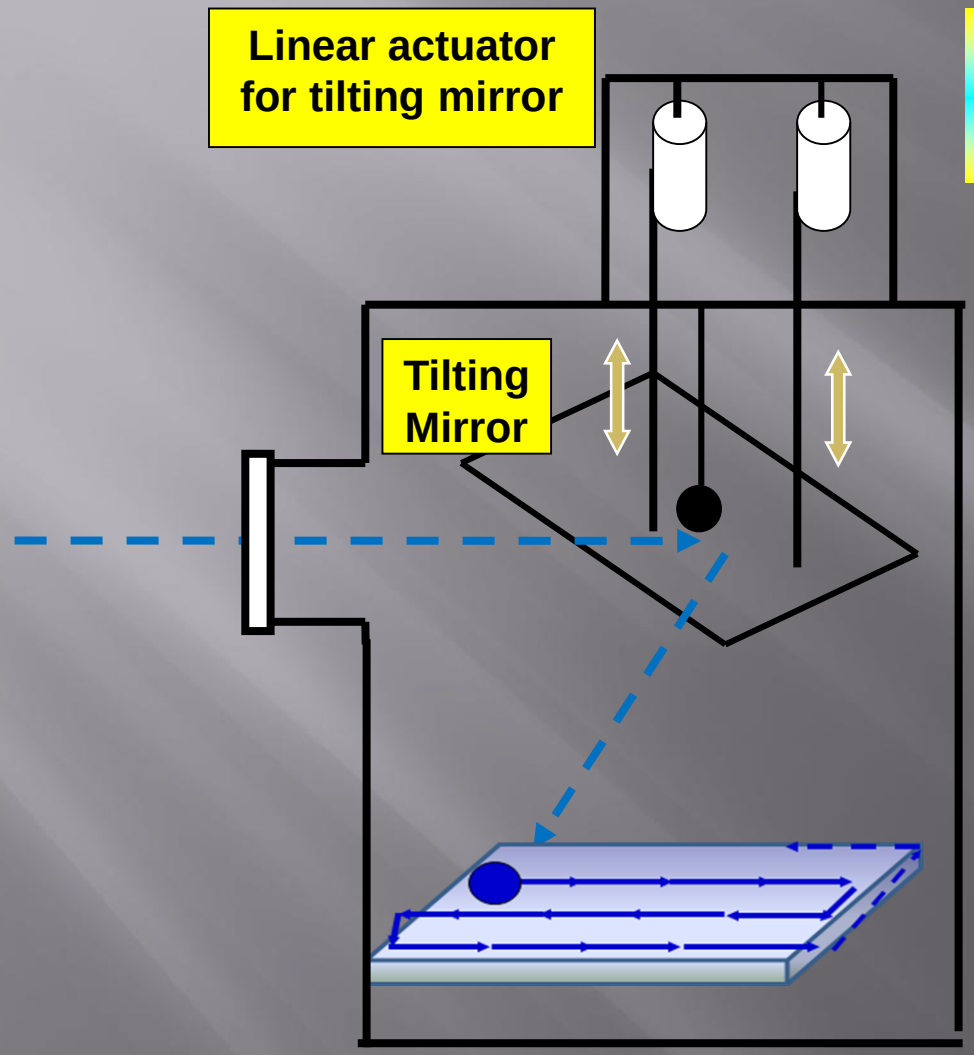
Water Collector

Control

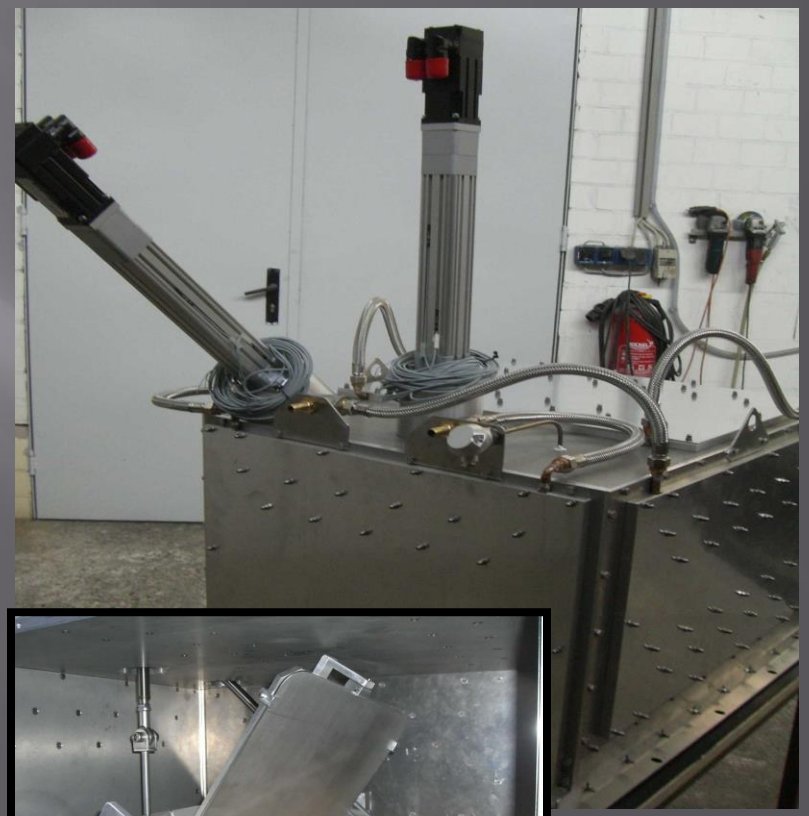
Main Installation Parts: Focusing Optics



Main Installation Parts: Scanning Optics



Trajectory of mirror motion is determined through programmable motion of linear actuators.



Moving Forward

Specification the product/s for gyrotron processing

Developing a processing approach/es

Testing the approach at GTI

Determination of economic and technical data for pilot/commercial installation

Installation design, purchasing parts, assembling, training, support, etc