High resolution near infrared capability at Gemini-N → PRVS reborn at a fraction of the cost!!

Based on the growing symbiosis between Gemini-N and CFHT as spearheaded by GRACES, we propose an even more exciting collaboration with near infrared fiber feed from Gemini-N to the high resolution echelle spectro-polarimeter, SPIRou at CFHT. This will provide Gemini users similar high-res NIR spectroscopy capabilities as PRVS but at a fraction of the cost. The significant benefits to both observatories as listed below make this a win-win case!

- Simultaneous wavelength coverage: 0.95-2.35 μm (YJHK wavebands)
- Resolving power : 75,000
- RV accuracy <1m/s
- S/N=119, J=12
- Sensitivity: H=14, I=10, 30 minutes.
- Achromatic polarimeter, <1% x-talk
- Zeeman splitting scales as λ 2
- Wide A coverage + polarimeter key to mitigate/calibrate jitter noise

**What is SPIRou @ CFHT?**

The next generation high-resolution, near-infrared spectro-polarimeter at CFHT (first light ~ Jan 2016)

- High resolution near infrared capability at Gemini-N

**SPIRou With a NIR Fiber Feed From Gemini**

<table>
<thead>
<tr>
<th>Model</th>
<th>CFHST + Gemini-N</th>
<th>Gemini-S + Gemini-N</th>
<th>Gemini-S + Gemini-S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achromatic</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Faint Object</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Chromatic</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>High Stability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Polarimetry</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>T.L.I.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Post at 6x5 Port</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Additional science opportunity for SPIRou with Gemini’s 8m aperture**

Feeding SPIRou from Gemini yields a third dimension to the SPIRou science case, enhancing the research opportunities for both the CFHT and Gemini communities

- Polarization + K-band mode
- Embedded magnetic sources
- High resolution + stability mode
- Planet search
- Faint Object Mode
- High-z targets, exo-planet physics, etc.

**What is SPIRou @ CFHT?**

The combination of SPIRou on CFHT (large surveys) and SPIRou on Gemini (large aperture) is powerful and would be unique in astronomy

- SPIRou on Gemini-N is comparable to PHOENIX on Gemini-S except SPIRou offers a huge gain via X-dispersion
- The cost of PRVS prior to its cancellation was ~$13 M - for a fraction of that cost it will be possible to pursue much of the PRVS science case within a few years except R=40K (vs. 70K) and no high stability capability for exo-planet RV searches (CFHT mode)

**Exciting science with SPIRou at CFHT**

How do stars/planets form and evolve?

- What is the role of magnetic field, especially in young embedded stars?
- What is the prevalence of exoplanetary systems?
- What fraction of M dwarfs host habitable planets?
- What are the characteristics of these exo-earth systems?

**Where from here?**

- Do you think pursuing a CFHT/Gemini partnership in the development and operation of SPIRou is worthwhile?
- What additional opportunities and challenges do you see in building such a SPIRou partnership?
- If you are interested in exploring this unique initiative, convey this to rep’s from Gemini (including the STAC) and CFHT during this meeting...

**For details contact:** Doug Simons (simons@cfht.hawaii.edu), Karun Thanjavur (karun@cfht.hawaii.edu)

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**What Science can SPIRou Do When Fiber-Fed From Gemini?**

<table>
<thead>
<tr>
<th>Science topic</th>
<th>Gemini-Fed SPIRou</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planetary atmospheres</td>
<td>Chemical composition, dynamics &amp; physics of solar system planetary atmospheres (venus, mars, etc.)</td>
</tr>
<tr>
<td>Exo-planetary atmospheres</td>
<td>Measurements of exo-planetary atmospheric composition using Rosssiter Effect on transiting exo-planets</td>
</tr>
<tr>
<td>Brown dwarf spectroscopy</td>
<td>Atmospheric spectroscopy to define BD models (mass, gravity, “weather”), doppler imaging of BD surface</td>
</tr>
<tr>
<td>Low-mass spectroscopic binaries</td>
<td>Fraction of spectroscopic M-L binaries, mass ratios &amp; orbital parameters</td>
</tr>
<tr>
<td>Rotational velocities of young stars and low-mass stars</td>
<td>Distribution of Vini in young clusters and low mass stars (M, L, T dwarfs)</td>
</tr>
<tr>
<td>Stellar magnetic fields</td>
<td>High sensitivity measurements of magnetic fields using Zeeman splitting</td>
</tr>
<tr>
<td>Astro-seismology</td>
<td>Activity of stars across the main sequence</td>
</tr>
<tr>
<td>Jet &amp; shock physics</td>
<td>Use [FeII] lines to measure extinction, excitation, electron density across line profiles</td>
</tr>
<tr>
<td>Masses &amp; ages of nuclear stellar clusters in spiral galaxies</td>
<td>The role of nuclear stellar clusters in defining the properties of the host galaxy</td>
</tr>
<tr>
<td>Time Evolved Fine Structure Constant</td>
<td>Extend measurements to high-z targets</td>
</tr>
<tr>
<td>Absorption lines against GRBs</td>
<td>Follow up spectroscopy against bright GRBs to measure gas and metallicities at high red shifts. Measure lines of [FeII], [FeIII], [OII], [NII] etc. for high-z targets</td>
</tr>
</tbody>
</table>

**Key Project Milestones for SPIRou**

- A key milestone is the November 2012 CFHT Board meeting, when a go/no-go decision will likely be made before negotiating the Phase C contracts and making major purchases (optics, H4RG)
- Ideally a preliminary agreement between Gemini and CFHT toward the joint funding of this instrument should be in place by the end of this year...

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**CFHT Milestones**

Oct  Nov  Dec  Jan  Feb  Mar  Apr  May  June

**Gemini Milestones**

- STAC Board
- SAC Board

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**Additional text**

- D. Simons, D. Devost, G. Barrick, K. Thanjavur, and the international SPIRou collaboration
- simons@cfht.hawaii.edu, karun@cfht.hawaii.edu

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**What is SPIRou?**

Envisioned SPIRou performance and operational modes at CFHT vs Gemini (reasonable replacement for PRVS)

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