

# Scientific Solutions

*Accelerating Science2Solutions™*

**[www.ssolutions.cc](http://www.ssolutions.cc)**  
**San Diego, CA 92128**  
**858-485-6411 Office**  
**858-485-9180 FAX**

# At Scientific Solutions, We

- Create and advance technologies to “see” what cannot be seen with the human eye – MRI, PET, and stand-off detection of radioactive materials and explosives.
- Advance the science of particle accelerators: ion sources, magnets, vacuum & plasmas, radio frequency (rf) power & instrumentation, diagnostic instrumentation (medical and non-medical), signal acquisition and processing, & ion implantation.
- Create technologies that excite investors, sponsors, and clients.

# Overview

**Privately Held:** Scientific Solutions is a privately held, self-funded, C-corporation located in San Diego, CA

**Founded:** February, 1994. Reorganized August 2006 as a California Corporation.

**Virtual Company:** 5 to 16 people who “formally” telecommute 80% of the time. Work together online using virtual community tools for discussion, chatting, design, analysis, and review. Core group of accelerator consulting scientists who provide expertise in specific areas.

# Leadership Team

- **Wayne D. Cornelius**

Founder, President, and CEO, has 37 years experience in theoretical and mechanical designs in engineering and physics.

Wayne led innovation in compact accelerators, FEL, ECR design and fabrication, magnets, ion accelerators, linear and circular accelerators, RF power and diagnostic instrumentation, control systems, medical diagnostics, compact MRI, proton therapy, and stand-off detection of radioactive materials and explosives.

Working for LANL, SAIC, and the Supercollider along with various start-ups, he now applies those same skills and acumen at Scientific Solutions.

He has numerous scientific publications which can be found at [www.ssolutions.cc](http://www.ssolutions.cc).

Dr. Cornelius is a unique theoretical and mechanical designer, who has the ability to merge disparate disciplines to create devices that work the first time and can be successfully monetized.

- **Susan R. Cornelius**

Founder and Chief Operations Officer is an entrepreneur with over 30 years of experience in seven different industries.

Susan has led several “lean” high-tech and life science start-ups after serving as a leader at . LANL, UCSD, and UCSD Health Systems.

For Scientific Solutions, Susan applies her experience in start-ups, finance, sales, operations/supply chain management, contracting, negotiations, quality, recruitment, commercialization, and sustaining innovation.

Susan currently coaches numerous CEO's as a “lean” start-up coach and the Vice Chair of San Diego MIT Enterprise Forum.

# Past Projects #1

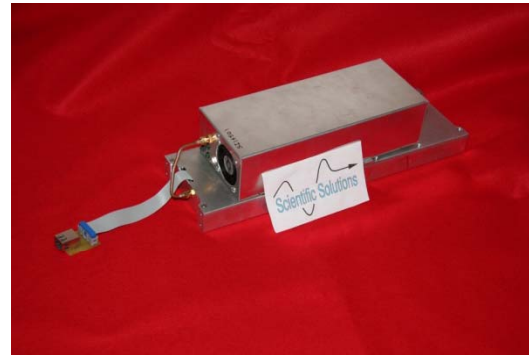
- Delivered an ECR Charge Breeder Ion Source to Texas A&M University (Proc. 18<sup>th</sup> International Workshop on ECR Ion Sources and Their Applications, Chicago IL, Sept. 2008--<http://accelconf.web.cern.ch/accelconf/> ). Project supported by US DOE Office of Nuclear Physics under SBIR grant DE-FG02-04ER84066.
- Developed a software-defined radio to deliver multi-frequency and broadband rf power to ECR systems (Proc. 18<sup>th</sup> International Workshop on ECR Ion Sources and Their Applications, Chicago IL, Sept. 2008--<http://accelconf.web.cern.ch/accelconf/> ). Project supported by US DOE Office of Nuclear Physics under SBIR grant DE-FG02-05ER84166.
- Developed design of an on-axis rf power coupler for superconducting accelerator cavities. Project supported by US DOE Office of Basic Energy Sciences under SBIR grant DE-SC0006292.
- Developed concept for a large-area (m<sup>2</sup>), flat-panel photo-sensor based on gaseous electron multiplier (GEM) technology as a potential replacement for photomultiplier tubes in radiation detectors (project supported by US Department of Homeland Security).

# Past Projects #2

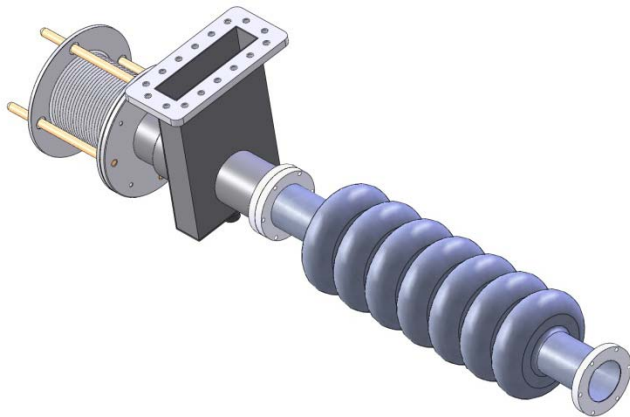
## Charge-Breeder



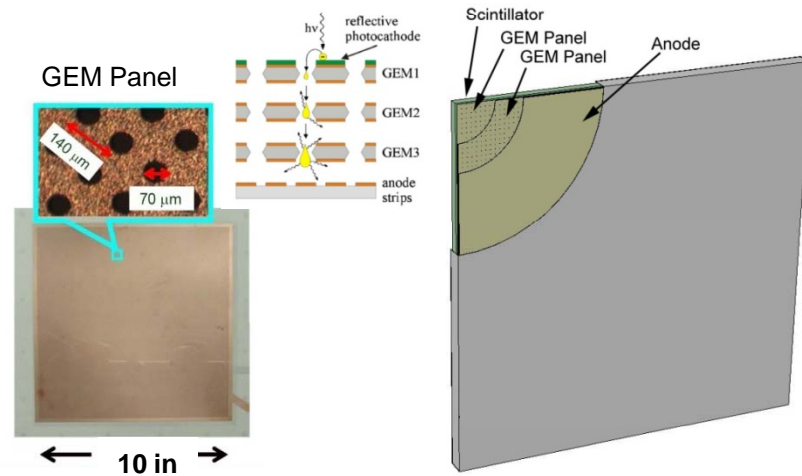
## Multifrequency RF Source



## RF Power Coupler



## Flat-Panel GEM Photodetector



# Past Projects #3

- Scientific Solutions analyzed the interaction of beam ions with vacuum windows of radio-isotope production targets.
- Scientific Solutions designed and implemented a computer control and data acquisition system for a photocathode electron gun.
- Scientific Solutions designed and developed components for MRI systems (magnets, rf coils, gradient coils, etc.).

# Current Projects

- Scientific Solutions developed the concept and patented a miniature ECR ion source. Fabrication and testing of prototype sources is currently funded by the US DOE, Office of Nuclear Physics under SBIR grant DE-SC0004512.
- Scientific Solutions is currently validating designs for superconducting magnets and systems based on MgB<sub>2</sub> superconductor.

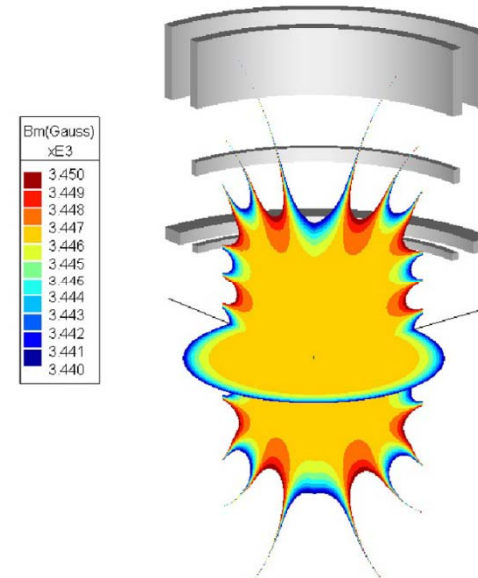


# Overview

## Mini ECR Source



## Superconducting MRI Magnet



# MiniECR Project Overview

## ***Miniature ECR Source for Industrial Applications and Research***

Project supported by the U.S. DOE Office of Nuclear Physics under SBIR grant ER-SC0004512.

# Phase I Program

With funding from US DOE, designed and fabricated two miniature electron-cyclotron resonance (MiniECR) ion sources per US Patent 6,812,647.



# Phase I Program

Benefits of smaller size include:

- Reduced rf power
- Compatible with portable systems
- Easily replaceable
- Can make “arrays” of sources to provide particular beam properties

# Phase I Program

Two sources needed for rf testing and evaluation.

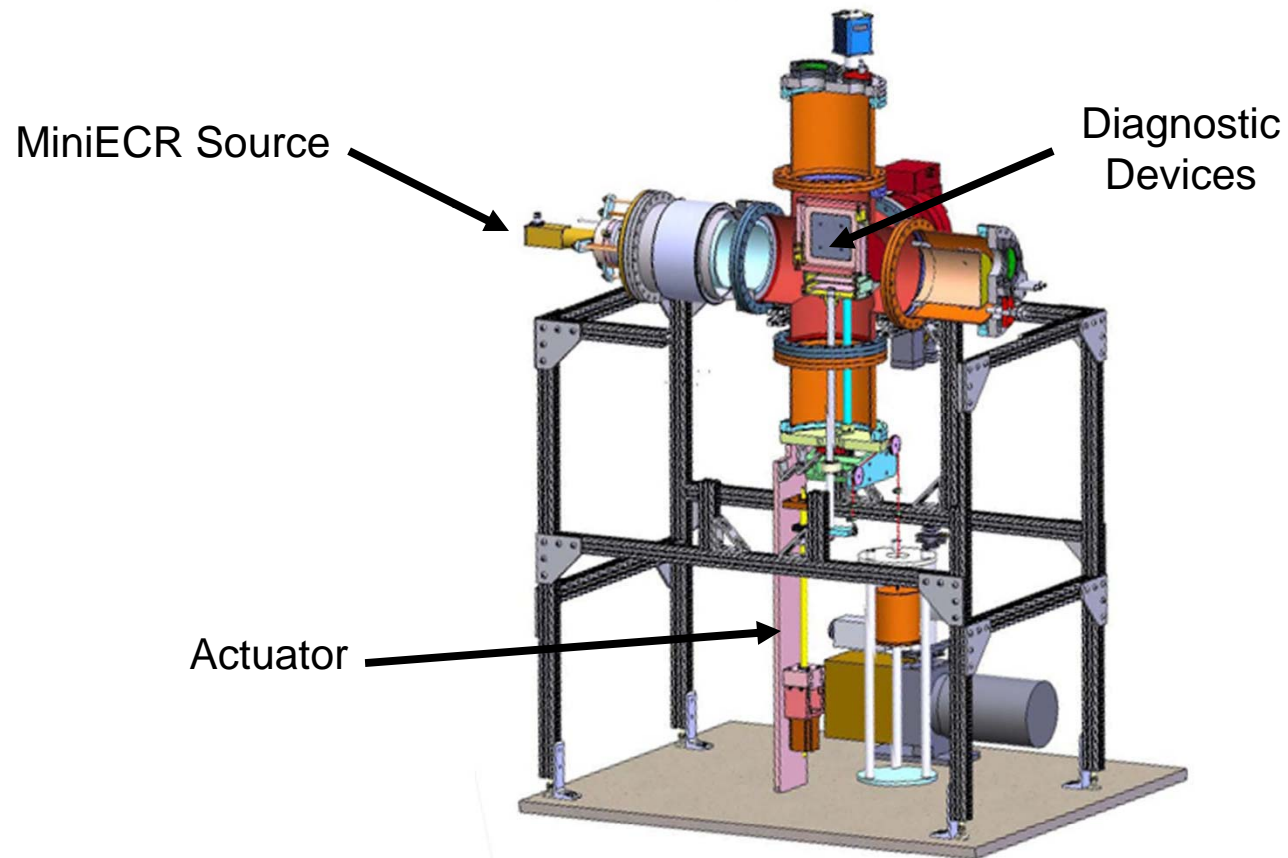


# Phase II Program Goals

- Develop capability to measure beam quality (emittance and species ratio).
- Optimize proton beam quality as a function of rf power and frequency, gas pressure, plasma chamber dimensions, magnetic field profile, etc.
- Measured performance characteristics are critical for commercializing the source (*Performance comparable to the LEDA source at LANL is expected*).

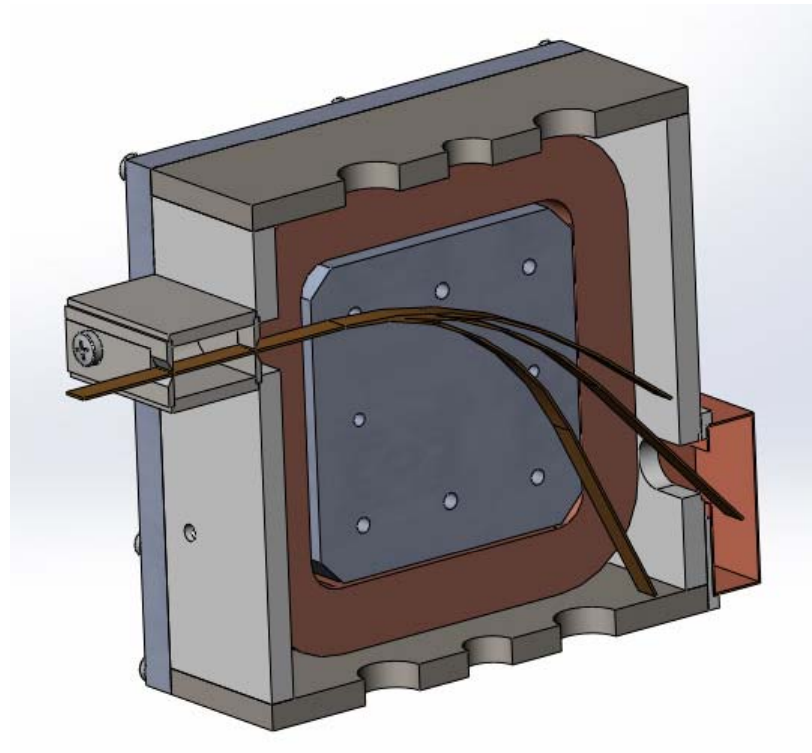
# Ion Source Test Stand

## Diagnostics Mounted on Linear Actuator



# Beam Quality Diagnostics

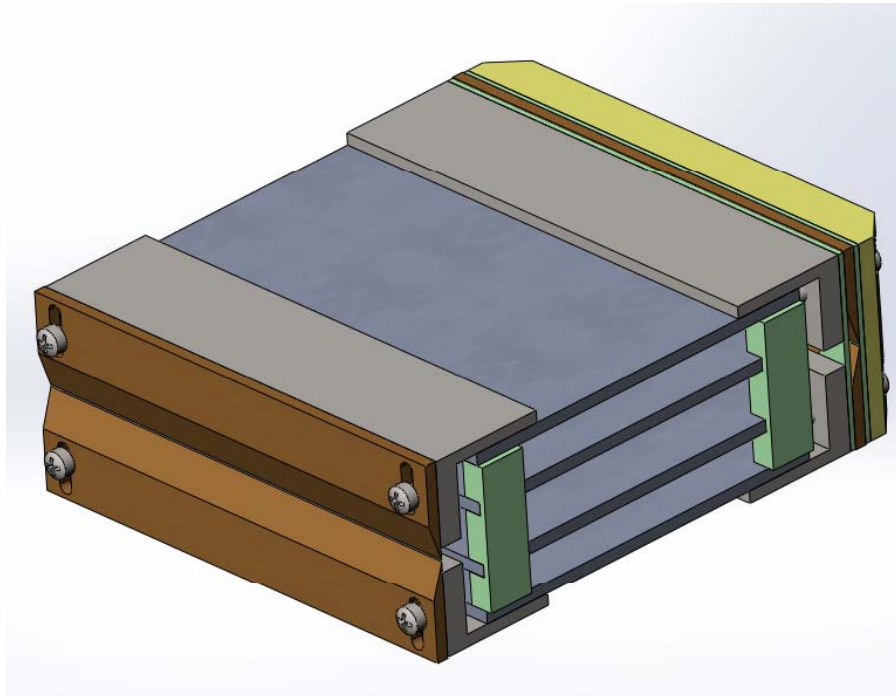
- Species Analyzer





# Beam Quality Diagnostics

- Emittance Scanner



# Progress to Date

- Design of all components is complete.
- The computer control and data acquisition/analysis system is ready for connection and debugging.
- The ion source test stand is being assembled.

# Testing Plans (Argonne)

## Testing at Argonne National Laboratory

- Measure performance with heavy ions (O, Ne, Ar, Kr, Xe).

### Goals:

- Qualify source as 1<sup>+</sup> ion source for charge breeder tuning
- Qualify source performance for ion implantation.
- Measurements needed to design array of sources for ion implantation.

# Testing Plans (Adelphi)

## Testing at Adelphi Technologies

- Measure performance with deuterium ions.

## Goals

- Qualify source performance for neutron generator applications.
- Adelphi is one of several organizations interested in the MiniECR source for neutron generators.

# Commercialization Plan: #1

Our research, networking, and scientific relationships have helped us establish the foundation of our commercialization plan.

The MiniECR source is designed to generate high currents of  $1^+$  ions, these applications are found in:

- Proton therapy
- Semiconductor manufacturing
- Particle accelerators
- Surface engineering and optical coatings

# Commercialization Plan: #2

- Focus on ion implantation in the semi-conductor industry and particle accelerator research.
- Ion implantation drives particles at high velocity so that kinetic energies drive them close enough for a strong interaction to take place and bind them together.
- Collaborating with two industrial partners to define the attributes required of an implantation source.
- Current implantation sources operate 24/7. Failure of a source interrupts the factory production line (\$\$).
- Our source is predicted to solve some of the challenges with reliability, maintainability, simplification, and cost experienced by our current target market.

# Commercialization Plan: #3

- Scientific Solutions thanks the DoE for the opportunity to work with Dawnbreaker and Richard Smerbeck to develop additional ideas for commercialization within the semiconductor manufacturing industry.
- We have been given a “green” light!
- The focus is on equipment suppliers to that industry.
- There is interest!

# Summary

Note: The Mini ECR source is part of a portfolio of devices currently under development at Scientific Solutions:

- ***Ion Sources***
- ***Low- $\beta$  accelerators***
- ***SC Cavities***
- ***Superconducting Magnets***
- ***High Gradient Accelerator Concepts***
- ***High Power uw and mmw RF Sources***

This portfolio will be used to create a new generation of accelerators.