The HADES RICH Upgrade Program

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The HADES Experiment

- The HADES (High Acceptance DiElectron Spectrometer) experiment at GSI covers a broad physics program ranging from form factors of hadrons, the investigation of dense baryonic matter to π + p scattering and further
- It currently operates at the SIS 18 accelerator at GSI, Darmstadt as a key element of the FAIR phase 0 activities
- Upcoming beamtime of four weeks data taking starting in Aug 18 and aiming to record 5B Ag+Ag collisions at 1.65 AGeV beam
- Major detector upgrades: An electromagnetic calorimeter is added (4 of 6 sectors operational for upcoming beamtime) and a RICH upgrade is performed

RICH Performance Studies in Ag+Ag simulation

Simulation studies performed with UrQMD simulation of Ag+Ag collisions at 1.65 AGeV (upcoming beam time in Aug 18) with additionally embedded signal (φ → e+e−) from the PLUTO event generator

- On average 12.5 converted photons (hits) per ring for signal electrons detected
- This number strongly depends on the azimuth angle θ
- Simulation gives an integrated single electron efficiency of 84% for signal electrons (φ → e+e−, originating from primary vertex)
  - We require the track to have a hit in all other detectors to reject fakes and those not being in acceptance
  - With increasing azimuth angle θ, efficiency increases due to a larger number of converted photons per ring resulting from a longer path in the gas radiator with rising θ
  - We see a strong momentum dependence on efficiency: It is rising to high momenta and saturates at around 90% For the upcoming beamtime, we aim for extracting a complete invariant mass spectrum of Di-electrons exceeding the mass of the φ-meson using the so-far unreached background suppression in electron identification enabled by the new high performance RICH detector → in 5B events we expect about (depending on selection cuts):

<table>
<thead>
<tr>
<th>Signal</th>
<th>η→φ+e−</th>
<th>η→φ−e+</th>
<th>ω→φ+e−</th>
<th>φ→e+e−</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries</td>
<td>338,739</td>
<td>178,335</td>
<td>683</td>
<td>110</td>
</tr>
</tbody>
</table>

Upper: Typical event display (note: Uncorrelated photons originate from scintillation in the radiator and the CaF2 window - upper estimation; noise level - 1 Hit/event)

Left: Simulated invariant mass spectrum of Di-electrons in Ag+Ag at 1.65 AGeV for 5B events and corresponding S/B ratio from the HADES beam time proposal; improvements with more refined cuts possible (see upper table)