High energy scattering in QCD — lecture plan

Tuomas Lappi

1. **Preliminaries** Collider experiments — partons, hadrons — cross section and scattering amplitude — Feynman rules — chromodynamics (L1-2)
2. **High energy kinematics** classical optics — eikonal scattering — eikonal vertex — optical theorem (L3-4), [BP chap 2]
3. **Pre-QCD models** analyticity, unitarity — Regge trajectories — the pomeron (L5), [FR chap. 1]
4. **The QCD pomeron** scattering via 2-gluon exchange — the Lipatov vertex — ladder diagrams (L6-7), [BP chap 8]
5. **DIS at low x** Infinite momentum frame vs. dipole frame — dipole scattering (L8), [BP chap 9]
6. **Light front** coordinates — quantization — virtual photon wave function (L9)
7. **Diffraction** Diffractive DIS — diffraction in pp — DDIS as elastic dipole scattering — Good-Walker (L10), [BP chap 10]
8. **Gluon radiation** idea of RGE — DGLAP — BK (L11)
9. **Color Glass Condensate** Timescales — effective theory — DIS on classical color field — gluon production in AA, glasma (L12-13)

Literature

BP V. Barone and E. Predazzi, High-Energy Particle Diffraction (Springer 2002). Part of the book is based on E. Predazzi, "Diffraction: Past, present and future," `arXiv:hep-ph/9809454`.

FR J. R. Forshaw and D. A. Ross, Quantum Chromodynamics and the Pomeron (Cambridge 1997)

- E. Iancu and R. Venugopalan, "The color glass condensate and high energy scattering in QCD," `arXiv:hep-ph/0303204`.
- F. Gelis, E. Iancu, J. Jalilian-Marian and R. Venugopalan, "The Color Glass Condensate," `arXiv:1002.0333 [hep-ph]`.
- F. Gelis, T. Lappi and R. Venugopalan, "High energy scattering in Quantum Chromodynamics," Int. J. Mod. Phys. E **16** (2007) 2595 `[arXiv:0708.0047 [hep-ph]]`.
- S. J. Brodsky, H. C. Pauli and S. S. Pinsky, "Quantum Chromodynamics and Other Field Theories on the Light Cone," Phys. Rept. **301** (1998) 299 `[arXiv:hep-ph/9705477]`.
- C. Marquet, "Chromodynamique quantique à haute énergie, théorie et phénoménologie appliqué aux collisions de hadrons," PhD thesis, in French, `http://tel.archives-ouvertes.fr/tel-00096416/fr/`