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Rudimentary cost estimate for fabrication of inner tracking system for SPHENIX

This is intended for internal discussion in RNC as an aid to discussing the impact of joining SPHENIX. This is not intended as a fully thought out and accurate estimate, just as a first guess at what it would take to fabricate the inner detector silicon.

We estimate the full cost of delivering the inner tracking system containing the support mechanics, silicon, readout system, cooling system, powering system, slow controls and detector control system, interfaces to DAQ and trigger, database and logging of parameters, online display and detector monitoring system, commissioning and all else required to deliver a demonstrated working and monitoring system.

Assumptions and boundary conditions:

* This is detector only – no simulations, analysis or any other required support for full physics utilization.
* The project will procure the inner staves from ALICE for ~2-3 MSFr.
* Activities are presented in FTE equivalents without costs, burdened or otherwise.
* The DAQ and triggering systems developed for SPHENIX are not radically different from those employed in ALICE. In other words, it is not necessary to radically redesign what will be produced to ALICE to interface to these systems.
* We will purchase the RDO boards and perhaps even DAQ interfaces from ALICE.
* The installation of the project takes place in 2020. A commissioning run takes place in 2021. First full physics run in 2022.
* Mechanics will need to be updated for SPHENIX.

Project estimated costs (the fraction covered by LANL LDRD are highlighted in yellow):

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| Task | FTE | Material |
| Management (technical 0.7, support 0.3) | 1 x 5y = 4y Staff + 1y Staff(for Mechanics) | $20k travel/y + misc = $130k |
| Inner staves from ALICE | 0.5 x 1y = 0.5y staff | 2-3M SF |
| System design and integration | 1 x 5y = 5y Staff/EE |  |
| Staves – testing and integration, mounting onto new mechanics and full testing. | 1.5 x 3 y = 4.5y (PD) | $70k |
| Mechanics redesign including support. Management of below | 1 x 2.5y = 2.5y ME | $100k |
| Mechanics fab (support structures for inner layer staves and infrastructure support, NOT full inner detector designs) | 1 x 1.5y = 1.5y MT | $300k-500k |
| RDO system procurement (RDO boards and structures, receiver boards for DAQ PCs) | 0.25 x 1y = 0.25y staff | $400k? |
| Update firmware/software to SPHENIX environment. Provide interfaces to trigger, DAQ, slow controls, experiment detector controls. | 1 x 3y = 3y staff  0.5 x 3y = 1.5y staff/EE  1 x 1y = 1y PD  1 x 0.5y = 0.5y ET | Glue boards, etc.  $100k |
| Commissioning dedicated (includes installation) | 2 x 1y = 2y staff  0.5 x 1y = 0.5y EE  2 x 1y = 2y PD | $50k misc.  $100k travel |
| Software online, offline, event displays, detector monitor, etc. | 1 x 1.5y = 1.5y PD | $15k misc |
| Total | 10.75y staff  7.0y staff/EE  9y PD  0.5y EE  2.5y ME  1.5y MT  0.5y ET | $1.5 M  2-3 MSF |