Segmented Germanium Array SeGA Service Level Description

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Revision History

Revision	Issued	Changes
R001	2 December 2020	Original issue

Authorizing Document

None.

Authorized Documents

None.

Authorized Committees and Boards

None.

Named Program Roles

None.

1 Objective of this Service Level Description (SLD)

This document describes the level of service FRIB will be able to provide for the operation of the Segmented Germanium Array SeGA and for user support for experiments with this scientific instrument.

2 Abbreviations

ADC – Analog to Digital Converter

DDAS – Digital Data Acquisition System

SLD – Service Level Description

SeGA - Segmented Germanium Array

TDC – Time-to-Digital Converter

3 SeGA Overview

The Segmented Germanium Array (SeGA) consists of a maximum of eighteen 32-fold segmented germanium detectors [1]. The array is primarily designed to detect gamma rays from nuclei that decay in-flight at velocities of 20 to 40% the speed of light. Position determination is made from that analysis of the energy deposition patterns of the gamma ray scattering in the segments. The central-contact energy (the total energy detected in the detector) is Doppler corrected based on the position determination. The detectors themselves can be arranged in several different configurations, and there are several standard frames available.

4 Standard Configuration

4.1 Physical Configuration

Several frames and detector holder types are available for setting up following array configurations. Photographs of those configurations are shown in the Appendix. Energy resolutions are quoted for in-beam gamma rays after Doppler reconstruction (FWHM).

- c**lassicSeGA** (18 detectors at 20 cm from the target)
  Typical application: High-velocity (>0.3c) in-beam
  Typical energy resolution: 2-4%

- **plungerSeGA** (16 detectors in 2 rings [30^o, 30cm] and [140^o, 23cm])
  Typical application: Lifetime measurement with plunger method

- **miniSeGA** (6 detectors surrounding at 5 cm from the target)
  Typical application: Low-velocity (<0.1c) in-beam
  Typical energy resolution: 1.5-2%

- **betaSeGA** (16 detectors in two rings surrounding at 8.6 cm the target)
  Typical application: Stopped beam spectroscopy (e.g. beta/isomer decay) or low-velocity in-beam
  Typical energy resolution: 3.5 keV @ 1.3 MeV (for beta decays)
  Note: This setup replaces a compact *betaSeGA consisting of 12 detectors at 8.5 cm*

- **deltaSeGA** (18 detectors at 21 cm distributed over nine separate angle groups)
  Typical application: Angular dependence of gamma radiation
  Typical energy resolution: 2-4%

4.2 Operational Features

Full-energy peak efficiency for the different array configuration are given in the table:

Energy [keV]	classicSeGA	MiniSeGA	betaSeGA	deltaSeGA
100	8.5%	27.6%	20.5%	7.8%
250	5.5%	17.7%	18.6%	5.1%
500	3.7%	11.7%	11.7%	3.4%
1000	2.3%	7.3%	7.4%	2.1%
2000	1.4%	4.2%	4.6%	1.3%
3000	1.1%	3.0%	3.5%	1.0%

4.3 Electronics and Data Acquisition

All low voltage and high voltage infrastructure for biasing the Germanium detectors will be provided.

A complete data acquisition system based on conventional analogue electronics (shaper, TDC, ADC) is available and supported within the framework of this SLD. However, since 2011, experimenters have preferred the utilization of Digital Data Acquisition System DDAS to read out SeGA. The support of DDAS itself for the readout SeGA is not covered under this SLD.

In case that the user plans to employ the lab-supported conventional SeGA electronics, the user is encouraged to communicate this request early to the FRIB Manager of User Relations in order to assure its readiness at the time of the experiment.

4.4 Analysis Software and Tools

If the conventional SeGA electronics is used, a data analysis tool based on the SpecTcl software suite is provided for the online monitoring of the SeGA data.

5 Instrument Support Level

5.1 Support by Device Scientist

FRIB provides support of SeGA by a Device Scientist. The setup of the instrument will be coordinated by the Device Scientist. On-site support is normally available from 9 a.m. to 5 p.m. on working days. On-call support outside of the regular working hours for critical technical assistance during the experiment can be requested through the operator in charge (OIC), who will then contact the Device Scientist on call.

At the beginning of an experiments, users will be briefed in the operation (such as starting/stopping data taking runs) of the array as well as which typical online spectra have to be checked regularly to ensure proper operation of the array.

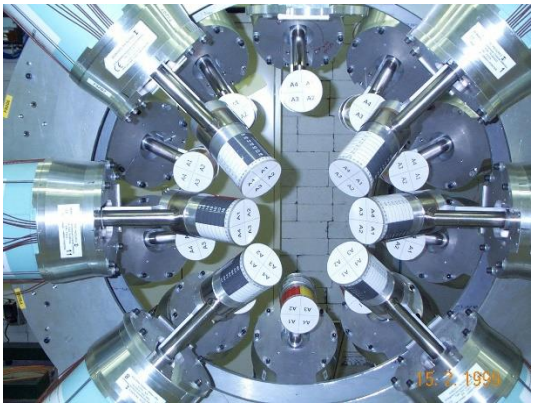
Interested users are invited to participate in the setup of SeGA. The Device Scientist should be contacted for coordination.

6 Additional instrument support not covered in this Service Level Description

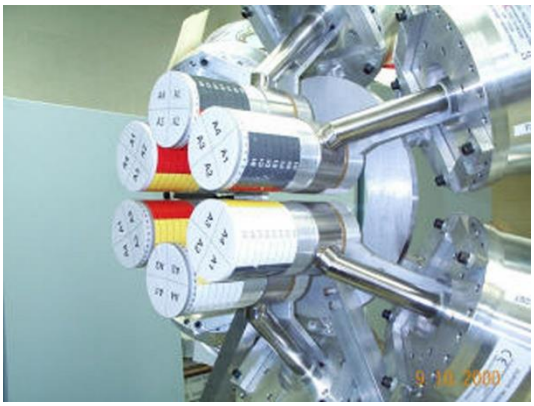
Any request for support not covered in this service level description, such as for DDAS, must be submitted to the FRIB Manager of User Relations prior to the submission of an experiment proposal for pre-approval.

[1] W. F. Mueller, J.A Church, T. Glasmacher, D. Gutknecht, G. Hackman, P.G Hansen, Z. Hu, K.L Miller, P. Quirin, Nucl. Instr. and Meth. A 466 (2001) 492.

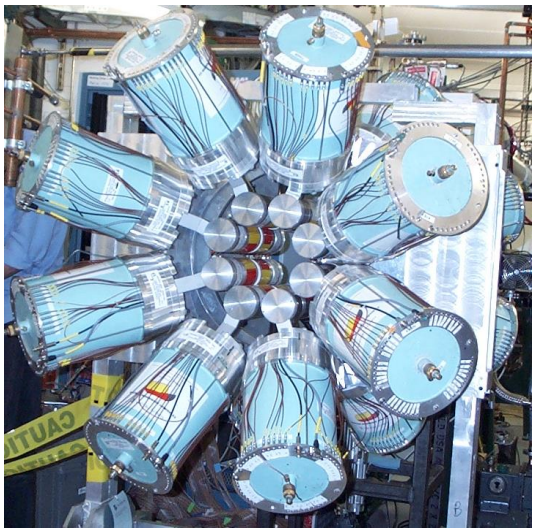
Appendix



ClassicSeGA: Note that this photo only shows 6 detectors in the forward ring. The forward ring can accommodate up to 8 detectors (for 18 in the full array) except when run at the S800 target position where only 7 detectors can be placed in the forward ring.

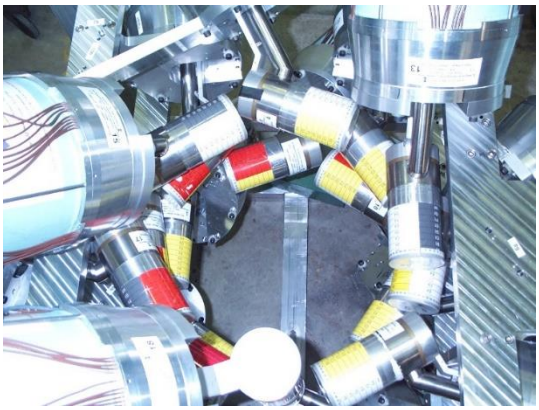


miniSeGA: A barrel of six close packed detectors (Inner diameter ~10.2 cm).

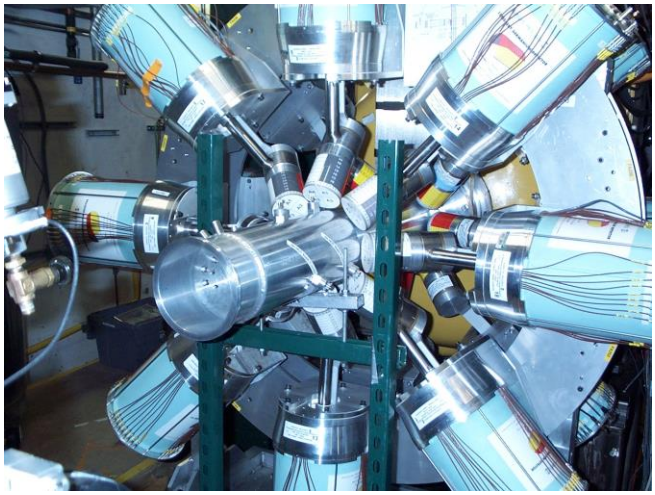


betaSeGA: 16 detectors in 2 rings surrounding beam line in a diameter of 17.3cm.

PLEASE NOTE: This setup replaces the old betaSeGA setup consisting of two rings of six detectors each (Inner diameter ~16 cm). The betaSeGA setup is still available if explicitly requested.



deltaSeGA: 18 detectors in nine different angle positions.



plungerSeGA: two rings of 8 detectors each at maximum forward (30^{o}) and backward (140^{o}) angle in order to obtain maximum Doppler shift of gamma lines for lifetime measurement in RDDS technique.