VESPA report to Spectroscopy STAP

October 8th, 2025

Adrien Perrichon, on behalf of the VESPA team

VESPA team

Since the last STAP in April 2025, Monika Hartl has joined VESPA full time as instrument scientist, Gianfranco Belcastro (CNR/ISIS) has left the project, and in response ESS has provided additional engineering resource by contracting Alexander Johansson. The current team is shown below.

Team members	*Affiliation, %FTE*	*Role*
Adrien Perrichon	ESS, 100%	Lead Scientist
Monika Hartl	ESS, 100%	Instrument Scientist
Rosa Camilleri Lledó	ESS, 100%	Lead Engineer
Liam Whitelegg	ESS, 50%	Lead Engineer
Helen Popland	ESS, 100%	Mechanical Engineer
Alexander Johansson	ESS, 100%	Mechanical Engineer
Lorenzo Di Fresco	CNR, 50%	Project Engineer
Roberto Senesi	CNR, 20%	Project Sponsor

Transfers of Scope and Procurement & Updated Timeline

Several acceleration measures have been agreed between CNR, INFN and ESS, and implemented in the VESPA plan, which now has a TG5 brought forward from November 2029 to March 2029. This has been achieved by transferring the procurement of all civil engineering (cave, hutch, sample preparation area, etc), of the beryllium filter, and of the analyser backplates and other minor mechanical parts to ESS. Furthermore, the scope of the heavy shutter, analyser coating including development efforts, and integration of the beam monitors, has also been transferred to ESS. Finally, VESPA has also joined the common projects for utilities (CUP), electrical (CEP), and motion control (CMCA).

The latest critical paths are shown in Fig. 1. The timeline is aggressive but not unrealistic given the current project resources. The cave is the visible bottleneck, and acceleration options are being discussed with NSS. The procurement of the guide by INFN is well on track, and it is likely that the timeline for detail design and manufacturing will shorten once the contract is awarded. Note that the plan will be further updated, and the project re-baselined, once the preliminary design of the secondary spectrometer will have been completed, tentatively in December 2025. It is likely that subsystems of the secondary then constitute the primary critical paths, especially for components with long lead time (beryllium, HOPG) or those that require dedicated technical resources (detectors, beam monitors).

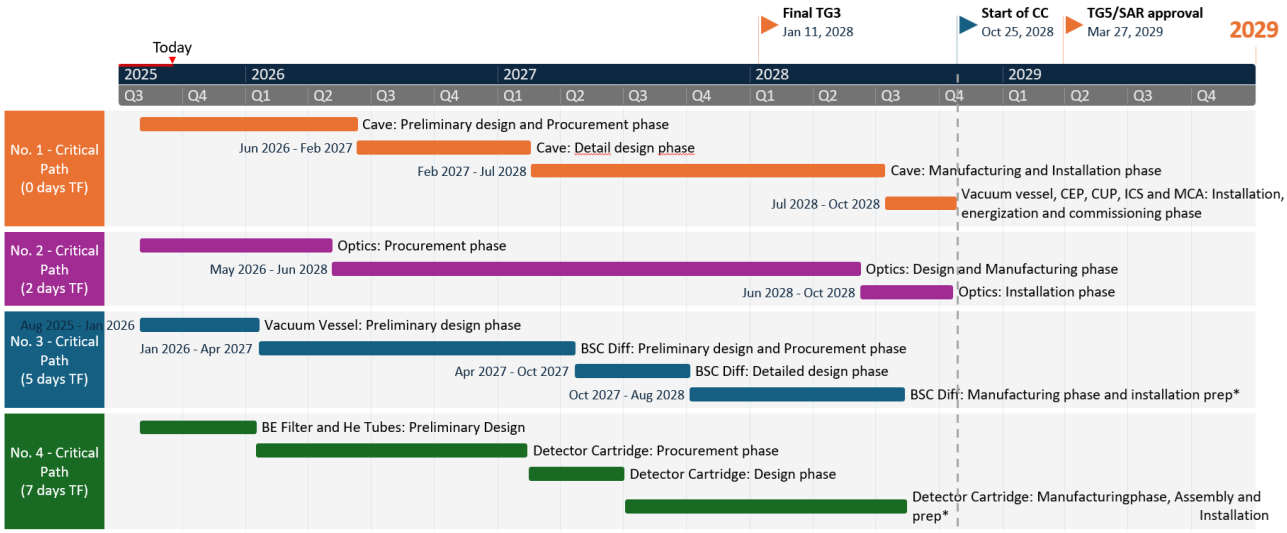

Figure 1 - Top 4 critical paths of VESPA, based on P6 data from August 2025.

Rescoping

As part of the instrument rescoping activities, VESPA has requested both the addition of a T0 chopper as well as the completion of its analyser module coverage (only 4 modules out of 16 in the initial scope). The addition of the T0 chopper was approved in August 2025 and is scheduled to be delivered in time for day 1 operation. Regarding the analyser coverage, the formal change request will be presented to ESS in Q1 2026 once the PDR of the secondary spectrometer has been completed, which is necessary to obtain a realistic cost estimate for the analyser modules.

Overview of recent activities

VESPA has made rapid progress since April 2025. Beyond the transfers of scope and procurement to ESS, the main activities have been to prepare and start the procurement of the supermirror guide, to start the design of the cave, to conduct tests, prototyping and feasibility studies of components and processes, and to advance the design of the secondary spectrometer of VESPA.

Supermirror guide

The procurement of the guide, which started over the summer, is ongoing. The tender period has recently closed on September 26th, with bids from Swiss Neutronics and S-DH. The technical evaluation of the bids is expected to start mid-October once the validity of the administrative documents has been confirmed. The contract signature is expected by the end of the year with a kick-off tentatively in Q1 2026. Note that the preparation phase of the procurement process has taken longer than predicted, which has tied-up engineering resources and thus delayed the start of the preliminary design of the cave, as reflected in the critical paths.

Testing HOPG crystals at ISIS

A second campaign of HOPG crystal tests was completed at ISIS in May 2025. The first 100 crystals from an order of 1500 crystals from Optigraph have been tested (Fig. 2a). The statistical distribution

is slightly lower than measured previously, and it became apparent that there is no significant benefit in selecting tile orientation (artefact from low statistics Dec 2024). The measurements of the next 500 crystals are planned in Q4 2025 at ISIS. Additional crystals from Optigraph, which were normally excluded based on X-ray measurements, have also been tested in an attempt to increase the supplier's capacity. Unfortunately, these crystals, labelled 'Optigraph Test' in Fig. 2a, are not suitable.

Momentive has provided VESPA with new prototype crystals following their R&D to improve peak reflectivity. These crystals have also been tested in May 2025, and one batch has shown promising performance ('B' in Fig. 2b). Additional prototypes have been produced by Momentive to confirm and attempt to further improve the performance, which will also be tested in Q4 2025.

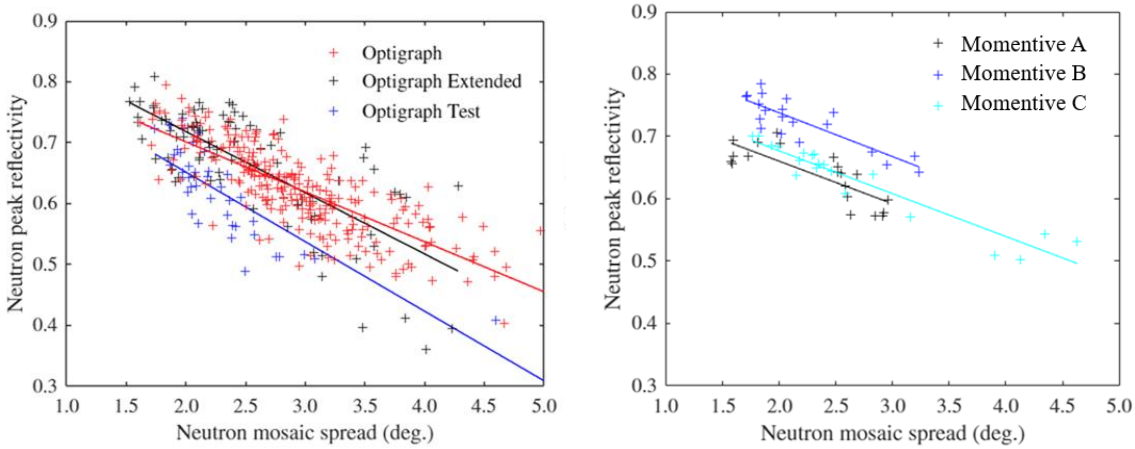

Figure 2 - Peak reflectivity as a function of mosaic spread measured on ALF at ISIS for HOPG crystals from (a) Optigraph abd (b) Momentive Technnologies.

Analyser prototyping

By April 2025, we had confirmed that the analyser backplate can be machined to suitable tolerances of +/- 20 microns with standard CNC machining. Since then, we have focused on the positioning and alignment strategy of the analyser and on the neutron absorbing coating of the backplate – its composition, application method, and post-machining. The background suppression performance of several prototypes will be tested on MARI at ISIS, tentatively in Q4 2025. One of the samples is shown in Fig. 3 where the composition is 50% epoxy and 50% enriched boron.

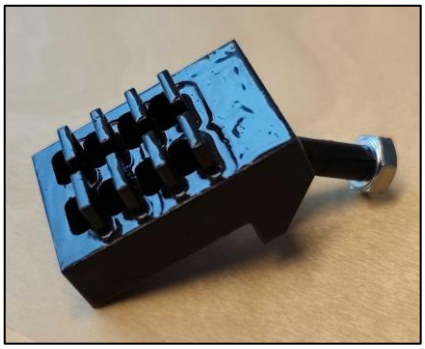

Figure 3 - Analyser prototype to evaluate the coating performance on MARI.

Preliminary design of VESPA secondary spectrometer

In January 2025, the concept design of VESPA was modified (from the 2024 TOSCA+ concept) to simplify the engineering design, reduce or eliminate some technical risks, increase the modularity, accessibility and maintainability, improve the background suppression performance, while maintaining the resolution and flux performances, at the expense of the cost.

Over the past 6 months, most efforts were expanded to solve the three main technical difficulties, which are (1) the interface between analysers, gas box, and filters, (2) the beryllium filter thermal and mechanical properties, and (3) the detector mechanical integration and saturation issues. Solutions have been identified to address all three issues, and draft designs have been produced. Further in-depth examinations are ongoing to confirm the design feasibility, which is necessary to complete the preliminary design phase of the secondary spectrometer and fix the space reservation of each of its sub-components. Current activities include the development of a prototype of the gas box to assess and attempt to reduce the window thickness, and the realisation of detailed FEAs and thermal simulations of the beryllium filter to improve the thermal insulation and rigidity of the link between the beryllium filter frame and the vacuum box. Selected CAD drawings to illustrate the latest concept of the secondary spectrometer are shown in Figure 4.

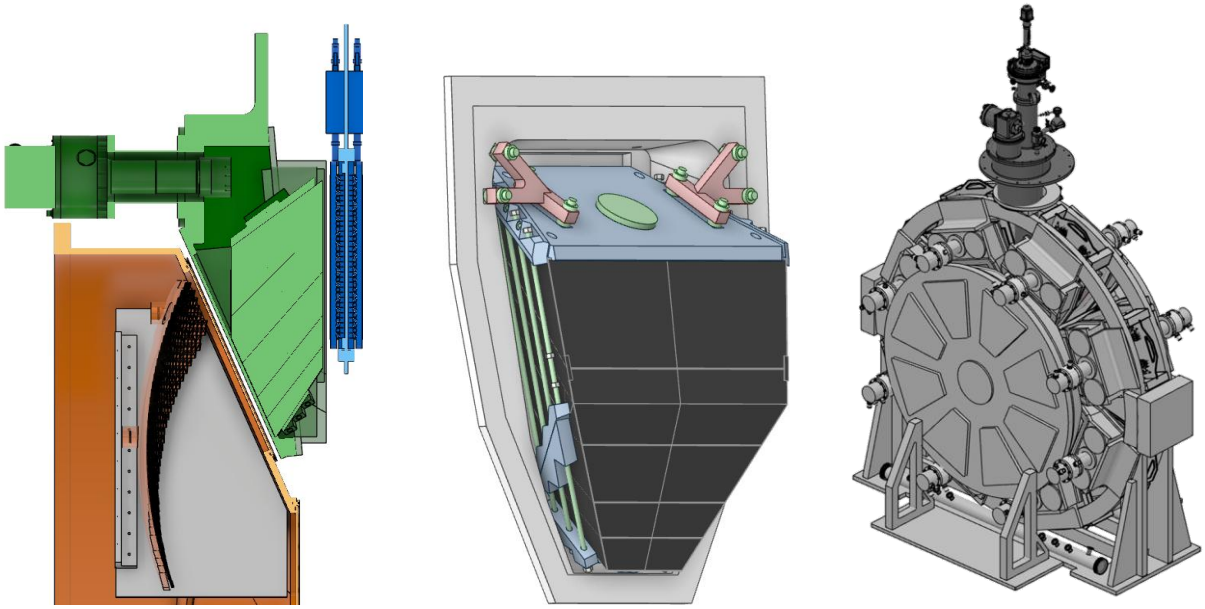

Figure 4 – (left) CAD of a spectroscopy module featuring the HOPG analyser inside a He gas box (orange), the beryllium filter, its vacuum box and CCR (green) and the detector cartridge constituted of horizontally arranged ∅ 6 mm PSD ^{3}He tubes (blue). (centre) CAD of the beryllium filter highlighting the 'San Francisco' design of the inner frame (blue and green) holding the beryllium wedges in place (black). The link between the inner frame and the vacuum box is shown in pink. (right) CAD of the complete secondary spectrometer with its 16 spectroscopy modules, 2 lateral diffraction modules, and cryostat.

Upcoming activities

The priorities over the next few months are to complete the feasibility studies to be ready to pass the preliminary design review of the secondary spectrometer in December, and to progress and complete the preliminary design of the cave, so that its procurement by ESS can start in Q1 2026.